Las Tablas Creek and Lake Nacimiento

Total Maximum Daily Load for Mercury

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1.0 Introduction

Lake Nacimiento and Las Tablas Creek (including North and South Forks) are on California's Clean Water Act section 303(d) list of impaired waters for metals. The primary metal of concern in the database is mercury, which occurs naturally in the area in sufficient concentrations to have made mining historically profitable.

1.1 Background Information

Problems in the Las Tablas Creek watershed and Nacimiento Reservoir have been documented in the Clean Lake Assistance Program Report for Nacimiento Reservoir (Rice et al., 1994, p.1). The report was prepared by faculty of California Polytechnic State University, San Luis Obispo (Cal Poly) through contract with the California State Water Resources Control Board. The project was funded by the United States Environmental Protection Agency (USEPA) using Clean Water Act Section 314 grant funds to conduct a water quality management planning study to develop best management practices for reducing the concentration of mercury in Lake Nacimiento. The report summarizes extensive sampling in the watershed, identifies key potential sources, and provides a discussion of potential remediation methods. Other studies have also been conducted by the Central Coast Regional Water Quality Control Board (Regional Board) to evaluate past mining operations and their potential impacts on waters of the region (RWQCB, 1993; RWQCB, 1999).

1.2 Physical Setting

On April 26, 1955, the Monterey County Flood Control and Water Conservation District approved a general obligation bond issue for the construction of a 350,000 acre-foot reservoir on the Nacimiento River for municipal and irrigation water supply, groundwater recharge, flood control, and recreational purposes. The dam construction project was completed in April 1958 (Rice et al., 1994, p. 2).

1.2.1 Lake Nacimiento

The Lake Nacimiento watershed encompasses approximately 316 square miles located about half in northern San Luis Obispo County and half in southern Monterey County. Land use in the watershed is reported to be about 50% grazing, 47% open space, 1% housing, 1% camping, and 1% inactive mines (Rice et al., 1994, p. 3). Most of the land in the watershed is publicly owned as Hunter Liggett Military Reservation and Los Padres National Forest.

The individual drainage basins within the watershed can be divided into two groups: the lower basins that drain directly to the lake, and the upper basins that drain to the Nacimiento River which then flows into the lake (Figure 1). The lower basins include Las Tablas, Franklin, Town, Gould, Asbury, Dip, and Snake Creeks as shown on Figure 2. The crest of the Santa Lucia Range forms the southwestern boundary of the watershed, and the San Antonio River watershed divide bounds it on the northeast (Rice et al., 1994, p. 3).

Figure 1. The Lake Nacimiento Watershed, showing Calwater 2.2 Sub-areas.

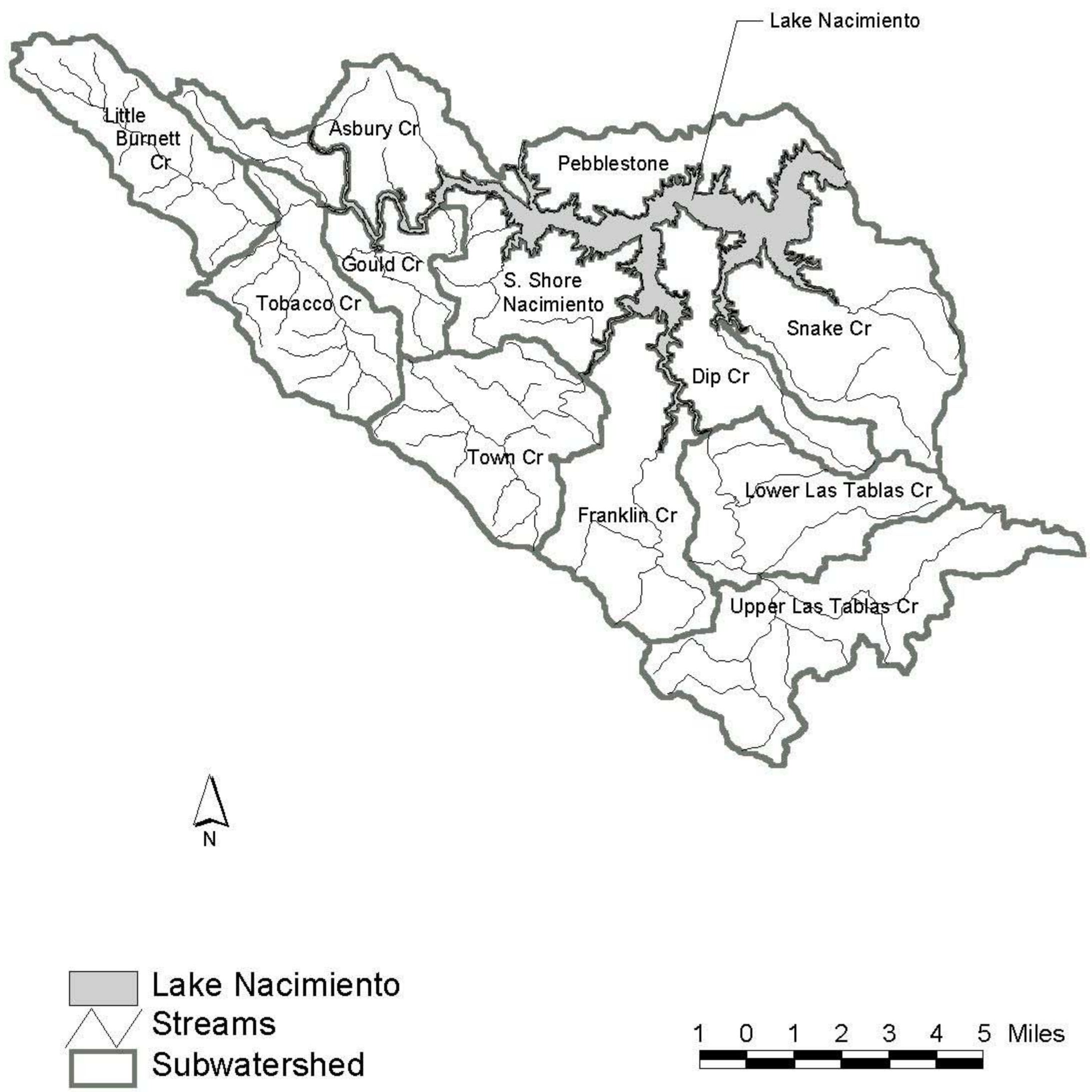

Figure 2. Southern Drainage Areas from Calwater 2.2.

1.2.2 Las Tablas Creek

The South Fork Las Tablas Creek (including the Klau Branch) and the North Fork Las Tablas Creek join together to form Las Tablas Creek (the "lower Las Tablas Creek basin") which flows into Lake Nacimiento (see Figure 3). Upper areas of the Las Tablas Creek watershed include the eastern drainages of the Santa Lucia range. The Santa Lucia range contains a variety of mineral deposits, many of which have been mined. The Las Tablas Creek watershed contains a number of inactive mines which were involved in mercury production (Rice et al., 1994, p. 51). Bigley (1994, p. 13) evaluated historic mercury mine production data and determined approximately 94% of the mercury produced in the entire Lake Nacimiento watershed was produced from the "Klau-Mahoney District" in the Las Tablas Creek drainage area. The "Klau-Mahoney District" of Bigley (1994) consists of two principal mines, the Klau mine and the Buena Vista mine (Figure 3).

1.3 Climate

The climate in San Luis Obispo County is mediterranean, with cool, wet winters and warm, dry summers. There is typically little or no precipitation during the period May – November. The average annual rainfall in the city of San Luis Obispo is about 22 inches (San Luis Obispo County Convention and Visitors Bureau, 2002). Rainfall in the upper portions of the Las Tablas Creek watershed may be significantly higher than county-wide averages due to orographic effects of the Santa Lucia range.

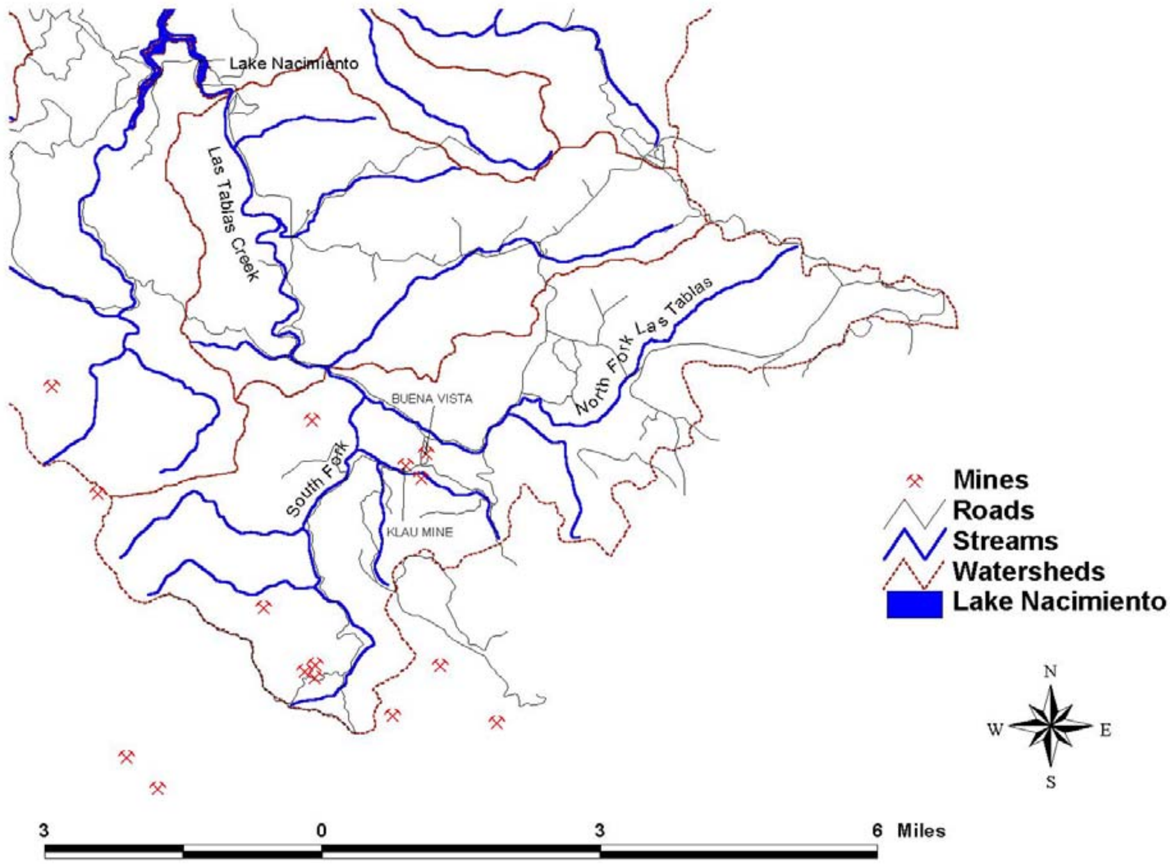

Figure 3. Las Tablas Drainage Area

2.0 Problem Statement

<u>2.1 General Overview</u>

<u>2.1.1 Las Tablas Creek Mercury</u>

The North fork, South fork, and mainstem of Las Tablas Creek exceed water quality objectives for mercury. As shown on Table 1, seven of 14 samples tested in a Regional Board study exceeded the Freshwater Aquatic Habitat (warm and cold waters) Basin Plan numeric objective for total mercury in the water column of Las Tablas Creek (see Appendix B of RWQCB, 1999 for sample details). Regulatory permit files also contain information indicating mercury is in excess of water quality objectives (USEPA, 1997). In addition, metals-rich sediment is associated with mercury in fish tissue at levels that pose a nuisance for fish consumers and therefore impact the Commercial and Sport Fishing beneficial use designated for Lake Nacimiento and Las Tablas Creek.

Table 1. Mercury Results from Las Tablas Creek.

Sample Site	Sample Date	Mercury Concentration (ug/L)
W-LT-21: BLM Reservoir	2/28/95	0.1
W-LT-22: Klau Branch of S. Fork Las Tablas	2/28/95	**1.0**
W-LT-23: Klau Branch of S. Fork Las Tablas	3/1/95	**0.3**
W-LT-24: Klau Branch of S. Fork Las Tablas	3/1/95	**0.43**
W-LT-25: Klau Branch of S. Fork Las Tablas	3/2/95	**6.1**
W-LT-26: S. Tributary to Klau Branch	3/2/95	ND
W-LT-41: BVM Culvert (NPDES point)	6/2/95	**1.4**
W-LT-42: Dodd Pool at N. Fork Las Tablas	6/2/95	**0.7**
W-LT-43: N. Fork Las Tablas above Dodd Pool	6/2/95	ND
W-LT-65: Above Buena Vista Mine, N. Fork Las Tablas	4/24/96	ND
W-LT-67: Below Buena Vista Mine, N. Fork Las Tablas	4/24/96	ND
W-LT-69: Below confluence N & S forks Las Tablas	4/24/96	ND
W-LT-71: Klau Branch of S. Fork Las Tablas	4/24/96	**0.23**
W-LT-73: “Background” –S. Fork Las Tablas	4/24/96	ND

ND = Not Detected.
All data from Regional Board, 1999.
Basin Plan Mercury Objective = 0.2 ug/L

2.1.2 Lake Nacimiento Mercury

Fish sampling conducted in Lake Nacimiento has resulted in fish consumption advisories due to mercury content of fish tissue exceeding US Food and Drug Administration (FDA) guidelines (Rice et al., 1994, p. 1; Rasmussen and Blethrow, 1990, p. L-12, L-13). The state of California’s current guidance value Maximum Tissue Residue Level (MTRL) is 0.37 mg/kg, which is lower than the previous FDA value of 1.0 mg/kg (Rasmussen, 2000, p.11). Fish tissue levels of mercury that cause a fish consumption advisory are considered an impact to the Commercial and Sport Fishing beneficial use designated for Lake Nacimiento. Based on the available information, Las Tablas Creek and Lake Nacimiento require establishment of a total maximum daily load (TMDL) for mercury.

2.1.3 Other Metals

The total nickel content of waters in the Klau Branch tributary to the South Fork Las Tablas Creek has been found to exceed Basin Plan Water Quality Objectives (see Appendix B of RWQCB, 1999). Other samples collected at the same time in the North Fork and South Fork of Las Tablas Creek indicate those segments are meeting appropriate objectives for nickel. Because the available nickel data in the Klau Branch are insufficient to develop a loading estimate for nickel, a separate report will be developed in the future to address nickel in the Klau Branch. The current TMDL document addressing mercury will meet the Clean Water Act section 303(d) requirement of a TMDL for metals impairments in Lake Nacimiento and Las Tablas Creek (North and South Forks). The nickel impairment of Klau Branch tributary to South Fork Las Tablas Creek will be proposed for the next update cycle of the 303(d) List (anticipated as 2004).

2.2 Water Quality Objectives

The Water Quality Control Plan, Central Coast Basin (Basin Plan) lists specific beneficial uses for Las Tablas Creek and Nacimiento Reservoir (Table 2) and objectives for protecting these beneficial uses.

Table 2. Beneficial Uses for Lake Nacimiento and Las Tablas Creek.

Designated Beneficial Uses:	Lake Nacimiento	Las Tablas Crk
Municipal and Domestic Water Supply	X	X
Agricultural Supply	X	X
Ground Water Recharge	X	X
Water Contact Recreation	X	X
Non Contact Water Recreation	X	X
Navigation	X	X
Cold Freshwater Habitat	X	X
Warm Freshwater Habitat	X	X
Wildlife Habitat	X	X
Rare, Threatened or Endangered Species	X	X
Freshwater Replenishment	X	-
Commercial and Sport Fishing	X	X
Spawning, Reproduction , and/or Early Development	X	X

With the exception of Freshwater Replenishment and Navigation, Las Tablas Creek (including the North Fork and South Fork) is listed for the same Beneficial Uses as Lake Nacimiento.

2.2.1 Numeric Objectives

Numeric mercury objectives for the beneficial uses listed in Table 2 range from 0.0002 mg/L (for Cold or Warm Freshwater Habitat) to 0.01 mg/L (for Agricultural use in livestock watering). The lowest pertinent Basin Plan objective for mercury is the numeric Freshwater Habitat water quality objective for total mercury in water, which is 0.0002 mg/L (0.2 micrograms per liter [μg/L], RWQCB, 1994a). The California Toxics Rule includes a health-based total mercury objective of 0.05 μg/L for consumption of organisms and water (Federal Register, 2000). This value supersedes the Basin Plan total mercury objectives for Municipal/Domestic Supply and Freshwater Habitat.

2.2.2 Narrative Objectives

Narrative water quality objectives are listed in the Basin Plan for suspended and settleable materials. Table 3 lists narrative water quality objectives for sediment in the Central Coast region. Mercury in fish tissue at levels above Maximum Tissue Residue Level (MTRL) guidelines is considered an exceedence of the suspended and settleable material narrative objectives because of the nuisance for fish consumers and the adverse effect on the Commercial and Sport Fishing beneficial use. This TMDL has been developed to achieve appropriate numeric and narrative Basin Plan objectives for the beneficial uses that were listed in Table 2.

Table 3. Water Quality Objective: Narrative Objective Description.

Suspended Material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Settleable Material	Waters shall not contain settleable material in concentrations that result in deposition of material that causes nuisance or adversely affects beneficial uses.

2.3 Current Conditions in the Watershed

Data from Regional Board (1999) shows levels of mercury in mine waste sediments in the Las Tablas watershed as high as 16,500 mg/kg and mercury in sediments in Las Tablas Creek as high as 200 mg/kg (RWQCB, 1999, p. 16). Sediment quality studies indicate that toxic effects to macro-organisms may be anticipated from sediment containing mercury at levels less than one milligram per kilogram of sediment (Buchman, 1999). Table 4 shows sediment quality screening guidelines from the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Table for Inorganics in freshwaters (Buchman, 1999).

Table 4. Screening levels considered for sediments in the Central Coast Region.

Substance	Threshold Effects Level, NOAA-TEL (mg/kg)	Probable Effects Level, NOAA-PEL (mg/kg)
Mercury	0.174	0.486

Mercury contaminated materials are likely transported mostly as suspended sediment in streams and deposited in the Lake Nacimiento reservoir during periods of high water flow. Sediments in areas of shallow water may undergo microbiological processes which transform inorganic mercury into methylmercury in the process known as methylation (Wiener and Krabbenhoft, 1999). This methylation process initiates mercury bioaccumulation and biomagnification in the food chain that results in potential adverse threats to animal and human health (Rice et al., 1994, p. 71). Bioaccumulation of methylmercury can result in toxic levels of mercury in organisms and is one of the main methods of mercury poisoning of organisms in the environment. Since the binding rate of methylmercury to tissue is faster than the rate of methylmercury excretion from tissue, the bioaccumulation of methylmercury results in toxicity to susceptible organisms in the environment (Wiener and Krabbenhoft, 1999).

A 1994 letter from the Regional Board to the San Luis Obispo County Health Department cites the detection of mercury in benthic, phytovore and predator species of various sizes collected from multiple locations in Las Tablas Creek and Lake Nacimiento (RWQCB, 1994b). Generally, higher mercury concentrations were found in higher trophic level species, in larger fish, and in fish residing in quiet waters above mercury-rich sediments.

The California Department of Health Services has posted a health advisory calling for reduced consumption of large mouth bass and white bass because of high tissue mercury concentrations (Rice et al., 1994, p. 257). Large mouth bass taken from the Las Tablas

Creek Arm of Lake Nacimiento had mercury concentrations up to 1.80 parts per million (ppm) in the filets, exceeding the FDA action level of 1.00 ppm and the MTRL of 0.37 ppm (Rasmussen and Blethrow, 1990, p. L-13).

The available data indicate that Basin Plan and California Toxics Rule objectives have been exceeded with respect to mercury in the waters of Lake Nacimiento and Las Tablas Creek. Numeric objectives designed to protect the Freshwater Habitat (cold and warm water) were exceeded by direct measurements of samples from these waters. Narrative objectives designed to protect Commercial and Sport Fishing were exceeded because mercury in sediments in these waterways has accumulated to unacceptable levels in fish tissue.

3.0 Numeric Targets

3.1 Background Data

In many parts of the Lake Nacimiento watershed, the natural mercury levels in soil (“background”) tend to be relatively high since the area has numerous natural geologic mercury deposits. Three studies have considered what background or natural mercury content of soils in the area might be. The first study was by Rice et al. (1994), who studied the entire Lake Nacimiento watershed. A second study was conducted by Regional Board staff with a specific emphasis on understanding past mining activities in the region (RWQCB, 1999). Subsequent to those two studies, US EPA evaluated the Buena Vista and Klau Mine sites for potential nomination to the “Superfund” List of sites needing federal cleanup (USEPA, 2001).

Rice et al. (1994) reported ranges of data based on a limited number of samples collected in specific sub-watersheds (North Fork Las Tablas Creek, South Fork Las Tablas Creek, and Klau Branch tributary to South Fork Las Tablas Creek). They reported five samples ranging from 0.06 mg/kg to 0.36 mg/kg (Rice et al., 1994, p. 76-78). Perhaps most pertinent is the only sample they collected from the North Fork of Las Tablas creek, upstream of the Buena Vista Mine, which had a reported mercury concentration of 0.31 mg/kg (Rice et al., 1994, p.78).

The Regional Board sponsored an effort to sample geologically similar soils and sediment that was not impacted by mines in the Las Tablas Creek area to estimate watershed background concentrations (RWQCB, 1999, p. C-11). Five sample locations were chosen over a wide area to include naturally mineralized sediments and determine metals concentrations which may have existed in the Las Tablas Creek watershed before mining. Total mercury concentrations in sediment at the five sites ranged from 0.04 to 1.0 mg/kg with a reported mean of 0.28 mg/kg (RWQCB, 1999, p.C-10).

In 2001, US EPA evaluated the Buena Vista and Klau Mine sites and conducted additional sampling which included six sites they considered “background:” two sites on the Klau Branch tributary, two on the South Fork, and two on the North Fork of Las Tablas creek (USEPA, 2001, Table 3.3, p.20). Because of high confidence in the quality of these data and the certainty of their locations, Regional Board staff have evaluated the USEPA data as indicators of current background mercury concentrations in the Las Tablas creek watershed. Regional Board staff felt the most appropriate samples for evaluating background were the upstream samples on the South and North Forks of Las Tablas Creek (given the smaller size of the Klau Branch and extensive past mining history in the Klau area, staff considered samples from that area as likely impacted by mining or likely out of the mineralized zone the mines followed in their development). Using the four remaining samples and performing a logarithmic transformation on the data (most natural concentration data tend to fit a log-normal distribution because concentration data are zero or greater with no negative values), Regional Board found the background mercury concentration in the North and South Forks to be 0.28 mg/kg (the geometric mean of four data points ranging from 0.12 to 1.4 mg/kg). The Regional Board analysis did use the data as reported although two of the values were reported as "estimated" concentrations (meaning the lab detected mercury at a level between the machine's analytical limit and the method's practical quantitation limit).

Regional Board staff also calculated the standard deviation of the logarithmic EPA data and determined that a one-sigma range of variability from the geometric mean of 0.28 mg/kg would range from 0.09 mg/kg to 0.84 mg/kg. In statistical probabilities, approximately 68 percent of a normal population is found between one sigma below the mean and one sigma above the mean.

The results of the three independent studies provide reasonably good agreement for a background mercury soil concentration of 0.28 mg/kg. This is close to the single North Fork Las Tablas Creek background value (0.31 mg/kg) reported by Rice et al. (1994) and matches well with the Regional Board (1999) background value of 0.28 (although that value was an arithmetic mean). Table 5 compares estimated background levels for mercury in sediment in the Las Tablas Watershed to sediment quality guidance from NOAA (Buchman, 1999).

Table 5. Background levels for mercury in sediment in the Las Tablas watershed compared to NOAA screening levels developed for sediments.

Substance	NOAA-TEL	NOAA-PEL	Las Tablas (Rice, 1994)	Las Tablas (RWQCB 1999)	Las Tablas (USEPA 2001)
Mercury (sediment)	0.174 mg/kg	0.486 mg/kg	0.31 mg/kg	0.28 mg/kg (arithmetic)	0.28 mg/kg (geometric)

3.2 Numeric Target Goal

The remediation goal for the Lake Nacimiento watershed is to return aquatic habitat and sport fishing beneficial uses to the waters. The Maximum Tissue Residue Level (MTRL) for acceptable levels of mercury in fish tissue was developed directly from the CTR total mercury water column concentration of 0.05 ug/L (see Table 3, p. 11 of Rasmussen, 2000 where the MTRL of 0.37 mg/kg is calculated by multiplying a water column mercury concentration of 0.051 ug/L times a Bioconcentration Factor of 7432 L/kg). However, it is noted that uncertainty exists about the relationship between sediment levels of mercury and water column or fish tissue levels of methylmercury. Some workers have reported little correlation between sediment mercury levels and methylmercury levels in fish (Tetra-Tech, 1999, p. 33) while others have reported a correlation between sediment mercury and water column methylmercury levels (Krabbenhoft et al., 1999).

Despite the uncertainty, efforts to restore beneficial uses must start with some loading reduction and make use of an adaptive management approach. This approach involves gathering site specific data during initial phases of implementation and using those data to guide subsequent phases. As a first step in restoring beneficial use to these waters, the NOAA PEL has been chosen as an appropriate sediment mercury target level.

The NOAA Probable Effects Level (PEL) was selected as an appropriate target rather than the NOAA Threshold Effects Level (TEL) because the PEL is considered a good indicator of when effects are generally likely to impact the beneficial uses established for a waterbody (RWQCB, 1998).

Further support for use of the PEL is found in the available background data for the Las Tablas drainage area that indicate average “background” mercury levels of 0.28 mg/kg, which is notably higher than the TEL of 0.174 mg/kg. Assuming that natural background conditions (0.28 mg/kg) are the lowest concentration that can be achieved by managing “controllable” sources, the TEL would clearly be an unnaturally low target value. It is not clear from the available data whether achieving a sediment target of 0.486 mg/kg will result in reaching the total water column mercury concentration of 0.05 ug/L (CTR value), however, this value seems to be a reasonable point from which to start. Further sampling and analysis during implementation will confirm this assumption and will be used to restore beneficial uses to Lake Nacimiento and Las Tablas Creek. Uncertainty associated with the selection of a sediment target value and the relation of the sediment value to water column values has been considered in the margin of safety allocated to this TMDL (see section titled “Margin of Safety”).

3.3 Numeric Targets Selected for this TMDL

The following numeric targets have been selected for this TMDL:

Water: 0.05 μg/L total mercury at all locations (based on California Toxics Rule)

Sediment: 0.486 mg/kg mercury in Lake Nacimiento and Las Tablas Creek bottom (surface two inches) sediments (based on NOAA PEL)

Efficient locations for monitoring attainment of these targets are discussed later in this report in Section 9.2.

4.0 Source Analysis

4.1 Source Area Identification

Several inorganic mercury forms occur naturally. One natural source of mercury is the mineral cinnabar, which was extensively mined in the Santa Lucia Range along the western portion of the Lake Nacimiento watershed. Regional Board staff developed a Lake Nacimiento Mercury Loading Model to estimate mercury loads to Lake Nacimiento based on general sedimentary influx of mercury from the various streams entering the lake.

Rice et al. had developed and presented a loading model for mercury loading to Lake Nacimiento (1994, p. 136), however, their model contained errors in drainage area measurements in both the overall watershed and sub-watersheds (Chipping, 2001). Because the various drainage areas needed to be re-measured and the entire loading model re-developed based on the new area measurements, Regional Board staff developed an entirely new loading model for Lake Nacimiento using the existing chemical sample data from Rice et al. (1994, p. 73, 77, 82, 96, 114). The chemical sample data appear to be of good quality and are unrelated to incorrect area measurements used in the report.

4.2 Regional Board Lake Nacimiento Loading Model for Mercury

In developing a mercury loading model for Lake Nacimiento, Regional Board staff were able to use a Geographic Information System (GIS) database combined with existing chemical sample data from Rice et al. (1994). The model followed a basic methodology similar to the one used by Rice et al. (1994). The methodology of the Regional Board model was:

1. Estimate drainage areas and sub-areas using Calwater 2.2 basin outlines (California, 2001) and areas from GIS (note that Calwater basin outlines are developed to address more than just surface water matters and therefore may not correspond perfectly with surface water drainages observed in the field).

2. For each selected drainage area, develop an estimate of the area drained, the estimated annual sediment load from that area, and the estimated, averaged, or measured mercury concentration of sediment from that area.

3. Sum the estimated annual mercury loadings from all sub-areas and develop an estimated total annual mercury load for Lake Nacimiento.

Regional Board staff developed the model as simply as possible to lessen the number of assumptions made in the model. Staff made the following assumptions in the model to get a basic estimate of annual mercury loading to Lake Nacimiento:

A) Drainage areas were best represented by using a sediment sample from the most downstream location within the area as an overall representation of long-term sediment mercury loads from that area.

B) All generalized areas 1 square mile or larger of the watershed were estimated to have a basic sedimentation rate of 1000 tons (2000 pounds) per square mile per year, that was considered average for the region (see Rice et al., 1994, p. 134; Angelo, 2001, p.1).

C) Areas where no sediment sample data were available were reasonably represented by using mercury content of sediments from an adjacent drainage area.

Regional Board staff tested some of these assumptions by performing multiple model runs where some of these parameters were varied. For example, runs with different scenarios of estimated mercury content of sediments were performed. Further details of the model results are presented in Appendix A.

Estimates from the Regional Board Lake Nacimiento Loading Model indicate that approximately 77 to 93 percent of the total mercury loading into the lake enters the lake from the Las Tablas Creek drainage area. The model results that represent the most reasonable scenario (Run 3 in Appendix) are summarized in Table 6.

Table 6. Estimated Mercury Loads from Regional Board Lake Nacimiento Loading Model.

Area Name (Calwater2.2)	Area Size (sq. mi.)	Concentration of Hg in sediment (mg/kg)	Estimated Mercury Load to Lake (kg/yr)	Percent of total load
Mainstem Nacimiento River (includes: Carrals Spring, Slickrock Creek, Stony Creek, San Miguel Creek, Upper Los Berros Creek, N. Fork Los Burros Creek, San Miguelitos Ranch, Gabilan Creek, Los Bueves Creek, Lower Los Burros Creek, Oak Flat, Waller Creek, Mesa Coyote, Pozo Honda Creek, Turtle Creek, Gulch House Creek)	163.48	0.018	2.675	5.47
Western Shore drainages (includes: Tobacco Creek, Little Burnett Creek, Gould Creek, Town Creek, South Shore Lake Nacimiento, Asbury Creek, Kavanaugh Creek, Franklin Creek)	86.59	Values set for each basin (see Appendix for details)	2.239	4.58
Las Tablas Creek (Upper Las Tablas and Lower Las Tablas)	30.65	1.55	43.18	88.36
Dip Creek	8.77	0.018	0.144	0.29
Snake Creek	17.47	0.018	0.286	0.59
Pebblestone	9.02	0.042	0.344	0.70
Total	315.98	-	48.868	99.99 *

*= does not add up to 100.00 due to rounding

The model results are intuitively reasonable considering that the steeper upland areas of the Las Tablas drainage are much closer to the lake itself than almost any other drainage into the lake. Four separate lines of evidence support this intuitive finding:

1) Sediment samples collected directly from the lake by Rice et al. (1994) suggest

that the majority of mercury load into the lake comes from the Las Tablas Creek drainage area. Eight of the 10 lake sediment samples reported by Rice (1994, Table 4-10, p.114) had mercury contents less than 0.20 mg/kg with an average mercury content of 0.08 mg/kg. Two of three samples reported from the Las Tablas arm of the lake had mercury contents of 1.6 and 1.5 mg/kg (the third sample, at 0.08 mg/kg was collected where the "mouth" of the Las Tablas arm meets the midpoint of the main section of the lake). Using either the 0.28 mg/kg average background mercury soil value or the proposed numeric mercury sediment target of 0.486 mg/kg in this report as a guideline, one can see that the sample data from Rice et al. (1994), suggest mercury in sediment is essentially background or natural loading in the main east-west section of the lake and is significantly elevated above the target level in the Las Tablas arm of the lake.

2) In samples reported by Rice et al. (1994, p. 118), the only water samples in the lake exceeding Basin Plan mercury objectives were collected in the Las Tablas arm of the lake.

3) In ten years of fish tissue sampling conducted as part of the California Toxic Substance Monitoring Program, largemouth bass sampled in the Las Tablas creek area of Lake Nacimiento had average tissue mercury concentrations of 1.15 parts per million (ppm) while largemouth bass collected in five other sections of the lake all averaged less than 1.00 ppm (Rasmussen and Blethrow, 1990, p. L-11 through L-14).

4) Historic mercury production data compiled by Bigley (1994, p.13) indicates the Las Tablas Creek drainage area contains two mines (Klau and Buena Vista) that produced over 90% of the mercury produced from the entire Lake Nacimiento watershed.

4.3 Estimated Source Load Calculations

Given the apparent loading to Lake Nacimiento entering from Las Tablas Creek (shown on Table 6), Regional Board staff performed a separate calculation to estimate mercury source loadings specifically within the Las Tablas creek watershed based on various source materials identified in the literature.

Because of the natural occurrence of mercury in this area and the human impacts of historical mining of the mercury, mining was considered a major land use category. As shown earlier (on Figure 3), the Las Tablas Creek area has two major mines that are key potential mercury source areas for this category. Because sediment samples along the mainstem of Las Tablas Creek from the confluence of the north and south forks to the Harcourt dam had a trend of decreasing mercury content, it was determined that no major mercury source was present in that creek segment. The only other local land use identified as a potential source of mercury-rich sediment was runoff from unpaved roads in the area which were reported to have used mine waste rock as a construction element in some fill areas (Rice et al., 1994, p.97). Therefore, three major categories were selected as potential sources of mercury loading to local waters. These three sources are:

- General soil runoff
- Runoff from unpaved roads
- Runoff from mine areas

An Estimated Source Loading calculation was made based on these three land uses in the Las Tablas Creek drainage area. In the Estimated Source Loading calculations, specific areas smaller than one square mile were estimated to have a sedimentation rate four times higher than the large area basic rate (i.e., 4000 tons per square mile per year for small areas, compared to the same 1000 tons per square mile per year large area basic rate used in the Regional Board Lake Nacimiento Loading Model). This assumed small area sedimentation value was at the lower end of data presented by Scott and Williams (1974, p. 59-60, range of approximately 4000 – 10,000 cubic yards per square mile per year for areas less than one square mile). This sedimentation value is also consistent with other data reported for the region (Knott, 1976, p. 28, showing 1800 tons per square mile per year for a 2.95 square mile drainage), and with the understanding that sediment yield rates increase as drainage area size decreases (Ritter, 1986, p.195; and Chorley, Schumm, and Sugden, 1984, p.326).

The Estimated Source Loading (shown in Table 7) was calculated using the following:

- a "background" source amount of general soils of 0.28 mg/kg mercury content and covering all of the 30.65 square mile drainage area not otherwise attributed to roads or mines,
- a specific source area contribution estimated for roads based on data reported by Bigley (1994, p. 83, p. 98) and Rice et al. (1994, p. 96) which indicated approximately 9 acres of unpaved roads along Las Tablas Creek with an average mercury content of 15.5 mg/kg,
- a specific source area contribution estimated for the Klau and Buena Vista mines with an average mercury concentration of 21 mg/kg (based on data for "BV Mine drain @ Klau Rd." from Rice et al., 1994, p. 77) and covering 320 acres.

Table 7. Estimated Source Loading Calculations.

Source Category	**Area (sq.mi.)**	**Mercury Concentration (mg/kg)**	**Estimated Load (kg/yr)**	**Percent of Total Load Estimate**
General Soils	30.14	0.28	7.67	16.45 %
Unpaved Roads	0.014	15.5	0.77	1.65 %
Mined Areas	0.5	21.0	38.18	81.90 %
Las Tablas Creek Total Source Estimate	**30.65**	-	**46.62**	100.00 %

Note that the total current mercury load estimated for the Las Tablas Creek drainage area from the RWQCB Lake Nacimiento Loading Model shown on Table 6 (43.19 kg/yr) compares well with the Estimated Source Loading Calculations shown on Table 7 (46.62

kg/yr, approximately an 8% difference).

A second calculation was performed as a check on the assumed small area sediment rates by using a value of 3000 tons per square mile per year. This calculation resulted in an Estimated Source Loading of 36.88 kg/yr, which was approximately 15% below the Regional Board Loading Model value (43.18 kg/yr). The larger difference of this second calculation, and that it was below the Regional Board Model number rather than above it as the first calculation was, supports the reasonable nature of the assumption of 4000 tons per square mile of sediment per year from areas smaller than one square mile. The uncertainty associated with the small area sedimentation rate has been incorporated into the Margin of Safety of this TMDL.

To better understand the potential mercury sources, Regional Board staff also considered the variability in the background soil mercury concentration (as discussed in Section 3.1 "Background Data"). Regional Board staff used estimated background concentrations of 0.09 mg/kg (one sigma below the mean) and 0.84 mg/kg (one sigma above the mean) to provide greater insight into the range of potential source estimates. The results of these calculations are summarized in Table 8. From Table 8, one can see that although the percentages vary, the mines are the major source of mercury loading in the watershed at both the upper bound and lower bound calculations. Beyond the percentage contribution attributable to the mines, it is important to keep in mind that the mines and the roads are the only *controllable* mercury source areas identified in the watershed.

Table 8. Range of Estimated Source Loading Calculations.

Background Soil Concentration used	% of Total Load from **General Soils**	% of Total Load from **Unpaved Roads**	% of Total Load from **Mined Areas**
0.09 mg/kg	5.96%	1.86%	92.18%
0.28 mg/kg	16.45%	1.65%	81.90%
0.84 mg/kg	37.15%	1.24%	61.61%

4.3.1 Comparison of the Two Mathematical Methods – The Regional Board Lake Nacimiento Loading Model and The Estimated Source Load Calculations

It is striking that the two loading estimates are so similar because they were derived using notably different methods and data. The Regional Board Lake Nacimiento Loading Model used sample data from a downstream sample point (1.55 mg/kg at Harcourt Reservoir Spillway) as the representative average load from the entire 30.65 square mile Las Tablas Creek drainage area, generating 1000 tons per square mile per year of sediment.

The Estimated Source Loading Calculations model was based on an average "background" value of 0.28 mg/kg mercury and 1000 tons sediment per square mile per year over most of the area with additional specific source area estimates for unpaved roads and mined areas of higher mercury concentrations and higher sediment delivery rates.

4.3.2 Primary Sources

The Estimated Source Loading Calculations (Table 7) indicate that over 80% of the mercury load generated in the Las Tablas Creek watershed comes from the two mine areas, Buena Vista and Klau mines. The remaining load is largely attributed to general background soil erosion of the naturally occurring mercury-rich lithology.

It should be noted that, in an effort to be conservative in Estimated Source Loading Calculations, the surface mine workings were slightly overestimated by estimating their extent as 0.5 square mile (320 acres). Although the surface features of the mines may cover less than this area used in the source calculations, it is felt that the larger estimate is reasonable when considering underground workings and acid mine drainage loads not explicitly incorporated into the source loading calculations. No data were found which would allow quantification of the specific load attributable to acid mine drainage.

Potential overestimation of mined area is balanced by the use of 21 mg/kg (the downstream sample #LM1S1 at the "BV Mine Drain" as reported in Rice et al., 1994, Table 4-2, p. 77) rather than 61 mg/kg (the average of all 24 mine area samples reported on Table 4-2, p.77, Rice et al., 1994) as the mercury content of soils in this area. Use of the 21 mg/kg value is consistent with the same general approach used in the Regional Board Lake Nacimiento Loading Model to use a "downstream sample" as representation of average conditions across an area. However in this case, using 21 mg/kg appears to be using a mercury content in the lower part of the range of available data. The agreement (less than 10 % difference) between results using this value in Estimated Source Loading calculations for Las Tablas Creek and the estimated Las Tablas Creek totals derived from the larger Regional Board Lake Nacimiento Loading Model suggests the approach is reasonable.

Given the richness of the ore in the vicinity of the Buena Vista and Klau mines, and the location of these two mines adjacent to each other in steep slopes of creek banks near to the lake (as opposed to other mines which drain to waters further away from a mainstem creek or river before flowing into the lake), it is reasonable to consider the Buena Vista and Klau mine area as the highest priority source of mercury loading in the Las Tablas Creek drainage area.

Rice et al. (1994) also provide a graph (Figure 4-1, p.83 of Rice et al., 1994) that supports the interpretation that the Buena Vista mine is a key source of mercury-rich sediment to Las Tablas Creek and down the creek to Lake Nacimiento. This graph is reproduced as Figure 4.

Based on the reasonable nature of the Estimated Source Loading Calculations shown in Table 7, these estimates of current loading conditions will form the baseline from which future mercury load allocations are derived in the section titled "Total Maximum Annual Load and Load Allocations."

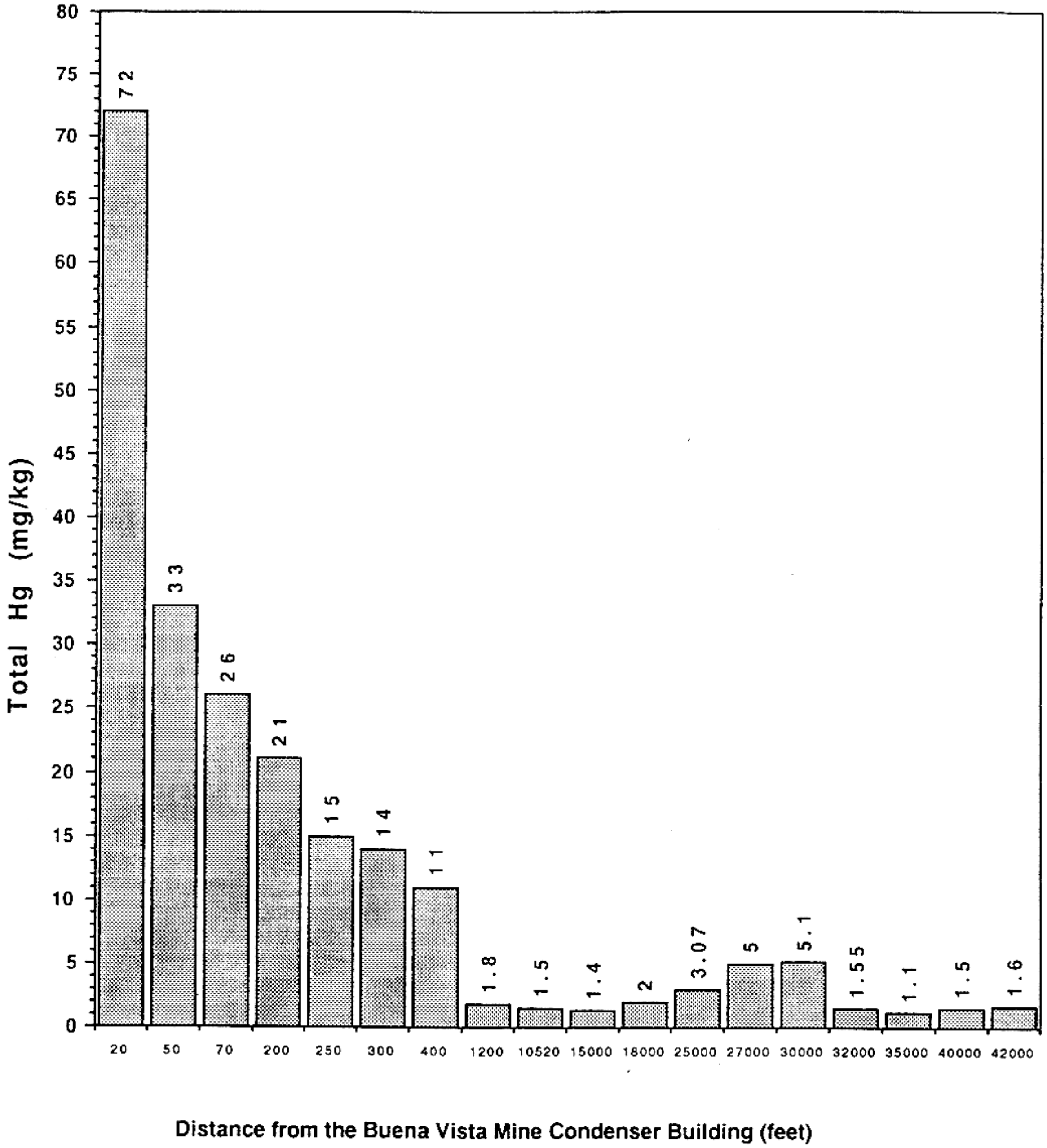

Figure 4. Total Mercury in the Las Tablas Creek System Sediments as a function of distance downstream from the Buena Vista Mine condenser facility (from Rice et al., 1994).

5.0 Total Maximum Annual Load and Load Allocations

5.1 Total Maximum Annual Mercury Load for Las Tablas Creek

5.1.1 Sediment

A loading equation to achieve water quality objectives and protect beneficial uses was developed for Las Tablas Creek (Upper creek and Lower creek) only. Because sediment levels in the main sections of Lake Nacimiento are currently below the 0.486 mg/kg mercury content target, no explicit loading equation was developed for the entire lake. Reductions achieving the allocations for Las Tablas Creek will result in reductions in load to the lake.

Because the available data on sediment fluxes is in terms of tons of sediment per unit area on an annual basis, target maximum loads were developed on an annual basis for the Las Tablas Creek drainage area. Considering that metals don't significantly degrade and tend to exist over a long timeframe in sediments, an annual maximum mercury load is a reasonable approach to address impaired conditions in the creek.

Applying the target sediment mercury content (0.486 mg/kg) to a basic estimate of 1000 tons sediment per square mile per year for the entire 30.65 square miles of the Las Tablas Creek drainage area results in a calculated maximum annual acceptable mercury load of 13.54 kg/yr (30.65 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.486 mg Hg/kg sed.*1 kg/1000000mg= 13.54 kg Hg/yr).

The target Las Tablas Creek loading equation can then be expressed as the annual sum of target loads of mercury from the three categories evaluated in the earlier section titled "Estimated Source Load Calculations" with the incorporation of an appropriate margin of safety considering the uncertainties involved. In equation form, this annual load is:

7.67 kg/yr + 0 kg/yr +4.52 kg/yr + 1.35 kg/yr = 13.54 kg Hg/yr
(general soils)+(roads)+ (mines)+(margin of safety) = (total load from Las Tablas Creek drainage area)

Details of the individual load allocations and how they are derived are presented below in the section titled "Load Allocations."

5.1.2 Seasonality

In implementing measures to achieve this maximum annual loading, it will be necessary to incorporate the seasonal nature of rainfall and runoff in the central coast region (typically wet winters with little or no rainfall in summer months). The importance of this approach has recently been demonstrated in the work of Whyte and Kirchner (2000), which shows that a significant portion of long-term mercury loading near a mine site could occur in a single storm event.

Two approaches can be used to account for this seasonality. The first approach recognizes the sediment target developed in this TMDL is an integration of watershed conditions over time (considering that stream bottom sediments accumulate over time and reflect more long-term generalized conditions than water samples). Therefore, achieving the 0.486 mg/kg mercury target for sediments will incorporate the seasonal nature of rainfall and runoff in the region.

The second approach considers the methods of Whyte and Kirchner (2000) to be a more direct method of measuring loading. Developing a baseline correlation between automated monitoring data (e.g., optical turbidity and flow) and the target constituent of mercury allows essentially continuous monitoring of estimated mercury loading. This approach allows quick identification of ongoing mercury loading to the creek. Use of a correlated turbidity measure also incorporates suspended sediment into the measurement of mercury loading. This automated monitoring improves the likelihood that runoff loading from a significant storm event will be measured whereas a grab sampling water column monitoring program may miss "peak" flow events.

This TMDL accounts for the seasonal nature of rainfall and runoff in the region by setting both water column and sediment targets rather than only a total water column mercury target which would include suspended sediment. Automated continuous monitoring is encouraged in the permits for the mines as a more detailed method to quantify loading.

5.2 Load Allocations

The annual mercury loads from sediment expressed in the Loading equation above (section 5.1.1) were derived from the key source area categories of the Estimated Source Loading Calculations (see Table 7) as shown on Table 9. The allocations are based upon reducing the volume of mercury-rich sediments because this is an easier way to achieve load reductions than reducing the mercury concentration of the sediments.

Table 9. Current and Projected estimated annual mercury loads for Las Tablas Creek.

Source Area Category (and size in square miles)	Mercury concentration (mg/kg) (existing and projected)	Current sediment rate (tons/sqmi/yr)	Current mercury load (kg/yr)‡	Projected target sediment rate (tons/sqmi/yr)	Projected target mercury load (kg/yr)	% reduction needed from existing sediment rate
General Soils (30.14)	0.28	1000	7.67	1000	7.67	0
Roads (0.014)	15.5	4000	0.77	0†	0	100
Mines (0.5)	21.0	4000	38.18	474	4.52	88.2
Total	-	-	46.62	-	13.54*	-

*= projected total includes 10% margin of safety, estimated 12.19 kg/yr+1.35 kg/yr= 13.54 kg/yr
†= target is for mercury-rich sediment, assumes mercury not discharged (encapsulated or similar control)
‡ = Current load estimates as developed in Table 7, Estimated Source Load Calculations

The allocations shown on Table 9 are based upon three criteria:

1. General soils represent an uncontrollable "background" source of mercury loading in the watershed. As such, no reduction is made to their allocated mercury load to the waterways.
2. Roads represent a source where currently unpaved roads allow mercury-rich runoff into waters of Las Tablas Creek and its' tributaries. Mercury loading from this source is prohibited in the Basin Plan unless a specific permit has been issued by the Regional Board. The Regional Board will require that no mercury be discharged because local waters are currently impaired and such a discharge can be readily prevented by paving the road or taking other equivalent action.
3. Mined areas represent a controllable source which has traditionally been regulated under permitting authority of the Regional Board. This TMDL Report serves as justification for revising or updating any existing mine permits in the area. The allocation above (Table 9) represents the upper range of mercury-rich sediment control that appears practicable based on commonly accepted practices as documented in section 8.2.2 below (and on Table 10).

6.0 Linkage Analysis

This TMDL proposes a sediment load derived from NOAA guidance levels for sediment. These sediment levels are believed to be an appropriate starting point for an adaptive management approach to achieve the numeric target water quality objectives (RWQCB, 1998). The targets proposed were selected from the available literature and data regarding mercury in sediments, mercury in the water column, methylmercury, and aquatic impacts of various forms of mercury. It is acknowledged that the literature describing the relationship between sedimentary mercury and fish tissue levels of mercury is still evolving. As new information emerges, it will be considered along with the information indicated in this report. Achievement of TMDL target values and allocations will be evaluated in light of such information should it become available.

Because water quality objectives of the California Toxics Rule (CTR) were developed for the protection of human health, it is anticipated that achieving the CTR objectives in the water column will result in restoration of Lake Nacimiento and Las Tablas Creek to its listed beneficial uses. Fish tissue guidance values (MTRLs) are based on bioconcentration of water column mercury concentrations and so achieving water quality targets are expected to achieve acceptable fish tissue quality.

6.1 Margin of Safety

A margin of safety of 10% has been included in the annual load equation presented in the section titled "Total Maximum Annual Mercury Load for Las Tablas Creek" because of:

- Uncertainty associated with the selection of an appropriate sediment target, and the relationship between sediment targets and water column or fish tissue concentrations;

- Conservative usage of only largemouth bass (no lower trophic levels) fish tissue in evaluation of potential human health exposures
- Uncertainty associated with Regional Board Lake Nacimiento Model calculations (extrapolations of data points to unsampled areas);
- Uncertainty associated with the small area sedimentation rate incorporated into the Estimated Source Load Calculations;
- Conservative estimation of mine area size in the Estimated Source Load Calculations and uncertainty about acid mine drainage; and,
- The existence of other smaller mines currently estimated to contribute less than 5 % of the total mercury load in the drainage area.

7.0 Public Participation

This TMDL will be submitted for public review as part of the Regional Board public hearing process for adoption of this TMDL as a Basin Plan Amendment.

8.0 Implementation

The overall intent of this Implementation Plan is to reduce mercury-rich sediment loading into Lake Nacimiento by reducing such sediment loading in Las Tablas Creek and its tributaries. This Implementation Plan describes existing regulatory controls and cites relevant sections of the California Water Code (CWC) establishing the Regional Board's authority to enforce the provisions set forth in the Implementation Plan. The Plan also describes the way in which the Regional Board will implement the TMDL.

Because the sediment load of the Las Tablas Creek watershed derives primarily from point sources (mines and roads), this Implementation Plan will describe the control of these identifiable sources. The Plan identifies the specific actions that are expected to bring about the reductions in mercury-rich sedimentation specified in the TMDL.

Section 13242 of the CWC requires that a plan of implementation be incorporated into the Basin Plan when the Regional Board adopts TMDLs. The implementation plan must include: 1) a description of the nature of the actions necessary to achieve the water quality objectives, including recommendations for appropriate action by any entity, public or private; 2) a time schedule for the actions to be taken; and 3) a description of the monitoring and surveillance to be undertaken to determine compliance with the objectives. Pursuant to CWC §13141, this implementation plan identifies available means for complying with the TMDL; evaluates the economic impacts of implementation of the TMDL; and identifies potential sources of funding for implementation actions identified herein.

The Basin Plan amendment process has been certified by the Secretary for Resources as "functionally equivalent to," and therefore exempt from, the California Environmental

Quality Act (CEQA) requirement for preparation of an environmental impact report or negative declaration and initial study (CCR Title 14, §15251(g)). However, a CEQA-required Environmental Checklist must be completed and is included in the Basin Plan Amendment package that will be considered for adoption by the Regional Board.

8.1 Implementation Actions – Unpaved Road Areas

8.1.1 Regulatory Mechanism to Achieve Required Actions

The unpaved segment of Cypress Mountain road between Chimney Rock Road and Klau Mine Road will be addressed through the existing regulatory authority of the Regional Board. San Luis Obispo County will be asked to provide to the Regional Board a schedule for eliminating mercury-rich runoff from the specified road segment. In the event that the county fails to either provide the schedule in a timely manner or progress in controlling the discharge in a timely manner, the Regional Board will use its authorities to control discharges of hazardous materials based on this TMDL's identification of the mercury load from roadway runoff. This authority may take the form of a Cleanup and Abatement Order of the California Water Code or other similar action.

8.1.2 Actions Required

San Luis Obispo County will be required to have a schedule for controlling discharge from the segment of Cypress Mountain Road in place within 6 months of State Water Resources Control Board (State Board) adoption of this TMDL. The schedule will need to show that the mercury load will be eliminated within 5 years of State Board adoption of this TMDL. It is assumed in the schedule for achieving this TMDL that the road segment will be paved or equivalent actions to eliminate mercury runoff from the designated section of Cypress Mountain road will be achieved by the end of implementation year 6. It is anticipated that improvements in streambed sediment quality may lag behind such actions. Because the relatively small loading attributed to the roads (less than 1 kg/yr) may not be detectable by itself in sediment samples collected from the streambed (relative to the 34 kg/yr loading reduction to be accomplished from mined areas), the act of paving the roadway (or other equivalent action) will be considered compliance with the requirements of the TMDL.

8.2 Implementation Actions – Mined Areas

The Central Coast Regional Water Quality Control Board (Regional Board) will require implementation of this TMDL in the mined areas by Buena Vista Mines, Inc., the owner of the two mines identified as major sources of mercury loading to Las Tablas Creek.

8.2.1 Regulatory Mechanism to Achieve Required Actions

The Buena Vista and Klau mines are within the permitting authority of the Regional Board in the National Pollutant Discharge Elimination System (NPDES) program or through the issuance of Waste Discharge Requirements (WDRs). Upon adoption of this TMDL, the owner of the mines must apply for either a new NPDES permit or a WDR for the properties (NPDES if the owner seeks a discharge directly to waterways or WDR if to lands near the waters). The permit will then include specific permit conditions to limit the sediment and mercury load runoff from the properties in accordance with the targets set forth in this TMDL.

8.2.2 Actions Required

Several erosion control measures were implemented at the mines as part of US EPA's Emergency Response Action at the site in 2000- 2001. These measures included re-grading of slopes, seeding, and mulching/netting. These are considered equivalent to the Soil Conservation Service (SCS) "urban construction" practices shown on Table 10. The SCS estimates shown on Table 10 indicate that implementing "urban construction" land treatment measures at the mine sites could achieve the needed 88 % reduction of sediment loading to the creek. Although these practices were implemented in 2000-2001 (RWQCB, 2001), the treatment has not been evaluated to verify that discharges have been eliminated, nor have ongoing operation and maintenance measures been planned or implemented to ensure no future discharges will occur. For these reasons, the remaining anticipated actions to reduce mercury loading from the mined areas are:

- plan and propose maintenance, monitoring, and operation of the land management practices implemented by USEPA in 2000-2001,
- submit application for an appropriate permit,
- comply with permit conditions, and,
- implement control practices and discharge requirements.

Although the available data did not allow quantification of acid mine drainage contributions to the mercury load in the creek, it would be prudent for the discharger to assess acid mine drainage contributions of the total mercury load. Control of all mercury load contributions, whether quantified or not, is required as part of the TMDL because the water column targets must be achieved regardless of the form of mercury present.

Table 10. Typical Sediment Reduction Rates from Best Management Practices (BMPs)

Erosion Category		Land Area	BMPs	BMP Reduction
Sheet and Rill and Gullies	**On-Site Measures**	Urban Construction (methods to be applied to surface mined areas)	Mulch, Sediment Fence, Sediment Basin	90%
		Gullies	Shape, Seed, Fertilization, Mulch	60%
All Categories	**Off-Site Measures**	Sediment Basins (changes in land use, meandering pattern alterations, flood area.)	Store Sediment	90%

Source: SCS, 1989, p. 23 and Appendix C.

Permit conditions will require implementation and maintenance of any combination of practices (such as those BMPs listed in Table 10) which will achieve the required 88% reduction in sedimentary mercury load to Las Tablas Creek and its forks and tributaries. It is anticipated that previous USEPA implementation of some of the on-site measures listed in Table 10 will achieve the necessary sediment reduction, however the responsible parties may wish to implement a combination of on-site and off-site measures to ensure compliance with any permits granted.

8.3 Regulatory Activities of Other Agencies

8.3.1 US Environmental Protection Agency – National Priorities List

The National Priorities List, commonly known by the term "Superfund," is a list of sites needing the attention of the US Environmental Protection Agency (US EPA) due to issues of risk to human health or the environment. The US EPA Region IX office is currently considering adoption of the Buena Vista Mines, Inc. properties (Buena Vista and Klau mines) for remediation under this program. Placement of the mine sites on the National Priorities List could result in revision of the implementation and monitoring plan for this TMDL.

8.4 Schedule of Compliance

8.4.1 Mined Areas

Regional Board staff estimate that recent (2000-2001) actions of the USEPA were adequate to achieve the required reductions of mercury rich sediment from the mine sites. However, the proper maintenance and monitoring of these land management practices will need to be implemented as soon as possible. Therefore, the schedule of compliance (as shown on Table 11) has been developed to require proper permitting and associated permit requirements in as short a timeframe as possible.

General local soil runoff (sediment) from those portions of the watershed not mined (i.e., essentially a "background" mercury content) will need sufficient time to deposit in local waterways on top of current mercury rich sediments before monitoring will be able to detect that sediment and water quality conditions are improving. Using very rough estimates of Las Tablas Creek streambed area, staff estimates it will take from 2 to 10 years of mercury-rich sediment control before results will be detectable in creek sediments. This was estimated by calculating a coverage of four inches of new sediment in the stream channel, the previously used 1000 tons of sediment per square mile per year rate, an average sediment density of 1 ton per cubic yard, and an estimated deposition rate of 5 to 15 % of total sediment. Achieving sediment targets in Las Tablas Creek (0.75 miles downstream of North and South Fork confluence) 10 years after adoption of this TMDL has been selected as an appropriate compliance date.

Given the episodic nature of sediment deposition and major storm events, it seems prudent to monitor the site for a sufficiently long period of time to encounter a significant stormwater runoff event. Major storm events are often categorized by typical statistical probabilities of their occurrence in historical records. For example, a "10-year storm" would be a rainfall amount statistically anticipated to occur once every 10 years, on average. Although the exact amount of rainfall involved in specific "storm events" is unknown for the Las Tablas area due to lack of rainfall records, a monitoring period of 25 years can be reasonably anticipated to include a significant rainstorm runoff event. Therefore, a monitoring period of 30 years has been chosen for this TMDL (estimated as at least 5 years to detect improved conditions and an additional 25 years of monitoring to capture a significant rainfall runoff event in the monitoring program). It is also anticipated that reduced mercury loading in Las Tablas Creek will need to occur before an identifiable change in sediment or fish tissue quality will be discernible in Lake Nacimiento, and this is included in the 30 year monitoring period.

8.4.2 Unpaved Roads

The Regional Board will require the County of San Luis Obispo to address the sediment runoff from the identified portion of Cypress Mountain Road under sediment control authorities of the Regional Board. Therefore, a compliance schedule for implementing mercury load reduction from unpaved roadway has been developed as shown in Table 11.

Table 11. Implementation Actions and Compliance Schedule for Lake Nacimiento and Las Tablas Creek TMDL for Metals.

By End of Implementation Year	**Implementation Action (Milestone)**	**Responsible Party or Discharger**	**Monitoring Activity (Responsible party for that monitoring)**	**Numeric Target associated with Load Allocation**
1 (baseline data)	Maintain BV and Klau Mine slope/vegetation, and sediment control measures. Submit complete application for discharge permits	BV Mines, Inc.		
1	Require schedule of Road load elimination	Regional Board	Notify San Luis Obispo County of adoption of TMDL and track response (Regional Board).	
2	Maintain BV and Klau Mine slope/vegetation	BV Mines, Inc.		
2	Review permit application(s) for mined areas Receive County Road load elimination schedule.	Regional Board	Establish discharge permit(s) for mines. If permit application not submitted, Regional Board staff will issue Cleanup and Abatement Order (CAO) or other appropriate regulatory action (Regional Board) If Road load elimination Schedule not received, Regional Board staff will issue CAO or similar regulatory action. (Regional Board)	
3	Maintain BV and Klau Mine slope/vegetation	BV Mines, Inc.	3 Storm Events and twice/year sampling for total mercury in water. Once per year for total mercury in sediment (BV Mines)	Water: Mercury = 0.05 ug/L Sediment: establish baseline data
3	Review progress and data to date	Regional Board	Review data for completeness; adjust sampling program as needed	

By End of Implementation Year	Implementation Action (Milestone)	Responsible Party or Discharger	Monitoring Activity (Responsible party for that monitoring)	Numeric Target associated with Load Allocation
4	Maintain BV and Klau Mine slope/vegetation	BV Mines, Inc.	3 Storm Events and twice/year sampling for total mercury in water. Once per year for total mercury in sediment. (BV Mines)	Water: Mercury = 0.05 ug/L Sediment: confirm baseline data
5	Maintain BV and Klau Mine slope/vegetation Sample Lake Nacimiento conditions	BV Mines, Inc. Regional Board	3 Storm Events and twice/year sampling for total mercury in water. Once per year for total mercury in sediment (may be modified if permits renewed or re-adopted in year 5) (BV Mines) Lake Nacimiento: Total mercury and methylmercury in water, total mercury in sediment and fish tissue (largemouth bass, as a guide) near where Las Tablas Creek enters lake (Regional Board)	Water: Mercury = 0.05 ug/L Sediment: Mercury = 0.486 mg/kg Fish Tissue Guide: < 0.37 mg/kg, or decreasing trend from existing data
5	Perform 5 year review of TMDL and Progress	Regional Board	Review tracked actions; review data of initial program years for trends showing TMDL will be achieved; report and document any changes needed to TMDL or plans (e.g., acid mine drainage control if monitoring data indicates a quantifiable impediment to achieving TMDL) (Regional Board)	

By End of Implementation Year	Implementation Action (Milestone)	Responsible Party or Discharger	Monitoring Activity (Responsible party for that monitoring)	Numeric Target associated with Load Allocation
6	Eliminate load from 3 mile segment of Cypress Mountain Road (between Chimney Rock Road and Klau Mine Road)	SLO County	Per schedule submitted by County or by CAO or other action of Regional Board. (SLO County)	Tracking/ Reporting of completed action (including photo documentation).
6 - 10	Review Monitoring Data	Regional Board	Review data from required Permit monitoring for total mercury in water (Regional Board)	Water: Mercury = 0.05 ug/L;
7 - 10	Maintain load control method for specified segment of Cypress Mountain Road	SLO County	Inspect general operation and perform necessary maintenance of load prevention method. Submit annual letter/report of inspection and any maintenance performed. (SLO County)	Tracking/ Reporting of completed actions.
10	Maintain BV and Klau Mine slope/vegetation Sample Lake Nacimiento conditions	BV Mines, Inc. Regional Board	Regular sampling for total mercury in water; total mercury in sediment (regularity of sampling as specified in permits – e.g., by storm event, quarterly, seasonally, or combination of these) (BV Mines) Lake Nacimiento: Total mercury and methylmercury in water, total mercury in sediment and fish tissue (largemouth bass, as a guide) near where Las Tablas Creek enters lake. (Regional Board)	Water: Mercury = 0.05 ug/L; Sediment: Mercury = 0.486 mg/kg Fish Tissue Guide: < 0.37 mg/kg
11 – 30	Repeat as above with 5 and 10 year milestones and annual permit requirements			

Note: Implementation begins on the date this TMDL is approved by the Office of Administrative Law.

8.5 Demonstrating Compliance

8.5.1 Measures of Success

The primary measure of success for implementation of this TMDL is attainment of the numeric targets which represent or indicate the load allocations, and restoration of the listed beneficial uses for the waters. A secondary measure of success for this TMDL will be tracking the implementation of the required actions identified in this TMDL.

Because it will be several years before we are able to evaluate the effectiveness of implementation using sediment target concentrations, the initial phase of implementation will emphasize the ongoing maintenance and reporting activities required of the responsible party and implementing agency. Thus, reporting requirements will provide an initial demonstration of compliance until monitoring data collected at intervals of 5 and 10 years after implementation of the TMDL will be available. A complete description of compliance monitoring is presented in the section titled "Monitoring Plan."

In assessing the status of compliance, Regional Board staff will consider the degree to which the responsible party has implemented, or is implementing and maintaining, sediment control measures. Through scheduled reporting required by the NPDES Permits or WDRs, responsible parties will provide the necessary information upon which staff will make the determination of compliance. Regional Board staff will review these submittals for compliance with the TMDL every year for the first 5 years and at least every 5 years thereafter.

8.5.2 Failure Scenarios

There are two "failure scenarios" in which implementation of the TMDL would be considered unsuccessful and Regional Board action would be required. The first scenario is a failure to achieve the numeric targets and corresponding load reductions while at the same time completing required implementation actions. Regional Board staff recognizes this outcome is a possibility, based on past occurrences of uncontrollable natural disturbances, such as major floods and catastrophic wildland fires. Under this failure scenario, the Regional Board's action would be to re-evaluate the numeric targets and implementation actions and to adjust them as necessary. Staff will consider information provided by responsible parties, including effectiveness monitoring data.

The second failure scenario is the failure of one or more of the responsible parties to perform its obligations under this TMDL. Regional Board staff recognizes this outcome is a possibility based on past litigation with BV Mines, Inc. Under this failure scenario, the Regional Board will consider the range of actions open to respond to such a failure, consider USEPA's potential actions at the site under the "Superfund" program, or other enforcement actions and penalties against the responsible party.

8.6 Compliance Assurance and Enforcement

As provided in the State Board's Water Quality Enforcement Policy, prompt, consistent, predictable, and fair enforcement are necessary to deter and correct violations of water quality standards, violations of the California Water Code, and to ensure that responsible dischargers carry out their responsibilities for meeting the TMDL allocations. This and progressive enforcement are particularly necessary to adequately deal with those responsible dischargers who fail to implement appropriate sediment control measures.

If the Regional Board were to find that significant discharges or threatened discharges of sediment occur despite the implementation of required implementation actions, it would consider the need to revise the actions and would consider the issuance of a Cleanup and Abatement Order (CAO) or other enforcement action to address the discharge.

8.7 Cost

The implementation activities have costs associated with them. The first activity is the required elimination of loads from local mercury-rich road surfaces. Based on recent indications that the county is anticipating paving the road as a method of encapsulating the mercury and preventing mercury-rich runoff, an evaluation of the cost associated with this method is presented here. Final selection of method of compliance rests with the county. Based on recent bid prices on locally delivered asphalt pavement (Walter, 2002), and an estimated 3 miles of existing two lane roads needing pavement, pavement costs (exclusive of the county's labor) to achieve the 100% "roads" load reduction is estimated to be approximately $980,000.

The second implementation activity is the installation and maintenance of erosion control land use practices on the BV Mines properties and monitoring activities to be added to discharge permits for the mines. Because the US EPA has already implemented those practices anticipated to achieve the 88% reduction in mined-area sediment, no effort has been made to estimate these costs. Although operation and maintenance costs can be highly variable and dependent upon a property owner's ongoing activities, the potential costs associated with ongoing maintenance of a one mile long vegetative buffer corridor are estimated as the implementation cost for the mines. Monitoring costs have been estimated for collection and analysis of the specific compliance samples (mercury and sediment grain size analyses) required in this TMDL beyond whatever monitoring might normally be required for the WDR or NPDES permit. The projected costs of implementing and maintaining the required actions are shown in Table 12.

Table 12. Estimated Costs.

Required Action	Estimated Cost (one time)	Estimated Cost (annual)
Pave road segment (1.5 mi.)	$980,000*	--
Maintain mine area Land Management practices	--†	$800‡
Monitor Mine (TMDL required samples only)	--	$700☼

* = Pavement Material Costs estimated for 30 foot wide road, 6-inch thickness (17820 tons @ $55/ton, per Walter, 2002) based on existing roadbed and grading.
‡ = 1 mile of vegetation corridor summertime irrigation (mine area) based on costs projected by Ketcham (2002).
† = No cost to implement as it is anticipated that USEPA has already implemented actions necessary to achieve required sediment reductions.

☼ = costs estimated as 5 water samples/year for mercury @ $100/sample, and 1/5 sediment sample per year (1 sample/5 years) for mercury and grain-size @ $100/yr/sample and $100/year for reporting

9.0 Monitoring Plan

The primary measures of success for implementation of this TMDL are attainment of the numeric targets, which represent or indicate corresponding load allocations. The proposed monitoring is discussed below and summarized on Table 13.

9.1 Coordination

Water quality monitoring will be performed by Regional Board staff and by responsible parties identified in this Monitoring Plan. This Monitoring Plan identifies the frequency, location, protocols and responsible parties for each water quality parameter being evaluated.

9.2 Monitoring Numeric Targets

The waters of Las Tablas Creek will need to be monitored for total mercury and Lake Nacimiento will need to be monitored for total mercury and methylmercury in order to see that numeric targets are being reached. In addition, bottom surface sediments of the creekbed (Las Tablas Creek) and lake bottom (Las Tablas arm of Lake Nacimiento) will need to be sampled and analyzed for mercury content to compare with the sediment concentration target set forth in this TMDL and grain size to develop better understanding of mercury transport for the adaptive management approach. This monitoring may be performed by the Regional Board, the responsible parties, or others either voluntarily or as requirements of a discharge permit. Discharge permits may also require monitoring of other constituents or locations.

An efficient focus area to monitor water quality objectives for Lake Nacimiento is where Las Tablas Creek enters the lake. Because of the presence of a small catchment basin, referred to as Harcourt dam, on private land near the point where the creek enters the lake, the point chosen for monitoring sediment target attainment on Las Tablas Creek is upstream of the waters behind Harcourt dam. The sampling point for monitoring target attainment will be on Las Tablas Creek approximately 0.75 mile downstream of the confluence of the North and South Forks of the creek. The monitoring point for water column targets will also be at this same location, just downstream of the confluence of the North and South Forks of Las Tablas Creek. An additional water column sampling point in Lake Nacimiento near the point where Las Tablas Creek enters the lake is also appropriate to confirm attainment of water column targets in the lake.

Locations selected for monitoring the progress of this TMDL are:

- Las Tablas Creek, approximately 0.75 mile downstream of the confluence of the North and South Forks
- Lake Nacimiento, in the general vicinity as sample BV-NR 5 of USEPA, 2001

It is anticipated that it will take several years of proper maintenance of improved land use practices before off-site sediment sampling will be able to indicate that conditions are improving and numeric targets are being achieved or approached. The permit(s) established to control sediment runoff and mercury loads from the mined areas will also include monitoring requirements tailored to the episodic nature of sediment runoff. This TMDL proposes that monitoring 3 "storm events" per year and then collecting one "wet season" (December - March) and one "dry season" (May – October) sample for years three through five of TMDL implementation is appropriate to develop an adequate database to understand variations in sediment runoff pertinent to this TMDL.

Future fish sampling conducted in Lake Nacimiento as part of California's Toxic Substances Monitoring Program will be used to confirm restoration of listed beneficial uses. Largemouth Bass or other trophic level four fish will be used for all fish tissue monitoring.

Table 13. Proposed Chemical Monitoring Activities

Parameter	Numeric Target	Sampling Frequency	Responsible Party	Protocol
Las Tablas Creek, approx. 0.75 mile downstream of North & South Fork confluence				
Total Mercury	0.05 ug/L	3 storm events and twice/year †	Buena Vista Mines	Board approved QAPP*
Mercury in Sediment (with grain size analysis)	0.486 mg/kg	Once each 5 years†	Buena Vista Mines	Board approved QAPP*
Lake Nacimiento, general vicinity of sample BV-NR-5 of USEPA (2001)				
Total mercury and methylmercury in water	0.05 ug/L (total)	Once each 5 yrs	Regional Board	Monitoring Program
Mercury in Sediment (with grain size analysis)	0.486 mg/kg	Once each 5 years	Regional Board	Monitoring Program
Mercury in Fish Tissue – Largemouth Bass	<0.37mg/kg	Once each 5 yrs as a guide to conditions.	SWRCB	TSM Program

† =Sampling will need to include 3 storm events and be twice per year for first three years until a baseline database is established. After two years of data are available, Regional Board staff will evaluate the data and consider possible relaxation to other sampling frequencies or combinations.

* = Discharger will need to submit a detailed quality assurance program regarding sample collection timing, collection methods, sample handling, transport, and analysis by state certified laboratory for Board approval as part of Permit. Permits will also allow the Board the right to collect independent samples or split samples as the Board may choose. Timeframes start with approval of TMDL.

9.3 Tracking Implementation Actions

Tracking Implementation Actions will be done by regular reporting of responsible parties submitted to the Regional Board and inspection visits by Regional Board staff to confirm proper operation and maintenance of implemented actions. These actions include:

- Control of 100% of mercury loading runoff from Cypress Mountain Road between Klau Mine Road and Chimney Rock Road
- Operation and Maintenance of grading and vegetation established at Buena Vista Mines, Inc. properties by US EPA's Emergency Response Actions in 2000- 2001
- Implementation and maintenance of any additional actions selected by responsible discharger or required as part of follow-up inspections of TMDL implementation (for example, sediment basins if needed).

10.0 References Cited

Angelo, Mark, 2001. Personal Communication, titled "Region 3 Sediment Data Summary" including sediment data from USGS Gage # 11148800, Nacimiento River near Bryson, CA

Bigley, Daniel G., 1994. Mercury Concentrations in the Las Tablas Watershed, San LuisObispo County, California. Masters Thesis, California Polytechnic State University, San Luis Obispo.

Buchman, M.F., 1999. NOAA Screening Quick Reference Tables, NOAA Hazmat Report 99-1, Seattle, WA. Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages.

California, 2001. California Geospatial Information Library. California Watersheds (Calwater 2.2) Meta File, datasets digitized from USGS 1:24000 Quad Maps by J. Kellogg and staff (Tierra Data Systems), updated Sept. 28, 1999. State Contact: Steve Flatt, CGIL Documentation updated 3/5/2001, metadata file obtained from CGIL website on 9/26/01, http://www.gis.ca.gov/

Chipping, David, 2001. Letter to Douglas Gouzie, Regional Water Quality Control Board, dated 9/6/01 from David Chipping, California Polytechnic State University, San Luis Obispo, CA.

Chorley, Richard J., Schumm, Stanley A., and Sugden, David E., 1984. Geomorphology. Methuen & Co., Ltd., London, 1984.

Federal Register, 2000. Federal Register, Thursday May 18, 2000. Part III Environmental Protection Agency, 40 CFR Part 131, Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. p. 31682 – 31719.

Ketcham, G., 2002. Gary Ketcham, Farm Supervisor III. Farm Operations Cal Poly, San Luis Obispo. Personal Communication with D. Gouzie, Regional Board staff.

Knott, J.M., 1976. Sediment Discharge in the Upper Arroyo Grande and Santa Rita Creek Basins, San Luis Obispo County, California. US Geological Survey, Report of Water Resources Investigation, WRI 76-64, June 1976.

Krabbenhoft, David P., Wiener, James G., Brumbaugh, William G., Olson, Mark L., DeWild, John F., and Sabin, Ty J., 1999. A National Pilot Study of Mercury Contamination of Aquatic Ecosystems along Multiple Gradients (abstract), in Proceedings of the Technical Meeting, Charleston, South Carolina, March 8-12, 1999, volume 2 of 3, Contamination of Hydrologic Systems and Related Ecosystems, Water Resources Investigation Report 99-4018B, US Geological Survey, 1999.

Rasmussen, Del, and Blethrow, Heidi, 1990. Toxic Substances Monitoring Program, Ten Year Summary Report, 1978 – 1987. California State Water Resources Control Board, Publication #90-1WQ, August, 1990.

Rasmussen, Del, 2000. State Mussel Watch Program, 1995- 1997 Data Report. California State Water Resources Control Board, September 2000.

Rice, Thomas J., Chipping, David H., Eatough, Norman L., Nakamura, Royden, and Bigley, Daniel, 1994. Clean Lakes Assistance Program for Lake Nacimiento. Coastal Resources Institute, California Polytechnic State University, San Luis Obispo, April, 1994.

Ritter, Dale F., 1986. Process Geomorphology, 2nd Edition. William C. Brown Publishers, Dubuque, Iowa, 1986.

RWQCB, 1993. Regional Water Quality Control Board, Central Coast Region. Surface Water Degradation by Inactive Metal Mines in Northwest San Luis Obispo County, California. December 1993.

RWQCB, 1994 a. Regional Water Quality Control Board, Central Coast Region. Water Quality Control Plan (Basin Plan). September 8, 1994.

RWQCB, 1994 b. Regional Water Quality Control Board, Central Coast Region. Correspondence dated April 22, 1994 addressed to George B. Rowland, MD, San Luis Obispo County Health Department.

RWQCB, 1998. Regional Water Quality Control Board, Central Coast Region. Chemical and Biological Measures of Sediment Quality in the Central Coast Region, Final Report. New Series Report No. 5, October 1998.

RWQCB, 1999. Regional Water Quality Control Board, Central Coast Region. Inactive Metal Mines in Four San Luis Obispo County Watersheds, Surface Water Quality Impacts and Remedial Options. June 1999.

RWQCB, 2001. Regional Water Quality Control Board, Central Coast Region. Staff Report for Regular Meeting of February 1-2, 2001. Item 20, Status Report – Remediation Project at the Buena Vista and Klau Mines. Prepared January 3, 2001.

San Luis Obispo County Convention and Visitors Bureau, 2002. Website of Travel Tips, San Luis Obispo County. Downloaded from: www.sanluisobispocounty.com/traveltips.asp Accessed on September 24, 2002.

Scott, Kevin M., and Williams, Rhea P., 1974. Erosion and Sediment Yields in Mountain Watersheds of the Transverse Ranges, Ventura and Los Angeles Counties, California – Analysis of Rates and Processes. US Geological Survey, Report of Water Resources Investigation, WRI 47-73, June 1974.

SCS, 1989. U.S. Department of Agriculture, Soil Conservation Service. Enhancement Plan Morro Bay Watershed. 1989.

Tetra-Tech, Inc., 1999. Total Maximum Daily Load and Implementation Plan for Mercury, Arivaca Lake, Arizona. October 15, 1999.

US EPA, 1997. Letter from U.S. Environmental Protection Agency, Region IX, to Mr. Harold J. Biaggini, President, Buena Vista Mines, Inc. Letter Referenced to Gerald Klug, Mail Code: WTR-7, dated Feb. 6, 1997 and enclosing "Finding of Violation and Order."

USEPA, 2001. Buena Vista/Klau Mercury Mines Preliminary Assessment/ Site Inspection Report. Prepared by Ecology and Environment for USEPA Region 9. October 26, 2001.

Walter, Jay, 2002. Personal Communication on recent “concrete asphalt” bid prices from Mr. Walter, City Engineer, City of San Luis Obispo to Doug Gouzie, RWQCB, April 9, 2002.

Whyte, Dyan C., and Kirchner, James W., 2000. Assessing water quality impacts and cleanup effectiveness in streams dominated by episodic mercury discharges, in The Science of the Total Environment, v 260, p 1- 9. Elsevier Science, 2000.

Wiener, James, and Krabbenhoft, David, 1999. Methylmercury in Aquatic Food Webs: Consequences and Management Challenges (abstract), in Proceedings of the Technical Meeting, Charleston, South Carolina, March 8-12, 1999, volume 2 of 3, Contamination of Hydrologic Systems and Related Ecosystems, Water Resources Investigation Report 99-4018B, US Geological Survey, 1999.

Appendix A – Regional Board Model

RWQCB 2001 Lake Nacimiento Loading Model – Overview

Method:
Multiple model runs to test sensitivity to allocations of load from available data where multiple mercury content sample points available (i.e., mainstem of Nacimiento River, Tobacco Creek, and Las Tablas Creek from confluence of forks to Harcourt reservoir).

Of 10 total test runs, Las Tablas Creek tributary to Lake ranged from 77.52 to 92.80% of total mercury load to Lake Nacimiento.

Four runs considered to most equitably treat the areas with multiple data points were:

Run 3: % of lake total load
Nacimiento Riv. represented with sample closest to lake (0.018 mg/kg) =5.47
Las Tablas Crk represented by sample closest to lake (Harcourt spillway, 1.55 mg/kg) =88.36

Run 6: % of lake total load
Nacimiento Riv. represented by average of 11 mainstem samples (0.012 mg/kg) =2.41
Las Tablas Crk represented by average of 6 mainstem samples (2.46 mg/kg)
(samples from confluence of forks to Harcourt reservoir) =92.75

Run 8: % of lake total load
Nacimiento Riv. represented by highest sample point on mainstem
(highest data value of 11 sampling points, 0.052 mg/kg) = 5.09
Las Tablas Creek represented by highest sample point on "mainstem"
(highest data value of 6 points from confluence to Harcourt reservoir, 5 mg/kg) =91.75

Run 10: % of lake total load
Nacimiento Riv. represented with mainstem geometric mean
(0.005 mg/kg) of all 11 samples = 1.56
Las Tablas Creek used Harcourt spillway sample (1.55 mg/kg) as "best average" =90.91

Taken together, these results indicate Las Tablas Creek drainage inputs an estimated 88 to 93 percent of total mercury load from sediment reaching Lake Nacimiento.

"Run 3" where drainage area mercury contents were represented by most downstream sample data point is considered the best representations of actual long-term conditions and is used for project calculations.

Regional Board Model – Lake Nacimiento Mercury Loading - Run 1

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)

Sample calculation: (for mainstem area)

(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.035 mg Hg/kg sed.*1 kg/1000000mg)= 5.202 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.035[a]	5.202	10.12%
Western sub-area					
Tobacco Creek	11.6	1000	0.052	0.548	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			2.239	4.36%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	1.55[b]	25.81	
Lower Las Tablas Creek	12.33	1000	1.55[b]	17.37	
Sub-area total:	30.65			43.18	84.02%
Dip Creek	8.77	1000	0.018	0.144	0.28%
Snake Creek	17.47	1000	0.018	0.286	0.56%
Pebblestone	9.02	1000	0.042	0.344	0.67%
Total	315.98			51.395	100.01%[c]

a= average of two most downstream samples above the lake
b= sample from Harcourt dam spillway
c=does not add up to 100.00% due to rounding

Regional Board Model – Lake Nacimiento Mercury Loading - Run 2

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.012 mg Hg/kg sed.*1 kg/1000000mg)= 1.783 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.012[a]	1.783	3.67%
Western sub-area					
Tobacco Creek	11.6	1000	0.105	1.107	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			2.798	5.76%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	1.55[b]	25.81	
Lower Las Tablas Creek	12.33	1000	1.55[b]	17.37	
Sub-area total:	30.65			43.18	88.97%
Dip Creek	8.77	1000	0.018	0.144	0.30%
Snake Creek	17.47	1000	0.018	0.286	0.59%
Pebblestone	9.02	1000	0.042	0.344	0.71%
Total	315.98			48.535	100.00%

a= average of 11 samples on mainstem above the lake
b= sample from Harcourt dam spillway

Regional Board Model – Lake Nacimiento Mercury Loading - Run 3 –(Preferred)

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.018 mg Hg/kg sed.*1 kg/1000000mg)= 2.675 kg Hg/yr

Sub-area name	**Area (sq.mi.)**	**Sediment Load (tons/sqmi/yr)**	**Mercury Concentration (mg/kg)**	**Mercury Load (kg/yr)**	**Percent of Total Load**
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.018[a]	2.675	5.47%
Western sub-area					
Tobacco Creek	11.6	1000	0.052	0.548	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			2.239	4.58%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	1.55[b]	25.81	
Lower Las Tablas Creek	12.33	1000	1.55[b]	17.37	
Sub-area total:	30.65			43.18	88.36%
Dip Creek	8.77	1000	0.018	0.144	0.29%
Snake Creek	17.47	1000	0.018	0.286	0.59%
Pebblestone	9.02	1000	0.042	0.344	0.70%
Total	315.98			48.868	99.99%[c]

a= southernmost sample on mainstem river above the lake
b= sample from Harcourt dam spillway
c= not 100.00 % due to rounding

Regional Board Model – Lake Nacimiento Mercury Loading - Run 4

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.052 mg Hg/kg sed.*1 kg/1000000mg)= 7.728 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.052[a]	7.728	13.87%
Western sub-area					
Tobacco Creek	11.6	1000	0.221[a]	2.331	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			4.022	7.22%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	1.55[b]	25.81	
Lower Las Tablas Creek	12.33	1000	1.55[b]	17.37	
Sub-area total:	30.65			43.18	77.52%
Dip Creek	8.77	1000	0.018	0.144	0.26%
Snake Creek	17.47	1000	0.018	0.286	0.51%
Pebblestone	9.02	1000	0.042	0.344	0.62%
Total	315.98			55.704	100.00%

a= highest sample on mainstem river above the lake, and on Tobacco Creek
b= sample from Harcourt dam spillway

Regional Board Model – Lake Nacimiento Mercury Loading - Run 5

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.052 mg Hg/kg sed.*1 kg/1000000mg)= 7.728 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.052[a]	7.728	9.53%
Western sub-area					
Tobacco Creek	11.6	1000	0.221[a]	2.331	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			4.022	4.96%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	2.46[b]	40.97	
Lower Las Tablas Creek	12.33	1000	2.46[b]	27.57	
Sub-area total:	30.65			68.54	84.55%
Dip Creek	8.77	1000	0.018	0.144	0.18%
Snake Creek	17.47	1000	0.018	0.286	0.35%
Pebblestone	9.02	1000	0.042	0.344	0.42%
Total	315.98			81.064	99.99%[c]

a= highest sample value from mainstem river above the lake, and on Tobacco Creek
b= average of 6 samples upstream of Harcourt reservoir (data from Table 4-3, p.82, Rice et al, 1994)
c= percents do not add to exactly 100.00% due to rounding

Regional Board Model – Lake Nacimiento Mercury Loading - Run 6

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.012 mg Hg/kg sed.*1 kg/1000000mg)= 1.783 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.012[a]	1.783	2.41%
Western sub-area					
Tobacco Creek	11.6	1000	0.105[a]	1.107	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			2.798	3.79%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	2.46[b]	40.97	
Lower Las Tablas Creek	12.33	1000	2.46[b]	27.57	
Sub-area total:	30.65			68.54	92.75%
Dip Creek	8.77	1000	0.018	0.144	0.19%
Snake Creek	17.47	1000	0.018	0.286	0.39%
Pebblestone	9.02	1000	0.042	0.344	0.47%
Total	315.98			73.895	100.00%

a= average of 11 samples from mainstem river above the lake, average of 3 samples on Tobacco Creek
b= average of 6 samples upstream of Harcourt reservoir (data from Table 4-3, p.82, Rice et al, 1994)

Regional Board Model – Lake Nacimiento Mercury Loading - Run 7

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.052 mg Hg/kg sed.*1 kg/1000000mg)= 7.728 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.052[a]	7.728	5.13%
Western sub-area					
Tobacco Creek	11.6	1000	0.105	1.107	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			2.798	1.86%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	5[b]	83.27	
Lower Las Tablas Creek	12.33	1000	5[b]	56.05	
Sub-area total:	30.65			139.32	92.50%
Dip Creek	8.77	1000	0.018	0.144	0.10%
Snake Creek	17.47	1000	0.018	0.286	0.19%
Pebblestone	9.02	1000	0.042	0.344	0.23%
Total	315.98			150.62	100.01%[c]

a= highest sample value from mainstem river above the lake; average of 3 samples for Tobacco Creek
b= highest of 6 samples upstream of Harcourt reservoir (data from Table 4-3, p.82, Rice et al, 1994)
c= percents do not add to exactly 100.00% due to rounding

Regional Board Model – Lake Nacimiento Mercury Loading - Run 8

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.052 mg Hg/kg sed.*1 kg/1000000mg)= 7.728 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.052[a]	7.728	5.09%
Western sub-area					
Tobacco Creek	11.6	1000	0.221[a]	2.331	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			4.022	2.65%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	5[b]	83.27	
Lower Las Tablas Creek	12.33	1000	5[b]	56.05	
Sub-area total:	30.65			139.32	91.75%
Dip Creek	8.77	1000	0.018	0.144	0.09%
Snake Creek	17.47	1000	0.018	0.286	0.19%
Pebblestone	9.02	1000	0.042	0.344	0.23%
Total	315.98			151.844	100.00%

a= highest sample value from mainstem river above the lake, and on Tobacco Creek
b= highest of 6 samples upstream of Harcourt reservoir (data from Table 4-3, p.82, Rice et al, 1994)

Regional Board Model – Lake Nacimiento Mercury Loading - Run 9

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.005 mg Hg/kg sed.*1 kg/1000000mg)= 0.743 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.005[a]	0.743	1.60%
Western sub-area					
Tobacco Creek	11.6	1000	0.052[a]	0.548	
Little Burnett Creek	10.99	1000	0.045	0.045	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			1.834	3.94%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	1.55[b]	25.81	
Lower Las Tablas Creek	12.33	1000	1.55[b]	17.37	
Sub-area total:	30.65			43.18	92.80%
Dip Creek	8.77	1000	0.018	0.144	0.31%
Snake Creek	17.47	1000	0.018	0.286	0.61%
Pebblestone	9.02	1000	0.042	0.344	0.74%
Total	315.98			46.531	100.00%

a= geometric mean of 11 samples on mainstem river above the lake, lowermost sample on Tobacco Creek
b= sample from Harcourt dam spillway

Regional Board Model – Lake Nacimiento Mercury Loading - Run 10

Loading estimated by using sub-area basins from Cal-Water 2.2 GIS and chemical sample data from Rice et al (1994)
Sample calculation: (for mainstem area)
(163.48 sqmi *1000 tons sed/sqmi/yr*2000 lbs/ton *1 kg sed/ 2.2 lbs*0.012 mg Hg/kg sed.*1 kg/1000000mg)= 1.783 kg Hg/yr

Sub-area name	Area (sq.mi.)	Sediment Load (tons/sqmi/yr)	Mercury Concentration (mg/kg)	Mercury Load (kg/yr)	Percent of Total Load
Nacimiento River – mainstem sub-area:					
Carrals Spring	17.71				
Slickrock Creek	11.25				
Stony Creek	14.01				
San Miguel Creek	15.45				
Upper Los Berros Creek	8.73				
N. Fork Los Berros Creek	6.8				
San Miguelitos Ranch	9.42				
Gabilan Creek	9.55				
Los Bueves Creek	5.18				
Lower Los Burros Creek	7.94				
Oak Flat	7.51				
Waller Creek	8.51				
Mesa Coyote	7.92				
Pozo Hondo Creek	11.66				
Turtle Creek	13.46				
Gulch House Creek	8.38				
Sub-area total:	163.48	1000	0.005[a]	0.743	1.56%
Western sub-area					
Tobacco Creek	11.6	1000	0.105[a]	1.107	
Little Burnett Creek	10.99	1000	0.045	0.45	
Gould Creek	5.64	1000	0.025	0.128	
Town Creek	13.32	1000	0.018	0.218	
S. Shore Lake Nacimiento	9.93	1000	0.018	0.162	
Franklin Creek	14.67	1000	0.04	0.53	
Asbury Creek	11.45	1000	0.003	0.031	
Kavanaugh Creek	8.99	1000	0.021	0.172	
Sub-area total:	86.59			2.798	5.89%
Las Tablas sub-area:					
Upper Las Tablas Creek	18.32	1000	1.55[b]	25.81	
Lower Las Tablas Creek	12.33	1000	1.55[b]	17.37	
Sub-area total:	30.65			43.18	90.91%
Dip Creek	8.77	1000	0.018	0.144	0.30%
Snake Creek	17.47	1000	0.018	0.286	0.60%
Pebblestone	9.02	1000	0.042	0.344	0.72%
Total	315.98			47.495	99.98%[c]

a= geometric mean of 11 samples on mainstem above the lake; average of 3 samples on Tobacco Creek
b= sample from Harcourt dam spillway
c= does not equal 100.00% due to rounding

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