# Chapter 6: Allocations

The allowable nutrient loading to three lake segments, Canyon Lake Main Lake, Canyon Lake East Bay and Lake Elsinore, is determined from analysis of hydrology and water quality for teh hypothetical reference watershed based on pre-development conditions. This information was developed in the following chapters:

* Reference watershed conditions were approximated for watershed subareas by removing imperviousness and reducing washoff concentrations to natural background levels (see Chapter 3, Numeric Targets).
* The loading of nutrients to the lakes under reference conditions was simulated by evaluating reference watershed conditions using the watershed runoff model developed to assess existing sources of nutrients from the watershed (see Chapter 4, Source Assessment).
* Approximations of internal loads associated with sediment nutrient flux, the single greatest source of TP and TN in Lake Elsinore, for a reference watershed condition are documented in Chapter 5 (Linkage Analysis).

This chapter partitions the total allowable loads of TP and TN from point sources into wasteload allocations (WLAs) and non-point sources into load allocations (LAs) for individual jurisdictions. The chapter includes the following sections:

* *Section 6.1 – Watershed Runoff*: Nutrient loads delivered to the lakes from watershed runoff are allocated to upstream jurisdictional areas in this section. A key element of this allocation involves allocation of watershed nutrients loads that are upstream of both Canyon Lake and Lake Elsinore by way of overflows from Canyon Lake. In addition to describing the allowable loading, the difference between current loads (as determined in Chapter 4, Source Assessment) and allowable loads is reported. This difference represents the reduction in TP and TN loads that must be achieved to meet WLAs.
* *Section 6.2 – Supplemental Water*: Allowable loads from addition of supplemental water to the lakes is described. While the addition of supplemental water to the lakes represents a discharge, it is important to recognize that the addition of supplemental water also represents a water quality management strategy. The WLA for supplemental water is based on a reference watershed runoff nutrient concentration and does not consider additional water quality benefit for response targets that may be achieved with a deeper lake. Potential offset credits from supplemental water addition are described in Chapter 7 on Implementation.
* *Section 6.3 – Internal Loads:* Estimates of allowable internal loads for atmospheric deposition and sediment nutrient flux are described in this section. Implementation of the TMDL will eventually return sediment nutrient flux rates to reference levels, but a significant lag time exists to account for legacy nutrient enrichment to cycle through the system. This section estimates the lag time for sediment nutrient flux rates to return to reference levels after the TMDL for external loads is achieved.
* *Section 6.4 – Summary of Allocated Loads.* This section summarizes the WLAs and LAs described in previous sections. In addition, this section discusses how compliance with allocations will be evaluated. As described in other chapters, the temporal variability associated with naturally occurring weather patterns results in significant variability in the delivery of nutrient loads to the lakes. Use of a 10-year averaging period for setting allocations in the revised TMDLs would provide a more appropriate measure of progress toward TMDL compliance by reducing the influence of naturally occurring annual fluctuations.

## 6.1 Watershed Runoff

### 6.1.1 Allowable Runoff Loads

Nutrient loads in watershed runoff under a reference watershed condition represent the total allowable load to each lake segment from external watershed runoff sources. Allowable nutrient loads are determined as the product of average annual runoff volume (*V*) and reference nutrient concentration (*C*) at the point of discharge into each lake segment, as follows:

Section 3.3 (Numeric Targets chapter) describes how long-term average runoff volume and nutrient concentrations are estimated for a reference watershed condition. The numeric targets in the revised TMDL are expressed as CDFs of estimated water quality response targets, chlorophyll-a and DO, expected with external loads representative of a refence watershed condition. **Table 6-1** computes the allowable nutrient load from watershed runoff. These allowable loads are totals for each of the subwatershed zones (see Figure 4.4), but are not WLAs for each lake segment, since runoff from some subwatershed zones is tributary to multiple lake segments.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table 6-1. Allowable Nutrient Loads from Watershed Runoff** | | | | | |
| **Subwatershed** | **Modeled Reference Runoff (AFY)1** | **Reference Nutrient Concentration** | | **Allowable Nutrient Loads from Runoff** | |
| **TP (mg/L)** | **TN (mg/L)** | **TP (kg/yr)** | **TN (kg/yr)** |
| 1 | 1,868 | 0.31 | 0.95 | 715 | 2,190 |
| 2 | 2,189 | 0.31 | 0.95 | 837 | 2,565 |
| 3 | 1,880 | 0.31 | 0.95 | 719 | 2,203 |
| 4 | 885 | 0.31 | 0.95 | 338 | 1,037 |
| 5 | 2,717 | 0.31 | 0.95 | 1,039 | 3,184 |
| 6 | 1,243 | 0.31 | 0.95 | 475 | 1,457 |
| 7 | 442 | 0.31 | 0.95 | 169 | 518 |
| 8 | 415 | 0.31 | 0.95 | 159 | 486 |
| 9 | 1,058 | 0.31 | 0.95 | 405 | 1,240 |
| 1 Runoff reported in the volume that reaches Canyon Lake after accounting for capture in Mystic Lake and channel bottom recharge | | | | | |

### 6.1.2 Allocations of Allowable Nutrient Loads to Lake Segment TMDLs

Allocations for nutrient loads associated with are developed for four groups as follows: Canyon Lake Main Lake; Canyon Lake East Bay; overflows from Canyon Lake to Lake Elsinore; and Local Lake Elsinore. Although four groups are given an allocation, there are three TMDLs; this is, because Canyon Lake Overflows to Lake Elsinore and Local Lake Elsinore comprise one Lake Elsinore TMDL (**Table 6-2**). Subwatershed zones upstream of Canyon Lake are tributary to multiple downstream waters and therefore will have allocations in more than one of these groups.

USGS flow gauges upstream and downstream of Canyon Lake facilitated estimation of runoff volume retention (see Section 4.1). On average, 65 percent of nutrient loads that reach Canyon Lake are retained and 35 percent overflow to Lake Elsinore. Therefore, allowable loads from the Canyon Lake watershed are converted into WLAs and LAs involving a 65/35 split to the Canyon Lake (either East Bay or Main Lake) or Lake Elsinore TMDLs (Table 6-2).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 6-2. Matrix Showing Three TMDLs and Allocation of Allowable Nutrient Loads by Subwatershed Zone** | | | | |
| **Subwatershed Zone** | **Canyon Lake**  **Main Lake** | **Canyon Lake**  **East Bay** | **Lake Elsinore** | |
| **Canyon Lake Overflows** | **Local Watershed** |
| 1 | -- | -- | -- | 100% |
| 2 | 65% | -- | 35% | -- |
| 31 | -- | 65% | 35% | -- |
| 41 | -- | 65% | 35% | -- |
| 5 | 65% | -- | 35% | -- |
| 6 | 65% | -- | 35% | -- |
| 7 | -- | -- | 100% | -- |
| 8 | -- | -- | 100% | -- |
| 9 | -- | -- | 100% | -- |
| 1 East Bay volume is transferred to Main Lake via a culvert under the Canyon Lake Drive causeway. The residence time of volume originating in East Bay that transfers to the Main Lake is limited prior to overflowing to Lake Elsinore and is considered negligible for the TMDL revision. Thus, no allocations are given to jurisdictions in subwatershed zones 3 and 4 (East Bay subwatershed) for Canyon Lake Main Lake. | | | | |

Allocations of nutrient loads were parsed by current estimates of the area within jurisdictional boundaries (**Figure 6-1**). Estimates of runoff and nutrient loading from these areas was done by removing all imperviousness and reducing nutrient EMCs to reference concentrations. The subwatershed zone for jurisdictional areas plays a role in reference loading because of different rainfall and levels of downstream retention in Mystic Lake or in channel bottoms. Distributions of allowable load by subwatershed were converted to allocations to each TMDL and jurisdiction based on the factors presented in Table 6-2. Based on the results of this analysis, **Table 6-3** provides allocations for each of the TMDLs for each jurisdiction in the watershed. The allocations represent the amount of load estimated to arrive at each lake segment from the reference watershed.

### 6.1.3 Watershed Runoff Load Reductions to Meet TMDL Allocations

The incremental load above the allocations (see Table 6-3) represents the portion that is attributable to watershed development. Thus, the difference between existing nutrient loads and allocations is the reduction needed for each watershed jurisdiction to comply with the TMDLs (**Table 6-4**).



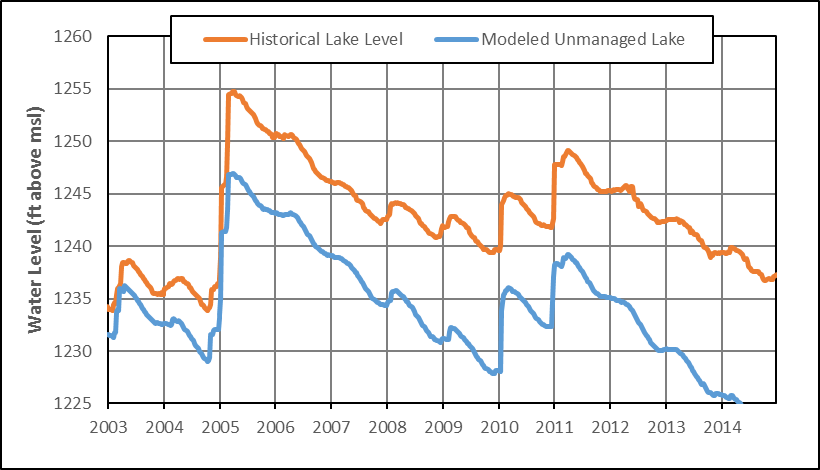
**Figure 6-1. Jurisdictional Boundaries in the Lake Elsinore and Canyon Lake Watershed**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 6-3. Allocations for Watershed Runoff in Lake Elsinore and Canyon Lake Nutrient TMDLs** | | | | | | | | |
| **Responsible Agency** | **Canyon Lake Main Lake** | | **Canyon Lake East Bay** | | **Local Lake Elsinore1** | | **Canyon Lake Overflow to Lake Elsinore1** | |
| **TP (kg/yr)** | **TN (kg/yr)** | **TP (kg/yr)** | **TN (kg/yr)** | **TP (kg/yr)** | **TN (kg/yr)** | **TP (kg/yr)** | **TN (kg/yr)** |
| **Wasteload Allocations** | | | | | | | | |
| Banning | - | - | - | - | - | - | 1 | 2 |
| Beaumont | - | - | - | - | - | - | 9 | 27 |
| CAFO | 5 | 14 | 2 | 6 | 0 | 0 | 7 | 22 |
| Caltrans | 11 | 33 | 4 | 12 | 6 | 17 | 12 | 35 |
| Canyon Lake | 12 | 36 | 14 | 44 | 7 | 23 | 14 | 43 |
| Federal – Dept. of Defense | 26 | 79 | - | - | - | - | 14 | 43 |
| Hemet | - | - | 48 | 147 | - | - | 34 | 104 |
| Lake Elsinore | 15 | 44 | 6 | 19 | 317 | 971 | 11 | 34 |
| March Joint Powers Authority | 28 | 87 | - | - | - | - | 15 | 47 |
| Menifee | 74 | 227 | 279 | 854 | 10 | 30 | 190 | 582 |
| Moreno Valley | 278 | 851 | - | - | - | - | 151 | 462 |
| Murrieta | - | - | 5 | 16 | - | - | 3 | 9 |
| Perris | 198 | 607 | 1 | 2 | - | - | 107 | 328 |
| Riverside | 6 | 18 | - | - | - | - | 3 | 9 |
| Riverside County | 559 | 1,712 | 220 | 674 | 139 | 427 | 587 | 1,799 |
| San Jacinto | 1 | 2 | 1 | 2 | - | - | 24 | 74 |
| Wildomar | - | - | 0 | 0 | 113 | 345 | 0 | 0 |
| **Load Allocations** | | | | | | | | |
| Agriculture (CWAD) | 171 | 523 | 80 | 246 | 0 | 1 | 163 | 500 |
| Agriculture (Small) | 26 | 79 | 14 | 43 | 1 | 4 | 23 | 71 |
| CA Dept. of Fish and Wildlife | 44 | 134 | - | - | - | - | 54 | 165 |
| Federal - National Forest | - | - | 2 | 5 | 121 | 371 | 318 | 976 |
| Federal – Other | 32 | 97 | 7 | 21 | - | - | 51 | 157 |
| Federal – Wilderness | - | - | - | - | - | - | 62 | 190 |
| State Land | 38 | 115 | - | - | - | - | 45 | 139 |
| Tribal Reservations | - | - | - | - | - | - | 17 | 53 |
| Western Riv. Co. Reg. Con. | 8 | 24 | 4 | 13 | - | - | 9 | 29 |
| **Total Allowable Watershed Load (WLAs and LAs)** | **1,528** | **4,684** | **687** | **2,106** | **715** | **2,190** | **1,925** | **5,900** |
| 1 Allocations for Local Lake Elsinore and Canyon Lake Overflow to Lake Elsinore are combined into a single Lake Elsinore TMDL. However, the allocations are reported separately here since source controls in the Canyon Lake watershed can be used to estimate credits toward reducing loads in Overflows from Canyon Lake to Lake Elsinore. | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 6-4. Nutrient Load Reduction Required for Watershed Jurisdictions to Comply with Lake Elsinore and Canyon Lake Nutrient TMDLs** | | | | | | | | |
| **Responsible Agency** | **Canyon Lake Main Lake** | | **Canyon Lake East Bay** | | **Local Lake Elsinore** | | **Canyon Lake Overflow to Lake Elsinore** | |
| **TP (kg/yr)** | **TN (kg/yr)** | **TP (kg/yr)** | **TN (kg/yr)** | **TP (kg/yr)** | **TN (kg/yr)** | **TP (kg/yr)** | **TN (kg/yr)** |
| **Point Sources with NPDES Permits** | | | | | | | | |
| Banning | - | - | - | - | - | - | 2 | 12 |
| Beaumont | - | - | - | - | - | - | 6 | 53 |
| CAFO | 10 | 16 | 1 | 1 | 0 | 1 | 12 | 17 |
| Caltrans | 19 | 344 | 5 | 106 | 9 | 141 | 15 | 268 |
| Canyon Lake | 23 | 159 | 37 | 271 | 13 | 94 | 32 | 231 |
| Federal – Dept. of Defense | 35 | 444 | - | - | - | - | 19 | 239 |
| Hemet | - | - | 108 | 683 | - | - | 83 | 532 |
| Lake Elsinore | 25 | 159 | 2 | 28 | 224 | 1,961 | 15 | 101 |
| March Joint Powers Authority | 19 | 143 | - | - | - | - | 10 | 77 |
| Menifee | 94 | 631 | 489 | 3,186 | 4 | 29 | 314 | 2,055 |
| Moreno Valley | 654 | 4,794 | - | - | - | - | 353 | 2,584 |
| Murrieta | - | - | 15 | 109 | - | - | 8 | 59 |
| Perris | 269 | 2,139 | 0 | 0 | - | - | 145 | 1,152 |
| Riverside | 27 | 183 | - | - | - | - | 15 | 99 |
| Riverside County | 418 | 2,310 | 202 | 688 | 96 | 724 | 440 | 2,072 |
| San Jacinto | 0 | 0 | 0 | 2 | - | - | 31 | 221 |
| Wildomar | - | - | 0 | 0 | 103 | 837 | 0 | 0 |
| **Nonpoint Sources** | | | | | | | | |
| Agriculture (CWAD) | 407 | 755 | 251 | 469 | 2 | 4 | 417 | 759 |
| Agriculture (Small) | 82 | 160 | 59 | 114 | 4 | 7 | 80 | 154 |
| CA Dept. of Fish and Wildlife | 2 | 7 | - | - | - | - | 2 | 6 |
| Federal - National Forest | - | - | (0) | (0) | 1 | 5 | 3 | 12 |
| Federal – Other | (0) | 1 | 1 | 1 | - | - | 1 | 2 |
| Federal – Wilderness | - | - | - | - | - | - | 0 | 1 |
| State Land | 9 | 28 | - | - | - | - | 5 | 16 |
| Tribal Reservations | - | - | - | - | - | - | 1 | 8 |
| Western Riv. Co. Reg. Con. | 1 | 2 | (0) | (1) | - | - | 3 | 6 |
| **Total Allowable Watershed Load** | **2,093** | **12,275** | **1,171** | **5,657** | **457** | **3,802** | **2,010** | **10,736** |

## 6.2 Supplemental Water

### Supplemental water is added to Lake Elsinore to maintain lake levels. The DYRESM-CAEDYM model for Lake Elsinore showed that without supplemental water additions since 2002, lakebed desiccation would have likely occurred in 2014 under reference conditions (**Figure 6-2**). A WLA for supplemental water additions to Lake Elsinore based on projected effluent rates for EVMWD reclaimed water is provided in Table 6-5. Beyond this known source of supplemental water, any amount of supplemental water for the lakes with concentrations equal to or less than reference watershed runoff is provisionally allowable in Lake Elsinore and Canyon Lake. Further, the increased lake level that results from supplemental water addition may also provide water quality benefits of increased habitat for littoral zone aquatic communities and reducing bioavailable nutrient concentrations in the water column. These benefits will be translated into estimated nutrient offsets in Chapter 7, Implementation.

**Figure 6-2. Actual Lake Level Compared to Reference Condition (without supplemental water and without LEMP basin)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table 6-5. WLAs for EVMWD Reclaimed Water Additions to Lake Elsinore** | | | | | | |
| **EVMWD Reclaimed Water Additions** | **Flow** | | **Concentration** | | **Nutrient Load** | |
| **MGD** | **AFY** | **TP (mg/L)** | **TN (mg/L)** | **TP (kg/yr)** | **TN (kg/yr)** |
| Current Permit | 8.0 | 6,037 | 0.50 | 1.00 | 3,721 | 7,442 |
| TMDL Revision | 9.5 | 10,642 | 0.31 | 0.95 | 4,067 | 12,463 |

## 6.3 Internal Loads

## 6.3.1 Sediment Nutrient Flux

## Sediment cores have been collected to estimate the flux of nutrients, as NH4-N and PO4-P, from lake bottom sediments in Canyon Lake and Lake Elsinore. The results of these studies are presented in Section 4.3.1.[[1]](#footnote-1) Results from 2001-2014 show a significant inter-annual variability in flux rates, which is most likely caused by natural temporal variability in hydrology. Flux rates are greatest when sediment cores are collected shortly following years with significant rainfall and associated sediment retention in Canyon Lake and Lake Elsinore. The average flux rates measured from these studies provides an estimate of nutrient flux to be used as a load allocation in the TMDLs (**Table 6-6**).

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| --- | --- | --- | --- | --- | --- |
| **Table 6-6. Load Allocations for Sediment Nutrient Flux** | | | | | |
| **Lake Segment** | **Acres** | **Sediment Nutrient Flux (mg/m2/day)** | | **Load Allocation (kg/yr)** | |
| **TP** | **TN** | **TP** | **TN** |
| Canyon Lake (Main Lake)1 | 355.3 | 8 | 33 | 4,199 | 17,319 |
| Canyon Lake (East Bay) | 102.5 | 11.5 | 58 | 1,741 | 8,782 |
| Lake Elsinore | 3,000 | 10 | 100 | 30,000 | 300,000 |
| 1 Includes North Ski Area, the portion of the Lake north of the causeway, but no sediment data has been collected to date to characterize flux rates from this zone. | | | | | |

## 6.3.2 Atmospheric Deposition

## Load allocations were developed for direct deposition from the atmosphere to the lake surfaces. Inconsistencies in the approach used to develop estimates for Canyon Lake and Lake Elsinore exist in the 2004 TMDL (Risk Sciences 2017).[[2]](#footnote-2) For example, depositional rates for TN employed for Canyon Lake and Lake Elsinore were based on differing regional literature values. The approach presented below is based on similar data used for the 2004 TMDL but ensures a consistent method for TN and TP is applied to each lake segment.

#### 6.3.2.1 Total Phosphorus

## Wet deposition of TP to each lake segment was estimated by assuming a concentration in rainwater of 30 µg/L (Walker, 1996).[[3]](#footnote-3) Assuming most TP deposition occurs as wet deposition and taking average annual rainfall over the surface area of each lake segment of 11.4 inches/yr, load allocations were developed as shown in Table 6-7.

#### 6.3.2.1 Total Nitrogen

Estimates for atmospheric deposition of TN are based on results of a wet and dry deposition sampling conducted as an element of a water quality study for Newport Bay conducted in 2002-2004 (Meixner et. al. 2004)[[4]](#footnote-4). Results showed that dry deposition accounts for most depositional load of TN, with seasonal average rates varying from 2 to 12 kg/ha/yr of TN. The value of 3.23 kg/ha/yr used for the 2004 TMDL based on preliminary findings by Meixner is therefore sufficient and will be used in the TMDL revision. **Table 6-7** shows the load allocation for TN in each lake segment.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table 6-7. Load Allocations for Atmospheric Deposition** | | | | | |
| **Lake Segment** | **Acres** | **Atmospheric Deposition Rate (kg/ac/yr)** | | **Load Allocation (kg/yr)** | |
| **TP** | **TN** | **TP** | **TN** |
| Canyon Lake (Main Lake)1 | 355 | 0.04 | 3.23 | 13 | 1,147 |
| Canyon Lake (East Bay) | 103 | 0.04 | 3.23 | 4 | 331 |
| Lake Elsinore | 3,000 | 0.04 | 3.23 | 108 | 9,682 |
| 1 Includes North Ski Area portion of Canyon Lake, north of causeway | | | | | |

## 6.4 Summary of Allocated Loads

## 6.4.1 Total for Point and Nonpoint Source Allocations

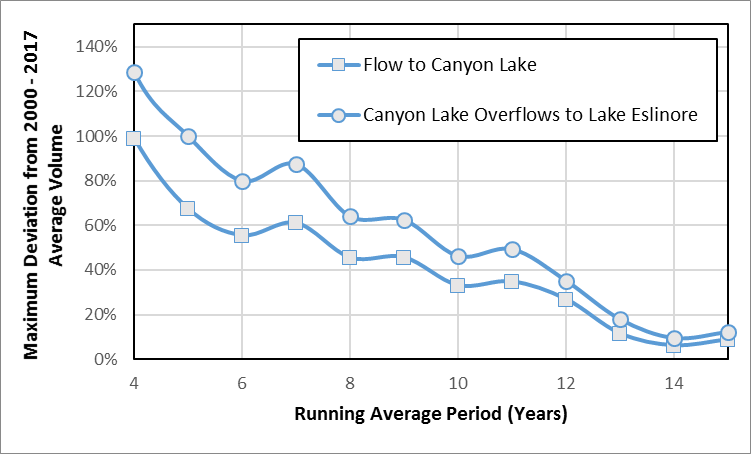
**Table 6-8** presents the total allocated load, considering both point and nonpoint sources of nutrients, to each lake segment. These total loads are also shown by the major categories of nutrient sources contributing to the total load.

## 6.4.2 Consideration of Averaging Periods

The nutrient load from the reference watershed to each lake segment will vary significantly from year to year because of prevailing climate patterns. In southern California, annual rainfall is influenced by water temperature patterns in the Pacific Ocean, which cause most rainfall and runoff from the San Jacinto River watershed in ‘El Nino’ years and droughts with limited runoff to the lakes in ‘La Nina’ years. Thus, mass-based allocations of allowable nutrient loads cannot be imposed based on the expected nutrient load in a single hydrologic year. To address this reality, the existing 2004 TMDLs used a 10-year period to determine whether annual average nutrient loads are being reduced to allowable levels. This approach allowed for consideration of fluctuations in rainfall and runoff above and below the decadal average in any given year.

As part of the revision of the existing TMDLs the basis for an appropriate averaging period has been reevaluated. This reevaluation relies on two datasets: (a) Flow data has been recorded at two inflows to Canyon Lake since 2000 from USGS gauges on Salt Creek and the San Jacinto River, providing 17 years of annual runoff volume records; and (2) overflows from Canyon Lake to Lake Elsinore were evaluated for this same period, based on records from USGS gauge 11070500. From the inflow records to Canyon Lake, different periods of multi-year annual running average total lake inflow volume were computed from this dataset. The greatest absolute deviation, in any one multi-year average from the actual 17-year average is plotted in **Figure 6-3**. Results show that the 10-year averaging period used in the 2004 TMDL does not preclude deviations in excess of 30 percent in some 10-year periods. Increasing the averaging period to 14 years would limit potential deviations to less than 10 percent.

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| --- | --- | --- | --- | --- |
| **Table 6-8. Summary of WLAs and LAs for Major Categories of Nutrient Sources to Each Lake Segment** | | | | |
| **Lake Segment** | **Wasteload Allocation (kg/yr)** | | **Load Allocation (kg/yr)** | |
| **TP** | **TN** | **TP** | **TN** |
| **Canyon Lake (Main Lake)** | | | | |
| Watershed Runoff | 1,211 | 3,711 | 317 | 973 |
| Supplemental Water | As needed | | n/a | |
| Atmospheric Deposition | n/a | | 13 | 1147 |
| Sediment Nutrient Flux | n/a | | 4,199 | 17,319 |
| **Canyon Lake (East Bay)** | | | | |
| Watershed Runoff | 580 | 1,778 | 107 | 328 |
| Supplemental Water | As needed | | n/a | |
| Atmospheric Deposition | n/a | | 4 | 331 |
| Sediment Nutrient Flux | n/a | | 1,741 | 8,782 |
| **Lake Elsinore** | | | | |
| Watershed Runoff (Canyon Lake overflows) | 1,181 | 3,620 | 744 | 2,280 |
| Watershed Runoff (local) | 592 | 1,814 | 123 | 376 |
| Supplemental Water | 4,067 | 12,463 | n/a | |
| Atmospheric Deposition | n/a | | 108 | 9,682 |
| Sediment Nutrient Flux | n/a | | 30,000 | 300,000 |

**Figure 6-3. Maximum Deviation from Long-Term (2000-2017) Average Annual Runoff Volume for Different Averaging Periods**

1. Note – this information is still in development and will be included in the Final Draft of Chapter 4. [↑](#footnote-ref-1)
2. Risk Sciences. 2017. Meeting Handout prepared for LE/CL Task Force, April 17, 2017. [↑](#footnote-ref-2)
3. Walker 1996. *Simplified Procedures for Eutrophication Assessment and Prediction: User Manual, Instruction Report*, W-96-2, 235 pp. [↑](#footnote-ref-3)
4. Meixner, Thomas, Barry Hibbs, Jennifer Sjolin, and James Walker. Sources of Selenium, Arsenic and Nutrients in the Newport Bay Watershed. April 30, 2004. [↑](#footnote-ref-4)