Appendix C

Staff Report

Mercury in San Francisco Bay

Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives

California Regional Water Quality Control Board
San Francisco Bay Region

August 1, 2006

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I. Introduction

On September 15, 2004, the San Francisco Bay Regional Water Quality Control Board (Water Board) adopted Resolution No. R2-2004-0082 amending the *Water Quality Control Plan, San Francisco Bay Region* (Basin Plan) to establish a mercury TMDL and implementation plan for San Francisco Bay (the "Mercury TMDL Amendment"). On September 7, 2005, after a series of workshops and consideration of comments from numerous stakeholders, the State Water Resources Control Board (State Board) adopted Resolution No. 2005-0060 ("Remand Order") remanding the Mercury TMDL Amendment to the Water Board for further consideration.

In its Remand Order, the State Board requested specific revisions to the TMDL and associated implementation plan designed to:

- Accelerate achievement of water quality objectives for mercury in the Bay;
- Be more protective of fish and other wildlife;
- Ensure the maximum practical pollution prevention by municipal and industrial waste water dischargers; and
- More clearly incorporate risk reduction measures addressing public health impacts on subsistence fishers and their families.

In response to the remand, the Water Board has revisited the Mercury TMDL Amendment and proposes revisions as set forth in the attached proposed Basin Plan Amendment (Appendix A) and explained in this Staff Report.

1. Project Description

The Project consists of the following changes to the Mercury TMDL Amendment:

1) Establish two numeric mercury water quality objectives for all segments of San Francisco Bay
    - To protect people who consume Bay fish (applies to larger fish consumed by humans): 0.2 mg mercury per kg fish tissue (average wet weight concentration, measured in edible portions (muscle tissue) of trophic level 3 and trophic level 4 fish)
    - To protect aquatic organisms and wildlife (applies to small fish consumed by birds): 0.03 mg mercury per kg fish (average wet weight concentration measured in whole fish 3–5 cm in length)
2) Vacate (i.e. remove) the water column four-day average mercury water quality objective for San Francisco Bay
3) Clarify TMDL targets as follows, in line with objectives stated above:
    - "To protect sport fishing and human health, the average mercury concentration in 60-cm striped bass muscle tissue shall not exceed 0.2 mg mercury per kg fish tissue (wet weight)."

- "To protect aquatic organisms and wildlife, the concentration of mercury shall not exceed 0.03 ppm, wet weight average, in whole fish 3–5 cm in length."
- The bird-egg target is a monitoring target.

4) Revise wasteload allocations and the implementation plan for wastewater sources, including:
   - Clarify the pollution prevention requirements for municipal wastewater
   - Establish more stringent wasteload allocations for municipal wastewater dischargers, to be implemented via individual mass limits and aggregate mass limits and incorporating ten-year interim and twenty-year final implementation schedules
   - Correct the wasteload allocations for industrial wastewater
   - Impose more stringent application of compliance triggers for both industrial and municipal wastewater
   - Require municipal and industrial wastewater and urban stormwater to conduct methylmercury monitoring
5) Add a statement to the dredging section of the Mercury TMDL Amendment clarifying the Water Board's intent that all dredging activities in the Bay comply with the Long Term Management Strategy.
6) Expand risk management activities to include investigation of ways to address public health impacts of mercury on people and communities most likely to be affected by mercury in San Francisco Bay-Delta caught fish, such as subsistence fishers and their families

2. Response to the Remand

In response to the State Board's Remand Order, Water Board staff has prepared a revised Mercury TMDL Amendment. This section summarizes the Remand Order's "Resolveds" and the Water Board's modifications to each.

Resolved 1: Reconsider the TMDL

Remands the amendment to the Basin Plan to incorporate a TMDL for mercury in San Francisco Bay adopted under San Francisco Bay Water Board Resolution No. R2-2004-0082 as corrected by the Executive Officer (Attachment 2) for further consideration consistent with this resolution.

The revised Mercury TMDL Amendment (Appendix A) is consistent with State Board Resolution No. 2005–0060.

Resolved 2: Pollution Prevention (P2)

Directs the San Francisco Bay Water Board to evaluate effective pollution prevention practices used in other states and the pollution prevention or other appropriate programs

of each San Francisco Bay discharger, and their potential effectiveness in reducing mercury in their discharges. The San Francisco Bay Water Board shall revise the TMDL to incorporate requirements for appropriate programs and practices into the TMDL, and require all dischargers to aggressively implement appropriate pollution avoidance practices that are most effective at eliminating or reducing mercury concentrations in their effluent.

The revisions to the San Francisco Bay mercury TMDL incorporated into the proposed Basin Plan Amendment (Appendix A) include reduced municipal wastewater wasteload allocations to reflect pollution prevention actions, and new requirements to implement pollution prevention practices. It is anticipated that aggressive implementation of mercury pollution prevention programs will be necessary in the first 10 years to achieve the interim allocations.

Resolved 3: Individual Wasteload Allocations

Directs the San Francisco Bay Water Board to evaluate and consider the effectiveness of any existing wastewater treatment technology that enhances the removal of mercury. The San Francisco Bay Water Board shall revise the TMDL to establish individual wasteload allocations, after reconsidering the appropriateness of the policy assumptions used by the Regional Water Board to derive the original wasteload allocations. In establishing such wasteload allocations, the San Francisco Bay Water Board shall incorporate provisions that acknowledge the efforts of those point sources whose effluent quality demonstrates good performance, and require improvement by other dischargers.

Revisions to the Mercury TMDL Amendment include a 40 percent reduction in municipal wastewater wasteload allocations. These reductions acknowledge good performance by dischargers already employing advanced treatment technologies by proposing a 20 percent reduction. No reduction is proposed if the loading is less than 0.1 kg/year. No reduction is proposed for industrial wastewater allocations; however revisions include new reporting requirements for these entities that will allow them to confirm that their performance is above average for the U.S. If industrial wastewater dischargers are not achieving above-average performance, the Water Board will consider reducing the load allocation at the next review cycle for this TMDL. Individual wastewater wasteload allocations are provided in Tables 4-v through 4-z in the revised Mercury TMDL Amendment.

Resolved 4: Stay within Regulatory Authority

In carrying out the requirements of this resolution, the Regional Water Board shall comply with the requirements of CWC section 13360 regarding specifying the manner of compliance with Regional Water Board orders.

The Water Code section referenced in the Order reads as follows:

> CWC ARTICLE 6. GENERAL PROVISIONS RELATING TO ENFORCEMENT AND REVIEW
>
> § 13360. Manner of compliance

> (a) No waste discharge requirement or other order of a regional board or the state board or decree of a court issued under this division shall specify the design, location, type of construction, or particular manner in which compliance may be had with that requirement, order, or decree, and the person so ordered shall be permitted to comply with the order in any lawful manner. However, the restrictions of this section shall not apply to waste discharge requirements or orders or decrees with respect to any of the following:

The revised Mercury TMDL Amendment adheres to the above requirements regarding specifying the manner of compliance.

Resolved 5: Methylmercury Monitoring

Directs the San Francisco Bay Water Board to revise the TMDL to require inclusion in the next round of NPDES permits or in the watershed NPDES permits monitoring for, and determination of the relative proportion of, methylmercury in effluent discharges.

Revisions to the mercury TMDL include such methylmercury monitoring requirements.

Resolved 6: Dredging

Directs the San Francisco Bay Water Board to ensure that in-Bay disposal of dredged material containing mercury complies with the requirements of the Long Term Management Strategy Plan (LTMS).

Revisions to the Mercury TMDL Amendment include a clarifying statement that is consistent with the Remand Order.

Resolved 7: Watershed Legacy Mercury Inventory

Directs the San Francisco Bay and Central Valley Water Boards to create a watershed legacy mercury inventory and establish a priority list for addressing these sources. The Water Boards shall also propose potential methods or strategies to remediate priority sources.

Water Board staff is reviewing existing inventories of mercury mine sites and Bay margin cleanup sites, and will set priorities and revise current efforts or initiate efforts accordingly, consistent with our existing Mine and Mineral Producers Program, and site cleanup efforts.

Resolved 8: Pollutant Offset Policy

Directs State Water Board staff to develop a State policy for water quality control that establishes alternative methods to allow dischargers to meet mercury effluent limitations that are directed to preventing contributions to excursions above water quality standards. The policy shall allow dischargers to perform other activities aside from eliminating more mercury from their discharges than they would be required to remove by applicable technology-based effluent limitations. This policy shall require more rigorous activities for:

(a) dischargers not in compliance with their wasteload allocations and/or other applicable criteria or objectives; and (b) dischargers seeking to increase their mercury load. The policy shall include provisions that recognize the efforts of those dischargers who are meeting or outperforming their wasteload allocations, and that recognize the expenditures made by dischargers who are employing higher treatment levels. The policy shall not include requirements that would leverage existing point source discharges as a means of forcing dischargers to bear more than their fair share of responsibility for causing or contributing to any violation of water quality standards. In this context "fair share" shall refer to the dischargers' proportional contribution to the impairment. The policy shall also include provisions that prevent localized disparate impacts.

Resolved 8 is an action for State Water Board staff to undertake.

Resolved 9: Reopener for Pollutant Offset Policy

The San Francisco Bay Water Board shall include requirements in the TMDL that any new or modified NPDES permit for dischargers shall contain a reopener to implement Resolved No. 7(sic), above.

The revised Mercury TMDL Amendment includes a reopener for new or modified NPDES permits for wastewater dischargers to incorporate the pollutant offset policy (see Resolved 8).

Resolved 10: Risk Reduction

Directs the San Francisco Bay and Central Valley Water Boards to investigate ways, consistent with their regulatory authority, to address public health impacts of mercury in San Francisco Bay/Delta fish, including activities that reduce actual and potential exposure of and mitigate health impacts to those people and communities most likely to be affected by mercury in San Francisco Bay-Delta caught fish, such as subsistence fishers and their families.

The revised Mercury TMDL Amendment incorporates the above language in the Risk Management section.

Resolved 11: Clarify Bird-egg is a Monitoring Target

Directs the San Francisco Bay Water Board to either develop an appropriate and allocable numerical target that is protective of wildlife, or clarify that the existing bird-egg target is a monitoring target, and that the TMDL will be revised if results of such monitoring reveal that the beneficial uses are not being protected.

The revised Mercury TMDL Amendment includes a wildlife water quality objective for mercury, and a revised wildlife numeric target developed by the USFWS to be protective of wildlife and aquatic life. It clarifies that the bird-egg target is a monitoring target.

Resolved 12: Address Marine 4-day Average Objective

Directs the San Francisco Bay Water Board to revise, withdraw, or take other appropriate action to address the marine waters mercury four-day average water quality objective. In so doing the Regional Water Board shall comply the provisions of Clean Water Act section 303, including but not limited to subparagraph (c)(2)(B), which require the adoption of numerical criteria for toxic pollutants.

The revised Mercury TMDL Amendment includes proposed numeric water quality objectives to protect human health and wildlife, and the rationale for vacating the marine waters 4-day average water quality objective for mercury.

Resolved 13: Revise the TMDL

Directs the San Francisco Bay Water Board to bring a revised TMDL, consistent with this resolution, back to the State Water Board within nine months of the date of this resolution. The San Francisco Bay Water Board shall report its progress in complying with this resolution to the State Water Board within six months of the date of this resolution.

Analysis included in this Staff Report supports the revised TMDL (see Appendix A) consistent with State Board resolution 2005-0060.

3. Compliance with the California Environmental Quality Act (CEQA)

The California Environmental Quality Act (CEQA) authorizes the California Resources Agency Secretary to exempt a state agency's regulatory program from preparing an Environmental Impact Report (EIR) or Negative Declaration if certain conditions are met. The Resources Agency Secretary has certified the basin planning process to be functionally equivalent to and therefore exempt from CEQA's requirement to prepare an EIR or Negative Declaration. As part of that certified regulatory program, the Water Board's regulations (at Title 23 Cal. Code of Regs. § 3775 et seq.) describe the environmental documents required for planning actions. This Staff Report and attachments serve as the required environmental documents.

4. Units Used in this Report

parts per million (ppm)	mg/kg (in sediment or fish tissue) and ug/l (in water) are both parts per million (ppm)
cm	centimeter
kg	kilogram
kg/y	kilogram per year
mg	milligram
mg/kg	milligram per kilogram parts per million (ppm)
ug/l	microgram per liter (ppm)

II. Proposed Water Quality Objectives for Mercury in San Francisco Bay

The proposed Basin Plan amendment will add two new mercury water quality objectives and vacate an outdated objective. The new objectives are based on targets the Water Board adopted as part of the Mercury TMDL Amendment. They apply to all segments of San Francisco Bay, including all marine and estuarine waters contiguous to San Francisco Bay.

The new objective to protect people who consume Bay fish applies to fish large enough to be consumed by humans. The objective is 0.2 mg mercury per kg fish tissue (average wet weight concentration measured in the muscle tissue of fish large enough to be consumed by humans).

The proposed objective to protect aquatic organisms and wildlife applies to small fish (3–5 cm in length) commonly consumed by the California least tern, an endangered species. This objective is 0.03 mg mercury per kg fish (average wet weight concentration).

These two new objectives replace the water column four-day average marine mercury objective, which will no longer apply to San Francisco Bay waters.

While it may be a fairly new approach to specify mercury water quality objectives as fish tissue concentrations rather than water column concentrations, this proposed action is not precedent-setting for California. The Central Valley Water Board recently adopted fish tissue mercury objectives concurrently with their mercury TMDLs for Clear Lake and Cache Creek watersheds. The Central Valley Board calculated mercury fish tissue levels needed to protect human health using the same method the United States Environmental Protection Agency (U.S. EPA) used to develop their methylmercury criterion (described below in 'Human Health Objective – Methodology') using local fish consumption rates. They calculated mercury fish tissue levels needed to protect aquatic organisms and wildlife as recommended by USFWS (described below in Proposed Wildlife Objective – Methodology). The details of these objectives are provided on the Central Valley Water Board's website at: http://www.waterboards.ca.gov/centralvalley/programs/tmdl/.

1. Existing Mercury Objectives and Criteria

Mercury objectives for waters in the San Francisco Bay region vary based on geography, salinity, and beneficial uses. Figure 2-1 depicts the applicability of the objectives listed in Table 2-1. Due to the scale of the map, only the largest marine water bodies are depicted.

The Basin Plan defines the water quality objectives for toxic pollutants in Chapter 3 in the "objectives for specific chemical constituents" section which includes Tables 3-3 and 3-4 (marine and freshwater objectives, respectively). Staff intends to replace the 4-day average marine mercury objective to reflect current scientific information and the latest U.S. EPA and USFWS guidance. However, our actions are limited to the geographic extent of the implementation plan—San Francisco Bay. Mercury water quality objectives for all other water bodies in the San Francisco Bay Region will be updated either as part of a statewide action or as TMDLs are developed for mercury impaired waters.

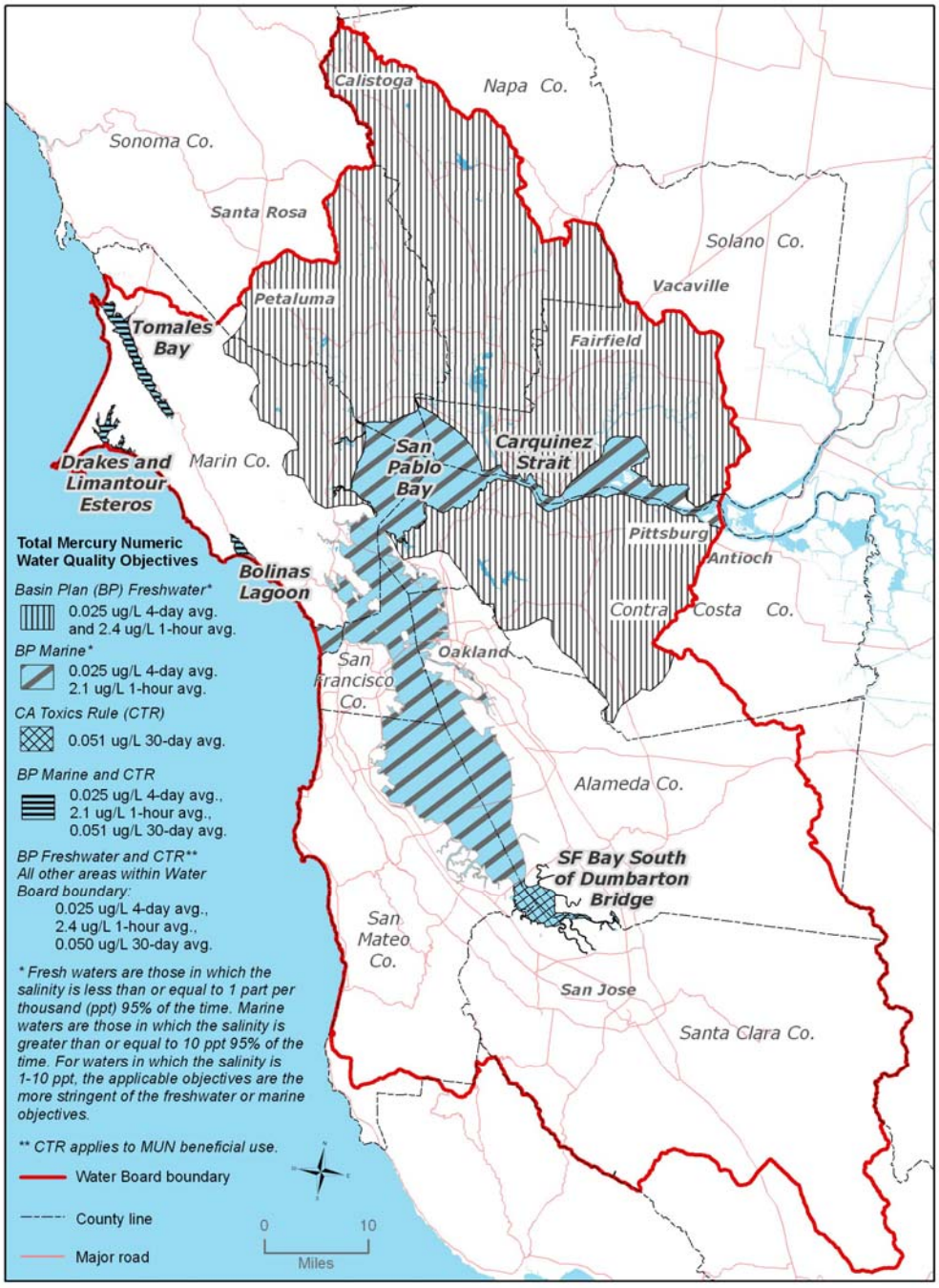

Figure 2-1: Existing Mercury Numeric Water Quality Objectives

Table 2-1. Existing Total Mercury Numeric Water Quality Objectives		
	Existing Basin Plan Marine Objectives (salinity greater than 10 PPT 95% of the time; does not apply to South Bay south of Dumbarton Bridge)	
	Table 3-3 (1986 Table III-2A)	• 0.025 ug/L 4-day average, and • 2.1 ug/L 1-hour average; Note: for waters in which the salinity is between 1 and 10 PPT this more stringent 1-hour objective applies
	The California Toxics Rule (CTR) criterion for human health for consumption of organisms applies to South Bay south of Dumbarton Bridge:	
	§131.38(b)(1)	• 0.051 ug/L 30-day average; this CTR criteria applies to consumption of organisms only
	Both Basin Plan (BP) objectives and California Toxics Rule (CTR) criterion for human health for consumption of organisms only apply in other marine waters outside of San Francisco Bay (e.g. Tomales Bay, Drake and Limantour Esteros, Bolinas Lagoon, etc.):	
	Table 3-3	• 0.025 ug/L 4-day average, and • 2.1 ug/L 1-hour average; see note above
	§131.38(b)(1)	• 0.051 ug/L 30-day average; this CTR criteria applies to consumption of organisms only
	Existing Basin Plan Freshwater Objectives (salinity less than 1 PPT 95 percent of the time)	
	Table 3-4 (1986 Table III-2B)	• 0.025 ug/L 4-day average, and • 2.4 ug/L 1-hour average; see note above
(unshaded)	BP and CTR apply in other freshwaters:	
	Table 3-4	• 0.025 ug/L 4-day average, and • 2.4 ug/L 1-hour average; see note above
	§131.38(b)(1) §131.38(D)(4)(b)	• 0.050 ug/l 30-day average; this CTR criteria applies to the "municipal or (MUN)" beneficial use
units: PPT = parts per thousand ug/L = micrograms per liter		

The California Toxics Rule (CTR; CFR 40 §131.38) specifies 0.050 micrograms of mercury per liter of water (i.e., parts per billion, ppb) for consumption of organisms and water, and specifies 0.051 ppb for consumption of organisms only. These standards apply to all waters in the San Francisco Bay Region except San Francisco Bay north of the Dumbarton Bridge and upstream of San Pablo Bay (see 'Regulatory Chronology' below). Although, per 40 CFR 131.38(D)(4)(b), the 0.050 ppb criterion for human health, water and organism consumption only applies to waters with the municipal and domestic supply or "MUN" beneficial use designation in the Basin Plan.

The U.S. EPA developed a human health criterion for methylmercury of 0.3 milligrams methylmercury per kilogram of fish tissue (i.e., parts per million, ppm) because the

consumption of fish is the most important route of mercury exposure to humans (USEPA 2001). This criterion has not yet been formally adopted for California, but staff used this methodology to develop the proposed human health water quality objective.

Regulatory Chronology

The applicability of the Basin Plan objectives (currently defined by salinity) and the CTR criteria (defined by beneficial use) within the San Francisco Bay region is a complicated patchwork because the CTR was promulgated around then-current Basin Plan mercury objectives (previously defined by geographic boundaries).

The 1986 Basin Plan numeric water quality objectives for toxic pollutants were specified in two tables. Table III-2A applied downstream of Carquinez Strait to San Francisco Bay, except for the South Bay below Dumbarton Bridge where "ambient conditions should be maintained until site specific objectives are developed." Table III-2B applied upstream of San Pablo Bay to portions of Marin, Sonoma, Napa, Solano, and Contra Costa counties. The 2000 CTR applies in the remaining portion of the San Francisco Bay region (for which the 1986 Basin Plan did not specify a numeric objective; see 40 CFR 131.38(b)(1) footnote b); the CTR provides two criteria depending on beneficial use: human consumption of organisms only, or human consumption of organisms and water.

U.S. EPA approved the 1995 Basin Plan subsequent to the CTR, which changed the applicability of toxic pollutant objectives from a geographic designation to a salinity threshold of 5 parts per thousand (PPT). The marine objectives were listed in Table 3-3, and freshwater objectives were listed in Table 3-4. The 1995 Basin Plan numbers applied in addition to the CTR (except for the South Bay below Dumbarton Bridge which is excluded from 1986 Basin Plan Table III-2A and 1995 Basin Plan Table 3-3).

Subsequently, the Basin Plan salinity threshold was amended to the current thresholds: a) marine waters are those in which the salinity is equal to or greater than 10 PPT 95 percent of the time, b) freshwaters are those in which the salinity is equal to or less than 1 PPT 95 percent of the time, and c) for waters in which the salinity is between 1 and 10 PPT, the applicable objectives are the more stringent of the freshwater (Table 3-4) or marine (Table 3-3) objectives.

2. Proposed Human Health Objective

The proposed human health water quality objective is the TMDL human health target of 0.2 mg mercury per kg fish.

Methodology

The method used to develop the human health objective for San Francisco Bay fish tissue is derived from the method the U.S. EPA used to develop its national criterion for methylmercury in fish tissue (USEPA 2001). To protect human health, U.S. EPA developed a criterion of 0.3 milligrams methylmercury per kilogram fish tissue (i.e., parts per million, ppm) using Equation 1:

Equation 1:

$$\text{Criterion} = \frac{\text{Body Weight} \times (\text{Reference Dose} - \text{Relative Source Contribution})}{\text{Fish Intake at Trophic Level}}$$

U.S. EPA assumed an adult body weight of 70 kilograms. The reference dose (RfD) in the equation is 0.0001 milligrams mercury per kilogram body weight per day (mg/kg-day). It represents a lifetime daily exposure level at which no adverse effects would be expected. It is derived from mercury levels shown to cause neurological developmental effects in children exposed to mercury prior to birth. In vitro exposure is the most sensitive exposure route and therefore the criterion is intended to protect for in vitro effects "In the studies so far published on subtle neuropsychological effects in children, there has been no definitive separation of prenatal and postnatal exposure that would permit dose-response modeling. That is, there are currently no data that would support the derivation of a child (vs. general population) RfD. This RfD is applicable to lifetime daily exposure for all populations including sensitive subgroups" (USEPA 2001). U.S. EPA's approach for developing its fish tissue criterion includes incorporating a factor of 10 in the RfD. The relative source contribution (0.000027 mg/kg-day) accounts for other sources of mercury exposure (USEPA 2001).

"Fish intake" is the consumption rate in kilograms/day. The relative location of the species in the food chain is called the trophic level (TL). Trophic level 1 plants are consumed by trophic level 2 herbivores, which are consumed by trophic level 3 predators, which are then consumed by trophic level 4 top predators. "Fish Intake at Trophic Level" is discussed in the next section.

Default Fish Consumption Rate

In the *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (USEPA 2000), U.S. EPA recommends a default fish intake rate of 0.0175 kilograms/day (kg/d) to adequately protect the general population of fish consumers, based on the 1994 – 1996 Continuing Survey of Food Intakes by Individuals (CSFII), conducted annually by the U.S. Department of Agriculture. The trophic level (TL) breakouts are TL2 = 3.8 grams/day (g/d); TL3 = 8.0 g/d; and TL4 = 5.7 g/d (USEPA 2000). The 0.0175 kg/d rate for the general adult population is protective of the majority of the population; it is the 90th percentile of the consumption rate for those who do and do not consume fish. In other words, 90 percent of the general population consumes less than 0.0175 kg/d. U.S. EPA considers the 0.0175 kg/d to be indicative of the average consumption among sport fishers (USEPA 2000).

Participants in the CSFII provided two non-consecutive, 24-hour days of dietary data collected by an in-home interviewer. Interviewers provided participants with an instructional booklet and standard measuring cups and spoons to assist them in adequately describing the type and amount of food ingested. One limitation of the 1994-96CSFII surveys is that individual food consumption data were collected for only two days—a brief period which does not necessarily depict "usual intake." Usual dietary intake is defined as "the long-run average of daily intakes by an individual." Despite the

limitations, the CSFII is considered one of the best sources of current information on consumption of water and fish-containing foods (USEPA 2000).

Substituting the above values and the default fish intake rate (0.0175 kg/d) into Equation 1 yields the U.S. EPA methylmercury criterion of 0.3 ppm mercury in fish, rounded to one significant figure, as was done by U.S. EPA (USEPA 2001).

San Francisco Bay Fish Consumption Rate

In their methodology document, U.S. EPA "suggests a four preference hierarchy for States and authorized Tribes to follow when deriving consumption rates that encourages use of the best local, State, or regional data available. A thorough discussion of the development of this policy method and relevant data sources is contained in the Exposure Assessment TSD. The hierarchy is also presented here because EPA strongly emphasizes that States and authorized Tribes should consider developing criteria to protect highly exposed population groups and use local or regional data over the default values as more representative of their target population group(s). The four preference hierarchy is: (1) use of local data; (2) use of data reflecting similar geography/population groups; (3) use of data from national surveys; and (4) use of EPA's default intake rates" (USEPA 2000).

Detailed local consumption data is available for San Francisco Bay. A very comprehensive consumption survey was conducted in 1998 and 1999 and is documented in the report entitled, "Technical Report: San Francisco Bay Seafood Consumption Report" (CDHS & SFEI 2000). The study methodology was developed with the assistance of an advisory task force, special consultants and outside reviewers, and employed face-to-face interviews with anglers and use of an 8-ounce fish fillet model. This methodology (technical review, face-to-face interviews, and consistent measurements) is comparable to the CSFII study methodology. Therefore, this study is appropriate to use as a basis to protect people who consume fish from San Francisco Bay.

To protect the Bay's beneficial use of sport fishing, mercury concentrations in Bay fish should be low enough so people who choose to eat Bay fish can do so on a regular basis. Roughly 170,000 sport and subsistence fishers currently choose to consume Bay fish (USEPA 1997). According to a survey of these fishers, the median consumption rate for all consumers of Bay fish was zero because about half of consumers did not eat Bay fish in the four weeks prior to being interviewed (CDHS & SFEI 2000). Both the national study, which U.S. EPA references for default consumption values, and the San Francisco Bay consumption study found a median consumption rate of zero. The San Francisco Bay results indicate that 90 percent eat less than 0.016 kg/d, a surprising finding because it is reasonable to assume that Bay Area residents, like many Pacific Rim communities, consume more fish than the general U.S. population (90^{th} percentile of 0.0175 kg/d). Therefore, Water Board staff propose to use the 95^{th} percentile from the San Francisco Bay consumption study; 95 percent eat less than 0.032 kg/d. The data were adjusted for avidity bias: in an otherwise random sampling design, avidity bias describes the increase in probability that data will be gathered from anglers fishing very frequently, as opposed to anglers who fish only rarely.

Substituting this fish intake rate (0.032 kg/d) into the equation above results in a fish tissue criterion of 0.2 ppm mercury, rounded to one significant figure, as was done by U.S. EPA (USEPA 2001). Therefore, **0.2 parts per million (ppm), wet weight, mercury in fish is selected to protect human health.**

The estimated 170,000 Bay Area sport and subsistence fishers (USEPA 1997) represent about 3 percent of the roughly 6.5 million people who live in the Bay Area (CDFFP 1999; CDF 2000). Because the selected objective protects the 95th percentile of these fishers, it protects well over 99 percent of the Bay Area's existing population.

An individual fish consumer's mercury exposure is a function of the type of fish consumed, the amount consumed, and the frequency of consumption. Because the objective is derived from a level of daily exposure assumed to occur over an entire lifetime, some fish above the objective could be consumed if others were well below it.

San Francisco Bay Fish Consumed

This section discusses a protective public policy for how the Water Board will determine compliance with the 0.2 mg mercury per kg fish tissue objective.

Species, trophic level, size of fish, and consumption rate affect mercury intake. The *Bay Seafood Consumption Report* indicates that about 78 percent of sport and subsistence fishers report consuming striped bass (CDHS & SFEI 2000), although the relative proportion of striped bass within their diet is unknown. The 78 percent was in response to the general question, "do you eat this fish" which was asked for three species (white croaker, leopard shark and striped bass). This contrasts to the more specific question, "have you eaten this fish in the last four weeks" which was asked for these three species of fish, plus10 additional fish species, and crab, clams and mussels (CDHS & SFEI 2000). The *Bay Seafood Consumption Report* does not provide shellfish consumption rates.

Commonly consumed fish species are discussed in some detail (CDHS & SFEI 2000). The report provides the percent of anglers who recently consumed Bay fish species, but it does not provide the amount consumed of each species. The five most commonly consumed species are striped bass, California halibut, jacksmelt, white sturgeon, and white croaker. These five fish were consumed by 15–55 percent of anglers. Less than 10 percent of anglers reported consuming shiner surfperch, leopard shark, or other fish. **Therefore, staff proposes that the water quality objective apply to the five most commonly consumed Bay fish**.

The dietary habits of these adult fish reportedly consumed by anglers and their corresponding trophic level are indicated on Table 2-2. As expected, humans eat relatively high on the food chain; jacksmelt is trophic level 3, and striped bass, halibut, sturgeon, and white croaker are trophic level 4.

Table 2-2. Trophic Level of Fish Species Caught in RMP Sampling		
Species	**Adult Diet**	**Trophic Level**
striped bass (Morone saxatilis)	Northern anchovy, shiner perch, Bay shrimp, striped bass young of the year, and herring. Diet varies greatly with location in the Bay and Delta	4
California halibut (Paralichthys californicus)	Pacific sardine, northern anchovy, white croaker, topsmelt, killifish, CA market squid, crustaceans	4
jacksmelt (Atherinopsis californiensis)	Algae (Ulothrix spp., Melosira monoiliformis, Enteromorpha spp.), copepods, mysids, cirripedian nauplius larvae, small northern anchovy, gammarid amphipods, jacksmelt eggs, heteronereid polychaetes, sessile diatoms, foraminifera	3
white sturgeon (Acipenser transmontanus)	Fish, fish eggs (herring), shellfish, crayfish, various aquatic invertebrates, clams, amphipods, and shrimp	4
white croaker (Genyonemus lineatus)	Wide variety of fish (mostly northern anchovy), squid, octopus, polychaetes, crabs, clams, detritus and dead organisms	4
leopard shark (Triakis semifasciata)	Cancer crabs, innkeeper worms, grasped crabs, squid, Bay shrimp, ghost shrimp, clams, fish (such as anchovies), fish eggs, octopus spp.	4
shiner perch (Cymatogaster aggregata)	Gammarid amphipods comprise bulk of year round diet in SFB, also algae, cumaceans, cyclopoid copepods, bivalve mollusks, polychaetes, smelt eggs, small shiner	3
citation: species and adult diet from Table 1, *Contaminant Concentrations in Fish from San Francisco Bay, 1997* (SFEI 1999)		

The San Francisco Bay Regional Monitoring Program (RMP) conducts fish tissue sampling and analysis in San Francisco Bay every three years. The RMP catches and analyzes a number of different fish species from all parts of the Bay. Targeted fish size classes are based on legal limits, U.S. EPA (2000) guidance, and growth curves where available (SFEI 2003). Fish fillets for pollutant analysis are prepared in a fashion similar to the typical culinary preparation for each species. White croaker are prepared using muscle with skin. Shiner surfperch and jacksmelt are prepared for compositing by removing heads, tails, and guts, leaving muscle with skin and skeleton to be included in the composites. Leopard shark, striped bass, halibut, and sturgeon are prepared using muscle tissue without skin (SFEI 2003). The RMP fish program analysis plan pertaining to the five most commonly consumed Bay fish is summarized in Table 2-3 (SFEI 2003).

Table 2-3. RMP Fish Sampling Program					
Species	Striped Bass *Morone saxatilis*	California Halibut *Paralichthys californicus*	Jacksmelt *Atherinopsis californiensis*	White Sturgeon *Acipenser transmontanus*	White Croaker *Genyonemus lineatus*
RMP Fish Sampling Plan					
Size classes	3	2	1	2	1
No. fish per composite	3	3	5	3	5
No. composites (approximate)	10	3	15	4	15
Size class range (cm)	Small (S): 45–59 Medium: 60–82 Large (L): >82*	S: 51–82 L: 84–98	21–30	S: 117–133 L: 134–183	20–30
Tissue sampled (edible portion)	muscle without skin	muscle without skin	muscle with skin and skeleton	muscle without skin	muscle with skin
Proposed Fish Evaluation Length					
Evaluation length	60	75	25	135	25

To provide sufficient data to evaluate the Bay-wide average mercury concentration, we propose that several composite samples of each species be caught and analyzed individually for mercury (see Table 2-3 for approximate numbers of fish per composite, and numbers of composites, per species). In the past, it has been relatively easy to catch striped bass in the small and medium size ranges. It has been difficult to catch striped bass in the large size category (larger than 82 cm) so there is the concern that not enough could be caught in the future to provide a large enough sample size. The proposed "evaluation length" in Table 2-3 is either the smallest length of the largest class size sampled (striped bass, sturgeon) or the average size (other fish), rounded to the nearest 5 cm.

For some species, the mercury concentration in fish has been shown to be proportional to the length of the fish. One approach for evaluating average concentrations is to plot mercury concentration against fish length, for each species, and compute the equation of the best fitting line through the data (Wiener et al. 2003; SFEI 1999). If a statistically significant linear relationship between mercury concentration and length can be established for a fish species, the equation for the linear fit should be evaluated at the

"evaluation length" specified in Table 2-3 to compute the average mercury concentration for the species. If a relationship between fish length and concentration cannot be established for a specific species, then the average fish mercury concentration for fish up to the length specified in Table 2-3 should be determined. The average fish mercury concentrations for the five species should be averaged and compared to the human health water quality objective. Staff does not propose a weighted average calculation because sufficient relative consumption data for each species is unavailable. The proposed method of determining compliance is protective of human health because four of the five species are trophic level 4.

Human Health Water Quality Objective

The proposed objective to protect humans who consume Bay fish is 0.2 mg mercury per kg fish tissue (average wet weight concentration measured in the edible portion of trophic level 3 and trophic level 4 fish), in larger fish consumed by humans. Compliance shall be determined by analysis of the edible portion of the five most commonly consumed fish (60–cm striped bass muscle without skin, 75–cm California halibut muscle without skin, 25-cm jacksmelt muscle with skin and skeleton, 135-cm white sturgeon muscle without skin, and 25-cm white croaker muscle with skin).

3. Proposed Aquatic Organisms and Wildlife Objective

The proposed water quality objective to protect aquatic organisms and wildlife is the revised Mercury TMDL Amendment's alternative wildlife monitoring target of 0.03 mg mercury per kg fish.

Whereas fish consumption accounts for only a portion of most human diets, some wildlife depend entirely on Bay fish or other aquatic organisms for their food. Numerous studies document mercury accumulation within the aquatic food web and its toxic effects on birds (Wiener et al. 2003). In the Bay Area, birds feeding on fish and other aquatic organisms are among the most sensitive mercury receptors (CDFG 2002; Davis et al. 2003). Protecting the most sensitive endpoints, that is developing embryos of humans and wildlife, should result in protection of the rest of the aquatic environment from toxicity due to mercury (Cooke et al. 2004). An aquatic organisms and wildlife objective that is calculated to protect birds is also expected to protect other wildlife reliant on the Bay for food (USFWS 2003). The proposed objective to protect aquatic organisms and wildlife is 0.03 mg mercury per kg fish (wet weight, measured in whole fish 3–5 cm in length) in small fish consumed by birds.

Protectiveness of the U.S. EPA Mercury Criterion

The Fish and Wildlife Service evaluated U.S. EPA's fish tissue residue criterion to determine if the criterion developed to protect human health would also protect wildlife, including rare and endangered wildlife (USFWS 2003). USFWS concluded that, if predatory fish at the top of the food web were to contain 0.3 mg mercury per kg fish (U.S. EPA's criterion), most San Francisco Bay wildlife species would be protected. The proposed human health water quality objective of 0.2 mg mercury per kg fish is lower than the U.S. EPA criterion and therefore would protect most wildlife related beneficial uses. The one species that potentially would not be protected is the California least tern, a

federally-listed species. Therefore, a second objective that protects all wildlife is proposed.

Methodology

The wildlife objective is determined using the method discussed in *Evaluation of the Clean Water Act Section 304(a) Human Health Criterion for Methylmercury: Protectiveness for Threatened and Endangered Wildlife in California* (USFWS 2003). Based on the information available in the scientific literature, and given consideration of methylmercury's capacity to bioaccumulate and biomagnify in the aquatic food chain, the USFWS assumed that upper trophic level wildlife species (i.e., predatory birds and mammals) have the greatest inherent risk from exposure to methylmercury. In San Francisco Bay these species include several piscivorous birds. A wildlife value (WV) represents the overall dietary concentration of methylmercury necessary to keep the daily ingested amount at or below a level at which no adverse effects are expected. For each species, the USFWS calculated a WV using body weight, total daily food ingestion rate, and a protective reference dose.

USFWS concluded that mercury concentrations of about 0.03 ppm in smaller prey fish comprising the California least tern diet would be protective for the beneficial use of the preservation of rare and endangered species. (The California least tern generally consumes fish less than 5 centimeters long.) The mercury content of smaller fish more closely relates to California least tern mercury exposure than the mercury content of larger fish.

In a March 2006 letter, the USFWS recommended that the objective apply to "the average mercury concentration in fish 3 to 5 centimeters long" and noted, "Diets of birds can change quickly for many reasons and since this is a Bay-wide target/objective the change allows for better protection and recognizes that other fish in the 3 to 5 cm range may be eaten by least terns besides their "typical" choice. Also, other tern species eat fish in the 3 to 5 cm range and if the 0.03 ppm is limited to the "typical" species eaten by the least tern, the other birds may not be protected" (USFWS 2006).

Aquatic Organisms and Wildlife Water Quality Objective

The proposed objective to protect aquatic organisms and wildlife is 0.03 mg mercury per kg fish (average wet weight concentration measured in whole fish 3–5 cm in length) in small fish consumed by birds.

4. Vacate 4-day Average Marine Water Quality Objective

Basis of the 4-day Average Marine Water Quality Objective

The Basin Plan 4-day average marine mercury water quality objective is based on science over two decades old (USEPA 1985). It is derived from the most sensitive adverse chronic effect, the U.S. Food and Drug Administration's (USFDA's) action level to protect human health for mercury in commercial fish and shellfish (1.0 ppm) (USEPA 1985). As noted (at the bottom of Table 3 in the 1985 document), the saltwater final residual value was calculated by dividing the lowest maximum permissible tissue

concentration (USFDA action level of 1.0 mg mercury per kg fish) by the bioconcentration factor of 40,000 (the relative methylmercury concentration found in the Eastern oyster compared to the total mercury concentration in the water the Eastern oyster lives in), which yields 0.025 ug/l, 4-day average concentration to not be exceeded more than once every three years on the average.

Although the Basin Plan 1-hour average marine and freshwater objectives are also based on this 1985 document, they are derived from toxicity tests on aquatic species themselves. Therefore, staff does not propose to vacate the 1-hour objectives.

Basis of the Proposed Water Quality Objectives

The proposed Basin Plan water quality objectives for mercury in fish tissue to protect human health, wildlife, and aquatic organisms reflect current scientific understanding. These objectives are calculated using on protective reference doses for mercury (see objective methodology sections, above).

The resulting fish tissue concentrations to protect human health (0.3 mg mercury per kg fish as a national default, and for San Francisco Bay is 0.2 mg mercury per kg fish) and to protect aquatic organisms and wildlife (0.03 mg mercury per kg fish) are much more stringent than the USFDA action level (1 mg mercury per kg fish).

In Chapter 3 the Basin Plan specifies that "…objectives to be considered by the Water Board shall be developed in accordance with the provisions of the federal Clean Water Act, the State Water Code, State Board water quality control plans, and this Plan. These site-specific objectives will take into consideration factors such as all available scientific information and monitoring data and the latest U.S. EPA guidance, and local environmental conditions and impacts caused by bioaccumulation…" These proposed water quality objectives have been developed in accordance with these requirements. The human health objective is based on the latest U.S. EPA guidance. The aquatic organisms and wildlife objective takes bioaccumulation into consideration, whereas the outdated objective took bioconcentration into consideration (bioconcentration does not account for mercury accumulated from prey).

Conclusions

The 1984 USFDA action level was used as the basis of the 4-day average marine mercury water quality objective, which we propose to vacate. The proposed water quality objectives (0.2 and 0.03 mg mercury per kg fish) reflect the latest scientific information (reference doses for humans and wildlife) and U.S. EPA guidance. The proposed human health objective is five times more stringent than the 1984 USFDA action level of 1.0 mg mercury per kg fish. The proposed aquatic organisms and wildlife objective is much more stringent than the proposed human health objective. Therefore, it is appropriate to vacate the outdated and less stringent 4-day average marine objective.

5. Summary of Revised Mercury Objectives and Criteria

The proposed objectives are shown in Table 2-4 and Figure 2-3.

Table 2-4. Proposed Total Mercury Numeric Water Quality Objectives		
	**SAN FRANCISCO BAY – North of Dumbarton Bridge**	
	Basin Plan Table 3-3B	• 0.2 ppm, average mercury, wet weight, in large fish, • 0.03 ppm, average mercury, wet weight, in small fish, and • 2.1 ug/L 1-hour average
	**SAN FRANCISCO BAY – South Bay south of Dumbarton Bridge**	
	Basin Plan Table 3-3B	• 0.2 ppm, average mercury, wet weight, in large fish, • 0.03 ppm, average mercury, wet weight, in small fish, and
	California Toxics Rule 40CFR131.38(b)(1)	• 0.051 ug/L 30-day average
	**OTHER MARINE WATERS** Both Basin Plan (BP) and California Toxics Rule (CTR) apply in other marine waters outside of San Francisco Bay (salinity greater than 10 PPT 95 percent of the time; e.g. Tomales Bay, Drake and Limantour Esteros, Bolinas Lagoon, etc.):	
	Basin Plan Table 3-3B	• 0.025 ug/L 4-day average, and • 2.1 ug/L 1-hour average; Note: for waters in which the salinity is between 1 and 10 PPT this more stringent 1-hour objective applies
	California Toxics Rule 40CFR131.38(b)(1)	• 0.051 ug/L 30-day average; this CTR criteria applies to consumption of organisms only
	**FRESHWATER UPSTREAM OF SAN PABLO BAY** Basin Plan Freshwater Objectives apply upstream of San Pablo Bay (salinity less than 1 PPT 95 percent of the time)	
	Basin Plan Table 3-4	• 0.025 ug/L 4-day average, and • 2.4 ug/L 1-hour average; see note below
(unshaded)	**OTHER FRESHWATERS** BP and CTR apply in other freshwaters:	
	Basin Plan Table 3-4	• 0.025 ug/L 4-day average, and • 2.4 ug/L 1-hour average; see note above
	California Toxics Rule 40CFR131.38(b)(1)	• 0.050 ug/L 30-day average; this CTR criteria applies to the "municipal and domestic supply (MUN)" beneficial use
	California Toxics Rule 40CFR131.38(D)(4)(b)	• this CTR criteria applies to the "municipal or (MUN)" beneficial use
units: PPT = parts per thousand ug/L = micrograms per liter		

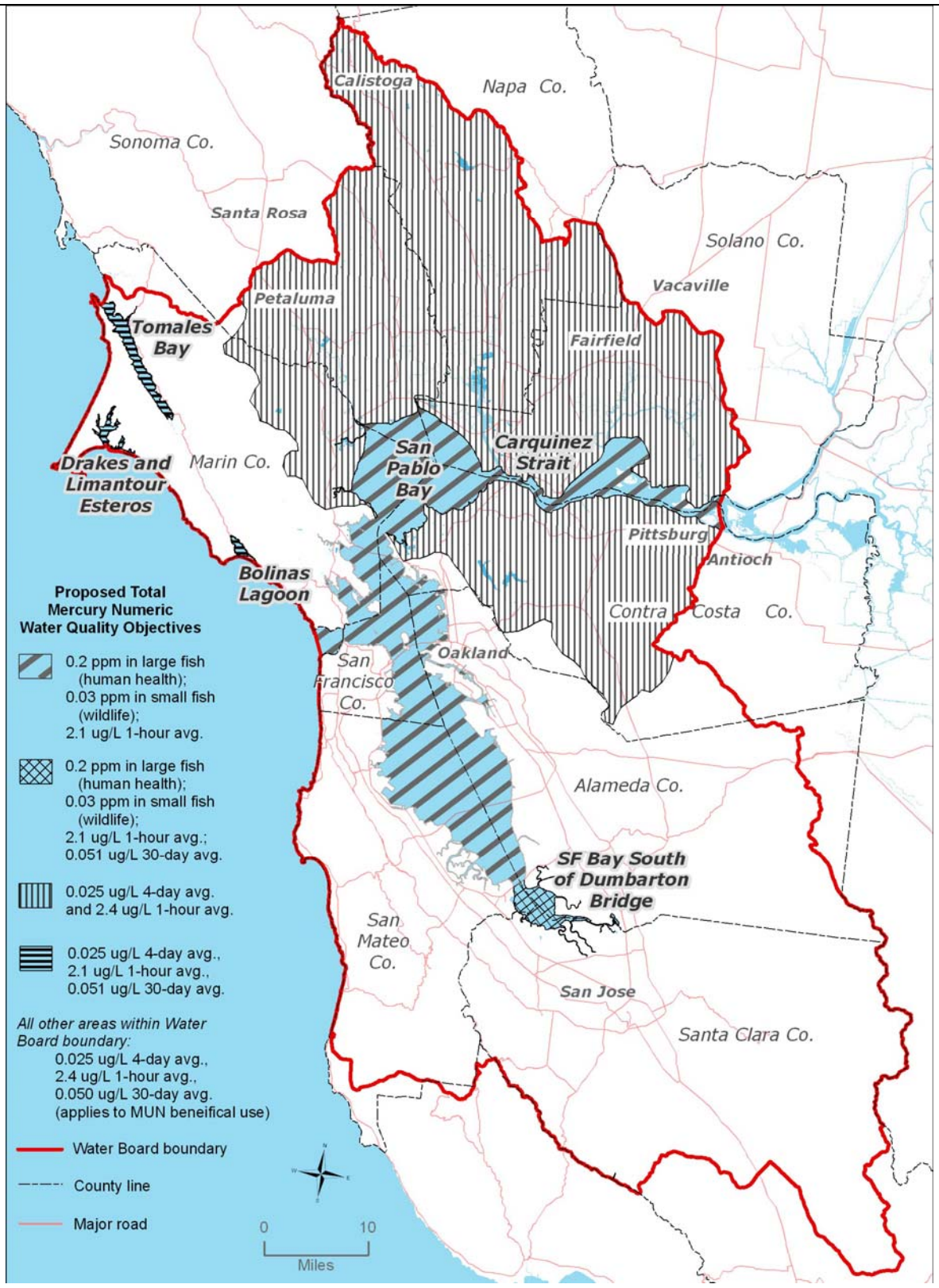

Figure 2-2: Proposed Mercury Numeric Water Quality Objectives

III. Revisions to San Francisco Bay Mercury TMDL

Revisions to the TMDL specifically address issues raised by State Board in the Remand Order. Changes described in this section:

- Clarify human health and wildlife targets;
- Revise wasteload allocations and associated implementation plan requirements for municipal and industrial wastewater dischargers;
- Clarify sections of the implementation plan affecting dredging operations;
- Require monitoring for methylmercury by municipal and industrial wastewater and urban stormwater runoff dischargers;
- Include commitments to address risk management related to human health concerns; and
- Add adaptive implementation components.

1. TMDL Water Quality Targets

Several revisions to the targets section of the TMDL are proposed. These revisions address issues raised by the State Board and are intended to clarify the targets and provide assurances that the targets are consistent with the proposed water quality objectives. These objectives are to protect human health, wildlife, and aquatic organisms. Consequently, a review of the human health and wildlife targets is necessary to ensure that attainment of TMDL targets will result in attainment of water quality standards. The proposed revisions, discussed below, include changing the wildlife target from a safe mercury level in bird eggs to a safe mercury level in the fish these same birds consume. The revised target is equally protective and preferred because it is expressed as a numeric value (0.03 mg mercury per kg 3 -5 cm fish) rather than an upper limit concentration (< 0.5 mg mercury per kg bird egg). Although the human health target remains unchanged (0.2 mg mercury per kg fish), text is proposed to clarify that the target applies to striped bass, a fish commonly consumed by anglers.

Human Health Target

In the Mercury TMDL Amendment, the Water Board adopted the following human health target: “To protect sport fishing and human health, the average fish tissue mercury concentration for typically consumed fish shall not exceed 0.2 mg mercury per kg fish tissue (wet weight).” The proposed human health target now reads as follows: “The human health target is a fish tissue mercury concentration (0.2 mg mercury per kg fish tissue). This target applies to average wet weight fish tissue muscle concentrations in 60 cm long striped bass.” The following clarifying text for the human health TMDL target is also proposed:

> The RMP conducts fish tissue sampling and analysis in San Francisco Bay every three years. Progress toward attainment of the human health target shall be evaluated by tracking mercury concentrations in striped bass, a commonly consumed sport fish with relatively high mercury concentrations. Striped bass are

> routinely caught in three size ranges: 45-59 cm (small), 60-82 cm (medium), and larger than 82 cm (large). To provide sufficient data to evaluate the target, striped bass in the small and medium size ranges should be caught and analyzed. The best functional relationship between mercury concentration and length shall be established for the fish caught, and the resulting equation of fit shall be evaluated at 60 cm to compute the mercury concentration to compare to the human health target. The RMP tracks mercury concentrations in other San Francisco Bay sportfish, such as halibut and jacksmelt. This information will be used to assess overall trends and human health risks.

Since the proposed 40 percent reduction in mercury concentration in 60-cm striped bass (to achieve 0.2 mg mercury per kg fish human health target) is the basis of the revised wasteload and load allocations, the proposed clarifying text does not change the allocation strategy and is consistent with the TMDL analysis. This target is also consistent with the proposed human health objective. Striped bass is a trophic level 4 fish; attainment of the proposed water quality objective shall be measured in trophic level 3 and 4 fish. Therefore, the target provides a measurable condition that demonstrates attainment of water quality standards.

Wildlife Target

Revisions to the wildlife target section of the TMDL include clarifying text 1) restating the wildlife target in terms of the proposed aquatic organism and wildlife water quality objective, 2) recognizing the bird-egg target as a monitoring target, and 3) reiterating that the TMDL will be revised if prey fish monitoring results indicate that beneficial uses are not being protected. The revised wildlife target is stated as follows:

> The wildlife target is a fish tissue mercury concentration (0.03 mg mercury per kg fish). This target applies to average wet weight whole fish concentrations in 3-5 cm length fish.

In the Mercury TMDL Amendment, the Water Board adopted the following wildlife target:

> "To protect wildlife and rare and endangered species, the concentration of mercury in bird eggs shall be less than 0.5 mg mercury per kg wet weight."

Further, the Water Board adopted the following language:

> "The goal of this target is that controllable water quality factors not cause detrimental mercury concentrations in San Francisco Bay bird eggs, which is consistent with the bioaccumulation objective in Chapter 3.… The wildlife target is expressed as a bird egg mercury concentration (less than 0.5 mg mercury per kg - wet weight). The RMP is collaborating with the U.S. Fish and Wildlife Service on long-term monitoring and analysis of bird eggs. Eggs will be collected at several locations throughout San Francisco Bay. The wildlife target will be compared to the computed 99^{th} percentile mercury concentration in eggs.

> In addition to measuring mercury concentrations in bird eggs directly, it is also useful to measure the amount of mercury in bird prey. The Water Board will work with the RMP to develop a long term monitoring program to evaluate mercury concentrations in prey typically consumed by birds. Prey species should include benthic invertebrates and small fish that are typically consumed by piscivorous birds. According to the U.S. Fish and Wildlife Service, the sensitive and endangered California least tern will be protected if the average mercury concentration in the fish it consumes does not exceed 0.03 mg per kg fish tissue (wet weight). Achieving this prey fish concentration is an alternative method of demonstrating attainment of the wildlife target."

Resolved 11 in the State Board Remand Order "directs the San Francisco Bay Water Board to either develop an appropriate and allocable numerical target that is protective of wildlife, or clarify that the existing bird-egg target is a monitoring target, and that the TMDL will be revised if results of such monitoring reveal that the beneficial uses are not being protected."

The primary fish species upon which the California least tern prey are described in a 2003 report by the U.S. Fish and Wildlife Service (USFWS 2003). In a March 2006 letter, the Service observed that most species forage opportunistically, and therefore it would be more protective to define the wildlife water quality objective as "3–5 cm whole fish" rather than limiting the objective to the primary California least tern prey (USFWS 2006). Therefore, the proposed wildlife target expressed as follows: "The wildlife target is a fish tissue mercury concentration (0.03 mg mercury per kg fish). This target applies to average wet weight whole fish concentrations in 3-5 cm length fish."

Whether the wildlife target is a bird egg or prey fish target, the mercury reductions needed for attainment are one and the same: Egg mercury concentrations reflect the pre-laying diet of the parent. The Linkage Analysis section of the 2004 staff report for the Mercury TMDL Amendment (Looker & Johnson 2004b) states:

> "…mercury sources are linked to the proposed bird egg target via mercury in sediment, methylation, accumulation within the aquatic food web, and bird exposure. Additional study is needed to quantify the relationship between the aquatic food web and bird eggs. Available information does not fully explore exposure (e.g., diet), mercury transfer to eggs, and the relationship between mercury levels in eggs and reproduction. In the absence of additional information, however, reductions in bird egg concentrations are assumed, for purposes of this report, to be proportional to reductions in fish tissue mercury."

In the intervening two years, mercury science has not provided information which supports a linkage different from the above (proportional). Reducing mercury loads will reduce bird egg mercury concentrations.

The assumption is that when prey fish consumed by the California least tern contain 0.03 mg mercury per kg fish, mercury concentrations in their eggs will be less than 0.5 mg mercury per kg egg. A greater than 25 percent reduction in California least tern egg mercury concentrations is needed to bring bird egg concentrations down below 0.5 mg mercury per kg egg. The allocations adopted by the Water Board in 2004 call for a 50 percent reduction in mercury sediment concentrations. A 50 percent reduction would result in average bird egg concentrations of about 0.3 ppm (Looker & Johnson 2004b).

Water Board staff proposes to keep the bird egg target as a monitoring target. This is noted in the proposed Basin Plan Amendment as follows: "The RMP is also collaborating with the U.S. Fish and Wildlife Service on long-term monitoring and analysis of bird egg mercury concentrations."

The TMDL will be revised if monitoring or other evidence shows that beneficial uses are not being protected. As stated in the Adaptive Implementation section of the revised Mercury TMDL Amendment (Appendix A),

> The Water Board will adapt the TMDL to incorporate new and relevant scientific information such that effective and efficient actions can be taken to achieve TMDL goals. Approximately every five years, the Water Board will review the San Francisco Bay Mercury TMDL and evaluate new and relevant information from monitoring, special studies, and scientific literature. The reviews will be coordinated through the Water Board's continuing planning program and will provide opportunities for stakeholder participation. Any necessary modifications to the targets, allocations, or implementation plan will be incorporated into the Basin Plan.

The wildlife target is the same as the proposed water quality objective. Therefore, the target provides a measurable condition that demonstrates attainment of water quality standards.

2. Revised Municipal Wastewater Allocations

The Remand Order directs the Water Board to make a number of modifications to sections of the TMDL dealing with wastewater sources. Resolved 2 directs the Water Board "to evaluate effective pollution prevention practices used in other states" and "require all dischargers to aggressively implement appropriate pollution avoidance practices that are most effective." Resolved 3 directs the Water Board "to consider the effectiveness of any existing wastewater treatment technology that enhances the removal of mercury" and to establish individual wasteload allocations" that "incorporate provisions that acknowledge the efforts of those point sources whose effluent quality demonstrates good performance, and require improvement by other dischargers."

Consistent with these directions, Water Board staff, after considering existing or potential pollution prevention and treatment options, proposes revising individual wasteload allocations for municipal facilities. Individual wasteload allocations for facilities employing secondary treatment are adjusted downward by 40 percent. This reduction

magnitude was chosen because it is achievable through the implementation of reasonably foreseeable measures and improvements in treatment technology. It is approximately the same percentage reduction represented by the total maximum yearly load compared to the current estimated yearly total mercury load to the Bay. Resolved 3 of the Remand Order instructs the Water Board to

> …incorporate provisions that acknowledge the efforts of those point sources whose effluent quality demonstrates good performance" (SWRCB 2005).

To accomplish this, for municipal wastewater facilities employing advanced treatment at all times (American Canyon, Fairfield Suisun, Mt. View Sanitary District, Palo Alto, San Jose/Santa Clara, and Sunnyvale), the individual wasteload allocations based on current (2000-2003) load were adjusted downward by 20 percent. Table 3-1 shows the reduced individual wasteload allocations in the column labeled "final allocation."

The midway point between the allocation based on current loading and the final allocation are now shown for each facility in Table 3-1 in the column labeled "interim allocation." Note that no reductions are required for those facilities given an individual wasteload allocation of 0.1 kg/yr or less. No load reductions are required for these small municipal discharges for two reasons. First, the total load from such facilities is less than 1 kg/yr (out of more than 1200 kg/yr reaching the Bay) so requiring a reduction would not result in substantial reductions in overall mercury load to the Bay. Second, the Water Board hypothesizes that these dischargers are already performing as well as or better than their counterparts elsewhere.

Facilities with advanced treatment whose effluent quality already demonstrates good performance are exempt from the requirement to reduce loading beyond the 20 percent reduction. The 20 percent reductions will be realized through implementation of aggressive pollution prevention and other cost-effective mercury reduction methods; the 40 percent reduction for those facilities not employing advanced treatment will be realized through continuation of aggressive pollution prevention and other cost-effective mercury reduction methods, wastewater treatment system improvements, and the implementation of a State-developed offset program that establishes pollutant offsets and credits.

In the course of revisions pursuant to the Remand Order, an error was corrected in the footnotes to the table of individual wasteload allocations for municipal facilities (Table 3-1 in this Staff Report, and Table 4-x in the revised Mercury TMDL Amendment). Footnote 'a' should apply to East Bay Municipal Utilities District for their wet weather facilities instead of East Bay Dischargers Authority.

TABLE 3-1: Individual Wasteload Allocations for Municipal Wastewater Discharges

Permitted Entity	NPDES Permit	Current Load (2000-2003) (kg/yr)	Interim Allocation (kg/yr)	Final Allocation (kg/yr)
American Canyon, City of	**CA0038768**	**0.12**	**0.095**	**0.095**
California Department of Parks and Recreation, Angel Island State Park	CA0037401	0.013	0.013	0.013
Benicia, City of	CA0038091	0.088	0.088	0.088
Burlingame, City of	CA0037788	0.089	0.089	0.089
Calistoga, City of	CA0037966	0.016	0.016	0.016
Central Contra Costa Sanitary District	CA0037648	2.23	1.8	1.3
Central Marin Sanitation Agency	CA0038628	0.18	0.15	0.11
Delta Diablo Sanitation District	CA0038547	0.31	0.25	0.19
East Bay Dischargers Authority Dublin-San Ramon Services District (CA0037613) Hayward Shoreline Marsh (CA0038636) Livermore, City of (CA0038008) Union Sanitary District, wet weather (CA0038733)	CA0037869	3.6	2.9	2.2
East Bay Municipal Utilities District	CA0037702	2.6[a]	2.1	1.5
East Brother Light Station	CA0038806	0.00001	0.000012	0.000012
Fairfield-Suisun Sewer District	**CA0038024**	**0.22**	**0.17**	**0.17**
Las Gallinas Valley Sanitary District	CA0037851	0.17	0.13	0.10
Marin County Sanitary District, Paradise Cove	CA0037427	0.00055	0.00055	0.00055
Marin County Sanitary District, Tiburon	CA0037753	0.0099	0.0099	0.0099
Millbrae, City of	CA0037532	0.052	0.052	0.052
Mountain View Sanitary District	**CA0037770**	**0.034**	**0.034**	**0.034**
Napa Sanitation District	CA0037575	0.28	0.23	0.17
Novato Sanitary District	CA0037958	0.079	0.079	0.079
Palo Alto, City of	**CA0037834**	**0.38**	**0.31**	**0.31**
Petaluma, City of	CA0037810	0.063	0.063	0.063
Pinole, City of	CA0037796	0.055	0.055	0.055
Contra Costa County, Port Costa Wastewater Treatment Plant	CA0037885	0.00072	0.00072	0.00072
Rodeo Sanitary District	CA0037826	0.060	0.060	0.060
Saint Helena, City of	CA0038016	0.047	0.047	0.047
San Francisco, City and County of, San Francisco International Airport WQCP	CA0038318	0.032	0.032	0.032
San Francisco, City and County of, Southeast Plant	CA0037664	2.7	2.1	1.6
San Jose/Santa Clara WPCP	**CA0037842**	**1.0**	**0.80**	**0.80**
San Mateo, City of	CA0037541	0.32	0.26	0.19
Sausalito-Marin City Sanitary District	CA0038067	0.078	0.078	0.078
Seafirth Estates	CA0038893	0.00036	0.00036	0.00036

TABLE 3-1: Individual Wasteload Allocations for Municipal Wastewater Discharges

Permitted Entity	NPDES Permit	Current Load (2000-2003) (kg/yr)	Interim Allocation (kg/yr)	Final Allocation (kg/yr)
Sewerage Agency of Southern Marin	CA0037711	0.13	0.10	0.076
Sonoma Valley County Sanitary District	CA0037800	0.041	0.041	0.041
South Bayside System Authority	CA0038369	0.53	0.42	0.32
South San Francisco/San Bruno WQCP	CA0038130	0.29	0.24	0.18
Sunnyvale, City of	**CA0037621**	**0.15**	**0.12**	**0.12**
US Naval Support Activity, Treasure Island WWTP	CA0110116	0.026	0.026	0.026
Vallejo Sanitation & Flood Control District	CA0037699	0.57	0.46	0.34
West County Agency, Combined Outfall	CA0038539	0.38[c]	0.30	0.23
Yountville, Town of	CA0038121	0.040	0.040	0.04
Total		***17*** [b]	***14*** [b]	***11*** [b]

Bold text indicates advanced treatment
[a] This allocation includes wastewater treatment and all wet weather facilities.
[b] Total differs slightly from the column sum due to rounding.
[c] Mercury monitoring data quality concerns pertaining to this discharger will need to be addressed during the next review.

3. Revised Industrial and Petroleum Refinery Wastewater Allocations

Industrial wastewater and petroleum refinery wastewater allocations have been corrected after detection of a calculation error. Combined, industrial and petroleum refinery wastewater facilities discharge 1.3 kg/yr mercury to the Bay (SFBRWQCB 2006). This estimated current load is selected as the combined wasteload allocations for this group of dischargers.

Individual wasteload allocations for industrial and refinery wastewater facilities based on current loading are shown in Tables 3-2 and 3-3. An error in the industrial and petroleum refinery allocations, which resulted from an inadvertent overstatement of C&H Sugar mercury loads, has been corrected in the revised amendment. In the analysis for the mercury TMDL amendment, the mercury load from that facility was incorrectly computed because we included cooling water in the effluent volume. However, load calculations and allocations should be based only on that portion of effluent *not* used as once-through cooling water. A footnote added to Table 4-z in the revisions to the mercury TMDL amendment clarifies this point. Once-through cooling water is taken directly from the Bay so there is no net increase in mercury load to the Bay due to discharge of cooling water. Correcting the C&H Sugar facility error reduced the

combined industrial and petroleum refinery wastewater mercury load from 3 kg/yr to 1.3 kg/yr.

With this error corrected, revised individual and combined wasteload allocations are still equivalent to estimated current performance, and no load reductions are proposed for two reasons:

1) Total load from industrial facilities is only about 1 kg/yr (out of more than 1200 kg/yr reaching the Bay), so improvements in treatment systems will not result in substantial reductions in overall mercury load to the Bay.
2) The Water Board hypothesizes that these dischargers are already performing as well as or better than their counterparts elsewhere in California and the United States. The Water Board may consider reducing wasteload allocations for this source category in the future pending the outcome of a demonstration called for in the implementation plan that these facilities are already performing better than their counterparts elsewhere in the United States.

For the period 2000-2003, petroleum refineries contributed 68 percent of the mean annual mercury load discharged by industrial and petroleum refinery wastewater facilities. Therefore, individual wasteload allocations for non- petroleum refinery facilities were computed by allocating 32 percent of the total category wasteload allocations (1.3 kg) by the facility fraction of non- petroleum refinery mean mercury loading from 2000 through 2003 (SFBRWQCB 2006). The individual wasteload allocations for petroleum refineries were computed using the same allocation factors employed in the remanded TMDL applied to 68 percent of the total category wasteload allocations of 1.3 kg/yr (SFBRWQCB 2006).

TABLE 3-2: Individual Wasteload Allocations for Industrial (Non-Petroleum Refinery) Wastewater Discharges[c]

Permitted Entity	NPDES Permit	Allocation (kg/yr)
C&H Sugar Co.	CA0005240	0.0013
Crockett Cogeneration	CA0029904	0.0047
The Dow Chemical Company	CA0004910	0.041
General Chemical	CA0004979	0.21[a]
GWF Power Systems, Site I	CA0029106	0.0016
GWF Power Systems, Site V	CA0029122	0.0025
Hanson Aggregates, Amador Street	CA0030139	0.000005
Hanson Aggregates, Olin Jones Dredge Spoils Disposal	CA0028321	0.000005
Hanson Aggregates, Tidewater Ave. Oakland	CAA030147	0.000005
Pacific Gas and Electric, East Shell Pond	CA0030082	0.00063
Pacific Gas and Electric, Hunters Point Power Plant	CA0005649	0.020
Rhodia, Inc.	CA0006165	0.011
San Francisco, City and Co., SF International Airport Industrial WTP	CA0028070	0.051

TABLE 3-2: Individual Wasteload Allocations for Industrial (Non-Petroleum Refinery) Wastewater Discharges[c]

Permitted Entity	NPDES Permit	Allocation (kg/yr)
Southern Energy California, Pittsburg Power Plant	CA0004880	0.0078
Southern Energy Delta LLC, Potrero Power Plant	CA0005657	0.0031
United States Navy, Point Molate	CA0030074	0.013
USS-Posco	CA0005002	0.045
Total		***0.4*** [b]

[a] Data quality concerns pertaining to this discharger will need to be addressed during the next review.
[b] Total differs slightly from the column sum due to rounding.
[c] Wasteload allocations for industrial wastewater discharges do not include mass from once-through cooling water. The Water Board will apply intake credits to once-through cooling water as allowed by law.

TABLE 3-3: Individual Wasteload Allocations for Petroleum Refinery Wastewater Discharges

Permitted Entity	NPDES Permit	Allocation (kg/yr)
Chevron Products Company	CA0005134	0.34
ConocoPhillips	CA0005053	0.13
Martinez Refining Co. (formerly Shell)	CA0005789	0.22
Ultramar, Golden Eagle	CA0004961	0.11
Valero Refining Company	CA0005550	0.08
Total		***0.9***

4. Revised Implementation Plan for Urban Stormwater Runoff

Consistent with Resolved 5 of the Remand Order, Water Board staff has added a provision to the implementation plan section for Urban Stormwater Runoff dischargers requiring methylmercury monitoring through their NPDES permits. The added provision is:

> Monitor levels of methylmercury in discharges.

This addition will support research and investigations designed to determine 1) whether methylmercury is discharged in quantities that would cause environmental concern, and 2) whether there are local effects from methylmercury at locations where discharges may be occurring. Concentrations of methylmercury in urban runoff discharges and in receiving waters will be evaluated during the adaptive management review of the TMDL to determine the appropriate frequency for any continued monitoring.

Additionally, a sentence was removed from page 16 of the proposed Basin Plan amendment that suggested that urban runoff management agencies that comply with "permit requirements shall be deemed to be in compliance with receiving water limitations relative to mercury."

The deleted sentence is, strictly speaking, not necessary in this context. The receiving water limitations referenced in the deleted sentence state that "discharges shall not cause or contribute to violations of applicable water quality standards." Under State Board Order WQ. 99-05, the Water Board must require urban runoff management agencies via their NPDES permits to demonstrate compliance with receiving water limitations through the timely implementation of control measures and other actions designed to effectively reduce pollutants in discharges. By design, the urban stormwater wasteload allocations in the TMDL reflect the loads stormwater discharges must attain to manage their cause and contributions to violations of applicable water quality standards for mercury. The associated implementation plan provides a means for urban runoff management agencies, to the extent it results in attainment of the wasteload allocations, to demonstrate attainment of receiving water limitations.

5. Revised Implementation Plan for Municipal Wastewater

The implementation plan section of the Mercury TMDL Amendment pertaining to municipal wastewater discharges has been revised to improve clarity and respond to specific elements of the Remand Order. Staff has added language clarifying that municipal wastewater individual wasteload allocations shall be implemented in NPDES permits via both individual mass limits and a recalculated aggregate mass limit of 11 kg/yr, which is equal to the sum of individual municipal wastewater wasteload allocations. Staff deleted similar language that referred to the previous load allocation of 17 kg/yr. This change clarifies how the Water Board intends to implement the wastewater wasteload allocations through the NPDES watershed permit.

Staff has added specific language defining the expected time frame for achievement of interim and final individual load allocations as well as the manner in which the Water Board proposes to pursue enforcement if allocations are exceeded. Because load reductions are required, it is necessary to state a timeframe by which the allocations will be achieved. The rationale for the schedule is discussed below under changes to the Adaptive Implementation portion of the amendment. The Water Board will issue a watershed NPDES permit for mercury to all dischargers in Table 3-1 that contains water quality-based effluent limitations consistent with this time schedule for achievement of the interim and final wasteload allocations. In conjunction with approval of the proposed water quality objectives and the revised Mercury TMDL, the Water Board will also seek U.S. EPA approval of the 20-year final NPDES wastewater and stormwater allocation implementation schedules under 40 C.F.R § 131.13, which allows U.S. EPA to approve water quality standard implementation policies.

The new time frame language follows:

> The wasteload allocations for this source category shall be achieved within 20 years, and, as a way to measure progress, interim individual allocations equal to a 20 percent reduction from 2000-2003 annual mass discharge levels shall be achieved within 10 years. These interim allocations, shown in Table 4-x, shall be implemented via individual mass limits and an aggregate mass limit that is the sum of the individual interim allocations, 14 kg/yr. During the initial ten years, individual mass limits shall be the 2000-2003 annual mass discharge levels shown

in Table 4-x, and the aggregate mass limit is the sum of these individual mass discharge levels.

If any aggregate mass limit is exceeded, the Water Board will pursue enforcement actions against those individual dischargers whose mass discharges exceed their individual mass limits.

The last statement reflects the Water Board's intention to pursue enforcement action against dischargers that exceed their individual mass limit only if the aggregate mass limit is exceeded. This is essentially the same statement included in the Mercury TMDL Amendment, but it was revised for clarity and to reflect the revised wasteload allocations and effluent limitations proposed in this amendment.

Concern was expressed in testimony during the State Board hearings about the performance of Bay Area municipal treatment facilities compared to similar facilities in other states. While the required load reductions for this category have obviated the need for a rapid assessment of such comparative performance, the revised Mercury TMDL Amendment does call for an updated assessment of source control measures and treatment technologies aimed at reducing the amount of mercury discharged to the Bay. Staff modified the following language to clarify measures to be implemented through municipal wastewater NPDES permits.

- Develop and implement effective programs that include but are not limited to pollution prevention to control mercury sources and loading, a plan and schedule of actions and effectiveness measures applicable for the term of the permit, based on identification of the largest and most controllable sources and an updated assessment of source control measures and wastewater treatment technologies (the level of effort shall be commensurate with the mercury load and performance of the facility) and quantify the mercury load avoided or reduced;

Consistent with Remand Order Resolved 4, the Water Board will not, where it cannot, specify the manner of compliance with this or other requirements of the Mercury TMDL Amendment. Dischargers are responsible for investigating the sources and strategies for controlling those sources. For example, a major source of mercury to wastewater treatment plants is from dental offices (NACWA 2006). Efforts are already underway by municipal wastewater facilities to manage and reduce the amount of mercury amalgam that is discharged from dental offices into the public collection systems. The target for this program is that 85 percent of dental offices in the region will be participating in an amalgam program five years after full adoption of the TMDL.

The following wastewater requirement is unchanged from the Mercury TMDL Amendment but is now separated from the previously described requirement.

- Develop and implement effective programs to reduce mercury-related risks to humans and wildlife and quantify risk reductions resulting from these activities;

Consistent with Resolved 5 of the Remand Order, Water Board staff modified the following language to require methylmercury monitoring through municipal wastewater NPDES permits. The watershed mercury NPDES permit will require effluent monitoring for methylmercury by individual municipal wastewater dischargers, both to determine if methylmercury is being discharged and to support research and investigations designed to determine 1) whether methylmercury is discharged in quantities that would cause environmental concern, and 2) whether there are local effects from methylmercury at locations where discharges may be occurring. Effluent and receiving water methylmercury data will be evaluated during the adaptive management review of the TMDL to determine the appropriate frequency for any continued monitoring.

- Monitor levels of methylmercury in discharges;
- Prepare an annual report that documents mercury loads from each facility, mercury and methylmercury effluent concentrations, and ongoing source control activities, including mercury loads avoided through control actions.

To further ensure implementation of effective programs to control mercury sources and loading, staff has revised the conditions under which a municipal wastewater discharger will be required to submit an explanatory report regarding exceedance of trigger concentrations or mass. The Mercury TMDL Amendment stated that a discharger would be required to submit a report if its effluent exceeded *both* the individual mercury load allocation and an effluent mercury trigger concentration. The revised language calls for the submittal of a report if *either* the load allocation or trigger concentration is exceeded.

A clarification was added that the mass trigger would be based on a 12-month rolling average. Also, the passage of the proposed Basin Plan amendment describing the trigger program for municipal wastewater treatment dischargers was strengthened in a number of ways. First, it was explicitly stated that a corrective action plan must be implemented and that a report (following a trigger exceedance) must be submitted within 60 days. Second, two additional requirements for the submitted report were added:

- Evaluates other measures for preventing future exceedances, depending on the cause of an exceedance; and
- Includes an action plan and time schedule to correct and prevent trigger exceedances.

Last, a passage was added to this portion of the proposed Basin Plan amendment that stated that Water Board's intention to pursue enforcement action against dischargers that do not respond to exceedances of triggers or do not implement reasonable actions to correct and prevent trigger exceedances. Figure 3-1 illustrates that both municipal (discussed herein) and industrial (discussed below) individual effluent limits based on individual allocations are enforceable when aggregate limits are exceeded. Figure 3-2 illustrates that monthly concentration and mass triggers provide further accountability and corrective actions for both municipal and industrial dischargers.

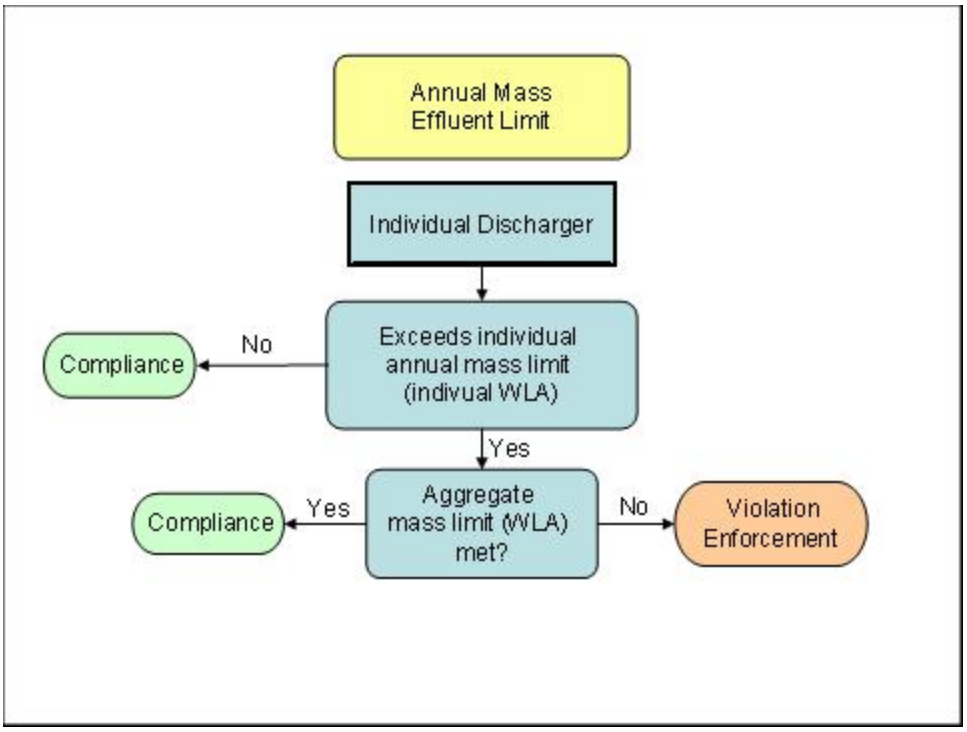

Figure 3-1: Enforceable Individual Wasteload Allocations (WLAs)

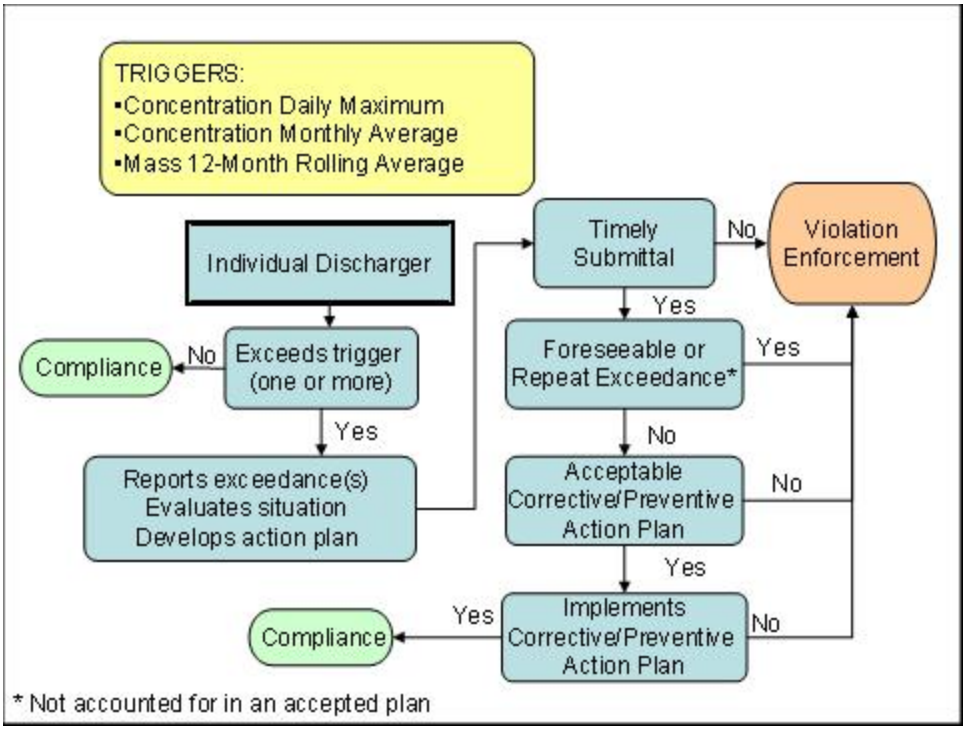

Figure 3-2: Enforceable Triggers

6. Revised Implementation Plan for Industrial Wastewater

The implementation plan section pertaining to industrial and petroleum refinery wastewater discharges has been edited to improve clarity as well as respond to elements of the Remand Order, including the State Board's request that measures addressing risk reduction be more clearly incorporated into the revised amendment. Staff has added language clarifying that individual industrial and petroleum refinery wastewater wasteload allocations shall be implemented both by individual mass limits and by a recalculated aggregate mass limit of 1.3 kg/yr. We have deleted similar language that referred to the previous load allocation of 3 kg/yr.

We have modified the following Basin Plan language to clarify measures to be implemented through industrial wastewater NPDES permits. An additional requirement has been added to demonstrate that discharge levels representing good performance support the Water Board's decision not to require load reductions.

- Develop and implement effective programs to control mercury sources and loading including demonstration that discharge levels represent good performance based on an updated assessment of source control measures and wastewater treatment technologies (the level of effort will be commensurate with the mercury load and performance of the facility) and quantify the mercury load avoided or reduced;
- Develop and implement effective programs to reduce mercury-related risks to humans and wildlife and quantify the risk reductions resulting from these activities;

Consistent with Resolved 5 of the Remand Order, Water Board staff has modified the following language to require methylmercury monitoring through industrial wastewater NPDES permits and those of petroleum refineries.

- Monitor levels of methylmercury in discharges;
- Prepare an annual report that documents mercury loads from each facility, mercury and methylmercury effluent concentrations, and ongoing source control activities, including mercury loads avoided through control actions.

To further ensure implementation of effective programs to control mercury sources and loading, we have changed the conditions under which an industrial wastewater discharger will be required to submit an explanatory report regarding exceedance of trigger concentrations or mass allocation. The Mercury TMDL Amendment stated that a discharger would be required to submit a report if it exceeded both the individual mercury load allocation *and* an effluent mercury trigger concentration. The revised language calls for the submittal of a report if either the load allocation or trigger concentration is exceeded. Additionally, changes identical to those made in the municipal wastewater section were also made in the section of the proposed Basin Plan

amendment describing the trigger program for industrial wastewater dischargers (see Figures 3-1 and 3-2 above). These changes state: the averaging period of the mass trigger; the obligation to implement a corrective action plan; the time frame of report submittal; the additional report requirements; and the Water Board's intent concerning enforcement.

7. Revised Implementation Plan for Sediment Dredging and Disposal

Consistent with Resolved 6 of the Remand Order, Water Board staff has added language to this provision in the implementation plan section for Sediment Dredging and Disposal. The Long-Term Management Strategy (LTMS) is documented in the *Management Plan 2001* (USACE et al., 2001). The additional language is as follows:

> All in-Bay disposal of dredged material shall comply with the Dredging and Disposal of Dredged Sediment program described in Chapter 4 and the Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region.

8. Revised Risk Management Provision

The Water Board has responded to Resolved 10 of the Remand Order by adding the following bullet item to the list of risk management activities:

- Investigate ways to address public health impacts of mercury in San Francisco Bay/Delta fish, including activities that reduce actual and potential exposure of and mitigate health impacts to those people and communities most likely to be affected by mercury in San Francisco Bay caught fish, such as subsistence fishers and their families.

9. Revised Adaptive Implementation Language

The following focusing question for adaptive management reviews has been added to the adaptive implementation section of the Mercury TMDL Amendment.

5. Do prey fish monitoring data confirm that TMDL load allocations are adequate to attain the wildlife target?

6. Are mercury mine and Bay margin contaminated site cleanups proceeding as expected? Are any additional actions needed to protect water quality?

This first additional question is necessary because the wildlife target is now stated as a mercury concentration in prey fish. Prey fish mercury concentration data are not currently available, although efforts are underway to collect such data. At this time it is not possible to verify that the reductions needed from current prey fish tissue concentrations are achievable with the load reductions called for by the TMDL. Monitoring efforts now being undertaken through the RMP will help make such a determination possible during the first review of the mercury TMDL.

Consistent with Remand Order Findings 7f and Resolved 7, this second additional question is necessary to ensure that legacy mercury sources are identified, inventoried, prioritized and remediated. Regarding mines, we note that the TMDL implementation plan for Mercury Mines adopted in 2004, states that, "(f)or those mines that are not currently meeting the conditions set forth in the Mines Program, responsible parties shall attain compliance within five years of the effective date of the San Francisco Bay mercury TMDL implementation plan."

The following passage has been added to the Adaptive Implementation section of the Mercury TMDL Amendment:

> Achievement of the wasteload allocations for municipal wastewater dischargers is required within 20 years, and interim allocations within 10 years. The interim allocations are expected to be attained though aggressive pollution prevention and other cost-effective mercury reduction methods. The final wasteload allocations are expected to be attained through wastewater treatment system improvements and/or implementation of a pollutant offset program. Approximately 10 years after the effective date of the TMDL or any time thereafter, the Water Board will consider modifying the schedule for achievement of the wasteload allocations or revisions to wasteload allocations if the State Board has not established a pollutant offset program that can be implemented within the 20 years required to achieve final wasteload allocations.

This passage provides the rationale for the timetable upon which the Water Board expects municipal dischargers to achieve interim and final wasteload allocations. It also references the Water Board's expectation of the development of an offset program by the State Board.

It is reasonable to anticipate wastewater treatment system improvements within 20 years for reasons other than the mercury TMDL. For example, other foreseeable regulatory drivers stemming from stricter air quality regulations for mercury or water quality concerns about emerging contaminants may well result in reduced mercury loads from wastewater facilities. During the first 10 years of implementation, we will be able to determine whether additional control measures or systems improvements are needed to achieve the 20-year wasteload allocation targets. If they are needed, such improvements can be financed, designed, constructed and brought into operation during the second 10-year period following adoption of the TMDL. In order to accomplish substantial systems improvements, communities must engage in a lengthy process that includes securing funding for new facilities, engineering design, construction, and permitting. The Water Board asserts that the second 10-year period following adoption of the TMDL is an appropriate and reasonable time frame to initiate and complete this process.

Consistent with Resolved 9 of the Remand Order, regarding expectation of the development of an offset program by the State Board. Water Board staff has added language to the Adaptive Implementation section of the Mercury TMDL Amendment.

The additional language is as follows:

> The Water Board will also include in any new or modified NPDES permit a reopener to implement a pollutant offset program when it is established.

IV. Regulatory Analyses

This section includes the analyses required by law for the adoption of new water quality objectives and for the proposed revisions to the Mercury TMDL Amendment. Subsections below provide an overview of the Project's compliance with California Water Code requirements; peer review requirements of Health and Safety Code §57004; federal and state antidegradation policies; and with CEQA.

1. California Water Code §§ 13241 and 13242

With respect to the proposed fish tissue water quality objectives,[1] the Water Board is authorized to adopt water quality objectives under California Water Code §13241 which identifies six factors that must be addressed when evaluating a water quality objective. These factors are considered below:

a) Past, present and probable future beneficial uses of water
b) Environmental characteristics of the hydrographic unit under consideration including the quality of water available thereto
c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area
d) Economic considerations
e) The need for developing housing within the region
f) The need to develop and use recycled water

a) Past, Present and Probable Future Beneficial Uses

Beneficial uses of San Francisco Bay are ocean, commercial, and sport fishing, estuarine habitat, industrial service supply, marine habitat, fish migration, navigation, industrial process supply, preservation of rare and endangered species, water contact recreation, noncontact water recreation, shellfish harvesting, fish spawning, and wildlife habitat. Beneficial uses of sport fishing, preservation of rare and endangered species, and wildlife habitat, are considered impaired due to mercury. When the proposed mercury water quality objectives are attained, these beneficial uses will be restored and protected.

b) Environmental Characteristics of the Hydrographic Unit

The hydrographic unit is San Francisco Bay. San Francisco Bay includes the following water bodies, as shown in Figure 4-1:

- Sacramento/San Joaquin River Delta (within San Francisco Bay region)

[1] The proposed water quality objectives are needed because they reflect current scientific understanding of mercury toxicity and so provide better protection to humans and wildlife than the existing objective, which was based on outdated science from over two decades ago. The proposed new objectives are clear, consistent with, and do not duplicate other statutes and regulations. They are expressed as numbers and therefore easily understood by affected persons.

- Suisun Bay
- Carquinez Strait
- San Pablo Bay
- Richardson Bay
- Central San Francisco Bay
- Lower San Francisco Bay
- South San Francisco Bay (including the Lower South Bay)

San Francisco Bay is a natural embayment in the Central Coast of California. With an average depth of six meters, the bay is broad, shallow, and turbid, which makes sediment an important factor in the fate and transport of pollutants. The movement of sediment within the bay is driven by daily tides, the spring-neap tide cycle, and seasonally variable wind patterns. About 150 years ago, during the California Gold Rush, hydraulic mining and dredging substantially altered the floor of the bay and mercury concentrations in Bay sediment. While still rebounding from those historic changes, the Bay is now affected by a growing metropolitan population of about 6.5 million people (USCB 2001).
The Bay is divided into two major hydrographic units, which are connected by the Central Bay to the Pacific Ocean. The northern reach is relatively well flushed because more than half of California's freshwater flows into the bay through the Sacramento and San Joaquin Rivers. In contrast, the southern reach receives more limited flushing from local watersheds.

c) Water Quality Conditions That Could Reasonably Be Achieved Through Coordinated Control of All Factors Affecting Water Quality

The proposed water quality objectives reflect the desired water quality conditions in San Francisco Bay such that beneficial uses will not be adversely affected by mercury. Factors that affect mercury water quality in San Francisco Bay include discharge of mercury from the Central Valley via the Sacramento and San Joaquin Rivers: the Guadalupe River; urban stormwater runoff; non-urban stormwater runoff; direct atmospheric deposition; municipal and industrial wastewater; contaminated sites at the Bay margin; sediment dredging and disposal in San Francisco Bay; and erosion of San Francisco Bay sediments. Other key factors are methylmercury discharge and production and its fate and transport within San Francisco Bay. All of these factors are recognized in the revised Mercury TMDL Amendment, which by design provides a program of coordinated control of these factors, via its TMDL, allocations and implementation plan. Compliance will result in attainment of the proposed water quality objectives.

d) Economic Considerations

The proposed fish tissue water quality objectives will be implemented through the Mercury TMDL as proposed to be revised. Therefore, the economics for the proposed water quality objectives can be considered by taking into account 1) the cost of compliance with the Mercury TMDL, which was analyzed in the Staff Report for the Mercury TMDL Amendment adopted by the Water Board in September 2004 and is

excerpted below, and 2) the costs associated with the additional requirements of the proposed Mercury TMDL revisions.

The 2004 Staff Report for the Mercury TMDL Amendment states as follows regarding economic costs:

> The economic costs of implementing the proposed Basin Plan Amendment are considered below. The discussion is organized by mercury source and monitoring and other data collection activities. All costs discussed below are only rough estimates. Expected costs are difficult to estimate because, although the proposed Basin Plan Amendment explains how the TMDL will be implemented, it does not prescribe the exact actions the parties responsible for implementing the TMDL must take to meet the allocations. A menu of options exists from which entities can choose. In many instances, selecting the most appropriate action will require obtaining information that is currently unavailable. Therefore, this economic analysis is primarily qualitative. The word "substantial" is used to refer to major economic burdens (e.g., on the order of $1 million or more). Quantitative information is included where available.
>
> *Bed Erosion*. Because bed erosion is a natural process due to uncontrollable factors, the Basin Plan Amendment does not prescribe any implementation actions to reduce the bed erosion mercury load. Therefore, there are no economic costs associated with reducing this load.
>
> *Central Valley Watershed*. To achieve the Central Valley watershed's proposed load allocation, the proposed Basin Plan Amendment relies primarily on mercury TMDL projects being completed for mercury in Central Valley impaired water bodies. The costs of preparing and implementing these TMDLs will likely be substantial. For example, the Central Valley watershed contains a number of waterbodies affected by mining, and remediating them could be costly. In addition, the costs of controlling urban storm water runoff in the Central Valley could be similar to those for the Bay Area (see below) because the populations and urbanization of the two regions are similar (USCB 2001). As shown in Table 9.2, the Central Valley Regional Water Quality Control Board has estimated unit costs for a number of mercury reduction options (USGS 2003c). The Central Valley Regional Water Quality Control Board has not yet estimated how many units of each type of activity will be needed.
>
> The Clean Water Act requires that the Central Valley TMDLs be completed whether or not the proposed Basin Plan Amendment for mercury in San Francisco Bay is approved. Therefore, the substantial costs associated with preparing and implementing the Central Valley TMDLs will occur with or without this proposed Basin Plan Amendment.

FIGURE 4-1: Map of San Francisco Bay Estuary

Eight unique segments of San Francisco Bay appear on the 303(d) list of impaired water bodies: Sacramento/San Joaquin River Delta, Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, Central San Francisco Bay, Lower San Francisco Bay, and South San Francisco Bay. Three additional mercury-impaired water bodies exist within these segments: Castro Cove, Oakland Inner Harbor, and San Leandro Bay.

Whether implementing the Central Valley TMDLs will cost more than they otherwise would because of the San Francisco Bay mercury TMDL is unknown. Economic considerations related to the Central Valley TMDLs will be evaluated when those TMDLs are proposed for adoption.

Urban Storm Water Runoff. The specific means by which urban storm water runoff management agencies will achieve their proposed wasteload allocations are unknown. Representatives of the Santa Clara Valley Urban Runoff Pollution Prevention Program have estimated that mercury TMDL-related activities will cost Santa Clara County municipalities roughly $0.33 per capita to initiate and roughly $0.42 per capita per year for ongoing operations (EOA 2003b). The Bay Area population is about 6.5 million (USCB 2001). If the Santa Clara Valley costs are representative of the Bay Area as a whole, mercury TMDL-related costs could exceed $2 million to initiate programs and roughly $3 million per year for ongoing operations. These estimates do not include waste disposal costs (e.g., disposal of mercury-containing sediment or consumer wastes) or costs for environmental monitoring. In addition, these estimates do not account for the potentially greater relative costs of newer and smaller urban runoff management programs. According to Santa Clara Valley Urban Runoff Pollution Prevention Program staff, actual costs could be roughly 10 times higher (EOA 2003b).

The costs of existing urban storm water runoff management programs are substantial. Assuming that they cost up to $18 per household (LARWQCB 2003), and that there are about 2.5 million households in the Bay Area (ABAG 2003), the Bay Area currently spends roughly $45 million per year specifically to manage urban storm water runoff (not including related activities that would occur with or without urban runoff permits). Although the additional costs to urban stormwater management programs associated with the proposed Basin Plan Amendment are unknown, they would likely range from $5 million per year to $500 million per year (Looker & Johnson 2004c) . These costs would cover a range of pollutants, including mercury, and would offer stream protection and flood management benefits as well. In accordance with existing storm water permits, urban runoff management agencies have already begun to implement mercury reduction measures. Many TMDL implementation activities could be accommodated within existing budgets by reprioritizing some activities. The extent to which this is possible is unknown.

Guadalupe River Watershed (Mining Legacy). To achieve the Guadalupe River watershed's proposed load allocation, the Basin Plan Amendment relies primarily on the TMDL project currently underway for mercury in the Guadalupe River. The costs of preparing and implementing this TMDL will likely be substantial because significant reductions are

needed. However, the Clean Water Act requires that the Guadalupe River TMDL be completed whether or not the proposed Basin Plan Amendment for San Francisco Bay is approved. Therefore, the substantial costs associated with preparing and implementing the Guadalupe River TMDL will occur with or without the proposed San Francisco Bay Basin Plan Amendment. Whether the Guadalupe River TMDL will cost more than it otherwise would because of the San Francisco Bay TMDL is unknown. Economic considerations related to the Guadalupe River TMDL will be evaluated when that TMDL is proposed for adoption.

Atmospheric Deposition. The Basin Plan Amendment does not include any implementation actions to control atmospheric deposition. The Basin Plan Amendment calls for additional study, and if appropriate, specific actions could be considered. The costs of undertaking such studies are discussed below.

Non-Urban Storm Water Runoff. The Basin Plan Amendment does not include any implementation actions to address non-urban storm water runoff because this is a natural process and sediment mercury concentrations are already close to pre-mining conditions (SFBRWQCB 2003f). Therefore, there are no economic costs to address non-urban storm water runoff.

Wastewater. Wastewater facilities are already meeting their wasteload allocations; therefore, the cost of implementing the Basin Plan Amendment would essentially be limited to the costs of implementing new pollution prevention measures. Most wastewater facilities are already implementing mercury pollution prevention programs. The cost of implementing these and additional programs has been estimated to be greater than $8 million (LWA 2002); however, this estimate may be high considering similar estimates for urban storm water runoff programs (discussed above).

Sediment Dredging and Disposal. The Basin Plan Amendment assumes that the Long Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS) will be implemented with or without the Basin Plan Amendment. The LTMS is expected to result in substantial costs as less dredged material is disposed of in the bay and more is disposed of in the ocean or at upland sites. These costs, however, would not result from any requirements contained in this proposed Basin Plan Amendment.

Mercury Mines. The Basin Plan's mines program will be implemented with or without this proposed Basin Plan Amendment. There are no new economic costs to address mercury mines.

Bay Margin Contaminated Sites. The Basin Plan's toxic site cleanup program will be implemented with or without this proposed Basin Plan Amendment. There are no economic costs to address bay margin contaminated sites.

Wetlands. Opportunities may exist to minimize mercury methylation in wetlands. Additional study is necessary before the most effective options can be determined. The costs of undertaking pilot studies could be substantial.

Risk Management. The Basin Plan Amendment calls for enhancing risk management efforts to minimize human exposure to mercury from San Francisco Bay fish. These efforts could be coordinated with the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, and other entities. Assuming that this coordination could require as much as 0.2 person-years each year, the cost could be roughly $20,000 per year. This investment in staff time could yield dividends by securing grant funds.

Adaptive Management. The Basin Plan Amendment calls for the Water Board to refine and reconsider the mercury TMDL about every five years. Adaptively managing the TMDL in this way will require Water Board staff time, monitoring, and scientific studies. The Basin Plan Amendment calls for a number of studies to help refine the TMDL through adaptive management. The costs of the studies will depend, in part, on available resources and the results of the initial studies. The 2004-2005 Clean Estuary Partnership budget contains over $170,000 specifically for mercury-related studies (AMS 2003). The Basin Plan Amendment calls for continued monitoring through the Regional Monitoring Program for Trace Substances (RMP). The 2003 RMP budget is about $3.4 million, with $1.7 million allotted for status and trends monitoring and $0.5 million allotted for pilot and special studies (SFBRWQCB 2003i). The RMP already measures mercury in sediment and fish tissue; therefore, the additional monitoring costs associated with implementing the Basin Plan Amendment would be minimal. Pilot projects and special studies could probably be accommodated within the existing budget. The U.S. Fish and Wildlife Service already measures mercury in bird eggs; therefore, the additional costs of implementing the proposed Basin Plan Amendment would be minimal.

The costs associated with the requirements of the proposed revisions to the Mercury TMDL Amendment are costs associated with the more stringent wasteload allocations for municipal wastewater and additional implementation actions such as requiring municipal and industrial wastewater treatment facilities to develop and implement programs to reduce mercury-related risks to humans and wildlife and to conduct methyl mercury monitoring. The corrected wasteload allocations for industry do not implicate any new

requirements because the allocations still represent an estimate of current loading, rather than reductions, and facilities will be able to maintain current loading using methods already in place. Thus, no additional expenditures would result.

With respect to wastewater's allocation, the TMDL revisions propose a final allocation of 11 kg, as opposed to 17 kg which was adopted by the Water Board in the 2004 TMDL. As set forth the in the 2004 Mercury TMDL Amendment Staff Report, efforts necessary to comply with the 17 kg allocation were projected to be limited to implementing additional pollution prevention measures, and that the cost of implementing these and additional programs had been generously estimated to be greater than $8 million (citing LWA 2002). On top of these efforts, compliance with the proposed revised 11 kg allocation is expected through a combination of aggressive pollution prevention and other mercury reduction methods, water re-use, pollutant trading, offsets, and/or system improvements and upgrades. The costs of compliance are difficult to estimate with any certainty because it is unknown exactly how the wastewater community will choose from its menu of options. It is likely that the wastewater community will seek and employ the most efficient and cost-effective strategies to comply with the more stringent wasteload allocations. Arguably the most expensive manner of compliance would be for all Bay Area municipal treatment facilities not already providing advanced treatment (filtration) to upgrade to that level of treatment; however, the municipal wastewater treatment plants without advanced treatment facilities have indicated through BACWA that "[i]t is not the expectation that the reductions from 14 kg/yr to 11 kg/yr of mercury would require the investment of tens of millions of dollars per year to build and operate advance wastewater treatment where it does not exists. Although the technology exists to reduce the effluent loading, the cost of such technologies is not at all reasonable. BACWA is committed to a periodic review of treatment technologies and enhancements to determine if new reasonable and feasible approaches to reducing the mercury in effluent are developed." In any case, The additional yearly cost associated with this upgrade (even though it is not a reasonably foreseeably method of compliance) has been estimated at approximately $80 million (LWA 2002). This scenario is more of a theoretic possibility and the cost is the upper bound on the cost of compliance with the load reductions for municipal wastewater discharges. Furthermore, the upgrades, if they were to occur, would likely be in response to other regulatory drivers, such as stricter air quality regulations for mercury or water quality concerns from emerging contaminants which may result in reduced mercury loads from wastewater facilities.

The costs associated with additional programs to reduce mercury-related risks to humans and wildlife are difficult to estimate because the TMDL does not specify the composition of the strategies to reduce such risks. However, there are already efforts underway to examine mercury and other chemicals in fish in the Bay-Delta watershed, increase public awareness of fish contamination issues, and monitor potential changes in mercury concentrations from marsh restoration projects in the Delta (SFEI 2006). The total cost for these Delta-related efforts is $4.5 million. If similar efforts are undertaken focusing on the Bay, this cost can provide a frame of reference for the total incurred expense.

The costs related to the additional monitoring requirements are not significant. Total mercury effluent monitoring was required for discharges to San Francisco Bay prior to the TMDL. The proposed revised TMDL requires that wastewater effluent discharges and urban storm water runoff be monitored for methylmercury. Methylmercury sample collection procedures and multi-step laboratory analysis make it a relatively labor-intensive and higher cost analytical parameter. Nonetheless, the relatively few and generally low frequency of methylmercury samples within the overall wastewater and urban storm water sampling programs means it is a fraction of the overall monitoring program cost. The projected cost is no more than $180,000 per year, assuming each of the monthly samples costs $200 (Hamilton 2006), and every NPDES permittee (storm water and wastewater) conducts monthly sampling.

The proposed water quality objectives and revisions to the TMDL have not changed the fish, bird egg, and sediment sampling programs greatly (if at all); therefore, the additional monitoring costs associated with the proposed water quality objectives and revisions to the TMDL would be minimal.

e) Need for Housing

Neither of the proposed water quality objectives would restrict the development of housing in the San Francisco Bay Area because they do not result in any economic costs related to housing development. The reduced wastewater wasteload allocations may result in economic costs due to wastewater treatment system improvements. Municipal wastewater treatment capacity is often designed to accommodate a large percentage of possible housing development in the collection area. Wastewater treatment system improvements may be necessary to accommodate housing development because the wasteload allocations are based on current performance, not plant design capacity. It is reasonable to assume that wastewater treatment system improvements will be undertaken over the next one to two decades for a range of reasons including replacing aging infrastructure, TMDLs for other pollutants, and other regulatory actions unrelated to the Clean Water Act. Historically, the state and federal governments have provided the majority of the funding for wastewater treatment system improvements, with contributions also made by landowners. It is unlikely that treatment system costs alone would restrict the development of more than a few housing units in the San Francisco Bay Area.

f) Need to Develop and Use Recycled Water

There are no present restrictions on recycling of water due to mercury. The intent of the proposed water quality objectives is to improve water quality and reduce mercury levels in San Francisco Bay. The proposed objectives, therefore, are consistent with the need to develop and use recycled water.

In addition to the requirements of California Water Code §13241, California Water Code §13242 requires a program for achieving water quality objectives, including but not limited to a description of the nature of actions necessary to achieve the objectives; recommendations for appropriate action by any entity, public or private; a time schedule for the actions to be taken; and a description of surveillance to be undertaken in order to determine compliance with the objectives.

The program of implementation to achieve the proposed water quality objectives for mercury in San Francisco Bay is the Mercury TMDL Amendment, as proposed to be revised. As revised, the proposed TMDL Implementation Plan still calls for a 50 percent reduction in sediment mercury concentrations. The Mercury TMDL Amendment assumes a one-to-one relationship between sediment mercury and fish tissue mercury: A 40 percent reduction in striped bass mercury concentrations is needed to meet the human health target of 0.2 ppm mercury in 60-cm striped bass muscle tissue, and a 25 percent reduction in prey fish mercury concentrations is needed to meet the wildlife target of 0.03 ppm in 3–5 cm fish. Attaining these targets, through implementation of the mercury TMDL, will attain both the human health and wildlife mercury water quality objectives. The one-hour average water column mercury objective is already attained.

The Mercury TMDL, as proposed to be revised, also spells out appropriate actions by public and private entities, a time schedule for actions to be taken and sets forth means to determine compliance with the proposed water quality objectives.

2. Peer Review and Sound Scientific Rationale

The revised Mercury TMDL Amendment will establish a new total maximum daily load and water quality objectives for mercury in San Francisco Bay. The basis of the regulatory portions of all TMDLs and water quality objectives are subject to the scientific peer review provisions of Health and Safety Code §57004. The "scientific portions" of the Mercury TMDL Amendment, proposed revisions to the Mercury TMDL Amendment, and proposed water quality objectives have already undergone the scientific peer review required by the Health and Safety Code. As a result, the Water Board has fulfilled Health and Safety Code §57004 requirements.

Certain water quality policies adopted pursuant to the Porter-Cologne Water Quality Control Act are subject to the peer review requirements of Health and Safety Code §57004. (Health & Saf. Code, §57004, subd. (a)(1)(B)) Historically, the State Water Resources Control Board (State Board), which must approve all revisions to water quality control plans, has construed §57004 to cover Basin Plan amendments. Health and Safety Code §57004 requires the scientific portion of Basin Plan amendments to undergo external scientific peer review before the Regional Board takes final action on the amendment. (*Id.*, §57004, subd. (d).)

The scientific portion of a rule consists of "foundations of a rule that are premised upon, or derived from, empirical data or other scientific findings, conclusions, or assumptions establishing a regulatory level, standard, or other requirements for the protection of public health or the environment." (Health & Saf.Code, §57004, subd. (a)(2).) The California Environmental Protection Agency (Cal/EPA) has described this review as an objective, critical review of a draft Agency scientific work product. Taken together, it is clear that Health and Safety Code §57004 is designed to ensure that the scientific assumptions of a rule are tested by external peer review.

The scientific portions and basis of the revised Mercury TMDL Amendment and proposed water quality objectives for mercury in San Francisco Bay were peer-reviewed in connection with the Mercury TMDL Amendment, adopted by the Water Board in September 2004, and the Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch mercury TMDL, adopted by the Central Valley Regional Water Quality Control Board (Cooke et al. 2004). Proposed revisions to the Mercury TMDL Amendment include revised wastewater wasteload allocations, for which the scientific basis were peer reviewed in connection with the Mercury TMDL Amendment. The scientific basis of the proposed mercury water quality objectives and the revised TMDL wildlife numeric target were peer-reviewed in connection with the Mercury TMDL Amendment and/or the water quality objectives adopted concurrently with the Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch mercury TMDL. Further details are provided below.

Wastewater Wasteload Allocations

A peer review of the scientific basis of the wasteload allocations and implementation requirements of the September 2004 Mercury TMDL Amendment was conducted in accordance with the requirements of Health and Safety Code §57004. Proposed revisions to the TMDL include reduced wasteload allocations for wastewater discharges. The scientific basis for the revised allocations is the same as for those in the Mercury TMDL Amendment that were peer reviewed and subsequently adopted by the Water Board. The peer-reviewed documents included analysis of empirical data (wastewater discharge data), application of a one-box mass budget model of San Francisco Bay, and analysis of the linkage between sources and the numeric targets of the TMDL. The combined outcome of these analyses was a demonstration that allocations based on existing discharge levels could be justified as well as more conservative (lower) allocations. This renders the determination of the allocations to a policy not a scientific decision. The implementation requirements of the revised TMDL are essentially the same as those of the existing TMDL. Actions necessary to meet the lower wasteload allocations of the revised TMDL are the same as those already required by or considered in establishing the existing TMDL requirements.

Mercury Water Quality Objective to Protect Human Health

The proposed mercury water quality objective to protect human health (0.2 mg mercury per kg fish) was adopted in 2004 by the Water Board in the Mercury TMDL Amendment as a TMDL target. The scientific basis for the target was peer reviewed prior to adoption by the Water Board. The target is derived using the methodology recommended by USEPA, which was scientifically peer-reviewed as part of the development of USEPA's water quality criterion of 0.3 mg mercury per kg fish. As recommended by USEPA in the documentation for this criterion, San Francisco Bay specific fish consumption data are used in the derivation of the proposed mercury water quality objective.

Mercury Water Quality Objective to Protect Wildlife

The proposed wildlife water quality objective, 0.03 mg mercury per kg fish, applies to fish three to five centimeters in length. This value was adopted by the Water Board in 2004 in the Mercury TMDL Amendment as an alternative TMDL target for demonstrating protection of wildlife and was peer reviewed prior to adoption by the

Water Board. The Mercury TMDL Amendment specifies a numeric target of < 0.5 mg mercury per kg bird egg to protect the California Least Tern, the most sensitive wildlife species in the Bay. The Mercury TMDL Amendment also recognizes that "According to the US Fish & Wildlife Service (USFWS), the sensitive and endangered California least tern will be protected if the average mercury concentration in the fish it consumes does not exceed 0.03 mg per kg fish tissue (wet weight)." The Mercury TMDL Amendment also includes monitoring of prey fish mercury concentrations as an alternative method of demonstrating protection of wildlife (the purpose of the bird egg target).

The scientific basis for this water quality objective is an approach developed by the USFWS that was peer reviewed in connection with the Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch mercury TMDL. The USFWS approach considers mercury's capacity to bioaccumulate and biomagnify in the aquatic food chain, assumed that upper trophic level wildlife species (i.e. predatory birds and mammals) have the greatest inherent risk from exposure to mercury, and evaluated federal listed species, including the California least tern. USFWS reviewed the scientific literature to determine the body weight and consumption habits (dietary composition, food ingestion rates) of these species at greatest risk and calculated a safe mercury concentration as follows:

$$\text{Acceptable mercury level in fish tissue} = \frac{\text{Safe daily intake (reference dose) X Consumer's body weight}}{\text{Consumption rate}}$$

The proposed water quality objective, 0.03 mg mercury per kg fish consumed by wildlife, is based on the USFWS method. USFWS concludes that in San Francisco Bay California least tern consume fish (topsmelt, jacksmelt, and northern anchovy) less than 5 cm in length and a safe mercury level in their prey is 0.03 mg/kg (USFWS 2003).

3. Antidegradation

The numeric targets and proposed water quality objectives must be consistent with antidegradation policies. Title 40 of the Code of Federal Regulations (§131.12) contains the federal antidegradation policy. State Water Resources Control Board Resolution 68-16 contains California's antidegradation policy. These antidegradation policies are intended to protect beneficial uses and the water quality necessary to sustain them. When water quality is sufficient to sustain beneficial uses, it cannot be lowered unless doing so is consistent with the maximum benefit to the citizens of California. Even then, water quality must sustain existing beneficial uses.

The two proposed Basin Plan water quality objectives for mercury in fish tissue reflect current scientific understanding and are more stringent than the existing Basin Plan four-day average total mercury objective of 0.025 µg/l. The proposed fish tissue objectives address the current understanding of mercury bioaccumulation and include estimated "bioaccumulation factors" (BAFs) to describe mathematically how mercury is concentrated up the food chain from one trophic level to the next. The existing Basin Plan objective is based on science from over two decades ago, which used "bioconcentration factors" (BCFs) which described how mercury concentrated from water into an aquatic species, but did not describe the bioaccumulation across trophic

levels. This objective was also based on 1 ppm in fish tissue, and both the proposed objectives are more stringent (0.2 and 0.03 ppm).

The numeric TMDL targets are designed to attain the existing Basin Plan narrative water quality objective for bioaccumulation and the two proposed Basin Plan water quality objectives for mercury in fish tissue. (As noted in Attainment of Standards, above, the Basin Plan one-hour numeric objective and CTR objective are not exceeded.) The two fish tissue targets are consistent with the two proposed Basin Plan objectives. Since mercury concentrations in biota already exceed conditions of the narrative bioaccumulation objective and two proposed objectives, meeting the numeric TMDL targets will attain water quality standards. Therefore, the proposed targets are consistent with the antidegradation policies and the protection of water quality and beneficial uses.

4. California Environmental Quality Act (CEQA)

CEQA requires agencies to review the potential for their actions to result in adverse environmental impacts. CEQA further requires agencies to adopt feasible measures to mitigate significant impacts. The water quality planning process is a certified regulatory program approved by the Secretary of Resources as functionally equivalent to and exempt from CEQA's requirements for preparation of an environmental impact report or negative declaration. As part of that regulatory program, the State Board's regulations at 23 Cal. Code of Regs. §3720 et seq. require any standard, rule, regulation or plan proposed for board approval to be accompanied by a completed Environmental Checklist and a written report containing (1) a brief description of the proposed activity; (2) reasonable alternatives to the proposed activity and (3) mitigation measures to minimize any significant environmental impacts of the proposed activity. Upon completion of the written report, the Water Board is required to provide a Notice of Filing of the report to the public.

This Staff Report is the written report required by the State Board's regulations. This subsection contains the CEQA analyses required for *both* the proposed water quality objectives and the proposed revisions to the Mercury TMDL.[2] Specifically, the Project analyzed herein and in the attached Environmental Checklist for potential environmental impacts is (for reader ease, the Project description is repeated here from part I. Introduction):

Project Description

The Project consists of the following changes to the Mercury TMDL Amendment:

1) Establish two numeric mercury water quality objectives for all segments of San Francisco Bay
    - To protect people who consume Bay fish (applies to larger fish consumed by humans): 0.2 mg mercury per kg fish tissue (average wet weight concentration,

[2] The environmental analyses for the Mercury TMDL Amendment were completed and adopted by the Water Board when it adopted the original amendment on September 15, 2004; however, since revisions are now proposed to that amendment, an environmental impact analyses associated with those revisions is necessary.

measured in edible portions (muscle tissue) of trophic level 3 and trophic level 4 fish)

- To protect aquatic organisms and wildlife (applies to small fish consumed by birds): 0.03 mg mercury per kg fish (average wet weight concentration measured in whole fish 3–5 cm in length)

2) Vacate (i.e. remove) the water column four-day average mercury water quality objective for San Francisco Bay
3) Clarify TMDL targets as follows, in line with objectives stated above:
   - "To protect sport fishing and human health, the average mercury concentration in 60-cm striped bass muscle tissue shall not exceed 0.2 mg mercury per kg fish tissue (wet weight)."
   - "To protect aquatic organisms and wildlife, the concentration of mercury shall not exceed 0.03 ppm, wet weight average, in whole fish 3–5 cm in length."
   - The bird-egg target is a monitoring target.
4) Revise wasteload allocations and the implementation plan for wastewater sources, including:
   - Clarify the pollution prevention requirements for municipal wastewater
   - Establish more stringent wasteload allocations for municipal wastewater dischargers, to be implemented via individual mass limits and aggregate mass limits and incorporating ten-year interim and twenty-year final implementation schedules
   - Correct the wasteload allocations for industrial wastewater
   - Impose more stringent application of compliance triggers for both industrial and municipal wastewater
   - Require municipal and industrial wastewater and urban stormwater to conduct methylmercury monitoring
5) Add a statement to the dredging section of the Mercury TMDL Amendment clarifying the Water Board's intent that all dredging activities in the Bay comply with the Long Term Management Strategy.
6) Expand risk management activities to include investigation of ways to address public health impacts of mercury on people and communities most likely to be affected by mercury in San Francisco Bay-Delta caught fish, such as subsistence fishers and their families

As explained in the Environmental Checklist, the proposed Project will not have any significant adverse environmental effects and no mitigation measures are proposed.

Despite the lack of significant adverse environmental effects, State Board's CEQA regulations require consideration of a reasonable range of feasible alternatives to the proposed activity. Under CEQA, the purpose of an alternatives analysis is to focus on alternatives to the project which are capable of avoiding or substantially lessening any significant effects of the project even if these alternatives would impede to some degree the attainment of the project objectives or would be more costly.

The Project objectives include:

1. Comply with the State Board remand so that the Mercury TMDL can be approved by State Board, Office of Administrative Law, and USEPA.
2. Replace the outdated 4-day marine mercury water quality objective with new objectives that protect human health and wildlife.
3. Commence implementation of the Mercury TMDL as soon as possible.
4. Implement the proposed water quality objectives in the most efficient manner, i.e., via Mercury TMDL implementation.

Alternatives

The alternatives to the project are: (1) take no action, (2) adopt the CTR mercury criterion as a water quality objective and target, (3) adopt USEPA methylmercury criterion as a water quality objective and target; or (4) adopt the proposed new water quality objectives with no revisions to the 2004 adopted TMDL.

Alternative 1: No Action

Under this alternative, the Water Board would not adopt the two proposed water quality objectives for mercury in fish tissue nor vacate the four-day average total mercury water column objective nor revise the Mercury TMDL. The no action alternative would be inconsistent with State Board Resolution No. 2005-0060 and the Mercury TMDL Amendment would likely not be approved by both the State Water Board and USEPA. This alternative would not meet the Project objectives and would not address San Francisco Bay's mercury impairment. Assuming no action were ever taken to address the Bay's mercury impairment, sediment mercury concentrations would likely decrease eventually due to existing processes, including foreseeable changes in the bed erosion mercury load. However, the bay-wide sediment mercury concentration would probably not reach levels consistent with applicable water quality objectives. As shown in Figure 7.2, the sediment mercury concentration would decline from about 0.44 ppm to about 0.22 ppm over a period of more than 200 years.

Under the no action alternative, USEPA may end up adopting a mercury TMDL on its own. The requirements of such a TMDL are unknown and therefore it would be speculative to analyze the environmental impacts of such a scenario. USEPA would likely rely, at least in part, on analyses completed to date; however, USEPA would be free to develop its own TMDL in any manner it deemed appropriate, within legal constraints. USEPA would identify targets and allocate mercury loads. USEPA would not impose an implementation plan directly. However, the Water Board would be expected to incorporate USEPA's TMDL and appropriate implementation actions into the Basin Plan through the continuing planning process.

Alternative 2: Adopt the CTR Mercury Criterion as an Objective and Target

Alternative 2 consists of:

- Adoption of the CTR criterion of 0.051 ug/l as a water quality objective and numeric target for mercury in San Francisco Bay
- Deletion of the existing Basin Plan Table 3-3's 4 day average water quality objective (0.025 ug/l) for mercury
- Adoption of the proposed revised Mercury TMDL Amendment

Under this alternative, the Water Board would not adopt the two proposed water quality objectives for mercury in fish tissue, but rather would adopt the CTR criterion, and would vacate the four-day average total mercury in water objective and revise the Mercury TMDL. The CTR criterion is not based on local consumption data, and therefore does not provide adequate protection of human health for consumption of fish from San Francisco Bay. The CTR criterion does not provide adequate protection of San Francisco Bay wildlife. This CTR criterion alternative would be inconsistent with State Board Resolution No. 2005-0060. Thus, taking the above into consideration, this alternative would not meet the project goals and would not address San Francisco Bay's mercury impairment and it is a less environmentally protective alternative than the proposed Project.

Alternative 3: Adopt USEPA Methylmercury Criterion as an Objective and Target

Alternative 3 consists of:

- Adoption of the USEPA methylmercury criterion of 0.3 mg mercury per kg fish as a water quality objective and numeric target for mercury in San Francisco Bay
- Deletion of the existing Basin Plan Table 3-3's 4 day average water quality objective (0.025 ug/l) for mercury
- Adoption of the revised Mercury TMDL Amendment

Under this alternative, the Water Board would not adopt the two proposed water quality objectives for mercury in fish tissue, but rather would adopt the USEPA methylmercury criterion, and would vacate the four-day average total mercury water column water quality objective and adopt the revised Mercury TMDL Amendment. The USEPA methylmercury criterion is not based on local consumption data, and as discussed above, does not provide adequate human health protection for consumption of fish from San Francisco Bay. The USFWS has concluded that the USEPA methylmercury criterion does not adequately protect at least one wildlife species in San Francisco Bay, the California least tern (USFWS 2003). This USEPA methylmercury criterion alternative would be inconsistent with State Board Resolution No. 2005-0060. This alternative would not meet the project goals and would not address San Francisco Bay's mercury impairment. It is less a less environmentally protective alternative than the proposed Project.

Alternative 4: New Water Quality Objectives and Previous TMDL

Alternative 4 consists of:

- Adoption of the two proposed water quality objectives for mercury in fish tissue as water quality objectives and numeric targets for mercury in San Francisco Bay
- Deletion of the existing Basin Plan Table 3-3's 4-day average water quality objective (0.025 ug/l) for mercury
- Not revising the September 2004 Mercury TMDL Amendment

Under this alternative, the Water Board would adopt the two proposed water quality objectives for mercury in fish tissue, vacate the four-day average total mercury in water objective and not revise the September 2004 Mercury TMDL Amendment. The TMDL would stand as the implementation plan for the new water quality objectives. Because this alternative would not address the concerns stated in State Board Resolution No. 2005-0060, the Mercury TMDL Amendment would likely not be approved by the State Water Board. This alternative would not meet the project goals and would not address San Francisco Bay's mercury impairment. It is also less environmentally protective than the proposed Project.

Reasonably Forseeable Methods of Compliance

CEQA additionally requires that whenever a Water Board adopts a rule that requires the installation of pollution control equipment or establishes a performance standard or treatment requirement, it must conduct an environmental analysis of reasonably foreseeable methods of compliance. This analysis must take into account a reasonable range of factors, including economics. The proposed project includes performance standards (i.e., water quality objectives and an additional wildlife target and more stringent waste load allocations for wastewater) and therefore requires an environmental analysis of the reasonably foreseeable methods of compliance with these standards, including economics.

Compliance with the proposed water quality objectives will occur through compliance with the Mercury TMDL. The environmental analyses presented in the Environmental Checklist and this Staff Report and the 2004 Mercury TMDL Amendment Staff Report and its companion Environmental Checklist account for potential environmental impacts associated with complying with the Mercury TMDL, as proposed to be revised. With respect to economics, the costs associated with complying with the proposed Project are evaluated above under the California Water Code §13241 Economic Considerations discussion.

References

California Department of Finance (CDF) 2000. "Census 2000 PL94-171, Table One, Population Change 1990-2000, Incorporated Cities by County."

California Department of Forestry and Fire Protection (CDFFP) 1999. "California Watersheds (CALWATER 2.2)," ed. 2.2.

California Department of Health Services and San Francisco Estuary Institute (CDHS & SFEI) 2000. *San Francisco Bay Seafood Consumption Report*, Technical Report, pp. 41 to 42, 51 to 57, and 60, Appendix E, and Appendix K (Table K30a).

Cooke Janis, C. Foe, S. Stanish, P. Morris (Cooke et al.) 2004. *Cache Creek, Bear Creek, and Harley Gulch TMDL for Mercury. Staff Report*. November, p. 11.

Hamilton (2006). Personal Communication (email) with Mike Hamilton of Caltest Laboratory regarding the unit cost of methylmercury analysis. April 19.

Larry Walker Associates (LWA) 2002. "CEP Project Hg-IP-1: Technical Assistance in Support of Mercury TMDL Implementation Plan for San Francisco Bay—Wastewater Facilities," prepared for Applied Marine Sciences on behalf of the Clean Estuary Partnership, September 3 (draft).

Looker, Richard, and B. Johnson (Looker & Johnson) 2004a. *Mercury in San Francisco Bay. Total Maximum Daily Load (TMDL) Proposed Basin Plan Amendment and Staff Report*, April 30, pp. Appendix B: Environmental Checklist.

Looker, Richard, and B. Johnson (Looker & Johnson) 2004b. *Mercury in San Francisco Bay. Total Maximum Daily Load (TMDL) Proposed Basin Plan Amendment and Staff Report*, September 2, pp. 38, 48 and 49.

Looker, Richard, and B. Johnson (Looker & Johnson) 2004c. *Mercury in San Francisco Bay. Total Maximum Daily Load (TMDL) Responses to Comments*, September 2, pp. 6-7.

National Association of Clean Water Agencies (NACWA) 2006. *Controlling Mercury in Wastewater Discharges from Dental Clinics: White Paper, p. 1*. January.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) 1995. *Water Quality Control Plan San Francisco Bay Basin (Region 2)*, June 21. http://www.waterboards.ca.gov/sanfranciscobay/basinplan/web/BP_CH1.html

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) 2006. *Calculation Of Final And Interim Mercury Load Allocations For Wastewater Facilities*, February 23.

San Francisco Estuary Institute (SFEI) 1999. *Contaminant Concentrations in Fish from San Francisco Bay, 1997*, May, pp. 3 and 10.

San Francisco Estuary Institute (SFEI) 2003. *Contaminant Concentrations in Fish from San Francisco Bay, 2000*, prepared by B. Greenfield, J. Davis, R. Fairey, C. Roberts, D. Crane, G. Ichikawa, and M. Petreas, *RMP Technical Report: SFEI Contribution 77*, July, pp. 4, 6, and 8.

San Francisco Estuary Institute (SFEI) 2006. Website describing California Bay-Delta Authority Fish Mercury Project. http://www.sfei.org/cmr/fishmercury/

State Water Resources Control Board (SWRCB) 2005. *State Water Board Resolution No. 2005-0060 Remanding An Amendment To The Water Quality Control Plan For The San Francisco Bay Region To Incorporate A Total Maximum Daily Load (Tmdl) For Mercury In San Francisco Bay*, September.

U.S. Army Corps or Engineers (USACE), U.S. Environmental Protection Agency (USEPA), San Francisco Bay Conservation and Development Commission (BCDC), San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) 2001. *Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region, Management Plan 2001*.
http://www.spn.usace.army.mil/ltms2001/

U.S. Environmental Protection Agency (USEPA) 1985. *Ambient Water Quality Criteria for Mercury – 1984*. January, pp. 23, 24, and 47.

U.S. Environmental Protection Agency (USEPA) 1997. *Analysis of the Potential Benefits Related to Implementation of the California Toxics Rule*, Office of Policy, Planning and Evaluation and Region IX, June, pp. 3-36 to 3-37 and 4-1 to 4-29.

U.S. Environmental Protection Agency (USEPA) 2000. *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health*, EPA-822-B-00-004,Office of Water, Office of Science and Technology, October, pp. 4-21 to 4-29.

U.S. Environmental Protection Agency (USEPA) 2001. *Water Quality Criterion for the Protection of Human Health: Methylmercury*, EPA-823-R-01-001, Office of Water, January, pp. xiv, 5-56 to 5-59, and 7-1 to 7-2.

U.S. Fish and Wildlife Service (USFWS) 2003. *Evaluation of the Clean Water Act Section 304(a) Human Health Criterion for Methylmercury: Protectiveness for Threatened and Endangered Wildlife in California*. October, pp. 2, 3, 7, 8, 25 to 28, and 64-66.

U.S. Fish and Wildlife Service (USFWS) 2006. Letter from David L. Harlow, Acting Field Supervisor. Subject: Comments on Draft Mercury in San Francisco Bay: Total Maximum Daily Load (TMDL) and Site Specific Water Quality Objectives. March 13.

Wiener, J., D. Krabbenhoft, G. Heinz, and A. Scheuhammer (Wiener et al.) 2003. "Ecotoxicology of Mercury," *Handbook of Ecotoxicology*, 2nd ed., ed. by D. Hoffman, B. Rattner, G. Burton, Jr., and J. Cairns, Jr., CRC Press, Boca Raton, pp. 409 to 463.

U.S. Census Bureau (USCB) 2001. "Population, Housing Units, Area, and Density: 2000," Census 2000 Data for the State of California, Census 2000 Summary File 1, www.census.gov, August 8.