U.S. Environmental Protection Agency

Los Angeles Area Lakes TMDLs
March 2012

Section 12 El Dorado Park Lakes TMDLs

8 El Dorado Park Lakes TMDLs

The El Dorado Park lakes (#CAL4051501020000228153407) are located in the San Gabriel River Basin (HUC 18070106) in the city of Long Beach. The El Dorado Park lakes are listed as impaired by algae, ammonia, copper, eutrophication, lead, mercury (fish tissue), and pH (SWRCB, 2010). There are not sufficient data to calculate TMDLs for each lake individually, so TMDLs have been developed for each lake system; i.e., northern and southern lake systems. This section of the TMDL report describes the impairments and the TMDLs developed to address nutrients (Section 8.2) and mercury (Section 8.3). In the northern lake system, nutrient load reductions are required to achieve the chlorophyll *a* target and restore beneficial uses. Nutrient TMDLs are identified for the southern lake system based on existing conditions since nitrogen and phosphorus levels are achieving the chlorophyll *a* target level. The mercury TMDL identified for the southern lake system is also based on existing conditions since mercury levels are likely achieving the fish tissue 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 El Dorado Park lakes; therefore, TMDLs are not included for these pollutants. Analyses are presented below for lead (Section 8.4) and for copper (Section 8.5).

8.1 ENVIRONMENTAL SETTING

The El Dorado Park lakes are a chain of six small lakes located within El Dorado Regional Park in the county of Los Angeles (Figure 8-1). The park was opened to the public in 1969. The northern four lakes (Coyote, Alamo, Large, and Horseshoe) are hydraulically connected and separate from the system comprised by the two southern lakes (Nature Center North and Nature Center South), which are hydraulically connected to each other. The 2006 303(d) GIS coverage shows only four of the six lakes in the system. There is an additional lake in each system, one at the downstream end of the northern chain (Horseshoe Lake) and one at the upstream end of the southern chain (Nature Center North Lake). The 2006 303(d) GIS coverage also shows an additional lake to the left of the San Gabriel River, which is located in the El Dorado Park Golf Course. The State Water Board concluded this lake was erroneously included in the GIS coverage and is removing it for the following reasons: 1) it is not hydraulically connected with the El Dorado Park lakes, 2) it is in another drainage area, and 3) it has not been sampled for water quality (personal communication, Nancy Kapellas, SWRCB to Thomas Siebels, RWQCB, February 4, 2009). This updated layer will be available from the SWRCB after finalization of the 2010 303(d) list.

The park borders the San Gabriel River for approximately two miles (Figure 8-2) and Coyote Creek for three-quarters of a mile. The lakes were created on what was formerly San Gabriel River floodplain but are not hydrologically connected to the river at this time. The northern four lakes have a cumulative surface area of 30.1 acres, and the southern two lakes have a combined surface area of 5.2 acres (surface areas based on Southern California Association of Governments [SCAG] 2005 land use). Figure 8-3 shows Coyote Lake, the northernmost lake in the park. When constructed, the depth in Nature Center South Lake was approximately 28 feet (personal communication, Ed Gahafer [park staff], USEPA field notes 2-26-09); however, the maximum depth measured by the USEPA Region 9 laboratory staff, on February 26th, 2009 was less than ten feet (USEPA field notes 2-26-09). Restrooms on the park grounds are connected to the city sewer system. The lakes are periodically stocked (CDFG, 2009) and recreational fishing is allowed in the northern four lakes (the CDFG "Fishing in the City" program periodically holds events at the lakes). Paddle boating and radio controlled model boating occurs in Alamo Lake (Figure 8-4), but boating is prohibited in all other lakes. Visitors are not allowed to swim in the lakes. Bird feeding is another recreational activity at the lakes and some feeding has been observed during recent fieldwork. The Nature Center, located in the southern part of the park, conducts environmental education and receives more than 150,000 visitors a year. Lake managers use algaecides including

(Cutrine Plus and Reward) in some of the lakes on an as-needed basis. Additional characteristics of the watershed are summarized below.

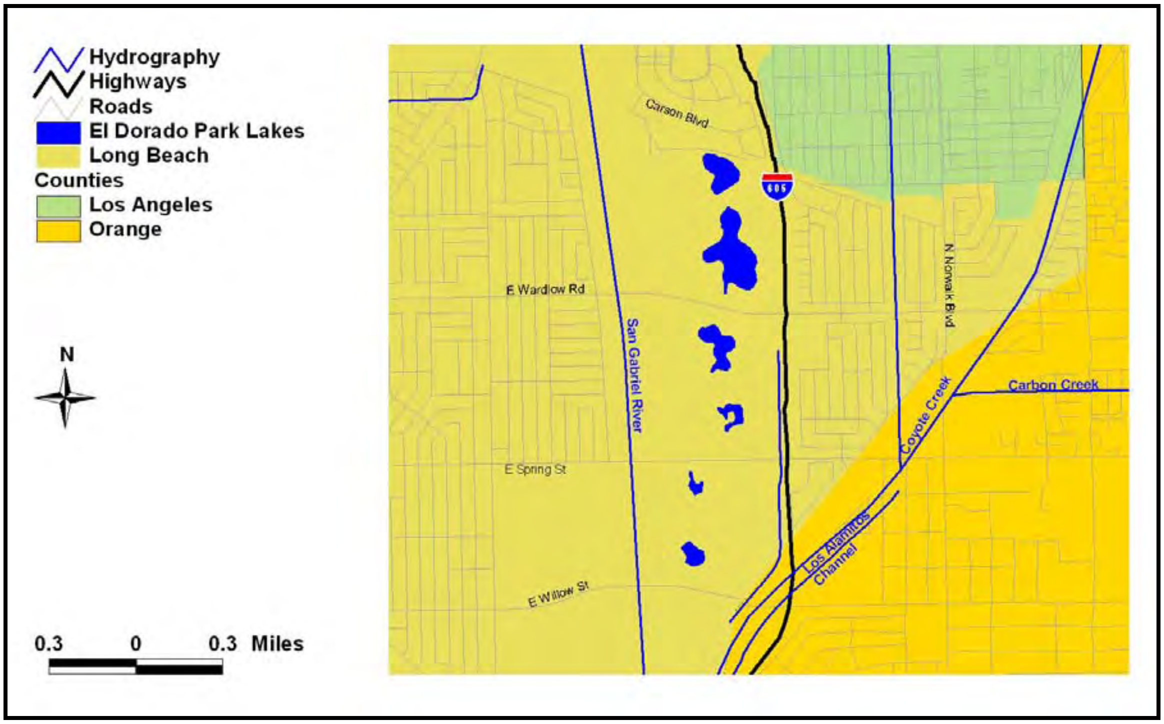

Figure 8-1. Location of El Dorado Park Lakes

Figure 8-2. San Gabriel River Adjacent to the El Dorado Regional Park

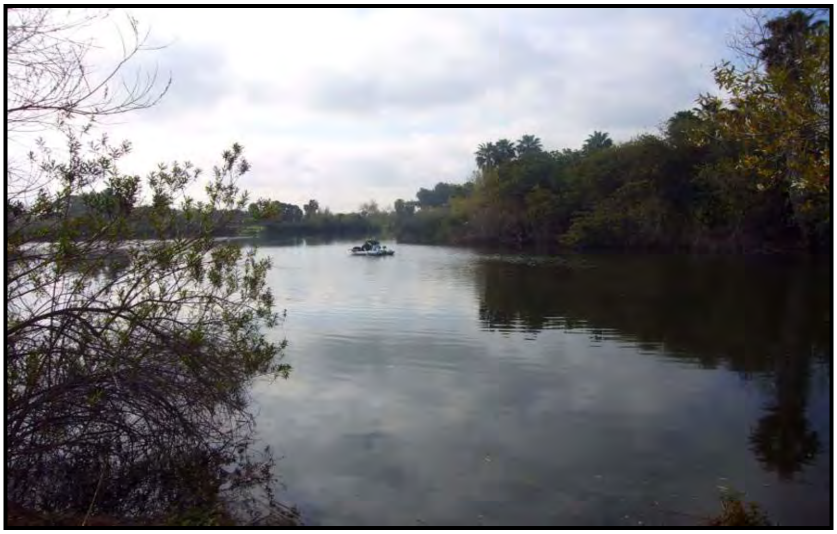

Figure 8-3. North Side of Coyote Lake

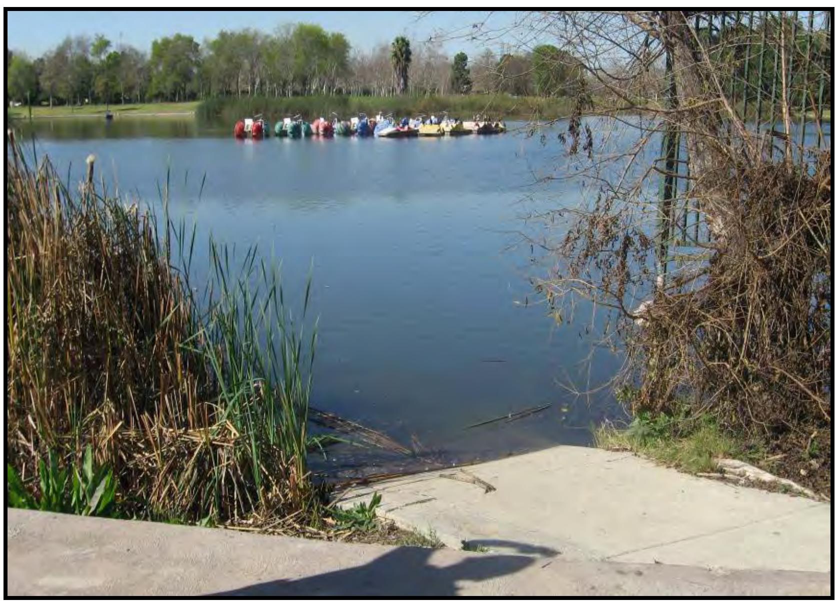

Figure 8-4. Paddle Boating at Alamo Lake

8.1.1 Elevation, Storm Drain Networks, and Subwatershed Boundaries

The El Dorado Park lakes have a 219-acre drainage area and are located in a low-elevation watershed (6.5 meters to 9.9 meters above sea level). The two TMDL subwatershed boundaries for the El Dorado Park lakes were based on watershed boundaries obtained from the county of Los Angeles, digital elevation data, aerial imagery, and the storm drain network provided by the county of Los Angeles (Figure 8-5). The subwatershed draining to the northern four lakes is comprised of 185 acres, and the subwatershed draining to the southern two lakes is comprised of 33.8 acres. Neither subwatershed contains an organized storm drain network nor a permitted point source, so all allocations for the surrounding watershed will be load allocations except wasteload allocations for the supplemental water additions; however, the lakes are actively pumped into the county of Los Angeles storm drain network during heavy rain events.

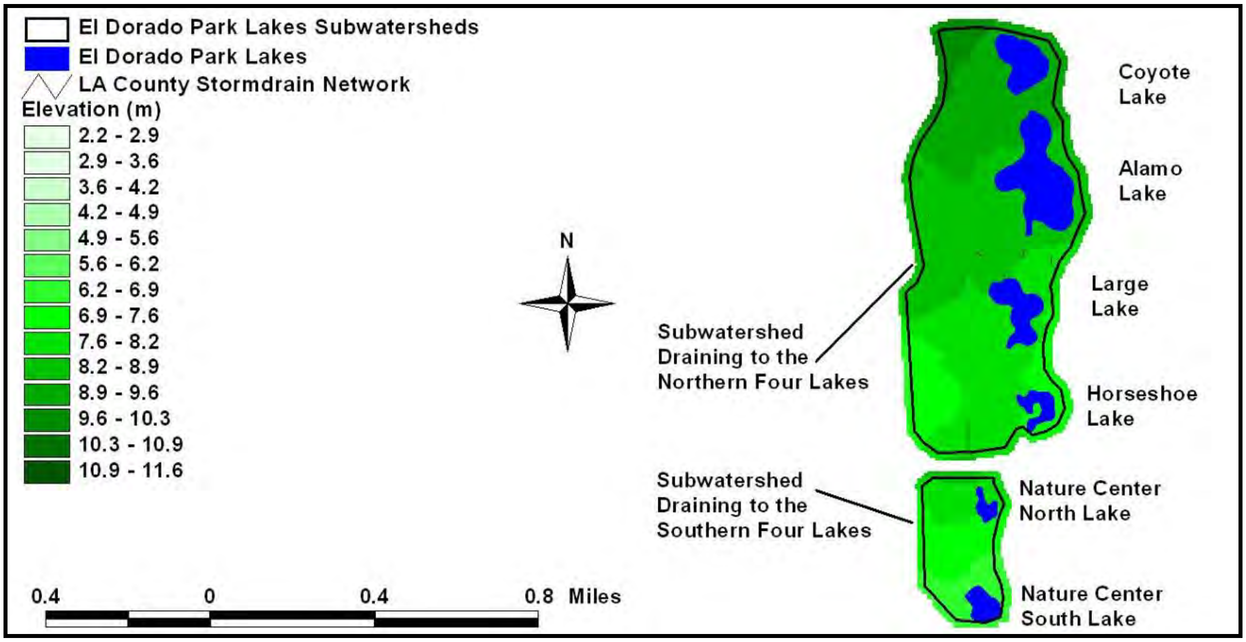

Figure 8-5. Elevation, Storm Drain Networks, and TMDL Subwatershed Boundaries for the El Dorado Park Lakes

8.1.2 MS4 Permittee

Figure 8-6 shows the MS4 stormwater permittee that comprises both the northern and southern subwatersheds of the El Dorado Park lakes as well as the county of Los Angeles storm drain network. Although both watersheds are in the city of Long Beach incorporated area, there are no major drains that divert runoff directly to any of the lakes. Loads from the parkland will be assigned load allocations because they do not drain to pipes or culverts prior to discharge to the lake.

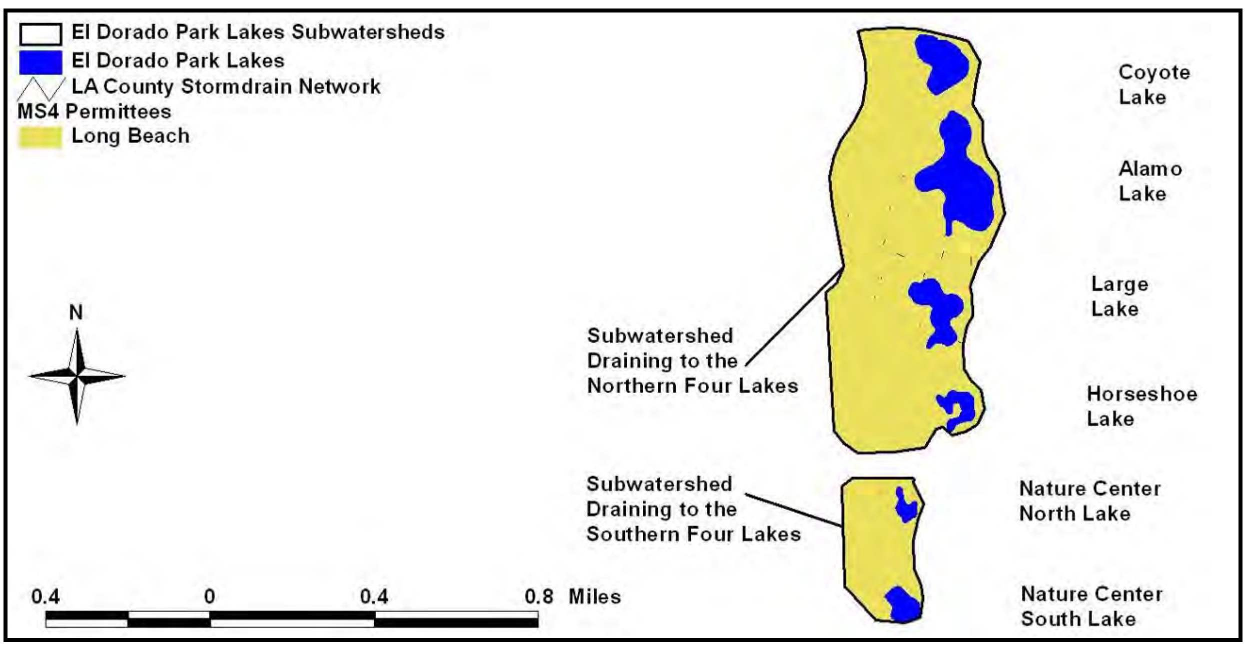

Figure 8-6. MS4 Permittee and the Storm Drain Network in the El Dorado Park Lakes Subwatersheds

8.1.3 Non-MS4 NPDES Dischargers

As of the writing of these TMDLs, there are no additional (non-MS4) NPDES permitted discharges in the El Dorado Park lakes watershed. This includes non-stormwater discharges (individual and general permits) as well as general stormwater permits associated with construction and industrial activities.

8.1.4 Land Uses and Soil Types

Several of the analyses for the El Dorado Park lakes watershed include source loading estimates obtained from the San Gabriel River Basin LSPC Model, discussed in Appendix D (Wet Weather Loading) of this TMDL report. Both subwatersheds are comprised of land classified by the San Gabriel River Basin LSPC model as "other urban or built-up" (based on SCAG 2000 land use data), except for the two polygons classified as water (Figure 8-7). Comparison of the LSPC land use coverage to SCAG 2005 data and recent satellite imagery indicate that the areas draining to the El Dorado Park lakes are parkland.

The LSPC land use data were also inaccurate with regard to lake surface area and omitted two of the six lakes in the park. To improve accuracy in land use areas, the SCAG 2005 database was used to estimate the area of the lakes in each subwatershed. All remaining areas were assumed parkland (185 acres in the northern subwatershed and 33.8 acres in the southern subwatershed).

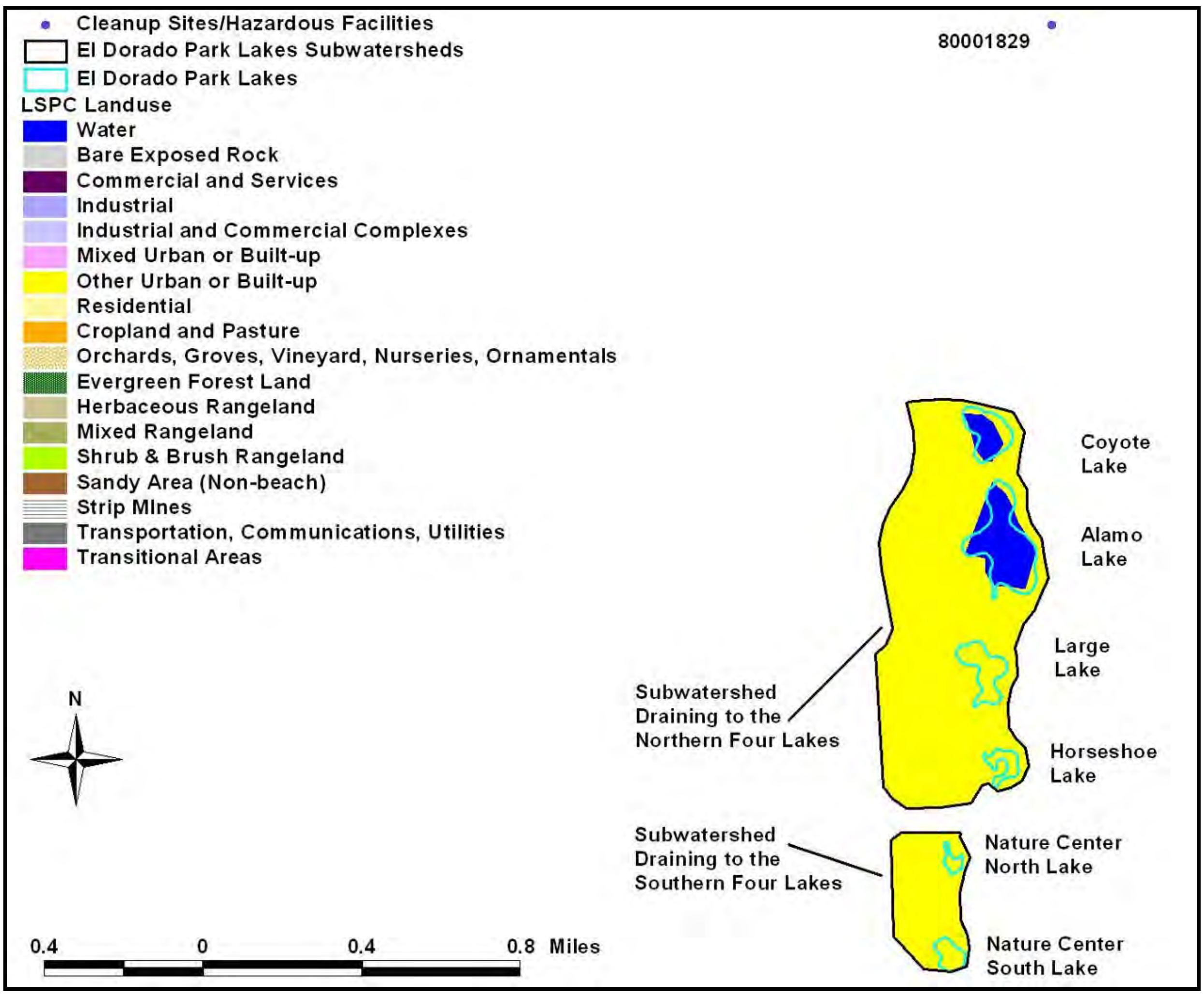

Figure 8-7. LSPC Land Use Classes for the El Dorado Park Lakes Subwatersheds

There is one Resource Conservation and Recovery Act (RCRA) contaminated industrial facility located within one mile of the El Dorado Park lakes. Available information for this facility (a liquid waste refiner) is summarized in Table 8-1. No additional information was readily available regarding potential contaminants of concern for this facility; however, the site does not drain to the El Dorado Park lakes.

Table 8-1. RCRA Cleanup Site near the El Dorado Park Lakes

Envirostor #	Facility Name	Cleanup Status
80001829 (CAT080011059)	Enviropur West Corporation	Assessed; not identified for corrective action

Figure 8-8 shows the predominant soils identified by STATSGO (Appendix D, Wet Weather Loading) in the El Dorado Park lakes subwatersheds. The soil type is identified as Urban land-Sorrento-Hanford (MUKEY 660473), a hydrologic group B soil, which has moderate infiltration rates when wet and consists chiefly of soils that have a moderately coarse texture.

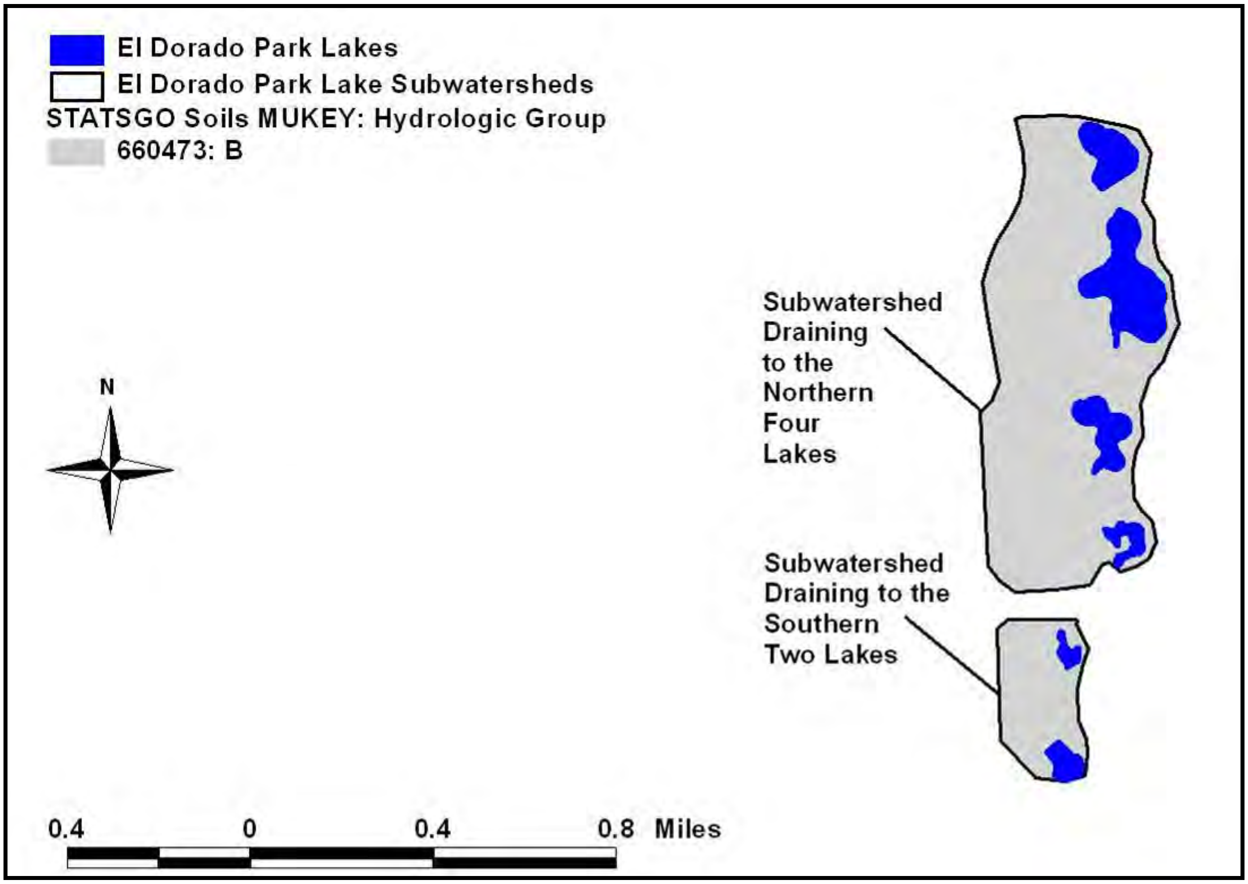

Figure 8-8. STATSGO Soil Types Present in the El Dorado Park Lakes Subwatersheds

8.1.5 Additional Inputs

The El Dorado Park lakes are comprised of two hydraulically separate systems. The northern four lakes receive supplemental water additions from a groundwater well that pumps into Coyote Lake (Figure 8-5) at a rate of approximately 110 ac-ft/yr. The southern lakes in El Dorado Park receive supplemental water from a potable water source. On average, 105 ac-ft are pumped annually into Nature Center North Lake

(Figure 8-5). Parklands surrounding both systems are irrigated with reclaimed water, some of which may reach the lakes. Irrigation water is applied to 221 acres surrounding Coyote and Alamo Lakes (known as Area III) and 179 acres surrounding Large and Horseshoe Lakes (known as Area II). At the Nature Center where the two southern lakes are located, 91.1 acres are irrigated. The applied average annual volumes to these respective areas (based on utility bills) are 244 ac-ft, 280 ac-ft, and 64.7 ac-ft; applied depths range from 8.5 inches to 18.8 inches (3.9 percent of the total irrigation volume is assumed to reach the lake). Loads resulting from these inputs are described in Appendix F (Dry Weather Loading).

8.2 NUTRIENT RELATED IMPAIRMENTS

A number of the assessed impairments for the El Dorado Park lakes are associated with nutrients and eutrophication. Nutrient-related impairments for the El Dorado Park lakes include algae, ammonia, eutrophication, 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.

8.2.1 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 the El Dorado Park lakes include REC1, REC2, WARM, WILD, MUN, and WET. 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 biology that impair the aquatic life use, and cause odor and aesthetic problems. At high enough concentrations WILD, MUN, and WET uses could become impaired.

8.2.2 Numeric Targets

The Basin Plan for the Los Angeles Region (LARWQCB, 1994) outlines the numeric targets and narrative criteria that apply to the El Dorado Park lakes. The following targets apply to the algae, ammonia, eutrophication, and pH impairments (see Section 2 for additional details and Table 8-2 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 the El Dorado Park lakes in these TMDLs, a median temperature of 16.2 ºC and a 95th percentile pH of 8.5 were used, as explained in Section 2. The resultant acute (one-hour) ammonia target is 3.20 mg-N/L, the four-day average is 2.44 mg-N/L, and the 30-day average (chronic) target is 0.98 mg-N/L (Note: the median temperature and 95th percentile pH values were calculated from the observed data and used in the calculation of the acute and chronic targets. These are presented as example calculations since the actual target varies with the 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 the El Dorado Park lakes; however, as described in Tetra Tech (2006), summer (May – September) mean and annual mean chlorophyll *a* concentrations 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 "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 the El Dorado Park lakes systems, must meet the DO target in the water column from the surface to 0.3 meters above the bottom of each 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 the El Dorado Park lakes, 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 are based on simulation of allowable loads with the NNE BATHTUB model (see Section 8.2.5). Based on the calibrated model for the northern four El Dorado Park lakes, the target nutrient concentrations within the lakes are

- 0.69 mg-N/L summer average (May – September) and annual average
- 0.069 mg-P/L summer average (May – September) and annual average

For the southern two El Dorado Park lakes, the target nutrient concentrations within the lakes are

- 1.15 mg-N/L summer average (May – September) and annual average
- 0.115 mg-P/L summer average (May – September) and annual average

Table 8-2. Nutrient-Related Numeric Targets for the El Dorado Park Lakes

Parameter	Numeric Target	Notes
Ammonia[1]	3.20mg-N/L acute (one-hour) 2.44 mg-N/L four-day average 0.98 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	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

Parameter	Numeric Target	Notes
	natural conditions as a result of waste discharge. (Basin Plan) 6.5 – 9.0 (EPA's 1986 Recommended Criteria)	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	Northern Lake System: 0.69 mg-N/L summer average (May – September) and annual average Southern Lake System: 1.15 mg-N/L summer average (May – September) and annual average	Northern Lake System: Based on simulation of allowable loads from the NNE BATHTUB model Southern Lake System: Conservatively based on existing conditions, which are maintaining chlorophyll *a* levels below the target of 20 µg/L
Total Phosphorous	Northern Lake System: 0.069 mg-P/L summer average (May – September) and annual average Southern Lake System: 0.115 mg-P/L summer average (May – September) and annual average	Northern Lake System: Based on simulation of allowable loads from the NNE BATHTUB model Southern Lake System: Based on an in-lake TN to TP ratio of 10, typical of natural systems

[1] The median temperature and 95th percentile pH values were calculated from the observed data and used in the calculation of the acute and chronic 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..

8.2.3 Summary of Monitoring Data

Water quality monitoring has been conducted in the El Dorado Park lakes since the early 1990s. This section summarizes the monitoring data relevant to the nutrient impairments. Additional details regarding monitoring are discussed in Appendix G (Monitoring Data).

The El Dorado Park lakes were included in the 1992/1993 sampling effort to support the Urban Lakes Study (UC Riverside, 1994). Data were collected from the north end of Alamo Lake. Total Kjeldahl Nitrogen (TKN) concentrations ranged from 1.2 mg-N/L to 4.2 mg-N/L. Nineteen of 45 samples for ammonium were less than the detection limit (0.01 mg-N/L); ammonium concentrations as high as 1.9 mg-N/L were observed and therefore exceeded the acute ammonia target of 0.98 mg-N/L. Nitrite samples were consistently less than the detection limit (0.01 mg-N/L), as were the majority of nitrate concentrations. Measurable amounts of nitrate were only observed in January and February of 1993 when concentrations ranged from 0.1 mg-N/L to 0.3 mg-N/L. Orthophosphate concentrations ranged from 0.2 mg-P/L to 0.9 mg-P/L, and total phosphorus concentrations generally ranged from 0.3 mg-P/L to 0.5 mg-P/L though two samples near the lake bottom were 0.6 mg-P/L and 1.1 mg-P/L. pH ranged from 8.2 to 9.4. The summary table from the 1994 Lakes Study Report (UC Riverside, 1994) lists chlorophyll *a* concentrations ranging from 5 µg/L to 133 µg/L with an average of 48 µg/L.

Although the 1996 Water Quality Assessment Database does not contain monitoring data for the El Dorado Park lakes, the summary table in the Report does include a synopsis. pH was listed as partially supporting the aquatic life use and not supporting the contact recreation use: 116 measurements of pH were collected with values ranging from 6.9 to 9.4. Ammonium was not supporting the aquatic life or contact recreation uses; 45 ammonia samples were collected with concentrations ranging from non-detect to 1.92 mg-N/L. Raw data are not available to assess location, date, time, depth, temperature, or pH with regard to these samples. Algae were listed as not supporting the contact and non-contact recreation uses. Eutrophication was listed as not supporting the aquatic life use.

On May 8th 2008, the northern four lakes were sampled by Marine Biochemists. DO concentrations ranged from 7.36 mg/L to 8.63 mg/L, and pH ranged from 7.37 to 8.76. The concentrations of nitrates were highly variable and ranged from 0.3 mg/L to 3.0 mg/L; phosphates ranged from 0.09 mg/L to 0.58 mg/L. It is not clear from the report if the units on the nitrate samples were “as N” or “as NO_3” or if the units on the phosphate samples were “as P” or “as PO_4.”

The El Dorado Park lakes were sampled February 26, 2009 and July 15, 2009 by USEPA and the Regional Board. In the northern four lakes, ammonia, nitrite, and nitrate concentrations were below detection limits (0.03 mg-N/L, 0.01 mg-N/L, and 0.01 mg-N/L, respectively) during both monitoring events. TKN averaged 1.98 mg-N/L in the winter event and 0.92 mg-N/L in the summer event. Orthophosphate averaged 0.022 mg-P/L in the winter event and was less than the detection limit of 0.0075 mg-P/L in the summer. Total phosphorus concentrations averaged 0.129 mg-P/L in the winter event and 0.101 mg-P/L in the summer event. Chlorophyll *a* concentrations averaged 31 µg/L to 34 µg/L during both events in the northern four lakes. Profile measurements were conducted in Coyote and Alamo lakes during these events. pH ranged from 7.17 to 8.47 during both events. During the winter sampling event, DO concentrations near the surface of each lake were greater than 9 mg/L. DO declined with depth and concentrations measured at 0.3 meters above the bottom of both lakes were less than the target concentration of 5 mg/L (4.37 mg/L in Coyote Lake and 3.35 mg/L in Alamo Lake). During the summer event, DO concentrations in Coyote Lake decreased from 8.2 mg/L at the surface to 2.0 mg/L at 0.3 meters above the bottom of the lake. In Alamo Lake, DO concentrations decreased from 9.6 mg/L at the surface to 2.5 mg/L at 0.3 meters above the bottom of the lake.

In the southern two lakes, ammonia, nitrite, and nitrate concentrations were at or below detection limits (0.03 mg-N/L, 0.01 mg-N/L, and 0.01 mg-N/L, respectively) during the winter monitoring event. TKN was 1.1 mg-N/L in both lakes. Orthophosphate and total phosphorus were approximately 0.016 mg-P/L and 0.03 mg-P/L, respectively, in both lakes. Chlorophyll *a* measurements in the winter were 5.3 µg/L and 5.9 µg/L. During the summer event, ammonia ranged from 0.04 mg-N/L to 0.1 mg-N/L and nitrate ranged from 0.09 mg-N/L to 0.12 mg-N/L. TKN was only measured in Nature Center South Lake and had a concentration of 0.98 mg-N/L. Orthophosphate was less than the detection limit of 0.0075 mg-P/L, and total phosphorus was approximately 0.139 mg-P/L in both lakes. Chlorophyll *a* concentrations ranged from 1.3 µg/L to 6.2 µg/L, although application of algaecide in mid-June may have continued to impact concentrations in July. pH ranged from 7.95 to 8.6 during both events. Both of the Nature Center lakes and Horseshoe Lake were treated with algaecides in mid-June (personal communication, Ed Gahafer, July 15, 2009), which may have reduced chlorophyll *a* concentrations during the July sampling event. However, Horseshoe Lake was not included in the nutrient monitoring, so this application does not impact sampling in the northern four lakes. Profile measurements were conducted in Nature Center North and Nature Center South lakes on February 26th 2009. DO concentrations decreased from greater than 8 mg/L at the surface to 3.8 mg/L and 4.1 mg/L, respectively, at 0.3 meters above the bottom of each lake. However, this may have been anomalous because during the July 15th 2009 event, profile measurements were conducted in Nature Center South Lake. DO concentrations decreased from 9.6 mg/L at the surface to 8.2 mg/L at 0.3 meters above the bottom of the lake.

Field data were also collected at shoreline stations at El Dorado Park on December 1, 2009. In the northern four lakes, temperatures ranged from 14.71 ºC to 17.01 ºC, while the pH range was 8.23 to 9.20. Temperatures were 14.94 ºC and 15.34 ºC and pH values were 8.17 and 8.12 at the Nature Center North and South lakes, respectively.

On August 10, 2010 the southern two lakes were sampled for nutrients. Ammonia concentrations ranged from 0.03 mg-N/L to 0.05 mg-N/L. TKN concentrations ranged from 0.67 to 1.03 mg-N/L. Nitrite was approximately 0.05 mg-N/L in both lakes, and nitrate ranged from 0.23 mg-N/L to 0.24 mg-N/L. Orthophosphate ranged from 0.022 mg-P/L to 0.027 mg-P/L, and total phosphorus ranged from 0.027 mg-P/L to 0.038 mg-P/L. Chlorophyll *a* ranged from 4.81 µg/L to 6.23 µg/L. During this event, two continuous monitoring probes were deployed in each southern lake over a 24-hour period at depths of about 0.7 to 1.3 meters below the surface. DO concentrations ranged from 8.3 mg/L to 9.5 mg/L in Nature Center North Lake and from 9.5 mg/L to 12.6 mg/L in Nature Center South Lake. pH ranged from 8.5 to 9.0 in both lakes. On August 10, 2010, DO measurements collected at varying depths (from the surface to 0.3 meters above the bottom) in Nature Center North Lake ranged from 8.4 mg/L to 8.5 mg/L. In Nature Center South Lake, depth-varying DO ranged from 11.8 mg/L at the surface to 9.9 mg/L at 0.3 meters above the bottom of the lake.

On September 28, 2010 the southern two lakes were sampled again for nutrients. Ammonia concentrations ranged from <0.03 mg-N/L to 0.05 mg-N/L. TKN concentrations ranged from 0.79 to 0.86 mg-N/L. Nitrite was approximately 0.05 mg-N/L in both lakes, and nitrate ranged from 0.36 mg-N/L to 0.41 mg-N/L. Orthophosphate ranged from 0.008 mg-P/L to 0.017 mg-P/L, and all total phosphorus measurements were below the detection limit of 0.0165 mg-P/L. Chlorophyll *a* ranged from 6.01 µg/L to 6.68 µg/L. During this event, two continuous monitoring probes were deployed in each southern lake over a 24-hour period at depths of about 1 to 1.3 meters below the surface. DO concentrations ranged from 7.4 mg/L to 8.2 mg/L in Nature Center North Lake and from 6.6 mg/L to 9.7 mg/L in Nature Center South Lake. pH ranged from about 7.6 to 8.1 in both lakes. On September 28, 2010, depth-variable DO measurements collected from the surface of Nature Center North Lake ranged from 9.2 mg/L to 10.9 mg/L. At 0.4 meters above the bottom, DO was measured as 9.2 mg/L. Depth-profile data were not collected at Nature Center South Lake due to time constraints.

In summary, pH exceedances have been observed in both systems (northern and southern). Ammonia concentrations exceeded the acute target in the northern lake system in the early 1990s. There were no exceedances of the acute or chronic ammonia criteria during any recent sampling events with associated pH and temperature measurements. DO concentrations have consistently been observed at less than the target concentration of 5 mg/L at 0.3 meters above the bottom of the northern four lakes during both 2009 monitoring events (at two lakes each time). Additionally, DO concentrations have been observed at less than the target concentration during one sampling event (winter 2009) in the southern two lakes. Algal concentrations in the northern lake system exceeded the target during historic and recent sampling. Chlorophyll *a* concentrations in the southern lake system have only been monitored recently: neither winter nor summer sampling show exceedances of the chlorophyll *a* target though summer concentrations may have been impacted by prior application of an algaecide. The nutrient TMDLs presented in Section 8.2.6 account for summer season critical conditions by assessing loading rates consistent with meeting the summer chlorophyll *a* target concentration of 20 µg/L in the northern four lakes. These reductions in nutrient loading are expected to alleviate pH, odor, DO, and ammonia problems associated with excessive nutrient loading and eutrophication.

8.2.3.1 Summary of pH Non-Impairment in the Southern Lake System

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."* In the southern two lakes 97 percent of the flow is potable water discharged to the lakes. Potable water was sampled for pH during the August and September 2010 sampling events, and measurements ranged from 7.98 to 8.22. In addition, the Long Beach Water Department reports the following: El Dorado Park lakes are in an area that primarily receives groundwater during the summer and purchased Metropolitan Water District water during the winter. The "MWD Zone" had a reported average pH of 7.9 (range of 7.4-8.2) and the "Groundwater Zone" had a reported average of 8.1 (7.8-8.2) (Long Beach Water Department, 2008). Based on this information, the potable water discharged to these lakes is not causing elevated pH levels. There are no other waste discharges that could be elevating the pH. As discussed in the linkage analysis (Section 8.2.5), the southern two lakes currently meet the chlorophyll *a* target, so nutrient loading is not elevating pH in those lakes. Based on these multiple lines of evidence, the southern two lakes in El Dorado are attaining beneficial uses and meeting pH water quality standards. USEPA concludes that preparing a

TMDL for pH is unwarranted at this time. USEPA recommends that the southern two lakes in El Dorado Park not be identified as impaired by pH in California's next 303(d) list.

8.2.4 Source Assessment

The source assessment for the El Dorado Park lakes includes loading estimates from the surrounding watershed (Appendix D, Wet Weather Loading; Appendix F, Dry Weather Loading); irrigation (3.9 percent of the total irrigation volume is assumed to reach the lake), groundwater and potable water inputs used for supplemental water additions to the lake (Appendix F, Dry Weather Loading); and atmospheric deposition (Appendix E, Atmospheric Deposition). Table 8-3 summarizes the sources of existing loading to the northern lake system and Table 8-4 summarizes those loadings to the southern lake system. The majority of the phosphorus loading to the northern four lakes is a result of groundwater used for supplemental water additions. The nitrogen loading to the northern four lakes comes primarily from additional parkland loading such as excessive bird populations. The two southern lakes receive the majority of both phosphorus and nitrogen loading from the potable water input used to supplement water levels in the lakes. Section 8.2.5 describes the method used to estimate the additional parkland loading.

Table 8-3. Summary of Average Annual Flows and Nutrient Loading to the Northern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus (lb-P/yr) (percent of total load)	Total Nitrogen (lb-N/yr) (percent of total load)
City of Long Beach	Runoff	1.69	3.08 (2.6)	20.3 (0.95)
City of Long Beach	Supplemental Water Additions (Groundwater)	110	71.5 (59.3)	287 (13.4)
City of Long Beach	Parkland Irrigation	20.6	9.29 (7.7)	320 (14.9)
City of Long Beach	Additional Parkland Loading	unknown	36.6 (30.4)	1,500 (70.0)
	Atmospheric deposition (to the lake surface)*	29.3	NA	16.5 (0.77)
Total		**164**	**120**	**2,144**

*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).

Table 8-4. Summary of Average Annual Flows and Nutrient Loading to the Southern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus (lb-P/yr) (percent of total load)	Total Nitrogen (lb-N/yr) (percent of total load)
City of Long Beach	Runoff	0.309	0.563 (2.9)	3.71 (0.8)
City of Long Beach	Supplemental Water Additions (Potable Water)	105	13.67 (70.5)	269 (59.8)
City of Long Beach	Parkland Irrigation	2.54	1.15 (5.9)	39.6 (8.8)

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus (lb-P/yr) (percent of total load)	Total Nitrogen (lb-N/yr) (percent of total load)
City of Long Beach	Additional Parkland Loading	unknown	4.0 (20.6)	135 (30.0)
	Atmospheric deposition (to the lake surface)*	5.07	NA	2.8 (0.6)
Total		**113**	**19.4**	**450**

*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).

8.2.5 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 the El Dorado Park lakes, the nutrient numeric endpoints (NNE) BATHTUB Tool was set up and calibrated for each hydraulically connected system. 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 the northern system, the model was calibrated to represent conditions in Coyote Lake because 1) this lake receives the groundwater input which represents the majority of nutrient loading to this system and 2) simulation of Coyote Lake individually was needed to calibrate the model within recommended guidelines (Walker, 1987). Based on the turnover ratio for this lake (Walker, 1987), the annual averaging period is most appropriate (i.e., annual loads are input to the model rather than summer season loads).

The NNE BATHTUB Tool was calibrated to recent average annual water quality data observed (calibration typically occurs to summer monitoring data but due to the limited monitoring data available for this lake an average of the summer and winter monitoring data were needed to create a more conservative analysis). Both nitrogen and phosphorus concentrations were underpredicted when the calibration factors were adjusted within normal range. To predict the average concentrations of total phosphorus (0.10 mg-P/L) and total nitrogen (1.36 mg-N/L) observed in Coyote Lake, loads from additional parkland sources were increased to 12 lb-P/yr and 300 lb-N/yr, respectively, with calibration factors on the net sedimentation rates set to 1. 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 4.66 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 7.33 lb-P/yr. The resulting calibration factor on the net phosphorus settling rate is 0.85 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 chlorophyll *a* concentration in Coyote Lake, the calibration factor on concentration was set to 0.92 for a predicted concentration of 36 µg/L. To estimate loading from additional parkland sources to the entire northern lake system, nutrient loads were scaled up by the ratio of surface areas for the northern lake system relative to Coyote Lake (30.1 acres / 6 acres = 5.0).

For the southern lake system, the cumulative surface area is 5.2 acres, the average depth is 4.6 ft, and the cumulative volume is 24 ac-ft. No historic monitoring data are available for this lake system and based on recent monitoring data, chlorophyll *a* concentrations are relatively low although application of algaecide in the southern two lakes in mid-June likely impacted chlorophyll *a* concentrations during the July 2009 monitoring event. Because insufficient data are available to calibrate the model to chlorophyll *a* concentrations, and no observations of chlorophyll *a* have exceeded the target concentration of 20 µg/L, these TMDLs will require that nutrient loading remain at existing levels as an antidegradation measure. If subsequent data are collected that will allow for calibration of the NNE BATHTUB model, then these TMDLs may be revisited. Note that the NNE BATHTUB Tool was set up to estimate loading from surrounding parkland areas. To predict the average concentrations of total phosphorus (0.061 mg-P/L) and total nitrogen (1.15 mg-N/L) observed in the southern two lakes, loads from the additional parkland sources were increased to 11.5 lb-P/yr and 135 lb-N/yr, respectively, with calibration factors on the net sedimentation rates set to 1. The amount of the phosphorous loading from additional parkland sources due to internal recycling was calculated with the method discussed in Appendix A (Nutrient TMDL Development) and is 7.6 lb-P/yr. This portion of the phosphorus load was subtracted out of the additional parkland source category, and the model was recalibrated with a loading from additional parkland sources of 4.0 lb-P/yr. The resulting calibration factor on the net phosphorus settling rate is 0.13 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 loading and calibration factor for nitrogen were not changed. This configuration of the NNE BATHTUB Tool for the southern two lakes should not be considered a calibrated model as it was only used to develop an estimate of additional parkland loading and the calibration factors on the net phosphorus settling rate of 0.13 is out of the recommend range (0.5 to 2).

8.2.6 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).

Following calibration of the NNE BATHTUB Tool (Section 8.2.5), the allowable loading combinations of nitrogen and phosphorus were calculated using Visual Basic's GoalSeek function (Appendix A, Nutrient TMDL Development). The loading combination that is predicted to result in an in-lake ratio of total nitrogen concentration to total phosphorus concentration close to 10 was selected 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 for the northern four lakes are

- 0.69 mg-N/L summer average (May – September) and annual average
- 0.069 mg-P/L summer average (May – September) and annual average

For the northern four lakes, the loading capacities for total nitrogen and total phosphorus are 902 lb-N/yr and 63.7 lb-P/yr, respectively. These loading capacities can be further broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margin of Safety (MOS) using the general TMDL equation:

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

For total nitrogen, the allocatable load (divided among WLAs and LAs) is 37.8 percent of the existing load of 2,144 lb-N/yr, or 811 lb-N/yr. This value represents 90 percent of the loading capacity, while the MOS is 10 percent of the loading capacity. WLAs and LAs are developed assuming equal percent load reductions in all sources. The resulting TMDL equation for total nitrogen is then:

902 lb-N/yr = 109 lb-N/yr + 703 lb-N/yr + 90.2 lb-N/yr

For total phosphorus, the allocatable load (divided among WLAs and LAs) is 47.6 percent of the existing load of 120 lb-P/yr, or 57.3 lb-P/yr. This value represents 90 percent of the loading capacity, while the MOS is 10 percent of the loading capacity. The resulting TMDL equation for total phosphorous is then:

63.7 lb-P/yr = 34.0 lb-P/yr + 23.3 lb-P/yr + 6.37 lb-P/yr

For the southern two lakes, existing levels of nitrogen and phosphorus loading appear to be resulting in attainment of the chlorophyll *a* target. Monitoring data indicate that the average in-lake total nitrogen concentration is 1.15 mg-N/L (Appendix G, Monitoring Data). Because the measured in-lake phosphorous concentrations varied widely between sampling events (<0.0165 mg-P/L to 0.138 mg-P/L), 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

- 1.15 mg-N/L summer average (May – September) and annual average
- 0.115 mg-P/L summer average (May – September) and annual average

To prevent degradation of the southern two lakes, 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.

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

For total nitrogen, the allocatable load is equal to the existing load and is divided among WLAs and LAs, assuming equal percent load reductions from all sources.

450 lb-N/yr = 269 lb-N/yr + 181 lb-N/yr + 0 lb-N/yr

For total phosphorus, the allocatable load is equal to the existing load and allocated to WLAs and LAs.

19.4 lb-P/yr = 13.7 lb-P/yr + 5.7 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 two lake systems based on simulation of allowable loads with the NNE BATHTUB model (see Section 8.2.5). These in-lake concentrations are calculated from a complex set of equations that consider 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.

8.2.6.1 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 for total phosphorus and total nitrogen for the northern and southern lake systems as well as alternative WLAs for total phosphorous and total nitrogen for the northern lake system. The alternative WLAs will be effective and supersede the WLAs listed in Table 8-5 for the northern lake system if the conditions described in Section 8.2.6.1.2 are met.

Under either wasteload allocation scheme responsible jurisdictions are encouraged to consider the construction of wetland systems and bioswales (or other retention or 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. 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).

Local jurisdictions have performed studies on nearby waterbodies that may be considered when evaluating nutrient-reduction strategies for this lake. For example, the City of Los Angeles has modeled expected nutrient concentration reductions to stormwater flows to Echo Park Lake from constructed wetlands, and construction is currently underway. Information about this and other City of Los Angeles water quality improvement projects are available on the Proposition O website: http://www.lapropo.org/sitefiles/lariver.htm.

8.2.6.1.1 *Wasteload Allocations*

There are no MS4 discharges to the El Dorado Park lakes and no other (non-MS4) permitted dischargers in the watershed. The supplemental water sources to maintain lake levels are the only sources of nutrient loading to the El Dorado Park lakes that are assigned WLAs. The WLA for this source to the northern four lakes represents a 62.2 percent reduction in total nitrogen loading and a 52.4 percent reduction in total phosphorus loading (Table 8-5) and must be met as a one year average. In contrast, the WLAs for the supplemental water additions to the southern two lakes are equivalent to existing levels of loading (Table 8-4) and must be met as a three year average. These loading values (in pounds per year) represent the TMDLs wasteload allocations (Table 8-5 and Table 8-6). Each WLA must be met at the point of discharge.

Table 8-5. Wasteload Allocations for Nutrient Loading to the Northern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus[1,2] (lb-P/yr)	Total Nitrogen[1,2] (lb-N/yr)
City of Long Beach	Supplemental Water Additions	110	34.0	109

[1]A one year average will be used to evaluate compliance.

[2]The wasteload allocation must be met at the point of discharge.

Table 8-6. Wasteload Allocations for Nutrient Loading to the Southern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus[1] (lb-P/yr)	Total Nitrogen[1] (lb-N/yr)
City of Long Beach	Supplemental Water Additions	105	13.7	269

[1]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.

8.2.6.1.2 *Alternative "Approved Lake Management Plan Wasteload Allocations" for the Northern Lake System*

Concentration-based WLAs not exceeding the concentrations listed in Table 8-7 are effective and supersede the corresponding WLAs for the City of Long Beach in Table 8-5 if:

1. The City of Long Beach requests that concentration-based wasteload allocations not to exceed the concentrations established in Table 8-7 apply to it;
2. The City of Long Beach provides to USEPA and the Regional Board a Lake Management Plan describing actions that will be implemented and cause each of the following to be met: the applicable water quality criteria for ammonia, dissolved oxygen and pH; and the chlorophyll *a* targets listed in Table 8-2. A Lake Management Plan may include the following types of actions: 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; and/or fisheries management actions to

reduce nutrient availability from sediments. The City of Long Beach may use monitoring data and modeling to show that the water quality criteria, targets and requested WLAs will be met;

3. The Regional Board Executive Officer approves the request and applies concentration-based wasteload allocations for total nitrogen and total phosphorus. These wasteload allocations are not to exceed the concentrations in Table 8-7 as a summer average (May-September) and annual average, and

4. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Each concentration-based wasteload allocation must be met in the lake. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met, then the total phosphorus and total nitrogen allocations are considered attained.

Table 8-7. Alternative Wasteload Allocations for Phosphorus and Nitrogen in the Northern Lake System of the El Dorado Park Lakes if an Approved Lake Management Plan Exists

Responsible Jurisdiction	Input	Maximum Allowable Wasteload Allocation Total Phosphorus[1,2] (mg-P/L)	Maximum Allowable Wasteload Allocation Total Nitrogen[1,2] (mg-N/L)
City of Long Beach	Supplemental Water Additions	0.1	1.0

[1]A one year average will be used to evaluate compliance.

[2]The concentration-based wasteload allocation must be met in the lake. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met, then the total phosphorus and total nitrogen allocations are considered attained.

8.2.6.2 Load Allocations

These TMDLs establish load allocations (LAs) for total phosphorus and total nitrogen for the northern and southern lake systems as well as alternative LAs for total phosphorous and total nitrogen for the northern lake system. The alternative LAs in the northern lake system will be effective and supersede the LAs listed in Table 8-8 if the conditions described in Section 8.2.6.2.2 are met.

8.2.6.2.1 Load Allocations

There are no storm drains that discharge runoff flows into the El Dorado Park lakes. Therefore, all loads associated with the surrounding drainage area are assigned LAs. Atmospheric deposition and additional parkland loading are also assigned LAs. For the northern four lakes, total phosphorus LAs represent a 52.4 percent reduction in existing loading, and total nitrogen LAs represent a 62.2 percent reduction in existing loading (Table 8-8). LAs are provided for each responsible jurisdiction and input and must be met at the point of discharge. These loading values (in pounds per year) represent the TMDLs load allocations (Table 8-8 and Table 8-9).

Table 8-8. Load Allocations for Nutrient Loading to the Northern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus (lb-P/yr)[1,2]	Total Nitrogen (lb-N/yr)[1,2]
City of Long Beach	Runoff	1.69	1.47	7.68
City of Long Beach	Parkland Irrigation	20.6	4.42	121

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus (lb-P/yr)[1,2]	Total Nitrogen (lb-N/yr)[1,2]
City of Long Beach	Additional Parkland Loading	unknown	17.4	568
	Atmospheric deposition (to the lake surface)[3]	29.3	NA	6.24
Total		**54.2**	**23.3**	**703**

[1]A one year average will be used to evaluate compliance.

[2] Each load allocation must be met at the point of discharge.

[3] 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).

For the southern two lakes, the LAs are set equal to existing loading rates. Assuming flow volumes remain at existing levels (Table 8-4), targeted concentrations of nitrogen and phosphorus in the city of Long Beach runoff to the southern two lakes may be 0.670 mg-P/L and 4.42 mg-N/L. Targeted concentrations in the irrigation returns may be 0.166 mg-P/L and 5.73 mg-N/L (3.9 percent of the total irrigation volume to both lake systems is assumed to reach the lake; Appendix F, Dry Weather Loading). The targeted nitrogen concentrations for precipitation to the surfaces of the southern two lakes may be 0.20 mg-N/L. Targeted concentrations for the additional parkland loading cannot be estimated because the associated flow volumes are unknown.

Table 8-9. Load Allocations for Nutrient Loading to the Southern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus (lb-P/yr)[1]	Total Nitrogen (lb-N/yr)[1]
City of Long Beach	Runoff	0.309	0.563	3.71
City of Long Beach	Parkland Irrigation	2.54	1.15	39.6
City of Long Beach	Additional Parkland Loading	unknown	4.0	135
	Atmospheric deposition (to the lake surface)[2]	5.07	NA	2.8
Total		**6.75**	**5.7**	**181**

[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.

[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).

8.2.6.2.2 Alternative "Approved Lake Management Plan Load Allocations" for the Northern Lake System

Concentration-based load allocations for the northern lake system not exceeding the concentrations listed in Table 8-10 are effective and supersede corresponding load allocations for the City of Long Beach in Table 8-8 if:

1. The City of Long Beach requests that concentration-based load allocations not to exceed the concentrations established in Table 8-10 apply to it;

2. The City of Long Beach provides to USEPA and the Regional Board a Lake Management Plan describing actions that will be implemented and cause each of the following to be met: the applicable water quality criteria for ammonia, dissolved oxygen and pH; and the chlorophyll *a* targets listed in Table 8-2. A Lake Management Plan may include the following types of actions: 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; and/or fisheries management actions to reduce nutrient availability from sediments. The City of Long Beach may use monitoring data and modeling to show that the water quality criteria, targets and requested load allocations will be met;
3. The Regional Board Executive Officer approves the request and applies concentration-based load allocations for total nitrogen and total phosphorus. These load allocations are not to exceed the concentrations in Table 8-10 as a summer average (May-September) and annual average; and
4. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Each concentration-based LA must be met in the lake. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met, then the total phosphorus and total nitrogen allocations are considered attained.

Table 8-10. Alternative Load Allocations of Nutrient Loading to the Northern Lake System of the El Dorado Park Lakes if an Approved Lake Management Plan Exists

Responsible Jurisdiction	Input	Maximum Allowable Load Allocation Total Phosphorus[1] (mg-P/L)	Maximum Allowable Load Allocation Total Nitrogen[1] (mg-N/L)
City of Long Beach	Runoff	0.1	1.0
City of Long Beach	Parkland Irrigation	0.1	1.0
City of Long Beach	Additional Parkland Loading	0.1	1.0

[1] Each concentration-based load allocation must be met in the lake. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met, then the total phosphorus and total nitrogen allocations are considered attained.

8.2.6.3 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. To account for the uncertainties concerning the relationship between nutrient loading and the resultant in-lake chlorophyll *a*, an explicit MOS is included in the northern lake system TMDLs. This explicit MOS is set at 10 percent of the loading capacity for total phosphorus and total nitrogen. The southern lake system 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.

8.2.6.4 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. The northern lake system TMDLs are expected to alleviate any pH and ammonia problems associated with excessive nutrient loading and eutrophication. The southern lake system 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.

8.2.6.5 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 do present a maximum daily load according to the guidelines provided by USEPA (2007).

For each lake system, the primary contributor of nutrient loading is the supplemental water addition. Daily loads are calculated by multiplying the maximum daily flow rates from each source with the average allowable concentrations consistent with attaining the TMDLs. 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.

For the northern four lakes, the average allowable concentration of total nitrogen in the supplemental water addition is the allowable load from this source (109 lb-N/yr) divided by the average annual flow from this source (110 ac-ft/yr) or (0.363 mg-N/L) (see Table 8-5). For total phosphorus, the average allowable concentration in the supplemental water addition is the allowable load from this source (34.0 lb-P/yr) divided by the average annual flow (110 ac-ft/yr) or (0.113 mg-P/L) (see Table 8-5). Peak daily flow from the supplemental water addition is estimated as the maximum metered flow rate (30.8 ac-ft/mo) divided by the number of days in the peak flow month (31) or 0.994 ac-ft/d. Total maximum daily loads from this source are 0.981 lb-N/d and 0.307 lb-P/d.

For the southern two lakes, daily maximum loads will likely result from use of supplemental water additions to the lakes: this source contributes the majority of the nitrogen and phosphorus loading to this lake system. The peak daily flow rate from this source is estimated from the maximum monthly metered flow rate (29.4 ac-ft/mo) divided by the number of days in the month (31) or 0.948 ac-ft/d. The average allowable nitrogen concentration is the allowable load from the supplemental water addition (269 lb-N/yr) divided by the average annual flow (105 ac-ft/yr) or (0.94 mg-N/L) (see 8.2.6.1). For total phosphorus, the average allowable concentration is the allowable load from the supplemental water addition (13.7 lb-P/yr) divided by the average annual flow (105 ac-ft/yr) or (0.048 mg-P/L) (see 8.2.6.1). Daily maximum allowable loads from supplemental water additions at the southern two lakes are 2.43 lb-N/d and 0.124 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 systems every day. The WLA and LA loads presented above are annual loading caps that cannot be exceeded.

8.2.6.6 Future Growth

The El Dorado Park lakes watershed is comprised entirely of parkland. It is not likely that the watershed will be developed and it is expected to remain as open space. No load allocation has been set aside for future growth, and it is unlikely that any dischargers will be permitted in the watershed.

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).

8.3 MERCURY IMPAIRMENT

The 1996 LA Region Water Quality Assessment Report lists mercury in fish tissue as an impairment of the El Dorado Park lakes, although no study was cited directly. No mercury fish tissue data were included in the summary table or the accompanying database.

Although the data were not included in the Water Quality Assessment Report, the Toxic Substances Monitoring Program (TSMP) collected fish tissue samples in the late 80s and 90s that exceeded the fish tissue guideline of 0.22 ppm. Recent data collected by the Surface Water Ambient Monitoring Program (SWAMP) indicate that fish tissue levels of mercury remain elevated (see Section 8.3.3). All fish tissue samples were collected from either Coyote Lake or Alamo Lake, both of which are in the system comprised by the northern four lakes. Thus, there is no direct evidence of fish tissue impairment for the southern two lakes.

In 2008, the Southern California Coastal Water Research Project (SCCWRP) published a report titled "Extent of Fishing and Fish Consumption by Fishers in Ventura and Los Angeles County Watersheds." The purpose of the study was to document the fishing habits and consumption rates of fishers in these counties (SCCWRP, 2008). The El Dorado Park lakes were visited three times, during which 45 fishers were observed. Eighteen fishers were interviewed, and 11 percent of those consume fish caught from these lakes. The El Dorado Park lakes are also part of the California Department of Fish and Game "Fishing in the City" program which encourages people in the Los Angeles area to fish from local waterbodies. Fish are periodically stocked and fishing is only allowed from the northern four lakes.

8.3.1 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. Applicable water quality criteria are also specified in the California Toxics Rule (USEPA, 2000a). The existing beneficial uses assigned to the El Dorado Park lakes include REC1, REC2, WARM, WILD, MUN, and WET. Descriptions of these uses are listed in Section 2 of this TMDL report. Concentrations of mercury measured in fish tissue collected from the northern four lakes indicate that the REC1, REC2, and WARM, uses are currently impaired. Data are not available to assess compliance with the fish tissue standard in the southern two lakes. At high enough concentrations WILD, MUN and WET uses could become impaired.

8.3.2 Numeric Targets

Numeric targets for mercury in the El Dorado Park lakes apply to both the water column and fish tissue. Water column targets are based on beneficial use. For waters designated MUN (existing, potential, or intermittent), the Basin Plan lists a total mercury maximum contaminant level of 0.002 mg/L, or 2 µg/L. The California Toxics Rule includes total mercury human health criteria for the consumption of "water and organisms" or "organisms only" as 0.050 µg/L and 0.051 µg/L, respectively (USEPA, 2000a). California often implements these values on a 30-day average. Because El Dorado Park lakes do not have an existing MUN designated use, a total mercury water column target of 0.051 µg/L (51 ng/L) for "organisms only" is the appropriate target.

In addition, a water column target for dissolved methylmercury of 0.081 ng/L is applicable for the El Dorado Park lakes. This value was calculated by dividing the fish tissue guideline (0.22 ppm) with a national bioaccumulation factor (for dissolved methylmercury) of 2,700,000 applicable for trophic level 4 fish (and multiplying by a factor of 10^6 to convert from milligrams to nanograms).

The fish contaminant goal (FCG) for methylmercury defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) is 220 ppb or 0.22 ppm (wet weight). This concentration is protective of human and wildlife consumers of trophic level four fish. The target length for comparison to this target is 350 mm (13.8 inches) in largemouth bass. Refer to Section 2.2 of this report for more information regarding these targets.

8.3.3 Summary of Monitoring Data

Total mercury concentrations in the water columns of the El Dorado Park lakes have been measured at various locations since 1992. In-lake water column mercury concentrations were measured in July and August 1992 in Alamo Lake as part of the Urban Lakes Study (UC Riverside, 1994). All 12 measurements were less than the detection limit of 0.51 µg/L (500 ng/L). As the detection limit of this dataset is 10 times higher than the water quality criterion for mercury (51 ng/L), it is difficult to assess compliance in terms of a water column concentration.

More recent samples collected in February and July 2009 were collected and analyzed with ultra-clean methods and detection limits no greater than 0.15 ng/L. Samples were collected from Coyote, Alamo, and Nature Center South lakes. All total mercury samples collected during these events ranged from 0.41 ng/L to 1.17 ng/L and were more than one order of magnitude less than the total mercury water column target. Concentrations of total methylmercury in the northern four lakes ranged from 0.041 ng/L to 0.072 ng/L with an average concentration of 0.056 ng/L, which is less than the dissolved target concentration (0.081 ng/L). The observed concentration of total methylmercury in the southern two lakes was 0.02 ng/L and was therefore less than the dissolved target concentration.

Mercury concentrations were also measured for each supplemental water source. Total mercury concentrations measured in the groundwater ranged from 131 ng/L to 142 ng/L, and methylmercury concentrations in the groundwater ranged from 0.109 ng/L to 0.215 ng/L. Thus, total and methylmercury concentrations in the groundwater used for supplemental water additions to the northern four lakes exceeded the water column targets of 51 ng/L and 0.081 ng/L, respectively. Total mercury concentrations measured from the potable water input ranged from 1.46 ng/L to 2.84 ng/L; methylmercury concentrations were approximately 0.02 ng/L. Neither total nor methylmercury concentrations in the potable water source exceeded the respective targets.

Mercury concentrations in the fish tissue of largemouth bass have been measured in the northern lakes at El Dorado Park since 1991. Coyote Lake was sampled by the TSMP in the 1990s and analyzed as composites, with six fish in each composite. The California Surface Water Ambient Monitoring Program (SWAMP) sampled individual fish from Alamo Lake during the summers of 2007 and 2010. No fish tissue samples have been collected from the southern two lakes at the nature center and recreational fishing is not allowed in those two lakes.

Figure 8-9 shows the total mercury concentrations in largemouth bass plotted against length, which is an approximate surrogate for age. For composite fish samples, concentration is plotted against mean length.

As expected, fish tissue mercury concentrations increase with length. Concentrations exceed 0.22 ppm in all individual or composite samples greater than 370 mm. Fourteen individual and three composite samples had fish tissue concentrations greater than the target, while six individual samples had concentrations less than the target. All of the fish tissue data were reported as total mercury concentrations, of which over 90 percent is expected to be in the methyl form (USEPA, 2001a). These total mercury data were compared to the methylmercury fish contaminant guidelines, resulting in conservative assessments.

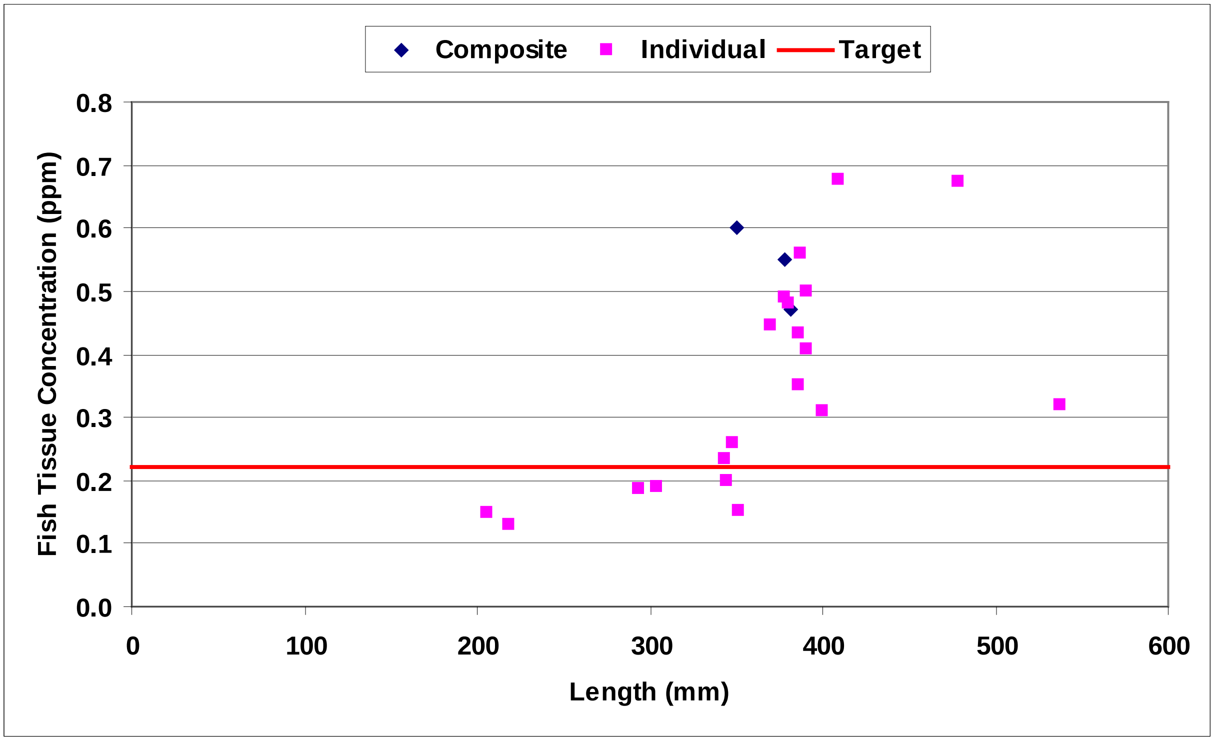

Figure 8-9. Mercury Concentrations in Largemouth Bass Collected from the El Dorado Park Lakes (1991-2010)

8.3.4 Source Assessment

There are several sources of mercury loading to the El Dorado Park lakes. For the northern four lakes, the majority of mercury loading originates from the groundwater that is pumped into Coyote Lake (Figure 8-5) to maintain water levels in the system. Atmospheric deposition is the second largest source of mercury loading to the northern four lakes and the largest contributor to the southern two lakes. The potable water source pumped into Nature Center North Lake (Figure 8-5) is the second largest source of mercury to the southern system. Loads resulting from precipitation and irrigation runoff from the adjacent parklands (3.9 percent of the total irrigation volume is assumed to reach the lake; Appendix F, Dry Weather Loading) contribute insignificant amounts of mercury relative to the other sources.

Table 8-11 and Table 8-12 summarize the total mercury loads to the northern four lakes and southern two lakes, respectively. Estimation of loading from runoff, direct inputs, and irrigation of parkland are discussed in more detail in Appendices D and F (Section 8 of both appendices). The atmospheric deposition component of the mercury load is discussed in Appendix E (Atmospheric Deposition). In both lake systems, the city of Long Beach runoff is assigned a load allocation (associated with 185 acres in the northern lake system and 33.8 acres in the southern lake system). Irrigation and atmospheric deposition will also receive load allocations in both systems; however, the supplemental water additions will receive wasteload allocations. The northern four lakes receive approximately 20 times more mercury annually than the southern two lakes.

Table 8-11. Summary of Existing Total Mercury Loading to the Northern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Total Annual Hg Load (g/yr)	Percent of Load
City of Long Beach	Runoff	0.0109	0.04
City of Long Beach	Supplemental Water Additions (Groundwater)	18.5	73.8
City of Long Beach	Parkland Irrigation	0.0371	0.15
	Atmospheric deposition (to the lake surface)*	6.49	26.0
Total		**25.0**	**100**

*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).

Table 8-12. Summary of Existing Total Mercury Loading to the Southern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Total Annual Hg Load (g/yr)	Percent of Load
City of Long Beach	Runoff	0.00199	0.13
City of Long Beach	Supplemental Water Additions (Potable Water)	0.368	24.6
City of Long Beach	Parkland Irrigation	0.00458	0.31
	Atmospheric deposition (to the lake surface)*	1.12	74.9
Total		**1.49**	**100**

*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).

8.3.5 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. Specifically, models of watershed loading of mercury are combined with an estimated rate of bioaccumulation in the lake. This enables a translation between the numeric target (expressed as a fish tissue concentration of mercury) and mercury loading rates. The loading capacity is then determined via the linkage analysis as the mercury loading rate that is consistent with meeting the target fish tissue concentration.

Neither data nor resources are available to create and calibrate detailed lake response models for mercury cycling in the El Dorado Park lakes. The TMDL target is based on achieving acceptable concentrations in fish. In midwestern and eastern lakes, methylation in lake sediments is often the predominant source of methylmercury in the water column. However, in western lakes with high sedimentation rates, rapid burial tends to depress the relative importance of regeneration of methylmercury from lake sediments. In lakes with high sedimentation rates, fish tissue concentrations are therefore likely to respond approximately linearly to reductions in the watershed methylmercury and total mercury load. For the El Dorado Park lakes, watershed loading is an insignificant amount of the total load compared to the loads from supplemental water addition and air deposition. However, it is expected that fish tissue concentrations will also respond linearly to reductions of direct inputs and atmospheric deposition, which contribute the majority of the loading to each lake system in El Dorado Park.

Nationally, authors such as Brumbaugh et al. (2001) have shown a log-log linear relationship between methylmercury in water and methylmercury in fish tissue normalized to length. However, this relationship is well-approximated by a linear relationship for the ranges of fish tissue concentration of concern for these impaired lakes. For the lakes where fish tissue data are available (the northern four lakes), the groundwater supplemental water additions contribute over 70 percent of the total mercury load and 97.5 percent of the methylmercury load (see Section 8 in Appendices D and F; Wet Weather Loading and Dry Weather Loading). Until such time as a lake response model for mercury is constructed, and sufficient calibration data are collected, an assumption of an approximately linear response of fish tissue concentrations to changes in external loads is sufficient for the development of a TMDL. For a more detailed discussion of the linkage analysis between mercury loading and fish body burden, see Section 3.2.3 of this report.

8.3.6 TMDL Summary

A waterbody's loading capacity represents the maximum pollutant load that can be assimilated without violating water quality standards (40 CFR 130.2(f)). This is the maximum load consistent with meeting the numeric target of 0.22 ppm for mercury in largemouth bass. The methodology for determining the loading capacity is described briefly in this section. For more detail, refer to Appendix C (Mercury TMDL Development).

Calculating the loading capacity first requires an estimate of the existing mercury concentration in largemouth bass. To do this, a linear regression analysis was performed on tissue concentrations versus length for the northern four El Dorado Park lakes. The resulting regression equation is

$$Hg(fish) = -0.15316 + 0.001461 \cdot Len, R^2 = 0.35$$

where *Hg(fish)* is the total mercury concentration in largemouth bass (ppm) and *Len* is length in mm. The regression analysis is shown in Figure 8-10, along with the one-sided 95 percent upper confidence limits on mean predictions about the regression line (95 percent UCL) and the 95 percent upper prediction intervals on individual predicted concentrations (95 percent UPI). The UPI gives the confidence limit on the individual predictions for a given length while the UCL gives the confidence limit on the average of the predictions for a given length. This regression has a non-zero intercept and should not be considered valid for lengths less than 200 mm.

For mercury, long-term cumulative exposure is the primary concern. Therefore, it is appropriate to use the 95 percent UCL rather than the UPI to provide a Margin of Safety on the appropriate age class. Use of the UCL provides an explicit Margin of Safety because it represents an upper confidence bound on the long-term exposure concentration.

Both the observed data and the predicted concentrations show that mercury concentrations in largemouth bass typically exceed the target of 0.22 ppm in the system comprised by the northern four El Dorado Park lakes. The TMDL target is established for a 350 mm largemouth bass (see Section 2.2.8). The predicted mercury concentration based on the UCL equation for this length is compared to the target concentration to determine the required reduction in mercury loading, which includes an explicit Margin of Safety as described above.

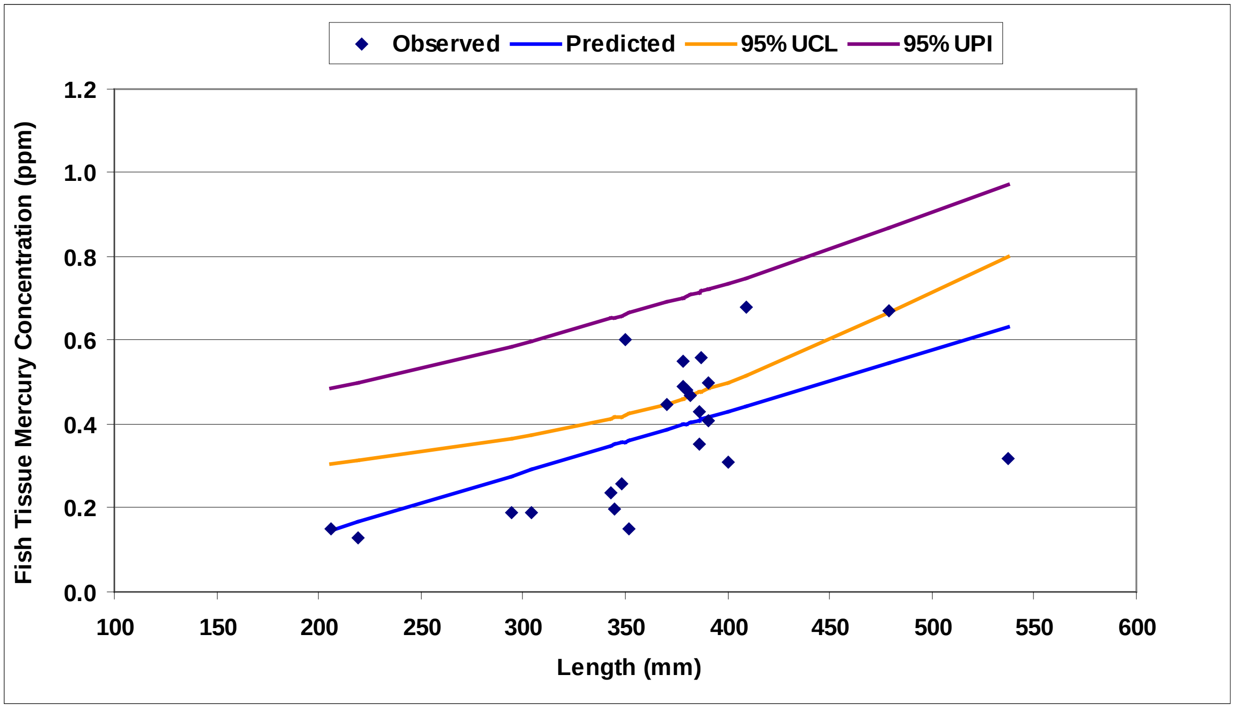

Figure 8-10. Regression Analysis of Mercury in El Dorado Park Lakes Largemouth Bass

For the northern four El Dorado Park lakes, the fraction of the existing load consistent with attaining the target (the loading capacity) is the ratio of the target (0.22 ppm) to the best estimate of current average concentrations in the target fish population. The difference between the direct regression estimate and the 95 percent UCL provides the Margin of Safety. Therefore, the allocatable fraction of the existing load (the loading capacity less the Margin of Safety) is the ratio of the target to the 95 percent UCL. The resulting loading capacities and allocatable loads are expressed as fractions of the existing load as summarized in Table 8-13. This analysis indicates that a 47.8 percent reduction in mercury loading to the northern four lakes will be required to bring fish tissue concentrations in 350 mm largemouth bass down to 0.22 ppm (see Section 2.2.8).

Table 8-13. Estimated Total Mercury Loading Capacity and Allocatable Load for the Northern Lake System of the El Dorado Park Lakes (as Fractions of the Existing Load)

Parameter	Value
Target Concentration (ppm)	0.22
Target Length (mm)	350
Predicted Mercury Concentration at Target Length (ppm)	0.358
95^{th} Percent UCL (ppm)	0.422
Loading Capacity (ratio of target to predicted value)	0.614
Allocatable Load (ratio of target to 95^{th} percent UCL)	0.522
Required Reduction in Existing Load (1 minus allocatable fraction)	0.478
Margin of Safety Fraction (loading capacity fraction minus allocatable fraction)	0.093

The loading capacity can also be expressed as grams per year (g/yr) of total mercury using the existing loads presented in Table 8-11 and the calculated fractions of the existing load (Table 8-13). For the northern four lakes, the loading capacity is 61.4 percent of the existing load of 25.0 g/yr, or 15.4 g/yr.

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

The allocatable load for the northern four lakes (divided among WLAs and LAs) is 52.2 percent of the existing load. Thus the allocatable load is 13.0 g/yr which represents 84.4 percent of the loading capacity. The Margin of Safety is 9.3 percent of the loading capacity.

$$15.4g / yr = \sum 9.62g / yr + 3.41g / yr + 2.32g / yr$$

For the southern two lakes, there are no fish tissue data to indicate whether or not the system is impaired, and the observed total mercury concentrations in the water column are well below the targets (Section 8.3.3). The following comparisons may be made to the northern four lakes:

1) The ratio of the allowable load to the northern four lakes (13.0 g/yr) divided by their cumulative volume (243 ac-ft) is 0.05. The ratio of the existing load to the southern two lakes (1.49 g/yr) divided by their cumulative volume (24 ac-ft) is 0.06. Thus, the volume-weighted existing load to the southern two lakes is approximately equal to the volume-weighted allowable load to the northern four lakes.

2) The northern four lakes require a reduction in mercury loading of 47.8 percent. Over 73 percent of the loading to the northern four lakes is a result of direct groundwater input. Based on data collected and analyzed with ultra-clean methods in February and July 2009, the average total mercury concentration of the groundwater is 136 ng/L (nearly three times the water column target of 50 ng/L). The largest contributor of mercury loading to the southern two lakes is atmospheric deposition. Areal rates of atmospheric mercury deposition to each system are the same. The second largest contributor of mercury to the southern lake system is the potable water input, which has an average concentration of 2.84 ng/L, which is more than one order of magnitude below the water column target (based on data collected in February and July 2009). If the existing loading from atmospheric deposition to the northern four lakes was held constant, but the groundwater concentration was reduced to the same level observed in the potable water input, the total mercury load to the northern four lakes would be 7.4 g/yr, which is a reduction from existing loading of almost 71 percent. Thus, the two major sources of loading to the southern two lakes would not cause impairment of the northern lake system, assuming the volume of water applied to the northern four lakes remains at current levels.

3) The average total methylmercury concentration observed in the groundwater input is 0.162 ng/L, which is two times higher than the dissolved methylmercury water column target (0.081 ng/L) (Note: data are presented for the total fraction, while the water column target is for the dissolved fraction, resulting in a conservative assessment). The potable water input has an observed concentration of 0.02 ng/L (below the 0.081 ng/L methylmercury water column target). As bioaccumulation is directly proportional to methylmercury concentration, the southern two lakes are less likely to exhibit fish tissue concentrations that are as high as those seen in the northern lakes.

4) Fishing is not allowed from the two southern lakes and has not been observed during any of the recent monitoring events.

While none of the above statements offer a direct comparison to the mercury fish tissue guideline, they do indicate that impairment is unlikely. Since the southern lake system has very different mercury loading than the northern lake system, the TMDL for the southern lake system will be different than for the northern lake system. For this TMDL, total mercury loads in the southern two lakes will be held to existing levels as an antidegradation measure until fish tissue data are collected to either confirm or deny the mercury impairment. The MOS for the southern two lakes will be zero.

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

$$1.49 g/yr = \sum 0.368 g/yr + 1.13 g/yr + 0 g/yr$$

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.

8.3.6.1 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). The direct inputs to the northern and southern lake systems are assigned WLAs. Table 8-14 and Table 8-15 summarize the existing total mercury loads and WLAs for these sources. This TMDL establishes WLAs at their point of discharge. For the northern four lakes, the WLA is a 47.8 percent reduction from the existing loads (Table 8-14); for the southern two lakes, the wasteload allocation (Table 8-15) is equal to the existing load (Table 8-12). These loading values (in grams per year) represent the TMDLs wasteload allocations (Table 8-14 and Table 8-15) and each wasteload allocation must be met at the point of discharge. However, point source discharges to the lake must also meet CTR criteria for total mercury so the targeted concentration for the northern lake system must be at a maximum of 51 ng/L. At a maximum concentration of 51 ng/L a greater volume of water may be discharged to the lakes than is currently discharged and still attain the mass-based WLA. In addition to the WLAs presented below for total mercury, an in-lake water column dissolved methylmercury target of 0.081 ng/L applies. -

Table 8-14. Wasteload Allocations of Total Mercury for the Northern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Existing Annual Hg Load (g/yr)	Wasteload Allocation[1] (g/yr)
City of Long Beach	Supplemental Water Additions	18.5	9.62

[1] Each mass-based wasteload allocations must be met at the point of discharge.

Table 8-15. Wasteload Allocations of Total Mercury for the Southern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Existing Annual Hg Load (g/yr)	Wasteload Allocation[1] (g/yr)
City of Long Beach	Supplemental Water Additions	0.368	0.368

[1] Each mass-based wasteload allocations must be met at the point of discharge.

8.3.6.2 Load Allocations

Load allocations of total mercury are required for the atmospheric deposition and watershed sources. Table 8-16 and Table 8-17 summarize the existing total mercury loads and LAs for the northern and southern lake systems, respectively. The LAs for the northern system are a 47.8 percent reduction from the existing loads. The LAs for the southern two lakes are equal to the existing load (Table 8-12); no reductions are required for the southern lake system. LAs are provided for each responsible jurisdiction and input. These loading values (in grams per year) represent the TMDLs load allocations (Table 8-16 and Table 8-17) and each load allocation must be met at the point of discharge. In addition to the LAs presented below for total mercury, an in-lake water column dissolved methylmercury target of 0.081 ng/L applies.

Table 8-16. Load Allocations of Total Mercury for the Northern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Existing Annual Hg Load (g/yr)	Load Allocation[1] (g/yr)
City of Long Beach	Runoff	0.0109	0.0057
City of Long Beach	Parkland Irrigation	0.0371	0.0193
	Atmospheric deposition (to the lake surface)[2]	6.49	3.38
Total		**6.54**	**3.41**

[1] Each mass-based load allocations must be met at the point of discharge.

[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).

Table 8-17. Load Allocations of Total Mercury for the Southern Lake System of the El Dorado Park Lakes

Responsible Jurisdiction	Input	Existing Annual Hg Load (g/yr)	Load Allocation[1] (g/yr)
City of Long Beach	Runoff	0.00199	0.00199
City of Long Beach	Parkland Irrigation	0.00458	0.00458
	Atmospheric deposition (to the lake surface) [2]	1.12	1.12
Total		**1.13**	**1.13**

[1] Each mass-based load allocations must be met at the point of discharge.

[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).

8.3.6.3 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. The TMDL for the northern lake system includes both an implicit and explicit MOS. The implicit MOS includes comparing the total mercury concentration reported for fish tissue samples to the methylmercury fish tissue target. Most mercury in fish tissue is in the methyl form, but not all, so this is a conservative assumption. In this TMDL, an explicit MOS is also included by selecting the 95 percent UCL to represent the existing mean fish tissue concentration rather than the regression predicted mean (Figure 8-10). Use of the UCL provides a margin of safety because it represents an upper confidence bound on the long-term exposure concentration. For the northern lake system, the fraction of the existing load set aside for the explicit MOS is 0.093, or 2.32 g/yr, which represents 9.3 percent of the loading capacity. The TMDL for the southern lake system includes an implicit MOS. This lake system is likely achieving the fish tissue target and TMDLs are being established at the existing mercury loads. This conservative anti-degradation measure is the implicit margin of safety for this TMDL.

8.3.6.4 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 in the northern lake system and maintaining existing water quality in the southern lake system. Because fish bioaccumulate mercury, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, annual mercury loading is more important for the attainment of standards than instantaneous or daily concentrations, and the TMDL is proposed in terms of annual loads. For the northern four lakes, the primary source of mercury load is the groundwater input, and peak flows do represent a critical condition in terms of peak loading rates. The majority of supplemental flows are added to each system during the dry season (May through October) when precipitation is generally low and evaporation rates are high. For the southern two lakes, the largest source of mercury loading is atmospheric deposition which is not known to have a critical condition.

However, the greatest impact to fish occurs when methylmercury, a more biologically available form of mercury, is at its greatest concentration. Bacterially mediated methylation of mercury varies seasonally and typically results in the greatest methylmercury concentrations in the water column in the late summer. However, the impact of seasonal and other short-term variability in loading is damped out by the biotic response since the target concentrations in tissues of edible sized game fish integrate exposure over a number of years. Additionally, this TMDL includes a methylmercury water column target applicable year round. This TMDL therefore protects for critical conditions.

8.3.6.5 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. Although it is long-term cumulative load rather than daily loads of mercury that are driving the bioaccumulation of mercury in fish in the El Dorado Park lakes, these TMDLs does present a maximum daily load according to the guidelines provided by USEPA (2007). 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.

For the northern four lakes, the primary contributor of mercury loading is the groundwater input. Peak daily flow from this source is estimated as the maximum metered flow rate (30.8 ac-ft/mo) divided by the number of days in the peak flow month (31) or 0.994 ac-ft/d. The average mercury concentration consistent with achieving the long-term loading target for the northern four lakes is the allowable load from this source (9.62 g/yr; Table 8-14) divided by the total average annual flowrate to the lake system (110 ac-ft, see Appendices D and F) which is 70.9 ng/L. The daily maximum allowable load of mercury to the northern system in the El Dorado Park lakes is the highest measured groundwater flowrate multiplied by the mercury concentration that will be consistent with achieving the long-term loading target, or 0.087 g/d.

$$0.994\ ac\text{-}ft/d \cdot 70.9\ ng/L \cdot 43{,}560\ ft^2/ac \cdot 28.32\ L/ft^3 \cdot 1g\ /\ 1{,}000{,}000{,}000\ ng = 0.087\ g/d$$

For the southern two lakes, the maximum allowable daily mercury load is estimated from the dry and wet atmospheric deposition rates (Appendix E, Atmospheric Deposition) and the cumulative lake surface area for the two lakes (5.2 acres or 0.021 km^2). Dry deposition rates are fairly constant and the average daily load deposited to the southern lake system may be estimated by dividing the annual deposition rate by the average number of days per year:

$$50.0656 g / km^2 / yr \cdot 0.021 km^2 \cdot \frac{1yr}{365.25d} = 0.00288 g / d$$

The daily maximum wet deposition rate is equal to the annual rate times the fraction of precipitation that falls during the wettest month of the year divided by number of days in that month. Weather data for the Long Beach area indicate that February is typically the wettest month, receiving 24.7 percent of annual precipitation. The likely maximum wet deposition rate to the southern lakes at El Dorado Park is:

$$3.176 g / km^2 / yr \cdot 0.021 km^2 \cdot 24.7\% / 100 yr / mo \cdot \frac{1mo}{28.25d} = 0.00058 g / d$$

As no reductions in existing load are required for the southern lake system, the total maximum daily load is the sum of the daily dry and wet loads or 0.00346 g/d.

8.3.6.6 Future Growth

The El Dorado Park lakes watershed is comprised entirely of parkland. It is not likely that the watershed will be developed and it is expected to remain as open space. No load allocation has been set aside for future growth, and it is unlikely that any dischargers will be permitted in the watershed.

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).

8.4 LEAD IMPAIRMENT

The El Dorado Park lakes were 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), EPA and local agencies collected 38 additional samples (six wet weather) between February 2009 and September 2010 to evaluate current water quality conditions. There were zero dissolved lead exceedances in 38 samples (Appendix G, Monitoring Data). USEPA also collected eight sediment samples between August and September 2010 to further evaluate lake conditions. There were zero sediment lead exceedances of the 128 ppm freshwater (Probable Effect Concentrations) sediment target (Appendix G, Monitoring Data). Therefore, the El Dorado Park lakes meet lead water quality standards, and USEPA concludes that preparing a TMDL for lead is unwarranted at this time. USEPA recommends that the El Dorado Park lakes not be identified as impaired by lead in California’s next 303(d) list.

8.5 COPPER IMPAIRMENT

The El Dorado Park lakes were 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), EPA and local agencies collected 38 additional samples (six wet weather) between February 2009 and September 2010 to evaluate current water quality conditions. There were two dissolved copper exceedances in 38 samples (Appendix G, Monitoring Data). USEPA also collected eight sediment samples between August and September 2010 to further evaluate lake conditions. There were four sediment copper exceedances of the 149 ppm freshwater (Probable Effect Concentrations) sediment target (Appendix G, Monitoring Data). In order to address the impairment for copper, on January 10, 2012 the Regional Board issued Cleanup and Abatement Order (CAO) No.R4-2012-0003 *Requiring the City of Long Beach to take remedial action to reduce copper loading to El Dorado Park Lakes pursuant to California Water Code Section 13304 in order to implement a Total Maximum Daily Load for copper*. This CAO contained all the elements of a TMDL and was approved by USEPA on March 20, 2012.

8.6 IMPLEMENTATION RECOMMENDATIONS

Implementation measures may be developed in the future by the Regional Board through an implementation plan, NPDES permits, or nonpoint 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.

If necessary, these TMDLs may be revised as the result of new information (See Section 8.7 Monitoring Recommendations). The State Board is in the early stages of developing a Statewide Mercury Policy and Mercury Control Program for Reservoirs. According to CEQA scoping materials, the Policy would define an overall structure for adopting water quality objectives; general implementation requirements; and control plans for mercury impaired water bodies. The final structure of the control program could include a total maximum daily load (TMDL) for mercury in reservoirs along with an implementation plan to achieve the TMDL; or an implementation plan that does not rely on a TMDL. How this upcoming policy and program will affect implementation of this TMDL is unknown at this time.

8.6.1 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 8-8 and Table 8-16 for the northern lake system and Table 8-9 and Table 8-17 for the southern lake system for nutrients and mercury, respectively.

8.6.2 Point Sources and the Implementation of Wasteload Allocations

Wasteload allocations apply to the supplemental water additions (Table 8-5 and Table 8-14 for the northern lake system and Table 8-6 and Table 8-15 for the southern lake system for nutrients and mercury, respectively). These mass-based waste load allocations will be implemented by the Regional Board.

8.6.3 Source Control Alternatives

Responsible jurisdictions are encouraged to consider the construction of wetland systems and bioswales (or other retention or 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. The City of Los Angeles has modeled expected nutrient concentration reductions to stormwater flows to Echo Park Lake from constructed wetlands, and construction is currently underway. Information about this and other City of Los Angeles water quality improvement projects are available on Proposition O website: http://www.lapropo.org/sitefiles/lariver.htm.

The El Dorado Park lakes have both nutrient-related and mercury impairments. While there are some management strategies that would address both of these impairments (i.e., sediment removal BMPs), their differences warrant separate implementation and monitoring discussions. One potential source control measure that has previously been proposed by the city of Long Beach would help implement TMDLs for both impairments and is detailed below.

These lakes are currently supplied by potable and groundwater, but the city of Long Beach has proposed adoption of the following grant (City of Long Beach, 2008):

> *The project will convert six lakes in the El Dorado Regional Park and Nature Center from potable water to excess reclaimed water by the installation of nano-filtration plants at the northern-most lake in the Regional Park and in the maintenance yard adjacent to the Nature Center. The nano-filtration will provide clean water to the lakes, and allow the lakes to overflow into the connecting streambeds, thereby providing increased circulation and cleansing of the lake water. The estimated potable water savings would be 190 acre-feet per year.*

The original grant application (Watershed Conservation Authority, 2005) states the following:

> *El Dorado Park lakes Water Usage and Wetlands Restoration integrates water conservation, water quality, habitat restoration and recreational use benefits. Reclaimed water will be used to create a continuous, natural stream flow through the park lakes. The creation of a stream will restore riparian habitat. Wetland habitat will be created within a detention basin that will improve water quality and support a variety of wildlife species. Expansion of the existing Nature Center, introduction of native habitat into the regional park, and expanding environmental education enhancements will offer diverse recreational opportunities in the regional park….*
>
> *El Dorado Park lakes Water Usage and Wetlands Restoration will significantly reduce the pollution in the six lakes in the Park and Nature Center caused by insufficient water circulation and excessive levels of nitrogen in the water. This is especially important in the sensitive Nature Center lakes. It will also improve storm drain outlet flows into the San Gabriel River Estuary in order to meet water quality standards….*
>
> *Effluent from a storm drain from a 100-acre shopping center will be intercepted, filtered for trash, and cleansed in a treatment wetland before discharge into the San Gabriel River or Coyote Creek. The project also improves the water quality of the lakes through the desalination of the*

reclaimed water entering the lakes and replacing an artificially maintained constant water level with a constantly flowing water body.

Implementing changes into the source of water for the lakes will have vast impacts on water quality. The existing groundwater used to fill the northern lake has anomalously high mercury concentrations and switching to a different source of water would likely results in much lower mercury concentrations. Additionally, if filtration of other water sources provides a low nutrient water source and additional flow and circulation to the lakes, reductions in chlorophyll *a* levels should result.

8.6.3.1 Nutrient-Related Impairments

Additionally, to further address nutrient-related impairments, source reduction and pollutant removal BMPs designed to reduce sediment loading could be implemented throughout the watershed as these management practices will also reduce the nutrient loading associated with sediments. Dissolved loading associated with dry and wet weather runoff also contributes nutrient loading to the El Dorado Park lakes. Some of the sediment reduction BMPs may also result in decreased concentrations of nitrogen and phosphorus in the runoff water. Storage of storm flows in wet or dry ponds may allow for adsorption and settling of nutrients from the water column. BMPs that provide filtration, infiltration, and vegetative uptake and removal processes may retain nutrient loads in the upland areas.

If fertilizer application is used in the future at El Dorado Park lakes, education of park maintenance staff regarding the proper placement, timing, and rates of fertilizer application will be necessary to ensure that there is not excess nutrient loading to the lakes. 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 bird populations. The NNE BATHTUB model indicated Additional Parkland Loading is present in the northern four lakes. These lakes are those most heavily frequented by bird feeders and the additional bird feces produced by bird feeding contributes to this load.

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.

8.6.3.2 Mercury Impairment

The primary source of mercury loading to the northern four lakes is the groundwater input. Reducing this loading is imperative to ultimately achieving the fish tissue target in the lakes. Additional source(s) of water may be required to maintain lake levels and/or treatment of the groundwater may be necessary to reduce mercury concentrations to acceptable ranges.

To reduce watershed loading, several management practices can be implemented. Dissolved loading associated with storm event runoff also contributes some mercury loading to the El Dorado Park lakes, however, these were not identified as significant sources of mercury in the El Dorado Park lakes watershed. Specifically, source reduction and pollutant removal BMPs designed to reduce sediment loading can be implemented throughout the watershed as these management practices will also reduce the mercury loading associated with sediments. Some of the sediment reduction BMPs may also result in decreased concentrations of mercury in the runoff water. BMPs that provide filtration or infiltration processes may retain dissolved mercury in the upland areas. Additionally, reducing nutrient loading to the lake and improving aeration would likely reduce methylation rates within the lake overall.

Unfortunately, sediment reduction BMPs will not mitigate mercury loading from the second largest source in the watershed, atmospheric deposition to the lake surface. Mercury available for deposition in the southwest region typically originates from both local and global sources. In the US, mercury emissions from most facilities have been reduced over the past few decades as the best available technology has improved over the years. In 2008, USEPA modeled mercury air emissions nationally as a tool for tracking airborne mercury to assist in watershed planning. The mercury emission estimates were principally based on 2001 data. The highest modeled impact in California was located in the Long Beach area and the largest single source contributor was the Long Beach South East Resource Recovery facility which combusts municipal waste to produce electricity. Since that time USEPA has promulgated regulations to reduce mercury from solid waste incinerators and the emissions from this facility and another solid waste incinerator in the city of Commerce have been significantly reduced. In addition to these regulations for solid waste combustors, USEPA is in the process of finalizing regulations for Portland Cement plants which also contribute to mercury air loading and deposition in the Los Angeles area.

8.7 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 will indeed result in compliance with the chlorophyll *a* and mercury 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 mercury and algal densities and bloom frequencies.

8.7.1 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. At El Dorado Park Lakes the only wasteload allocations are for supplemental water additions. These sources should be monitoring once a year during the summer months (the critical condition) for at minimum; ammonia, TKN or organic nitrogen, nitrate plus nitrite, orthophosphate, total phosphorus, total suspended solids and total dissolved solids.

The nutrient TMDLs for the northern four lakes of El Dorado Park lakes conclude that a 52.4 percent reduction in total phosphorus loading and a 62.2 percent reduction in total nitrogen loading are needed to maintain a summer average chlorophyll *a* concentration of 20 µg/L (note that the southern two lakes have TMDLs equal to the existing load, so no reductions are required). As an example of concentrations that responsible jurisdiction 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). For the supplemental water additions, the targeted concentrations may be 0.113 mg-P/L and 0.363 mg-N/L for the northern lake system, and 0.048 mg-P/L and 0.94 mg-N/L for the southern lake system, assuming flow volumes for both sources remain at existing levels (Table 8-5 and Table 8-6). Similarly, targeted concentrations of nitrogen and phosphorus in the city of Long Beach runoff to the northern four lakes may be 0.319 mg-P/L and 1.67 mg-N/L. Targeted concentrations in the parkland irrigation returns may be 0.079 mg-P/L and 2.16 mg-N/L (3.9 percent of the total irrigation volume to both lake systems is assumed to reach the lake; Appendix F, Dry Weather Loading). The targeted nitrogen concentrations for precipitation to the surfaces of the northern four lakes may be 0.082 mg-N/L. Targeted concentrations for the additional parkland loading cannot be estimated because the associated flow volumes are unknown. As stated above, these concentrations are provided as guidelines; however, mass-based WLAs must be achieved.

8.7.2 Mercury Impairment

To assess compliance with the mercury TMDLs, monitoring should include monitoring of largemouth bass (325-375mm in length) fish tissue (skin-off fillets) at least every three years as well as twice yearly sediment and water column sampling in each lake. At a minimum, compliance monitoring should measure the following in-lake water quality parameters: total mercury, dissolved methylmercury, chloride, sulfate, total organic carbon, alkalinity, total suspended solids, and total dissolved solids; as well as the following in-lake sediment parameters: total mercury, methylmercury, total organic carbon, total solids and sulfate. 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. Additionally, in order to accurately calculate compliance with allocations expressed in yearly loads, monitoring should include flow estimation or monitoring as well as water quality concentration measurements. At El Dorado Park Lakes the only wasteload allocation is to supplemental water additions. This source should be monitored twice a year for at minimum: total mercury, methyl mercury, chloride, sulfate, total organic carbon, alkalinity, total suspended solids, and total dissolved solids.

The mercury TMDLs for the El Dorado Park lakes concludes that a reduction in total mercury loading to the northern four lakes of 47.9 percent will result in compliance with the fish tissue target of 0.22 ppm (note that the southern two lakes have TMDLs equal to the existing load, so no reductions are required). As an example of concentrations that responsible jurisdiction 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 8-5 and Table 8-6 for the northern and southern lake systems, respectively), targeted concentrations of total mercury in the supplemental water additions may be 71.0 ng/L for the northern lake system and 2.84 ng/L for the southern lake system. Similarly, the targeted concentration of total mercury in the city of Long Beach runoff to the northern four lakes may be 2.72 ng/L, and the targeted concentration in the irrigation return flows may be 0.768 ng/L. For the southern two lakes, the targeted concentration of total mercury in the runoff from the city of Long Beach may be 5.22 ng/L, and the targeted concentration in the parkland irrigation return flows may be 1.47 ng/L (3.9 percent of the total irrigation volume for both lake systems is assumed to reach the lake; Appendix F, Dry Weather Loading). As stated above, these concentrations are provided as guidelines; however, mass-based WLAs must be achieved. An in-lake water column dissolved methylmercury target of 0.081 ng/L also applies.

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