U.S. Environmental Protection Agency

Los Angeles Area Lakes TMDLs
March 2012

Section 5 Lincoln Park Lake TMDLs

5 Lincoln Park Lake TMDLs

Lincoln Park Lake (#CAL4051501020000303205453) is listed for ammonia, eutrophication, lead, odor, organic enrichment/low dissolved oxygen, and trash (SWRCB, 2010). This section of the TMDL report describes the impairments and the TMDLs developed to address nutrients (Section 5.2) and trash (Section 5.4). Nutrient load reductions are required to achieve the chlorophyll *a* target; these reductions are also expected to alleviate pH, odor, DO and ammonia problems. Comparison of metals data to their associated hardness-dependent water quality objectives indicates that lead is currently achieving numeric targets at Lincoln Park Lake; therefore, a TMDL is not included for this pollutant. Analyses for lead are presented below (Section 5.3).

5.1 Environmental Setting

Lincoln Park Lake is located in the Los Angeles River Basin (HUC 18070105) within the city of Los Angeles (Figure 5-1). The Urban Lakes Study (UC Riverside, 1994) reported that the area was dedicated for park purposes on August 18, 1883, and that the lake and surrounding park were developed sometime in the early 1890s. The small urban lake has a surface area of 4.9 acres (based on Southern California Association of Governments [SCAG] 2005 land use), an average depth of approximately four feet as estimated from 2009 sampling events and the Urban Lakes Study (UC Riverside, 1994), and a total volume of approximately 19.6 acre-feet (volume calculated from estimated depth and surface area estimated from land use data). The lake is filled primarily with potable water and the park restrooms are connected to the city sewer system. Recreation includes catch and release fishing and there is a fountain near the center of the lake (Figure 5-2). According to the California Department of Fish and Game, trout are stocked periodically (CDFG, 2009). Visitors are not allowed to boat or swim in the lake. Bird feeding is another recreational activity at Lincoln Park Lake, and heavy feeding has been observed during recent fieldwork, likely contributing to larger bird populations. Lake managers use algaecides to control algal growth in the lakes on an as needed basis. Additional characteristics of the watershed are summarized below.

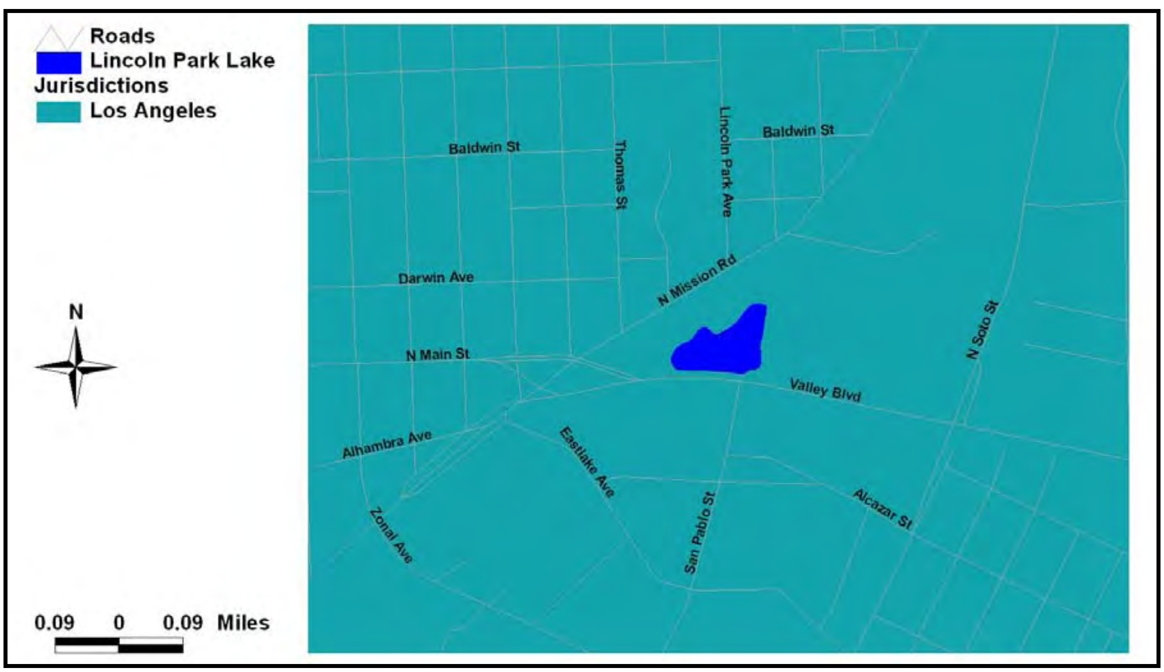

Figure 5-1. Location of Lincoln Park Lake

Figure 5-2. View of Lincoln Park Lake from the West Shore Boat Ramp

5.1.1 Elevation, Storm Drain Networks, and TMDL Subwatershed Boundaries

The Lincoln Park watershed is 37.1 acres and ranges in elevation from 104 meters to 132 meters (Figure 5-3). Though the lake appears to be connected to a storm drain network (coverage provided by the county of Los Angeles), this system actually passes under Lincoln Park Lake and does not discharge stormwater to the lake (personal communication, Shoukofe Marashi, city of Los Angeles, to Anna Sofranko, USEPA Region 9, September 25, 2009). Overflow from the lake discharges to the storm drain system (Figure 5-4). The subwatershed boundary for Lincoln Park Lake is comprised only of the surrounding parklands. The TMDL subwatershed boundary was manually delineated based on the digital elevation data. The resulting area is assigned load allocations for TMDL development; the supplemental water additions are assigned wasteload allocations.

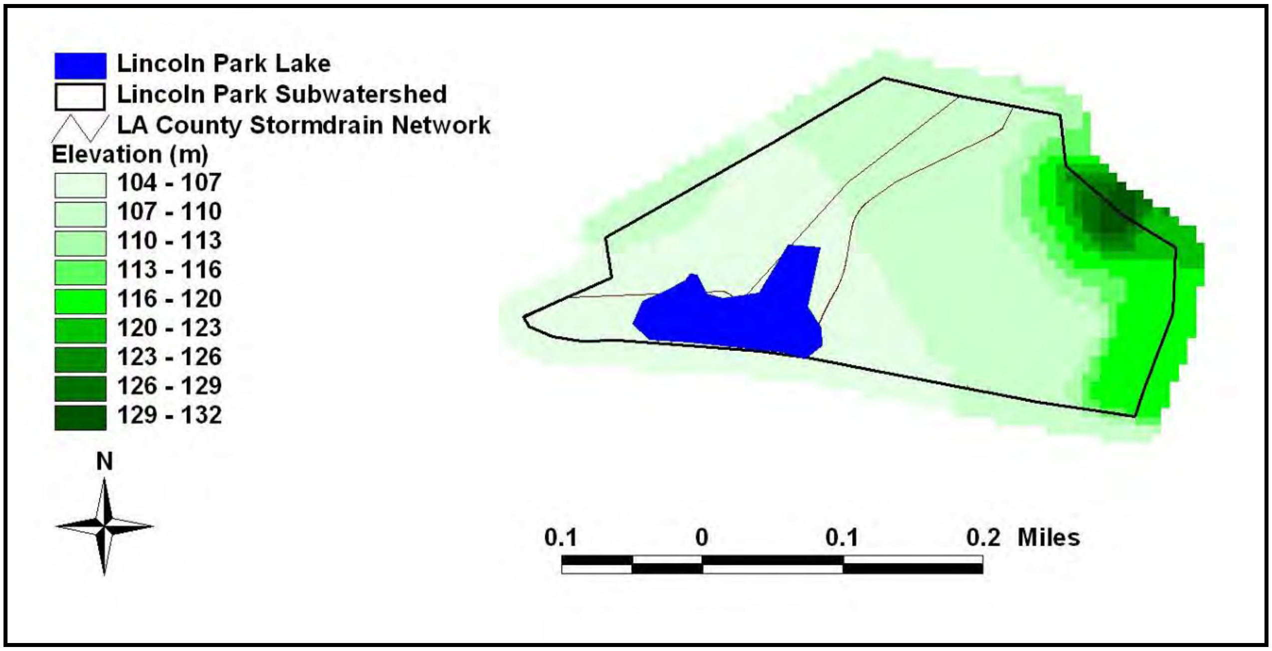

Figure 5-3. Elevation, Storm Drain Networks, and TMDL Subwatershed Boundary for Lincoln Park Lake

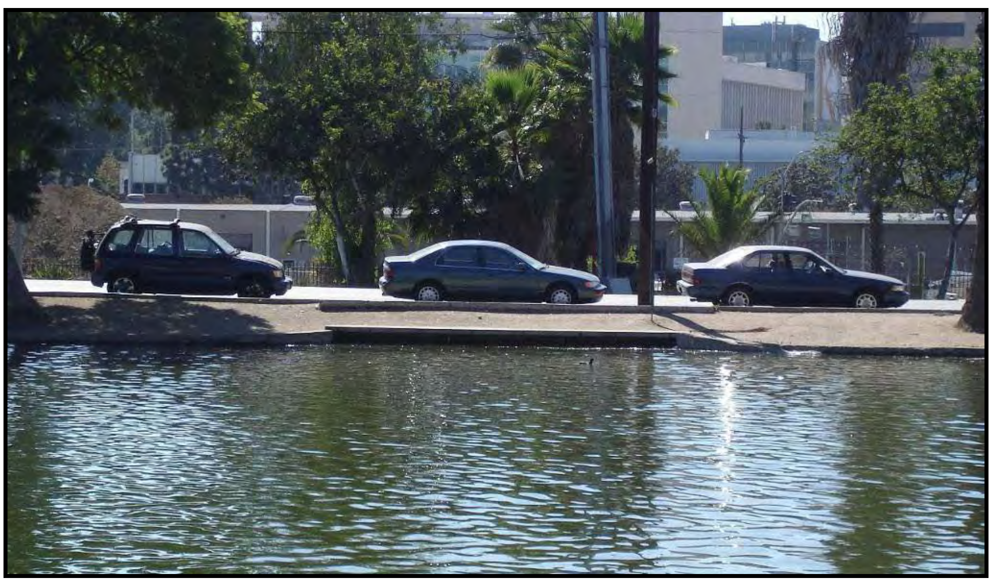

Figure 5-4. Lincoln Park Lake Outflow

5.1.2 MS4 Permittee

Figure 5-5 shows the municipal separate storm sewer system (MS4) stormwater permittee in the Lincoln Park Lake watershed. The watershed is entirely within the city of Los Angeles; however, the lake does not receive drainage from the MS4. The storm drain coverage was provided by the county of Los Angeles and is labeled accordingly.

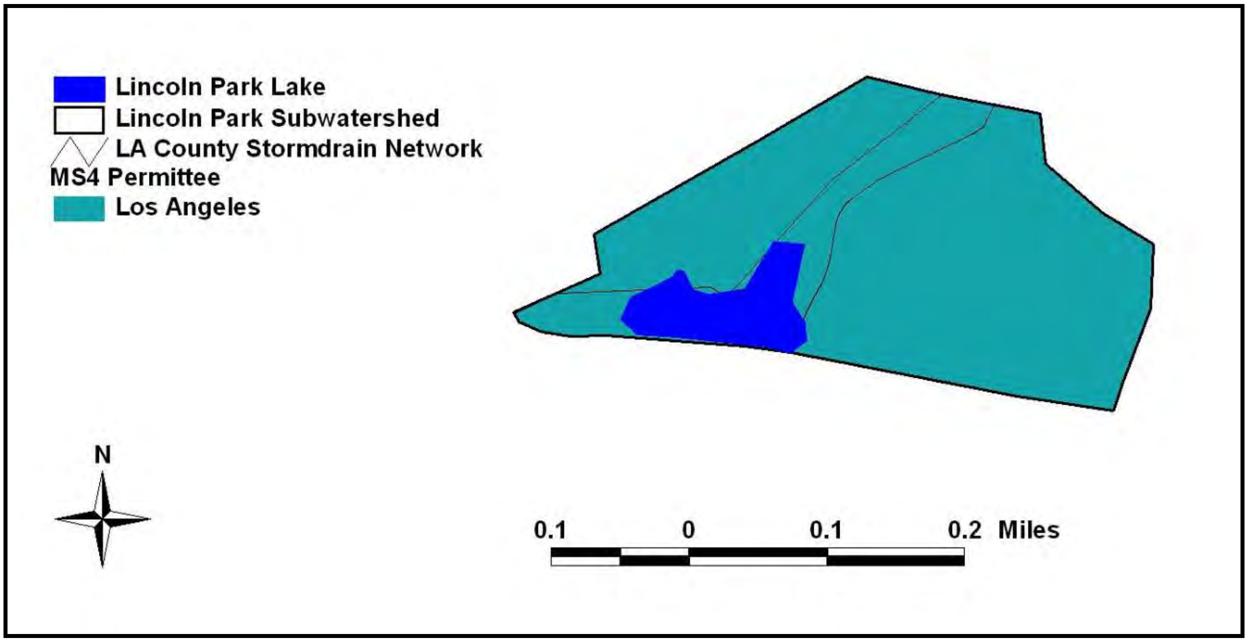

Figure 5-5. MS4 Permittee and the Storm Drain Network for the Lincoln Park Lake Subwatershed

5.1.3 Non-MS4 NPDES Dischargers

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

5.1.4 Land Uses and Soil Types

The analysis for the Lincoln Park Lake watershed includes source loading estimates obtained from the Los Angeles River Basin LSPC Model discussed in Appendix D (Wet Weather Loading) of this TMDL report. Land uses identified in the Los Angeles River LSPC model are shown in Figure 5-6. The watershed is comprised of open space and industrial areas. Table 5-1 summarizes the land use areas for the subwatershed.

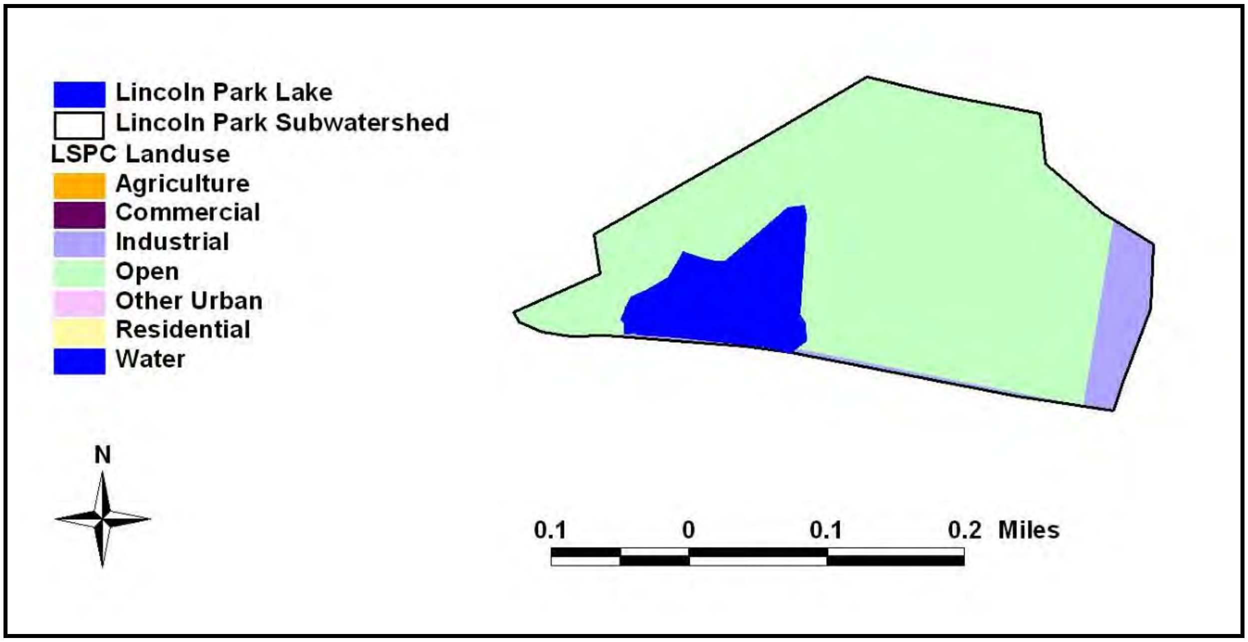

Figure 5-6. LSPC Land Use Classes for the Lincoln Park Lake Subwatershed

Table 5-1. Land Use Areas (ac) Draining from the Lincoln Park Lake Subwatershed

Land Use	Los Angeles
Agriculture	0
Commercial	0
Industrial	3.40
Open	33.7
Other Urban	0
Residential	0
Total	**37.1**

There are no Resource Conservation and Recovery Act (RCRA) contaminated industrial facilities located near the Lincoln Park Lake watershed. Figure 5-7 shows the predominant soils identified by STATSGO in the Lincoln Park Lake subwatershed. The soil type is identified as Urban land-Lithic Xerorthents-Hambright-Castaic (MUKEY 660489), a hydrologic group D soil, which has high runoff potential, very low infiltration rates, and consists chiefly of clay soils.

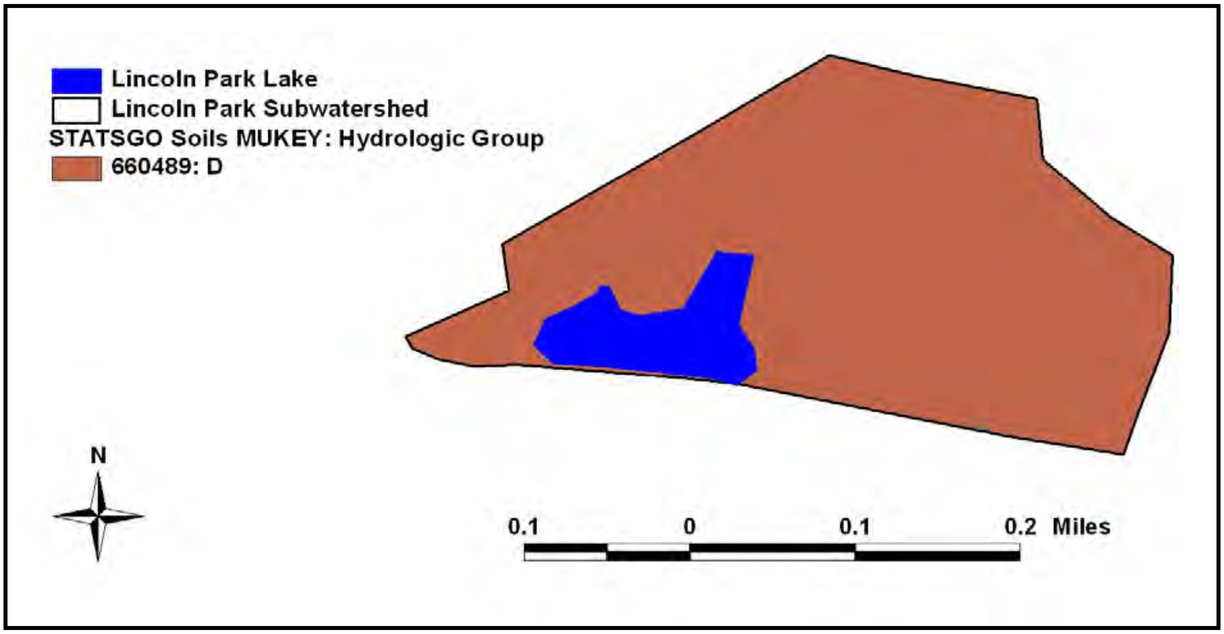

Figure 5-7. STATSGO Soil Types Present in the Lincoln Park Lake Subwatershed

5.1.5 Additional Inputs

Lincoln Park Lake receives supplemental flows from a potable water source to maintain lake levels and irrigate parkland. Two years of monthly usage data were used to estimate the average annual volume pumped into the lake (30.8 ac-ft/yr). An additional 1 foot of potable water is used annually to irrigate 32 acres of surrounding parkland. Some of this irrigation water may reach the lake (5.6 percent of the total irrigation volume is assumed to reach the lake).

5.2 Nutrient Related Impairments

A number of the assessed impairments for Lincoln Park Lake are associated with nutrients and eutrophication. Nutrient related impairments for Lincoln Park Lake include ammonia, eutrophication, odor, and organic enrichment/low dissolved oxygen (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. Respiration during nighttime hours may cause decreased dissolved oxygen (DO) concentrations. Algal blooms may also contribute to odor problems.

5.2.1 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 Lincoln Park Lake include REC1, REC2, WARM, WILD, and MUN. Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated nutrient levels are currently impairing the REC1, REC2, and WARM uses by stimulating algal growth that may form mats that impede recreational and drinking water use, alter pH and dissolved oxygen (DO) levels and alter biology that impair the aquatic life use, and cause odor and aesthetic problems. At high enough concentrations WILD and MUN uses could become impaired.

5.2.2 Numeric Targets

The Basin Plan for the Los Angeles Region (LARWQCB, 1994) outlines the numeric targets and narrative criteria that apply to Lincoln Park Lake. The following targets apply to the ammonia, eutrophication, odor, and organic enrichment/low dissolved oxygen impairments (see Section 2 for additional details and Table 5-2 for a summary):

- Ammonia toxicity to aquatic life is caused primarily by the un-ionized form (NH_3), while most ammonia in water is present in the ionic form of ammonium (NH_4^+). The Basin Plan expresses ammonia targets as a function of pH and temperature because these determine the un-ionized fraction. 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 Lincoln Park Lake in these TMDLs, a median temperature of 19.0 ºC and a 95th percentile pH of 9.0 were used, as explained in Section 2. The resultant acute (one-hour) ammonia target is 1.32 mg-N/L, the four-day average is 0.91 mg-N/L, and the 30-day average (chronic) target is 0.36 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 overgrowth of algae, odors, and scum. The narrative 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 Lincoln Park Lake; 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 is specified at half of the Secchi depth during the summer (May – September) and annual averaging periods.
- The Basin Plan states that "waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible aquatic resources, cause nuisance, or adversely affect beneficial uses."
- The Basin Plan states "at a minimum the mean annual dissolved oxygen concentrations of all waters shall be greater than 7 mg/L, and no single determinations shall be less than 5.0 mg/L, except when natural conditions cause lesser concentrations." In addition, the Basin Plan states, "the dissolved oxygen content of all surface waters designated as WARM shall not be depressed below 5 mg/L as a result of waste discharges." Shallow, well-mixed lakes, such as Lincoln Park Lake, must meet the DO target in the water column from the surface to 0.3 meters above the bottom of the lake.
- The Basin Plan states that "the pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge." Shallow, well-mixed lakes, such as Lincoln Park Lake, must meet the pH target in the water column from the surface to 0.3 meters above the bottom of the lake.

Nitrogen and phosphorus target concentrations are based on simulation of nutrient concentrations and chlorophyll *a* response with the NNE BATHTUB model (see Section 5.2.5). Based on the calibrated model for Lincoln Park Lake, the target nutrient concentrations consistent with achieving the mean chlorophyll *a* target within the lake are:

- 0.88 mg-N/L summer average (May – September) and annual average
- 0.088 mg-P/L summer average (May – September) and annual average

Table 5-2. Nutrient-Related Numeric Targets for Lincoln Park Lake

Parameter	Numeric Target	Notes
Ammonia[1]	1.32 mg-N/L acute (one-hour) 0.91 mg-N/L four-day average 0.36 mg-N/L chronic (30-day average)	Based on median temperature and 95th percentile pH
Chlorophyll *a*	20 µg/L summer average (May – September) and annual average	
Dissolved Oxygen	7 mg/L minimum mean annual concentrations and 5 mg/L single sample minimum except when natural conditions cause lesser concentrations	
pH	The pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge. (Basin Plan) 6.5 – 9.0 (EPA's 1986 Recommended Criteria)	The existing water quality criteria for pH is very broad and in cases where waste discharges are not causing the alteration of pH it allows for a wider range of pH than EPA's recommended criteria. For this reason, EPA's recommended criteria is included as a secondary target for pH.
Total Nitrogen	0.88 mg-N/L summer average (May – September) and annual average	Based on simulation of allowable loads from the NNE BATHTUB model
Total Phosphorous	0.088 mg-P/L summer average (May – September) and annual average	Based on simulation of allowable loads from the NNE BATHTUB model

[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.

5.2.3 Summary of Monitoring Data

This section summarizes the in-lake water quality data for Lincoln Park Lake related to the nutrient impairments. Shoreline sampling is not included in this discussion. Appendix G (Monitoring Data) provides more detail regarding sampling events and monitoring results.

In 1992 and 1993, the lake was sampled from a station located in the western half of the lake (UC Riverside, 1994). Sampling occurred from the surface to over 2 meters of depth on 12 sampling days. Total Kjeldahl nitrogen (TKN) ranged from 0.3 mg-N/L to 2.8 mg-N/L. Eight of 28 samples for ammonium were less than the detection limit (0.01 mg-N/L), and the maximum observed ammonium concentration was 1.1 mg-N/L which is less than the acute target assuming the analysis methodology converted all ammonia to ammonium. All nitrite samples were less than the detection limit (0.01 mg-N/L), and 17 of 28 nitrate samples were less than the detection limit (0.01 mg-N/L). The maximum nitrate concentration was 0.3 mg-N/L. Orthophosphate concentrations in 1992 were less than or equivalent to the detection limit (0.01 mg-P/L), while concentrations in 1993 ranged from 0.2 mg-P/L to 0.3 mg-P/L. Total phosphorus was also higher in 1993 with concentrations ranging from 0.2 mg-P/L to 0.5 mg-P/L compared to concentrations in 1992 of which nine samples were less than the detection limit (0.01 mg-P/L), and the maximum observed concentration was 0.2 mg-P/L. pH measurements ranged from 7.7 to 9.1 throughout the water column. Total organic carbon (TOC) ranged from 6.0 mg/L to 14.5 mg/L, with one outlier of 132 mg/L. The summary table from the 1994 Lakes Study Report (UC Riverside, 1994) lists chlorophyll *a* concentrations ranging from <1 µg/L to 97 µg/L with an average of 33 µg/L. For this data set, exceedances of the pH and chlorophyll *a* targets were observed.

The Water Quality Assessment Report (LARWQCB, 1996) states that DO was partially supporting the aquatic life use with 78 measurements of dissolved oxygen ranging from 0.1 mg/L to 13.7 mg/L. Ammonia was listed as not supporting the aquatic life or contact recreation uses. Twenty-eight ammonium samples were reported ranging from non-detect to 1.14 mg-N/L which is less than the acute target, but greater than the chronic target for total ammonia N (assuming the analytical method converted all ammonia to ammonium). Raw data are not available to assess location, date, time, depth, temperature, or pH with regard to these samples.

In 2009, the city of Los Angeles Bureau of Sanitation, Watershed Protection Division began collecting water quality samples approximately monthly at three locations in Lincoln Park Lake. The nitrate in the lake at all locations and sampling times was below the detection level (0.02 mg-N/L). Nitrite samples ranged from below the detection level (0.02 mg-N/L) to 0.13 mg-N/L. Ammonia samples ranged from below the detection limit (0.05 mg-N/L) to 0.27 mg-N/L, with all observations less than the chronic target. Chlorophyll *a* concentrations ranged from 13 µg/L to 47 µg/L and exceeded the average summer target with an average of 34 µg/L.

Vertical profile data using datasondes were also collected by the city of Los Angeles Bureau of Sanitation during 2003. For a given collection day, there was little variability between the stations or depths for temperature, specific conductivity, dissolved oxygen, or pH, indicating absence of significant stratification. Dissolved oxygen concentrations ranged from 6.49 mg/L to 9.19 mg/L; pH ranged from 8.16 to 8.72. There were no exceedances of the DO target during these events; 20 percent of pH measurements exceeded the maximum allowable value (all were recorded on one sampling day in July over the entire lake depth).

On March 10, 2009, the Regional Board and USEPA sampled water quality in Lincoln Park Lake at two sites that were accessed by wading in from boat access ramps located on either side of the lake. Samples were collected 1 foot from the surface at each site and the total depth at each site was approximately 2.2 feet. Ammonia concentrations ranged from 1.2 mg-N/L to 1.26 mg-N/L; TKN was 2.2 mg-N/L at both stations. Nitrate and nitrite concentrations were 0.07 mg-N/L and 0.04 mg-N/L, respectively. Orthophosphate concentrations were approximately 0.08 mg-P/L at both stations, and total phosphorus concentrations were approximately 0.126 mg-P/L. Chlorophyll *a* concentrations at both sites were less than the detection limit of 1 µg/L. DO concentrations in the lake generally ranged from 5.9 mg/L to 6.2 mg/L with one reading of 7.0 mg/L from a surface sample. pH ranged from 6.7 to 7.0. The Secchi depth was greater than the total depth at both stations. No exceedances of targets for this lake were observed during this event. Field notes for the March 2009 sampling event indicate the presence of large numbers of birds (100 to 150 pigeons and ducks) and the presence of food left on the boat ramps by visitors to feed the birds.

Profile data were collected at one station on May 10, 2009. The DO concentration ranged from 8.32 to 10.19 mg/L over the depth of the lake. The total depth at this station was 1.7 meters, and the Secchi depth was 0.66 meters. The pH was approximately 9.1 at all depths, which exceeds the target for this parameter, but may not be due to waste discharges so may not represent an exceedance of the standard.

On August 4, 2009, USEPA and the Regional Board collected additional nutrient samples from Lincoln Park Lake. Ammonia, TKN, nitrite, and nitrate were all less than the detection limits of 0.03 mg-N/L, 0.456 mg-N/L, 0.01 mg-N/L, and 0.01 mg-N/L, respectively. Orthophosphate was less than the detection limit (0.0075 mg-P/L), and total phosphorus was 0.182 mg-P/L. The chlorophyll *a* concentration was 27.3 μg/L. The chlorophyll *a* concentration exceeds the target value of 20 μg/L. At the time of this sampling event, the potable water input had been turned off for approximately 2.5 weeks due to water shortages and budget cuts. Field notes also indicate that submerged plants were visible.

In summary, exceedances of the pH and chlorophyll *a* targets have been observed in Lincoln Park Lake. The 1994 Urban Lakes Study suggested that the lake liner and aeration system appear to be effective in suppressing excessive algal growth in the lake; however, the lake did not meet the chlorophyll *a* target during that study (UC Riverside, 1994) nor during more recent sampling. DO concentrations do appear to be successfully managed by the aeration system and annual averages were greater than the target of 7 mg/L. No odors were observed during four recent sampling events by USEPA and/or the Regional Board. There were no exceedances of the acute or chronic ammonia criteria during any recent sampling events with associated pH and temperature measurements. The nutrient TMDLs for Lincoln Park Lake presented in Section 5.2.6 account for summer season critical conditions by assessing loading rates consistent with meeting the summer chlorophyll *a* target concentration of 20 μg/L. These reductions in nutrient loading are expected to alleviate any pH, odor, DO, and ammonia problems associated with excessive nutrient loading and eutrophication.

5.2.4 Source Assessment

The source assessment for Lincoln Park Lake includes load estimates from the surrounding watershed (Appendix D, Wet Weather Loading; Appendix F, Dry Weather Loading) including irrigation (5.6 percent of the total irrigation volume is assumed to reach the lake), potable water used for supplemental water additions to the lake (Appendix F, Dry Weather Loading), and atmospheric deposition (Appendix E, Atmospheric Deposition). In addition to these sources, there are other sources of loading to Lincoln Park Lake associated with the parkland area for which loading estimates were not available (Appendix F, Dry Weather Loading). These include excessive fertilization relative to product recommendations, internal loading from lake sediments, natural wildlife populations, excessive bird populations caused by the improper disposal of food waste (Figure 5-8), and pet wastes. Loads in the additional parkland loading category were quantified using the NNE BATHTUB model by increasing the inputs until simulated concentrations of total phosphorus and total nitrogen matched those observed (see Section 5.2.5). For this waterbody, the additional parkland loading comprises 56 percent of the total phosphorus load and 35 percent of the total nitrogen load. All existing loads to Lincoln Park Lake are summarized in Table 5-3.

Precise bird counts for Lincoln Park Lake are not available; however, field notes indicate excess bird populations which are likely a significant portion of the nutrient loading associated with additional parkland areas. At Echo Park Lake, total phosphorus and total nitrogen loads of 78 lb-P/yr and 780 lb-N/yr were estimated for the approximately 1,000 birds observed to reside at that lake (Black and Veatch, 2010). The bird population at Lincoln Park Lake is likely one-half to one-quarter of that. Thus total phosphorus loads due to the bird population at Lincoln Park Lake likely range from 19.5 lb-P/yr to 39 lb-P/yr; total nitrogen loads range from 195 lb-N/yr to 390 lb-N/yr. The estimated loading from the resident bird population at Lincoln Park Lake is greater than the additional parkland loading estimated from the BATHTUB model. This overestimation may be due to 1) an inaccurate estimate of the bird population at Lincoln Park Lake, and 2) the conservative assumption that 100 percent of bird waste and associated nutrient loading reach the lake. Regardless of the accuracy of the estimated loading associated with bird waste, this analysis indicates that nutrient loading associated with the excess bird population comprises a significant portion of the additional parkland loading. If the resident bird population is reduced to 100 birds their total phosphorus loads would be only 7.8 lb-P/yr and 78 lb-N/yr.

Table 5-3. Summary of Average Annual Flows and Nutrient Loading to Lincoln Park Lake

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 Los Angeles	Runoff	4.15	4.72 (13.6)	46.1 (23.3)
City of Los Angeles	Supplemental Water Additions (Potable Water)	30.8	9.88 (28.4)	74.6 (37.7)
City of Los Angeles	Parkland Irrigation	1.80	0.577 (0.02)	4.36 (2.20)
City of Los Angeles	Additional Parkland Loading	NA	19.6 (56.3)	70 (35.4)
	Atmospheric Deposition (to the lake surface)*	6.25	NA	3.10 (1.57)
Total		**43.1**	**34.8**	**198**

* 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).

Figure 5-8. Inappropriate Bird Feeding Maintains an Excessive Bird Population at Lincoln Park Lake

5.2.5 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 Lincoln Park Lake, the nutrient numeric endpoints (NNE) BATHTUB Tool was set up and calibrated to lake-specific conditions. The NNE BATHTUB Tool is a version of the US Army Corps of Engineers (USACE)

BATHTUB model and was developed to support risk-based nutrient numeric endpoints in California (Tetra Tech, 2006).

BATHTUB is a steady-state model that calculates nutrient concentrations, chlorophyll *a* concentration (or algal density), turbidity, and hypolimnetic oxygen depletion based on nutrient loadings, hydrology, lake morphometry, and internal nutrient cycling processes. BATHTUB uses a typical mass balance modeling approach that tracks the fate of external and internal nutrient loads between the water column, outflows, and sediment. 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 Lincoln Park Lake, the following inputs apply: surface area of 4.9 acres, average depth of 4 ft, and volume of 19.6 ac-ft. Based on the turnover ratio for the limiting nutrient for this lake (nitrogen) (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 average summer season water quality data observed over twice the Secchi depth (2*0.66 m = 1.32 m). Both nitrogen and phosphorus concentrations were underpredicted when the calibration factors were adjusted within normal range. To predict the average summer concentrations of total phosphorus (0.14 mg-P/L) and total nitrogen (1.29 mg-N/L), loads from additional parkland sources were increased to 23.5 lb-P/yr and 70 lb-N/yr, respectively with calibration factors on the 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 3.93 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 19.6 lb-P/yr. The resulting calibration factor on the net phosphorus settling rate is 0.82 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 phosphorous 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, the calibration factor on concentration was set to 0.62 for a predicted concentration of 32.6 µg/L.

5.2.6 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 5.2.5), 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 are

- 0.88 mg-N/L summer average (May – September) and annual average
- 0.088 mg-P/L summer average (May – September) and annual average

The loading capacities for total nitrogen and total phosphorus are 120 lb-N/yr and 17.0 lb-P/yr, respectively. These loading capacities can be further broken down into 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 54.5 percent of the existing load of 198 lb-N/yr, or 108 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 an equal percent load reductions in all sources. The resulting TMDL equation for total nitrogen is then:

120 lb-N/yr = 40.7 lb-N/yr + 67.4 lb-N/yr + 12.0 lb-N/yr

For total phosphorus, the allocatable load (divided among WLAs and LAs) is 44.0 percent of the existing load of 34.8 lb-P/yr, or 15.3 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:

17.0 lb-P/yr = 4.34 lb-P/yr + 10.9 lb-P/yr + 1.70 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 based on simulation of allowable loads with the NNE BATHTUB model (see Section 5.2.5). 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.

5.2.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). These TMDLs establish WLAs and alternative WLAs for total phosphorous and total nitrogen.

The alternative WLAs will be effective and supersede the WLAs listed in Table 5-4 if the conditions described in Section 5.2.6.1.2 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.

5.2.6.1.1 Wasteload Allocations

There are no MS4 discharges to Lincoln Park Lake and no other (non-MS4) permitted dischargers in the watershed. The supplemental water addition used to maintain the lake level is the only source of nutrient loading to Lincoln Park Lake that is assigned a WLA (Table 5-4). Total phosphorus WLAs represent a 56.0 percent reduction in existing loading, and total nitrogen WLAs represent a 45.5 percent reduction in existing loading. These loading values (in pounds per year) represent the TMDLs wasteload allocations. The wasteload allocations must be met at the point of discharge.

Table 5-4. Wasteload Allocations of Phosphorus and Nitrogen Loading to Lincoln Park Lake

Responsible Jurisdiction	Input	Existing Total Phosphorus Load (lb-P/yr)	Wasteload Allocation Total Phosphorus[1] (lb-P/yr)	Existing Total Nitrogen Load (lb-N/yr)	Wasteload Allocation Total Nitrogen[1] (lb-N/yr)
City of Los Angeles	Supplemental Water Additions	9.88	4.34	74.6	40.7
Total		**9.88**	**4.34**	**74.9**	**40.7**

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

5.2.6.1.2 Alternative "Approved Lake Management Plan Wasteload Allocations"

Concentration-based WLAs not exceeding the concentrations listed in Table 5-5 are effective and supersede corresponding WLAs for the City of Los Angeles in Table 5-4 if:

1. The City of Los Angeles requests that concentration-based wasteload allocations not to exceed the concentrations established in Table 5-5 apply to it,
2. The City of Los Angeles 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 5-2. 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 Los Angeles 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 5-5 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.

The concentration-based WLAs 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 5-5. Alternative Wasteload Allocations of Phosphorus and Nitrogen in Lincoln Park Lake if an Approved Lake Management Plan Exists

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

[1] 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.

5.2.6.2 Load Allocations

These TMDLs establish load allocations (LAs) and alternative LAs for total phosphorous and total nitrogen. The alternative LAs will be effective and supersede the LAs listed in Table 5-6 if the conditions described in Section 5.2.6.2.2 are met.

5.2.6.2.1 Load Allocations

There are no storm drains that discharge runoff flows into Lincoln Park Lake. Therefore, all loads associated with the surrounding drainage area are assigned LAs (Table 5-6). Atmospheric deposition and additional parkland loading are also assigned LAs. Total phosphorus LAs represent a 56.0 percent reduction in existing loading, and total nitrogen LAs represent a 45.5 percent reduction in existing loading. 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 5-6. Load Allocations of Phosphorus and Nitrogen Loading to Lincoln Park Lake

Responsible Jurisdiction	Input	Existing Total Phosphorus Load (lb-P/yr)	Load Allocation Total Phosphorus[1] (lb-P/yr)	Existing Total Nitrogen Load (lb-N/yr)	Load Allocation Total Nitrogen[1] (lb/yr)
City of Los Angeles	Runoff	4.72	2.07	46.1	25.1
City of Los Angeles	Parkland Irrigation	0.577	0.254	4.36	2.38
City of Los Angeles	Additional Parkland Loading	19.6	8.62	70	38.2
	Atmospheric Deposition (to the lake surface)[2]	NA	NA	3.1	1.69
Total		**24.9**	**10.9**	**124**	**67.4**

[1] Each load allocation 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).

5.2.6.2.2 Alternative "Approved Lake Management Plan Load Allocations"

Concentration-based load allocations not exceeding the concentrations listed in Table 5-7 are effective and supersede corresponding load allocations for the City of Los Angeles in Table 5-6 if:

1. The City of Los Angeles requests that concentration-based load allocations not to exceed the concentrations established in Table 5-7 apply to it;
2. The City of Los Angeles 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 5-2. 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 Los Angeles 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 5-7 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 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 5-7. Alternative Load Allocations of Phosphorus and Nitrogen Loading to Lincoln Park Lake 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 Los Angeles	Runoff	0.1	1.0
City of Los Angeles	Parkland Irrigation	0.1	1.0
City of Los Angeles	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.

5.2.6.3 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 these TMDLs. This explicit MOS is set at 10 percent of the loading capacity for total phosphorus and total nitrogen.

5.2.6.4 Critical Conditions/Seasonality

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

5.2.6.5 Daily Load Expression

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

The maximum daily loads from the supplemental water additions were calculated from the largest metered monthly water volume and the long-term average concentration consistent with meeting the

TMDLs. For the supplemental water additions, the allowable loads of nitrogen and phosphorus are 40.7 lb-N/yr and 4.34 lb-P/yr (Table 5-4), respectively. The volume of water discharged from this source is approximately 30.8 ac-ft/yr. The allowable concentrations from this source are 0.486 mg-N/L and 0.052 mg-P/L. The maximum metered monthly flow rate is 5.81 ac-ft/mo or 0.187 ac-ft/d (5.81 ac-ft/mo divided by 31 d/mo). The maximum daily nutrient loads from this source are 0.247 lb-N/d and 0.026 lb-P/d.

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

5.2.6.6 Future Growth/Conditions

The Lincoln Park Lake watershed is comprised entirely of parkland with a small section of adjacent industrial area. 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.

The city of Los Angeles would like to use a reclaimed/recycled water source to supplement water levels at Lincoln Park Lake instead of the potable water source that is currently used. Recent monitoring data performed by the City indicate that total nitrogen and total phosphorus concentrations from the potential reclaimed water source are approximately 8.82 mg-N/L and 1.93 mg-P/L. If the City were to use this reclaimed source, this would add an additional 664 lb-N/yr and 152 lb-P/yr relative to existing conditions. Unless BMPs are implemented at the lake to provide treatment of the reclaimed water source, the use of this source will not meet the requirements of these TMDLs. It is advisable that alternative solutions and BMPs be investigated during the implementation planning for this lake.

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).

5.3 Lead Impairment

Lincoln Park Lake was listed as impaired for lead in 1996 based on an assessment in the Regional Board's Water Quality Assessment and Documentation Report (LARWQCB, 1996). Consistent with project plan recommendations provided in California's Impaired Waters Guidance (SWRCB, 2005), EPA and local agencies collected 40 additional samples (11 wet weather) between October 2008 and December 2010 to evaluate current water quality conditions. There were zero dissolved lead exceedances in 40 samples (Appendix G, Monitoring Data). USEPA also collected one sediment sample in 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, Lincoln Park Lake meets lead water quality standards and USEPA concludes that preparing a TMDL for lead is unwarranted at this time. USEPA recommends that Lincoln Park Lake not be identified as impaired by lead in California’s next 303(d) list.

5.4 Trash Impairment

5.4.1 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 Lincoln Park Lake include REC1, REC2, WARM, and WILD. Descriptions of these uses are listed in Section 2 of this TMDL report. Trash can potentially impair the REC1, REC2, WARM, and WILD in a variety of ways, including causing toxicity to aquatic organisms, damaging habitat, impairing aesthetics, and impeding recreation.

5.4.2 Numeric Targets

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

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

and for solid, suspended, or settleable materials:

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

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

5.4.3 Summary of Monitoring Data

The existing beneficial uses are impaired by the accumulation of suspended and settled debris. Common items that have been observed include plastic bags, plastic pieces, paper items, Styrofoam, bottle caps, and cigarette butts.

According to California's 2008-2010 303(d) Impaired Waterbodies list, trash is causing water quality problems in Lincoln Park Lake. USEPA and Regional Water Quality Control Board staff confirmed the trash impairment during a site visit to Lincoln Park Lake on March 9, 2009. Staff conducted quantitative trash assessments and documented the trash impairment with photographs. Trash was observed in the lake and along the shorelines.

Although some trash management practices were in place at Lincoln Park, improvements could be added. Many uncovered trash cans were observed throughout the park so trash may be transported from the cans via animals or wind; for example, two open dumpsters were observed near the school. Field staff did not observe any fences between the street and the lake, and between neighboring residences and the street. Over 100 birds were observed in and near this small lake, leading to unnaturally large amounts of bird droppings in and around the lake. The cause of the unnaturally large bird population is likely due to people feeding the birds and birds eating from uncovered trash cans.

Trash observed in the lake was predominantly found in sharp corners of the lake where the water was stagnant (Figure 5-9).

Figure 5-9. Scum and Trash Accumulate in the Sharp Corners of Lincoln Park Lake

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

5.4.3.1 Near Valley Boulevard

The trash assessment conducted on the shore near Valley Boulevard (Figure 5-10) scored 91/120. Field staff observed two uncovered trash cans which may lead to trash transported by animals or wind. This is a highly accessible portion of the lake due to its close proximity to on-street parking and a sidewalk. Trash is likely transported from the road and people picnicking along the shore. Some trash was found in the water but no accumulation of trash was observed.

Figure 5-10. Shoreline Along Valley Boulevard

5.4.3.2 Picnic Tables

The second trash assessment was conducted on the eastern shore near the palm tree island, a park path, and picnic tables (Figure 5-11). This area scored a 93/120 and may have been recently cleaned due to the presence of an orderly pile of trash along the shore and almost empty trash cans. Trash is likely transported from people littering in the picnic area and along the path, and from uncovered trash cans. Some items were found in the water.

Figure 5-11. Location of the Second Quantitative Trash Assessment with Trash Cans and Picnic Tables Nearby

5.4.3.3 After School Program

An after school program organized by a non-profit organization, Plaza De La Raza, takes place on the northern shore. The school is completely fenced off and no trash was observed within the school yard's deck area. The school is an unlikely source of trash.

5.4.3.4 Wildlife Feeding

Bird feeding was observed the following day, March 10, 2009. Large piles of rice were observed near Valley Boulevard and on the eastern boat ramp (Figure 5-12). This food was likely left by visitors to feed the birds. Human food is unhealthy for wildlife and the massive amounts discarded can cause an overabundance of birds to inhabit this area. An unnaturally large bird population leads to greater excrement quantities which add to the nutrient problem in the lake.

Figure 5-12. Food is Trash and Encourages an Overabundance of Birds to Live in the Area

Locations of the quantitative monitoring sites are shown in the map below (Figure 5-13).

Figure 5-13. Quantitative Trash Assessment Locations

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

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

5.4.4 Source Assessment

The major source of trash in Lincoln Park Lake results from litter, which is intentionally or accidentally discarded to the lake and watershed. Potential sources can be categorized as nonpoint sources with the following transport mechanisms:

1. Wind action: trash that is blown into the lake directly.
2. Direct disposal: direct dumping or litter into the lake.

Since the Lincoln Park Lake watershed primarily includes open space and parks, only nonpoint sources contribute trash to the lake.

5.4.4.1 Point Sources

There are no point sources of trash to Lincoln Park Lake. The area directly surrounding the waterbody is designated as nonpoint source. Therefore, it is included in the load allocation section.

5.4.4.2 Nonpoint Sources

Based on reports from similar watersheds, the amount and type of trash transported is a function of the surrounding land use. The city of Long Beach recorded trash quantity collected at the mouth of the Los Angeles River; the results suggest total trash amount is linearly correlated with precipitation (Figure 5-14, R^2=0.90, Signal Hill, 2006). A similar study found that the amount of gross pollutants entering the stormwater system is rainfall dependent but does not necessarily depend on the source (Walker and Wong, 1999). The amount of trash entering the stormwater system depends on the energy available to re-mobilize and transport deposited gross pollutants on street surfaces, rather than the amount of available gross pollutants deposited on street surfaces. Where gross pollutants exist, a clear relationship is established between the gross pollutant load in the stormwater system and the magnitude of the storm event. The limiting mechanism affecting the transport of gross pollutants, in the majority of cases, appears to be re-mobilization and transport processes (i.e., stormwater rates and velocities). In order to estimate trash generation rates, data from a comparable watershed was analyzed.

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

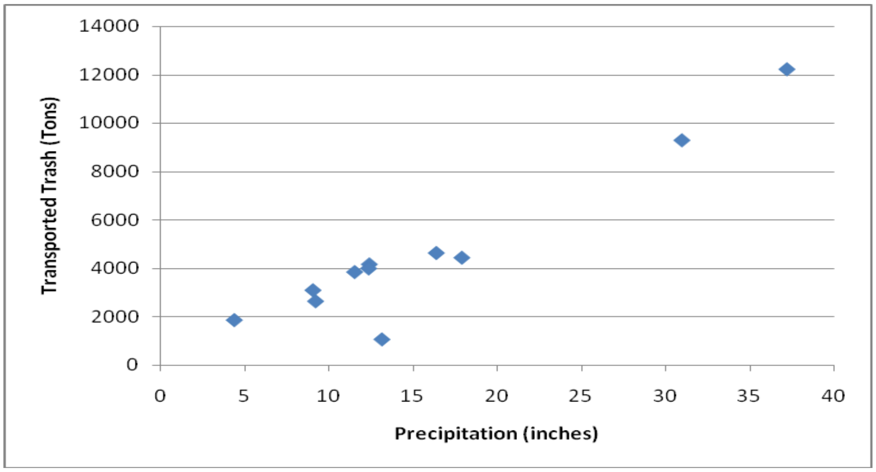

Figure 5-14. Storm Debris Collection Summary for Long Beach (Signal Hill, 2006)

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

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

Existing trash surrounding the lake is the fundamental cause of nonpoint source trash loading. The land use directly surrounding Lincoln Lake is recreational and educational. Visitors may intentionally or accidentally discard trash to the grass or trails in the park, which initiate the journey of trash to waterbodies via wind or overland water flow. The after-school facilities can contribute nonpoint source trash especially if dumpsters are overflowing and trash is not confined within a given area. Varying uses of the park are responsible for different degrees of trash impairment. For example, areas with picnic tables generate more trash than parking lots. Visitation rates are also likely linked to the amount of trash from nonpoint sources.

Table 5-8 summarizes the nonpoint source area and current estimate of nonpoint source trash loads for responsible jurisdictions, assuming a trash generation rate of 640 gallons of uncompressed trash per square mile per year. The current loads need to be reduced 100% to meet the TMDL target of zero trash.

Table 5-8. Lincoln Park Lake Estimated Nonpoint Source Trash Loads

Responsible Jurisdictions	Nonpoint Source Area (Mile^2)	Current Nonpoint Source Trash Load (Gal/year)
City of Los Angeles	0.058	37

Note: Current Nonpoint Source Trash Load (gal/yr) = Nonpoint Source Area (mi2) * 640 (gal/ mi2/yr)

5.4.5 Linkage Analysis

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

5.4.6 TMDL Summary

Nonpoint sources are identified as the only source of trash in Lincoln Park Lake. For nonpoint sources, water quality standards are attained by assigning load allocations (LAs) to municipalities and agencies having jurisdictions over Peck Road Park Lake and its subwatershed. These LAs may be implemented through regulatory mechanisms that implement the State Board's 2004 Nonpoint Source Policy such as conditional waivers, waste discharge requirements, or prohibitions.

The TMDL of zero trash requires that current loads are reduced by 100 percent. Final LAs are zero trash (Table 5-9).

Table 5-9. Lincoln Park Lake Trash LAs

Lincoln Park Lake	Allocation
Trash LA	0

5.4.6.1 Wasteload Allocations

Since there are no point sources in the Lincoln Park Lake watershed, wasteload allocations are not provided. If a point source is added to the watershed in the future, its wasteload allocation will be zero allowable trash.

5.4.6.2 Load Allocations

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

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

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

5.4.6.3 Margin of Safety

A margin of safety (MOS) accounts for uncertainties in the TMDL analysis. The MOS can be expressed as an explicit mass load, or included implicitly in the WLAs and LAs that are allocated. Because this

TMDL sets WLAs and LAs as zero trash, the TMDL includes an implicit MOS. Therefore, an explicit MOS is not necessary.

5.4.6.4 Critical Conditions/Seasonality

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

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

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

5.4.6.5 Future Growth

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

5.5 IMPLEMENTATION RECOMMENDATIONS

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

If necessary, these TMDLs may be revised as the result of new information (See Section 5.6 Monitoring Recommendations).

5.5.1 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 5-6 and Table 5-9 for nutrients and trash, respectively.

5.5.2 Point Sources and the Implementation of Wasteload Allocations

Wasteload allocations apply to supplemental water additions (Table 5-4). These mass-based waste load allocations will be implemented by the Regional Board.

5.5.3 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.

Lincoln Park Lake has both nutrient-related and trash impairments. While there are some management strategies that would address both of these impairments (i.e., discouraging bird feeding), their differences warrant separate implementation and monitoring discussions.

5.5.3.1 Nutrient-Related Impairments

To 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 Lincoln Park Lake. Some of the sediment reduction BMPs may also result in decreased concentrations of nitrogen and phosphorus in the runoff water. BMPs that provide filtration, infiltration, and vegetative uptake and removal processes may retain nutrient loads in the upland areas.

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

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

5.5.3.2 Trash Impairment

LA may be complied with through the implementation of nonstructural BMPs or any other lawful methods which meet the target of zero trash. USEPA recommends implementation plans be consistent with the Los Angeles River trash TMDL. A minimum frequency of trash collection and assessment should be established at an interval that prevents trash from accumulating in deleterious amounts in between collections. Trash should be prevented by providing effective public education about littering impacts. Signs dissuading littering and wildlife feeding along roadways and around the lake are recommended.

A city ban, tax, or incentive program reducing single-use plastic bags, Styrofoam containers, and other commonly discarded items which cannot decompose is recommended (Los Angeles County Department of Public Works, 2007).

Lincoln Park's grounds and facilities are maintained by the city of Los Angeles. Trash is currently collected and removed from the park daily. USEPA recommends continuation and expansion of the current trash pick-ups by the city of Los Angeles, including the collection of small trash items, such as cigarette butts.

The city of Los Angeles is also responsible for the trash in the lake. Currently trash is removed from the middle of the lake if a problem is reported. A more frequent in-lake trash removal program should be established to prevent the accumulation of small trash pieces in the waterbody.

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

5.6 MONITORING RECOMMENDATIONS

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

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

5.6.1 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 Lincoln Park Lake the only wasteload allocation is to supplemental water additions. This source 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 Lincoln Park Lake conclude that a 56.0 percent reduction in total phosphorus loading and a 45.5 percent reduction in total nitrogen loading are needed to maintain a summer average chlorophyll *a* concentration of 20 µg/L. 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 5-3), target concentrations in supplemental water additions may be 0.0519 mg-P/L and 0.486 mg-N/L. Similarly, target concentrations associated may be 0.184 mg-P/L and 2.23 mg-N/L in the city of Los Angeles runoff , 0.0518 mg-P/L and 0.486 mg-N/L in the parkland irrigation return flows, and, assuming an average precipitation depth, the target concentration associated with precipitation may be 0.112 mg-N/L (note: the flows associated with the additional parkland loading are unknown, so target concentrations cannot be estimated). As stated above, these concentrations are provided as guidelines; however, mass-based WLAs must be achieved.

5.6.2 Trash Impairments

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

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