DRAFT STAFF REPORT, INCLUDING SUBSTITUTE ENVIRONMENTAL DOCUMENTATION

FOR

PART 2 OF THE WATER QUALITY CONTROL PLAN FOR INLAND SURFACE WATERS, ENCLOSED BAYS, AND ESTUARIES OF CALIFORNIA—TRIBAL AND SUBSISTENCE FISHING BENEFICIAL USES AND MERCURY PROVISIONS

JANUARY 3, 2017

DIVISION OF WATER QUALITY

STATE WATER RESOURCES CONTROL BOARD

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

STATE OF CALIFORNIA
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Executive Summary

Introduction

The State Water Resources Control Board is proposing *Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions* (referred to as the Provisions throughout the Staff Report). The Provisions would establish the following elements: (1) three beneficial uses pertaining to tribal traditional and cultural use, tribal subsistence fishing use, and subsistence fishing use by other cultures or individuals; (2) one narrative and four numeric mercury water quality objectives to protect numerous beneficial uses of water involving human health and aquatic dependent wildlife; and (3) a program of implementation to control mercury discharges.

California currently has no statewide water quality objectives to protect wildlife. Although some of the Regional Water Quality Control Boards have developed regional and site-specific numeric mercury water quality objectives to protect wildlife, these objectives are not consistent across the state. Therefore, new statewide numeric mercury water quality objectives are needed. Also, new statewide mercury water quality objectives for human health are needed to update the level of protection for consumers of fish. The Provisions are needed to align California with the most recent guidance from the U.S. Environmental Protection Agency (U.S. EPA 2001) and to include protections for Native American tribes and other subsistence fishers. The new water quality objectives would replace the mercury criteria for human health established by the California Toxics Rule (40 C.F.R. § 131.38).

The Clean Water Act considers mercury as a priority toxic pollutant in water, although it is methylmercury that is the highly toxic form of mercury in the environment. The main route through which humans and wildlife are at risk for methylmercury toxicity from water is through the consumption of methylmercury contaminated fish and shellfish. Consequently, the U.S. Environmental Protection Agency established the latest recommended mercury ambient water quality criterion, in accordance with the Clean Water Act section 304(a), for the protection of human health in the form of a methylmercury fish tissue criterion. Controlling and monitoring the methylmercury concentrations in fish tissue provides more direct protection of human health and wildlife, and it is more closely tied to the Clean Water Act goal of protecting public health and wildlife. Therefore, the water quality objectives for mercury were derived as concentrations of methylmercury in fish tissue.

Mercury has multiple forms in water, and all forms of mercury are toxic. Methylmercury is the form that is of the most concern because it is the form that accumulates in fish tissues and it is very toxic to humans and wildlife. Almost all of the mercury in fish is methylmercury. Fish accumulate methylmercury from the water by consuming other organisms that have directly or indirectly accumulated mercury from the water. The organisms that are highest on the food web accumulate the most mercury.

Geographic Scope
The geographic scope of the Provisions is California's inland surface waters, enclosed bays, and estuaries. More specifically, the water quality objectives and associated implementation would apply to inland surface waters, enclosed bays, and estuaries with Commercial and Sport Fishing (COMM), Wildlife Habitat (WILD), Marine Habitat (MAR), Cold Freshwater Habitat (COLD), Warm Freshwater Habitat (WARM), Estuarine Habitat (EST), Inland Saline Water Habitat (SAL), Wetland (WET), Rare, Threatened, or Endangered Species (RARE), Tribal Traditional and Culture (CUL), California Native American Tribal Subsistence Fishing (T-SUB), and Subsistence Fishing (SUB) beneficial uses. However, the water quality objectives would not apply to the waters described above where site-specific mercury water quality objectives are established. The implementation provisions do not apply to discharges to receiving waters for which a mercury total maximum daily load is established.

The beneficial use definitions would be used by the State Water Resources Control Board and the Regional Water Quality Control Boards (collectively, the Water Boards) to the extent that such activities are described in a water quality control plan. The Provisions do not establish any designations of the beneficial uses to any particular waterbody.[1] The Provisions only establish the beneficial use definitions.

Relationship to the Statewide Mercury Control Program for Reservoirs
Concurrent with the development of the Provisions, the State Water Resources Control Board is developing a separate project to establish a program to implement the Provisions' water quality objectives to control mercury in reservoirs in California. The Provisions, described in this Staff Report, are a separate and distinct project from the project to control mercury in reservoirs in California. Although both projects are being developed to control mercury, only the Provisions would establish numeric water quality objectives and new beneficial uses.

Project Elements

Beneficial Uses
Beneficial uses are the cornerstone of water quality protection. Beneficial uses must be established in water quality control plans and designated to applicable water bodies. In 1973, the State Water Resources Control Board provided a uniform list of beneficial uses, including definitions, to the Regional Water Quality Control Boards to designate waters within their respective regions where the use was occurring. The State Water Resources Control Board

[1] Even when a beneficial use category or definition is established, specific waters are not designated with that beneficial use unless a water quality standards action occurs to make the designation, which is typically done through the adoption of a water quality control plan (basin plan) amendment. Generally, the Regional Water Boards designate specific waterbodies within their respective region where the use applies. A Regional Water Board's waterbody-designation would occur through its basin planning process in accordance with Water Code sections 13244 (hearing and notice requirements) and 13245 (approval by the State Water Board).

updated that list in 1996. The updated list of beneficial uses does not contain an explicit beneficial use for tribal traditional, cultural, or subsistence fishing.

The Provisions would establish three beneficial use definitions. The first beneficial use is Tribal Tradition and Culture (CUL). This use reflects uses of water that support the cultural, spiritual, and traditional ways of living by California Native American tribes (California tribes). To recognize populations that are assumed to consume more fish than the average recreational angler in California (protected under the Commercial and Sport Fishing (COMM) beneficial use), the Provisions include the two beneficial uses pertaining to Tribal Subsistence Fishing (T-SUB), and Subsistence Fishing by other communities or individuals (SUB).

As discussed below, the Provisions contain two associated mercury water quality objectives that would support the two subsistence beneficial uses (T-SUB and SUB). However, water quality objectives that may be necessary to reasonably protect these two beneficial uses are not limited to the pollutant mercury. Additional water quality objectives for other pollutants could be adopted if new objectives are needed to protect these beneficial uses.

Water Quality Objectives

The Mercury Water Quality Objectives are summarized in Table i and briefly described below. The numeric water quality objectives are expressed in units of milligrams of methylmercury mercury per kilogram of fish tissue (mg/kg).

Table i. Summary of the Mercury Water Quality Objectives

Objective Type	Beneficial Uses	Objective
Sport Fish	Commercial and Sport Fishing; Wildlife Habitat[a]; Marine Habitat	0.2 mg/kg in highest trophic level fish, 150-500 mm (millimeters)
Tribal Subsistence	Tribal Subsistence Fishing	0.04 mg/kg in 70% trophic level 3 fish and 30% trophic level 4 fish, 150-500 mm
Subsistence	Subsistence Fishing	Waters… shall be maintained free of mercury at concentrations which accumulate in fish and cause adverse biological, reproductive, or neurological effects. The fish consumption rate used to evaluate this objective shall be derived from water body and population-specific data and information of the subsistence fishers' rate of and form of (e.g. whole, fillet with skin, skinless fillet) fish consumption
Prey Fish	Wildlife Habitat[a]; Marine Habitat, (where there are no trophic level 4 fish)	0.05 mg/kg in fish 50-150 mm

California Least Tern Prey Fish	Wildlife Habitat [a], Marine Habitat, Rare, Threatened, or Endangered Species (where California least tern habitat exists) (may be designated for the same beneficial uses as the Prey Fish Objective and Preservation of Rare, Threatened or Endangered Species)	0.03 mg/kg in fish less than 50 mm
[a] The objectives may also be applied to Warm Freshwater Habitat, Cold Freshwater Habitat, Estuarine Habitat, and Inland Saline Water Habitat because each of those includes protection of wildlife habitat (see Section 5.1).		

The Sport Fish Water Quality Objective would apply to waterbodies where the highest trophic level fish are present. The highest trophic level is trophic level 4 fish (e.g. bass, large catfish, gopher rockfish). If there are no trophic level 4 fish, then the objective would apply to trophic level 3 fish (e.g. trout, sunfish, perch, and blue rockfish). This objective would apply to four beneficial uses: Commercial and Sport Fishing, Wildlife Habitat, Marine Habitat, and the proposed Tribal Tradition and Cultural Beneficial Use. This objective is based on the method used by the U.S. Environmental Protection Agency for its most recent methylmercury criterion (January 2001). In accordance with that method, the objective is derived from an adjusted consumption rate of one 8 ounce meal per week (224 grams per week or 32 grams per day) of locally caught fish to reflect California recreational fishers, which is higher than the U.S. Environmental Protection Agency criterion (17.5 grams per day) developed under the Clean Water Act, section 304(a).

The second and third water quality objectives, the Tribal Subsistence Fishing Water Quality Objective and the Subsistence Fishing Water Quality Objective, are being established to reasonably protect the two new beneficial uses pertaining to Tribal Subsistence Fishing and Subsistence Fishing (T-SUB and SUB, respectively). These objectives would generally only apply where the corresponding uses are designated. Currently neither of these beneficial uses has been designated to any waters in California. The Tribal Subsistence Fishing Water Quality Objective was derived to protect humans consuming four to five meals per week (142 grams per day) that applies to mostly trophic level 3 fish, based on a survey of fish consumption by California tribes. For subsistence fishing by other individuals, the Subsistence Fishing Water Quality Objective is narrative rather than a numeric to accommodate the wide variation in the amount of fish and types of fish consumed by various members of the population. The two objectives that support the subsistence fishing beneficial uses may be modified by the Water Boards based on site-specific consumption patterns of the particular communities they would protect.

The fourth and fifth water quality objectives, the Prey Fish Water Quality Objective and the California Least Tern Prey Fish Water Quality Objective, were developed to protect wildlife and accommodate situations where measuring the Sport Fish Water Quality Objective cannot ensure protection of all wildlife species. These apply to the smaller size fish that many wildlife species prey upon. The Prey Fish Water Quality Objective would apply to prey fish in waters where trophic level 4 fish are not present. The California Least Tern Prey Fish Water Quality Objective would protect the California least tern (*Sterna antillarum browni*), since it is a very sensitive species that is on the federal list of endangered species. This objective would apply only to the habitat of the California least tern and to the very small fish that the tern preys upon.

Implementation Program to Control Discharges of Mercury
The Porter-Cologne Water Quality Control Act (Wat. Code § 13000 et seq.) requires the establishment of a program of implementation to achieve water quality objectives, which includes a description of actions necessary to achieve the water quality objectives, a time schedule for the actions to be taken, and monitoring to determine compliance with the water quality objectives in accordance with Water Code section 13242.

In general, the principal sources of mercury pollution to the waters within California are historic mines and atmospheric deposition. This mercury is transported to water bodies through discharges of storm water, from historic mines or mine tailings, and from other nonpoint sources (other lands that may experience erosion, especially due to human activity, and the sediments that may be carried in storm water runoff). Since mercury bound to sediments is often transported through the environment, reducing the amount of sediments in discharges also reduces the amount of mercury. Other types of regulated discharges also present potential sources of mercury contamination to waters of the state. Diffuse atomic mercury suspended in air spreads over large areas, accumulates between storm events and during the long dry season, and then is flushed into storm water systems. Mercury is also present (but in smaller absolute amounts) in point-source discharges, due to a wide variety of potential industrial, commercial and residential sources. The Provisions therefore establish mandatory control requirements or provide discretionary control measures applicable to discharges from point sources, storm water sources, and non-point sources.

For municipal wastewater and industrial dischargers regulated through (non-storm water) National Pollutant Discharge Elimination System (NPDES) permits, the Provisions modify the reasonable potential analysis and the approach to determine an effluent limitation contained in the State Water Resources Control Board’s Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (generally referred to as the SIP). The Provisions which modify the SIP are exclusive to reasonable potential analyses and effluent limitations for mercury. These modifications do not apply to dischargers to waters that have site-specific mercury water quality objectives or to dischargers that discharge to receiving waters for which a mercury or methylmercury total maximum daily load (TMDL) has been approved. Because the Mercury Water Quality Objectives are fish-tissue based and not water-column based, fish-tissue based water quality objectives were converted to water column values to be used to determine whether a discharge requires an effluent limitation.

Regarding the Sport Fish Water Quality Objective, Prey Fish Water Quality Objective, and California Least Tern Prey Fish Water Quality Objective, which protect recreational consumption of fish and wildlife, for discharges projected to cause or contribute to an excursion above the applicable water quality standard (referred to as having reasonable potential), the effluent limitation would be 12 nanograms per liter (ng/L) total mercury for discharges to flowing water bodies (generally, rivers, creeks and streams) and 4 ng/L for discharges to slow moving water bodies (generally, lagoons and marshes). Regarding the Tribal Subsistence Fishing Water Quality Objective, for discharges with reasonable potential, the effluent limitation would be 4 ng/L total mercury for discharges to flowing water bodies and 1 ng/L for discharges to slow moving water bodies. The same concentration values would be used to determine reasonable potential for non-storm water NPDES discharges for the respective Mercury Water Quality Objectives. These effluent limitations may be modified based on a site-specific bioaccumulation factor. For the narrative Subsistence Fishing Water Quality Objective, the reasonable potential analysis and the effluent limitation would need to be calculated using site-specific information and/or the available bioaccumulation factors and translators.

For discharges of storm water regulated through NPDES permits that apply to Municipal Separate Storm Sewer Systems (Phase I and Phase II MS4s), the Provisions require a set of mercury control measures and give the Water Boards the discretion to substitute additional measures and require best management practices for individual permits. For many MS4s, permits already contain such control measures and best management practices. For areas that are specifically designated as “Areas with Elevated Mercury Concentrations,” the Water Boards would be required to include best management practices for erosion control in MS4 permits. For industrial discharges regulated under the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities, the Provisions require that the permit, upon reissuance, include a revised Numeric Action Level for total mercury, from 1400 ng/L to 300 ng/L.

For dischargers subject to the requirements of Title 27 of the California Code of Regulations, section 22510 (closure and post-closure of mining sites), the Water Boards would continue to use the existing program to control these discharges. The Provisions specify that erosion and sediment control measures are required for mine site remediation in all future permits with Waste Discharge Requirements (WDRs) or waivers of WDRs adopted, and re-issued or modified WDRs. For non-point sources regulated under WDRs or waivers of WDRs, the Water Boards have discretion under existing law to require dischargers to implement erosion and sediment control measures. For discharges relating to dredging activities (including disposal), the Water Boards have discretion under existing law to require total mercury monitoring and procedures to control the disturbance and discharge of mercury contaminated materials. For projects that create or restore wetlands, the Water Boards have the discretion under existing law to require project applicants to include design features or management measures to reduce the production of methylmercury in the wetland, particularly in areas with elevated mercury. For nonpoint source discharges, dredging activities, and wetland projects, the Water Boards should consider requiring the respective measures in areas with elevated mercury concentrations when adopting, re-issuing, or modifying WDRs, waivers of WDRs, or water quality certifications.

1. Introduction

Humans and wildlife are at risk of methylmercury toxicity due to the consumption of fish containing high levels of mercury. New water quality objectives are needed to close a long standing gap in the protection of wildlife, the lack of which has resulted in a lawsuit against the U.S. Environmental Protection Agency (U.S. EPA) and a subsequent consent decree (*Our Children's Earth Foundation and Ecological Rights Foundation vs. U.S. EPA*, No. 3:13-cv-2857-JSW [2014]). Furthermore, new water quality objectives for human health are needed to align California with the most recent Clean Water Act section 304(a) criterion from the U.S. EPA, and to include protection for California Native American tribes (California tribes) and subsistence fishers. In addition, beginning in October 2013, California tribes and environmental justice groups petitioned the State Water Resources Control Board (State Water Board) to consider whether the current beneficial use definitions in the Regional Water Quality Control Plan (basin plans) adequately protect Tribal cultural practices and traditional uses of waters by California tribes, subsistence fishing by California tribes, and subsistence fishing by other communities and individuals. Because these groups are known to consume a greater amount of fish, bioaccumulative contaminants such as mercury are of particular concern.

The State Water Board is therefore proposing to establish Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions, which this Staff Report will refer to as the Provisions.[2] The Provisions would establish the following elements: (1) three beneficial uses pertaining to tribal traditional and cultural use, tribal subsistence fishing use, and subsistence fishing use by other cultures or individuals; (2) one narrative and four numeric Mercury Water Quality Objectives to protect numerous beneficial uses of water involving human health and aquatic dependent wildlife; and (3) a program of implementation to control mercury discharges.

Mercury is a priority pollutant in water identified by the Clean Water Act (see 40 C.F.R. section 423, Appendix A). Unlike most other priority pollutants, the main route of exposure to humans and wildlife is not through water contact or water ingestion, but through consumption of methylmercury contaminated fish and shellfish. Consequently, the U.S. EPA established a methylmercury fish tissue recommended criterion in their 2001 update, in accordance to section 304(a) of the Clean Water Act. Therefore, the Provisions include water quality objectives in the form of fish tissue objectives.

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[2] The Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries (ISWEBE Plan) is not yet adopted.

1.1 Regulatory Authority for the Provisions

Federal Clean Water Act

The Clean Water Act is the primary federal water pollution control statute. The State Water Board is designated as the State Water Pollution Control Agency for all purposes under the Clean Water Act. The Clean Water Act also creates the basic structure under which point source discharges of pollutants are regulated and establishes the statutory basis for the National Pollutant Discharge Elimination System (NPDES) permit program.

Porter-Cologne Water Quality Control Act

In 1969, the Porter-Cologne Water Quality Control Act (Wat. Code § 13000 et seq.) was adopted as the principal law governing water quality in California. The Porter-Cologne Water Quality Control Act established a comprehensive statutory program to protect the quality and "beneficial uses" (or "designated uses" under federal parlance) of waters of the state. Beneficial uses include, but are not limited to, "domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Wat. Code, § 13050, subd. (f)).

Pursuant to California Water Code section 13241, regulatory protection of beneficial uses is carried out, in part, through water quality objectives established by each of the Regional Water Quality Control Boards (Regional Water Boards) in each of the ten basin plans adopted in California or by the State Water Board in a water quality control plan. Beneficial uses of water bodies, water quality objectives designed to protect those uses, a corresponding implementation program, and an antidegradation policy constitute a complete water quality standard. Basin plans also designate specific waters with corresponding beneficial uses made for their waters.

The State Water Board also adopts water quality control plans for waters of the state. Statewide water quality control plans, when adopted, supersede a basin plan adopted by any Regional Water Board to the extent there is any conflict between the two plans for the same waters (Wat. Code, § 13170). In such circumstances, when the State Water Board adopts a statewide plan, the statewide plan automatically has effect for those waters within the respective Regional Water Board's jurisdiction—without the Regional Water Board having to revise their basin plan. (Throughout the Staff Report the State Water Board and the Regional Water Boards are collectively referred to as the Water Boards.)

1.2 Consent Decree Requiring a Mercury Water Quality Objective to Protect Wildlife

The United States District Court for the Northern District of California issued a consent decree to resolve the dispute in a lawsuit captioned, *Our Children's Earth Foundation and Ecological Rights Foundation vs. U.S. EPA*, No. 3:13-cv-2857-JSW (2014) (order granting stipulation to vacate hearing on U.S. EPA's motion to dismiss and enter consent decree). Pursuant to the consent decree, U.S. EPA is obligated to propose (by publishing in the Federal Register) water quality criteria for wildlife by June 30, 2017, initiate endangered species consultation within nine months of proposal, and finalize the rule within six months of the conclusion of the endangered species consultation between the U.S. EPA and the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). If the State Water Board adopts the Provisions and U.S. EPA approves it prior to June 30, 2017, U.S. EPA's obligation to establish the water quality criteria for wildlife would be satisfied. If the Provisions are not adopted by the State Water Board and approved by U.S. EPA before that date, U.S. EPA would remain obligated to satisfy its obligations under the consent decree. However, if U.S. EPA approves the State Water Board's submittal after June 30, 2017, but before the federal rule is finalized, U.S. EPA would not be required to finalize the federal rule.

1.3 Purpose of the Staff Report

The purpose of the Staff Report for the Provisions (referred to as the Staff Report) is to provide the supporting information used to develop the Provisions. This includes the need for the Provisions, technical information to support recommended approaches as well as options for each approach, and alternatives considered in accordance with the California Water Code (Wat. Code) and California Environmental Quality Act (CEQA). The Staff Report also provides a record of the process used to develop the Provisions, including the environmental review, early consultation requirements, and the public participation process discussed in section 2.6, the scientific peer review described in Appendix S, and an economic analysis, which is included in Appendix R.

1.4 Intended Use of the Staff Report by Agencies

The State CEQA Guidelines require that the project description include, among other things, a statement briefly describing the intended uses of the Environmental Impact Report (EIR) (Cal. Code Regs., tit. 14, § 15124, subd. (d)). The agencies expected to use this Staff Report in decision making are described below.

The State Water Board will use this Staff Report in determining whether to adopt the Provisions. The State Water Board or any of the Regional Water Boards may use the information contained within this Staff Report for future decision making and/or permitting. Furthermore, implementation procedures have been included in this Staff Report in order to achieve the proposed water quality objectives for the permitted discharges described in the Provisions and in this Staff Report. Therefore, if the Provisions are approved, the following entities, where they are considered public agencies for purposes of CEQA, may be considered responsible agencies and may use the final Staff Report adopted by the State Water Board in their decision making actions to comply with the Provisions:

- Permitted non-storm water dischargers (e.g. publicly owned treatment works, industrial discharges)

- Permitted storm water dischargers
- Dischargers with Waste Discharge Requirements (WDRs) or waivers of WDRs
- The Water Boards

1.5 Note on the Use of the Terms "Mercury" and "Methylmercury" in the Staff Report

Generally the term "mercury" is used to indicate all forms of mercury, including inorganic mercury (elemental mercury, cinnabar) and methylmercury. For analytical measurements, either "methylmercury" or "total mercury" is typically specified. "Total mercury" includes methylmercury and inorganic forms. Mercury in fish tissue is referred to as "methylmercury" since almost all of the mercury in fish is methylmercury (see Section 4.2). However, mercury in fish in often measured as "total mercury" because it is less costly than measuring methylmercury alone.

1.6 Relationship to the Statewide Mercury Control Program for Reservoirs

Concurrent with the development of the Provisions, the State Water Board is developing a separate project, generally referred to as the statewide mercury control program for reservoirs, to establish a program to implement the Provisions' water quality objectives for Commercial and Sport Fishing (COMM), Wildlife Habitat (WILD), and Rare, Threatened, or Endangered Species (RARE) in all California reservoirs impaired by mercury for those uses. (State Water Board 2016, State Water Board 2014). That project is referred to throughout this Staff Report as the Reservoir Program. The Provisions, described in this Staff Report, are a separate and distinct project from the Reservoir Program. The Provisions have independent utility, whether or not the Reservoir Program is ultimately adopted by the State Water Board. If the State Water Board does not adopt a Reservoir Program, the Provisions will be implemented on a case-by-case basis for discharges to reservoirs, as described below in Section 6.13.3.

2. Project Description

The Water Boards' regulations for implementation of CEQA require the Staff Report to include a brief description of the Provisions (Cal. Code Regs., tit. 23, § 3777 subd. (b)(1)). The following Chapter provides information about the Provisions, including (1) the precise location and boundaries of the project; (2) an overview of the goals (i.e., project objectives) of the Provisions; (3) a general description of the project's technical, economic, and environmental characteristics; and (4) contains non-exclusive lists of: (a) the agencies that are expected to use this Staff Report in their decision making and permits, (b) other approvals required to implement the project, and (c) related environmental review and consultation requirements required by federal, state, or local laws, regulations, or policies (as required by the CEQA Guidelines (Cal. Code Regs., tit. 14, § 15124). The complete text of the Provisions is included in this Staff Report as Appendix A.

2.1 Project Title

This project is titled "Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial uses, Mercury Provisions", and is referred to as the Provisions.

2.2 Project Objectives

The policy objectives of the Provisions are to:

1. Recognize beneficial uses of water made by California Native Americans and subsistence fishers, including fishing, cultural, and ceremonial uses of water;
2. Adopt numeric water quality objectives for mercury to protect piscivorous wildlife from consumption of fish with elevated levels of mercury;
3. Adopt water quality objective(s) for mercury to protect recreational fishers, subsistence fishers, and California tribes from consumption of fish with elevated levels of mercury;
4. Provide a program of implementation to control mercury discharges and achieve the Mercury Water Quality Objectives in California waters; and
5. Provide statewide consistency for objectives 1 through 4.

2.3 Description of the Provisions

2.3.1 Beneficial Uses

The Provisions would establish three new beneficial uses related to: tribal traditional and cultural use, tribal subsistence fishing use, and subsistence fishing. (See Chapter 6, Issue D.) The Provisions would require each of the Regional Water Boards to use the beneficial uses and abbreviations listed below, to the extent it defines such activities in a water quality control plan after the effective date of the Provisions.

To designate the Tribal Tradition and Culture or Tribal Subsistence Fishing beneficial uses in a water quality control plan for a particular waterbody segment and time(s) of year, a California Native American tribe must confirm the designation is appropriate. No confirmation is required to designate the Subsistence Fishing beneficial use in a water quality control plan.

The Tribal Subsistence Fishing and Subsistence Fishing beneficial uses relate to the risks to human health from the consumption of noncommercial fish or shellfish. The two subsistence fishing beneficial uses assume a higher rate of consumption of fish or shellfish than that protected under the Commercial and Sport Fishing and the Tribal Tradition and Culture beneficial uses. The function of the Tribal Subsistence Fishing and Subsistence Fishing beneficial uses is not to protect or enhance fish populations or aquatic habitats. Fish populations and aquatic habitats are protected and enhanced by other beneficial uses, including but not limited to, Aquaculture, Warm Freshwater Habitat, and Cold Freshwater Habitat, that are designed to support aquatic habitats for the reproduction or development of fish.

1) Tribal Tradition and Culture (CUL): Uses of water that support the cultural, spiritual, ceremonial, or traditional rights or lifeways of California Native American Tribes, including, but not limited to: navigation, ceremonies, or fishing, gathering, or consumption of natural aquatic resources, including fish, shellfish, vegetation, and materials.

2) Tribal Subsistence Fishing (T-SUB): Uses of water involving the non-commercial catching or gathering of natural aquatic resources, including fish and shellfish, for consumption by individuals, households, or communities of California Native American Tribes to meet minimal needs for sustenance.

3) Subsistence Fishing (SUB): Uses of water involving the non-commercial catching or gathering of natural aquatic resources, including fish and shellfish, for consumption by individuals, households, or communities, to meet minimal needs for sustenance.

2.3.2 Water Quality Objectives

The Provisions would establish five new water quality objectives for mercury (the Mercury Water Quality Objectives) to protect people and wildlife from consuming fish that contain high levels of mercury. These objectives are named the Sport Fish Water Quality Objective, the Tribal Subsistence Fishing Water Quality Objective, the Subsistence Fishing Water Quality Objective, the Prey Fish Water Quality Objective, and the California Least Tern Prey Fish Water Quality Objective and are collectively referred to as the Mercury Water Quality Objectives. The Mercury Water Quality Objectives protect recreational fishers, California tribes and other subsistence fishers, the endangered California least tern, and other wildlife listed in Table 2.1 (see Appendix A for full details). With the exception of the Subsistence Fishing Water Quality Objective, the Mercury Water Quality Objectives in these Provisions are expressed as concentrations of milligrams of methylmercury per kilogram of fish tissue (mg/kg), since consuming fish is the main route of exposure to harmful levels of mercury in the environment. The Subsistence Fishing Water Quality Objective is a narrative water quality objective.

Since methylmercury accumulates up the food web, the trophic level (the place an organism occupies on the food web) of the fish is an important component in setting a water quality objective for mercury in fish tissue. Trophic level three fish are those that typically feed on plankton and insects (e.g. trout). Trophic level four fish are predators that often feed on trophic level three organisms (e.g. bass). Trophic level four fish typically accumulate much higher methylmercury concentrations than trophic level three fish.

Table 2.1. Summary of the Mercury Water Quality Objectives

Objective Type	Beneficial Uses	Objective
Sport Fish	Commercial and Sport Fishing; Wildlife Habitat[a]; Marine Habitat	0.2 mg/kg in highest trophic level fish, 150-500 mm
Tribal Subsistence	Tribal subsistence fishing	0.04 mg/kg in 70% trophic level 3 fish and 30% trophic level 4 fish, 150-500 mm
Subsistence	Subsistence fishing	"Waters… *shall be maintained free of mercury at concentrations which accumulate in fish and cause adverse biological, reproductive, or neurological effects…"* (see Provisions, Appendix A)
Prey Fish	Wildlife Habitat[a]; Marine Habitat (where no trophic level 4 fish)	0.05 mg/kg in fish 50-150 mm
California Least Tern Prey Fish	Wildlife Habitat[a], Marine Habitat, Rare, Threatened, or Endangered Species (where California least tern habitat exists) (may be designated for Rare, Threatened, or Endangered Species; Wildlife Habitat; Marine Habitat)	0.03 mg/kg in fish less than 50 mm
[a] The objectives supporting Wildlife Habitat and Marine Habitat may also be applied to Warm Freshwater Habitat, Cold Freshwater Habitat, Estuarine Habitat, and Inland Saline Water Habitat because each of those includes protection of wildlife habitat (see Section 5.1).		

The Sport Fish Water Quality Objective protects California recreational fishers at a consumption rate of one meal per week of sport fish. The Tribal Subsistence Fishing Water Quality Objective is three to four times more stringent than the Sport Fish Water Quality Objective in order to protect tribal communities that consume greater amounts of fish. The Tribal Subsistence Fishing Objective protects tribal fish consumers at a consumption rate of four to five meals of fish per week of mostly lower trophic level fish (e.g., trout and salmon), based on a study of tribal fish consumption. The Subsistence Fishing Objective is a narrative objective and protects other consumers at a rate determined on a site-specific basis, since the consumption rate and species consumed vary, in absence of site-specific information, U.S. EPA guidance may be used. The Prey Fish Water Quality Objective and the California Least Tern Prey Fish Water Quality Objective protect wildlife that typically consume smaller fish. The Prey Fish Water Quality Objective focuses on sampling smaller trophic level three fish that are shorter lived and thus have not had time to accumulate as much methylmercury as larger sport fish. These fish constitute a significant portion of the diet in smaller piscivorous birds and wildlife. The California Least Tern Prey Fish Water Quality Objective applies to the habitat of the California least tern, since the California least tern is a very sensitive endangered species. The Prey Fish Water Quality Objective is for situations where the Sport Fish Water Quality Objective is measured using trophic level 3 fish, which would not ensure protection of all wildlife species that prey upon smaller fish for food. The details of the development of the Mercury Water Quality Objectives are discussed in Section 6.1 through Section 6.8.

2.3.3 Program of Implementation

The Provisions include a program of implementation to control mercury inputs to water bodies through NPDES permits issued pursuant to section 402 of the Clean Water Act, water quality certifications issued pursuant to section 401 of the Clean Water Act, WDRs, and waivers of WDRs, where any of the five Mercury Water Quality Objectives apply. Permits with the new requirements may be issued to: owners of active and legacy gold and mercury mine sites, dredging activity permittees, wetland project applicants, other nonpoint source dischargers, municipal separate storm sewer systems and other storm water dischargers, and wastewater treatment plants and industrial dischargers, as listed below. For MS4 storm water, point source wastewater and industrial dischargers, and mine site remediation permittees, new requirements are mandatory. For non-point source discharges, wetland projects, and dredging activities, new requirements are at the discretion of the Water Boards under existing law. For some of the discharges, existing management practices may be sufficient to comply with the new requirements. For municipal wastewater treatment systems and non-storm water industrial discharges, a water column translation of the mercury concentration in fish tissue would be used in permitting. A summary of the requirements by discharge type is listed below. For more details see the relevant sections of the Staff Report (indicated below) or the Provisions.

Mine Site Remediation

For discharges subject to California Code of Regulations, title 27, section 22510 (closure and post-closure of mining sites), where mercury was mined or used in the processing ore, erosion and sediment controls are required at a minimum to control mercury in the discharge (see Section 6.9). Since mercury binds to sediments, preventing discharges of sediments also minimizes discharges of mercury.

Additionally, discharges from mine tailings from historic mines may be regulated as Storm Water Discharges (i.e., through Municipal, Construction, or California Department of Transportation storm water permits), Nonpoint Source Discharges, or Dredging Activity Discharges, as described below. Discharges from currently operating mines may be regulated as Waste and Industrial Discharges or as Storm Water Discharges from Industrial Facilities, as described below.

Dredging Activities

The Water Boards have discretion under existing law to require dischargers to implement total mercury monitoring and procedures to control the disturbance and discharge of mercury-contaminated material during dredging and disposal of dredged material. The draft Provisions emphasize that the permitting authority should consider requiring such measures in areas with elevated mercury concentrations (see Section 6.10).

Wetland Projects

Projects that create or restore wetlands will provide valuable wildlife habitat, and the Provisions encourage responsible wetland development. For these projects, the Water Boards would have discretion under existing law to require the project applicant to include design features or management measures to reduce the production of methylmercury in the wetland. The draft Provisions emphasize that the permitting authority should consider requiring such measures in areas with elevated mercury concentrations (see Section 6.10).

Other Nonpoint Source Discharges

Where there are elevated concentrations of mercury in the soil, the Water Boards have discretion under existing law to require dischargers to implement erosion and sediment control measures in WDRs and waivers of WDRs. The draft Provisions emphasize that the permitting authority should consider requiring such measures in areas with elevated mercury concentrations (see Section 6.10).

Storm Water Discharges

Storm Water from Municipal Separate Storm Sewer Systems

While MS4s already conduct pollution prevention and pollution control activities, the Provisions require that all Phase I and Phase II MS4 permits include pollution prevention activities specifically for mercury (e.g., thermometer exchange programs, fluorescent lamp recycling programs, public education and outreach, auto dismantler education, and survey of use, handling, and disposal of mercury-containing products, see Section 6.11).

Storm Water from California Department of Transportation Activities
The Provisions would not impose any new requirements. The existing California Department of Transportation storm water permit provided a sufficient level of baseline controls for mercury in the form of sediment controls (see Section 6.11).

Storm Water from Construction Activities
The Provisions would not impose any new requirements. The existing construction storm water permit provides a sufficient level of baseline controls for mercury in the form of sediment controls (see Section 6.11).

Storm Water from Industrial Activities
The Provisions would not impose any new requirements. The exiting general permit for industrial activities already includes methods to control mercury if the Numeric Action Level for mercury is exceeded. However, the Provisions would update the Numeric Action Level from 1400 nanograms per liter (ng/L) to 300 ng/L (see Section 6.11).

Wastewater and Industrial Discharges
For discharges to waters protected by the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, or the California Least Tern Prey Fish Water Quality Objective, discharges to flowing water bodies (rivers, creeks, and streams) that are determined by the Water Boards to have reasonable potential would need to meet an effluent limitation calculated using a water column concentration value for total mercury of 12 ng/L and perform required monitoring of the mercury concentration in the effluent. Discharges to estuaries with slow moving water (lagoons and marshes) that have total mercury concentrations higher than 4 ng/L would need to meet an effluent limitation calculated using the 4 ng/L value. The water column concentrations were derived from bioaccumulation factors (BAFs) and translators (Appendix I, Section 6.12 to 6.13). Rather than applying the above effluent limits, dischargers may determine site-specific BAFs to calculate effluent limits specific to their receiving waters. In addition, Water Boards have the discretion to allow dilution credits where appropriate.

For dischargers to waters protected by the Tribal Subsistence Fishing Water Quality Objective, discharges to flowing water bodies that are determined by the Water Boards to have reasonable potential with total mercury concentrations higher than 4 ng/L would need to meet an effluent limitation calculated using a water column concentration value for total mercury of 4 ng/L and perform required monitoring of the mercury concentration in the effluent. For estuaries with slow moving water, discharges that are determined by the Water Boards to have reasonable potential with total mercury concentrations higher than 1 ng/L would need to meet an effluent limitation calculated using a water column concentration value for total mercury of 1 ng/L. For discharges to waters protected by the Subsistence Fishing Water Quality Objective, effluent limitations would need to be derived on a site-specific basis.

All effluent limitations would be based on an annual average concentration of total mercury. Additional exceptions to these requirements may apply. If the discharge originates from a publicly owned wastewater treatment plant (POTW) that serves a small disadvantaged community or is designated as an insignificant discharge, then the monitoring requirements may be waived (see Section 6.12 to 6.13).

For dischargers that have new requirements under the Provisions, the Provisions would result in additional costs. The costs incurred by different individual dischargers may vary widely, depending on the degree to and the methods by which those dischargers are already currently controlling mercury. The costs are evaluated in Appendix R. For some dischargers, the Provisions would not result in new requirements and those dischargers would not incur additional costs. The Provisions' new requirements imposed on dischargers are discussed in the Staff Report in comparison to existing policy, existing requirements, and where possible, the current performance of discharges in Chapter 6, to anticipate the new costs or new requirements the Provisions may impose on dischargers.

2.3.4 Effective Date of the Provisions and their Implementation

The Provisions would establish new beneficial uses pertaining to tribal traditional and cultural, tribal subsistence fishing, and subsistence fishing. The establishment of the beneficial uses would be effective for purposes of the Clean Water Act upon adoption by the State Water Board and approval by the Office of Administrative Law (OAL) and U.S. EPA. However, the Provisions would not designate these beneficial uses to any specific water body. There is an expectation that the beneficial uses would be designated in the future by Regional Water Boards through the basin plan amendment process (a process that is often a minimum of two years). This process may be initiated at any time by a Regional Water Board, but would depend on the Regional Water Board's other priority projects, input from California tribes or subsistence fishing communities, and the availability of information to support the designation.

Generally, the Mercury Water Quality Objectives would become effective upon adoption by the State Water Board and approval by OAL and U.S. EPA, which typically occurs within a few months after the State Water Board adoption. The Tribal Subsistence Fishing Water Quality Objective and the Subsistence Fishing Water Quality Objectives would only apply to a particular water body after the corresponding beneficial use is designated to a water body. However, either of the objectives may be incorporated into a permit prior to formal designation if the Water Boards determine that tribal subsistence fishing or subsistence fishing is an existing use.

The requirements contained in the Provisions would become effective for a specific discharger once the Water Boards incorporate the mandatory conditions into the discharger's permit. Insofar as the Provisions acknowledge that the Water Boards have discretion to include requirements for particular dischargers, those requirements would also become effective upon inclusion in the applicable permit. This process would generally be done permit-by permit as the permits are issued, modified, or renewed. In the case of NPDES permits regulated by section 402 of the Clean Water Act, the U.S. EPA must approve the Provisions and the final permit for such requirements to be effective. Any new condition or requirement added or amended into a WDR could be implemented upon approval by OAL. The State Water Board has the authority to amend certifications under section 401 of the Clean Water Act pursuant to the Provisions. As a result, new requirements should be incorporated into all existing applicable NPDES permits within 5 to10 years of date of approval by U.S. EPA. New mercury requirements should be included in most other applicable WDRs within 15 years of the date of approval(s). The mercury requirements would also be included in any applicable new permit for new discharges. Timelines for compliance are already established by existing programs and in the State Water Board's *Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits* (Resolution 2008 – 0025).

2.4 Location and Boundaries of the Provisions and Relationship to Regional Water Quality Control Plans

After the State Water Board adopts and establishes the new beneficial use definitions, to the extent a Regional Water Board defines such activities in its basin plan after the effective date of the Provisions, the Regional Water Board would use the beneficial use definitions and abbreviations contained in the Provisions. Upon being included within their respective basin plans, the Regional Water Boards may designate waters (inland surface waters, enclosed bays, and estuaries of the State (Figure 2-1)) within their respective regions as having one or more of the beneficial uses. Similarly, the State Water Board may designate waters applicable to its water quality control plans.

Of the nine Regional Water Boards, only the North Coast Regional Water Board's basin plan explicitly lists a beneficial use for Native American Culture (which includes subsistence fishing) and a separate Subsistence Fishing beneficial use (North Coast Water Board, 2011, p. 2-3.00). The new beneficial use definitions proposed by the Provisions would not supersede the North Coast Water Board's existing beneficial use definitions for Native American Culture and Subsistence Fishing contained in its basin plan.

The Provisions' Mercury Water Quality Objectives would apply to inland surface waters, enclosed bays, and estuaries in California designated with the corresponding beneficial uses: Commercial and Sport Fishing (COMM); Wildlife Habitat (WILD); Warm Freshwater Habitat (WARM); Cold Freshwater Habitat (COLD); Estuarine Habitat (EST); Inland Saline Water Habitat (SAL); Marine Habitat (MAR); Rare, Threatened, or Endangered Species (RARE); Tribal Traditional and Culture (CUL); Tribal Subsistence Fishing (T-SUB); and Subsistence Fishing (SUB). The Mercury Water Quality Objectives associated with these beneficial uses would not supersede site-specific mercury water quality objectives meant to protect human health or wildlife. (See Figure 2-1 and Section 3.10 for a list of site-specific water quality objectives). Additionally, the Tribal Subsistence Fishing Water Quality Objective would not apply to waters designated by the North Coast Regional Water Board's basin plan with the beneficial uses for Native American Culture (which includes subsistence fishing) (North Coast Water Board, 2011, Table 2-1). State Water Board staff is uncertain what activities within the North

Coast Regional Water Board's Native American Culture beneficial use definition supported the designations. Additionally, the beneficial use definitions proposed by the Provisions for CUL and T-SUB, and SUB in some respects are more broad, and in other respects more narrow, than the North Coast Regional Board's beneficial use for Native American Culture. As a result, State Water Board staff is uncertain which waters designated with Native American Culture in the North Coast region would be appropriate to apply the Mercury Water Quality Objectives. In the future, if the North Coast Regional Water Board amends its basin plan with the Provisions' beneficial uses for CUL, T-SUB, and SUB, such designation would determine which of the Mercury Water Quality Objectives would apply. The Provisions' Subsistence Fishing Water Quality Objective would apply to the Subsistence Fishing (FISH) beneficial use contained in the North Coast Regional Water Board basin plan, but no waters in that region have been designated with that use.

The Provisions' program of implementation would apply to the same waters as the Mercury Water Quality Objectives, but the implementation provisions would not apply to dischargers that discharge to receiving waters for which a mercury or methylmercury total maximum daily load (a mercury or methylmercury TMDL) has been approved. See Section 3.10 for a list of TMDLs).

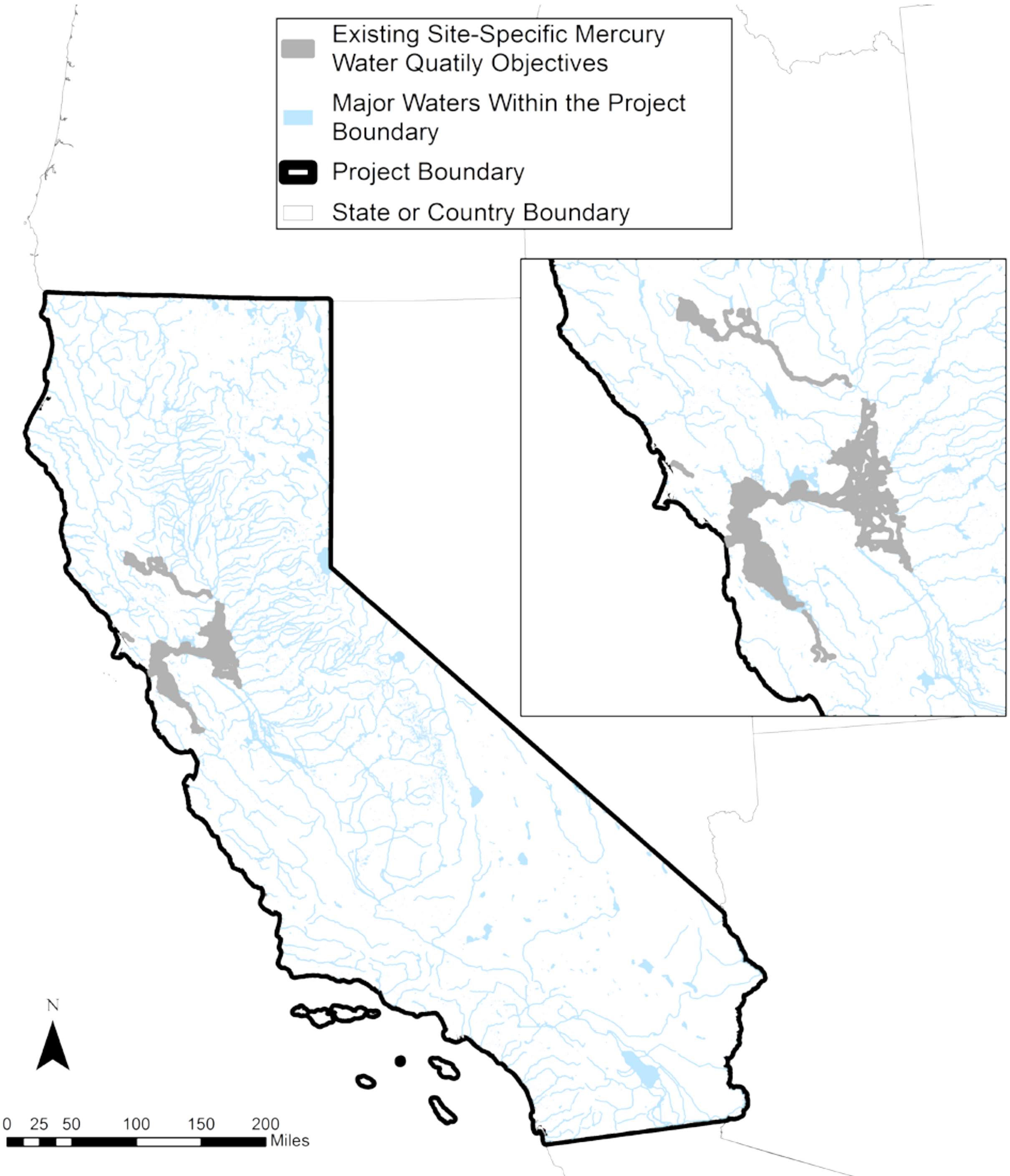

Figure 2-1 Project Boundary and Major Waters Included in the Project. For a list of site-specific objectives see Table 3-2.

2.5 Permits and Other Approvals Required to Implement the Provisions

After adoption by the State Water Board, the Provisions must be submitted to the California Office of Administrative Law for review and approval. Because the Provisions include the adoption of new water quality standards, pursuant to Clean Water Act section 303, subdivision (c), the Provisions' water quality standards must also be submitted to U.S. EPA for review and approval.

Except as may be required by other environmental review and consultation requirements as described below, no other agency approvals are expected to be required to implement the final Provisions. However, governing bodies of NPDES permittees may determine that separate approval actions are necessary to formally approve the approach they would take to comply with permits that implement the final Provisions. Beyond analyzing the reasonably foreseeable methods of compliance, the Staff Report is not required to, and therefore does not analyze the details related to the project specific actions that might be implemented by any particular permittee as a result of the State Water Board's proposed project (see Cal. Code Regs., tit. 23, § 3777, subd. (c); Pub. Resources Code § 21159, subd. (d)).

2.6 Environmental Review and Consultation Requirements

The Staff Report includes the State Water Board's Substitute Environmental Documentation (SED) required to satisfy the provisions of the CEQA, pursuant to Public Resources Code sections 21080.5, 21159 and CEQA Guidelines sections 1520 through 15253, and the State Water Board's Regulations for Implementation of the California Environmental Quality Act of 1970, California Code of Regulations, title 23, sections 3720 through 3781. These requirements are listed below, along with other regulatory process requirements.

2.6.1 California Environmental Quality Act

CEQA authorizes the Secretary for Natural Resources to certify that state regulatory programs meeting certain environmental standards are exempt from many of the procedural requirements of CEQA, including the preparation of a separate EIR, negative declaration, or initial study. (Pub. Resources Code, § 21080.5). The Secretary for Natural Resources has certified as exempt the State Water Board's Basin/208 Planning Program for the protection, maintenance, and enhancement of water quality in California. (Cal. Code Regs., tit. 14, § 15251(g)). Exempt regulatory programs include the Water Boards' adoption or approval of water quality standards and provisions to implement water quality standards, such as the Provisions. (Cal. Code Regs., tit. 23, § 3775-3781). Therefore, the Staff Report includes the Substitute Environmental Documentation required for compliance with CEQA, and a separate CEQA document will not be prepared. The State Water Board must still comply with CEQA's goals and policies, including the policy of avoiding significant adverse effects on the environment where feasible (Cal. Code. Regs., tit. 14, § 15250).

According to the State Water Board regulations for the implementation of CEQA (Cal. Code Regs., tit. 23, § 3777), the Substitute Environmental Documentation shall consist of a written report prepared for the Board containing an environmental analysis of the project; a completed Environmental Checklist (where the issues identified in the checklist must be evaluated in the checklist or elsewhere in the SED); and other documentation as the Board may include. The SED is required to contain, at a minimum, the following information:

1. A brief description of the proposed project;
2. An identification of any significant or potentially significant adverse environmental impacts of the proposed project;
3. An analysis of reasonable alternatives to the project and mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts; and
4. An environmental analysis of the reasonably foreseeable methods of compliance. The environmental analysis shall include, at a minimum, all of the following:
    a. An identification of the reasonably foreseeable methods of compliance with the project;
    b. An analysis of any reasonably foreseeable significant adverse environmental impacts associated with those methods of compliance;
    c. An analysis of reasonably foreseeable alternative methods of compliance that would have less significant adverse environmental impacts; and
    d. An analysis of reasonably foreseeable mitigation measures that would minimize any unavoidable significant adverse environmental impacts of the reasonably foreseeable methods of compliance. (Cal. Code Regs., tit. 23, § 3777, subd. (b)).

Accordingly, these analyses are contained in Chapter 2 and Chapters 7 through 9 of the Staff Report.

2.6.2 Reasonably Foreseeable Methods of Compliance

The State Water Board's Substitute Environmental Documentation for the Provisions is required to include an environmental analysis of the reasonably foreseeable methods of compliance with the Provisions (Cal. Code Regs., tit. 23, § 3777, subd. (b)(4); Pub. Resources Code, § 21159, subd. (a)). In developing the environmental analysis, the State Water Board is not required to conduct a site-specific project level analysis of the methods of compliance, but the environmental analysis shall account for a reasonable range of environmental, economic, and technical factors (Cal. Code Regs., tit. 23, § 3777, subd. (c); Pub. Resources Code, § 21159, subd. (d)). A general description of the reasonably foreseeable methods of compliance is contained in Chapter 7 of the Staff Report and the environmental analysis of the reasonably foreseeable methods of compliance is contained in Chapter 8 of the Staff Report.

2.6.3 Early Public Consultation/Scoping

CEQA requires the State Water Board to seek early public consultation with public agencies and members of the public prior to circulating the draft SED. (Cal. Code Regs., tit. 23, § 3775.5, subd. (a).) The consultation may include one or more scoping meetings to engage the stakeholders and public agencies early in the planning and formulation stages of the project to scope the range of actions, alternatives, reasonably foreseeable methods of compliance, significant impacts, and cumulative impacts, if any, that should be analyzed in the study and mitigation measures that will reduce impacts to a less than significant level, and to eliminate from the project any elements found not to be important (Cal. Code Regs., tit. 23, § 3775.5, subd. (b)). A scoping meeting for the Provisions was held in February 2007 in Sacramento, California. Oral and written comments were received, but development of the Provisions was delayed due to shifting staff resources to other State Water Board priority plans and policies.

2.6.4 Focus Group Meetings

To continue engagement and consultation with interested members of the public, State Water Board staff held nine targeted outreach meetings from June through October of 2014 to discuss and solicit feedback on the Provisions' key elements. These meetings also included discussion on the Reservoir Program (see Section 1.6). Eight meetings were held with representatives from California tribes, industry, municipal governments, environmental interest groups, the Department of Conservation, the Bureau of Land Management (BLM), U.S. Forest Service (USFS), the U. S. Army Corps of Engineers, California Department of Public Health (CDPH) and county health departments (Table 2-1). Participants were provided an issue paper that provided an overview of the fundamentals of the Provisions and 21 key unresolved issues and options to discuss. Documents from these meetings and the 2007 scoping meeting are available at http://www.waterboards.ca.gov/water_issues/programs/mercury/.

Table 2-1. Focus Group Meetings

Group	Location, Date
California Native American Tribes	Sacramento (teleconference), June 27, 2014
Northern California Environmental & Environmental Justice Groups	Sacramento, July 8, 2014
Municipal Wastewater	Sacramento, July 14, 2014
Northern California Municipal Storm Water Agencies	Sacramento, July 25, 2014
Southern California Municipal Storm Water Agencies	Costa Mesa, July 31, 2014
Land Managers/Mining	Sacramento, August 7, 2014
Public Health Departments	Sacramento, September 3, 2014
Industrial Wastewater Dischargers	Sacramento, September 11, 2014
Presentation at U.S. EPA Tribal Conference	Sacramento, October 15, 2016

In formulating the Provisions, State Water Board staff consulted with staff from the Regional Water Boards in a meeting in October 2014. Staff from the San Francisco Bay Water Board and the Central Valley Water Board who are developing the Reservoir Program have been involved in the development of the Provisions. In addition, State Water Board staff has consulted with staff from U.S. EPA and the Office of Environmental Health Hazard Assessment (OEHHA).

2.6.5 Tribal and Subsistence Fishing Beneficial Uses Outreach Meetings
Eleven meetings were held by State Water Board staff with California tribes and other stakeholders as part of staff's efforts to receive input on the proposed beneficial uses (Table 2-2). These focused outreach meetings were held prior to the formal comment period, therefore no formal responses to comments were made. Staff altered the definitions based on input received during these outreach meetings.

Table 2-2. Focus Group Meetings for the Beneficial Uses

Group	Location, Date
Tribal Ad-hoc Committee	Lower Lake, May 5, 2016
Agriculture Representatives	Sacramento, May 12, 2016
Association California Water Agencies	Sacramento, May 13, 2016
Association California Water Agencies	Sacramento (and webcast), June 15, 2016
Southern California Tribal Representatives	Coachella, June 27, 2016
Municipal Storm Water and Wastewater	Sacramento (and webcast), July 12, 2016
Northern California Tribal Representatives	Loleta (Eureka), July 15, 2016
Central California Tribal Representatives	Sacramento (and webcast), July 20, 2016
NGOs and Environmental Justice Groups	Sacramento (and webcast), July 26, 2016
Industry	Sacramento (and webcast), July 26, 2016
Ag, Dairy, Grazers	Sacramento (and webcast), July 27, 2016

2.6.6 Notice to California Native American Tribes of Opportunity for Consultation
AB 52 (Gatto, 2014) established a new category of resources in CEQA called Tribal Cultural Resources:

> 'Tribal cultural resources' are either of the following: (1) Sites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American tribe that are either of the following: (A) Included or determined to be eligible for inclusion in the California Register of Historical Resources. (B) Included in a local register of historical resources as defined in subdivision (k) of Section 5020.1. (2) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Section

> 5024.1. In applying the criteria set forth in subdivision (c) of Section 5024.1 for the purposes of this paragraph, the lead agency shall consider the significance of the resource to a California Native American tribe." (Pub. Resources Code, § 21074)

AB 52 also established a consultation process with all California tribes on the Native American Heritage Commission List. Consultation with a California Native American tribe that has requested such consultation may assist a lead agency in determining whether the project may adversely affect tribal cultural resources, and if so, how such effects may be avoided or mitigated. AB 52 requires formal notice to California tribes of an opportunity to consult with the lead agency prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report if the tribe is traditionally and culturally affiliated with the geographic area of the proposed project.

The requirements to consider tribal cultural resources and to consult with California tribes apply to CEQA projects for which the lead agency issues a notice of preparation or a notice of intent to adopt a negative declaration or mitigated negative declaration on or after July 1, 2015. The State Water Board considers AB 52's requirements as also applying to SED.

In addition to the outreach described above, letters dated May 10, 2016 were sent via certified mail to 14 tribal communities, including all of the California tribes registered at the time to receive AB 52 notices. All delivery receipts were received by the State Water Board by June 17, 2016. The State Water Board received no response to these letters requesting consultation within the 30 days (or at any other time) following the tribes' receipt of the letters.

2.6.7 Consultation with U.S. Fish and Wildlife Service, California Department of Fish and Wildlife and National Marine Fisheries Service

Since the Provisions could affect threatened or endangered species, the California Endangered Species Act of 1984 requires State agencies to consult with the California Department of Fish and Wildlife (CDFW) on State-listed species. Additionally, the Federal Endangered Species Act requires consultation with USFWS and NMFS on federally listed species.

Moreover, because a major impetus of the Provisions is to address concerns raised by USFWS in the 1998 draft Biological Opinion (see Section 3.5), satisfying the concerns of USFWS is critical to the success of the project.

State Water Board staff consulted with staff from USFWS and CDFW in the development of the Mercury Water Quality Objectives for wildlife.   A draft was sent to USFWS in March 2014. Meetings were held with representatives from USFWS and U.S. EPA in March 2015 and with representatives from USFWS, U.S. EPA, and National Marine Fisheries Service on December 7, 2015. The CDFW was sent drafts and was invited to the last meeting, but did not attend.

2.6.8 Scientific Peer Review

The California Health and Safety Code section 57004 requires external scientific peer review of the scientific basis for any rule proposed by any board, office, or department within the California Environmental Protection Agency. Scientific peer review is a mechanism for ensuring that the scientific portions of regulatory decisions and initiatives are based on sound science. Scientific peer review also helps strengthen regulatory activities, establishes credibility with stakeholders, and ensures that public resources are managed effectively. The scientific portions of the Provisions underwent external scientific peer review in the summer of 2016. The scientific reviewer's comments, Water Board staff responses, and the resulting changes to the Provisions, are included in Appendix S.

The external peer reviewers prepare a written report that contains an evaluation of the scientific basis of the proposed rule. If a review finds that the State Water Board has failed to demonstrate that the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices, the report shall state that finding, and the reasons explaining the finding (Health & Safety Code, § 57004, subd. (d)(2)). In such a case, if the State Water Board disagrees with any aspect of the finding of the external scientific peer review, it shall explain its disagreement and include as a part of the administrative record for the rule "its basis for arriving at such a determination in the adoption of the final rule, including the reasons why it has determined that the scientific portions of the proposed rule are based on sound scientific knowledge, methods, and practices" (Health & Safety Code, § 57004, subd. (d)(2)). The scientific peer review should be completed and changes to the Provisions should be made, if necessary, before the draft Provisions and Staff Report are distributed for public comment.

2.6.9 Water Code section 13241

In accordance with Water Code section 13241, the Water Boards are required to establish water quality objectives to "ensure the reasonable protection of beneficial uses and the prevention of nuisance." In doing so, the Water Boards shall consider the following factors:

1. Past, present, and probable future beneficial uses of water.
2. Environmental characteristics and water quality of the hydrographic unit under consideration.
3. Water quality conditions that could be reasonably attained through coordinated control of all factors affecting water quality.
4. Economic considerations.
5. The need for developing new housing.
6. The need to develop and use recycled water.

Discussion of the six factors are in Chapter 10, however, several factors (including economic considerations) are also discussed in Chapter 6 (discussion of the policy issues).

2.6.10 Other Requirements

Antidegradation, the Human Right to Water, and climate change are described in Chapter 10.

2.7 Project Contacts

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Program Website
http://www.waterboards.ca.gov/water_issues/programs/mercury/

Updates on the Provisions can be obtained by subscribing to the electronic subscription mailing list (listserv) for the "Mercury - Statewide Provisions", under "Water Quality": http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml.

3. Regulatory Background

3.1 Regulatory History and the Need for New Beneficial Uses

The Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. § 1251 et seq. (Clean Water Act or Act) "is a comprehensive water quality statute designed to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (*PUD No. 1 of Jefferson City v. Washington Dept. of Ecology* (1994) 511 U.S. 700, 704 (internal quotation marks omitted).) The Clean Water Act requires states to adopt new or revise existing water quality standards for all waters within their boundaries. (33 U.S.C. § 1313(a); 40 C.F.R. § 131.4(a).) If a state does not set water quality standards, or if U.S. EPA determines that the state's standards do not meet the requirements of the Clean Water Act, U.S. EPA promulgates standards for the states. (33 U.S.C. § 1313(b), (c)(3)-(4).) "Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the Act." (40 C.F.R. 131.3(i).) Water quality standards generally consist of three components: designated uses for each water body or segment, water quality criteria for those waters intended to protect the designated uses, and an antidegradation policy (40 C.F.R §131.6(a), (c), and (d); 40 C.F.R. § 131.13). In general, "uses" refer to what a water body is or potentially may be used for (40 C.F.R. § 131.3(f)), either by the public or by plants, fish, and other forms of life, with examples as diverse as use as wildlife and riparian habitat, use of water for industrial production, agricultural supply, or use for recreation due to activities such as fishing and swimming in water bodies (40 C.F.R. 131.10(a)). Most, if not all, water bodies have multiple uses. "Existing uses" are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." (40 C.F.R. § 131.3(e).) "'Designated uses' are those uses specified in water quality standards for each water body or segment whether or not they are being attained." (40 C.F.R. § 131(f).) "Water quality criteria" are "expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use." (40 C.F.R. § 131.3(b).) Antidegradation policies generally must provide three levels (tiers) of water quality protection to maintain and protect existing water uses, high quality waters, and outstanding national resource waters, consistent with 40 Code of Federal Regulations section 131.12.

Under the Porter-Cologne Water Quality Control Act (Wat. Code, § 13000 et seq.), California law designates the State Water Board and the nine Regional Water Boards as the principle state agencies for enforcing federal and state water pollution law (Wat. Code, §§ 13140, 13160, 13225, 13240). California law defines "designated uses" and "water quality criteria," respectively, as "beneficial uses" and "water quality objectives" (Wat. Code, § 13050, subds. (f), (h)). Regional Water Boards are required to establish water quality control plans for all areas within their regions (Wat. Code, §13240), and those water quality control plans must designate or establish, in part, beneficial uses within the areas governed by that plan (Wat. Code § 13050, subd. (j)).

Beneficial uses form the cornerstone of water quality management and protection in California. The Water Boards carry out their water quality protection authority through, among other actions, the adoption of regional water quality control plans (referred to as "basin plans" when adopted by the Regional Water Boards). Through these plans, the Water Boards establish water quality standards, and the Regional Water Boards designate specific waters within their respective regions where the use applies (Wat. Code, §§ 13240, 13050, subd. (j)). Once beneficial uses are designated in basin plans, water quality objectives can be established and programs that maintain or enhance water quality can be implemented to ensure the reasonable protection of beneficial uses (Wat. Code, § 13241) for surface waters, ground water, marshes, wetlands, and other waters of the state. The federal Clean Water act allows states to adopt sub-categories of a use and set the appropriate water quality criteria (objective) to reflect the varying needs of such sub-categories of uses (40 C.F.R. § 131.10(c)). For example water quality criteria should be set to differentiate "fisheries" between cold water and warm water fisheries.

Beginning in 2012, while new statewide water quality objectives for mercury were under development, California tribes began addressing the State Water Board and the U.S. EPA with concerns regarding the lack of consideration of tribal input in water quality decisions made in California. Many California tribes consume much higher amounts of fish for traditional, cultural, and subsistence reasons, meaning that the consumption rates assumed in existing criteria for mercury underestimates use by these groups. U.S. EPA commissioned a study by UC Davis researchers who found, through a survey of 40 California tribes and tribal groups, that fish consumption was approximately 5 to 25 times higher for tribal fishers, greatly increasing the risk of methylmercury exposure. In addition, environmental justice advocacy groups requested that non-tribal subsistence fishers be considered in a mercury rulemaking.

Communication between the State Water Board and several California tribes began in 2013. The Chair of the State Water Board wrote to a tribal ad hoc group in October 2013 and acknowledged "the importance of identifying and describing beneficial uses unique to California tribes, in addition to subsistence fishing by other cultures or individuals." State Water Board staff corresponded and engaged with tribal representatives during 2014 and 2015, as well as with environmental justice representatives, to receive their input concerning matters uniquely within their knowledge, tradition, and practices. During spring 2015, eight tribes submitted resolutions from their respective tribes to the State Water Board which proposed specific language for two beneficial uses pertaining to tribal traditional and cultural use and tribal subsistence fishing. On February 16, 2016, the State Water Board adopted Resolution No. 2016-0011, which directed staff to develop proposed beneficial uses, including definitions "pertaining to tribal traditional and cultural use, tribal subsistence fishing use, and subsistence fishing use by other cultures or individuals." (Resolve Clause No. 1)

Currently, with the exception of beneficial uses that are in effect in the North Coast Regional Water Board's basin plan, these plans do not contain beneficial uses that directly address traditional tribal cultural uses or subsistence fishing uses.

3.2 Statement of Necessity for Beneficial Uses

As stated above, State Water Board Resolution No. 2016-0011 formally directs staff to develop and define proposed beneficial use definitions that pertain "to tribal traditional and cultural use, tribal subsistence fishing use, and subsistence fishing use by other cultures or individuals." (Resolve Clause No. 1). These beneficial uses are necessary because existing beneficial uses do not take into account the greater consumption of finfish and shellfish by some cultures or individuals.

The State Water Board will consider adopting the beneficial use definitions proposed by staff as part of the Provisions in order "to create a consistent set of beneficial uses to be used" (State Water Board Resolution No. 2016-0011, Resolve Clause 4) by the Regional Water Boards to the extent a Regional Water Board defines such activities in a water quality control plan.

3.3 Existing Beneficial Uses

The Clean Water Act and the Porter-Cologne Water Quality Control Act establish a comprehensive program for the protection of beneficial uses of the waters of the state. California Water Code section 13050, subdivision (f), describes the beneficial uses of surface and ground waters that may be designated by the Water Boards for protection as follows:

> "Beneficial uses" of the waters of the state that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

Specific beneficial uses that achieve the above goals are defined in the basin plans of each the nine Regional Water Boards. Most of the Regional Water Boards' basin plans contain identical beneficial uses and definitions, but in some cases, the basin plans contain different or modified beneficial uses. In general, most Basin Plans use the same beneficial uses, as described in a 2001 document (State Water Resources Control Board, 2001). These uses were:

Municipal and Domestic Supply (MUN) — Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water.

Agricultural supply (AGR) — Uses of water for farming, horticulture or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC) — Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND) — Uses of water for industrial activities that do not depend primarily on water quality, including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Groundwater Recharge (GWR) — Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting salt water intrusion into fresh water aquifers.

Fresh Water Replenishment (FRSH) — Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation (NAV) — Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW) — Uses of water for hydropower generation.

Water Contact Recreation (REC 1) — Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-Contact Water Recreation (REC 2) — Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Ocean Commercial and Sport Fishing (COMM) — Uses of water for commercial or recreational collection of fish and shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture (AQUA) — Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Fresh Water Habitat (WARM) — Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Fresh Water Habitat (COLD) — Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Saline Water Habitat (SAL) — Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST) — Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Marine Habitat (MAR) — Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat (WILD) — Uses of water that support terrestrial ecosystems including, but not limited to, preservation or enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats of Special Significance (BIOL) — Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

Rare, Threatened, or Endangered Species (RARE) — Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

Migration of Aquatic Organisms (MIGR) — Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

Spawning, Reproduction, and/or Early Development (SPWN) — Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Shellfish Harvesting (SHELL) — Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, abalone, and mussels) for human consumption, commercial or sport purposes.

Flood Peak Attenuation/Flood Water Storage (FLD) — Beneficial uses of riparian wetlands in flood plain areas and other wetlands that receive natural surface drainage and buffer its passage to receiving waters.

Water Quality Enhancement (WQE) — Beneficial uses of waters that support natural enhancement or improvement of water quality in or downstream of a water body including, but not limited to, erosion control, filtration and purification of naturally occurring water pollutants, streambank stabilization, maintenance of channel integrity, and siltation control.

Limited Warm Freshwater Habitat (LWRM) — Waters support warm water ecosystems which are severely limited in diversity and abundance as the result of concrete-lined watercourses and low, shallow dry weather flows which result in extreme temperature, pH, and/or dissolved oxygen conditions. Naturally reproducing finfish populations are not expected to occur in LWRM waters.

Many of the beneficial uses listed in this section are not related to this project, which emphasizes consumption of fish by humans and wildlife.

3.4 Regional Water Board Basin Plans

The Clean Water Act and the Porter Cologne Water Quality Control Act require the Water Boards to identify appropriate water uses as well as develop sub-categories of beneficial uses to water quality control plans (40 C.F.R. § 130.10(a), (c); Wat. Code, §§ 13240, 13050, subds. (f), (j)). Beneficial uses identified in basin plans that are in addition to, or significantly different from, the above 2001 standard beneficial uses are listed below by region. Regions that do not have additional beneficial uses are not listed.

<u>North Coast Regional Water Board</u>

Preservation of Areas of Special Biological Significance (ASBS) — Includes marine life refuges, ecological reserves and designated areas of special biological significance, such as areas where kelp propagation and maintenance are features of the marine environment requiring special protection. (This is a modification of BIOL that focuses on marine habitat.)

Wetland Habitat (WET) — Uses of water that support natural and man-made wetland ecosystems, including, but not limited to, preservation or enhancement of unique wetland functions, vegetation, fish, shellfish, invertebrates, insects, and wildlife habitat.

Native American Culture (CUL) — Uses of water that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving and jewelry material collection, navigation to traditional ceremonial locations, and ceremonial uses.

Subsistence Fishing (FISH) — Uses of water that support subsistence fishing.

<u>San Francisco Bay Regional Water Board</u>

AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE (ASBS) — These include marine life refuges, ecological reserves, and designated areas where the preservation and enhancement of natural resources requires special protection. In these areas, alteration of natural water quality is undesirable. The areas that have been designated as ASBS in this Region are Bird Rock, Point Reyes Headland Reserve and Extension, Double Point, Duxbury Reef Reserve and Extension, Farallon Islands, and James V. Fitzgerald Marine Reserve, depicted in Figure 2-1 in the San Francisco Bay Regional Water Board's basin plan. The California Ocean Plan prohibits waste discharges into, and requires wastes to be discharged at a sufficient distance from, these areas to assure maintenance of natural water quality conditions. These areas have been designated as a subset of State Water Quality Protection Areas as per the Public Resources Code. These areas are designated by the State Water Board.

Central Coast Regional Water Board

Areas of Special Biological Significance (ASBS) — are those areas designated by the State Water Resources Control Board as requiring protection of species or biological communities to the extent that alteration of natural water quality is undesirable.

Los Angeles Regional Water Board

Limited Water Contact Recreation (LREC-1)) — Uses of water for recreational activities involving body contact with water, where full REC-1 use is limited by physical conditions such as very shallow water depth and restricted access and, as a result, ingestion of water is incidental and infrequent.

High Flow Suspension (Special Requirement for REC-1 and REC-2 Uses)) — The High Flow Suspension shall apply to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities. Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where the (av) footnote appears in Table 2-1a (in the Los Angeles Regional Water Quality Control Board's Basin Plan). The High Flow Suspension shall apply on days with rainfall greater than or equal to ½ inch and the 24 hours following the end of the ½-inch or greater rain event, as measured at the nearest local rain gauge, using local Doppler radar, or using widely accepted rainfall estimation methods. The High Flow Suspension only applies to engineered channels, defined as inland, flowing surface water bodies with a box, V-shaped or trapezoidal configuration that have been lined on the sides and/or bottom with concrete. The water bodies to which the High Flow Suspension applies are identified in Table 2-1a in the column labeled "High Flow Suspension".

Santa Ana Regional Water Board

Limited Warm Freshwater Habitat (LWRM) — waters support warm water ecosystems which are severely limited in diversity and abundance as the result of concrete-lined watercourses and low, shallow dry weather flows which result in extreme temperature, pH, and/or dissolved oxygen conditions. Naturally reproducing finfish populations are not expected to occur in LWRM waters.

3.5 Regulatory History and the Need for New Water Quality Objectives

Section 303(c)(2)(B) of the Clean Water Act (33 U.S.C. § 1313) requires states to adopt water quality criteria (i.e., objectives) for all priority pollutants (33 U.S.C. § 1317(a)). However, as a result of litigation that ended with the rescission of the State Water Board's Inland Surface Waters and the Enclosed Bays and Estuaries Plans, California was left without water quality standards for many priority pollutants in 1994. To reestablish water quality criteria for these priority pollutants, and to effectively bring California into compliance with the federal regulations, the U.S. EPA promulgated the California Toxics Rule in May 2000 (40 C.F.R. § 131.38). In 2005, the State Water Board adopted SIP to provide a mechanism to implement the water quality criteria established in the California Toxics Rule.

With the California Toxics Rule, the U.S. EPA promulgated total recoverable mercury criteria for the protection of human health for California waters of 0.050 micrograms per liter (µg/L) for consumption of water and organisms and 0.051 µg/L for consumption of organisms only. The U.S. EPA did not promulgate criteria for the protection of wildlife because USFWS and NMFS had determined that the proposed criteria were not protective of endangered species (USFWS and NMFS 1998). Instead, the U.S. EPA agreed to derive a new human health criterion in the near future that would likely protect wildlife as well. In 2001, pursuant to the Clean Water Act § 304(a), the U.S. EPA published the new recommended human health methylmercury fish tissue criterion of 0.3 mg/kg (U.S. EPA 2001) using a default consumption rate of 17.5 grams per day (g/day) – roughly two fish meals per month. This U.S. EPA criterion is a *recommended* threshold for the nation. To make the criterion enforceable, states must adopt it into their water quality standards.

Rather than a criterion expressed as a mercury concentration in the water, the U.S. EPA concluded that it was more appropriate to derive the criterion for methylmercury in the form of a fish tissue concentration. A fish tissue concentration was more closely tied to the Clean Water Act goal of protecting the public health, because it was based directly on the main route that humans are exposed to harmful levels of methylmercury.

In 2003, the USFWS evaluated the new U.S. EPA methylmercury criterion and found that it was still not protective of two of seven threatened or endangered species evaluated (USFWS 2003), leaving California in need of a modification of the U.S. EPA criterion to protect wildlife. Currently, the U.S. EPA's 2001 fish tissue criterion has not been adopted as an enforceable statewide water quality objective in California, nor has an objective been adopted that is sufficient to protect all wildlife from mercury statewide.

3.6 Statement of Necessity for the Mercury Water Quality Objectives

As described above, several events have left California without numeric water quality objectives to protect wildlife from mercury. Such water quality objectives must be established and are required by the Clean Water Act (33 U.S.C. § 1317(a)).

An environmental organization, Our Children's Earth Foundation, filed a lawsuit against U.S. EPA for the lack of certain criteria to protect wildlife in California. As part of the settlement for that lawsuit, U.S. EPA is required to propose a new mercury criterion to protect wildlife by June 30, 2017. If, however, the State Water Board adopts a protective objective for wildlife, and U.S. EPA approves it before that date, U.S. EPA's obligation from the lawsuit will be satisfied.

Additionally, the statewide human health water quality criterion is outdated. A new water quality objective should be adopted to incorporate the most recent methods used for the U.S. EPA human health criterion for methylmercury (U.S. EPA 2001), and such objective should reflect Californians who consume self-caught fish including California tribes and subsistence fishers. Therefore, the Provisions include the Mercury Water Quality Objectives to protect both wildlife and human health.

3.7 Existing Mercury Objectives

The current regulatory limits that are intended to protect human health from consuming methylmercury contaminated fish in California are discussed below. The relationship between these limits and other limits for mercury in water, such as drinking water guidelines are discussed in the last part of this section.

The California Toxics Rule Criteria (40 C.F.R § 131.38) is currently the only *statewide* regulatory limit for mercury in water meant to protect people from consuming too much mercury/methylmercury from fish they catch and consume on a recreational basis. There is currently no statewide mercury objective (or criterion) for the protection of subsistence fishers. There is currently no statewide mercury objective (or criterion) for the protection of wildlife from consuming too much mercury/methylmercury from eating prey fish in California. The criteria are shown in Table 3-1, along with the U.S. EPA's 2001 fish tissue criterion, which is not an enforceable limit in California because it was never adopted by the State Water Board or promulgated by the U.S. EPA.

Table 3-1. Current Statewide and National Criteria and Guidelines

Agency and Year	Applicability	Criterion or guideline
California Toxics Rule 2000 (40 C.F.R. § 131.38)	Statewide: inland surface water, enclosed bays and estuaries	0.050 µg/L total mercury in water, for consumption of water and aquatic organisms; 0.051 µg/L total mercury in water, for consumption of aquatic organisms only (Criteria are based on a mercury fish tissue concentration of 0.37 mg/kg and a bioconcentration factor of 7345. The criteria do no account for bioaccumulation up the food web.)
National Criterion (U.S. EPA 2001)	Non-enforceable, but has been used to assess narrative objectives	0.3 mg/kg methylmercury in fish tissue
Fish Contaminant Goal, OEHHA (Klasing and Brodberg 2008)	Non-enforceable, but has been used to assess narrative objectives	0.22 mg/kg methylmercury in fish tissue

3.8 Regional Water Board Basin Plans

In addition to the statewide California Toxics Rule criteria, Regional Water Boards may regulate pollutants by establishing numeric or narrative water quality objectives in their basin plans.

The *narrative* objectives are the main methods by which the Regional Water Boards have recently assessed water for possible mercury impairments. All nine Regional Water Boards have a narrative objective for toxicity that are similar to "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life" (from the Central Valley Regional Water Board's Water Quality Control Plan for the Sacramento and San Joaquin River Basins, p. III-8.01, Central Valley Water Board 2009). To implement this narrative objective, numeric criteria (that are otherwise non-enforceable) are often used as translators. The U.S. EPA fish tissue criteria of 0.3 mg/kg methylmercury in fish tissue, or OEHHA's 1999 Fish Contaminant Goal of 0.3 mg/kg methylmercury in fish tissue (Brodberg and Pollock 1999) have been used to fulfill the narrative toxicity objective in regards to mercury. In 2008, OEHHA revised its Fish Contaminant Goal and lowered it to 0.22 mg/kg based on California fish consumption rates, making it the preferred criterion to fulfill the narrative objective for mercury (Klasing and Brodberg 2008). The 2008 fish contaminant goal has been used for water quality assessment purposes in the statewide integrated report (Clean Water Act § 303(d), 305(b)) since 2012.

The only *numeric* objectives for mercury that are intended to protect human health or wildlife from consuming methylmercury contaminated fish are site-specific objectives that were established in basin plans with mercury/methylmercury TMDLs which are discussed later in this section.

3.9 Water Quality Assessment

Section 303(d) of the Clean Water Act (33 U.S.C. § 1313 (d)) and 40 C.F.R. § 130.7(b) requires states to identify water bodies where technology-based effluent limitations and other required controls fail to meet water quality objectives and are not supporting their beneficial uses (referred to as impaired waters). These substandard or impaired waters are placed on the Clean Water Act section 303(d) List of Water Quality Limited Segments (impaired water bodies).

In the 2012 California Integrated Report (approved by U.S. EPA in July 2015), more than 190 California water bodies are listed as impaired because of elevated mercury concentrations in fish tissue (Figure C-1, list of waterbodies in Appendix C). Many of the listings of impaired water bodies are based on interpretation of the narrative objectives with the 2001 U.S. EPA criterion of 0.3 mg/kg in fish tissue, the 1999 OEHHA guideline of 0.3 mg/kg in fish tissue, or the aqueous California Toxics Rule criterion of 50-51 ng/L. The first time the more recent guideline of 0.2 mg/kg was used for a major statewide assessment was for the 2012 Integrated Report.

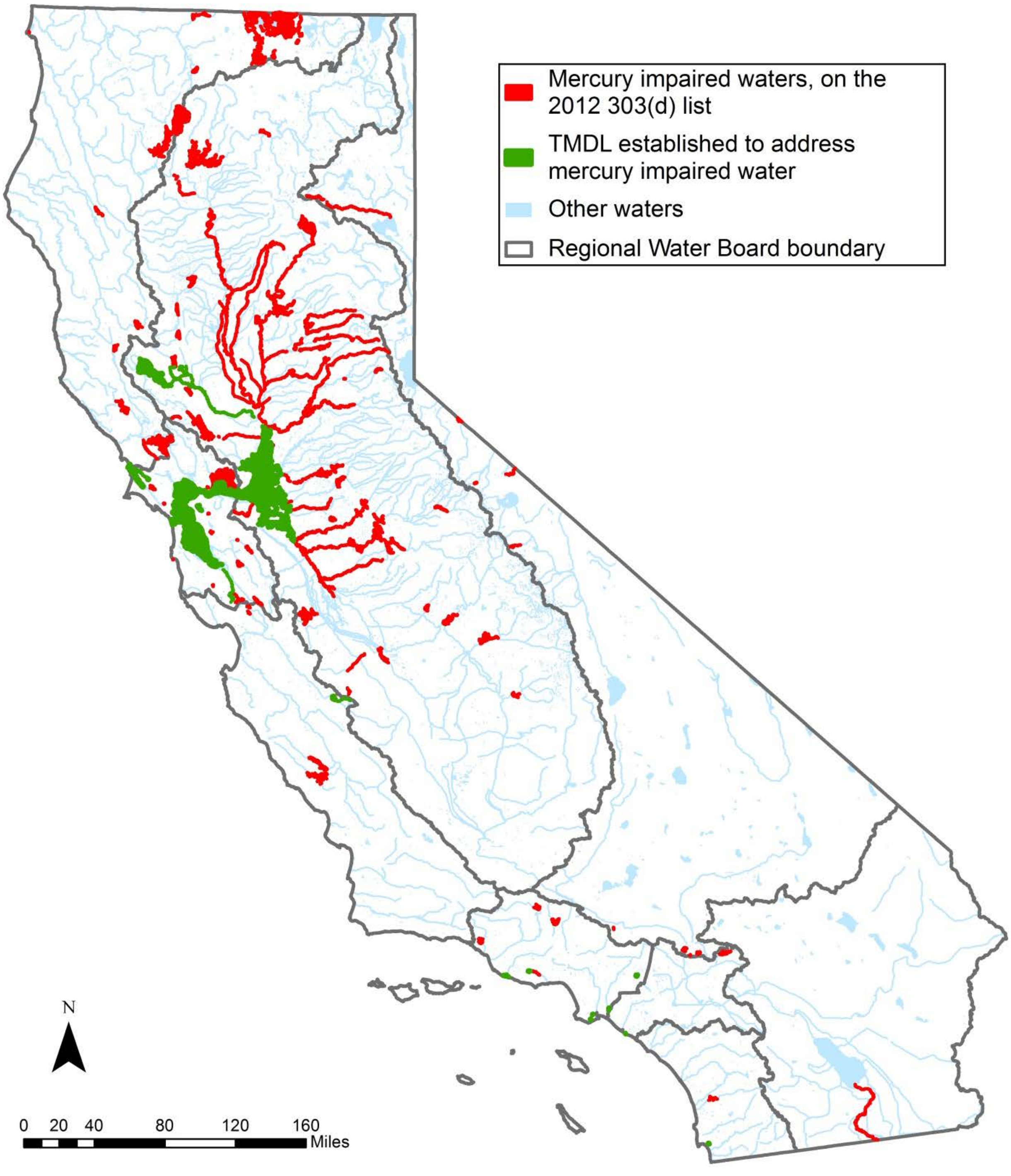

Figure 3-1. Map of mercury impaired waters in California and mercury (or methylmercury) TMDLs.

These mercury impaired water bodies are not attaining the water quality standards for mercury related to fishing and recreational fish consumption (such as the COMM) beneficial use, see Chapter 5 on beneficial uses for a complete list), and therefore, have been placed on the 303(d) list of impaired water bodies. As such, OEHHA has issued advisories warning people about the dangers of eating certain fish (See Appendix E for more details about related programs in other agencies).

3.10 TMDLs and Site-Specific Objectives

For impaired water bodies, federal regulations require the development of a TMDL for each pollutant of concern to reduce the amount of pollution entering the water body and to implement and achieve water quality standards. The TMDL includes a calculation of how much the pollutant loading must be reduced and a plan of action to do so. A TMDL is not self-enforcing, but serves as an informational tool or goal for the establishment of further pollution controls. For most water bodies impaired by mercury, a TMDL has not yet been developed, as seen in Figure 3-1.

When adopting a TMDL for an impaired water body, sometimes numeric objectives can be used as the TMDL target. Often, to comply with the TMDL requirements, the objectives are translated into another measured unit (e.g., a concentration of a chemical in µg/L becomes a daily allowable mass of a chemical in pounds/day) that is amenable to allocating the total load. In the past 10 years, the Regional Water Boards have adopted TMDLs to address several of the major mercury impaired waters. For many of these mercury (or methylmercury) TMDLs, the Regional Water Board chose to establish a new water quality objective that also served as the numeric target of the TMDL. These water quality objectives were adopted as site-specific water quality objectives for the particular water bodies addressed by the TMDL (listed in Table 3-2). More details of all mercury TMDLs in California are included in Appendix M.

These site-specific water quality objectives resolve the need for a new mercury objective for wildlife (a major impetus for the Provisions, as described in Section 3.5), but only for individual water bodies on a case-by-case basis. The site-specific objectives have been calculated using similar methods as the calculation for the objectives for recreational fishing and wildlife in the Provisions, and these objectives provide a similar level of protection. Therefore, the Provisions' mercury objectives for the COMM and WILD beneficial uses do not supersede the site-specific objectives listed in Table 3-2.

Also, each of the site-specific water quality objectives listed in Table 3-2 were adopted through a TMDL and program of implementation. The implementation requirements in the Provisions do not supersede these mercury TMDLs and their programs of implementation because the site-specific water quality objectives are essentially the same as those in the Provisions (as described above). Also, the programs of implementation for TMDLs are designed to restore an impaired water body, so the programs of implementation may be more stringent or may focus on significant sources of mercury to that particular water body (e.g. remediation of a mine). The mercury TMDLs include detailed identification of local sources and tailored site-specific programs of implementation. The implementation requirements in the Provisions are not designed to remedy specific impaired waters but are established to achieve the applicable water quality objectives. (Wat. Code, § 13242.).

Table 3-2. Site-Specific Objectives to Protect Human Health[a] or Wildlife Related to Consuming Fish with Elevated Methylmercury

Regional Water Board	Applicable Water Body(s), (effective date)	Aqueous	Fish Tissue Objective[b]	Hg/ MeHg[c]
San Francisco Bay	San Francisco Bay (2008)		0.2 mg/kg for TL3 and TL4 fish (size specified for certain species), 0.03 mg/kg for 3-5 centimeter (cm) fish	Hg
	Walker Creek, Soulajule Reservoir (2008); Guadalupe River[d] (2010)		0.1 mg/kg for 15-35 cm TL3 fish, 0.05 mg/kg for 5-15 cm TL3 fish	MeHg
Central Valley	Clear Lake (2003)		0.19 mg/kg for 30-40 cm TL4 fish (largemouth bass, catfish, brown bullhead, but 20-30 for crappie), 0.09 mg/kg for TL3 fish (< 30cm for catfish, otherwise no size)	MeHg
	Cache Creek and Bear Creek (2007)		0.23 mg/kg for 25-35 cm TL4 fish, 0.12 mg/kg for 25-35 cm TL3 fish	MeHg
	Harley Gulch (2007)		0.05 mg/kg for 7.5 -10 cm TL2 and TL3 fish	MeHg
	Sulphur Creek (2009)	1,800 ng/L (low flow), 35 mg/kg Hg: suspended sediment ratio (high flow)	[A fish tissue objective was not developed or adopted because the geothermal waters of the creek do not support fish]	Hg
	Sacramento-San Joaquin Delta & Yolo Bypass (2010)		0.24 mg/kg for 15-50 cm TL4 fish, 0.08 mg/kg for 15-50 cm TL3 fish, 0.03 mg/kg in fish < 5 cm	MeHg

[a] Generally applies to the Commercial and Sport Fishing (COMM) beneficial use, although some basin plans do not specify the use.
[b] TL indicates the fish trophic level: TL2 fish are fish that eat plants, TL3 fish eat TL2 organisms, and TL4 fish are top predators that eat TL3 fish.
[c] Indicates that the objective is for mercury (Hg) or methylmercury (MeHg).
[d] Full water body description: Walker Creek, Soulajule Reservoir and tributaries, Guadalupe River Watershed, except Los Gatos Creek and its tributaries upstream of Vasona Dam, Lake Elsman, Lexington Reservoir, and Vasona Lake.

Regional Water Boards have also adopted TMDLs that are based on numeric targets (Table 3-3). The implementation actions required by the Provisions would not apply to dischargers that discharge to receiving waters for which a mercury or methylmercury TMDL has been adopted, and the Provisions would not supersede any part of such TMDLs. (Such "receiving waters" are those for which a mercury or methylmercury TMDL is approved and does not include upstream water bodies even if the TMDL contains waste load allocations for the dischargers to the upstream water bodies to be implemented as effluent limitations to achieve the downstream water quality standard. For such upstream dischargers, the Provisions' implementation requirements apply. In the case where both the TMDL and application of the implementation provisions requires an effluent limitation, the more stringent requirement shall apply to such upstream discharge(s).) Generally, the proposed Mercury Water Quality Objectives will not significantly vary from existing TMDL numeric target values for mercury or methylmercury, as existing TMDLs have already been designed to protect the beneficial uses of Commercial and Sport Fishing or Wildlife habitat. Although the targets in the existing TMDLS are not always exactly the same as the proposed Sport Fish Water Quality Objective or the Prey Fish Water Quality Objective in the Provisions, they are expected to achieve an appropriate level of protection for humans and wildlife. Some of the TMDLs in Table 3-3 were developed to clean up areas with highly contaminated sediments and were not listed for elevated mercury in fish tissue. In general, the implementation requirements are consistent with the goals of the Provisions.

Table 3-3. TMDL Targets (Not Objectives) to Protect Human Health[a] or Wildlife from Consuming Fish with Elevated Methylmercury

Region	TMDL Name (effective date)	Targets	Implementation /Notes
San Francisco Bay	Tomales Bay (2012)	Fish tissue:0.2 mg/kg methylmercury in legal halibut (55 cm), methylmercury 0.05 mg/kg for 5-15 cm TL3 fish	No actions. Adopted via resolution, as implementation action already taken, and additional actions being implemented under the Walker Creek Mercury TMDL (see Table 3-2) are expected to address impairment. (Walker Creek is upstream of Tomales Bay).
Central Coast	Hernandez Reservoir and Clear Creek (2004)	Aqueous: 0.050 µg/L total mercury (CTR[b]) Fish tissue: 0.3 mg/kg methyl mercury (EPA 2001)	Implemented through non-regulatory action - a U.S. Bureau of Land Management remediated site. No additional action was necessary.
	Lake Nacimiento and Las Tablas Creek (Postponed)	Aqueous: 0.050 µg/L total mercury (CTR), Sediment: 0.486 mg/kg mercury	No actions. The Regional Water Board approved in 2002, but no State Board or U.S. EPA approval. TMDL project indefinitely postponed until U.S. EPA takes further action regarding potential superfund site.

Table 3-3. TMDL Targets (Not Objectives) to Protect Human Health[a] or Wildlife from Consuming Fish with Elevated Methylmercury

Region	TMDL Name (effective date)	Targets	Implementation /Notes
Los Angeles	LA Lakes TMDL: El Dorado Park Lakes, Puddingstone Reservoir and Lake Sherwood (2012)	Aqueous: 0.081 ng/L (dissolved methyl mercury) Fish tissue: 0.22 mg/kg methylmercury in 350 mm largemouth bass	EPA established the TMDL. The TMDL has WLAs[c] and LAs[d], but only recommendations for implementation. Sources are mainly storm water, nonpoint source runoff, and water additions.
	Calleguas Creek Watershed Mugu Lagoon Metals TMDL (2007)	Aqueous: 0.050 µg/L total mercury (CTR), Fish tissue (methylmercury): 0.3 mg/kg 0.1 mg/kg for 15-35 cm TL3 fish, 0.05 mg/kg for 5-15 cm TL3 fish, 0.03 mg/kg in fish < 5 cm, Bird egg: < 0.5 mg/kg mercury	Storm water required to implement BMPs[e] to reduce mercury load in suspended sediments by 80%. Wastewater treatment plants have average monthly mass cap at current monthly median. For other point source dischargers there was limited information, so applied CTR criterion. These WLAs are set to be reevaluated every 5 years, during the 20 year plan.
	Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxics TMDL (2012)	Aqueous: 0.050 µg/L total mercury (CTR), Marine Sediment: 0.15 mg/kg Hg	Addresses sediment contamination, not fish tissue. Mercury WLAs apply to existing sediment (not discharges) in Consolidated Slip and Fish Harbor. Contaminated sediment to be remediated. Later phases of implementation to be determined and may involve other dischargers. Los Angeles Co., Los Angeles Co. Flood Control District and City of Los Angeles MS4 permittees can do (not required) BMPs to help achieve WLA.
Santa Ana	Toxic Pollutants San Diego Creek and Newport Bay TMDL (2002, U.S. EPA technical TMDL)	Sediment: 0.13 mg/kg dry weight (no observed effect on benthic organisms, see references in TMDL report). Fish tissue: 0.3 mg/kg (U.S. EPA's proposed criteria in 2000)	Addresses sediment contamination, not fish tissue. LAs only, no program of implementation. The existing sediments are the largest sources of mercury in Rhine Channel (not discharges). U.S. EPA recommended continued implementation of an existing sediment reduction plan to

Table 3-3. TMDL Targets (Not Objectives) to Protect Human Health[a] or Wildlife from Consuming Fish with Elevated Methylmercury

Region	TMDL Name (effective date)	Targets	Implementation /Notes
			reduce loads of the pollutants included in this TMDL.
San Diego	Shipyard Sediment Site Cleanup (2012)	Sediment: 0.57 mg/kg, or 0.68 mg/kg if the lower concentration is technologically or economically infeasible	Cleanup and Abatement Order No. R9-2012-0024 (March 14, 2012) (also categorized as a TMDL: "NASSCO and Southwest Marine")

[a] Generally applies to the Commercial and Sport Fishing (COMM) beneficial use, although some basin plans do not specify the use.
[b]CTR: California Toxics Rule
[c]WLA: waste load allocation
[d]LA: Load allocation
[e]BMPs: Best Management Practices

The only exception is the Calleguas Creek TMDL which has effluent limitations for point source discharges that are based on the California Toxics Rule criteria. (The mercury criteria in the California Toxics Rule would be replaced by the objectives in the Provisions.) However, the implementation requirements in the Provisions would not supersede the Calleguas Creek TMDL program of implementation. This is because the Calleguas Creek TMDL has prey fish targets that are equivalent to the Prey Fish Water Quality Objective and the California Least Tern Prey Fish Water Quality Objective in the Provisions. So the TMDL program of implementation should be consistent with meeting the objectives that protect wildlife and recreational fishing in the Provisions. On the other hand, the Provisions do not include a relative load analysis such as that done as part of a TMDL. Also, the Calleguas Creek TMDL includes a reevaluation of waste load allocations every five years. At the next five year review, the Los Angeles Regional Water Board should reevaluate the requirements and revise the effluent limitations if appropriate.

The fish tissue objectives in the basin plans (Table 3-2) and the fish tissue targets associated with the TMDLs (Table 3-3) are all slightly different. There are several reasons for the differences. Some of the objectives or targets are based on values to protect wildlife because the site-specific analysis for that water body suggested that wildlife is more sensitive than humans to mercury contamination (i.e.: Walker Creek & Guadalupe watershed, Clear Lake, Cache Creek, Harley Gulch). When the objectives or targets were derived to protect wildlife, the types and sizes of fish that the objectives were applied to were representative fish that wildlife consume, not the fish caught and consumed by humans. For Sulphur Creek, a fish tissue objective was not developed or adopted because the geothermal waters of the creek do not support fish.

Other mercury objectives and targets in the basin plans (Table 3-2, Table 3-3) were initially derived to protect human health. These human health targets were also found to protect wildlife. Among the objectives and targets based on human health, there are a few more reasons for variations. The San Francisco Bay objective was based on a consumption rate of 32 g/day of trophic level 4 fish, while the U.S. EPA consumption rate of 17.5 g/day was used in the Cache Creek and Clear Lake site-specific objectives. In the Delta TMDL, the objective is also based on a consumption rate of 32 g/day, but the calculation included a mixed consumption of trophic level 3 and trophic level 4 fish, vs. trophic level 4 only. That is why the objective for the Delta is a bit higher than the objective for San Francisco Bay (0.24 vs. 0.2 mg/kg). The Los Angeles Lakes TMDL target is calculated similarly to the San Francisco Bay TMDL, with the exception that there is not a separate consideration for methylmercury exposure from commercially-bought fish as represented by the "relative source contribution" (RSC) in the U.S. EPA's criterion.

Despite all the differences the targets and site-specific objectives (Table 3-2, Table 3-3), they are all still quite similar. Even if the lower level of consumption was used for human health (17.5 g/day), the value used for wildlife required a higher level of protection that was consistent with other TMDLs based on 32 g/day. In addition, many TMDLs have multiple targets. For example, in the Calleguas Creek TMDL, the human health target is based on 17.5 g/day, but there is another target of 0.03 mg/kg in fish less than 50 mm long for the protection of wildlife, which is more protective than the 32 g/day consumption rate for trophic level 4 fish. When the Regional Water Boards revisit these TMDLs, if they used 17.5 g/day as a consumption rate, they should consider updating it to 32g/day. This change should not make a substantial difference in the implementation for the reasons just described, but it would make targets more consistent statewide.

3.11 Other Mercury Water Quality Objectives and Criteria

There are other criteria and water quality objectives for mercury that have different goals than the objectives in the Provisions. Some of these criteria and objectives are described below to distinguish them as not relevant to the Provisions, or to confirm that they not be affected by the Provisions. Some criteria or objectives, on the other hand, have similar purposes and this section describes why they would be superseded.

California Drinking Water Objectives

All basin plans incorporate the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations to protect MUN beneficial use (Cal. Code Regs., tit. 22, § 64431). The MCL for mercury is 0.002 mg/L. The Mercury Water Quality Objectives would be protective of this beneficial use, but the objectives are much more stringent than necessary to protect this use. Therefore, the Mercury Water Quality Objectives are not recommended to replace objectives for the MUN beneficial use.

California Aquatic Life Objectives

The San Francisco Bay Water Board adopted the U.S. EPA aquatic life criteria as region-wide objectives (San Francisco Bay Water Board 2013). Acute and chronic criteria for freshwater are

2.4 µg/L (1 hour average) and 0.025 µg/L (4 day average). For marine waters, acute and chronic objectives are 2.1 µg/L (1 hour average) and 0.025 µg/L (4 day average). The basis of these national criteria is described below. When the San Francisco Bay Regional Water Board adopted fish tissue water quality objectives for mercury, the board vacated the chronic aquatic life criteria since the fish tissue objectives were meant to protect the same endpoint of fish consumption and the fish tissue objectives were based on newer science. Similarly, the Provisions' water quality objectives for protecting Wildlife Habitat (the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, and the California Least Tern Prey Fish Water Quality Objective) would supersede the San Francisco Bay Water Board's chronic mercury aquatic life objective (0.025 µg/L), since the objectives in the Provisions would be protective of aquatic life and wildlife. However, the San Francisco Bay Water Board's objective should be superseded only where it applies to inland surface waters, enclosed bays and estuaries, because the Provisions would apply only to those waters and not marine waters.

The basin plan for the Central Coast Regional Water Board also includes mercury water quality objectives to protect aquatic life (Central Coast Water Board 2011). The objective of 0.2 µg/L is not to be exceeded in freshwater to protect both the COLD and WARM beneficial uses (Table 3-5 in the basin plan). The Central Coast Water Board's basin plan also contains a mercury objective of 0.1 µg/L, not to be exceeded in marine waters to protect the MAR beneficial use (Table 3-6 in the Region 3 basin plan). The objectives in the Provisions for protection of Wildlife Habitat are more stringent that the values for aquatic life habitats (0.2 and 0.1 µg/L), but the objectives in the Provisions act as chronic criteria. The values in the basin plan could be maintained as acute maximums (no averaging period is specified in the basin plan). Although the values (0.2 µg/L and 0.1 µg/L) are not fully evaluated here, these objectives are lower and therefore more protective than the current U.S. EPA national recommended acute criterion (0.77 µg/L).

The Central Coast Regional Water Board's basin plan also stipulates a body burden objective for mercury, or a maximum allowable concentration of mercury in any aquatic organism. The objective is defined as the "maximum acceptable concentration of total mercury in any aquatic organism is a total body burden of 0.5 µg/g wet weight." (Note that typographical errors appearing in the basin plan in the units and "body burden" have been corrected here.) This footnote was based on U.S. EPA's 1972 Water Quality Criteria "Blue Book" document. The tissue concentration could be interpreted to protect birds that eat fish. The Central Coast Regional Water Board mercury objective is less stringent than the objectives in the Provisions for protection of Wildlife Habitat. For clarity, the Provisions' water quality objectives for protecting Wildlife Habitat (the Sport Fish and the prey fish objectives) would supersede the Central Coast Regional Water Board's body burden objective.

National Aquatic Life Criteria

The 1997 U.S. EPA national recommended freshwater aquatic life criteria are an acute criterion of 1.4 µg/L and a chronic criterion of 0.77 µg/L (62 Fed. Reg. 42169 (Aug 5 1997)). These are not used in any basin plan throughout the state of California. These values are designed to protect aquatic life from direct exposure to aqueous inorganic mercury and do not account for uptake via the food web because sufficient data were not available when the criterion was derived. These criteria were determined to not be fully protective of aquatic life (mainly wildlife that consumes fish) when the California Toxics Rule was promulgated by the U.S. EPA, so they were not included in the California Toxics Rule. The mercury objectives for protecting Wildlife Habitat in the Provisions are more protective than the old recommended freshwater aquatic life criteria (1.4 µg/L and 0.77 µg/L) and are intended to protect wildlife from bioaccumulation of methylmercury.

The U.S. EPA also published acute and chronic water quality criteria of 2.4 µg/L and 0.012 µg/L for freshwater and 2.1 µg/L and 0.025 µg/L for saltwater in 1984, and these values were included in the "Gold Book" of water quality criteria (U.S. EPA 1985a, U.S. EPA 1986). The chronic value was designed to protect fish consumption. It was calculated from a Food and Drug Administration Action level and a BAF, but it was derived under the assumption that all mercury in water is methylmercury. This value is in some Regional Water Board basin plans (the San Francisco Bay Water Board's basin plan, described above), and is still used in some states (i.e., Oregon, Washington and Idaho) because there is no better value to protect aquatic life. The recommended value of 0.012 µg/L is equivalent to the effluent limitation in the Provisions for wastewater and industrial discharges to rivers. The effluent limitation of 0.012 µg/L was derived to protect wildlife (and humans) from bioaccumulation of methylmercury in flowing waters.

4. Environmental Setting

4.1 Forms of Mercury

Mercury can exist in various forms in the environment. Physically, mercury can exist in water in a dissolved, colloidal or particulate bound state. Chemically, mercury can exist in three oxidation states: elemental mercury (Hg^0), mercurous ion (monovalent mercury, Hg^+), or mercuric ion (divalent mercury, Hg^{+2}). Ionic mercury can react with other chemicals to form inorganic compounds, such as cinnabar (HgS) and it can be converted by sulfate-reducing bacteria to more toxic organic compounds, such as methylmercury (CH_3Hg) or dimethylmercury ($(CH_3)_2Hg$).

Methylmercury is the predominant form of organic mercury present in biological systems, such as the aquatic environment. Methylmercury is the form of mercury that is most readily incorporated into biological tissues and poses the greatest risk to humans and wildlife in the aquatic environment (Agency for Toxic Substances and Disease Registry 1999). The methylation of mercury is generally thought to be a bacterially mediated process. In addition to sulfate-reducing bacteria, there is evidence that iron-reducing bacteria may also play an important role in methylating mercury in some systems (Gilmour et al., 2013; Alpers et al., 2014). The formation of methylmercury is a complex, far from fully understood, biogeochemical process driven by factors that control the activity of methylating bacteria, such as the availability of metabolic electron donors and acceptors, and the availability of aqueous phase mercury complexes (Jonsson et al. 2012).

Numerous environmental factors influence the rates of mercury methylation and the reverse reaction known as demethylation. Important factors controlling the conversion rate of inorganic to organic mercury include temperature, percent organic matter, redox potential, salinity, pH, and mercury concentration. Because dimethylmercury is an unstable compound that dissociates to methylmercury at neutral or acidic pH, it is not a concern in freshwater systems (U.S. EPA 1997a).

4.2 Methylmercury Bioaccumulation

Methylmercury accumulates most efficiently in the aquatic food web. Predatory organisms at the top of the food web, like bald eagles and humans, generally have higher mercury concentrations than organisms lower in the food web. Methylmercury accumulates in organisms because rates of uptake are greater than rates of elimination. Inorganic mercury does not tend to accumulate because it is less efficiently absorbed and more readily eliminated from the body than methylmercury.

The process by which mercury accumulates in organisms is called *bioaccumulation*. Both inorganic and organic mercury can be taken up by aquatic organisms from water, sediments and food. Low trophic level species such as phytoplankton obtain all their mercury directly from the water. Also, biofilms and algae play an important role in providing methylmercury at the base of food webs (Tsui et al. 2012). Zooplankton consumes phytoplankton, and then small fish and invertebrates consume zooplankton and algae. Repeated consumption and accumulation of mercury from contaminated food sources results in tissue concentrations of mercury that are higher in each successive level of the food web. This process is termed *biomagnification*. The proportion of mercury that exists as the methylated form generally increases with increasing levels in the food web. Methylmercury comprises 85% to 100% of the mercury measured in fish (Slotton et al. 2004; U.S. EPA 2010).

Consumption of contaminated, high trophic level fish is the primary route of methylmercury exposure to humans. For example, the aquatic food web provides more than 95% of humans' intake of methylmercury (U.S. EPA 1997a). California wildlife species of potential concern that consume fish and other aquatic organisms include piscivorous birds and wildlife such as, terns, rails, plovers, herons, egrets, mergansers, grebes, bald eagle, kingfisher, peregrine falcon, osprey, mink, raccoon and river otter. Even though the concentrations of mercury in water may be very low and deemed safe for human consumption in drinking water, the methylmercury concentration in some fish inhabiting these waters may reach levels that are considered potentially harmful to humans and fish-eating wildlife.

Another possible exposure route of methylmercury to wildlife is through the consumption of insects. Aquatic insects bioaccumulate methylmercury as they consume plankton and other insects in their aquatic environment. Many aquatic insects spend a portion of their lifecycle in a terrestrial stage, making them available as a viable food source to a wide variety of birds and other wildlife. Insectivorous birds and wildlife can accumulate high levels of methylmercury as they consume aquatic insects or spiders and other predators that consume aquatic insects. Although there is some evidence of methylmercury in insectivorous birds and wildlife, there is a lack of research and information to determine what concentrations of mercury in aquatic insects may result in unsafe levels in birds and wildlife.

Trophic levels are used to describe the hierarchy of an aquatic food web. The U.S. EPA's *Trophic Level and Exposure Analysis for Selected Piscivorous Birds and Mammals* report used the following definitions to designate trophic levels based on an organism's feeding habits (U.S. EPA 1995):

Trophic level 1 (TL1): Phytoplankton and bacteria.
Trophic level 2 (TL2): Zooplankton, benthic invertebrates and some small fish.
Trophic level 3 (TL3): Organisms that consume zooplankton, benthic invertebrates, and other TL2 organisms, such as carp and trout.
Trophic level 4 (TL4): Organisms that consume TL3 organisms, such as bass and catfish.

Since organisms highest on the food web have the highest methylmercury concentrations these trophic levels are used in other sections of this Staff Report to categorize fish by their propensity to accumulate methylmercury.

4.3 Mercury Toxicity

Mercury is a potent neurotoxin. Organic forms of mercury, such as methylmercury, are the most toxic form of this metal. Methylmercury exposure causes multiple effects including: tingling or loss of tactile sensation, loss of muscle control, blindness, paralysis, birth defects and death. Adverse neurological effects in children appear at dose levels five to ten times lower than associated with toxicity in adults (National Research Council 2000). Children may be exposed to methylmercury during fetal development and/or by eating fish. The effects on human health are described in more detail in Section 4.7.

Wildlife species may also experience neurological, reproductive or other detrimental effects from methylmercury exposure. Behavioral effects such as impaired learning, reduced social behavior, and impaired physical abilities have been observed in mice, otter, mink and macaques exposed to methylmercury (Wolfe et al. 1998). Reproductive impairment following mercury exposure has been observed in multiple species, including common loons and western grebe (Wolfe et al. 1998), mink (Dansereau et al. 1999) and fish (Sandheinrich and Wiener 2011; Depew et al. 2012). Effects of mercury on wildlife are described in more detail in Section 4.6 and Appendix J.

4.4 Sources of Mercury

Mercury is a rare, dense metal, slightly more common than gold in the earth's crust. It has unusual properties that have made it valuable in metallurgy, electrical systems and chemical processes. It conducts electricity, forms alloys with other metals, and expands in response to changes in temperature and pressure. It is a liquid at ordinary temperatures and evaporates when exposed to the atmosphere. These unusual physical characteristics, combined with mercury's common use from the beginning of the industrial revolution, have contributed to its widespread dispersion through land, air, and water (U.S. Geological Survey 2005, U.S. Geological Survey 2012).

Mercury is naturally released through erosion, forest fires, and geothermal areas. Mercury is released anthropogenically into the environment through mining activities, activities that lead to soil erosion or disturbance of sediment in water bodies, combustion processes, manufacturing processes, and other sources. These processes are described in more detail in the following sections.

Because of the strong association of mercury and methylmercury with sediment, the movement of natural and anthropogenic mercury through water and over land is closely tied to the movement of soils and sediments (especially fine-grained particles) and organic matter, which are typically transported by precipitation, irrigation runoff, natural and anthropogenic erosional processes. This point is important when considering how certain sources affect water bodies and when choosing effective methods to control mercury.

4.4.1 Mining in California

Mercury is released into the environment through mercury and gold mining. Both mercury and gold have been mined extensively in California. Mercury's discovery in California predates the discovery of gold by several years.

Mercury Minning

The first mercury mines were located in New Almaden, about 10 miles south of present-day San Jose in the Santa Cruz Mountains. The California Coast Ranges, on the west side of California's Central Valley, went on to be among the most productive mercury districts in the world, with major production centers along the ranges, from as far south as New Idria in San Benito County to Clear Lake in the north (U.S. Geological Survey 2005).

Historic mercury production in California between 1850 and 1981 was more than 220 million pounds of elemental mercury (Churchill, 2000). There were few controls on the dispersion of mercury from these operations, leading to significant increases in environmental mercury concentrations in affected soil, sediment, plants, fish, and other animals. Health advisories on fish consumption because of elevated mercury concentrations are widespread in the Coast Ranges, where more than a dozen separate water bodies are affected, including commonly fished areas like San Francisco Bay, Lake Berryessa, and Clear Lake. The location of mercury and gold mines in California is shown in Figure 4-1.

Gold Mining

Although most of the mercury mined in the Coast Ranges was exported, a significant portion (about 12 percent, or 26 million pounds) was used for gold recovery in California (Churchill 2000). Miners used mercury to recover gold at both of the two major types of industrial scale mining in California: placer mines (sand and gravel deposits) and hard rock (lode) mines. The placer mines were mined using a high pressure jet of water to break up the sand and gravel deposits, known as hydraulic mining. The resulting slurry was directed through sluices (a long wooden trough or channel). Hundreds of pounds of liquid mercury (several 76- pound flasks) were added to a sluice, which had an area of several thousand square feet. The gold in the sediments would form an amalgam with the mercury. Because mercury is very dense, the mercury and gold-mercury amalgam would remain at the bottom of the sluice, while the sand and gravel would pass through the sluice. The large volumes of turbulent water flowing through the sluice would cause many of the finer gold and mercury particles to wash through and out of the sluice before they could settle. The gold-mercury amalgam was retrieved from the bottom of the sluice and then heated to vaporize the mercury, leaving the gold behind (Churchill 2000; U.S. Geological Survey 2005). Vaporized mercury and mercury that escaped the sluice contaminated the surrounding environment.

From the 1860s through the early 1900s, hundreds of hydraulic placer-gold mines operated in the Sierra Nevada (Figure 4-1). The total amount of mercury lost to the environment from these operations may have been between three and eight million pounds or more, from estimates by Churchill (2000) that about 26 million pounds of mercury were used in California. Elevated mercury concentrations in present-day mine impacted waters and sediments indicate that hundreds to thousands of pounds of mercury remain at each of the many sites affected by hydraulic mining. Mercury from hydraulic mining was transported with sediments downstream into the Sacramento-San Joaquin Delta estuary and the San Francisco Bay, where it has contributed to elevated mercury concentrations in fish, resulting in additional consumption advisories and regulatory action by the Water Boards through the TMDL process.

However, mining is not the only important source of mercury in California. A separate project that is being developed to address mercury in reservoirs conducted a more detailed analysis of mines as a source of mercury into the reservoirs. The preliminary analysis found that a large fraction of the 303(d)-listed mercury-impaired reservoirs, about 30 percent, have no record of upstream mercury and gold mines (California Water Boards 2013).

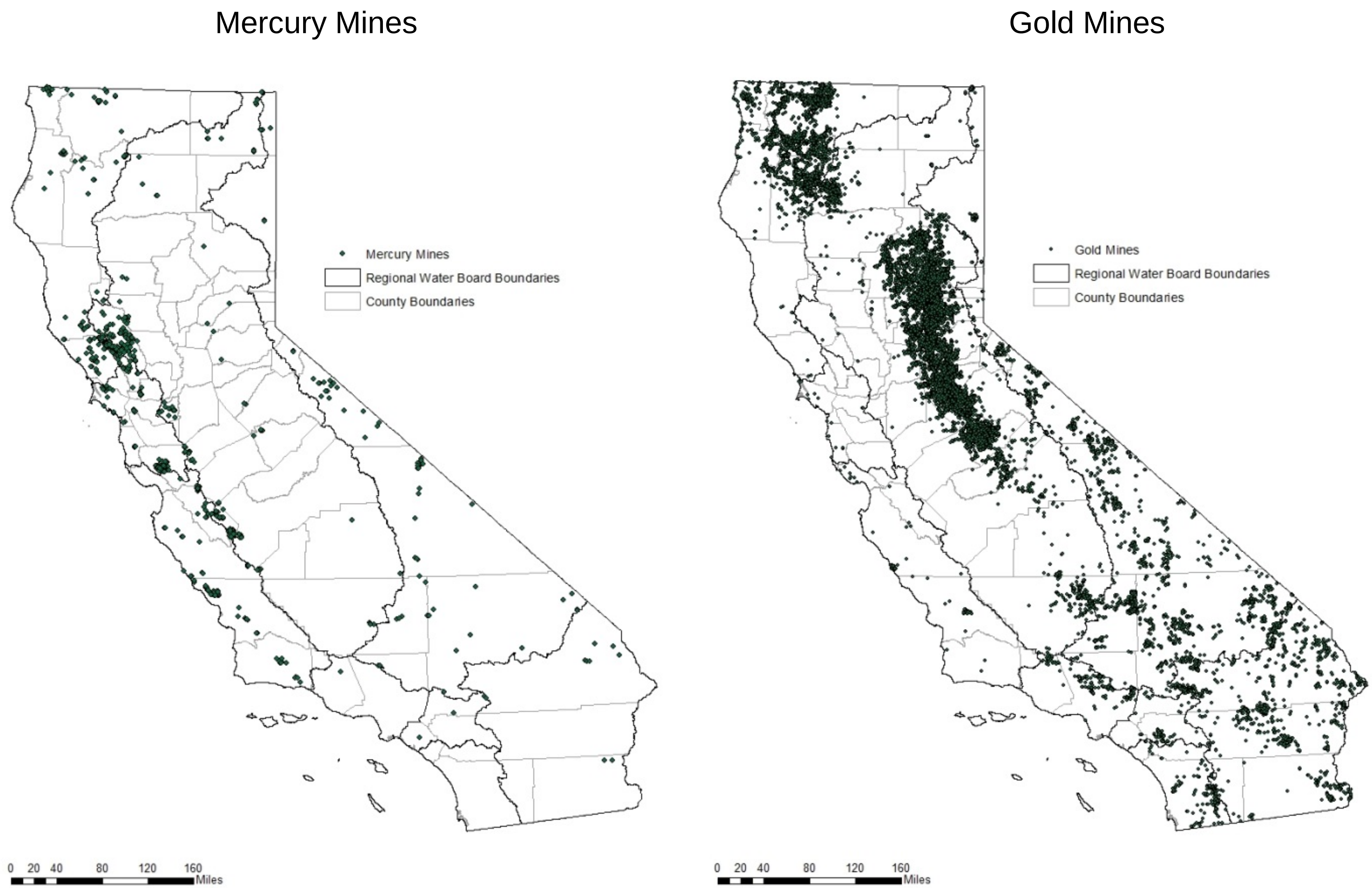

Figure 4-1. Map of mercury and gold mines in California. Data from the U.S. Geological Survey's Mineral Resource Data System (U.S. Geological Survey 2015) where mercury or gold was the primary commodity.

4.4.2 Natural Geology

The Coast Ranges are naturally high in mercury. Mercury has been concentrated extensively in natural hydrothermal systems, including active thermal springs that continue to discharge into streams and lakes, and in fossil (inactive) systems that were the sites of commercial mercury mining. The hydrothermal activity contributes to high natural background levels of mercury in parts of the Coast Ranges (U.S. Geological Survey 2005).

The soils in these areas that are naturally enriched with mercury erode, contributing to the mercury load in waterways. Human activities can increase soil erosion or disturb sediment in water bodies releasing more mercury. The mercury from mine waste, naturally enriched soils, and geothermal springs is a major source of mercury in the Coast Ranges, the Sierra Nevada Mountains, and also downstream in the Sacramento/San Joaquin Delta and San Francisco Bay.

4.4.3 Atmospheric Deposition

Mercury can be released into the atmosphere through combustion processes (burning fuel, waste, wood), heating metals (as in gold production or iron smelting), geothermal vents and other processes. A summary of anthropogenic global sources of mercury emissions is shown in Figure 4-2. Atmospheric mercury can be deposited on land or on the surface of water bodies. Mercury deposited on land can then be washed by storm water into waterways. Atmospheric mercury can travel across continents, but much of it can be deposited locally. Mercury deposition from atmospheric emissions is thought to be the major source of mercury in some Southern California lakes and reservoirs (U.S. EPA 2012, Tetra Tech 2008).

However, in heavily mercury contaminated environments of California (gold mining regions), atmospheric deposition of mercury is unlikely to play an important role in delivering methylmercury to the food web. Recent work has shown that the isotopic signature of methylmercury in food webs of Coast Ranges, Yolo Bypass, and Yuba/Feather Rivers, for example, is similar to that of the mercury stored in sediments deposited during the historical mining period (Gehrke et al., 2011; Donovan et al., 2016a, b). See also Table N-11, on the estimated mercury loadings from the Sacramento-San Joaquin Delta TMDL (Delta) and the San Francisco Bay TMDL.

The U.S. EPA has issued several regulations addressing the major contributors of mercury to the air, including, for example, municipal waste combustors; hospital, medical, and infectious waste incinerators; chlor-alkali plants; and hazardous waste combustors and cement plants. As the result of the U.S. EPA's regulatory efforts, the United States achieved a 58 percent reduction in domestic mercury air emissions between 1990 and 2005 (U.S. EPA 2008a). While coal may be one of the largest sources of mercury in the U.S., California has relatively few coal fired power-plants. A more detailed analysis of mercury from atmospheric deposition in California has been done to support the program being developed to control mercury in reservoirs (California Water Boards 2013).

Direct deposition of mercury to water bodies (vs. deposition on land upstream) has been found to be very important in determining mercury levels in fish. Harris and colleagues applied isotopically labeled mercury (as $HgNO_3$) to a lake and the surrounding watershed. Essentially all of the increase in methylmercury in fish after 3 years was due to the mercury deposited directly to the lake surface. Less than 1 percent of the mercury deposited to the watershed was exported to the lake. This study indicates the importance of direct deposition of inorganic mercury to waters. Furthermore, the results could suggest that controlling emissions that are deposited directly on the water surface may have a rapid effect (few years) on mercury level in fish (Harris et al. 2007).

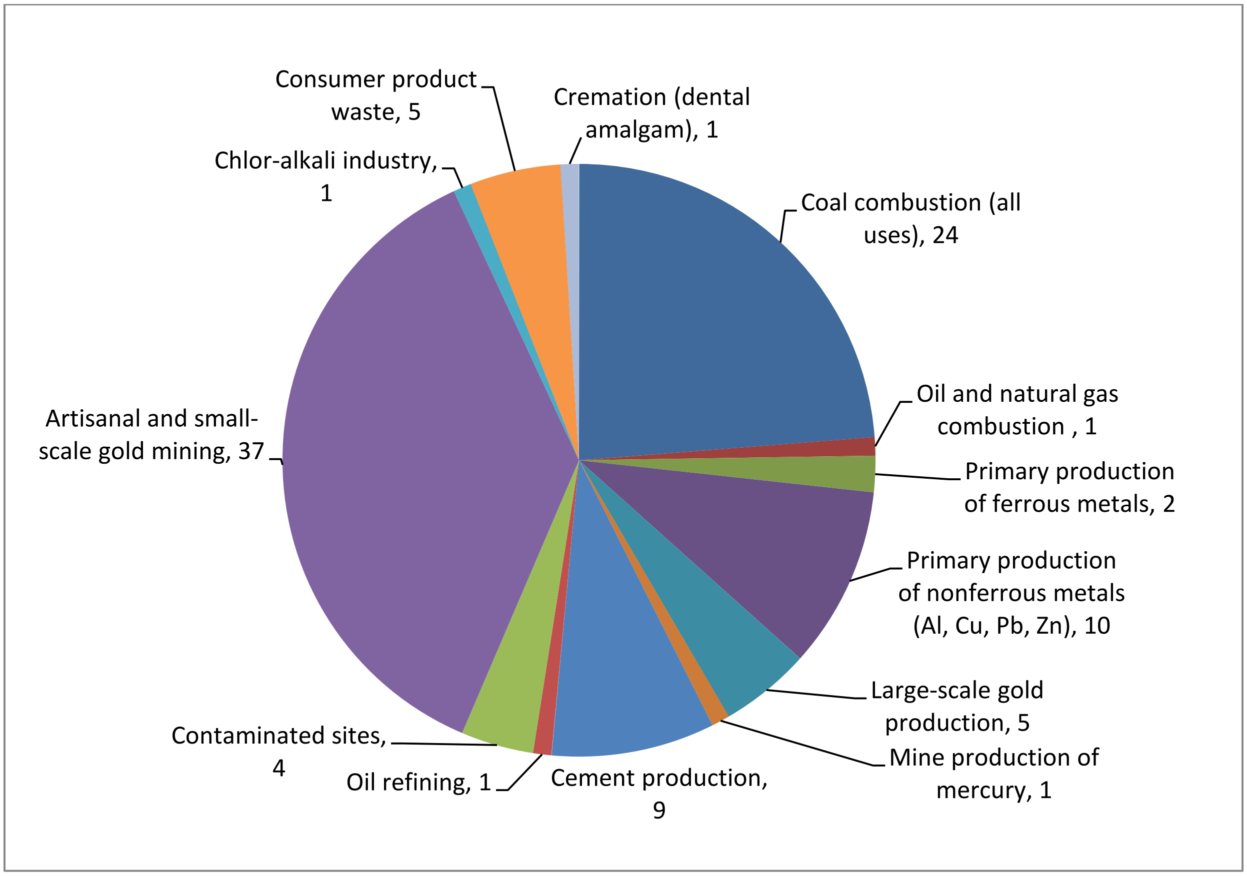

Figure 4-2. Relative contributions to estimated global emissions to air from anthropogenic sources in 2010 (reproduced from United Nations Environment Programme 2013).

Similarly, direct deposition to the Chesapeake Bay was found to contribute more than half the mercury entering the Bay and estimates suggested that most of the mercury deposited to the watershed (90% or greater) is retained in the terrestrial domain (Mason et al. 1997). The fact that the majority of the mercury is retained by the land in the watershed agrees with earlier studies (Johansson et al. 1991; Hurley et al. 1995).

4.4.4 Urban Areas, Consumer Products, and Manufacturing

Mercury in urban runoff can come from local urban sources, consumer products, historical and ongoing industrial activities, native soils and atmospheric deposition. There may be a higher contribution of mercury from atmospheric deposition in urban areas because of local point sources such as air emissions from waste incinerators, power plants, and vehicle exhaust. Mercury is contained in common consumer products, such as batteries, compact fluorescent light bulbs (CFLs), thermostats, and electrical switches. Mercury is no longer used to make paint and household thermometers but these products are still around today. Improper disposal or broken items can release mercury into municipal or industrial wastewaters.

In most California settings, manufacturing is likely a smaller contributor of mercury. Manufacturing processes that can release mercury are: chlor-alkali production using the mercury cell process, pulp and paper manufacturing, instrument (thermometers) manufacturing, secondary mercury production (recycling), electrical apparatus manufacturing, carbon black production, lime manufacturing, primary lead smelting, primary copper smelting, fluorescent lamp recycling, battery production, primary mercury production, mercury compounds production, byproduct coke production, and petroleum refining. Mercury has been recognized as a serious environmental contaminant for many years. As a result, industrial uses have declined significantly over recent decades as effective substitutes have been developed.

Most wastewater treatment plants are efficient at removing mercury. Since mercury tends to adhere to solids, the removal of solid materials also removes the mercury. Major contributors of mercury to municipal wastewater treatment systems are typically dental offices, hospitals, and schools (Larry Walker Associates 2002, U.S. EPA 2004). The original sources may be mercury amalgam dental fillings, broken thermometers, other consumer products and hospital equipment.

Dental Amalgam

Dental offices have been a source of mercury by releasing waste from mercury amalgam fillings into sewer systems. A study funded by the American Dental Association (ADA) published in 2005 estimated that 50 percent of mercury entering municipal wastewater treatment plants was contributed by dental offices (Vandeven and McGinnis, 2005). The U.S. EPA estimates that across the United States, 4.4 tons of mercury from waste dental amalgam are collectively discharged into municipal wastewater treatment plants annually. Much of the mercury in municipal wastewater treatment plants partitions to the sludge, which is the solid material that remains after wastewater is treated. Mercury from amalgam can then make its way into the environment through the incineration, landfilling, or land application of sludge or through surface water discharge. In 2014, the U.S. EPA proposed a rule that would control mercury discharges to municipal wastewater treatment plants by requiring dentists to reduce their discharge of dental amalgam through the use of amalgam separators and BMPs (79 Fed. Reg. 63258 (Oct. 22, 2014); http://water.epa.gov/scitech/wastetech/guide/dental/).

4.4.5 Other Sources

Imported Water

Numerous reservoirs in California receive water imported from outside the reservoir watersheds by state, federal, and other water projects for the purposes of water supply, power production, and other uses. Supplemental water additions of potable water and ground water were one of the sources of mercury in the LA Lakes TMDL (U.S. EPA Region 9 2012).

Historic Use of Pesticides

Widespread use of mercury in agriculture, either as a spray on crops or as a seed preservative, was halted in 1976, when the U.S. EPA banned most uses of mercury in pesticides. Exceptions were initially made for fungicidal uses in paints and outdoor fabrics. Mercury use in paints was discontinued in 1991 under the Federal Insecticide, Fungicide and Rodenticide Act. Since most uses of mercury in pesticides have been discontinued for thirty years and all uses banned for almost ten years, it is unlikely that past uses of mercury significantly contribute to current agricultural runoff. However, mercury-containing chemicals may still be present in soils and in the form of old stocks.

Land Management Practices

Natural and anthropogenic deposits of mercury generally move through watersheds with soil and sediments. Land management that effects erosion can contribute to the transport of mercury to waterways. Forest management activities that affect the movement of sediment during storms could play an important role in mercury transport in many watersheds throughout the state. Forests are the primary land cover in many watersheds of the reservoirs on the 303(d) list due to elevated mercury.

4.4.6 Conversion to Methylmercury as a Source

Most sources release mercury in the form of inorganic mercury. Once in the environment, inorganic mercury can be converted to methylmercury (Section 4.1). Methylmercury is the form most readily incorporated into biological tissues and most toxic to humans and wildlife. Methylmercury is formed from inorganic mercury, usually in conditions with low oxygen and high organic matter. Inorganic mercury is available in most aquatic systems due to widespread atmospheric deposition. Therefore, any anoxic aqueous environment that is rich in organic matter and contains the conditions necessary for conversion of inorganic mercury to methylmercury can be said to be a potential source of methylmercury.

The conditions that favor methylmercury production are typical of wetlands, other flooded areas, or the sediment at the bottom of reservoirs (California Water Boards 2013). Additionally, structural BMPs used to enhance microbial denitrification, such as treatment wetlands, can have anaerobic zones and are rich in organic matter both, factors that promote mercury methylation. Also, storm water catch basins can become anaerobic. Therefore, while these BMPs serve important function in controlling nutrients and possibly other pollutants, these BMPs may also inadvertently incorporate conditions that promote mercury methylation.

Wetlands and reservoirs can often have higher methylmercury concentrations, and tend to be the places where fish have higher concentrations of methylmercury. In a recent review of national data, methylmercury concentrations in aquatic organisms in streams were found to correlate strongly with wetland abundance in stream basins (Wentz et al. 2014). There is some evidence that permanent wetlands may be a sink for methylmercury, while seasonal wetlands, which can be used for agriculture part of the year, are more likely to generate methylmercury (Ackerman & Eagles-Smith 2010; Alpers et al. 2014; Windham-Myers et al. 2014).

Understanding this conversion process is important for identifying both sources and control measures for methylmercury. For instance, methylmercury levels in fish in a particular river with inorganic mercury in the sediments may be relatively low. However, these same mercury rich sediments can be washed downstream into a reservoir, where they begin to accumulate. The reservoir environment with the lower oxygen and a higher concentration of organic matter is much more conducive to converting inorganic mercury to methylmercury. Even if the concentration of inorganic mercury in the sediment is the same in both the river and the reservoir, the concentration of methylmercury in the reservoir tends to be elevated much higher than the levels in the river. The fact that fish in reservoirs will have higher concentrations of mercury is exemplified by the five-fold difference in BAFs for rivers compared to the BAF for lakes and reservoirs (listed in Appendix I). Consequently, the fish living in the reservoir have a greater chance of accumulating methylmercury to levels that are a risk to public health and wildlife.

Another potentially large source of methylated mercury is the landscape downstream from historic mining areas that are contaminated with mercury-laden sediment. This sediment has become part of the landscape and covers large areas to substantial depths (examples are described in Bouse et al., 2010; Donovan et al., 2013; Singer et al., 2013, Donovan et al., 2016a, b). When occasionally flooded, methylmercury is produced, which could drain back into rivers and become available to food webs.

4.4.7 Wetlands

Recent studies required by the Sacramento-San Joaquin Delta methylmercury TMDL are trying to understand the methylmercury contribution of agricultural wetlands. While permanent wetlands may be a sink for methylmercury, seasonal wetlands, which can be used for agriculture part of the year, are more likely to generate methylmercury (Ackerman & Eagles-Smith 2010, Alpers et al. 2014, Windham-Myers et al. 2014).

Alpers et al. 2014 found methylmercury concentrations in the Yolo Bypass that were among the highest ever recorded in wetlands. The highest methylmercury concentrations in unfiltered surface water were observed in drainage from wild rice fields during harvest (September 2007), and in white rice fields with decomposing rice straw during regional flooding (February 2008). However, during the summer growing season, even though the typical anoxic wetland conditions favored for microbial methylmercury production are present, these same fields were not found to discharge methylmercury to surrounding waters. Outflow management during times when methylmercury is high could reduce methylmercury exports (Bachand et al. 2014).

The Central Valley Regional Water Board is currently working with non-point source dischargers and scientists to explore management practices that can reduce mercury methylation in the environment as part of the Sacramento-San Joaquin Delta methylmercury TMDL. Another area of study is the South Bay Salt Ponds Restoration Project in San Francisco Bay. The wetland restoration design for this project is attempting to reduce the potential for mercury methylation and other contaminant problems. New management practices to control methylation in wetlands may be developed in the near future. See Appendix Q for more details.

4.4.8 Bioavailability of Mercury

In the *Mercury Strategy for the Bay-Delta Ecosystem,* the issue of bioavailability is highlighted. "We believe that changes in bioavailability or methylation rates have much greater potential to significantly increase methylmercury exposure in this ecosystem than do changes in the spatial distribution of total (mostly inorganic) mercury" (Wiener et al. 2003, pg. vi). In addition, there is a limited ability to predict how an ecosystem may respond to changes in the various sources of mercury (Hsu-Kim et al. 2013). Evidence suggests some forms or sources of mercury/methylmercury are more likely to enter the food web. The inputs of methylmercury from terrestrial and atmospheric sources have been found to bioaccumulate to a substantially greater extent than methylmercury formed *in situ* in sediment (Jonsson et al. 2012, Jonsson et al. 2014). Additionally, preliminarily results with isotopically labeled mercury indicate that the mercury that is taken up into food webs comes from mercury that is dissolved in the water column, rather than the mercury associated with the bottom sediments in a water body (Fleck et al. 2014). This is not surprising because for mercury to be methylated, it must first be available in the dissolved form through solubilization from inorganic particles and remineralization from organic particles (Henry et al. 1995, Paquette and Helz 1997, Benoit et al. 1999).

4.4.9 Sources of Mercury Identified in TMDLs

The sources of mercury determined for California mercury TMDLs along with progress reports for TMDLs, are included in Appendix M and the sources are also briefly summarized here. The sources of mercury vary by TMDL, but more than half focus on historic mines (Guadalupe River, Walker Creek, Cache Creek, Clear Lake, Clear Creek and Hernandez Reservoir). The historic mining legacy is also the major source in two other mercury TMDLs: the San Francisco Bay TMDL and the Sacramento-San Joaquin Delta TMDL. These two TMDLs also include minor contributions from atmospheric deposition and points sources.

Mines were not identified as a source of mercury in the TMDLs in Southern California. Two of the Southern California TMDLs have other historical mercury sources: the Rhine Channel of Newport Bay; and Los Angeles/Long Beach Harbor. In the latter TMDL, the sources included historic manufacturing, military facilities, fish processing plants, wastewater treatment plants, oil production facilities, and shipbuilding or repair yards in the ports.

Mercury deposited from atmospheric emissions was a more important source in two other TMDLs in Southern California. In the Calleguas Creek/Mugu Lagoon TMDL, sources are atmospheric deposition and runoff from agriculture and open space. It is not clear what the original source of mercury is in the runoff. It could be atmospheric, historic pesticides, naturally enriched sediments, imported water from Northern California or another source. Atmospheric deposition, run off, ground water pumping and imported water are described as sources in the Los Angeles area Lakes TMDLs.

4.4.10 The Effects of Climate Change on Fish Mercury Levels

Climate change is expected to exacerbate the problem of elevated mercury in fish. Climate change is expected to increase average temperatures in California, including in the inland surface waters. Elevated water temperatures could lead to higher concentrations of methylmercury in fish and mammals. This is related to an increase in metabolic rates and increased mercury uptake at higher water temperatures (Booth and Zeller 2005; Dijkstra et al. 2013; Pack et al. 2014).

A second aspect of climate change to consider is the increased frequency and strength of storms. A great deal of mercury remains stored away in sediment fans from historic hydraulic gold mining. While these sediments may seem currently out of reach of flood waters, the increased frequency of larger flood events that is expected to accompany global warming could liberate this stored mercury (Singer et al. 2013). Increased frequency and strength of storms is related to increasing frequency and duration of inundation of areas that contain high mercury inventories over multiple meters of depth from the historic mining legacy (Singer et al. 2016). This increase in flooding will enable higher methylmercury production in these mercury contaminated areas. Such areas may be important locations of methylmercury production and uptake into food webs (Donovan et al. 2016a, b).

One of the major sources of climate change is also a major source of mercury. The burning of fossil fuels, such as coal, is a main source of greenhouse gases. Coal burning is also one of the major sources of atmospheric mercury. California does not burn very much coal relative to other states and countries, but about 60% of the atmospheric mercury deposited in California is estimated to come from outside of California, including global sources (California Water Boards 2013). Global efforts to decrease greenhouse gases will likely help control mercury.

4.5 Current Levels of Mercury in the Environment

Current levels of mercury in the environment in California are described in the following section to provide an understanding of the magnitude of the mercury contamination. Also the mercury levels in the environment are compared with current human health guidelines and the water quality objectives in the Provisions. For a description of the geography and waterbodies in the nine regions of California, see Appendix D.

4.5.1 Mercury Levels in Surface Water

The Surface Water Ambient Monitoring Program (SWAMP) and regional monitoring programs (RMP) have been measuring mercury and methylmercury in water and fish tissues for years. This section briefly summarizes the most recent data, from 2000 - 2013, which is obtainable from the State Water Board's California Environmental Data Exchange Network (CEDEN) public database (www.ceden.org). The concentrations of mercury in surface water from all over the state (Table 4-1) are generally less than the water quality criteria from the California Toxics Rule of 50 and 51 ng/L. However, much of the data was from areas with elevated mercury such as San Francisco Bay. See Figure N-4, in Appendix N, for the spatial distribution of samples.

Table 4-1. Mercury concentrations (ng/L) in surface water 2004 – 2012

	Hg total	Hg dissolved	MeHg total	MeHg dissolved
Median	2.0	0.82	0.053	0.017
Mean (Average)	4.7	1.4	0.062	0.024
95th percentile	16.1	4.1	0.15	0.061
5th percentile	0.43	0.1	0.019	0.0050
Standard deviation	11	1.9	0.040	0.024
Max	283	24	0.23	0.21
Min	ND (0.15-1.3)	ND (0.13-0.41)	ND (0.01-0.03)	ND (0.01-0.03)
Number of samples	1120	424	154	155

ND indicates non-detect with a range of the accompanying detection limits given in ng/L. For the other statistics, if the sample was non-detect then a value of one half of the detection limit was used.

4.5.2 Methylmercury Levels in Sport Fish

Fish methylmercury data are summarized in the graphs within this section, particularly in context to the Mercury Water Quality Objectives. Also, the State Water Board hosts an interactive map on the internet to inform the public on methylmercury levels in fish. This website allows the user to enter any threshold, select the fish species, and see the results on a statewide map: http://www.mywaterquality.ca.gov/safe_to_eat/data_and_trends.

Although the mercury concentrations in the water throughout the state are generally below the California Toxics Rule criteria (Table 4-1), the concentrations in many fish throughout the state are above the U.S. EPA human health criteria of 0.3 mg/kg and OEHHA's more recent Fish Contaminant Goal of 0.22 mg/kg (Figure 4-3). Fish tissue data from the past 12 years are compiled in the following figures and compared with the recommended mercury objective for sport fish of 0.2 mg/kg and the default translation of the narrative objective for subsistence fishing of 0.05 mg/kg (the tribal subsistence objective is similar, 0.04 mg/kg). The Sport Fish Water Quality Objective is very similar to the Fish Contaminant Goal of 0.22 mg/kg which suggests that many of these fish are not safe to eat on a consistent basis.

The Sport Fish Water Quality Objective and the Subsistence Fishing Water Quality Objective would apply to trophic level 4 fish, while the Tribal Subsistence Fishing Water Quality Objective would apply to mostly trophic level 3 fish. Recall from Section 4.2 that trophic level 4 fish (such as bass) accumulate more methylmercury than trophic level 3 fish (such as carp, perch and trout). Both trophic level 4 fish and trophic level 3 fish are some of the most common fish that recreational anglers catch and consume. Trophic level 4 fish will have the highest methylmercury concentrations of all fish because they are highest on the food web. Figure 4-3 shows that methylmercury concentrations in the majority of the trophic level 4 fish sampled in 2000-2011 are higher than the Sport Fish Water Quality Objective, while Figure 4-4 shows that the methylmercury concentrations in the majority of trophic level 3 fish sampled over that same time period are below the Sport Fish Water Quality Objective. The methylmercury concentration in fish tissue is often directly related to fish length. The objective to protect human health would apply to fish 150-500 millimeters (mm), so this subset of trophic level 4 and trophic level 3 fish data is also shown in Figures 4-3 and 4-4.

Trout and other land-locked (non-migratory) salmonids are mostly considered trophic level 3, although some are considered trophic level 4. Data from trout or related species were compiled separately because these fish have different feeding habits that result in lower methylmercury concentrations in their tissues. The methylmercury concentrations in trout (Figure 4-5) are considerably different than the methylmercury concentrations in other trophic level 3 fish (Figure 4-4). Very few trout have tissue methylmercury levels that exceed the Sport Fish Water Quality Objective. These figures show how the particular species of fish that a person eats greatly affects that person's exposure to methylmercury.

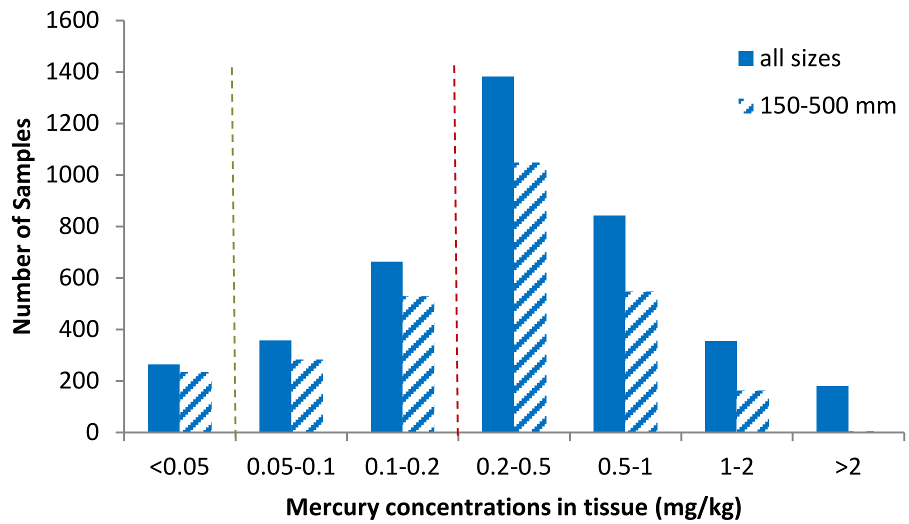

Figure 4-3. Methylmercury concentrations in trophic level 4 fish (highest on the food web) from 2000-2011. Data were from common trophic level 4 fish species: largemouth bass, small mouth bass, spotted bass, white catfish, channel catfish, Sacramento pike minnow, crappie, and black crappie (total lengths: 100 – 800 mm). The recommended Sport Fish Water Quality Objective (red-dashed line) and a subsistence objective (green-dashed line) are also shown.

"All sizes" includes additional concentration data for which the length of the fish was not reported.

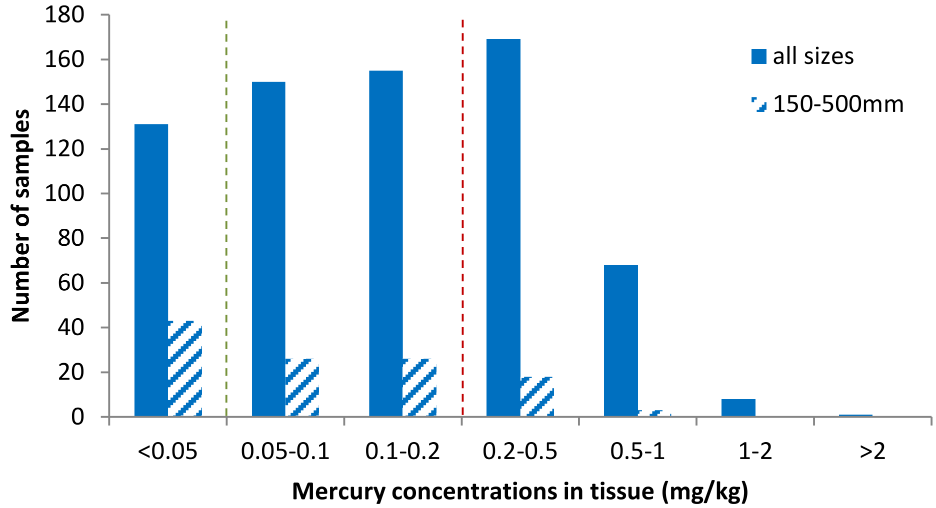

Figure 4-4. Methylmercury concentrations in trophic level 3 fish (second highest on the food web), excluding trout, from 2000 – 2011. Species were bluegill, common carp, golden shiner, redear sunfish, yellowfin goby, black bull head, brown bullhead (total lengths: 100 – 820 mm). The recommended Sport Fish Water Quality Objective (red-dashed line) and a subsistence objective (green-dashed line) are also shown. "All sizes" includes additional concentration data for which the length of the fish was not reported.

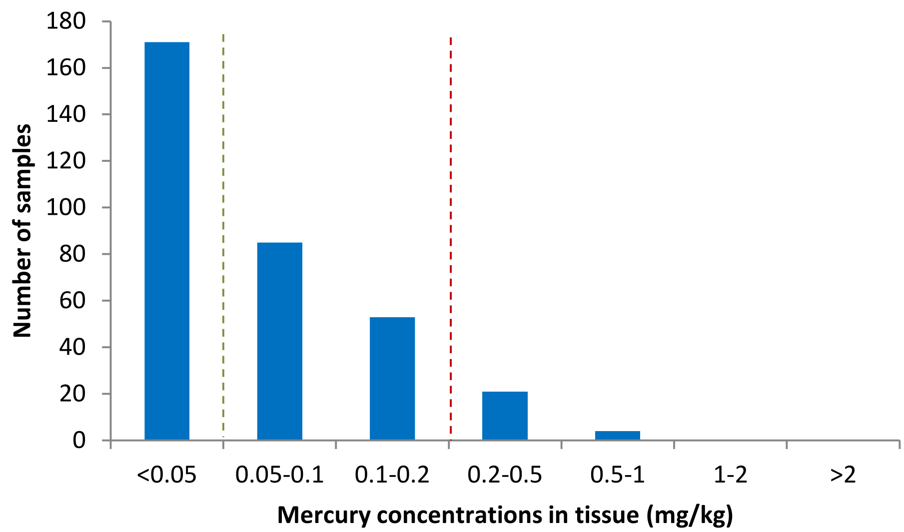

Figure 4-5. Methylmercury concentrations in trout, which are also trophic level 3 fish, from 2000-2011. Species were brown trout, brook trout, lake trout, rainbow trout, eagle lake trout, kokanee, (total lengths: 200 – 605 mm). The recommended Sport Fish Water Quality Objective (red-dashed line) and a subsistence objective (green-dashed line) are also shown.

Striped bass and Chinook salmon are also popular among anglers, and the methylmercury levels in these fish are shown in the next two figures. These are anadromous fish species, and their methylmercury exposure changes as they migrate and their food sources change in the different habitats. Striped bass are a trophic level 4 fish and prey on other fish, which typically results in higher concentrations of methylmercury (Figure 4-6). Anadromous salmon, such as Chinook salmon are generally a trophic level 3 fish and have lower mercury concentrations because they consume organisms that are lower on the food web (Figure 4-7). Landlocked salmon can have higher mercury concentrations than the anadromous salmon (Figure 4-7).

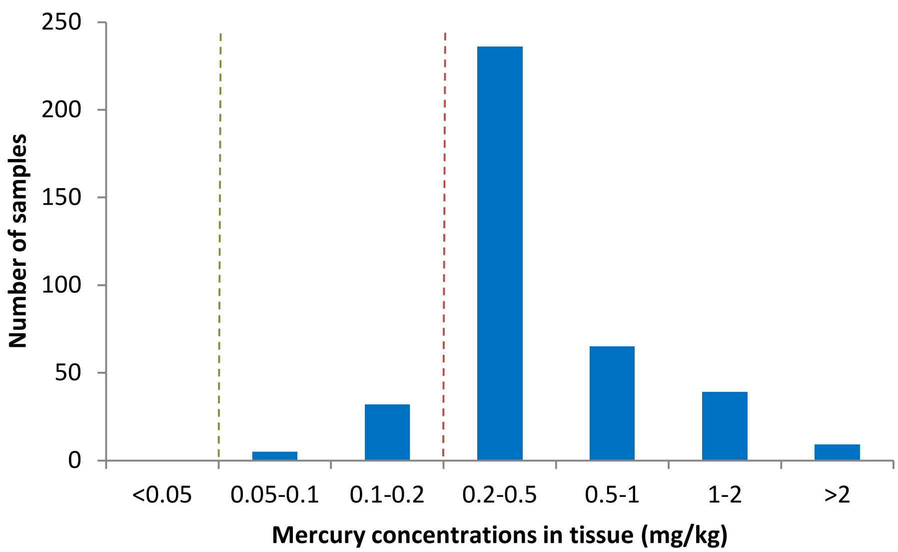

Figure 4-6. Methylmercury concentrations in striped bass, from 2000 – 2011. The recommended Sport Fish Water Quality Objective (red-dashed line) and a subsistence objective (green-dashed line) are also shown.

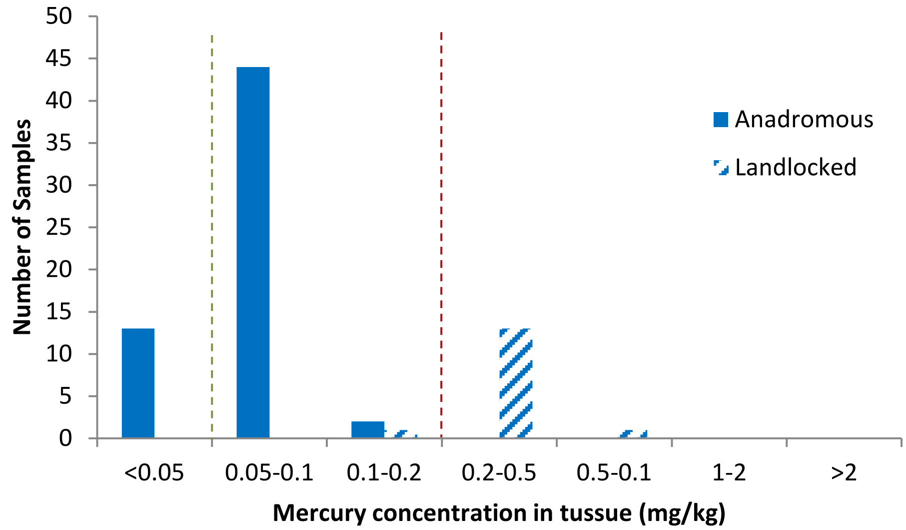

Figure 4-7. Methylmercury concentrations in Chinook salmon, from 2000 – 2011. The recommended Sport Fish Water Quality Objective (red-dashed line) and a subsistence objective (green-dashed line) are also shown.

4.5.3 Methylmercury Levels in Prey Fish

The Provisions contain the Prey Fish Water Quality Objective to protect wildlife that prey on smaller lower trophic level fish. This objective is intended to fill a gap in protection when the Sport Fish Water Quality Objective cannot be assessed in trophic level 4 fish, for example in trout dominated waters (see Chapter 5 issue G). The objective of 0.05 mg/kg in whole fish samples would apply to prey fish that are 50 – 150 mm. A similar water quality objective was adopted for Walker Creek, Soulajule Reservoir and the Guadalupe River (see Table 2-2). Available mercury concentration data in whole prey fish (wet weight) are summarized by geographic regions where the fish were collected, in Figure 4-8 and Figure 4-9 below. Data were obtained from CEDEN and are fairly limited. Many of the data were from a recent study that found that about one third of the grebes sampled in California have an elevated risk of mercury toxicity (Ackerman et al. 2015a, b).

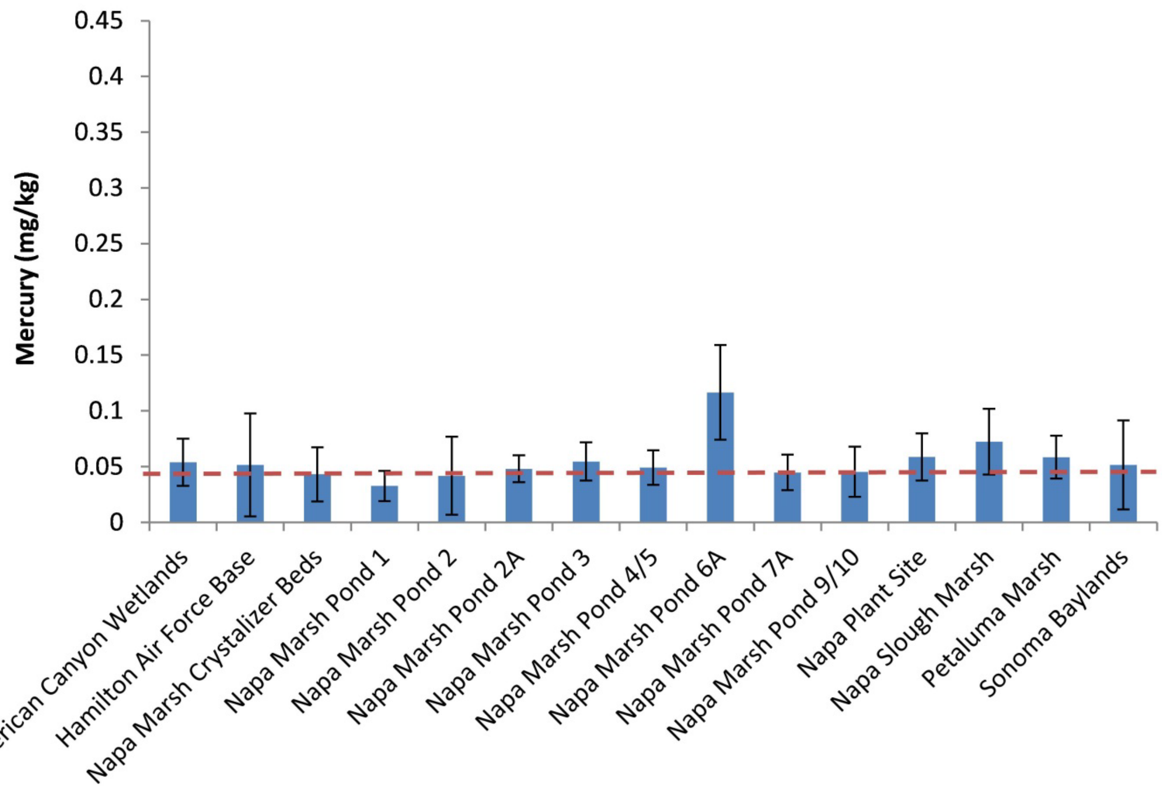

Figure 4-8. Mercury concentration data in prey fish (50 – 150 mm) from sites in the San Francisco Bay Region. The red dashed line shows the Prey Fish Water Quality Objective of 0.05 mg/kg.

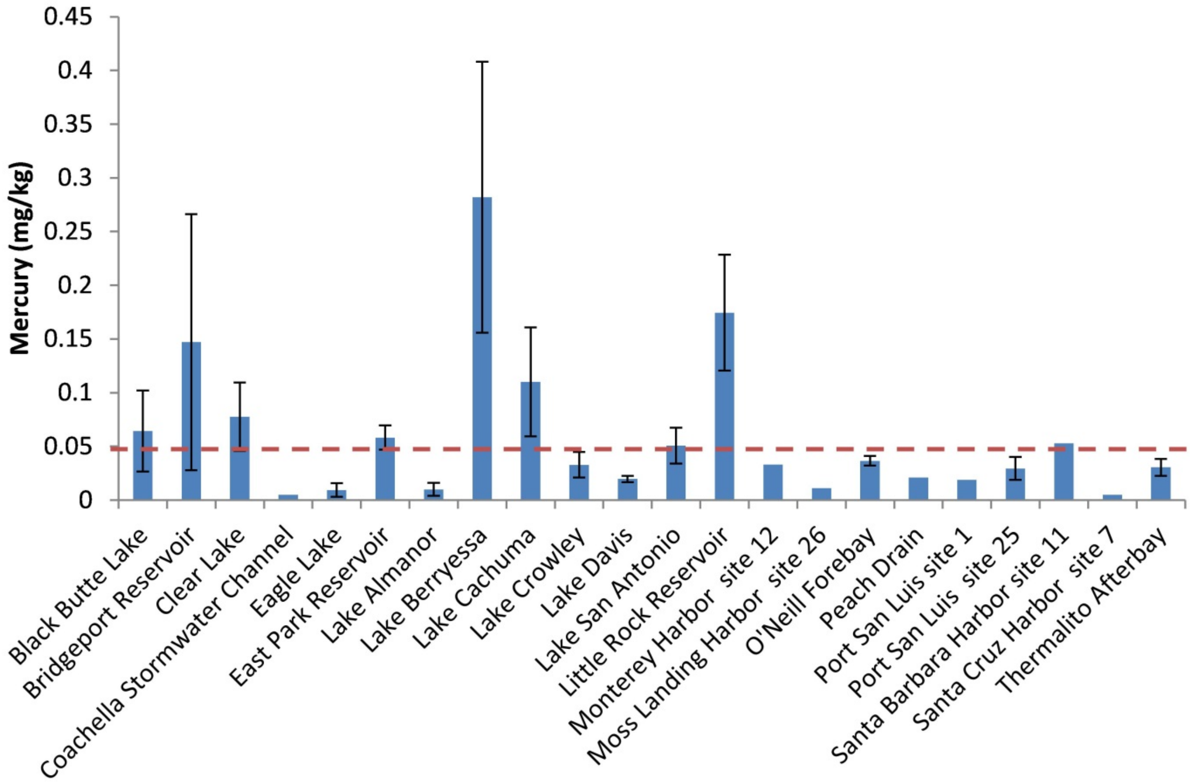

Figure 4-9. Mercury concentration data in prey fish (50 – 150 mm) from sites in the Central Coast Region, Central Valley Region, Lahontan Region, and Colorado River Basin Region. The red dashed line shows the Prey Fish Water Quality Objective of 0.05 mg/kg.

4.5.4 Methylmercury Levels in Small Prey Fish

The Provisions also contain the California Least Tern Prey Fish Water Quality Objective to protect threatened and endangered birds. The species of greatest concern is the California least tern (*Sterna antillarum browni*). The objective of 0.03 mg/kg in whole fish samples would apply to small prey fish that are less than 50 mm, which is typical of the fish that the tern prey on. This objective has already been adopted in San Francisco Bay and the Sacramento–San Joaquin Delta to protect the California least tern. Methylmercury concentration data in these size fish in the environment are limited. Data in fish less than 50 mm were only available for San Francisco Bay (Greenfield et al. 2013, data can also be found at www.ceden.org). Figure 4-10 shows that most small fish in the Bay are above the mercury objective of 0.03 mg/kg that has already been adopted there. However, these fish are from an area that is heavily impacted by mercury mining. The Lower South Bay (Figure 4-11a), which is downstream of the historic New Almaden mining district, has the highest fish methylmercury concentrations, while further away in Suisun Bay (Figure 4-11b) fish methylmercury concentrations are closer to the objective.

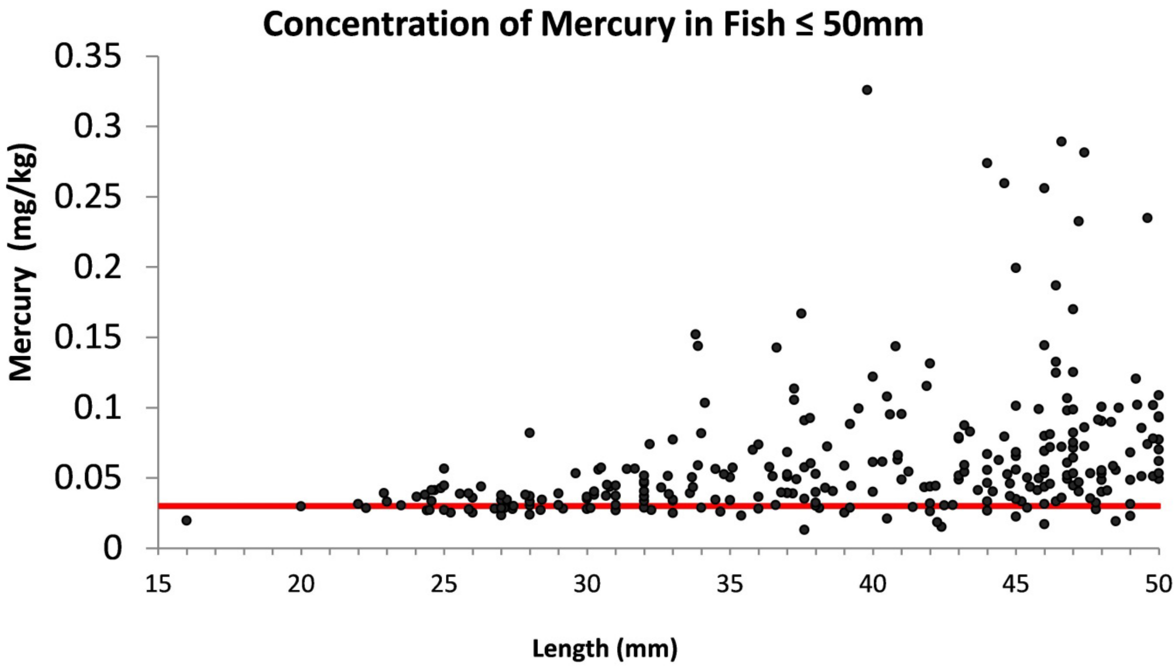

Figure 4-10. Methylmercury concentrations in fish ≤ 50mm compared to fish length. Samples collected in the San Francisco Bay from 2008 – 2010, including South bay, Lower South Bay, Central bay, San Pablo Bay and Suisun Bay. The red line shows the California Least Tern Prey Fish Objective of 0.03 mg/kg.

These small fish have also been used as mercury "biosentinels" since they provide a sensitive measure of methylmercury uptake (Eagles-Smith and Ackerman 2010). Compared to larger fish that accumulate methylmercury over a long period of time, these fish more directly reflect recent methylmercury concentrations since they consume species that readily absorb methylmercury. Figure 4-10 shows the relationship between the mercury concentration and the length of the fish.

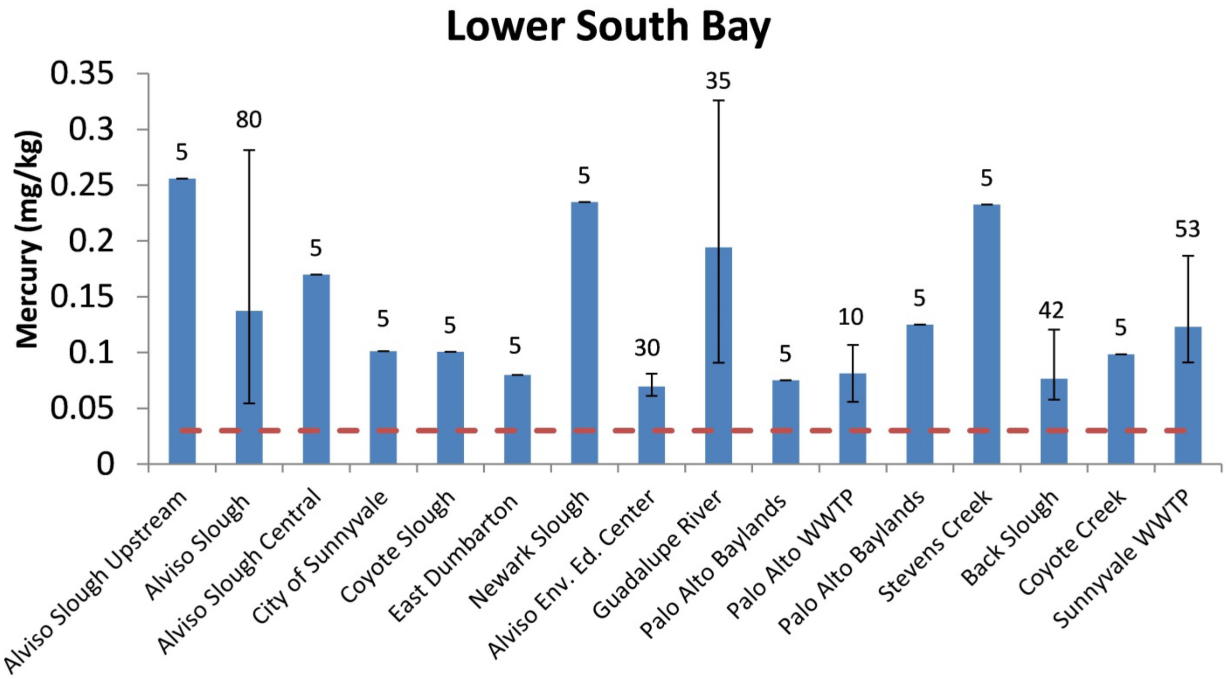

Figure 4-11a. Average methylmercury concentration in fish ≤ 50mm in Lower South Bay. The average concentration is shown with the minimum and maximum (error bars) and the number of samples. The red line shows the California Least Tern Prey Fish Objective of 0.03 mg/kg.

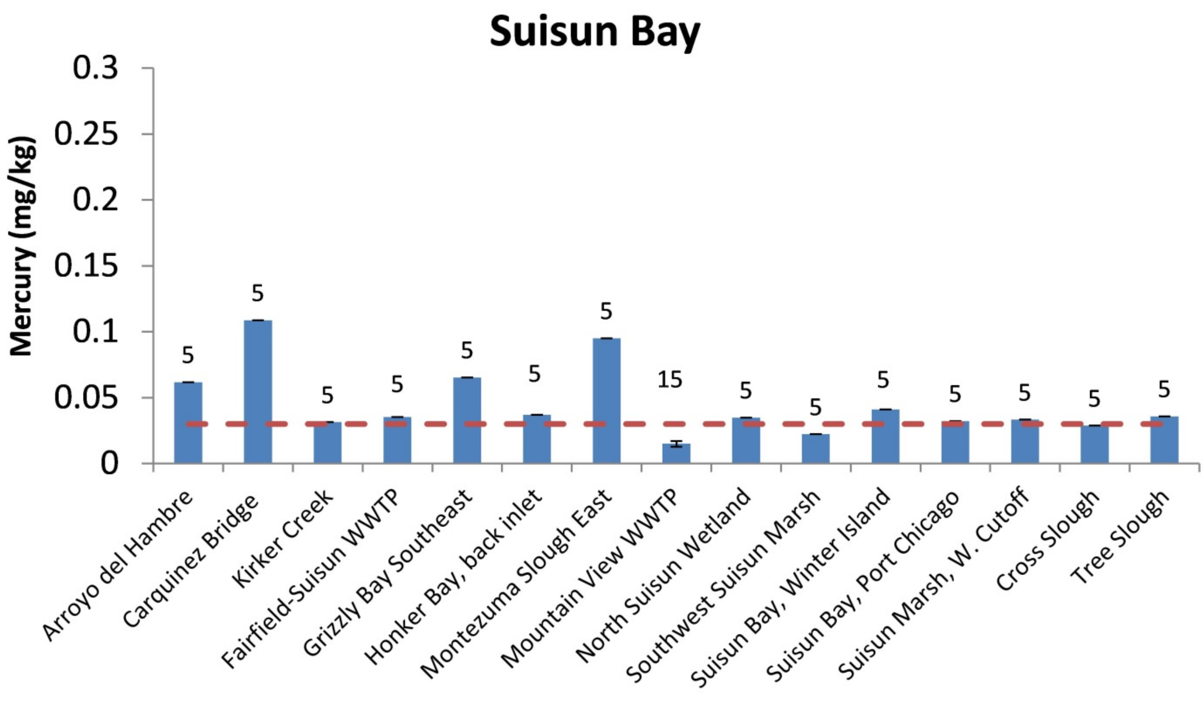

Figure 4-11b. Average methylmercury concentration in fish ≤ 50mm in Suisun Bay. The average concentration is shown with the minimum and maximum (error bars) and the number of samples. The red line shows the California Least Tern Prey Fish Objective of 0.03 mg/kg.

4.5.5 Mercury Levels in Sediment

A survey of sediment mercury concentrations in the Cache Creek Canyon provides an idea of background concentrations compared to typical concentration areas enriched with mercury or where mercury was mined. The Cache Creek watershed is naturally enriched in mercury and includes portions of three historic mercury mining districts, one of which is the Sulphur Bank Mine in Clear Lake which is now a U.S. EPA superfund site. The *Mercury Inventory in the Cache Creek Canyon* found that the upstream background mercury concentrations in sediment in the Cache Creek watershed averaged 0.06, 0.10, and 0.09 mg/kg total mercury, in silt, sand and gravel sized material, respectively. Meanwhile, the average mercury concentration in 78 sediment samples collected in a segment of Cache Creek that is downstream of historic mines, between Harley Gulch and Bear Creek, was 0.98, 0.77 and 0.89 mg/kg in silt, sand, and gravel sized material, respectively. In an area closer to two mines, the Harley Gulch Delta, mercury concentrations in silt and sand sized material, averaged 4.83 and 4.20 mg/kg (Central Valley Water Board 2008). This indicated that the two mines upstream of the Harley Gulch Delta were a significant contributor to the elevated mercury in Cache Creek downstream of Harley Gulch.

Additionally, several studies in the San Francisco Bay suggest that the threshold for background mercury (total mercury) in various parts of the basin is about 0.08 mg/kg (Domagalski, 2001; Domagalski et al. 2004; Bouse et al., 2010; Donovan et al. 2013; Singer et al. 2013; Donovan et al. 2016a, b), similar to the findings for Cache Creek. Furthermore, these studies document mercury concentrations that are an order of magnitude higher or more in many locations (including river floodplains, bypasses, and Bay-Delta bottom sediments), for example 3 to 10 mg/kg in the Yuba River (Singer et al. 2013).

4.6 Methylmercury Effects on Wildlife

Appendix J contains a review of effects on wildlife and the effects are briefly summarized here. The species most at risk for methylmercury toxicity are generally piscivorous (fish-eating) wildlife, because methylmercury tends to accumulate to very high concentrations in the aquatic food web (USFWS 2003). However, recently some terrestrial songbirds have been found with higher mercury levels than fish eating birds because they feed on predatory invertebrates, like spiders, which lengthens their food web and increases the bioaccumulation of methylmercury (Cristol et al. 2008). Methylmercury is also toxic to the fish themselves and can impair reproduction in fish. Methylmercury toxicity in mammals, such as mink and otter, is primarily manifested as central nervous system damage; including sensory and motor deficits and behavioral impairment (Wolfe et al. 1998, Scheuhammer et al. 2007).

Methylmercury has been found to impair the ability of birds to fly and also alter their songs (Hallinger et al. 2010; Carlson et al. 2014). In great white herons, liver mercury contamination (6 mg/kg) correlated with mortality from chronic diseases in southern Florida (Spalding et al. 1994). Weight loss, neurologic, and immunologic effects were observed in captive great egrets fed a diet with 0.5 mg/kg methylmercury (Spalding 2000a, Spalding 2000b). Reproduction is one of the most sensitive endpoints to methylmercury toxicity, and effects in birds include reduced hatching due to early mortality of embryos, fewer eggs laid, changes in pairing behavior and territorial behavior (Heinz 1979; Barr 1986; Wolfe et al. 1998; Frederick and Jayasena 2011). A recent study found that almost one third of the grebes sampled in 25 lakes throughout California during the spring and summer of 2012 and 2013 had mercury levels in the blood that put them at an elevated risk of methylmercury toxicity (>1 mg/kg wet weight, Ackerman et al. 2015a,b).

Appendix J also contains suggested dietary methylmercury thresholds from peer reviewed literature that were derived from both control experiments and field studies (Tables J-1 and J-2).

4.7 Methylmercury Effects on Human Health

Methylmercury is a "highly toxic substance" (U.S. EPA 1987). Toxicity to the developing nervous system of the fetus is considered the most critical endpoint. The water quality objectives were derived from the U.S. EPA reference dose, which was based on protecting the developing fetus. However, subsequent evidence suggests that cardiovascular effects can occur in adults at comparably low doses (U.S. EPA 2001). Methylmercury may also be immunotoxic and genotoxic as well (Agency for Toxic Substances and Disease Registry 1999).

Methylmercury has long been known as a potent neurotoxicant, particularly due to incidents of acute and high-level exposures such as the poisoning of many in Minamata, Japan, when pregnant women consumed seafood highly contaminated with methylmercury, up to 40 mg/kg (Iyengar and Rapp 2001). This resulted in extreme fetal abnormalities and neurotoxicity (i.e., microcephaly, blindness, severe mental and physical developmental retardation) even among infants born to mothers with minimal symptoms (Harada 1995).

Since then, more subtle neurodevelopmental effects have been observed in populations with moderate methylmercury exposures from regular consumption of fish and/or marine mammals. A well-designed cohort study in the Faroe Islands found that prenatal exposure to organic methylmercury from maternal fish and pilot whale consumption during pregnancy was associated with subtle neurodevelopmental deficits in children, such as poorer performance on tests of attention, fine motor function, language, visual-spatial abilities, and verbal memory (Grandjean et al. 2001, Debes et al. 2006). In a cohort from the Seychelles, however, investigators did not find evidence for a neurodevelopmental risk from prenatal methylmercury exposure resulting from ocean fish consumption (Myers et al. 2003). The Faroe Islands study was used by the U.S. EPA to develop the fish tissue criterion of 0.3 mg/kg (U.S. EPA 2001).

In the Faroe Islands, the primary source of mercury exposure in the study population was through the traditional consumption of whale meat, not fish, and co-exposure to other contaminants such as polychlorinated bi-phenyls (PCBs) that are of concern. However, in California, PCBs are also contaminants in fish tissue at levels that limit the advised consumption amount (Davis et al. 2010, Davis et al. 2012). One hypothesis as to why adverse effects of mercury were not found in the Republic of Seychelles, but adverse effects were found in the

Faroe Islands, is that there are other neuroprotective nutrients in seafood, such as selenium and iodine, and long chain polyunsaturated fatty acids (Oken 2012, Meyers 2009). Freshwater fish do not have these nutrients in the same amounts as marine fish (Steffens 1997; Haldimann et al. 2005; Steffens 2006), and many California are exposed to mercury by consuming freshwater fish. While many people in the Faroe Islands and the Republic of Seychelles ate fish several times a week, in the Faroe Islands most of the methylmercury exposure was from infrequent (twice a month) consumption of pilot whale meat (Dourson 2001). Recreational fishers in California may also have infrequent high methylmercury exposure from weekend fishing trips, along with a steady methylmercury exposure from regularly purchased commercial fish. There are other theories as to why the two studies found conflicting results, such as study design (Debes et al. 2006; Oken et al. 2008). Ultimately, mercury is a known neurotoxin and the Faroe Islands study provides data to support a reference dose.

Epidemiologic studies continue to find harmful effects of methylmercury on humans in the U.S. and other countries, including neurological effects in children and effects on cardiovascular disease (Jedrychowski et al. 2006; Oken et al. 2005, 2008, Suzuki et al. 2010; Murata et al. 2011). However, other studies in the Republic of Seychelles (van Wijngaarden et al. 2006; Strain et al. 2015), United States (Oken et al. 2016), the United Kingdom (Daniels et al. 2004), and Spain (Llop et al. 2012) have found no consistent evidence of adverse consequences of prenatal methylmercury exposure from fish consumption on children's development. Some studies suggest a range of health effects in adults and children may result from methylmercury exposures at levels lower than previously observed (Lynch et al. 2010; Mergler et al. 2007, Oken et al. 2008). At the same time, these studies also show a beneficial effect of eating fish. Oken and colleagues discusses the wide range of trade-offs facing fish consumers and the difficulties in evaluating current fish consumption advice (Oken et al. 2008). Consumers need to consider not only the contaminant concentrations in fish but also their nutritional value, the sustainability of the fishery, and the cost of different fish choices.

Recent national data on blood mercury concentrations in women of childbearing age (16 - 49), suggest that most people in the U.S. are at low risk for methylmercury toxicity (U.S. EPA 2013). Generally most people eat commercial fish that are from the ocean, but the sources of fish in this study were not reported. The geometric mean blood total mercury concentration for 2009-2010 was 0.9 µg/L, which is below the suggested threshold of 5.8 µg/L blood mercury, a concentration associated with neurologic effects on the fetus (National Research Council 2000). The study authors found a significant relationship between mercury intake from fish consumption and blood mercury. Also in the last decade, the mean blood mercury concentration has slightly decreased, but the analysis showed few changes in fish consumption and mercury intake over the study period (1999 – 2010). This is consistent with women shifting their consumption to fish with lower methylmercury concentrations. Demographic characteristics associated with blood mercury concentrations were: higher concentrations observed with increasing age and income; higher concentrations observed in the "other" race category; and lower concentrations observed in Mexican Americans.

Blood mercury levels in frequent consumers of fish can be dramatically higher than the national average. Patients at a general internal medicine practice in San Francisco, whose dietary history suggested their methylmercury intake was high, were asked to be screened with a whole blood mercury test (Hightower and Moore 2003). Only consumption of commercial fish was considered in this study. Mercury levels ranged from 2.0 to 89.5 µg/L for the 89 subjects. The mean for 66 women was 15 µg/L (standard deviation of 15), and for 23 men was 13 µg/L (standard deviation of 5). These values are well above the thresholds suggested by the National Research Council in 2000, indicating higher risks for negative health effects from methylmercury. Knobeloch and colleagues examined 14 individuals in Wisconsin who consumed commercial or locally caught fish twice a week or more. Blood mercury levels ranged from < 5 µg/L to 58 µg/L and most of the study participants had blood mercury concentrations above 20 µg/L (Knobeloch et al. 2006). These values show that majority of the study participants had blood mercury levels more than three times higher than the suggested mercury threshold.

4.8 Interactions of Selenium and Mercury

Selenium is an element that functions as a micronutrient for plant and animal life. However, in concentrations beyond the very small amounts required for some biological functions, selenium is toxic to animal life. When selenium is present in the same environment as mercury or methylmercury, complex interactions involving the toxicity of both pollutants occur. Selenium appears to counteract or even protect against the toxic effects of methylmercury, but the relationship is not well understood, and regulatory measures that would adjust limits based on the presence of both pollutants simultaneously are not possible. These interactions are described in detail in this section.

4.8.1 Selenium is an Essential Nutrient and a Toxin

Selenium is essential for many functions in our bodies. Selenium fosters growth and development, has powerful antioxidant and cancer prevention properties, and is essential for normal thyroid hormone homeostasis and immunity. Studies indicate that selenium is especially important for the brain, heart, and immune systems. Ocean fish are among the richest sources of nutritional selenium in the American diet. On the other hand, the selenium in freshwater fish is more variable and may be limited in certain regions. The selenium levels in lake fish reflect the regional selenium levels in the soils. Selenium is thought to reduce the bioaccumulation of methylmercury, and methylmercury concentrations are higher in fish living in lakes where selenium availability is limited (Energy & Environmental Research Center 2011).

Selenium can also be toxic at high doses. In vertebrates, selenium is toxic to the reproductive system. Egg laying vertebrates such as birds and fish seem to have substantially lower thresholds for reproductive toxicity than placental vertebrates (mammals). In fish, effects may occur at 2 µg/L in water or 2 mg/kg in fish (U.S. Department of the Interior 1998). An important feature of selenium ecotoxicity is the narrow margin between nutritionally optimal and potentially toxic dietary exposers for vertebrate animals. Nutritionally optimal dietary selenium exposure is generally reported as 0.1 – 0.3 mg/kg. Thresholds for dietary toxicity in animals are generally reported as 2 – 5 mg/kg. (U.S. Department of the Interior 1998 and references within). In July 2016, U.S. EPA established new national Clean Water Act 304(a) freshwater aquatic life water quality criteria for selenium, including a Whole Body value of 8.5 mg/kg dry weight and a water concentration ranging from 1.5 – 3.1 µg/L (U.S. EPA 2016). U.S. EPA also proposed a new fish tissue-based (whole body) selenium criterion of 8.5 micrograms per gram (µg/g) dry weight, a dissolved water column criterion of 0.2 µg/L, and a proposed particulate (i.e., sediment-bound) water column criterion of 1 µg/L for the San Francisco Bay and Delta (81 FR 46030, July 15, 2016).

4.8.2 Does Selenium Completely Counteract the Effects of Mercury?

If selenium clearly countered the toxic effects of methylmercury in every study, this fact could eliminate the need for mercury remediation. However, the mercury selenium interaction does not appear to be a simple relationship that works in all situations. In fact, waters in California that contain high levels of selenium also have high levels of methylmercury. Waters that are on the 303(d) list due to high levels of both selenium and mercury include Central San Francisco Bay, San Pablo Bay, Suisun Bay, and portions of the San Joaquin River watershed. The high levels of selenium are apparently not preventing methylmercury from accumulating to high levels in fish in these waters.

Most studies that indicate the protective effect of selenium do not show full reversal of toxicity. No evidence has been found to suggest that selenium can fully counteract toxic effects of methylmercury in the human population. The protective effect of selenium likely depends on the ratio of methylmercury to selenium, concentrations of methylmercury and selenium, the speciation and bioavailability of methylmercury and selenium, the presence of other toxic compounds or nutrients, and the anti-oxidant systems/metabolism of the species in question. A protective effect that is highly situation dependent will be very difficult to incorporate into a methylmercury guideline. Overall, the state of the science on selenium–mercury interaction is not close to a point at which it could be incorporated into regulatory limits for mercury. Studies on the selenium-mercury interactions are summarized below.

4.8.3 Selenium and Mercury Interactions

Selenium has long been known to interact with mercury and reduce the toxic effects of methylmercury. The interaction gained attention after Ganther and colleagues showed that quail that were also fed selenium did not have the same methylmercury induced growth inhibition as when they were fed methylmercury alone (Ganther et al. 1972). The protective effects seem to occur through formation of a mercury-selenium complex that is not bioavailable (Kahn and Wang 2009, Raymond and Ralston 2004).

The interaction with selenium offers possible insight into the mechanism of methylmercury toxicity itself because the mechanism of methylmercury toxicity is still unknown. Although methylmercury has long been known to cause damage to the nervous system, it remains unclear how the effects occur. Selenium is a key component in some proteins, and if the selenium is bound to mercury it could cause the function of the selenoprotein to be compromised. It is thus possible that the observed toxicity of methylmercury is at least in part caused by mercury-induced selenium deficiency (Raymond and Ralston 2004, Khan and Wang 2009).

A handful of subsequent studies in rats or mice have also shown protective effects of selenium (Watanabe et al. 1999a, Watanabe et al. 1999b, Ralston 2007, Ralston et al. 2008, Sakamoto et al. 2013). However the effects monitored in these studies were generally acute effects from high doses of methylmercury, such as changes in growth and death. These observations may not reflect the effect of selenium on methylmercury toxicity at concentrations that induce chronic effects such as cognitive impairments. Such chronic effects of methylmercury are really the concern for human health. Sakamoto and colleagues acknowledged the need to study effects at environmentally relevant concentrations (Sakamoto et al. 2013). Meanwhile, other studies do not find any interaction between mercury and selenium. Reed and colleagues used low-level methylmercury and nutritionally relevant dietary selenium and did not find that selenium was able to reverse the behavior impairment from methylmercury (Reed et al. 2006).

Although several studies report protective effects of selenium, some studies also report detrimental effects on other endpoints measured. For example, Hoffman and Heinz found selenium reduced methylmercury induced mortality in adult males, yet deformities in embryos of the offspring were worse in combined selenium and methylmercury treatment than in either treatment alone (Hoffman and Heinz 1998). Again, an important characteristic of selenium is that it is toxic at doses that are not that much higher than the dose that provides nutritional benefit. Also, recently Sakamoto and colleagues found selenium protected against neuronal degeneration from mercury exposure in rats, but there were still differences from control in other endpoints measured (body weight and organ weight, Sakamoto et al. 2013). Ganther and colleagues (2007) dosed cats with methylmercury and selenium and found that selenium delayed methylmercury toxicity by months. However, most of the cats still died by the end of the experiment (Ganther et al. 2007). The authors concluded that it is likely that selenium is a major protective factor in marine fish, but it may not be the only factor.

Another complication in the selenium-mercury story is that the effects may vary by species. Scheuhammer and colleagues found in a comparison of the brains of bald eagles and common loons that bald eagles displayed a greater apparent ability to demethylate methylmercury (Scheuhammer et al. 2008). These interspecies differences may influence relative susceptibility to methylmercury toxicity.

4.8.4 Selenium Dosing of Lakes to Reduce Fish Methylmercury

Selenium was added to Lake Oltertjarn in Sweden for the purpose of reducing fish methylmercury levels. It was noted above that fish generally have higher methylmercury in soils with low selenium. If the selenium will bind to the mercury in an organism, and increases the elimination of methylmercury, then it should also reduce the methylmercury bioaccumulations up the food web. The treatment in Lake Oltertjarn did reduce the methylmercury levels in perch more than 75 percent (Paulsson and Lundbergh 1989, 1991). Just after that, in 1987, 11 additional lakes were treated with a similar or lower level of selenium (to achieve 1-5 µg /L Selenium) to reduce methylmercury. However, two years later, researches were unable to find any perch in five of the lakes. Selenium is also a well-known reproductive toxin and mostly likely caused a collapse of the perch populations in these lakes (Skorupa 1998). Reproductive toxicity has been found in other lakes, including in California (e.g. Kesterson Reservoir, Tulare Basin, and Slaton Sea), with similar concentrations of selenium (Skorupa 1998).

4.9 Human Fish Consumption Rates

The amount of fish that people consume is a critical variable in calculating a protective limit of methylmercury. This variable is shown in the equation that U.S. EPA used for calculating the fish tissue criterion (U.S. EPA 2001), which was also used to calculate the Mercury Water Quality Objectives to protect human heath, below:

$$FTC = \frac{BW * (RfD - RSC)}{FI}$$

where,

FTC = a fish tissue concentration in milligrams (mg) methylmercury (MeHg) per kilogram (kg) fish. The FTC will be used as the methylmercury water quality objective.

BW = human body weight, default value of 70 kg

RfD = reference dose of 0.0001 mg MeHg/kg body weight-day. The value was derived from a study of mothers and their children in the Faroe Islands, where fish and whale is a large part of the diet, and blood mercury concentrations were correlated to cognitive effects in the children.

RSC = relative source contribution, estimated at 2.7 x 10^{-5} mg MeHg/kg body weight-day. This value is subtracted from the reference dose to account for other sources (e.g., marine fish).

FI = human fish intake (consumption rate, kg fish/day).

Since the fish consumption rate is such a critical variable, this section briefly summarizes fish consumption rates from various sources. Table 4-2 shows fish consumptions rates used by the U.S. EPA and rates used in California. Also included in Table 4-2 is Oregon's recently established rate, which is a much higher fish consumption rate than many states have used. The U.S. EPA derived the recommended methylmercury water quality criterion on the basis of a default fish intake rate for the general population of 17.5 grams/day (U.S. EPA 2001). The 17.5 g/day used by U.S. EPA was the rate for average U.S. consumption (90^{th} percentile) for people who do and do not eat fish. The U.S. EPA default subsistence rate of 142 g/day is also shown in Table 4-2.

Of all fish consumption surveys in California, the San Francisco Bay Seafood Consumption Study (San Francisco Estuary Institute 2000), included in Table 4-2, is recognized as one of the best studies to date. The fish consumption rate (32 g/day) from this study has been used as the basis of fish consumption advisory issued by OEHHA (see Appendix E for more details) and this rate (32 g/day) has also been used to establish site-specific water quality objective for San Francisco Bay and the Sacramento-San Joaquin Delta.

Table 4-2. Selected National and California Fish Consumption Surveys

Type/ Source	Fish Consumption Rate (g/d)	Equivalent 8 oz Meals per Week	Type of Estimate Used to Derive Rate
General U.S. population (U.S. EPA 2000)	17.5 g/d	0.5*	90^{th} percentile
Subsistence, U.S. population (U.S. EPA 2000)	142 g/d	4.3	99^{th} percentile
San Francisco Bay, California (San Francisco Estuary Institute 2000),	32 g/d	1*	95^{th} percentile
Subsistence, Sacramento-San Joaquin Delta, California (Shilling 2009, Shilling et al. 2010)	127 g/d	3.9*	95^{th} percentile
Oregon, including Tribes of the Columbia River (ODEQ 2011)	175 g/d	5-6	95^{th} percentile
Promulgated by U.S. EPA for Washington State (81 FR 85417, November 28, 2016)	175 g/d	5-6	95^{th} percentile
Proposed by U.S. EPA for Maine (81 FR 23239, April 20, 2016)	286 g/d**	9	NA***
California Tribes - contemporary (Shilling 2014)	142 g/d	4.4*	95^{th} percentile
California Tribes – two generations ago (Shilling 2014)	223 g/d	7	95^{th} percentile

*The reference shows that the population consumes an additional, but smaller proportion of store bought fish, so this should be included in the relative source contribution part of the equation (see equation at the beginning of Section 4.9)

**U.S. EPA proposed to use trophic-specific fish consumption rates of 103 g/day (trophic level 2), 114 g/day (trophic level 3), and 68.6 g/day (trophic level 4).

***Estimates were based on a general consideration of resources present and reported to be used combined with nutritional information, but are not derived as statistically-derived calculations with ranges because that level of precision would not be warranted (Haper & Ranco 2009).

Two California subsistence rates are included in Table 4-2. Shilling's 2009 survey of subsistence fishers in the Sacramento-San Joaquin Delta was contracted to provide information for the methylmercury TMDL for the Delta (subsequently published as Shilling et al. 2010). Shilling's 2014 report on California tribes was specifically contracted to provide information for the Provisions.

The fish consumption rate use by the Oregon Department of Environmental Quality (ODEQ) is much higher than the national default rate of 17.5 g/day, but the rate is in part based on the same data set. A focus group of scientists (Cirone et al. 2008) reviewed the same national data (also used by U.S. EPA 2000) and recommended that ODEQ use rates that only included people who ate fish ("consumer only," shown in italics in Table 4-3) and not use rates based on data from people who do not eat any fish. ODEQ also included marine and freshwater fish recognizing the importance of salmon to the diet of many people in the state. And, ODEQ considered tribal consumption rates, many of which were actually lower than the fish "consumer only" rates from the national dataset (e.g. 176 g/day Columbia River Tribes 95th percentile vs. 334 g/d national data "consumer only").

Table 4-3. U.S. General Population Consumption Rates in grams per day

Population	**Consumption Habit**	**Fish type**	**Mean**	**Median**	**90th centile**	**95th centile**	**99th centile**
U.S. Adults	Consumer & Non-consumer	Freshwater	8	0	**17**	50	143
U.S. Adults	Consumer & Non-consumer	All Fish	20	0	75	111	216
U.S. Adults	*Consumer ONLY*	*All Fish*	*127*	*99*	*248*	*334*	*519*
U.S. Adults	Consumer ONLY	Freshwater	81	47	199	278	505
U.S. Women	Consumer ONLY	All Fish	108	77	221	315	494
U.S. Women	Consumer ONLY	Freshwater	75	36	172	273	502

Notes: Data from U.S. EPA 2002 and some of this data was summarized earlier by U.S. EPA 2000. "Freshwater" includes freshwater and estuarine finfish and shellfish, and "All fish" includes anadromous and marine. "Women" were 15-44 years old, while, "Adults" were 18 years and older. Non-consumers reported eating 0 g fish/day. The national default rate is shown in bold (17g/day). Numbers in italics were considered in part for ODEQ's 175 g/day rate.

The "consumer only" U.S. general population data (Table 4-3) should be used with caution because they probably over estimate true rates. The reported estimates were calculated using data from the combined 1994-1996 and 1998 Continuing Survey of Food Intakes by Individuals (CSFII), conducted annually by the United States Department of Agriculture (U.S. EPA 2002). This study asked participants to recall what they ate over two days. To separate "consumers" from “non-consumers”, data from those who reported eating no fish during the two day period were eliminated. Then, the fish consumption rates from those individuals who did eat fish over the two days were divided by two to derive the daily rate. This is misleading because this approach used only data from people who happen to eat fish on those two days and made that consumption the daily consumption rate. The people who happened to eat fish on those two days may not actually eat fish that often.

Appendix G summarizes other fish consumption studies conducted in California. Roughly 22 documented fish consumption studies are included. The studies vary in methodology, including the survey approaches used (phone interview vs. surveying anglers while fishing), the number and type of people surveyed and the resulting statistics presented and adjustments for bias. Not all studies calculated a fish consumption rate that could be equated to a rate in g/day. Of the studies that reported rates, the mean consumption rates ranged from 3 to 60 g/day and high end rates (e.g. 90^{th} or 95^{th} percentile) ranged from 32 to 225 g/day.

The State Water Board has considered additional California-only studies in order to determine subsistence fishing rates within the state. There are several studies, listed in Table 4-4, that provide information regarding subsistence fishing in California. Overall, the studies in Table 4-4 show that the amount of fish consumed and the type of fish consumed (classified here as “high mercury” versus “low mercury”) vary by geographic region. Seven of the studies in Table 4-4 support a subsistence fish consumption rate of four to five meals per week or more for the 95^{th} percentile of the surveyed populations, but the remaining studies either found a rate of consumption less than four meals per week or were inconclusive.

One of the issues in endeavoring to derive a numeric water quality objective for the SUB beneficial use is that it is not clear which studies or consumption rates represent subsistence fishing versus those that represent recreational fishing. For example, in the San Francisco Bay study (Table 4-4) it is not clear that one subset of the data by ethnicity better represents subsistence versus the whole study. If the “Asian” subgroup is chosen, the fish consumption rate is not different than the result from all participants. If the subgroup with the highest rate is used (Pacific Islander and “Other”), the data considered is narrowed down to only 19 responses out of 1152 responses from anglers who ate their catch, and still the consumption rate is only two meals per week. Data from the San Francisco Bay study was also broken down by other demographic information, but for example, income was not a good predictor of the fish consumption rate (on the whole, respondents with higher incomes were eating the same amount as people with lower incomes). Overall, for the San Francisco Bay study, it is not clear how a separate rate for subsistence fishers versus recreational fishers would be chosen.

To derive a numeric water quality objective for the T-SUB beneficial use, however, the California Tribes Fish-Use study provides a significant summary of statewide fish consumption by California tribes (Shilling et al. 2014). While the Tribes Fish Use study includes data from 40 tribes throughout the state, the study cannot be assumed to represent every tribe, since there are many other tribes in California. There are 109 tribes that are recognized by the federal government and 72 more communities are petitioning for recognition (California Environmental Protection Agency 2009). This study was somewhat unique in that study participants were volunteers, which may result in biased fish intake estimates. One obvious source of bias could be that people who eat large amounts could be more motivated to participate in the study. However, the study authors list reasons why some tribe members would not participate, including resistance to governmental intrusion, and knowledge of past failure of government to act to protect tribal interests (Shilling et al. 2014). These concerns may be more significant for a person for whom fish use is very important (and frequently eats fish), resulting in underrepresentation of those who eat large amounts of fish. The effects of various sources of bias are complex and difficult to predict. Nevertheless, the rate of 142 g/day for contemporary fish consumption for California tribes (Shilling et al. 2014) matches the US. EPA recommended subsistence rate of 142 g/day (U.S. EPA 2002).

To derive water quality objectives pertaining to the recreational and subsistence fishing beneficial uses contained in the Provisions, several possible options were developed based on the studies described in this section. The options for the water quality objectives are described in Section 6.2, Section 6.5, and Section 6.6 including the policy issues associated with each option. Appendix H provides details of the calculations for each of the options for the recreational and subsistence fishing objectives.

Table 4-4. California Fish Consumption Data Related to Subsistence Fishing[1]

Geographic Area	Group/ Subgroup	Number of Respondents	Meals per week (95th percentile)	Fish type[2]
San Francisco Bay (San Francisco Estuary Institute 2000)	Pacific Islander and "Other"	19	2	Mixed
	Asian	190	< 1	Mixed
	All participants (60% non-white)	1331	1	High Mercury
Sacramento- San Joaquin Delta (Shilling 2009, Shilling et al. 2010)	South East Asian	286	4	High mercury
	All participants (85% non-white)	373	4	High mercury
Gold Country (Sierra Nevada Mountains and foothills) (Sierra Fund 2011)	All participants (authors sought to include locations used by low income anglers)	159	1 (mean value, so a 95th percentile is presumably higher)	Mixed
Ventura County & LA County (coastal & inland waters) (Allen et al. 2008)	African American	27	3	Low mercury
	"No data"[3]	7	9	Low mercury
	All participants	495	2	Low mercury
Santa Monica Bay (Allen et al. 1996)	Asian	122	4	Mixed
	"Other"	14	5	(Not reported)
	All participants	1243	2.5	High mercury
California Tribes (statewide) (Shilling et al. 2014)	Contemporary	580	4.4	Low mercury
	Two generations ago	216	7	Low mercury

[1]The overall results for each study are also provided for comparison, even if not related to subsistence. See Appendix G for complete study results.
[2]"Fish Type" is a rough indicator of the type of fish most frequently consumed: "High mercury" indicates trophic level 4 fish, which tend to have higher levels of mercury. "Low mercury" indicates trophic level 3 fish, which tend to have lower levels of mercury (see Section 4.2). Some studies provided information on fish type for the demographic subgroups (Table K40, San Francisco Estuary Institute; Table 2, Shilling et al. 2010; Table 5, Allen et al. 1996). Otherwise, the details of the fish type consumed is shown in Appendix G.
[3]"No data" indicates respondents declined to state and ethnicity.

4.10 Uses of Water by California Native American Tribes

California has the second largest number of federally-recognized Native American Tribes and, according to the 2000 U.S. Census, the largest Native American population in the United States. In California, there are 109 Native American Tribes that are recognized by the federal government and 72 more communities are petitioning for recognition (California Environmental Protection Agency 2009).

The diversity of traditional cultures and lifeways within the boundaries of present-day California is enormous, by any measure. Linguistically, at least 80 distinct native languages were spoken in California at the beginning of the 19th century (http://linguistics.berkeley.edu/). As a point of reference, there are today merely 24 "official" languages in the European Union, a landmass approximately ten times the size of California. There are, at a minimum, 50 traditional tribal areas within the state where ethnically similar groups were once widespread (Castillo, 1998). Descriptions of California Native American tribal communities, culture and traditions are the subject of hundreds of volumes of scholarship and historical records. A complete description of these traditional lifeways is therefore beyond the scope of this report. However, several examples of California tribal traditional uses of water for illustrative purposes are provided, but this report in no way limits definitions of uses of water that support the cultural, spiritual, ceremonial, or traditional rights or lifeways of California tribes to these examples. .

Many traditions and lifeways are closely linked to natural resources available in the traditional tribal areas. For example, "Northwest" tribes, as described by Castillo, live in the temperate rainforest and have historically had access to navigable waterways as well as well as robust lumber resources (ibid.) The Yurok tribe maintains the tradition of *yoch* (redwood dugout canoe) building, which is essential for navigating rivers, streams and coastal waters; the *yoch* itself is part of the White Deerskin Dance, a ceremony that is still observed by the Yurok tribe, as a conveyance for the festival members (http://www.yuroktribe.org/culture/culture.htm).

In many cases, water bodies themselves provide building materials. A freshwater marsh plant called the *tule* (*Schoenoplectus actus*) has been immensely important in California native material culture. Many tribes, such as the Clear Lake Pomo, utilized tules to build large houses as well as canoes (Jones, 1998). This technology is still used today, and is now exhibited annually at the an inter-tribal competition, the Tule Boat Festival, at Clear Lake http://www.lakeconews.com/ Tules have also been used for construction of myriad goods by tribes throughout the state, including baskets and sleeping mats, and as components for houses.

Perhaps the most prevalent use of water by California tribes was as a food source, especially from salmon runs. Tribes and tribal groups with access to salmon runs established managed fisheries. Given salmon's importance, cultural and ceremonial traditions that honored salmon, especially the First Salmon Ceremony, are prevalent among not just California tribes but Native American tribes along much of the west coast of North America. The Karuk tribe's First Salmon Ceremony is briefly described as "a ritual thanksgiving held in spring, which marked the end of wither and the start of the fishing season." (McCarthy, 1998). However, an early 20th century ethnography of elderly Karuk tribe members details the complexity of the ceremony, which included ritual immersion in water, declaration of the arrival of the salmon run, a ritual first catch of the run, followed by preservation, preparation and sharing of the first catch (Roberts, 1932).

Recently, 40 California tribes were surveyed on how they fish and use California's waters (Shilling et al. 2014). Figure 6-1 below shows the areas fished by survey participants within the 30 days preceding the interview. Extrapolation of those results from those 40 tribes to all California tribes suggests that tribes may be fishing in a majority of waters in the state, rather than a few isolated locations.

A) **B)**

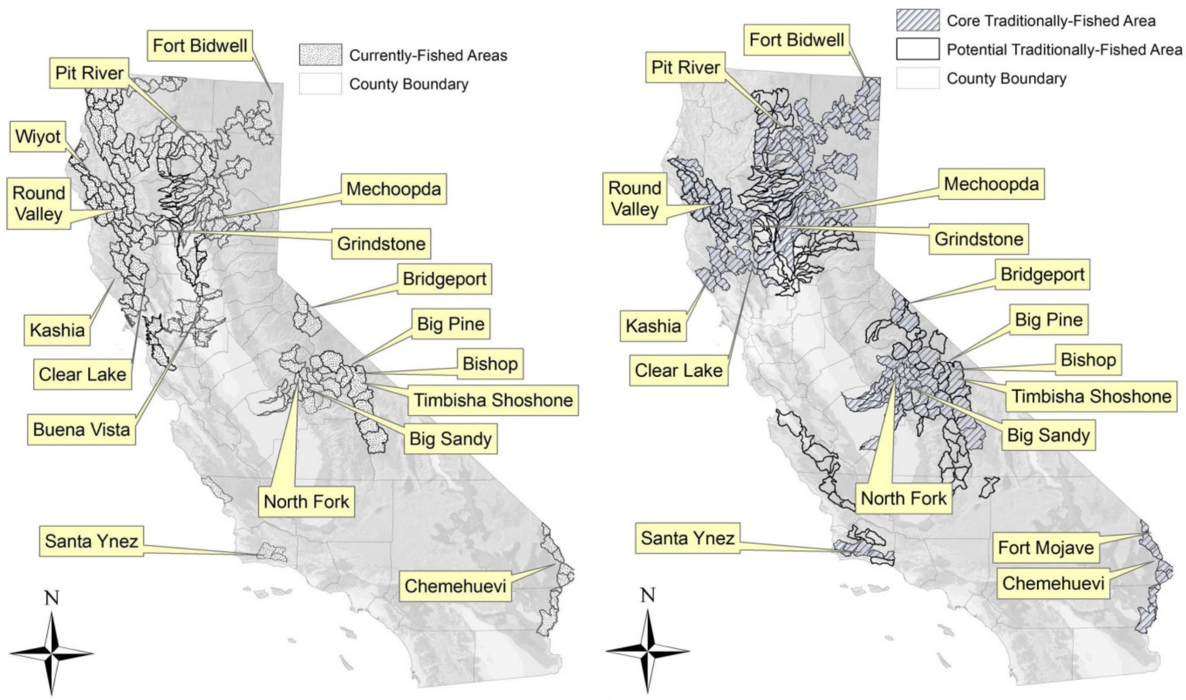

Figure 6-1. Waters used by some California tribes (Shilling et al. 2014). A) Currently-fished watersheds (hydrologic unit code HUC-10). Areas with darker color outlines represent areas where fishing areas of more than one tribe overlapped. B) Traditionally-fished watersheds (hydrologic unit code HUC-10). Areas with darker color represent areas where fishing areas of more than one tribe overlapped.

5. Beneficial Uses Impacted by Mercury

This section identifies which beneficial uses would be protected by the Provisions' five Mercury Water Quality Objectives. Regional Water Board basin plans define about 26 beneficial uses that can be applied to surface waters in California. The uses that the Mercury Water Quality Objectives would apply to are listed below, as well as the inapplicable beneficial uses. With the exception of the three beneficial uses the Provisions would define (CUL, T-SUB, and SUB), to aid the following discussion, this Chapter utilizes the beneficial use definitions contained in the Central Valley Regional Water Board's basin plan (Central Valley Water Board 2009) and the Continuing Planning Process Report (State Water Board 2001).

The Mercury Water Quality Objectives were derived to protect uses related to humans or wildlife that eat fish from water bodies in California. Although the objectives are derived using fish consumption rates, none of the objectives in the Provisions are designed to ensure that fish can be caught in an abundance to sustain that consumption rate. Uses pertaining to fish consumption are the most sensitive uses related to mercury because of the bioaccumulation of methylmercury in the food web. By protecting these uses, other aquatic life that is exposed to mercury through contact with water or via ingestion of food lower in the food web (by consuming insects or algae) would be protected as well.

The Mercury Water Quality Objectives are intended to protect the applicable beneficial uses discussed in this Chapter in all waters where they are designated in water quality control plans or where the use exists (see also section 2.4). Pursuant to federal regulations, existing uses must be protected – even if they have not been designated to specific waters in water quality control plans (40 C.F.R § 131.12(a)(1)). U.S. EPA's regulations implementing the Clean Water Act defines "existing uses" as "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (40 C.F.R. § 131.3(e)). U.S. EPA explains in its summary to the revised water quality standards regulations (80 Fed. Reg. 51027 (Aug. 21, 2015): "[E]xisting uses are known to be 'actually attained' when the use has actually occurred *and* the water quality necessary to support the use has been attained. U.S. EPA recognizes, however, that all the necessary data may not be available to determine whether the use actually occurred or the water quality to support the use has been attained." Additionally, the objectives would apply to waters for which a water quality control plan has expressly designated specific waters with the applicable beneficial uses (and, typically, when that occurs the use is designated as an existing or probable future use).

In some waters, the uses may be seasonal or intermittent. The Mercury Water Quality Objectives are intended to protect seasonal and intermittent uses in addition to year-round uses.

Table 5.1 identifies the Mercury Water Quality Objectives, the beneficial uses applicable to each, and the applicable numeric concentration in fish tissue (see Appendix A for full details). As described in sections 5.1 and 5.5, the Sport Fish Water Quality Objective and the Prey Fish

Water Quality Objective may be utilized for additional beneficial uses pertaining to wildlife and marine habitat.

Table 5.1. Summary of the Mercury Water Quality Objectives

Objective Type	Beneficial Uses	Objective
Sport Fish	Commercial and Sport Fishing; Wildlife Habitat; Marine Habitat	0.2 mg/kg in highest trophic level fish, 150-500 mm, skinless fillet
Tribal Subsistence	Tribal subsistence fishing	0.04 mg/kg in 70% trophic level 3 fish and 30% trophic level 4 fish, 150-500 mm, skinless fillet
Subsistence	Subsistence fishing	Waters …shall be maintained free of mercury at concentrations which accumulate in fish and cause adverse biological, reproductive, or neurological effects. The fish consumption rate used to evaluate this objective shall be derived from water body and population-specific data and information of the subsistence fishers' rate of and form of (e.g. whole, fillet with skin, skinless fillet) fish consumption
Prey Fish	Wildlife Habitat; Marine Habitat (no trophic level 4 fish)	0.05 mg/kg in whole fish 50-150 mm
Prey Fish for the California Least Tern	Wildlife Habitat, Marine Habitat, Rare, Threatened, or Endangered Species (Where California least tern habitat exists)	0.03 mg/kg in whole fish less than 50 mm

5.1 Applicable Uses – Sport Fish Water Quality Objective

The Sport Fish Water Quality Objective is intended to protect recreational fishers from eating fish with elevated levels of mercury. This objective is also protective of many wildlife species that eat fish (e.g. bald eagle, osprey), so the Sport Fish Water Quality Objective should be applied to waters with existing or designated wildlife beneficial uses. The Sport Fish Water Quality Objective applies to the following beneficial uses:

> ***Commercial and Sport Fishing (COMM)*** *- Uses of water for commercial or recreational collection of fish and shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.*
>
> ***Wildlife Habitat (WILD)*** *- Uses of water that support terrestrial ecosystems including, but not limited to, preservation or enhancement of terrestrial habitats, vegetation, wildlife*

(e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources).

Marine Habitat (MAR) - *Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).*

Tribal Tradition and Culture (CUL) - *Uses of water that support the cultural, spiritual, ceremonial, or traditional rights or lifeways of California Native American Tribes, including, but not limited to: navigational activities, ceremonial activities, and fishing, gathering, or consumption of natural aquatic resources, including fish, shellfish, vegetation, and materials*.

At the time of the development of the Provisions, not all of the basin plans for the nine Regional Water Boards had expressly designated waters within the regions with COMM where the use is known to exist and water quality supports the use. Historically, the Regional Water Boards associated human consumption of fish with the REC-1 beneficial use category because the REC-1 definition includes the activity "fishing," rather than COMM, which includes the activity "consumption of fish." As a result, numerous basin plans appear to have designated waters with REC-1 to reflect consumption of fish. In instances where the use associated with consumption of fish utilizes the REC-1 designation, rather than the COMM designation, many waters are identified on the 303(d) list as impaired for the REC-1 beneficial use due to *elevated levels of mercury in fish tissue*. Establishing corrected COMM designations in the applicable basin plans would make it clear that the applicable Sport Fish Water Quality Objective and related mercury control program applies. Additionally, the Water Boards may specify the correct beneficial use during the listing cycles for the 303(d) list of impaired water bodies.

The MAR beneficial use is included because the geographic scope of the Sport Fish Water Quality Objective includes enclosed bays and estuaries, and some of these waters have been designated with the MAR beneficial use. WILD is designated for almost all inland surface waters, but WILD is often not used for enclosed bays and estuaries, whereas MAR is designated for those waters and MAR includes uses of water that support wildlife and marine habitat.

All aquatic life is susceptible to toxic effects from mercury, not just piscivorous wildlife. However, fish and other organisms lower on the food web are much less sensitive than piscivorous wildlife. Chronic toxicity values for invertebrates to inorganic mercury tend to be on the order of 1 µg/L (U.S. EPA 1985a), which is 100 to 250 times higher than the proposed water column concentrations consistent with achieving the objectives (4 to 12 µg/L, Appendix I). In current basin plans, the use of WILD is more prevalent than the designations for both the WARM and COLD beneficial uses combined. In fact, most of the State's inland surface waters, enclosed bays, and estuaries are designated with either WILD or MAR. Therefore, applying the objective to WILD and MAR would effectively protect other aquatic life uses, including:

Warm Fresh Water Habitat (WARM*)*** *- Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.*

Cold Fresh Water Habitat (COLD*)*** *- Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.*

Saline Water Habitat (SAL*)*** *- Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.*

Estuarine Habitat (EST*)*** *- Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).*

The Sport Fish Water Quality Objective would be applied where waters are designated with RARE for the species listed below. However, these waters should already be designated with WILD or MAR, to which the objective applies.

Rare, Threatened, or Endangered Species (RARE*)*** *- Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.*

The following list of applicable threatened and endangered species is from the USFWS analysis (USFWS 2003):

California Ridgway's rail (*Rallus obsoletus*)
Light-Footed Ridgway's rail (*Rallus obsoletus levipes*)
Yuma Ridgway's rail (*Rallus obsoletus yumanensis*)
Western snowy plover (*Charadrius alexandrinus nivosus*)
Southern sea otter (*Enhydra lutris nereis*)

These species were the focus of the USFWS analyses related to the Draft Jeopardy Ruling and Final Biological Opinion on the California Toxics Rule (USFWS & NMFS 2000). Many of the species above do not prey on top predator fish, but maintaining the mercury concentrations in the top trophic level fish at the level specified by the water quality objectives should achieve sufficiently low mercury concentrations in lower trophic level fish that are eaten by the threatened and endangered species. A prey fish-based water quality objective designed to protect the endangered California least tern is addressed later in Section 5.4.

5.2 Applicable Uses – Tribal Subsistence Fishing Water Quality Objective

The Tribal Subsistence Fishing Water Quality Objective would apply to protect the corresponding Tribal Subsistence Fishing (T-SUB) beneficial use that the Provisions would establish. (See Section 6.4). Also, the Tribal Subsistence Fishing Water Quality Objective could apply to the following use that is contained in the North Coast Regional Water Board's basin plan:

> ***Native American Culture (CUL) -*** *Uses of water that support the cultural and/or traditional rights of indigenous people such as subsistence fishing, basket weaving and jewelry material collection, navigation to traditional ceremonial locations, and ceremonial uses.*

However, as discussed in section 2.4, it is uncertain if the waters designated with the Native American Culture beneficial use in the North Coast Regional Water Board's basin plan were designated based on the tribal subsistence fishing activity contained within that beneficial use. As a result, it would be inappropriate to apply the Tribal Subsistence Fishing Water Quality Objective to waters in the North Coast region designated with the Native American Culture beneficial use. If, after the effective date of the Provisions, the North Coast Regional Water Board amends its basin plan with the Provisions' CUL and T-SUB beneficial uses, to replace the region's Native American Culture beneficial use, and performs corresponding designations, such amendment would determine whether the Tribal Subsistence Fishing Water Quality Objective would apply. Alternatively, the North Coast Regional Water Board could amend its basin plan to specify that the Tribal Subsistence Fishing Water Quality Objective applies to all or some of the water bodies designated with Native American Culture beneficial use.

5.3 Applicable Uses – Subsistence Fishing Water Quality Objective

The Subsistence Fishing Water Quality Objective is a narrative water quality objective for subsistence fishing that would be used to protect the corresponding SUB beneficial use definition that the Provisions would establish (see Section 6.4). As discussed in section 2.4, the Subsistence Fishing Water Quality Objective would apply to the following beneficial use contained in the North Coast Regional Water Board's basin plan (although no water in that region has yet been designated with that use):

> ***Subsistence Fishing (FISH) -*** *Uses of water that support subsistence fishing*.

5.4 Applicable Uses – Prey Fish Water Quality Objective

The Prey Fish Water Quality Objective would apply to water bodies designated with WILD or MAR to protect wildlife, in waters that do not support trophic level 4 fish. This objective ensures protection of piscivorous birds that feed on trophic level 3 fish, such as kingfisher, merganser, osprey and grebe. This would also be protective of other aquatic life that is less sensitive to mercury (see section 5.1).

5.5 Applicable Uses – California Least Tern Prey Fish Water Quality Objective

The California Least Tern Prey Fish Water Quality Objective would apply to the list of Waters for the Least Tern Prey Fish Water Quality Objective and the Corresponding Regional Water Board (Appendix K, Table K-5). The list is comprised of water bodies within USFWS management areas for the California least tern, based on the most recent USFWS 5-year review of the California least tern's endangered species status (USFWS, 2006). These waters are already designated with RARE, WILD or MAR, to which the Sport Fish Water Quality Objective would apply. Additional water bodies would likely be added to this list as new information becomes available regarding the extent of habitat of the California least tern. Regional Water Boards may establish or add waterbodies to this list at a regional level through the basin planning amendment process.

5.6 Inapplicable Uses

This section identifies the beneficial uses to which the Mercury Water Quality Objectives do not apply.

The Sport Fish Water Quality Objectives are not being developed to apply to any of the beneficial uses listed in this section.

> ***Water Contact Recreation (REC-1***) - *Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.*

Many basin plans utilize theREC-1beneficial use to reflect activities associated with fishing and eating the fish, even though the definition does not explicitly describe consumption of fish as does the definition for the COMM beneficial use. The Sport Fish Water Quality Objective protects the consumption of fish, and not the activity of fishing. The act of fishing is distinct from the consumption of fish. Beneficial uses involving body contact with water pertaining to the act of fishing include REC-1 and CUL. Beneficial uses involving the consumption of fish include COMM, CUL, T-SUB, and SUB. Notice that CUL beneficial use includes both the act of fishing (body contact with water) and the consumption of fish. Waters with the existing or probable beneficial use regarding recreational human consumption of fish should be designated with COMM, see section 5.1. Until then, where fish consumption is an existing use, but COMM is not designated, the Sport Fish Water Quality Objective should apply, and the Sport Fish Water Quality Objective should not be linked to REC-1.

> ***Municipal and Domestic Supply (MUN)*** - *Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water.*

The Sport Fish Water Quality Objective would protect uses involving drinking water or ingestion of water, but this objective is much more stringent than necessary to protect the MUN beneficial use. Basin plans already include human health objectives for drinking water that are used for waters designated with the MUN beneficial use. The Mercury Water Quality Objectives should not be applied to the MUN beneficial use.

> ***Non-Contact Water Recreation (REC-2****)* - *Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.*

The Sport Fish Water Quality Objective would not apply because REC-2 does not include the activity of consuming fish.

> ***Shellfish Harvesting (SHELL****)* - *Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, abalone, and mussels) for human consumption, commercial or sport purposes.*

None of the Mercury Water Quality Objectives would apply to the SHELL beneficial use. The Mercury Water Quality Objectives are derived from data from consumption of finfish, not shellfish, and the definitions of each objective require that the objective be based on fish tissue. Although the COMM, EST, MAR, and proposed T-SUB beneficial uses explicitly include "shellfish" in their definitions, the State Water Board has not developed shellfish-specific mercury water quality objectives. However, shellfish are lower trophic level species which, in general, have lower concentrations of methylmercury. Applying the corresponding objectives to water bodies where finfish are present should maintain lower methylmercury concentrations in lower trophic level organisms including shellfish.

> ***Aquaculture (AQUA****)* - *Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.*

The Mercury Water Quality Objectives do not apply to the AQUA beneficial use. The objectives are meant to be applied to finfish, not shellfish. Finfish aquaculture generally utilizes a commercial pelleted feed, instead of a "free range" diet of smaller live organisms. Methylmercury bioaccumulates in finfish because of consumption of smaller organisms. Those smaller organisms are linked to anaerobic bacteria at the bottom of the food web of the local ecosystem, which is the main biological source of methylmercury production. Therefore, methylmercury in the tissues of aquaculture finfish would not reflect the ambient water quality.

__Limited Warm Freshwater Habitat (LWRM)__ - Waters [that] support warm water ecosystems which are severely limited in diversity and abundance as the result of concrete-lined watercourses and low, shallow dry weather flows which result in extreme temperature, pH, and/or dissolved oxygen conditions. Naturally reproducing finfish populations are not expected to occur in LWRM waters.

The LWRM beneficial use is meant to protect limited ecosystems that survive in inhospitable hydrological or geomorphic conditions. Waters such as these are not able to support aquatic life above very low trophic levels. Sustainable populations of finish do not exist in these ecosystems, and catching of fish for any type of consumption is not feasible in LWRM-designated waters. The Tribal Subsistence Water Quality Objective and the Subsistence Fishing Water Quality Objective would therefore not apply to the LWRM beneficial use, as those objectives are linked specifically to the activity of human consumption of fish. Furthermore, because the ecology of LWRM-designated waters is not known to support robust food webs or any fish in general, the presence of mercury in this type of waterbody is not expected to bioaccumulate into higher trophic levels (i.e., TL 3 and TL 4 fish). Mercury would therefore not impair this specific use in the context of the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective and the California Least Tern Prey Fish Water Quality Objective would not apply to LWRM. In addition, if fish were to exist in areas designated as LWRM, they would be protected by WILD.

__Preservation of Biological Habitats of Special Significance (BIOL__) - Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

The five Mercury Water Quality Objectives would not apply to the BIOL beneficial use because the protection of wildlife and people consuming fish in areas designated as BIOL would be protected under either WILD, MAR or COMM.

__Migration of Aquatic Organisms (MIGR__) - Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

The Tribal Subsistence Water Quality Objective and the Subsistence Fishing Water Quality Objective would not apply to the MIGR beneficial use, as those objectives are linked specifically to the activity of human consumption of fish. Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective and the California Least Tern Prey Fish Water Quality Objective Mercury Water Quality Objectives would not apply because mercury does not impede migration. Fish would be protected through other beneficial uses.

Spawning, Reproduction, an/or Early Development (SPWN*)* - *Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.*

The SPWN beneficial use is intended for special conditions necessary for spawning that do not apply elsewhere. The Mercury Water Quality Objectives do protect reproduction in fish, but should already be applied to fish habitat through the WILD beneficial use, or the COLD and WARM beneficial uses where WILD is not designated. Protective mercury thresholds for reproduction in fish are not that much higher than thresholds for other wildlife (e.g. 0.3 mg/kg, in the whole body, see Appendix J).

Additionally, the Mercury Water Quality Objectives do not apply to the following uses:

Agricultural supply (AGR) - *Uses of water for farming, horticulture or ranching including, but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.*

Industrial Process Supply (PROC) - *Uses of water for industrial activities that depend primarily on water quality.*

Industrial Service Supply (IND) - *Uses of water for industrial activities that do not depend primarily on water quality, including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.*

Fresh Water Replenishment (FRSH) - *Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).*

Groundwater Recharge (GWR) - *Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting salt water intrusion into fresh water aquifers.*

Navigation (NAV) - *Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.*

Hydropower Generation (POW) - *Uses of water for hydropower generation.*

Flood Peak Attenuation/Flood Water Storage (FLD) - *Beneficial uses of riparian wetlands in flood plain areas and other wetlands that receive natural surface drainage and buffer its passage to receiving waters.*

Water Quality Enhancement (WQE) *- Beneficial uses of waters that support natural enhancement or improvement of water quality in or downstream of a water body including, but not limited to, erosion control, filtration and purification of naturally occurring water pollutants, streambank stabilization, maintenance of channel integrity, and siltation control.*

6. Issues Analysis (Project Options)

This Chapter discusses the significant issues related to the Provisions. For each issue, several options are provided and for each option, advantages and disadvantages are described. A rationale is provided to support the State Water Board's recommended option. The basic framework and geographic scope of the Provisions is described in Chapter 2.

6.1 Issue A. What type of water quality objectives should be adopted: numeric water column objectives, numeric fish tissue objectives, numeric sediment objectives, or narrative objectives?

6.1.1 Current Conditions

The statewide regulatory limit for mercury in water meant to protect human consumption of fish is the California Toxics Rule criteria of 50 and 51 ng/L[3] in the water column. There are no statewide criteria (or objectives) for mercury to protect aquatic dependent wildlife. The California Toxics Rule criteria are meant to protect human health only, but these criteria do not reflect the most recent Clean Water Act 304(a) recommended human health criterion developed by the U.S. EPA. This criterion recommends a fish tissue criterion for methylmercury of 0.3 mg/kg in total fish, given a consumption rate of fish of 17.5 g/day. Because the California Toxics Rule criteria are under-protective for human health, the Water Boards currently use narrative toxicity water quality objectives together with more recent Clean Water Act section 304(a) recommended criteria, as well as OEHHA fish advisory levels (that are otherwise non-enforceable) to assess waters for possible impairment of beneficial uses related to fish consumption due to mercury.

The numeric criteria that have been used to implement the narrative toxicity objectives include the U.S. EPA fish tissue criteria of 0.3 mg/kg methylmercury in fish tissue and OEHHA's Fish Contaminant Goal of 0.3 mg/kg methylmercury in fish tissue. In 2008, OEHHA revised their Fish Contaminant Goal to 0.22 mg/kg based on California fish consumption rates, making it the preferred criteria to fulfill the narrative toxicity objective for assessing mercury data. Exceptions occur where site-specific water quality objectives for mercury / methylmercury have been adopted. These waters include San Francisco Bay, the Sacramento-San Joaquin Delta, Clear Lake, Cache Creek and others, for which site-specific objectives have been adopted in conjunction with TMDLs. These water quality objectives reflect the most recent guidance from the U.S. EPA and provide protection for wildlife (U.S. EPA 2001). They are also primarily expressed as fish tissue concentration of methylmercury.

For the majority of waters in California, the implementation requirements for mercury, such as water quality based effluent limits, are still based on the outdated California Toxics Rule criteria,

[3] The California Toxics Rule mercury criteria protect human health. The criterion of 50 ng/L protects consumption of water and aquatic organisms, and 51 ng/L protects consumption of aquatic organisms only (40 C.F.R. § 131.38).

except, for example, where site-specific objectives for mercury or methylmercury have been adopted in conjunction with TMDLs.

6.1.2 Issue Description

Section 303(c)(2)(B) of the Clean Water Act (33 U.S.C. § 1313) requires states to adopt numeric water quality criteria for all priority pollutants established in Clean Water Act section 307(a) (33 U.S.C. § 1317). The State Water Board is authorized to adopt water quality control plans for waters for which the Clean Water Act requires water quality standards. Pursuant to California Water Code section 13241, regulatory protection of beneficial uses is carried out, in part, through the adoption of water quality objectives.

The USFWS determined that the mercury criteria in the California Toxics Rule would not be protective of threatened and endangered species. As a result of that determination, California was left without mercury criteria for protection of wildlife. Currently U.S. EPA's 2001 fish tissue criterion has not been adopted as an enforceable water quality objective in California, nor has an objective been adopted statewide that is sufficient to protect all wildlife from mercury (see Section 3.5 for more details).

In 2013, an environmental organization, Our Children's Earth Foundation, filed a lawsuit against the U.S. EPA for the lack criteria to protect wildlife in California from mercury and a few other pollutants. As part of the settlement for that lawsuit, the U.S. EPA is required to propose a new mercury criterion by June 30, 2017. However, if the State Water Board adopts a protective objective before then and U.S. EPA approves the objective, then U.S. EPA's obligation with respect to criteria to protect wildlife in California from mercury under the settlement would be satisfied. As a result, California must adopt a statewide mercury water quality objective that will adequately protect wildlife, or the U.S. EPA will be required to promulgate a new wildlife mercury criterion for California.

Additionally, a new water quality objective should be adopted to incorporate the most recent U.S. EPA human health criterion for methylmercury, published in 2001, and adjusted using appropriate fish consumption data.

Mercury or methylmercury water quality criteria and objectives have either been expressed as a numeric concentration in the water column or as a numeric concentration in fish tissue. A typical water quality objective is expressed as a numeric concentration of the contaminant in water because toxicity is usually the result of drinking the pollutant in the water or exposure to the pollutant in the water. On the other hand, while methylmercury is a chemical that is present as a pollutant in water, it is not until the methylmercury bioaccumulates to high concentrations in fish that it becomes hazardous to the organisms that consume the fish.

6.1.3 Options

Option 1: No Action

The no action alternative would continue to leave a significant gap in the protection of wildlife. The U.S. Fish and Wildlife Service has determined that the California Toxics Rule is not protective of threatened and endangered species. As part of a lawsuit settlement the U.S. EPA agreed to propose a new mercury criterion by June 30, 2017, and would be required to do so if it does not approve an objective established by the State Water Board before then. Therefore, no State Water Board action would require the U.S. EPA to propose and promulgate new mercury criteria for wildlife.

Alternatively, under the no action alternative, the Regional Water Boards could derive water body specific objectives before the U.S. EPA promulgates criteria for wildlife. This option would require staff time and cost to evaluate each water body on a case-by-case basis and would not have the advantage of harmonizing the statewide effort to control mercury, as intended with the Provisions.

Option 2 (RECOMMENDED): Numeric Fish Tissue Objectives

This option would establish the objectives as numeric methylmercury concentrations in fish tissue. Fish tissue concentrations are already used for monitoring and as the basis for 303(d) listings. The methylmercury in fish tissue is the cause of toxicity to wildlife and humans who eat the fish. This is the primary exposure route for humans (in terms of environmental exposure to mercury) and the exposure with the highest risk of toxicity for wildlife.

The advantage of this option is that fish tissue objectives directly address this cause of toxicity. This option also avoids some of the uncertainty and controversy in deriving corresponding water column concentrations, which depends on many site-specific factors. The U.S. EPA used the fish tissue approach in developing its recommended criteria, and Regional Water Boards have adopted site-specific mercury or methylmercury objectives as fish tissue objectives. Therefore this option would provide statewide consistency throughout California. The implementation of this objective would also continue to provide monitoring data on mercury in fish tissue and provide information on health risks of eating contaminated fish.

The disadvantage of this option is that it does not utilize measurement of concentrations of pollutants in water, which is the most widely-used method to develop reasonable potential analyses and final effluent limitations for discharges, and monitoring and reporting requirements for both discharges and receiving water bodies. For most discharges, permit requirements typically rely on numeric water column concentration measurements. This difference can be addressed by providing a water column translator for determining when effluent limits are needed and for setting effluent limits (see Section 6.13). Another disadvantage to this option is that assessment of fish tissue objectives is more complicated and requires more resources than assessment of water column objectives because representative sampling of fish tissue requires careful capture and analysis of the correct size and trophic level fish.

Option 3: Numeric Water Column Objectives
This option would establish the objectives as numeric mercury water column concentrations. The calculation of a mercury concentration in the water that would equate to a target level of mercury in fish tissue requires a model or extrapolation procedure. An extrapolation factor known as bioaccumulation factor (BAF) could be used. The U.S. EPA derived national BAFs in the U.S. EPA 2001 human health criteria for mercury, but favors the use of site-specific BAFs because the degree of methylmercury bioaccumulation varies greatly depending on site-specific factors. Based on the recommended meal per week consumption rate (Section 6.2) and the available BAFs, water column concentrations that could be used as the objective are 4 or 12 ng/L total mercury (see Appendix I for calculations).

The advantage of a water column concentration is ease of implementation for wastewater and industrial discharges. A disadvantage of this option is that the water column based objective would have more uncertainty and is more likely to be either over-protective or under-protective in different water bodies. Also, the resulting threshold may be so low that current wastewater treatment technology will not be able to remove enough mercury from discharges to be able to achieve this level of mercury. Depending on the value selected, this option is potentially very expensive, and the environmental benefit is uncertain. On the other hand, if a high value is selected it may not be protective enough because a water column concentration is an indirect measure of whether or not fish are safe to eat.

Option 4: Numeric Sediment Objective
This option would establish the objective as a numeric concentration in sediment. A sediment objective could address some of the original sources of mercury. Sediments from mines and naturally enriched soils are thought to be a major source of mercury in many areas of California. Mercury is also often transported with sediments because mercury binds to sediments.

However, sediments are not a major source of mercury for all water bodies. There are several other potential sources including atmospheric deposition, which is likely the largest source of mercury in some water bodies. This biggest disadvantage with this approach is that it would be much harder to determine appropriate sediment concentration since sediment mercury concentrations are not very well correlated to mercury fish tissue concentrations.

Option 5 (Recommended for SUB): Narrative Objectives
This option would establish the objective as a narrative objective. This option would not contain numeric limits for mercury based on measurable concentrations. The objective could state: "Mercury shall not be present in the water in amounts that are toxic to humans or aquatic dependent wildlife."

To some extent, this option is similar to “option 1: No action.” Section 303(c)(2)(B) of the Clean Water Act states that: “criteria shall be specific *numerical* criteria” where available for all priority pollutants, such as mercury (emphasis added); therefore, narrative objectives would still leave California out of compliance with the Clean water Act and the U.S. EPA would likely promulgate criteria for wildlife and human health.

Additionally, this option would not establish a consumption rate to protect the COMM beneficial use. The objectives would need to be implemented on a permit-by-permit basis. If the permit writer must establish a numeric threshold in the permit, the permit writer would first need to find the appropriate fish consumption rate to represent local fishers. The consumption rate would be used to derive a threshold in fish tissue. Then the permit writer would need to make a conversion to a water column concentration of mercury. This option could not be used to promote statewide consistency (one of the objectives of the Provisions). However, in situations where there is a wide range of consumption rates and patterns of fish consumption it may be appropriate to adopt a narrative objective that would allow the water boards to apply site specific consumption rates. The use of a narrative objective to protect subsistence fishers, where there is a wide range of fish species consumed and varying amounts of fish consumed would avoid setting overly protective, or under protective objectives. Region-wide or site-specific fish consumption data could be used to set objectives that are most appropriate to water bodies or regions. For areas and water bodies where local fish consumption data is not available statewide or national consumption data could be used, but is not considered ideal.

6.1.4 Recommendation

Option 2 and 5: Adopt a numeric water quality objectives based on fish tissue and adopt a narrative objective to protect the SUB beneficial use which contains a consumption rate to be used in the absence of site-specific consumption information.

6.2 Issue B. What fish consumption rate should be used to calculate the Sport Fish Water Quality Objective to protect human health?

6.2.1 Current Conditions

There is not one clearly established statewide policy regarding consumption rates to calculate fish tissue water quality objectives for recreational consumption of fish. The U.S. EPA has provided an equation to derive a protective concentration of methylmercury in fish for a given population using a known fish consumption rate (U.S. EPA 2001). The U.S. EPA recommends adjusting the fish consumption rate when deriving water quality criteria for individual states. The U.S. EPA "strongly believes that States and authorized Tribes should develop criteria, on a site-specific basis, that provide additional protection appropriate for highly exposed populations" (U.S. EPA 2000). The consumption rate reflects only locally caught freshwater or estuarine fish. A moderate amount of mercury exposure from store-bought fish is accounted for as a separate parameter in the U.S. EPA's equation.

Although there is not currently a statewide policy to establish the appropriate consumption rate for humans, precedent has been set by several projects. Consumption rates for fish are typically referred to as "meals", but the amount of fish in a "meal" varies from study to study. The Water Boards and other California state agencies have used a consumption rate of one eight-ounce meal of fish per week, which is equivalent to consumption rate of 32 g/day. The most recent 303(d) assessments for the 2012 California Integrated Report have been made using OEHHA's Fish Contaminant Goal of 0.22 mg/kg mercury. This value was based on a rate of one meal per week (32 g/day), derived from a survey of anglers in San Francisco Bay (San Francisco Estuary Institute 2000). Site-specific objectives for mercury and methylmercury have been based on the same rate of one meal per week, including those for San Francisco Bay and the Sacramento-San Joaquin Delta (Section 3.10). On the other hand, site-specific objectives for Clear Lake and Cache Creek were based on a consumption rate of one meal every other week (17.5 g/day) the same rates as used by U.S. EPA to derive their 2001 national recommended fish tissue criterion of 0.3 mg/kg methylmercury in fish tissue (Section 3.10). However, in order to protect wildlife, they adopted a more stringent water quality objective that is closer to those that were derived based on one meal per week.

6.2.2 Issue Description

Porter Cologne requires that water quality objectives shall be established that "will ensure the reasonable protection of beneficial uses and the prevention of nuisance" (Wat. Code, § 13241). Pertinent here, when establishing water quality objectives, Porter Cologne also requires consideration of several factors, including: past, present, and probable future beneficial uses of water, environmental characteristics of the hydrographic unit at issue, water quality conditions that could reasonably be achieved, and economic considerations. (Ibid., § 13241, subds. (a)-(d).) While these factors must be considered the Water Boards are not required to develop formal analysis, such as a cost benefit analysis or a use attainability analysis. (The "13241 factors" are evaluated at Chapter 10 and sections referred to therein. Appendix R contains the economic considerations).

The issue in this section is which fish consumption rate should be used to derive the water quality objective to protect human health. Section 4.9 of the Staff Report summarizes several fish consumption studies, and Appendix G contains a more comprehensive list of fish consumptions studies from California. These studies demonstrate the beneficial use (fish consumption) and justify the need to protect the use.

However, any of the fish consumption rates proposed for the below-evaluated water quality objective options will not be easily achievable in the near future for many waters. Many waters currently have fish that exceed the mercury concentrations being considered for the water quality objectives to protect human health, for sport and subsistence fishing (see Section 4.5). Mercury does not break down in the environment, and methylmercury is slow to leave the tissues of living organisms, so even with remediation, decreases of methylmercury in fish tissue are very slow.

This issue contains a few options for the consumption rate, based on human fish consumption rates, to be used to calculate the Sport Fish Water Quality Objective. However, because wildlife that consumes fish must also be protected, some of the options below also discuss human consumption rates of fish that would also be protective of wildlife. Additional objectives are considered in Issue F and Issue G for certain situations where more protection is needed for wildlife.

6.2.3 Options

Option 1: Adopt a Sport Fish Water Quality Objective based on a fish consumption rate of one meal ever two weeks

In this option a statewide objective of **0.3 mg/kg** methylmercury in fish tissue would be used to calculate the Sport Fish Water Quality Objective. This objective would protect consumption of roughly one fish meal (8 oz.) every two weeks of California freshwater/estuarine fish and a small amount of store bought fish. This objective would be equivalent to U.S. EPA's 2001 human health criterion, protecting nationwide average consumption. This option would be inconsistent with OEHHAs Fish Contaminant Goals, which use a consumption rate of 32 g/day. This option is unlikely to fully protect all wildlife species, see Section 6.8.

Option 2 (RECOMMENDED): Adopt a Sport Fish Water Quality Objective based on a fish consumption rate of one meal per week

In this option, a statewide objective of **0.2 mg/kg** methylmercury in fish tissue would be used to calculate the Sport Fish Water Quality Objective. This objective would protect consumption of one fish meal (8 oz.) per week of California freshwater/estuarine fish and a small amount of store bought fish. This rate was derived from a survey of anglers in San Francisco Bay (San Francisco Estuary Institute 2000). The rate was the 95th percentile of consumption rates from anglers who reported ever eating fish. This consumption rate has also been used in adopted water quality objectives and by OEHHA to develop fish contaminant goals. This option would protect most wildlife species, see Section 6.8.

About two thirds of current monitoring data from all types of bass exceed 0.2 mg/kg (see Section 4.5.2), so it would be difficult to have all waters achieve this objective. Also, there have been doubts expressed that this rate does not represent fishing in inland waters in Southern California, but a survey of inland waters in Ventura and Los Angeles Counties found that one meal week was the average fish consumption rate (Allen et al. 2008).

The objective would be applied to the fillet as a conservative approach for anglers who consume only the fillet as well as anglers who eat more than just the fillet, because the fillets have higher mercury concentrations than whole fish. The objective would be expressed with an averaging period of a calendar year. For information on the calculations and averaging period, see Appendix H.

Option 3: Adopt a Sport Fish Water Quality Objective based on a fish consumption rate of five meals a week

In this option a statewide objective of **0.05 mg/kg** methylmercury in fish tissue would be used to calculate the Sport Fish Water Quality Objective. This objective would protect consumption of four to five fish meals a week for people who *only* consume California freshwater/estuarine fish and *no* store bought fish. This option would protect all wildlife species (see Section 6.8).

This objective would be intended to protect all people who eat fish, including those who eat more locally caught fish than the average fisher, such as subsistence fishers, including California tribal communities. This consumption rate is from a recommended subsistence consumption rate calculated by U.S. EPA from national data. This objective would be nearly consistent with the current daily consumption rates from a recent statewide survey of California tribes (Shilling et al. 2014). Also, many other studies in California show fish consumption rates higher than one meal per week in various locations (See Appendix G for more details). When taken all together, it may be that high rates of fish consumption by California tribes or other communities take place in a majority of waters in the state, not just a few select locations (see also Section 6.4).

Oregon recently adopted human health consumption rate of five meals per week and a mercury standard of 0.04 mg/kg based partly on the consumption rate of Native American tribes, but also other groups who eat larger amounts of locally caught fish. U.S. EPA has developed for Washington State and proposed for Maine the use of a consumption rate of five and nine meals per week for deriving water quality standards, respectively (81 Fed Reg. 85417 (Nov, 28, 2016); 81 Fed. Reg 23239 (April 20, 2016)).

This option may only be achievable in small fraction of California bass dominated waters or where other large trophic level 3 and trophic level 4 fish are the dominate fish. Currently few of the monitored waters meet this threshold (or a small fraction of fish, see graphs in Section 4.5.2). This raises concerns about devoting a large amount of limited public resources towards this effort. However, there are fish populations – including rainbow trout and anadromous salmonids that are safe to eat in larger quantities.

Finally, the Provisions propose two new beneficial uses pertaining to subsistence fishing. As a result, consumption rates for subsistence fishing would be developed as part of the objectives to protect the separate subsistence fishing beneficial uses. That is, the Sport Fish Water Quality Objective should be developed to protect recreational fishing consumption under the COMM beneficial use, and would not also protect higher consumption rates by subsistence fishers. As a result, the concentration of 0.05 mg/kg methylmercury in fish tissue would be more stringent than is reasonably necessary to protect consumption of fish by recreational fishers.

Option 4: Phased Approach

In this approach the State Water Board would start with a low consumption rate, that is more readily achievable, such as in option 1 or option 2 (0.3 or 0.2 mg/kg in fish tissue) in the near future. If successful after several decades, then the State Water Board could try to establish a concentration that would achieve an ultimate consumption rate that should also be protective of sub-populations of people that consume large quantities of fish, which could be five meals a week (e.g. 0.05 mg/kg). This approach may be advantageous because there is great deal of uncertainty in the effectiveness of mercury control programs. The uncertainty has created apprehension to committing to a goal that may be difficult to achieve in the near future even at great cost, because of widespread legacy contamination and global atmospheric emissions. On the other hand, if in the very long term progress can be made, a goal that better represents the use of the waters by all people should be set. As part of this program, the state could include information on which fish are safe to eat in larger quantities – such as trout and anadromous salmon.

This option could be used in conjunction with a long compliance schedule while implementation actions are being taken to achieve the less stringent objective. Alternatively, this option could be part of a statewide mercury variance.

Additionally, as with Option 3, the Provisions propose two new beneficial uses pertaining to subsistence fishing. As a result, consumption rates for subsistence fishing would be developed as part of the objectives to protect the separate subsistence fishing beneficial uses. That is, the Sport Fish Water Quality Objective should be developed to protect recreational fishing consumption under the COMM beneficial use, and would not also protect higher consumption rates by subsistence fishers.

6.2.4 Recommendation

Option 2: The fish consumption rate of one meal per week should be utilized to calculate the Sport Fish Water Quality Objective to protect human health, resulting in an objective with a concentration of 0.2 mg/kg methylmercury in fish tissue.

6.3 Issue C. To which fish species should the Sport Fish Water Quality Objective apply?

6.3.1 Current Conditions

There is no existing statewide policy on the fish species to which the water quality objective should apply. Several site-specific water quality objectives have been developed for mercury or methylmercury in fish. These objectives have taken different approaches to this issue depending on consumption information for the respective water body/ watershed. The site-specific objectives for the Sacramento-San Joaquin Delta were derived by applying the selected consumption rate to 50:50 mixture of trophic level 3 and 4 fish (Central Valley Water Board 2010b). The San Francisco Bay human health objective applies to four trophic level 4 species and one trophic level 3 species (San Francisco Bay Board 2006). For Cache Creek and Clear Lake site-specific objectives were derived to protect wildlife, since wildlife was more sensitive, but these Cache Creek and Clear Lake objectives also protect roughly one meal every week of trophic level 4 fish for human health (Section 3.10, Central Valley Water Board 2002b, 2005).

Nationwide, top predator fish have been the most common fish targeted by monitoring programs (mainly bass, walleye, and northern pike). There is a large body of monitoring data for black bass. Species of bass work well in California because they are common in many of our water bodies. Bass are efficient at bioaccumulating methylmercury and thus would provide a measure of safety to people who eat a mixture of fish species. Since bass are prevalent in California, they provide a measure that can be compared across water bodies. Additionally, trend analysis would be easier using methylmercury concentrations in bass, to determine if actions designed to reduce mercury are effective, or if the global problem of atmospheric mercury emissions is having a significant impact.

6.3.2 Issue Description

Since methylmercury accumulates up the food web, fish that are highest on the food web have the highest concentrations of mercury. Therefore, the particular position in the food web of the fish species that the objective is applied to will affect the stringency of the objective and the protection provided to humans and wildlife.

Fish species can be categorized by trophic level, which is the organism’s place in the food web. Freshwater trophic level 3 fish include species such as bluegill, sunfish, carp, rainbow trout, and tilapia. Trophic level 3 fish generally have lower concentrations of mercury than trophic level 4 fish. Trophic level 4 is the highest level in fish and includes top predator fish such as striped bass, black bass, large catfish, and crappie. The highest concentrations of methylmercury are usually found in large, long living fish such as bass, which eat mostly smaller fish.

6.3.3 Options

Option 1 (RECOMMENDED): Apply the Sport Fish Water Quality Objective to top trophic level fish (trophic level 4 fish)

This option would apply the selected consumption rate to calculate the objective (evaluated in Section 6.2 above) to fish that are highest in the food web (top predator fish that tend have highest levels of mercury, e.g. striped bass, black bass, large catfish). That is, the objective would be measured using trophic level 3 or trophic level 4 fish, whichever is the highest in the water body. If the objective for a water body is not measured using trophic level 4 fish, then the objective would be applied to the next highest trophic level of fish (trophic level 3 fish: e.g. rainbow trout, carp). In other words, in waters where trophic level 4 fish are not measured, the mercury concentrations in trophic level 3 fish must meet the same numeric threshold (methylmercury concentration in fish tissue) as applied to trophic level 4 fish. This option is more conservative then the second option.

This option protects people who consume predominantly trophic level 4 fish, at the selected consumption rates. This is recommended if many people consume fish primarily from trophic level 4. Additionally, since trophic level 3 fish have two to four times lower mercury concentrations than trophic level 4 fish, this option would allow people who consume only trophic level 3 fish to consume two to four times[4] more fish than the selected consumption rates. This option is also more protective of wildlife than the other options.

While some anglers catch and release bass, several studies show that bass are also commonly consumed. Black bass have been found to be commonly consumed in the Delta (Shilling et al. 2010, California Department of Health Services *unpublished*), Contra Costa County (Contra Costa County Public Works Department 2005, Ma'at Youth Academy (no date)), and Clear Lake (Harnly et al. 1997). Black bass have also been found to be a popular species for eating in the Sierra Nevada (Sierra Fund 2011), but not as popular as trout. Other commonly consumed trophic level 4 species are crappie, large white catfish, large channel catfish, sturgeon, and large brown trout. Studies have shown that trophic level 4 species are more commonly consumed than trophic level 3 species, in the Delta and San Francisco Bay, and Clear Lake (ibid., see Appendix G for details). Marine or estuarine trophic level 4 species were most commonly consumed in Santa Monica Bay (Allen et al. 1996).

This option could encourage monitoring resources to be focused on bass for inland waters and rockfish for coastal waters, since these are good sentinel species for detecting differences between water bodies and differences over time. However, the disadvantage of this option is that it does not encourage data collection on a wide range of species across trophic levels. More data from different species would be beneficial for

[4] To estimate evaluated consumption rates in lower trophic level fish. The consumption rates were multiplied by the national default food web multiplier of 4 (US. EPA 2001) and statewide TLR of 2 from Appendix L.

producing public health advisories and ensuring protection for wildlife (many wildlife feed on trophic level 3 fish).

Option 2: Apply the Sport Fish Water Quality Objective to a 50:50 mixture of trophic level 3 and 4 fish.

This option would apply the selected consumption rate to calculate the objective (evaluated in Section 6.2 above) to a mixture of trophic level 3 and trophic level 4 fish. If people eat a mixture of trophic level 3 and trophic level 4 fish, this option is more realistic, whereas option 1 would be conservative. In trout dominated waters, this option is more representative as seen from consumption surveys in the Sierra Nevada, in Ventura County and Los Angeles County (Sierra Fund 2011, Allen et al. 2008, see Appendix G).

Fish lower on the food web tend to have lower mercury concentrations, making this option less stringent than option 1. For example, if the selected consumption rate is one meal per week (option 2 from the previous issue, Section 6.2) and if this option is chosen then the objective would protect one meal per week that is comprised of 50% trophic level 3 fish and 50% trophic level 4 fish. If a person consumes *only* trophic level 4 fish this objective would support eating only about ¾ a meal per week. The 50:50 mixture could be applied in a few different ways which are explored in Appendix H.

The advantage of this option is that the water quality objective would be easier to achieve since this is a less stringent application of the objective. This mixed fish consumption likely reflects human consumption patterns in many areas, so it would be protective of human health in those areas.

However, this approach may not be fully protective of wildlife because this option is less stringent than option 1. (This depends on the option chosen for the Sport Fish Water Quality Objective in Section 6.2.) To maintain protection for all wildlife, a mercury level of 0.2 mg/kg or less should be maintained for trophic level 4 fish according to calculations in Appendix K. If this option is chosen, a separate objective for wildlife should be adopted. The objective to protect wildlife could be 0.05 mg/kg methylmercury in fish trophic level 3 fish that are 50-150 mm long. This objective would ensure protection of belted kingfisher, mergansers, grebes and ensures protection for other species such as otters (See Section 6.8, Appendix K).

Such wildlife objective would likely be more stringent than the Sport Fish Water Quality Objective, and the overall achievability of the objectives may not be greater than option 1. Therefore, this option is unlikely to provide much advantage, at least on a statewide basis. If site-specific data are available, this approach may prove useful on a site-specific basis.

Another disadvantage of this option is that it would require more monitoring resources to be able to measure compliance, since there are more species to monitor. However, this extra data would be beneficial for advisories and in ensuring protection for people and wildlife.

Option 3: Apply the Sport Fish Water Quality Objective to only native species, not to bass.

This option would apply the selected consumption rate to calculate the objective (evaluated in Section 6.2 above) to only native species and not bass. Bass are non-native to California and they accumulate much more methylmercury than native fishes, because they are a higher trophic level fish. Any policy or action that primarily supports native fish would likely also pertain to fish with lower mercury. The major disadvantage with this option is that both people and wildlife are likely to continue to eat non-native species.

This option may only be an effective option if bass were eradicated, but eradication of bass would be strongly opposed by many people. Bass sport fishing is a multi-million dollar industry in California. For example, California striped bass sport fishery alone had an estimated annual economic value of more than $45 million dollars, in 2001 (California Department of Fish and Wildlife 2001).

Salmon are native species and have lower mercury concentrations than bass. Bass are an invasive species that have a negative impact on native fishes such as salmon, by preying on young fish. Readily available estimates of the economic value of California's salmon fishery are hard to find. Most estimates focus on ocean fish, not inland fish. The total West Coast income impacts associated with recreational and commercial ocean salmon fisheries for all three states (Oregon, Washington, and California) combined in 2013 were estimated at $79.3 million (Pacific Fishery Management Council 2014). Both commercial and recreational fisheries have suffered substantial declines relative to harvest levels of the 1980s. The preliminary exvessel value of Chinook and coho landed in the treaty Native American ocean troll fishery was $6.4 million in 2013 (*Ibid.*). In addition to the commercial Native American fisheries, fish are taken in Native American fisheries each year for ceremonial and subsistence purposes (*Ibid.*).

There is less information on the value of California's river salmon. It has been suggested that these are California's most valuable salmon. On a per fish basis, recreational river salmon have been estimated to be more than twice as valuable as striped bass, at $1,176 economic impact per fish vs. $494 per fish. In the same comparison, recreational ocean salmon and commercial ocean salmon were valued at $281 and $49 per fish, respectively (FishBio 2014). These economic impacts are a result of expenditures on any number of the following: fees/licenses, boat maintenance, fuel, bait/tackle, food/beverage, travel costs, lodging, and any other associated goods and services used by recreational anglers. A 1985 economic analysis estimated that steelhead fishing in the Sacramento River and tributaries directly generated around 7.2 million dollars (California Department of Fish and Wildlife 2001).

6.3.4 Recommendation

Option 1: Apply the Sport Fish Water Quality Objective to top trophic level fish (trophic level 4 fish).

6.4 Issue D. Should the beneficial uses for tribal traditional and cultural, tribal subsistence fishing, and subsistence fishing be established as beneficial uses?

6.4.1 Current Conditions

In 1973, the State Water Board provided a uniform list of beneficial uses, including definitions, to the Regional Water Boards to use to subsequently designate waters within their respective regions. The State Water Board updated that list in 1996. The State Water Board's updated list of beneficial uses does not contain an explicit beneficial use for tribal traditional, cultural, or subsistence fishing. No statewide water quality control policy or plan has been adopted to address tribal traditional and cultural, tribal subsistence fishing, and subsistence fishing uses.

On February 16, 2016, the State Water Board adopted Resolution No. 2016-0011, directing staff to develop, as a part of the Provisions, three beneficial uses, including 1) tribal traditional and cultural use, 2) tribal subsistence fishing use, and 3) subsistence fishing use by other cultures or individuals. The beneficial uses the State Water Board directed staff to develop are for purposes of the Porter-Cologne Act, and may also serve as designated uses under the Clean Water Act. Beneficial uses under the Porter-Cologne Act are distinct from the statutory and common law beneficial uses applicable to appropriative water rights.

Resolution No. 2016-0011 included an attachment (Attachment A) which contained language suggested by a small number of tribes, tribal representatives, and environmental justice groups, as being representative of the three proposed definitions:

> ***California Indian Tribal Traditional and Cultural Use****: Uses of water that support the cultural, spiritual and traditional rights and lifeways of California Indian Tribes. This includes but is not limited to: fishing, gathering, and safe consumption of traditional foods and materials, as defined by California Indian Tribes, for subsistence, cultural, spiritual, ceremonial and navigational activities associated with such uses.*
>
> ***California Indian Tribal Subsistence Fishing Use****: Uses of water that support the gathering and distribution of natural aquatic resources, including fish and shellfish, to meet traditional food needs of California Tribal individuals, households and communities for personal, family and community consumption, and for traditional and/or ceremonial purposes.*
>
> ***Subsistence Fishing****: Uses of water that support the non-commercial catching or gathering of natural aquatic resources, including fish and shellfish, by individuals for the personal consumption by individuals and their households or communities, to meet fundamental needs for sustenance due to cultural tradition, lack of personal economic resources, or both.*

In addition to the beneficial uses the State Water Board identified on the statewide list, the Regional Water Boards have developed additional beneficial uses to be applied to waters within their respective region. One regional board, the North Coast Regional Water Board, adopted beneficial uses similar to the uses identified in Resolution No. 2016-0011in their water quality control plan (North Coast Water Board 2011):

> ***Native American Culture (CUL)****: Uses of water that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving and jewelry material collection, navigation to traditional ceremonial locations, and ceremonial use.*
>
> ***Subsistence Fishing (FISH)****: Uses of water that support subsistence fishing*.

As of February 2016, the Native American Culture beneficial use has been designated to 28 waters in the North Coast Region (North Coast Water Board 2011, Table 2-1), while the Subsistence Fishing beneficial use has not yet been designated to any water body in the region. No other Regional Water Board has adopted the above or similar beneficial uses. The North Coast Regional Water Board has not adopted water quality objectives unique to the above-noted uses.

The Governor's Executive Order, No. B-10-11 (Sept. 19, 2011), acknowledges that the State "is home to many Native American Tribes with whom the State of California has an important relationship" as affirmed by state and federal laws and provides that every state agency is encouraged to communicate and consult with tribes. The California Environmental Protection Agency's "Policy for Working with California Indian Tribes" (Oct. 19, 2009) sets forth a commitment to improve California Environmental Protection Agencies' (including its Boards, Departments, and Offices) understanding of and connection to California Indian Tribes, and a commitment to work together to resolve mutual interests of concern. The policy provides (at p. 2):

> California has the second largest number of federally-recognized tribes and, according to the 2000 U.S. Census, the largest Native American population in the United States. In California, there are 109 tribes that are recognized by the federal government. There are also indigenous communities which, although they existed prior to the formation of the United States, are not currently recognized as sovereigns by the federal government. At this time, there are 89 non-federally recognized California Indian Tribes of which 72 are engaged in seeking federal recognition. All California Indian Tribes, whether officially recognized by the federal government or not, may have environmental, economic, and public health concerns that are different from the concerns of other Tribes or from the general public. These differences may exist due to subsistence lifestyles, unique cultural beliefs and traditions, and/or specific connections to areas of California that are their ancestral homelands.

6.4.2 Issue Description

Because beneficial uses pertaining to tribal traditional and cultural use and subsistence fishing uses have not been established as beneficial uses statewide, California tribes have commented that their traditional and cultural uses of water are not adequately described by other beneficial uses and, therefore may not always be protected. For instance, Water Contact Recreation (REC-1) and Commercial and Sport Fishing (COMM) may encompass some or part of uses made by tribes, but do not adequately account for all of the uses tribes make on waters within the state. For example, the new beneficial uses would include ceremonial and traditional activities, such as fishing, emersion in water for ceremonies, and contact with water for activities such as the gathering and use of traditional plants and materials for activities like basket weaving. In many cases, these activities are practiced at specific times in specific places, generally at waterbodies on or near lands belonging to individual tribes. Such a practice is distinct from recreational uses of fishing or swimming which reflect leisure activities, in terms of discretionary time in which people engage in certain activities for enjoyment and pleasure, rather than such use being tied to traditional, ceremonial, and/or spiritual practices. The activities that the tribal traditional and cultural uses would protect are religious or traditional and essential to the tribal lifeways, and do not fall within a "recreational" meaning or category. Therefore, REC-1 and COMM may not be adequately protective of tribal and cultural uses.

A water quality objective for one beneficial use may be sufficiently protective of other beneficial uses. As a result, even when new beneficial uses are designated for a water body, new designations do not necessarily mean that additional water quality objectives, restrictions on waste discharges, or other new or different actions will be necessary. Existing water quality objectives for an existing beneficial use may be sufficient to protect the newly added beneficial uses. In instances where water quality objectives for existing beneficial uses are not protective of newly added beneficial uses, new water quality objectives may need to be developed. On the other hand, even when a new beneficial use is designated for a water body, the designation does not necessarily mean that an additional water quality objective, restriction on waste discharges, or other new or different action would be necessary to protect those uses. Existing water quality objectives for an existing beneficial use may be sufficient to protect the newly added beneficial uses.

For example, fish consumption associated with the subsistence uses (SUB and T-SUB) generally includes lager amounts and/or different species than normally consumed by recreational fishers in California. In some waters containing species of bass, subsistence fishers may be predominantly catching and eating trout or perch or another species of TL3 fish. If the COMM objective is applied to recreational fishers consuming bass the objective may be sufficiently protective of subsistence fishers in the same water body eating predominantly perch. For the CUL beneficial use, objectives designed to protect recreational swimmers may be sufficiently protective of many tribal traditional and cultural activities involving contact with water. However, other activities in the water pertaining to tribal traditional and cultural uses may present a higher chance of ingesting water, or a greater exposure to toxins or bacteria, placing people at a higher risk to illness. This is because some of the traditional and cultural practices involve people spending a longer time in the water or in contact with the water. For example, basket weaving involves placing reeds in water then in the mouth repeatedly. Other factors increase the potential exposure to contaminants in the water, such as the particular type of activity (e.g. whole body emersion), and locations that have rugged conditions which can make minor skin abrasions or cuts more likely.

U.S. EPA's regulations implementing the Clean Water Act provide, "A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses." (40 C.F.R. § 131.2.) States may adopt "sub-categories" of a use "to reflect the varying needs of such sub-categories of uses […]." (40 C.F.R. § 131.10(c).) For subsistence fishing by communities other than tribes, environmental justice groups have commented that consumption assumptions associated with the COMM beneficial use are not protective of the subsistence uses. Subsistence fishing is also not adequately described by the term "recreation," which is used to define the COMM beneficial use. Fishing by some communities is an innate part of the culture of that community and such communities place a more meaningful significance on the activity than that which is connoted by the term "recreation." Subsistence fishing may also be driven by economic need. In either case, the fishing rate is not optional or elective as the recreational term connotes, and the amount of fish consumed can be greater than that consumed by recreational fishers.

The consumption rate of one meal per week is recommended to use to calculate the water quality objective to support the commercial and sport fishing beneficial use (Section 6.2). A large body of evidence confirms that certain communities eat more than one meal per week of locally caught fish in various locations throughout the state, which justifies the need for the subsistence-type beneficial uses. The California Tribes Fish-Use study confirmed that tribes eat more than one meal per week of fish (Shilling et al. 2014). Several other California fish consumption studies show that some populations, in addition to California tribes, eat more than one meal per week. U.S. EPA recommends the use of the 90th or 95th percentile of the consumption rates for deriving criteria, rather than an average consumption rate (U.S. EPA 2000). In the Delta, the 95th percentile rate for anglers was four meals a week, and for some subgroups it was 10 meals a week (Shilling et al. 2010). In Santa Monica Bay, Asian and "other" subgroups were eating up to three to five meals a week (90th percentiles, Allen et al. 1996). In Ventura County and Los Angeles Country all anglers surveyed were eating up to two meals a week, and the African American /black group was eating up to three meals a week (90th percentiles, Allen et al. 2008). In San Diego Bay, 25 percent of the surveyed anglers reported that they ate fish at a rate of four to seven days per week (Environmental Health Coalition, 2005). In Los Angles, the Asian /Samoan groups were eating two fish meals a week on average (Puffer et al. 1982). See Appendix G for more details.

Establishing the three beneficial uses, California Indian Tribal Traditional and CUL, T-SUB and SUB (identified and defined in Section 2.3.1; for examples of traditional uses of water by California tribes, see Section 4.10) would be in alignment with the above-noted executive order, the goals of California Environmental Protection Agency's policy on Consultation with California Native American Tribes, and the goals of California Environmental Protection Agency's Intra-Agency Environmental Justice Strategy.

These beneficial uses are also consistent with Executive Order 12898, issued in 1994 by President Clinton to address environmental justice in minority and low-income populations, which established federal executive policy on environmental justice (Exec. Order No. 12829, 59 Fed. Reg. 7629 (Fe.16, 1994)). The order directs federal agencies to address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. Mercury in fish tissue would have a greater effect on those who consume large quantities of fish for subsistence, compared to recreational fishers who occasionally consume fish. Many subsistence fishers are low income and minority populations. While the Water Boards are not a federal agency, the Water Boards fulfill federal mandates including the Clean Water Act. Additionally, the beneficial uses are consistent with the principles and values described in the Water Board's *Strategic Plan Update* (commitment to environmental justice and collaboration with tribes (State Water Board 2008)).

On the other hand, although the issue here is limited to evaluating whether the beneficial uses should be established and defined, designating and protecting these uses will come with challenges. There are a few contaminants, including mercury and PCBs, that accumulate in fish tissue and can prevent many water bodies from supporting a subsistence level of fish consumption in California. These contaminants are generally very persistent in the environment. Even if all sources of the contaminants are eliminated, the contaminants are likely to remain high for decades, because either they do not degrade or they degrade very slowly. Much of the mercury in fish today is thought to be from historic mining in the late 19th century and early 20th century. Further, current sources may not be directly regulated by water boards (e.g. atmospheric emissions, naturally occurring in soils, or geothermal sources).

An important distinction to emphasize regarding the issue of developing new beneficial uses (relating to tribal traditional and cultural, tribal subsistence fishing, and subsistence fishing) is that water rights and water quality regulations both utilize terms called "beneficial uses," but the terms are distinct as used in their respective contexts. With respect to water rights, waters of the state must be put to reasonable and beneficial use to the fullest extent capable (Wat. Code § 100). By comparison, the beneficial uses the State Water Board directed staff to develop are for purposes of the Porter-Cologne Act, and may also serve as designated uses under the Federal Water Pollution Control Act (33 U.S.C. § 1251 et seq.) (Clean Water Act). These uses are intended to protect against water quality degradation (Wat. Code § 13050(f)). Beneficial uses under the Porter-Cologne Act are distinct from the statutory and common law beneficial uses applicable to appropriative water rights.

6.4.3 Options

Option 1: No action.

With this option, the Provisions would not include new beneficial uses pertaining to tribal traditional and culture and subsistence fishing. Under this option, the Regional Water Boards could still adopt the beneficial uses and definitions, or something similar.

Establishing the uses, by themselves, is not intended to set or reorganize Regional Water Board priorities. The uses would be established by the Provisions, which is separate from actual designations. The Regional Water Boards have discretion to set priorities for amending their basin plans during the triennial reviews. The designation of these beneficial uses may require angler surveys or other analyses. In any case, it will be up to the Regional Water Boards to designate the uses to waters within their regions.

Additionally, statewide consistency would be lost and trust from tribe and environmental justice groups could be diminished because of the change in direction.

Option 2 (RECOMMENDED): Establish beneficial uses for tribal traditional and cultural, tribal subsistence fishing, and subsistence fishing.

In this option, the Tribal Traditional and Culture beneficial use (CUL) and the two subsistence fishing uses (Tribal Subsistence Fishing (T-SUB) and Subsistence Fishing (SUB) would be adopted as a part of a statewide water quality control plan.
The definitions from the North Coast Water Board and those suggested by tribes and environmental justice groups (Resolution No. 2016-0011) were used as the basis for the proposed definitions after receiving input from all interested parties.

See Appendix A and Section 2.3.1 for the exact wording of the beneficial uses. See also "Frequently Asked Questions" at Appendix T pertaining to the development of the beneficial uses (which discusses the goals, necessity, specific language, application, and manner for designation).

The beneficial uses established by the Provisions would establish the use categories and provide consistent definitions for use by the Water Boards. Establishing the new beneficial uses, including their definitions, would not operate to designate those uses to any water body. Designation of the uses to specific water bodies would primarily remain the responsibility of the Regional Water Boards through their respective basin planning process. Generally, the Regional Water Boards designate specific waterbodies within their respective region where the use applies. A Regional Water Board's waterbody-designation would occur through its basin planning process in accordance with Water Code sections 13244 (hearing and notice requirements) and 13245 (approval by the State Water Board).

Designation of a new beneficial use is required to be done through the public process. The Water Boards will consider all of the evidence in the record when determining what designations to make. The Water Boards generally considers prioritizing designation of waters during their triennial review process. In addition, the Water Boards could consider designation during another basin planning activity such as the development of a total maximum daily load. The need for a designation may be brought to the attention of the particular Regional Water Board with a request that a beneficial use be designated to a water body. If the Regional Water Board declines to designate a water body, tribes or others may request the State Water Board to consider the designation. The Water Boards may consider whether the beneficial use is existing or a probable future use to determine whether to designate.

The beneficial uses would be established as water quality beneficial uses which are distinct from beneficial uses used in water rights. Pursuant to the Porter-Cologne Water Quality Control Act (Wat. Code, § 13000 et seq.), "beneficial uses" are defined, in part, as the uses "of the waters of the state that may be protected against quality degradation" and include agricultural and industrial supply, recreation, preservation of fish and wildlife, navigation, and other uses. (Wat. Code, § 13050, subd. (f).)

The State Water Board may develop a flow objective if the flow objective is necessary for the reasonable protection of a beneficial use. However, it is not anticipated that flow objectives would be developed to support the activities contained in the Tribal Traditional & Cultural beneficial use definition.

Such activities, including navigation, and to a lesser extent, ceremonial and spiritual activities, are similar to existing beneficial uses which have not required the development of flow objectives. For example, the Navigation Beneficial Use ("Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels") (NAV) has been designated to numerous waterbodies throughout the State, and no flow objective has been established for NAV.

When the State Water Board is acting on applications to appropriate water, it is required to consider water quality control plans and may subject appropriations to conditions the board deems necessary to carry out the plans. (Wat. Code, § 1258.) Finally, when acting on Clean Water Act section 401 water quality certifications, the State Water Board must include conditions deemed necessary to carry out the goals of water quality standards during the term of the permit.

For the subsistence beneficial uses (T-SUB and SUB), evidence could include an angler or community consumption study, preferably peer reviewed, that demonstrates a population or group that consumes fish at a higher rate than the average consumer. Consideration should be made on both the amount of fish eaten, the type of fish (TL3 vs TL4), as well as the location. For the CUL beneficial use the Water Boards can consider evidence from tribal communities on locations and timing of ceremonial and cultural activities on a water body. Activities could include ceremonial immersion, fishing (both the act of fishing and the ceremonial consumption of fish), basket weaving, and the gathering of aquatic vegetation for medicinal or ceremonial and cultural purposes. For Tribal uses, the Water Boards should consider both current and documented past practices, especially in areas where tribal practices have been limited due to lack of access. The Water Boards should not rely solely upon anecdotal evidence in designating beneficial uses.

Again, the designation does not require that the beneficial use be attained at the time a water body is designated. There is no requirement or threshold of use that the Water Boards must consider when determining beneficial use designations. However, it may not be reasonable to designate a beneficial use, and by extension apply applicable water quality objectives, if only one individual is using the water in a way that would meet the beneficial use definition

U.S. EPA's regulations implementing the Clean Water Act provide, "A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses." (40 C.F.R. § 131.2.) States may adopt "sub-categories" of a use "to reflect the varying needs of such sub-categories of uses […]." (40 C.F.R. § 131.10(c).) "Designated uses" are those uses that are specified in a water quality control plan whether they are "existing" uses or not. (See 40 C.F.R. 131.3(f).) For example, a water body may be designated by state regulations for 'aquatic life support' even though it might not contain a healthy aquatic ecosystem now." (U.S. EPA 2016b). Designated uses answer the policy question of "what do we want to use this water body for?" as well as for recognizing present or existing uses. "Existing uses" are defined as "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (40 C.F.R. § 131.3(e)). U.S. EPA explains in its summary to the revised water quality standards regulations (80 Fed. Reg. 51027 (Aug. 21, 2015): "[E]xisting uses are known to be 'actually attained' when the use has actually occurred *and* the water quality necessary to support the use has been attained. U.S. EPA recognizes, however, that all the necessary data may not be available to determine whether the use actually occurred or the water quality to support the use has been attained." When determining an existing use, U.S. EPA provides substantial flexibility to states and authorized tribes to evaluate the strength of the available data and information where data may be limited, inconclusive, or insufficient regarding whether the use has occurred and the water quality necessary to support the use has been attained. In this instance, states and authorized tribes may decide that based on such information, the use is indeed existing." Therefore, it may be possible to designate uses in water quality control plans as an existing use, even if water quality is not currently being attained for one particular contaminant or where information or data is insufficient or lacking regarding whether the use has occurred and the water quality necessary to support the use has been attained. Additionally, beneficial uses may be designated as a goal use (or a probable future use in Porter-Cologne parlance) where neither the water quality is currently being attained or the use is actually occurring, but there is evidence to indicate that the use would be a probable future use.

An advantage of establishing beneficial uses for subsistence fishers separate from the COMM beneficial use pertaining to recreational fishers is that the it would allow the Water Boards to separately designate the subsistence use, which is expected to require an objective with a higher level of protection of human health due to fish consumption, in a site-specific manner (i.e., to individual sites or water bodies). By comparison, if the Water Boards construed subsistence fishing to come within the COMM designation, then the subsistence use and its associated water quality objectives would apply to all COMM designations, which could be inappropriate in many instances where subsistence fishing is not occurring. Establishing a beneficial use specific to subsistence fishing could focus resources on areas where there is the greatest need for the more stringent objective or it could focus resources on maintaining high quality waters.

Pursuant to the Porter-Cologne Act, the Water Boards are required to establish water quality control plans and the plans must conform to the Porter-Cologne Act. (Wat. Code, § 13240.) Water Code section 13050, subdivision (j), defines water quality control plans as "consist[ing] of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected. (2) Water quality objectives. (3) A program of implementation needed for achieving water quality objectives." When setting objectives, the Water Boards consider the "[p]ast, present, and probable future beneficial" uses of the waters (Wat. Code, § 13241). The Regional Water Boards solicit information on priorities for amending their basin plans – which could include the designation or refining of the list of beneficial uses for any water – during their triennial review.

When designating the beneficial use, the Water Boards generally determine if the use is an existing use under the Clean Water Act (defined as "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (40 C.F.R. § 131.3(e)) or if it is a past, present or probable future use under the Porter Cologne Act. There is no specific threshold for determining when a use is an existing or when a use is a past use. The Water Boards rely on the total body of evidence in the record, and the quality of the waters to be protected for use and enjoyment by the people of the state (Wat. Code, § 13000). The Water Boards consider various factors including the physical, chemical, and biological health of the waters, and may also consider other factors, both tangible and intangible. The legislative findings for the Porter-Cologne Act provide, "activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible." (Ibid.)

The advantage of adopting these beneficial uses is that such adoption would clearly signal that these uses are made on some water bodies in California and could be designated where they are demonstrated to exist or where the Water Boards determine they should be set as a "goal use" so that they may be protected. Having the uses in a statewide water quality control plan would allow tribal and subsistence communities to request that the Water Boards recognize the uses, and thus protect the uses.

A disadvantage of establishing the beneficial uses, and subsequently designating waters with the uses, is that it may raise somewhat false expectations that the certain objectives (e.g. water quality objectives for mercury, PCBs and others) that may support the fish consumption within the beneficial uses can be readily achievable. This may not be possible in some waters for many decades because the level of persistent pollutants is high.

Option 3: Establish the three new beneficial uses and include formal guidance on the manner in which the Water Boards would designate the uses.
This option is similar to option 2, except that along with establishing the beneficial uses and definitions, the Provisions would also contain guidance for the Water Boards on how, or under what circumstances, the beneficial uses should be designated to water bodies. The guidance would clarify the type, quality, or quantity of data or information that should be used support the designation of the beneficial use. This information might be fish consumption surveys or other information from tribes or environmental justice advocates.

The advantage of this option is that this may enable designation of the uses sooner than option 2. Guidance should facilitate the designation process and make it clear what information would be needed. Therefore, when a Water Board begins to designate one of the uses, the process should experience fewer delays, if the guidance is followed. The disadvantage is that the development of the guidance would increase the scope of the Provisions. Such guidance would need to be developed in collaboration with tribes, environmental justice advocates, the State Water Boards Office of Public Participation and Regional Water Boards. Additionally, option 3 refers to U.S. EPA's framework for designating uses as existing uses or goal uses.

6.4.4 Recommendation

Option 2: Establish the beneficial uses for tribal traditional and culture, tribal subsistence fishing and subsistence fishing.

6.5 Issue E. What water quality objective (s) should be adopted for subsistence fishing by tribes (T-SUB) and other subsistence fishers (SUB)?

6.5.1 Current Conditions

Neither the State Water Board nor the Regional Water Boards have developed water quality objectives to protect subsistence fishing or tribal subsistence fishing. Although the North Coast Regional Water Board has adopted Native American Culture (which include subsistence fishing) and Subsistence Fishing beneficial uses, no water quality objectives for any contaminants have been derived to protect these uses.

As described in U.S. EPA's human health criteria methodology (U.S. EPA 2000), the level of fish consumption in highly exposed populations varies by geographical location. Therefore, U.S. EPA suggests a four preference hierarchy for states and authorized tribes that encourages use of the best local, state, or regional data available to derive fish consumption rates. U.S. EPA recommends that states and authorized tribes consider developing criteria to protect highly exposed population groups and use local or regional data in place of a default value as more representative of their target population group(s). The preferred 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 U.S. EPA's default consumption rates. The U.S. EPA recently published guidance on conducting fish consumption surveys (U.S. EPA 2016c), which is an update to the 1998 guidance (U.S. EPA 1998). The new guidance includes information on gathering data on subsistence fishing.

6.5.2 Issue Description

Since the fish consumption rate of one meal per week is recommended to protect the Commercial and Sport Fishing beneficial use (Section 6.2), a separate objective for subsistence fishing and tribal fishing would be needed. California tribes and environmental justice advocates have voiced concerns that an assumed consumption rate of one meal per week for all Californians is not protective of the cultural and subsistence uses. The information needed to calculate such an objective was not available until recently. The California Tribes Fish-Use study confirmed that tribes eat much more than one meal per week of fish (Shilling et al. 2014). Those results can be used to derive an objective for tribal subsistence fishing. Several other California fish consumption studies show that some populations, in addition to tribes, eat more than one meal per week (see Section 6.4.2 above or see Appendix G for more details).

However, there is not a similar statewide study that addresses subsistence fishing by non-tribal communities. Interpreting information in existing fish consumption studies in regards to subsistence fishing is not straightforward. It is not obvious which data represents subsistence fishers vs. recreational fishers. The data is limited and the consumption rates and fish species consumed vary widely by geographic area (Table 4-4). Therefore, it is not clear what consumption rate and fish species should be used to derive a water quality objective to protect subsistence fishing by non-tribal communities.

The Porter Cologne Act requires that water quality objectives shall be established that "will ensure the reasonable protection of beneficial uses and the prevention of nuisance" (Wat. Code §13241). Porter Cologne also requires the Water Boards to consider "Past, present, and probable future beneficial uses of water" (ibid.) when establishing objectives. Certainly tribal subsistence fishing is a past use of some of California's waters, as well as a present and probable future use. Subsistence fishing by other communities is also a present and probable future use of some of California's waters.

When establishing water quality objectives to reasonably protect beneficial uses, the Porter-Cologne Act requires consideration of the "Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area" (Wat. Code, § 13241). Only a fraction of waters would be able to currently support fish that meet a subsistence-type water quality objective when applied to TL4 fish (see Section 4.5.2 mercury levels in sport fish). In fact, many waters do not have fish that would meet the water quality objective for recreational fishers (see Section 6.2). The objectives listed below for subsistence fishing and tribal subsistence fishing objectives in options 2 and 3 are roughly three to four times more stringent that the objective to protect recreational fishing. Another complication is that the attainability of a subsistence objective would depend on the levels of other contaminants in the fish tissue, not just mercury. Some waters in the Sierra Nevada Mountains have elevated levels of dieldrin and PCBs (Davis 2010, Davis et al. 2013), which may prevent attainment of a subsistence-type objective even if the mercury concentrations are low enough.

The Porter Cologne Act also requires consideration of "economic considerations" when establishing water quality objectives and waste discharge requirements (Wat. Code, §§ 13241, 13263). Dischargers may strongly oppose such objectives because of the costs of the requirements that could result from such objectives for some dischargers.

6.5.3 Options

Option 1: No action.

This option would mean no water quality objective would be established pertaining to the SUB or T-SUB beneficial uses. The disadvantage of this option is that the development of any type of subsistence objective would be delayed. The Water Boards are required to establish water quality control plans which consist of beneficial uses of waters, water quality objectives to reasonably protect uses, and programs to implement objectives (Wat. Code, §§ 13050, subd.(j), 13240, 13241, 23142.)

This option may not have a significant impact on the amount of time it will take before such objectives are effective for specific waters. Typically, before the water quality objectives can take effect, the specific waters would need to be designated with the appropriate beneficial use category (e.g. tribal subsistence fishing or subsistence fishing). No waters would be designated with the beneficial uses as part of the Provisions. The designation would be done by the Regional Water Board through the basin plan amendment process (see Section 6.4.1 and Section 6.4.3 option 2). This work is generally a multi-year process, including regulatory and environmental analyses, and public participation.

The advantage of this option is that the scope of the Provisions would be smaller and less complex. This could enable faster adoption of a baseline statewide mercury program, and the required actions to control mercury could be started sooner, which are actions that lend themselves to obtaining the more stringent objective pertaining to higher fish consumers. To fulfill the project goals, the Provisions must be adopted and approved by U.S. EPA by June 30, 2017. This deadline is the result of a lawsuit settlement over the lack of protection for wildlife (see Section 3.5).

A disadvantage of this option is that it would create two projects, assuming that the objectives would be developed at a later date by one or more Water Boards. Splitting the work into two or more projects may not result is a net savings of time and resources.

Another disadvantage of this option is that U.S. EPA in Washington State and Maine (U.S. EPA, Regions 10 and 1, respectively) have recently disapproved state proposed water quality standards because they were not protective of tribal treaty or other reserved fishing rights, which includes rights to fish for subsistence purpose and promulgated and propose new objectives for all waters to be protective of tribal fish consumption rates (81 Fed. Reg. 85417 (Nov. 28, 2016); 81 Fed. Reg. 23239 (April 20, 2016)). Failure to include objectives to protect tribal uses may result in disapproval by U.S. EPA and promulgation of criteria to protect tribal uses.

Option 2 (RECOMMENDED): Adopt a numeric water quality objective for tribal subsistence fishing (T-SUB).

This option means the Provisions would contain a numeric water quality objective for tribal subsistence fishing (T-SUB). (To address subsistence fishing for other individuals (SUB), option 3, option 4, or option 5 could be adopted.)

For tribal subsistence fishing, the objective would be a fish mercury concentration of 0.04 mg/kg. This is based on the contemporary consumption rate for tribes of four to five meals a week from the recent Tribes Fish Use study (Shilling et al. 2014). (This also includes a moderate amount of store bought fish, see Appendix H for calculations.) This rate happens to be the same as the U.S. EPA recommended rate for subsistence (142 g/day, U.S. EPA 2000). The objective (0.04 mg/kg) would be applied as a mixture of 70 percent trophic level 3 (TL3) fish and 30% trophic level 4 (TL4) fish (see Appendix H for example calculations) based on the tribes study (Shilling et al. 2014).

The tribes study (Shilling et al. 2014) includes 40 California tribes, while there are more than 100 federally recognized tribes in California and other non-federally recognized tribes in California (see Section 4.10). If site-specific fish consumption information suggests that a different consumption pattern would better reflect the tribes in a certain area, the Regional Water Board should establish a modified water quality objective. This information would be determined by a suitable angler survey. The study could be done in conjunction with the designation of beneficial use of tribal subsistence fishing. Site-specific information may be available for some tribes in the Tribes Fish Use study (Shilling et al. 2014) or by contacting the author of the study.

The advantage of this option is that it does more to fulfill the Water Boards' mandate to protect beneficial uses of water as compared to option 1 or option 3. This option better achieves the principles and values described in the Water Board's *Strategic Plan Update* (commitment to environmental justice and collaboration with tribes (State Water Board 2008)). Another advantage is that if a water body can achieve objectives pertaining to subsistence or tribal subsistence fishing, such objectives would help to maintain high quality water.

A disadvantage of this option is that it cannot be guaranteed that the water quality objective will be able to bring about a significant improvement (or protection) of the environment. This may produce a false impression that subsistence fishing is safe in places where is it is not, even though, a water body not meeting standards could be on the 303(d) list of impaired waters. The achievability of such objective, when applied to trophic level 4 fish in bass dominated waters, may be difficult due to the persistent nature of the contaminants in fish tissue. This objective, however, could be achievable in some trout dominated waters (see Section 4.5.2 on mercury levels in fish, or for an interactive map of fish mercury data, see www.mywaterquality.ca.gov/safe_to_eat/data_and_trends/).

Option 3: Adopt a numeric water quality objective for subsistence fishing.
This option means the Provisions would contain a water quality objective for subsistence fishing (SUB) of 0.05 mg/kg in top trophic level fish. This is based on a consumption rate of approximately four and a half meals per week, derived from U.S. EPA nationwide subsistence fishing studies (see Appendix H for calculations). This objective should also be modified based on site-specific information, if available. This objective was derived using the national default fish consumption rate of four to five meals per week (142 g/day, U.S. EPA 2000) and is protective of all subsistence related studies listed in Table 4-4, including the study of the Sacramento-San Joaquin Delta (Shilling et al. 2010). However, such a numeric objective may be overprotective of some populations of subsistence fishers that don't eat such a high quantity of fish.

The advantage of this approach is that if water body can achieve this objective, such an objective would help to maintain high quality water.

One disadvantage is that this option could result in overly stringent requirements for dischargers, since the available data suggests that the subsistence objective may be overly protective for many areas. Also, the objective may be criticized as under-protective based on other studies. Available data on subsistence fishing is somewhat subjective to interpretation and the current data indicates that the use is fairly variable. For example, one of the largest studies, the San Francisco Bay study, does not support a consumption rate of four to five meals per week. Instead, it suggests a fish consumption rate of one or maybe two meals per week is protective (see Table 4-4 and Section 4.9). There is also a study currently being conducted in San Diego Bay that aims to include subsistence fishing. To address this issue, each Regional Water Board would be encouraged to evaluate site-specific data and information and develop site-specific objectives that would be tailored to the consumption rates and types of fish at particular waterbodies.

Option 4: Provide guidance for the Water Boards to develop a site-specific objective for other subsistence fishers (SUB) and provide direction to develop the objective upon water body designation.
In this option for SUB, the Water Boards would be directed to develop the water quality objective when the use is designated. The advantage to this option is that the limited data available indicate that the use is variable by water body with respect to the amount and type of fish consumed (see Table 4-4 and Section 4.9). A water quality objective to reasonably protect the use necessarily should be correlated to the amount and type of fish consumed. The use of local data is preferred by U.S. EPA rather than using national default values (see Section 6.5.1, U.S. EPA 2000), lending itself well to the development of a site-specific water quality objective rather than an objective established for statewide use to support the SUB beneficial use.

There is no statewide fish consumption study on subsistence fishing by communities other than tribes, but there are regional studies that included information on subsistence fishing that might be useful for deriving a water quality objective, for example, a San Diego Bay fish consumption was initiated in 2014 which may provide additional data on subsistence fishing in the near future (see Table 4-4 and Appendix G). Also, the information used to designate the subsistence fishing use to the particular water body could be useful for developing an objective for the same water body. If site-specific information is not available, it is recommended that a fish consumption study be conducted to provide data for the objective. In the absence of site-specific information, the Water Boards should consider using the national subsistence consumption rate of four to five meals per week (142 g/day, US EPA 2000) to calculate the objective.

An advantage of this option over option 3, is that it promotes the use of site-specific information for the subsistence objective. Site-specific data would provide a sound justification for the designation of the use and for the calculation of the water quality objective, which would facilitate the regulatory adoption process. The objective would be more stringent or less stringent as supported by data representing the specific population of fish consumers at the particular water body. Without the supporting evidence, the water quality objective would be less supported, making it more difficult for the Water Boards to adopt. A data-driven water quality objective more appropriately provides for the reasonable protection of the use and would be easier to justify and defend.

The lack of statewide numeric water quality objective to support SUB is a disadvantage of this approach compared to option 3. Environmental justice advocacy groups may oppose the Provisions based on the lack of parity between the Provisions establishing an objective for T-SUB (as recommended), but not SUB. On the other hand, this option would provide more certainty than option 5 in terms of ensuring the objective established by the Regional Water Boards would be catered to region-wide or water-body specific consumption rates and species.

Option 5 (RECOMMENDED): Adopt a narrative water quality objective for subsistence fishing (SUB).

This option means the Provisions would establish a statewide narrative water quality objective to support SUB.

The narrative water quality objective contained in the Provisions is:

> *Waters with the Subsistence Fishing (SUB) beneficial use shall be maintained free of mercury at concentrations which accumulate in fish and cause adverse biological, reproductive, or neurological effects. The fish consumption rate used to evaluate this objective shall be derived from water body and population-specific data and information of the subsistence fishers' rate of and form of (e.g. whole, fillet with skin, skinless fillet) fish consumption.*

When a water quality control plan designates a water body, or segment, with the Subsistence Fishing (SUB) beneficial use, development of a region-wide or site-specific numeric fish tissue mercury water quality objective is recommended to account for the wide variation in this use.

The Provisions also contain a footnote correlated with the narrative objective:

The United States Environmental Protection Agency (U.S. EPA) recommended national subsistence fishing consumption rate of 142 grams per day (four to five meals per week, U.S. EPA 2000) shall be used to translate the narrative objective unless a site-specific numeric water quality objective is developed or an external peer-reviewed consumption study uses a methodology to translate the narrative water quality objective.

The advantage of this option is that is more flexible and can be easily tailored to a water body. Since the data on subsistence fishing indicate that the use is variable around the state (as described in option 3), this option may be the best way to accommodate that variability, rather than proposing one set numeric objective for all of California's waters, as in option 3. The use of local data is preferred by U.S. EPA rather than using national default values (see Section 6.5.1, U.S. EPA 2000).

With a narrative water quality objective, effluent limitations contained in permits would be determined on a case-by-case basis, therefore, the effluent limitation could be developed considering site-specific factors, such as the discharger's relative contribution of mercury compared to other mercury sources. Another site-specific factor to consider is the species of fish in the waterbody. If no trophic level 4 fish are present in the water body, then the effluent limitation would not need to be as stringent compared to where trophic level 4 fish are present. The advantage of the narrative water quality objective is that these site-specific considerations could be taken into account without the lengthy regulatory process of adopting a site-specific water quality objective.

The disadvantage is that the objective may be interpreted in different ways, making the implementation of the objective inconsistent. Such objective would be implemented on a regulatory action-by-regulatory action basis. The objective could be interpreted differently as each permit is adopted or upon each assessment of whether the water body is meeting the objective. For instance, the objective could be interpreted in eight different ways in eight different permits, resulting in eight different effluent limitations. Lack of a clear numeric threshold may prompt criticism that this objective would be both under protective and over protective, because the actual level of protection is unknown. This is a disadvantage compared to option 3 and option 4.

6.5.4 Recommendation

Options 2 and 5: Adopt a numeric water quality objective for subsistence fishing by tribes (T-SUB) of 0.04 mg/kg as a mixture of 70 percent trophic level 3 (TL3) fish and 30 percent trophic level 4 (TL4) fish (to protect consumption of four to five meals a week); and adopt a narrative water quality objective for subsistence fishing (SUB) and direct the use of national subsistence fishing consumption rate of 142 g/day (four to five meals per week), unless site-specific information indicates otherwise.

6.6 Issue F. What mercury water quality objective should be adopted to protect the Tribal Tradition and Culture (T-SUB) beneficial use?

6.6.1 Current Conditions

With one exception, there are presently no beneficial uses defined in the state that address California Native American tribal traditional, cultural, or ceremonial uses of water. The exception is in the North Coast Regional Water Quality Control Board's basin plan, which explicitly defines a beneficial use for Native American Culture, CUL, which is defined in Section 3.4 of this report. The North Coast Regional Water Board has designated this use as an existing use for 27 individual water bodies or hydrologic areas and as a potential use for one hydrologic area (North Coast Water Board, 2011. Pp. 2-5.00 – 2.12.00). However, although the North Coast Regional Water Board has applied CUL and FISH for at least one permit, it has used the out-of-date CTR water column-based human health criterion of 50 ng/L for its reasonable potential analysis. (North Coast Water Board, 2013). The North Coast Regional Water Board has not established mercury effluent limitations for either of these uses in its NPDES permits.

6.6.2 Issue Description

When existing or past, present, or potential future beneficial uses are designated, water quality objectives are applied to the beneficial use in order to protect that use. These Provisions propose the adoption of a statewide Tribal Tradition and Culture use. However, the use is purposely defined to encompass the great variety of California Native American cultural, ceremonial and traditional uses of waters of the state. In terms of California's water quality regulatory system, this means that setting accurate objectives for any pollutant would require detailed study of the specific Tribe's use or uses of the waterbody wherever CUL may be designated. For the purposes of the proposed Provisions, the options discussed and the action taken by the State Water Board would apply to mercury objectives.

6.6.3 Options

Option 1: No action.

In this option, the State Water Board would make no requirements that any of the proposed Mercury Water Quality Objectives would be applicable to water bodies that are designated with the CUL beneficial use. This would place the requirement of developing or selecting appropriate mercury water quality objectives for CUL-designated water bodies to the Regional Water Boards. Under this scenario, it is possible that some Regional Water Boards would develop their own region-wide water quality objectives for mercury, or develop or endorse site-specific studies for a mercury objective for the designated water body. A disadvantage is that in not determining which mercury objectives should be used to protect the "fishing" use within the CUL beneficial use, the Provisions would leave a regulatory gap.

Option 2: Allow Regional Water Boards to choose a mercury objective applicable to CUL, given appropriate consideration of consumption patterns of the cultural uses of a particular water and particular California Native American Tribal Community.

In this option the Provisions could require that the rate of consumption – if any – that is associated with the CUL beneficial use be determined when the water is designated using a peer reviewed consumption study. A benefit to this option is that it would set site-specific and appropriately protective objectives on a case by case basis. A disadvantage is that it may be difficult to determine the difference between consumption that is ceremonial versus consumption related to the T-SUB beneficial use. Another disadvantage is that doing the site-specific consumption sturdy could delay designation of the CUL use and lead to a lack of recognition or protection for other, non-fish consumption, cultural uses,

Option 3 (RECOMMENDED): Use the Sport Fish Water Quality Objective that applies to COMM as the water quality objective to protect the consumption of fish contained in the CUL beneficial use.

In this option, the Water Boards would use the same consumption rate of one meal per week to protect the consumption of fish under the CUL use as used in the Sports Fish Water Quality Objective. An advantage to this option is that there would be a uniform application of a mercury objective to protect the fishing use recognizing that higher consumption rates are recognized in the T-SUB and SUB beneficial uses. Another advantage is that there would be no delay of the designation for the CUL beneficial use while a consumption study, specific to cultural and ceremonial uses, is conducted. A disadvantage to this option is that it could lead to overly-stringent or under-protective mercury objectives. However, it is anticipated that any water that is designated for CUL would also most likely be designated for COMM and WILD so the Sport Fish Water Quality Objective would already apply. Additionally, the Regional Water Boards may develop site-specific objectives to cater the consumption rate and species to the precise waters at issue, which could recognize any higher consumption rate associated with cultural or ceremonial fish consumption.

6.7 Issue G. What water quality objective should be adopted to protect sensitive endangered species (the RARE beneficial use) and to what waters should the objective apply?

6.7.1 Current Conditions

There are currently no statewide objectives or criteria to protect wildlife from mercury in California. In 2000, the USFWS issued its final opinion that the California Toxics Rule criteria for mercury would not protect several threatened and endangered species (USFWS 2000). This gap in protection remains in California's statewide water quality criteria. However, protections for wildlife have been established regionally as mercury /methylmercury site-specific objectives that have been adopted with several TMDLs. To protect a very sensitive endangered species, the California least tern, an objective of 0.03 mg/kg in fish 50 mm long (~2 inches) was adopted for the Sacramento-San Joaquin Delta and San Francisco Bay.

6.7.2 Issue Description

The California least tern is particularly sensitive to methylmercury because of its small size and its diet comprised almost exclusively of fish. This issue considers if a special water quality objective for the California least tern should be adopted, and if so, where the objective should apply. The objective would be 0.03 mg/kg methylmercury in fish less than 50 mm long as recommend by the USFWS (USFWS 2003, USFWS 2004). The very small size of the fish (less than 50 mm) is typical of the fish the tern typically preys upon. The habitat of the California least tern covers only a small fraction of California, including the coast from the San Francisco Bay area down to the Mexican border. The USFWS recommended adoption of a similar site-specific objective (0.03 mg/kg in fish less than 50 mm) for the Sacramento-San Joaquin Delta and the San Francisco Bay, because this species was unlikely to be protected by the Sport Fish Water Quality Objective adopted for those waters.

Although the Prey Fish Water Quality Objective is thought to be more protective than the recommended Sport Fish Water Quality Objective (0.2 mg/kg in sport fish), an objective of 0.03 mg/kg in 50 mm (2 inches) fish is *not* 10 times more stringent compared to an objective of 0.3 mg/kg in 350 mm (14 inches) fish. This is due to the bioaccumulative properties of methylmercury. Small prey fish are lower on the food web, and therefore generally have much less methylmercury in their tissue than the larger fish people typically eat. Because there is little data on methylmercury accumulation in small prey fish, it is difficult to determine the relationship between methylmercury concentrations in small prey fish (2") and sport fish (e.g. 14"). In some waters, 0.2 mg/kg in sport fish may be consistent with 0.03 mg/kg in small prey fish. Based on data from slightly larger prey fish, it appears that the relationship will depend on the water body (Ackerman et al. 2015a).

The California least tern feeds primarily in near shore ocean waters and in shallow estuaries and lagoons. After breeding, family groups regularly occur in lakes or lake-like waters near the coast of southern California (USFWS 2006, California Department of Fish and Wildlife 1990). The tern plunges for fish near the surface, including anchovy (Engraulis sp.), silversides (Atherinops sp.) and shiner surfperch (*Cymatogaster aggregate*, *ibid.*). In addition to being on the federal list of endangered species, the California least tern is on California's list of endangered species and is fully protected under the California Endangered Species Act of 1984. This legislation requires State agencies to consult with the CDFW on activities that may affect a State-listed species.

The Yuma Ridgway's rail (*Rallus obsoletus yumanensis*, formerly known as the Yuma Clapper rail) is another sensitive bird species on the federal endangered species list that may warrant extra protection. This species could be protected by the objective suggested in Section 6.8. Otherwise the Prey Fish Water Quality Objective suggested below should be used to protect the habitat of the Yuma Ridgway's rail.

6.7.3 Options

Option 1: No action.

In this option, no separate objective would be adopted to protect the California least tern. One of the primary drivers for developing the Provisions is the lack of protection for threatened and endangered species identified by the USFWS. The no action alternative would not resolve this issue and would not accomplish the goals of the Provisions. This option could accomplish the goals of the Provisions if the most stringent alternative for the Sport Fish Water Quality Objective is adopted (0.05 mg/kg in large fish, the subsistence–type option). The subsistence–type objective would be stringent enough to protect wildlife, including the California least tern.

Option 2: Apply the California Least Tern Water Quality Objective statewide

In this option, a separate objective would be adopted to protect the California least tern and other sensitive wildlife species. This objective would apply to all inland surface waters and enclosed bays and estuaries with the wildlife beneficial use. Applying this objective statewide would ensure complete protection of the California least tern as well as protection of many other wildlife species. This objective (0.03 mg/kg methylmercury in small prey fish) could be more stringent than 0.2 mg/kg methylmercury in large fish. Currently, the relationship is unclear.

The advantage of this option is that it would help ensure protection for all other sensitive wildlife. The disadvantage of this option is that it would require more resources for the statewide monitoring effort. This may be unnecessary, since the main sensitive species of concern has a limited habit range in California. Also, most wildlife species considered during the development of the Provisions (see appendix K) do not prey on fish this small. Therefore, these small prey fish are not the best indicator of protecting other wildlife species statewide.

Option 3 (RECOMMENDED): Apply the California Least Tern Prey Fish Water Quality Objective to waters based on United States Fish and Wildlife Service management areas for the species.

In this option, a separate objective would be adopted to protect the California least tern that would apply only to the habitat of the tern, since the California least tern only lives in a small part of the state. An advantage of using this alternative would be that it saves monitoring resources by limiting the geographic scope of the more stringent water quality objective. A disadvantage of this alternative is that other small birds sensitive to mercury could remain at risk, if no other objective is adopted to protect wildlife (see Section 6.8).

For a list of waters where protections for the least tern would apply, see Table K-5, Appendix K, which includes waters on or near the coast, from the San Francisco Bay area down to the Tijuana River. This list is based on the management areas in the

USFWS recovery plan. There is no official critical habitat for the California least tern (USFWS 2006).

No change to any Regional Water Board basin plan is necessary for these protections to take effect, because upon adoption of the Provisions, the objective would be effective in the specified waters. The basin plans include the RARE to protect habitat for such species. RARE has already been designated by Regional Water Boards to all the relevant waters (listed Table K-5, Appendix K).

If information becomes available at a later date to indicate that the California Least Tern Prey Fish Objective should be applied to other waters, then Regional Water Board could make findings that the use is an existing use and apply the objective to those waters.

If no other objective is adopted to protect wildlife statewide (see discussion in Section 6.8) then this option should include the Salton Sea and Colorado River to protect Yuma Ridgway's rail, which inhabit these waters. The Yuma Ridgway's rail is another sensitive species on the federal list of endangered species. This species was second most sensitive next to the California least tern in the USFWS analysis of the national methylmercury criterion (USFWS 2003).

In addition to providing habitat for the Yuma Ridgway's rail, the Salton Sea provides habitat for a great number of bird species. It is a major resting stop in a common migratory path for birds known as the Pacific Flyway. The Salton Sea has no top predatory fish because of the high salinity, so the objective for sport fish (0.2 mg/kg) would be applied to lower trophic level fish, which would be less protective for wildlife. The limited data available provide little assurance that 0.2 mg/kg in sport fish would correspond to a sufficiently protective mercury concentration in the prey of the Yuma Ridgway's rail.

6.7.4 Recommendation

Option 3. Adopt the small prey fish tissue objective (0.03 mg/kg in fish < 50 mm) for waters located within USFWS management areas for the California least tern.

6.8 Issue H. Should a water quality objective be adopted that is specifically for the protection of wildlife statewide?

6.8.1 Current Conditions

There are currently no statewide objectives or criteria to protect wildlife from mercury in California, although site-specific objectives have been adopted for several waters including the Sacramento-San Joaquin Delta, San Francisco Bay, Clear Lake, Cache Creek, and the Guadalupe River watershed. Because of the long standing lack of protections for wildlife, a lawsuit was filed against U.S. EPA. As a result, U.S. EPA is obligated to propose methylmercury water quality criteria to protect aquatic life and aquatic-dependent wildlife by June 30, 2017. This applies to waters where U.S. EPA has not already approved water quality objectives for mercury submitted by the State (Consent Decree: *Our Children's Earth Foundation and Ecological Rights Foundation vs. U.S. EPA*, No. 3:13-cv-2857-JSW (N.D. Cal., Aug 25 2014)).

6.8.2 Issue Description

A separate wildlife objective may be needed if the options selected for sport fish and the least tern (discussed in Issues B, C, and G) do not provide adequate protections for all threatened and endangered species and other wildlife in California, such as osprey, bald eagle, belted king fisher, grebe and merganser.

Some of the options being considered for the Sport Fish Water Quality Objective to protect the related human health beneficial use (i.e., COMM) are known to be inadequate to protect wildlife. If chosen for adoption, these options would necessitate an additional objective for wildlife. For example, the USFWS found that an objective of 0.3 mg/kg in sport fish (Option 1 in Issue B, in Section 6.2.3) would be inadequate protection for two to four threatened and endangered species. Conversely, the 0.2 mg/kg objective (ibid., Option 2) in trophic level 4 fish (Option 1 in Issue C, in Section 6.3.3) should reasonably protect most threatened endangered species and other piscivorous wildlife, with the exception of the California least tern. However, many waters in California do not support trophic level 4 fish, but are inhabited primarily by trout. This is especially true in the Sierra Nevada Mountains. If the objective of 0.2 mg/kg is applied to trout, it is not clear if wildlife that eats lower trophic level fish would be protected. This issue is described in more detail in Appendix K. An objective that applies directly to the smaller fish that many wildlife species prey on would more obviously protect wildlife.

If the option of the objective of 0.05 mg/kg (Option 3 of Issue B in Section 6.2.3) was chosen for the Sport Fish Water Quality Objective; or if the least tern objective is applied statewide (Option 2 of Issue G, in Section 6.7.3) then no other protection for wildlife would be needed. Other option combinations may need a more thorough evaluation.

6.8.3 Options

Option 1: No action, and rely on the Sport Fish Water Quality Objective to protect wildlife.

The recommend option for the Sport Fish Water Quality Objective (one meal per week consumption rate) equates to approximately the same required level of protection for most aquatic dependent wildlife. Therefore, this option should protect most wildlife. The advantage of this option is that it would require fewer resources than implementing two objectives statewide: one for sport fish and one for wildlife. The California Least Tern Prey Fish Water Quality Objective (Section 6.7) would still be needed in any case, at minimum in the tern's habitat.

The disadvantage is the objective that applies to large sport fish is not clearly protective of wildlife that prey on smaller fish such as grebe, merganser, and belted kingfisher in all cases. Existing data are limited, but this option does not seem thoroughly protective in freshwater ecosystems which lack trophic level 4 fish (e.g. bass, see Appendix K). It is also very likely the relationship between mercury concentrations in sport fish and mercury concentrations in prey fish is water body specific. Therefore, protecting wildlife indirectly through an objective for sport fish would not necessarily provide full protection of wildlife in all cases. This uncertainty may result in U.S. EPA promulgating a separate objective for wildlife for California (as in option 2 below), since U.S. EPA is being held responsible for mercury water quality criteria that protect wildlife as a result of the lawsuit.

Option 2 (RECOMMENDED): Adopt the Prey Fish Water Quality Objective for wildlife.

A water quality objective to protect aquatic dependent wildlife could be adopted statewide, in addition to the Sport Fish Water Quality Objective. This objective would be 0.05 mg/kg methylmercury for trophic level 3 prey fish (50-150 mm (2-6 inches)), and is based on the wildlife target for belted kingfisher (see Appendix K) and is consistent with achieving targets for merganser, grebe, osprey and Yuma Ridgway's rail, albeit in somewhat larger fish or crayfish (Appendix K). This objective is also based on a recent study in grebes, which suggested that 0.05 mg/kg methylmercury in prey fish corresponds to a benchmark between low and elevated risk of toxicity (Ackerman et al. 2015a, fish 21 -146 mm were included in the study).

The advantage of this additional prey fish objective is that it would more clearly protect wildlife, by applying the objectives to the type of fish many wildlife species prey upon instead of applying it to the larger type fish that are more typically eaten by recreational fishers. This objective would also fill a gap in protection where there are no trophic level 4 fish (see Appendix K). The disadvantage of this additional prey fish objective is the increase of statewide monitoring needs, compared to having only one objective statewide. However, statewide monitoring programs have already monitored this size of prey fish (50-150 mm) to check for effects on aquatic dependent wildlife, particularly grebes (Ackerman et al. 2015a). Since this objective is mostly needed to fill a gap in protection for waters without trophic level fish then the monitoring for 50-150 mm prey fish could be prioritized to waters where there are no trophic level 4 fish. Monitoring for 50-150 mm prey fish could be a lower priority where sport fish monitoring applies to trophic level 4 fish. Also, this objective need not apply where the California Least Tern Prey Fish Water Quality Objective protects the California least tern (Section 6.7). The recommended California Least Tern Prey Fish Water Quality Objective (0.03 mg/kg in fish less than 50 mm, Section 6.7) would still be needed in any case, at minimum in the tern's habitat.

6.8.4 Recommendation

Option 2. Adopt a separate trophic level 3 objective, the Prey Fish Water Quality Objective, for wildlife for waters without trophic level 4 fish.

6.9 Issue I. How should legacy mine sites and mining wastes be addressed?

6.9.1 Current Conditions

For any type of mine, not just legacy or abandoned mines, Water Boards may issue cleanup orders and permits (e.g. waste discharge requirements) to mine owners to address discharges from mine sites and mining waste that discharge mercury to surface waters.

Mine sites that do not discharge directly to surface water may be issued waste discharge requirements under the land disposal program. The Water Boards are authorized to regulate discharges of non-hazardous waste to land under Title 27 of the California Code of Regulations. This regulation includes active, inactive closed or abandoned mines. The Porter-Cologne Act (Wat. Code § 13260 et seq.) and State Water Board Resolution 92-49 (as amended on April 21, 1994 and October 2, 1996) (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304) provide the Water Boards with the authority to require measures to control pollution discharge from a mine site. Regional Water Boards use this authority to require "remediation plans" from mine owners. Mines may also be regulated though a cleanup and abatement order (Wat. Code, § 13304) or cease and desist order (Wat. Code, § 13304).

State Water Board's nonpoint source program addresses discharges from other types of land, such as forests and grazing land or open land, which may include mine tailings that have become part of the landscape (discussed in Section 6.10). For streams and creeks that are impacted by deposits of mercury contaminated sediments from historic mining, these sources may be more appropriately addressed through the Clean Water Act 401 Water Quality Certification and Wetlands Program by which the Water Boards regulate discharges of fill and dredged material under Clean Water Act section 401 (33 U.S.C.1341) and the Porter-Cologne Water Quality Control Act (13370 et seq.) (discussed in Section 6.10). Additionally, if mining (e.g. gravel mining) is conducted within a stream, in a wetland or in a riparian zone, the activity may be regulated under the Clean Water Act 401 Water Quality Certification and Wetlands Program.

Mines that are now inactive are responsible for much of the mercury contamination associated with mining activity in California today. Currently active mines, which must abide by waste discharge requirements, contribute far less mercury. Most of the old inactive mines have been abandoned. Some inactive mines do not have a responsible party to which a permit or clean up order can be issued. Many of the abandoned mines are on land now owned by the Bureau of Land Management or other public agencies. The mining activity responsible for much of the mercury contamination in California today is from mines that are now inactive and from historic mine tailings, which have been spread widely across the landscape.

Many other agencies are also involved in the regulation of mines and in addressing abandoned mines. The Department of Conservation in now developing a prioritization strategy to address hazards from 47,000 abandoned mines sites. Not all sites contain mercury. Abandoned mines may also pose a physical hazard or release other contaminants (See Appendix F).

Although active mines are required to implement measures to control sediment and erosion when closing per California Code of Regulations, title 27 section 22510, for many mine sites that have were closed or abandoned prior to inception of the regulations, the requirements for implementing sediment and erosion control measures may be a new requirement.

Currently operating mines are much smaller sources than historic mines. Before a mine may discharge to surface water the mine owner must first obtain an NPDES permit. For mines regulated with an NPDES permit, the requirements are discussed in Section 6.12 and Section 6.13. Mines that don't discharge directly to surface water still generate runoff from storm water. Storm water from a mine site may be regulated under the Water Board's NPDES Statewide General Permit for Storm Water Discharges Associated with Industrial Activities (Industrial General Permit), and the requirements for storm water discharges are discussed in Section 6.11.

6.9.2 Issue Description

The issue is how the Provisions should control mercury discharges from legacy/abandoned mines. Historic mercury and gold mining in California is known to be one of the largest sources of mercury pollution in the state. Currently active mines, which must abide by waste discharge requirements, contribute far less mercury (and are addressed in other sections). Therefore, the focus of this issue is on legacy/abandoned mines. Mines or mine tailings can contribute mercury through erosion, mercury carried in storm water, or effluent discharges to water bodies. Many Water Board programs already exist that can be used to control mercury from legacy/abandoned mines, but due to the large number of a mines and the lack of responsible parties (mine owners), few abandoned mines have been addressed. Some inactive mines do not have a responsible party to which a permit or clean up order can be issued, or they are now on land now owned by the Bureau of Land Management or other public agencies.

Another challenging aspect to the historic mining legacy is that much of the landscape downstream from mercury mines is already contaminated with mercury laden sediment over broad areas and to deep depths. These are not recognizable mine sites, rather the sediment has become part of the landscape. This type of mercury is very difficult to address and may be a more important source of methylmercury than the original mine sites. In some cases, these sources could be addressed though the Clean Water Act 401 certification and wetland program and the nonpoint source program (Section 6.10).

6.9.3 Options

Option 1: No action. Use existing programs.

In this option, mine sites and mining waste from legacy/abandoned mines that discharge mercury to surface water would be addressed through existing regulatory programs. Existing Water Board regulatory tools, such as cleanup orders and permits (waste discharge requirements), would be used to address discharges from mine sites and mining waste (including dredge tailings and dredge fields) that discharge mercury to surface waters. Such permits could require implementation of erosion and sediment controls and other management practices to reduce erosion and sediment runoff rates to the maximum extent practicable.

The disadvantage of this option is that mines that are more significant contributors may not be addressed, since there is no effort statewide for Water Boards to prioritize mine sites that may be mercury sources. The existing programs often rely on other agencies or private parties to identify sites that should be regulated. Many mine sites have not been evaluated as to their potential to discharge mercury (or other contaminants) to water bodies, and are not permitted. Another difficulty is that many mine sites do not have an obvious responsible party with funds to correct the discharge of pollutants. Other sites are on public lands, and while state and federal agencies remediate many mine sites, there are limited funds for this purpose.

Option 2 (RECOMMENDED): Require dischargers subject to California Code of Regulations, title 22, section 22510 to implement erosion and sediment control measures to control mercury.

This option is similar to the option 1, but this option would require dischargers subject to California Code of Regulations, title 22, section 22510 to implement erosion and sediment control measures to control mercury when the discharge is from land where mercury was mined or mercury was used during ore processing. Title 27 already requires mine site remediation plans that include maintenance and monitoring plans to ensure continued effectiveness of the mine site remediation control measures (Cal. Code Regs, tit. 27, § 22510, subd. (b)). The Provisions would contain requirements to control erosion rather than assigning some mercury sediment or water column threshold. Erosion controls would a likely already be required at mines to control sediments and pollutants that bind to sediments (such as mercury), but this option may result in more sediment controls being included in mine remediation plans. If a water body is on the 303(d) list of impaired water bodies and a TMDL is developed, any upstream mine sites would likely be prioritized for clean-up and may be issued additional requirements as part of the TMDL program of implementation.

Option 3: Statewide Mine Prioritization Strategy.

In this option the Provisions could include a strategy to identify and prioritize legacy/abandoned mine sites and mining waste for cleanup. This approach would be hindered by the limited funds available for clean up as noted above. This approach would focus efforts on the worst sites first. The developing Reservoir Program is considering a similar approach that includes many areas of the Sierra Nevada which are heavily impacted by historic gold mining. Other state agencies responsible for regulating mine lands may need to be involved to identify the mine sites. This option would require additional staff or contract resources for this work to be performed.

Since funding will limit the number of sites that can be remediated, an important part of this option would be to identify additional funding. Partnerships could be developed with industry to re-mine legacy/abandoned sites. Currently, there is little incentive for industry to clean up and reuse an old mine site that was abandoned by another party. Also, public agencies have little funding available for mine clean-up activities.

6.9.4 Recommendation

Option 2. Require dischargers subject to California Code of Regulations, title 22, section 22510 to implement erosion and sediment control measures to control mercury.

6.10 Issue J. How should dredging, wetlands, and nonpoint sources be addressed?

6.10.1 Current Conditions

The existing policy for nonpoint sources is the State Water Board's *Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program* (Nonpoint Source Policy, State Water Board 2004). The Nonpoint Source Policy aims to minimize nonpoint source pollution from land use activities in agriculture, grazing, urban development, forestry, recreational boating and marinas, hydromodification, and wetlands. This can include lands with historic mine tailings and other open land. Agriculture wetlands are usually regulated by the Irrigated Lands Regulatory Program. The requirements for dischargers in that program should take into account nearby mercury impaired waters.

Additionally, the State Water Board has a Clean Water Act 401 Water Quality Certification and Wetlands Program that regulates discharges of fill and dredged material under Clean Water Act section 401 (33 U.S.C.1341) and the Porter-Cologne Water Quality Control Act (13370 et seq.). This program has special responsibility for wetlands, riparian areas, and headwaters because these water bodies have high resource value, are vulnerable to filling, and are not systematically protected by other programs. The program includes the protection of special-status species and regulation of hydromodification impacts. The program encourages basin-level analysis and protection, and most projects are regulated by the Regional Water Boards. The State Water Board directly regulates multi-regional projects and supports and coordinates the Program statewide.

6.10.2 Issue Description

The issue is how the Provisions should control mercury discharges from dredging, wetlands, and nonpoint source discharges (other than legacy mines, addressed in Section 6.9 and current NPDES permitted discharges, addressed in Section 6.10 through Section 6.13). Soils in California can be either naturally enriched with mercury, contaminated with mercury from gold mining activities, or, increase mercury concentration through atmospheric deposition. These mercury enriched soils can be washed into water bodes by nonpoint source discharges. Nonpoint source discharges can include surface water runoff from forests, agricultural land, grazing land, some urban areas, wetland/riparian areas, hydromodifcations, and other land features. Landscape changes or activities that increase run off or erosion can increase the transport of mercury into water bodies.

Also the inundation of mercury contaminated sediments from occasional flooding of land can produce methylmercury. A great deal of mercury contaminated sediment has already left mine sites and become part of the landscape as a result of historic mining. The methylation of the mercury in these contaminated sediments during occasional flooding is not a feasibly controllable process at this time.

This issue also concerns wetland projects, flooded agricultural lands, and dredging activities. These areas/activities can increase mercury levels in fish because flooded areas typically have low oxygen and high organic matter content. Those conditions tend to promote the methylation of inorganic mercury, and a great deal of mercury contaminated sediment has already moved down into stream beds and wetlands as a result of historic mining. When a wetland is established (created), enhanced, or restored, the modified site could increase the methylation of mercury or the discharge of mercury or methylmercury to downstream waters. Similarly, other dredging activities could disturb the mercury contaminated sediment and exacerbated mercury methylation and spread contaminated sediment downstream and to the location where the dredged material is being placed. However, wetlands and wetland restoration projects are very valuable as habitat for wildlife and flood control. As of 1990 California had lost 91 percent of its wetlands, more than any other state in the U.S (Dahl 1990).

6.10.3 Options

Option 1: No Action.

In this option, Water Boards staff would continue to issue or reissue permits (e.g. WDRs or waivers of WDRs) to address discharges of non-point source pollutants, with requirements based on State Water Board's Nonpoint Source Policy. Such requirements may include erosion and sediment control measures. Waste discharges from other sources, such as construction and road maintenance, would continue to be covered under NPDES storm water permits (See Section 6.11.) Dredging activities and wetland projects would continue to be regulated under Clean Water Act section 401 and 404 requirements or WDRs.

Option 2 (RECOMMENDED): Emphasize that under existing law the Water Boards have discretion to address nonpoint source discharges of mercury and methylmercury production in wetlands and the Water Boards should consider such implementation measures in areas with elevated mercury concentrations.

This option would acknowledge existing authority and provide some guidance to programs on where mercury should be addressed and what could be done. Areas where mercury should be considered to be addressed would include areas with known elevated mercury concentrations. This would be: a site that contains naturally-enriched soil in the Coast Range of 1 ppm or higher; a site with soil or sediments with mercury concentrations of 1 ppm or higher (Section 4.5.5); or a site in historic mercury or gold mine tailings. Also, sites within historic hydraulic gold mining pits in the Sierra Nevada Mountains should be considered as high mercury areas for which mercury monitoring may be required. (A map of historic hydraulic gold mining pits may be available in the near future on the U.S. Geological Survey website in the form of a GIS shapefile related to the project described in Alpers et al. 2016)

In this option, discharges in high mercury areas could be required to implement sediment and erosion control measures. Such requirements may already exist pursuant to existing authority and implementation. The Provisions would emphasize that permit writers may consider requiring sediment controls to control mercury, particularly in areas with elevated mercury concentrations

Under the Nonpoint Source Policy, Regional Water Board permit writers have the discretion to include management practices for mercury in permits for nonpoint sources. The decision to include requirements for mercury should be based on information that indicates the area has high levels of mercury. The permits could require public and private landowners whose activities disturb and discharge soils containing mercury to implement enhanced erosion and sediment controls and other management practices to reduce erosion and sediment runoff rates to the maximum extent practicable.

Dredging fill activities would continue to comply with Clean Water Act section 401 and 404 requirements, particularly the avoidance and minimization requirements of the 404(b)(1) Guidelines. In addition, dredging activities not subject to federal regulation would continue to be required to comply with existing Porter-Cologne Act waste discharge requirements. In San Francisco Bay and the Sacramento San Joaquin Delta, which are more heavily impacted by mercury, existing programs specifically consider mercury. One such program is the *Long Term Management Strategy (LTMS) for the placement of dredged material in San Francisco Bay* and the strategy's accompanying *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines*. Also the *General WDR for maintenance dredging operation Sacramento-San Joaquin Delta* (Order R5-2009-0085) has mercury related requirements for dredging in the Bay and Delta. These guidelines and this permit can be used as guidance to address dredging in other areas where mercury levels are high. Through these guidelines and permit the discharger may be required to monitor mercury, although some of the numeric thresholds are site-specific based on the background sediment mercury concentrations in the specific area. If the sediment or water released from the sediment has high levels of mercury, alternative procedures may be required to minimize the disturbance and release of mercury-contaminated material during dredging, excavation, and/or disposal of dredged or excavated material.

New wetland projects (creation or restoration of wetlands) should not be prevented because of mercury concerns. However, wetland projects should be done in manner to reduce unintended impacts (see Section 4.4.7). If practicable, new wetlands should not be created in areas with high levels of mercury. This option essentially recommends methylmercury controls in high mercury areas. This is included in the Provisions by restating exiting authority (that a permit writer could require parties to include features or measures to reduce methylmercury), while specifying in areas with high mercury levels the permit writer should consider requiring such requirements. Frequent water level fluctuations (wetting and drying of soil) may exacerbate methylation (see Appendix Q) and should be avoided in high mercury areas. The minimization of wetting and drying of soil is included as a possible measure to control methylation. Additionally, if new wetlands are to be created, restored, or enhanced in areas with high mercury levels, then the permit writer may include requirements for sediment controls. Sediment controls can limit the transport of methylmercury out of a wetland. (For additional information on how wetlands can increase or decrease mercury methylation, see Section 4.4.7 or Appendix Q). Wetland projects also would need to adhere to the requirements of the Proposed Procedures for the Regulation of Discharges of Dredged or Fill Material, upon adoption.

Option 3: Establish new requirements for mercury and methylmercury and continue to use existing programs.
This option would use existing programs and require new implementation actions to control mercury and methylmercury. For example, if specific BMPs could be used to control mercury in wetlands, the Provisions could require the BMPs for every wetland project. However, the science on mercury/ methylmercury controls is not advanced enough to provide BMPs that will clearly reduce mercury or methylmercury in most situations.

6.10.4 Recommendation

Option 2: **Emphasize that under existing law, the Water Boards have discretion to include requirements to address nonpoint source discharges of mercury and methylmercury production in wetlands and the Water Boards should consider such implementation measures in areas with elevated mercury concentrations.**

6.11 Issue K. What should be required of NPDES storm water dischargers?

6.11.1 Current Conditions

Clean Water Act section 402, subdivision (p), and Water Code section 13376 authorize the State Water Board to issue individual and general NPDES permits for storm water discharges. There are a few categories of permit types depending on whether the storm water is related to industry, construction, or municipal separate storm sewer systems (MS4s). Municipalities serving between 100,000 and 250,000 people are required to apply for Phase I MS4 permits, while smaller municipalities and non-traditional permittees (e.g. some state parks) are enrolled in the statewide general Phase II MS4 permit. Storm water discharges arising from projects carried out by the California Department of Transportation (Caltrans) require a unique statewide Phase I MS4 permit (the Statewide Storm Water Permit WDRs for State of California Department of Transportation, or the "Caltrans Permit"). Construction projects that disturb one or more acres of soil are required to enroll in the General Permit for Discharges of Storm Water Associated with Construction Activity (Construction General Permit or CGP). A defined set of industrial dischargers are required to enroll in the General Permit for Storm Water Discharges Associated with Industrial Activity (Industrial General Permit or IGP). Also, individual permits are issued to industries that are either ineligible for the general permit or required to have an individual permit.

Most storm water permits do not have specific implementation for mercury, except when specified by a TMDL. However, many of the existing general requirements in storm water permits can help reduce mercury in storm water. For example, Phase I and II MS4 permits contain requirements for public education outreach, pollution prevention, sediment controls for construction areas, and low impact development; all of these elements can also help reduce mercury in storm water. The Caltrans Permit and the Construction General Permit both have requirements for erosion control. The Industrial General Permit requires monitoring if industrial activities or materials at the facility are a potential source of mercury, and additional action is required if the mercury Numeric Action Level is exceeded. Industrial facilities are not responsible for mercury deposited from atmospheric emissions, if they demonstrate that their facility is not the source. Additional details on requirements in storm water permits that are relevant to mercury are included in Appendix P.

6.11.2 Issue Description

Storm water can transport mercury to water bodies from a variety of sources. Much of the mercury in storm water may be from atmospheric emissions, including emissions that originate from outside of California. While storm water dischargers have control over mercury that comes from their activity or industry, storm water dischargers cannot control the original source of mercury that is deposited from the atmosphere, such as coal burning. Controllable sources of mercury include construction activities and road maintenance, which can increase erosion during storms and carry mercury enriched sediment to surface waters. Accordingly, enhanced erosion controls could be used to control mercury. In urban and industrial settings, items containing mercury can contribute mercury to storm water if not properly disposed (such as batteries, florescent tubes, or switches containing mercury). Additionally, storm drains that allow water to stagnate can create an environment that promotes the generation of methylmercury from inorganic mercury.

A second issue that needs to be considered is whether the current Numeric Action Levels for mercury in the Industrial General Permit should be lowered. A Numeric Action Level is a tool to assist a permittee to evaluate the effectiveness of its facility in preventing storm water pollution. Exceeding a Numeric Action Level is not by itself a permit violation. The current Numeric Action Level in the Industrial General Permit for mercury is 1400 ng/L total mercury, which is very high compared to water quality based thresholds. The threshold of 1400 ng/L is 28 times higher than the outdated California Toxics Rule criterion (50 ng/L). (The Industrial General Permit is the only storm water permit that includes requirements for mercury monitoring.)

Finally, a third issue under the Industrial General Permit is a requirement for new dischargers. New dischargers that directly discharge to a water body that is on the 303(d) list due to mercury (or through an MS4 that directly discharges to a water body that is on the 303(d) list) have to provide documentation that mercury 1) is not present or part of industrial activity at the facility, 2) is not exposed at the facility, or 3) concentrations in the receiving water are in compliance with an applicable water quality objective for mercury. The third requirement may be problematic because the Provisions do not include a water column objective for mercury, so it is not clear how a discharger can demonstrate compliance with the water quality objective. There are many mercury impaired waters throughout the state with no TMDL, where the lack of clarity for this requirement could cause a problem in how to determine compliance.

The requirements in any option below would not affect areas where a mercury TMDL or a site-specific objective is being implemented. In those cases, requirements specified in the TMDL program of implementation should be followed.

6.11.3 Options

Option 1: Best management practices (BMPs) for sediment and erosion control. Entities responsible for municipal separate storm sewer systems (MS4s), industrial facilities, construction activities, and Caltrans would be required to implement BMPs to control erosion and sediment to reduce mercury discharges. The BMPs would be based on existing permit requirements for erosion controls. Erosion controls are already required in many areas, which could fulfill the requirements. A situation that might warrant new controls (where absent) or enhanced sediment erosion controls could be a discharge that flows directly into an impaired water body. In addition, for all discharges in areas where there are elevated mercury levels in the soil (i.e.: in Coast Range, near legacy mining debris) new or enhanced erosion/ sediment controls would be required.

The Caltrans Permit already includes erosion controls that would fulfill these requirements. The Caltrans Permit requires enhanced erosion controls where there are TMDLs for mercury that include a waste load allocation for Caltrans (San Francisco Bay, Cache Creek, Sacramento San Joaquin Delta), and also where there are TMDLs for sediment, nutrients, turbidity or siltation. Moreover, in the mercury-enriched North Coast Regions (see the prevalence of mercury mines in Figure 4-1); the erosion control requirements would be fulfilled by the existing permit.

The Construction General Permit already includes erosion controls that would fulfill these requirements. In the Construction General Permit, sites with a higher risk of sediment discharge (based the slope of the site, erosion rates, ground cover, and other factors) are placed in a higher risk category (risk category 2 or 3). If a site is in an area that is naturally mercury enriched, and has a high potential for erosion (particularly the Coat Range Mountains), the site should be placed in risk category 2 or 3. This would effectively already be accomplished by the permit since many parts of the North Coast Region and the Coast Range Mountains are already risk 2 or 3 sites because these areas are sensitive to excessive sediment loads or these areas are already impaired due to sediment levels.

The Industrial General Permit already includes erosion and sediment controls that would fulfill these requirements. In the Industrial Activities General permit, facilities are required to implement minimum BMPs to control wind erosion, stabilize erodible areas, stabilize site perimeter (includes entrances and exits), divert run-off from erodible materials and adhere to design storm standards for new sediment basins. Dischargers must also consider advanced BMPs to control erosion and sediment discharges if the minimum BMPs are insufficient to control the storm water effluent quality. Finally, the permit includes a Numeric Action Level for suspended solids of 100 mg/L, which if exceeded, triggers the discharger to take action to address the exceedance.

Phase I and Phase II MS4s are, on the whole, a smaller source of sediments. The sediment and erosion controls in the current MS4s permits would fulfill the requirements for mercury.

Option 2: Mercury Pollution Prevention and Pollution Control
MS4s would be required to implement specific mercury pollution prevention and pollution control measures in their NPDES Storm Water Management Plans (SWMPs) or equivalent documents to reduce mercury/methylmercury discharges. At the Water Boards discretion, additional measures may be substituted for one or more of the required mercury pollution prevention and pollution control measures. Phase I and Phase II MS4s would be required to implement the actions listed below. The required effort involved in the actions would be proportional to the size and population of the community served by the MS4Required implementation actions include:

- Thermometer exchange programs and fluorescent lamp recycling programs, or enhancement of household hazardous waste collection programs to better address mercury-containing waste products (potentially including thermometers and other gauges, batteries, fluorescent and other lamps, switches, relays, sensors and thermostats);

- Public education and outreach, per the MS4 permit, on disposal of household mercury-containing products and use of non-mercury containing alternatives;
- Education of auto dismantlers on how to remove, store, and dispose of mercury switches in autos; and
- Survey of use, handling, and disposal of mercury-containing products used by the MS4 permittee agencies and development of a policy and time schedule for eliminating the use of mercury containing products by the permittees;

Mercury containing items need to be collected and disposed of in accordance with DTSC regulations. Details can be found at www.dtsc.ca.gov/HazardousWaste/Mercury/.

Phase I and II MS4s already have some existing requirements for public education outreach, pollution prevention, sediment controls for construction areas, and low impact development. Additionally, street sweeping is already required by both Phase I and II MS4s. Street sweeping removes fine dust, which may contain mercury from brake pads or atmospheric deposition and keeps improperly discarded mercury containing items from contaminating storm water. If the required actions are already being conducted by an MS4 those activities would count towards compliance.

Option 3: Update the Numeric Action Level in the Industrial General Permit

The Numeric Action Level for mercury in the Industrial General Permit would be changed from 1400 ng/L to 300 ng/L total mercury. A Numeric Action Level is a target concentration of a pollutant in storm water. If this concentration is exceeded it would trigger additional BMPs to control that pollutant. The Numeric Action Levels in the Industrial Activities Permit are intended to be economically feasible with current technology. They are not meant to be water quality standards, objectives, or criteria. All of the numeric action levels in the Industrial General Permit are from the U.S. EPA 2008 Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity (U.S. EPA 2008b). The development of the Numeric Action Levels incorporated the fact that pollutants would be diluted by large volumes of other storm water and that storm water discharges are sporadic (as opposed to water quality based effluent limitations that may apply to continuous discharges, Section 6.13).

Hazardous Waste Facilities are currently the only type of facility required to automatically monitor mercury (Order 2014-0057-DWQ, Table 1). However, permittees that handle mercury or materials containing mercury as part of the industrial process (not as a result of atmospheric deposition), and are therefore likely to discharge mercury in storm water, should also be monitoring mercury, especially if the discharge is to a water body on the 303(d) list due to mercury. Other facilities likely to discharge mercury include recycling facilities, dismantling yards or wrecking yards, scrap and waste material facilities (SIC 4953 -5093), and metal mining facilities (SIC10XX-14XX).

A Numeric Action Level below 300 ng/L is not recommended because Numeric Action Levels are technology based, not water quality based. It is not clear that a lower threshold would be achievable with currently available storm water treatment methods. The concentration of 300 ng/L is just above the quantitation limit of the old method (200 ng/L, method 245.1), so it is not clear from monitoring data whether a lower threshold could even be met.

Atmospheric mercury carried by rain should not cause an exceedance of the Numeric Action Level (300 ng/L) based on nationwide measured mercury concentrations in rain, including five locations in California. The median and average mercury concentrations in rain in California were 6 ng/L and 12 ng/L. The 99.8^{th} percentile of mercury concentrations in rain in the United States was 174 ng/L (Appendix P). Additionally, the Numeric Action Level for suspended solids should provide adequate control for mercury, if mercury in the discharge is from contaminated sediments (see Appendix P).

This concentration (300 ng/L) is six times higher than the outdated California Toxics Rule criterion (50 ng/L) and 25-75 times higher than water column targets that are consistent with meeting the objective (4 – 12 ng/L, Appendix I). Yet, the Numeric Action Level of 300 ng/L is about five times more protective than the current Numeric Action Level of 1400 ng/L.

For new dischargers discharging directly into a water body that is on the 303(d) list due to mercury, the discharger must meet one of three conditions specified in the Industrial General Permit (Order 2014-0057-DWQ, Section VII. B; or other conditions may apply if there is a TMDL). In fulfilling these requirements, the discharger may need to provide a demonstration that the discharge of any listed pollutant complies with water quality objective at the point of discharge. Because there would be no water column objective for mercury after the California Toxics Rule criteria are de-promulgated by U.S. EPA, compliance with the mercury Numeric Action Level (300 ng/L) is sufficient for demonstration of compliance with mercury water quality objectives for coverage under the Industrial General Permit.

Option 5 (RECOMMENDED): A combination of all of the above, using existing requirements and proposing new requirements for MS4s and the Industrial General Permit.

All of the requirements outlined in the options previously listed would be used. For some of the storm water dischargers, appropriate requirements are already included in storm water permits and a very unlikely to change over time, no new requirements would be developed (e.g., the erosion controls in the Caltrans Permit, the Construction General Permit, and Industrial General Permit). For MS4s and Industrial Activities, new requirements would be included in the Provisions. These requirements are a refinement of existing requirements, so they may result in dischargers needing to take additional actions. Meanwhile for other dischargers, the requirements may be fulfilled by existing actions of the discharger.

Many of these requirements have multiple benefits. Sediment/erosion controls are important for addressing the many sediment impairments throughout the State. Sediment controls are also valuable for controlling other pollutants that bind to sediments, such as pesticides, metals, and nutrients.

6.11.4 Recommendation

Option 5: A combination of all of the above, using existing requirements and proposing pollution prevention and erosion requirements for MS4s and lowering the NAL for the Industrial General Permit.

6.12 Issue L. What procedure should be used to determine which municipal wastewater and industrial dischargers would need effluent limitations?

6.12.1 Current Conditions

Municipal wastewater and industrial facilities that discharge directly to surface waters are regulated through NPDES permits. Federal regulations require water quality based effluent limitations for NPDES permittees with reasonable potential to cause or contribute to an excursion above any water quality objective (33 U.S.C. § 1311(b); 40 C.F.R. § 122.44(d)). The State Water Board's SIP 2005 is used to establish the need for effluent limitations for wastewater and industrial discharges (does not include storm water discharges), including those with NPDES permits.

Section 1.3 of the SIP outlines a procedure to determine whether a discharge causes, or has the reasonable potential to cause or contribute to an excursion above applicable objectives for priority pollutants. This process excludes discharges to receiving waters for which TMDLs have been developed and where the facilities have been assigned waste load allocations in the TMDL. In this process, the permit writer determines the maximum effluent concentration for a given pollutant from monitoring data submitted by the discharger. If the maximum effluent concentration is greater than or equal to the pollutant objective, or if the maximum background concentration of the pollutant is found to be above the pollutant objective and any amount of the pollutant is detected in the effluent, then "reasonable potential" has been established and an effluent limitation and routine monitoring is required for the discharge.

Currently, the SIP is used to implement the mercury criteria in the California Toxic Rule. Many facilities discharge much lower mercury concentrations than are required by the California Toxics Rule criteria (50/51 ng/L[5]). As a result, many dischargers currently do not have effluent limitations for mercury and do not monitor mercury routinely. A more protective approach has been used for discharges to mercury impaired waters, using the narrative considerations in the SIP. In some cases, an effluent limitation based on current performance was issued (which was lower than 50 ng/L), and the permit included a reopener in anticipation of a potential future TMDL waste load allocation.

All possible implementation requirements described in this section only apply to discharges that are not included in an adopted methylmercury/ mercury TMDL. Dischargers with a waste load allocation for the discharge of mercury/methylmercury from a TMDL must have a water quality based effluent limitation consistent with that waste load allocation (see 40 C.F.R. § 122.44(d)(1)(vii)(B)).

[5] The California Toxics Rule mercury criteria protect human health. The criterion of 50 ng/L protects consumption of water and aquatic organisms, and 51 ng/L protects consumption of aquatic organisms only (40 C.F.R. § 131.38).

Additionally, when modifying or reissuing permits with existing water quality based effluent limitations for mercury, permit writers must ensure compliance with Clean Water Act anti-backsliding requirements. For modified or reissued permits with existing effluent limitations for mercury, any less stringent effluent limitation must be consistent with anti-backsliding requirements within the Clean Water Act section 402(o)(1), unless a specific exception applies under anti-backsliding requirements (33 U.S.C. §1342 (o)(2), 40 C.F.R. §122.44(l)), or antidegradation requirements (33 U.S.C. § 1313(d)(4), State Water Board Resolution No. 68-16 (Statement of Police with Respect to Maintaining High Quality of Waters in California)). An example of a revision, would be one that is based on a waste load allocation from a TMDLs which will assure the water quality objective is attained (33 U.S.C. § 1313(d)(4)(B)(A)).

The U.S. EPA established *Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion*, which was used to develop the options described in this section (U.S. EPA 2010). This guidance may also be useful to permit writers for providing additional information on incorporating the methylmercury water quality objectives in NPDES permits.

6.12.2 Issue Description

A process is needed to determine which wastewater and industrial discharges would have effluent limitations, including municipal wastewater and industrial discharges. The SIP works well to establish which discharges must be issued effluent limitations for an objective expressed as a water column concentration. However, the SIP does not provide a method to assess the need for effluent limitations if the water quality objective is expressed as a concentration in fish tissue, as in the Mercury Water Quality Objectives. A method that is both consistent and simple to use would greatly aid the Regional Water Boards during the permit writing process. Municipal wastewater treatment plants are generally relatively minor sources of mercury to the environment compared to other sources. In addition, most wastewater treatment plants are efficient at removing mercury. About half of the current wastewater and industrial facilities are POTWs. Industrial dischargers also have been found to be a minor source in mercury TMDLs, such as the San Francisco Bay Mercury TMDL (San Francisco Bay Water Board 2006). However, there is a wide range of mercury removal achieved by different facilities, so there is no certainty that the mercury discharge from every discharge is insignificant.

The discussion on this issue does not focus on the possible numerical value of the effluent limitations. The effluent limitations themselves are described in the next issue (Section 6.13). For any of the options below and in Section 6.13, the Provisions include total mercury effluent limitations rather than effluent limitations for methylmercury or both. It is the methylated forms of mercury that are taken up into the food web. However, total mercury is relevant because any form of mercury can be methylated in the environment. Total mercury is less costly to monitor than methylmercury, or monitoring both forms separately. However, a permit writer may also require monitoring of methylmercury depending on the particular circumstances.

The Provisions would apply to dischargers with individual permits. The Provisions would not automatically apply to dischargers enrolled in general permits. General permits (non-storm water) should be considered on a case-by-case basis during development or renewal by the permit writer. Many general permits fall under exceptions in the SIP (vector control, drinking water systems) and others are low volume, low threat discharges. General storm water permits are addressed in Section 6.11.

6.12.3 Options

Option 1 (**RECOMMENDED): Use a mercury concentration in water.**

In this option, discharges with a mercury level above or equal to the water column target would generally need effluent limitations. The water column target would be used in the existing procedures in the SIP (Figure 6-2. Also see SIP section 1.3, the target would be used as “C”). Data on mercury level in fish tissue would not be a routine consideration in this option. There are three options to consider as the potential water column targets which are the options described in Section 6.13.

A major advantage of this option is that the typical procedures in the SIP can be utilized, and this option is much less complicated for permit writers to implement. This option is less complex because permit writers would not have to interpret fish tissue data (adequate number of data, appropriate size of fish, applicable species, etc.). Figure 6-2 and Figure 6-3 show that option 1 is less complex than option 2. Another advantage is that this approach may be more consistent with the federal regulations than the second option. An alternative to this approach is described in option 2, but the alternative is intended for cases where a water column translation in not available, infeasible, or appropriate (U.S. EPA 2010, see option 2).

This disadvantage of this option is that an appropriate value for the water column target is difficult to determine (the issues associated with using this value as the effluent limitation is discussed in 6.13). There will always be a fair amount of uncertainty associated with a water column target for mercury that is to be used in an area as large as California.

Another disadvantage is that this option could create unnecessary requirements for effluent limitations for some dischargers. This is because un-impaired waters still have assimilative capacity, so the mercury currently in the discharge might be acceptable or insignificant, depending on the circumstances.

However, mercury does not dissipate or break down over time. Once a water body is impaired for mercury it will take a very long time to reverse the impairment. The only way to prevent waters from becoming mercury impaired to is to control discharges before waters are impaired. Additionally, mercury impairments are not restricted to the vicinity of a discharge. Discharges of mercury may cause impairments far downstream, where the water flow slows and changes the water chemistry to promote the bioaccumulation of methylmercury in fish.

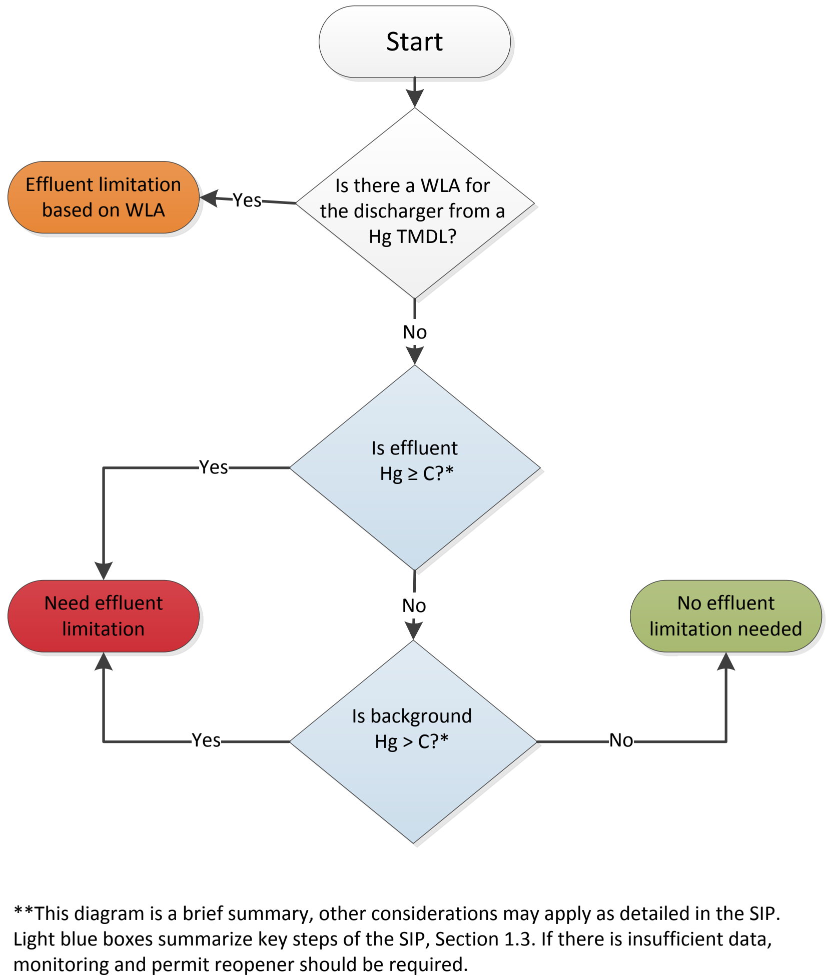

Figure 6-2. Summary of option 1: the water column target based approach to determine the need for effluent limitations. For "C" a target 4 ng/L or 12 ng/L could be used (see Section 6.13).

Option 2: Use mercury concentrations in fish tissue.
In this option, effluent limitations would be required for discharges to waters where the fish mercury levels exceed the water quality objectives if the discharge contains quantifiable levels of mercury, (≥ 0.5 ng/L total mercury). If these conditions do not exist, then depending on the specific circumstances, there may not be a need for effluent limitations.

The procedure for this option is not currently in the SIP. According to the SIP, fish tissue data may be considered when determining the need for effluent limitations, but there is not a specific procedure. The U.S. EPA *Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion* (U.S. EPA 2010, sections 7.2 and 7.5) outlined such a procedure, for cases where a water column translation in not available. This may apply in circumstances when it is also infeasible to calculate a water column translation as discussed further below.

A preliminary draft procedure is outlined in Figure 6-3. The following are some of the caveats that should apply (described in U.S. EPA 2010, sections 7.2.2 and 7.2.3).

a. If there are existing permits limitations, they may need to be retained to fulfil antidegradation and anti-back sliding requirements.
b. If a facility plans activities that could increase the mercury loading to the receiving water body, then an antidegradation review and requirements may be necessary (40 C.F.R. § 131.12, State Water Board Resolution No. 68-16, see also U.S. EPA 2010, section 7.5.1.2.2). Such activities may include: an increase in the design flow, a change in treatment, adding a new subdivision or an unsewered neighborhood to a sewer service area, or adding a new industry to the sewer service area that uses or handles mercury.
c. If fish mercury levels downstream exceed the water quality objective, then effluent limitations may be warranted.
d. If mercury concentrations in fish in the receiving water are close to the objective or trending up, then effluent limitations would be required.
e. The relative contribution of mercury or methylmercury from the source should be considered when determining whether a facility needs effluent limitations in waters that are not yet impaired.

Where objectives are being attained and dischargers have no effluent limitations, a new set of fish tissue data could be required for every permit renewal to ensure the mercury levels in fish tissue are not increasing, particularly if the effluent mercury concentration is above that from normal discharges (e.g. thresholds in Table 6-2, Section 6.13.3, option 3).

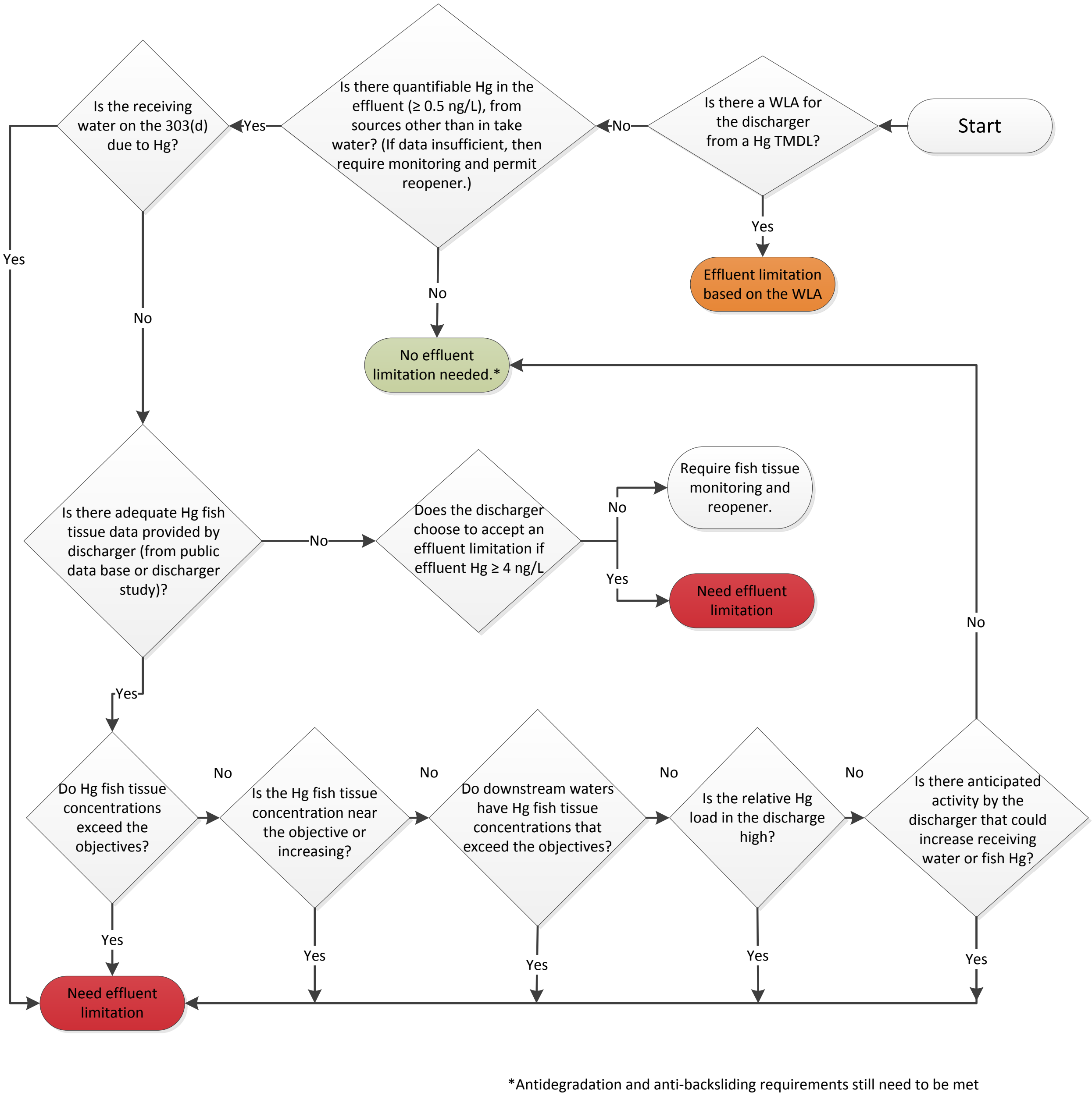

Figure 6-3. Summary of option 2: the fish tissue based approach to determine the need for effluent limitations.

The advantage of this option is that it avoids the uncertainty over using BAFs to calculate water column targets (as in the first option, above). Water column targets from BAFs include uncertainties involved in quantifying the relationship between mercury concentrations in fish tissue data to mercury concentrations in the water column and discharges. Water column concentrations of mercury or methylmercury are not always directly related to mercury impairments. Mercury fish tissue data, on the other hand, integrates spatial and temporal complexity as well as the cumulative effects of variable mercury loading from point and nonpoint sources that affect methylmercury bioaccumulation in aquatic systems. The fact that water quality objectives are currently being attained (in fish tissue) may be an effective indicator of current and potential continued future attainment, and could be used to justify that effluent limitations may not be needed. Although, the final decision of whether to issue an effluent limitation for mercury would depend on the particular case.

One disadvantage of this option is that it would be more difficult for permit writers to implement because the permit writer would have to evaluate fish tissue data. The list of caveats above and Figure 6-3 describes a number of factors that must be considered, many of which would not be straightforward. One difficulty would be assessing a situation where ambient fish mercury does not exceed the objective but is *close* to exceeding the objective (see U.S EPA 2010, section 7.5.1.2.3). In reality, significant increases in fish mercury (e.g. + 0.05 mg/kg) may not be detectable with typical fish tissue data sets since the data sets can be small (e.g. 12-24 data points) and fish tissue data can be fairly variable (e.g. standard deviation 0.09.)

A second disadvantage is that this approach may not be appropriate since a water column translation is possible. The appropriateness of such translation would ultimately depend on the calculations used and the resulting threshold. The possible water column thresholds and the achievability of such thresholds are discussed in the next issue when they are considered as effluent limitations. Still, the assumptions used to develop a water column translation (option 1) may be more consistent with the federal regulations that require an evaluation of the discharge, not just the receiving water as in this option (40 C.F.R. § 122.44(d)).

A third disadvantage is that this approach may fail to prevent future impairments because there would be no requirements to monitor or control mercury until a receiving water is impaired for mercury. A discharge into a receiving water with fish that meet the objective would have no restriction on how much mercury is allowed in the discharge. This approach ignores the fact that mercury can accumulate in a water body over time since mercury does not break down. To address some of these issues, the regulation would contain language with the caveats that apply to this option (listed above).

A fourth disadvantage is that dischargers would be required to provide data on fish mercury concentrations upon permit issuance or reissuance. If adequate fish tissue data are not already available (for example, in CEDEN), dischargers may be required to collect fish. Alternatively, if there is no fish tissue data then the dischargers could opt out of the fish collection obligation by agreeing to use a water column target to determine if they would be issued effluent limitations (same as option 1). That water column target may be based on the effluent limitation ultimately chosen. The water column target could be values in Table 6-1 (from Option 1, Section 6.13), a value based on facility type (Table 6-2, Option 2, Section 6.13), 4 ng/L (from Option 3, Section 6.13) or another value based on the effluent limitation ultimately chosen. In Figure 6-3, the value of 4 ng/L is shown as an example.

If dischargers are required to collect data, it would create extra expense for the discharger, which may be significant for a small discharger. However, additional fish tissue data would have the benefit of providing more monitoring data. Preferably fish collection and sample analysis would be done by a Regional Monitoring Program so that methods are consistent with appropriate monitoring protocols. However, many dischargers are not in a geographical area included in a Regional Monitoring Program (see Appendix N). Another complexity is how to handle situations where there are no fish in the receiving water, such as intermittent streams. In those cases, fish in downstream waters could serve as a substitute, such as fish in a bay or estuary.

6.12.4 Recommendation

Option 1: Use a mercury concentration in water.

6.13 Issue M. How should the effluent limitations be calculated for municipal wastewater and industrial discharges?

6.13.1 Current Conditions

Municipal wastewater and industrial facilities that discharge directly to surface waters are regulated through NPDES permits. Federal regulations require water quality based effluent limitations for NPDES permittees with reasonable potential to cause, or contribute to an excursion above any State water quality objective (33 U.S.C. § 1311(b); 40 C.F.R. § 122.44(d)). The State Water Board's SIP, 2005 is used to establish reasonable potential and water quality based effluents limitations for wastewater and industrial discharges (excluding storm water discharges). Currently, the SIP is used to implement the mercury criteria in the California Toxic Rule (50/51 ng/L[6]). Anti-backsliding requirements apply as described in Section 6.12.

Note that in addition to water quality based effluent limitations some industries must adhere to *technology-based* limitations pursuant to Clean Water Act section 301(b) and 40 C.F.R. sections 125.3 and 122.44(a)(1). The technology-based limitations establish a minimum level of treatment. The limitation also varies by industry type. (There are no technology-based limitations for mercury for POTWs.) These limitations often apply to one specific part of the industrial process, not to the final effluent. So the technology-based limitations are difficult to compare to a concentration limit for the final effluent. The Provisions would not affect technology-based limitations.

On December 15, 2016, the U.S. EPA established a new national rule establishing technology-based limitations for the dental sector. The U.S. EPA estimates that about half of the mercury entering POTWs comes from dental offices. The U.S. EPA proposed rule should reduce mercury discharges to POTWs nationwide. The rule would require dentists to reduce their discharge of dental amalgam through the use of amalgam separators and BMPs (http://water.epa.gov/scitech/wastetech/guide/dental/, 79 Fed. Reg. 63258 (Oct. 22, 2014)). In California, this new rule would be enforced by authorized municipal waste water treatment plants that implement a pretreatment program and Regional Water Board staff.

Additional information on wastewater and industrial discharges that is not included in this issues analysis is included in Appendix N. This includes the number, type, and location of facilities, and measured effluent mercury concentrations. As in Section 6.12, this issue only applies to discharges that are not included in an adopted methylmercury/ mercury TMDL.

[6] The California Toxics Rule mercury criteria protect human health. The criterion of 50 ng/L protects consumption of water and aquatic organisms, and 51 ng/L protects consumption of aquatic organisms only (40 C.F.R. § 131.38).

6.13.2 Issue Description

The issue is how to calculate effluent limitations for mercury for individual wastewater and industrial dischargers, including POTWs. While the SIP works well to establish effluent limitations for an objective that is expressed as a water column concentration, the SIP does not provide for a procedure to calculate effluent limitations from an objective expressed as fish tissue concentration. Therefore a procedure is needed to derive effluent limitations for dischargers.

Municipal wastewater treatment plants are generally a relatively minor source of mercury to the environment compared to other sources. Wastewater treatment plants already remove most of the mercury from the effluent. The plants are designed to remove solid materials and since mercury tends to adhere to solids, the removal of solid materials also removes the mercury. Major contributors of mercury to municipal wastewater treatment systems are typically dental offices, hospitals, and schools (Association of Metropolitan Sewage Agencies 2000, Larry Walker Associates 2002, U.S. EPA 2004). The original sources may be mercury amalgam dental fillings, broken thermometers, other consumer products and hospital equipment. Industrial dischargers, too, have been found to be minor sources of mercury when considering relative contribution compared to other sources in TMDL analyses, such as the San Francisco Bay Mercury TMDL (San Francisco Bay Water Board 2006).

Wastewater treatment plants with tertiary level treatment with nitrification and denitrification likely would meet any of the water column thresholds discussed in this issue (Central Valley Water Board 2010a). However, many facilities in California only have secondary treatment. Upgrading wastewater treatment plants to the tertiary level of treatment would have multiple benefits to the environment beyond just controlling for mercury. This level of treatment would assist in addressing nutrient over enrichment and could assist in meeting the goal for increased use of recycled water.

However, the costs to upgrade a wastewater treatment plant from secondary to tertiary level treatment are likely to be significant. (Costs will be evaluated as part of an economic analysis, see Section 1.1.) Additionally, most mercury 303(d) listings in California are thought to be due to the large mercury load from the mining legacy and atmospheric deposition (San Francisco Bay Water Board 2006, Central Valley Water Board 2010b).

It is difficult to accurately gauge the impact of the options for effluent limitations since most facilities are not routinely monitoring for mercury. Many facilities discharge much lower mercury concentrations than specified by the California Toxics Rule criteria (50/51 ng/L), therefore, many of these facilities do not currently have effluent limitations for mercury and do not routinely monitor mercury. Other factors that compound this issue include California's limited water supply, global climate change, and a growing population. These factors are driving reductions in per capita water use, while the population grows. The resulting effect of these factors on mercury levels in effluent is not clear. Mercury tends to stick to solids during treatment process at wastewater treatment plants, so the resulting effect to the mercury concentration in the effluent will not be as simple as the result of a loss of dilution.

Additionally, the background levels of mercury in some of California's waters are elevated. The average total mercury concentration in surface waters from 2004 to 2012 was 4.7 ng/L (median was 2 ng/L, 95th percentile: 16.1 ng/L, see section 4.5.1). The average is higher than the lowest water column target included in the options below, 4 ng/L total mercury. Where the background mercury level is high, it may not be reasonable to require smaller contributors of mercury to reduce their mercury discharge to levels below background

For any of the options below, the effluent limitations are in the form of total mercury rather than methylmercury, as explained in Section 6.12. Routine monitoring would be required once per calendar quarter, except for small facilities (authorized to discharge less than five million gallons per day), for which the frequency of monitoring may be reduced with the approval of the overseeing Water Board. Medium and large size facilities (authorized to discharge more than five million gallons per day) have requirements for pretreatment, since these facilities are more likely to receive discharges from industries or commercial facilities.

6.13.3 Options

Option 1 (RECOMMENDED): Effluent limitations based on water body type and bioaccumulation factors.

In this option, a modified version of the procedures in the SIP would be used and water column concentrations would be provided. The water column concentrations would be derived using BAFs and differ based on water body type, as shown below in Table 6-1. Additionally since there are five different mercury water quality objectives apply to different beneficial uses, the effluent limitations would depend on the beneficial use of the receiving water, also shown in Table 6-1.

Discharges with mercury levels above or equal to the water column concentration from Table 6-1 (e.g., 12 ng/L total mercury, as an annual average) would be required to meet an effluent limitation. The effluent limitation would be derived from the same water column concentration, and would be equal to the water column concentration or would be a higher concentration if dilution credits are granted (e.g.,12 ng/L total mercury or higher concentration, as annual average).

Table 6-1. Water column concentrations based on water body type and beneficial use.

Beneficial Use of the Receiving Water	**COMM, CUL, WILD, MAR, RARE**	**COMM, CUL, WILD, MAR, RARE**	**COMM, CUL, WILD, MAR, RARE, T-SUB**	**T-SUB**	**T-SUB**	**SUB**
Water body type	Flowing water bodies (generally, rivers, creeks and streams)	Slow moving water bodies (generally, lagoons and marshes)	Lakes and reservoirs	Flowing water bodies (generally, rivers, creeks and streams)	Slow moving water bodies (generally, lagoons and marshes)	Any
Value for "C"	12 ng/L total mercury	4 ng/L total mercury	Case-by-case	4 ng/L total mercury	1 ng/L total mercury	Case-by-case

For subsistence fishing, since the water quality objective is narrative, the effluent limitation would be derived on a case-by-case basis. The California or U.S. EPA BAFs could be used to calculate a water column concentration as was done in Appendix I.

This option includes two appropriate exceptions to avoid undue economic or social hardship: 1) facilities only serving small disadvantaged communities, and 2) insignificant discharges. These exceptions would not be automatic. The permit writer would have to review water body specific information and make a finding based on the information that the discharge will have no reasonable potential to cause or contribute to an exceedance of the water quality objective. For example, the fact that fish mercury concentrations meet the water quality objectives could support the finding. Insignificant discharges are discharges determined by the permit writer to be a very low threat to water quality, such as small, non-continuous discharges. The Provisions define "small disadvantaged communities" as "[m]unicipalities with populations of 20,000 persons or less, or a reasonably isolated and divisible segment of a larger municipality encompassing 20,000 persons or less, with an annual median household income that is less than 80 percent of the statewide annual median household income." These two exceptions could be used to relieve small dischargers form the expense of routine monitoring. Mercury monitoring using the newest method (Method 1631 E) is much more expensive than monitoring for other common metals.

Additionally, under this option the Provisions would provide that the Regional Water Boards could develop a site-specific BAF, from which a site-specific water column target could be derived. A study of the receiving water would need to be performed to provide the data. This study could be done by the Regional Water Board or by other parties, such as dischargers, with Regional Water Board approval. Using this procedure a study would be required that includes the collection of samples and measurements of the mercury concentrations in the water and mercury concentrations in applicable fish species. The study could include mercury samples collected from the water body and fish (using a minimum of 10 fish per time point or location, following Water Board's monitoring protocol (Bonnema 2014)). An alternative model that could be used to derive a site-specific water column concentration is linear regression (see Appendix I for examples). Other models may be used if peer reviewed such a food web model.

Dilution credits would be allowed but would not be recommended in most situations since mercury is a bioaccumulative compound, and the SIP (Section 1.4.2.2.B) and the U.S. EPA recommends limiting dilution for bioaccumulative compounds (U.S. EPA 2010, section 5.3.2). The U.S. EPA explains "While fish tissue contamination tends to be a far field problem affecting entire water bodies, rather than a narrow scale problem confined to mixing zones, the U.S. EPA's guidance recommends restricting or eliminating mixing zones for bioaccumulative pollutants such as mercury so that they do not encroach on areas often used for fish harvesting (particularly for stationary species such as shellfish). Restriction or elimination might also be used to compensate for uncertainties regarding the ability of aquatic life or the aquatic system to tolerate excursions above the criteria, uncertainties inherent in estimating bioaccumulation, or uncertainties in the assimilative capacity of the water body."

Advantages / Disadvantages

One advantage of this option is consistency with the SIP, which would make the process more straight forward for permit writers, as opposed to option 2. Another advantage is that this approach uses a water quality based threshold as required by federal regulations, as opposed to option 2. A third advantage is that the threshold for flowing waters, which would apply to the most discharges, is supported by California data. And finally, since the effluent limitations would match the level of protection needed for the receiving water type, dischargers would not need to meet unnecessarily stringent effluent limitations.

A disadvantage is that this approach has some complexity since the permit writer must judge the applicable water body type. However, in most cases (at least 65 percent of the cases, for rivers and creeks) this decision would be straight forward. Another disadvantage is that rivers flow through estuaries before reaching the ocean, and it is not clear that this approach would be protective of downstream uses. On the other hand, it is unknown if the mercury would reach the downstream water body. The mercury could settle out of the water column or be taken up into the local food web. To address these issues, option 3 uses one numeric effluent limitation for all water body types to avoid possible impacts to downstream waters and avoid the complication of evaluating "slow moving waters".

Derivation of effluent limitations and water body types

The water column target of 12 ng/L (total mercury) was calculated by using the U.S. EPA BAF from rivers and streams only, as shown in Appendix I. Most (65 percent) of the discharges from wastewater and industrial facilities flow into rivers or creeks (Appendix N). An equivalent threshold of 12 ng/L was derived using the California BAF. The California BAF was derived from data from rivers (Appendix I). Additional discharges (19 percent) flow to channels, canals, ditches and drains, which may experience roughly similar bioaccumulation rates as rivers or creeks, so the 12 ng/L effluent limitation would apply. These receiving waters were classified as "flowing water bodies" in the Provisions for permitting. This category includes intermittent or effluent dominated streams and creeks as well, since the bioaccumulation rate is not anticipated to be significantly different.

About 7 percent of discharges within the geographic scope of the Provisions flow into water bodies that are estuaries, sloughs, or wetlands, while 10 percent of discharges are to bays (Appendix N). Slower moving waters may experience higher rates of mercury methylation and bioaccumulation. For estuaries, there are no established BAFs. Some estuaries may experience flushing and the translation for the rivers BAF may be the most appropriate value to use. On the other hand, some estuaries may be enclosed and more stagnant, and the U.S. EPA BAFs for lakes may be more appropriate. Due to the uncertainties surrounding an appropriate number for estuaries, the draft national BAF that combined lakes and rivers data was used to derive a water column translation for slow-flowing estuaries and bays (Appendix I), and the resulting effluent limitation is 4 ng/L. These receiving waters were classified as "slow moving water bodies" in the Provisions for permitting. Professional judgment of the permit writer and site-specific information is needed to asses if the receiving water type would best be categorized as "slow moving" or "flowing" as listed in Table 1 as described here.

For reservoirs and lakes, since there are few discharges to these waters (about 12), and many of these discharges (6) would be assigned waste load allocation from the reservoir TMDL being developed as part of the Reservoir Program, specific effluent limitations were not developed for discharges to reservoirs or lakes as part of the Provisions. If any permit for these six facilities is renewed after the Provisions are adopted but before the reservoir TMDL is adopted as part of the reservoir program, the Provisions allow for requirements to be developed on a case-by-case basis. The permit writer should also include a reopener for the waste load allocation from the reservoir TMDL. For the other six discharges (or future discharges) to reservoirs not on the 303(d) list due to mercury, the requirements would be developed on a case-by-case basis and existing data could be used, such as the U.S. EPA BAFs and translators. Many of the discharges to reservoirs are small and may qualify for either the small disadvantaged communities or insignificant discharges exception, described above.

Achievability of effluent limitations

For the 12 ng/L effluent limitation, recent data from discharger self-monitoring reports indicates that about 8 percent of all discharges to rivers or other flowing waters included in geographic scope of the Provisions exceeded 12 ng/L at least once during 2009 – 2015 (Appendix N). Therefore, of the discharges to rivers or other flowing waters in the geographic scope of the Provisions (about 216 facilities), it is likely that about 8 percent (about 17 facilities) would be issued new requirements for mercury. These facilities would need to monitor their effluent and ensure their discharge meets the effluent limitation. Some of the facilities that exceeded this threshold only exceeded it in one or two samples within the past six years, so they may be able to adapt to the threshold without a major facility upgrade.

For the 4 ng/L effluent limitation, recent data from discharger self-monitoring reports indicates that about 27% of all discharges to waters included in the geographic scope of the Provisions exceeded 4 ng/L, based on 2009 – 2015 data (Appendix N). There are 29 facilities that discharge to estuaries or bays that may include slow moving waters in the geographic scope of the Provisions. Therefore, of facilities that discharge to estuaries/slow moving waters (roughly 29 facilities) in the geographic scope of the Provisions, it is likely that about a third (roughly 10 facilities) would likely need to meet the effluent limitation of 4 ng/L and or make upgrades to the facility. These numbers are illustrative only. Not all bays and estuaries are slow moving waters.

For the 1 ng/L effluent limitation, recent data from discharger self-monitoring reports indicates that about 73% of all discharges to waters included in the geographic scope of the Provisions exceeded 1 ng/L, based on 2009 – 2015 data (Appendix N). This data indicates that there is a good chance that the effluent limitation of 1 ng/L would cause a facility to upgrade. For this effluent limitation to take effect, the applicable beneficial use of Tribal Subsistence Fishing would need to be designated to a slow moving water body through the basin plan amendment process. It is unknown where this use may be designated in the future. The Subsistence Fishing Water Quality Objective, too, could result in effluent limitations of roughly 1 ng/L to 4 ng/L, where the corresponding use might be designated in the future.

For implementing the effluent limitations for either of the two subsistence fishing water quality objectives (1 to 4 ng/L), it may be appropriate for a compliance schedule to be issued with the permit if the resulting effluent limitation would require a major infrastructure upgrade. In general, this category of dischargers is not thought to be a major source of mercury, so a higher effluent limitation, could be appropriate upon consideration of all mercury sources, as would be done for a TMDL. An informational TMDL based on Clean Water Act section 303(d)(3) can aid in permitting (33 U.S.C. § 1313(d)(3)). If there is an existing TMDL for mercury, the TMDL could be reopened and revised to include the Subsistence Fishing Water Quality Objective. Additionally, since the subsistence type uses vary by water body, the Regional Water Boards are encouraged to develop site-specific subsistence water quality objectives at the same time that the beneficial use is designated. Site-specific water quality objectives may be adopted with compliance schedules that are longer than normal. The longer compliance schedule could allow time for facility upgrades, development of TMDLs, or studies to develop a site-specific BAF to implement the subsistence objective.

Additional details of this option

The effluent limitation in this option was calculated considering that the Mercury Water Quality Objectives are intended to protect against chronic effects from consumption of fish with elevated mercury, and the fact that the mercury concentration in fish is a result of a long term process of mercury methylation and bioaccumulation in the food web. Therefore, the calculation of the effluent limitation was made with the procedures in the SIP for human health criteria, which protect against chronic toxicity, rather than deriving effluent limitations both for human health and aquatic life, as indicated in the SIP (section 1.4. B). Also, the effluent limitation would be an annual average, not a monthly average, to account for the long term process of mercury methylation and bioaccumulation. On the other hand, the procedure in the SIP for calculating effluent limitations based on aquatic life criteria was derived to protect the short term averaging periods (1 hour or 4 days), which protect aquatic life from faster acting pollutants and toxicity through the water column. A daily maximum effluent limitation for mercury is not recommended for the same reason. Additionally, the effluent limitation (12 ng/L) is well below acute aquatic life thresholds for mercury (listed in Section 3.11). In a realistic scenario, a discharge that exceeded the U.S. EPA's most recent acute mercury threshold (1400 ng/L) would not be able to also meet the annual effluent limitation (12 ng/L). Federal regulations require daily and monthly or weekly and monthly limitations depending on the facility type, unless "impracticable" (40 C.F.R. 122.45 (d)). Such daily and monthly limitations are impracticable for mercury in that they do not provide necessary information over an annual average limitation for controlling the mercury levels in fish tissue.

The Reservoir Program may include waste load allocations for discharges upstream of reservoirs. These waste load allocations would be intended to achieve the Mercury Water Quality Objectives in the reservoir, not in the upstream water body. Therefore, the permit writer should consider both possible requirements (if applicable to the discharge) and select the most stringent requirement for the discharge.

The wildlife objectives are consistent with meeting the one meal per week objective in trophic level 4 fish or very close. Data are not available to make this determination in a very exact manner, but see Section 6.1 through Section 6.6 of Appendix K for estimations. Therefore, the Prey Fish Water Quality Objective and the California Least Tern Prey Fish Water Quality Objective would not require a different effluent limitation than the Sport Fish Water Quality Objective for wastewater and industrial discharges (unless a TMDL indicates otherwise).

Option 2: Effluent limitations from the Proposed Mercury Control Program for Reservoirs.

This option is being discussed for the Reservoir Program's mercury control program (see Section 1.6). In this option, dischargers with mercury in the effluent above or equal to the concentration specified in Table 6-2 would be issued an effluent limitation. The effluent limitation would be the same concentration from Table 6-2. The smallest dischargers would not have requirements as indicated in Table 6-2.

Table 6-2. Effluent Limitations Based on the Proposed Mercury Control Program for Reservoirs

Facility type	Reasonable potential Threshold/ Effluent limitation (total mercury) and other requirements
Design flow < 0.2 MGD	• No new requirements
Design flow : 0.2 MGD – 1 MGD	• Municipal wastewater: 20 ng/L annual average • Other facilities: 60 ng/L
Design flow >1 MGD	• Municipal wastewater: 10 ng/L annual average • Other facilities: 30 ng/L

MGD = million gallons per day

Current data from discharger self-monitoring report indicate that about 8 percent of all discharges to waters included in the geographic scope of the Provisions exceed the various thresholds in Table 6-2, based on 2009 – 2015 data (Appendix N). Therefore, it is likely that about 8 percent of facilities in the Provisions' scope would be issued new requirements for mercury, which is similar to option 1. These facilities would need to monitor their effluent and ensure their discharge meets the effluent limitation.

The thresholds in this option are based on the Reservoir Program (State Water Board 2016). The thresholds were derived based on a current performance of facilities statewide. The analysis included mercury effluent concentrations from 2008-2013 from all individual wastewater and industrial discharges (except discharges to the ocean), not only data from facilities that discharge into reservoir watersheds. These thresholds are also similar to the 95th and 99th percentiles of existing mercury concentrations from the 2009-2015 data set analyzed in Appendix N, (see Table N-10, e.g. 10 ng/L and 20 ng/L for municipal wastewater are the 95th and 99th percentiles, respectively). The Reservoir Program may have slightly different categories of facilities than shown in Table 6-2 and may include other requirements for impaired reservoirs that are not included here.

The advantage of this option is that it seeks reasonable controls for municipal wastewater facilities that are feasible with current technologies. Most facilities in California are already achieving these effluent limitations, since the limitations are based on current performance of facilities. This option rewards dischargers that maintain existing effluent quality.

A disadvantage is that this approach was designed to implement a TMDL for reservoirs which have few wastewater and industrial discharges. This approach is based on the assertion that these dischargers are not a significant source of mercury to reservoirs. Hence, capping the amount of mercury in the discharge at the level it is at currently should be a sufficient level of control. However, effluent limitations based on *current performance* are inconsistent with federal regulations that govern implementation of water quality objectives. The federal regulation require *water quality based* effluent limitations for wastewater and industrial discharges that have reasonable potential to cause, or contribute to an excursion above any State water quality objective (33 U.S.C. § 1311(b); 40 C.F.R. § 122.44(d)). The federal regulations essentially provide that if the level of mercury in the discharge has no reasonable potential to cause or contribute to an exceedance of the water quality criteria (objectives in California), then the discharge should not have any effluent limitation.

Another disadvantage is the assertion that all wastewater and industrial discharges in the state are an insignificant source of mercury. This is problematic since there was no analysis of the relative contribution of all discharges in their respective watersheds, statewide. The geographic scope of the Provisions includes many large discharges that are close together in urban areas, in contrast to the few discharges to or upstream of reservoirs. For example in the Sacramento-San Joaquin Delta TMDL the combined wastewater and industrial discharges contributed a methylmercury load that needed to be controlled (Central Valley Water Board 2010b). In that TMDL, the wastewater and industrial discharges contributed more methylmercury than atmospheric deposition. If the mining legacy were removed from the relative load analysis, then the wastewater and industrial discharges would be a much larger relative load. Therefore, the assumption that these dischargers are insignificant does not apply in areas of the state that are not impacted by historic mining.

A third disadvantage is that this approach is more stringent on POTWs compared to privately owned industrial facilities. A fourth potential issue with using this approach (outside of a TMDL), is that the current effluent limitation for industrial facilities is higher than the current California Toxics Rule mercury criteria (50 ng/L). This issue may be confusing or conflicting. In this option, facilities that have no new requirements (facilities less than 0.2 MGD) may retain their old limitation based on the California Toxics Rule mercury criteria, which is likely lower than the threshold for larger facilities (60 ng/L for facilities 0.2-1 MGD). Also, if facilities need to adhere to a lower effluent limitation based on the California Toxics Rule mercury criteria for the municipal and domestic supply beneficial use (MUN) then that limitation would apply.

Option 3: Combination: Mercury Minimization Plan, one statewide water column target, and effluent limitations from the Reservoir Program.

In this option the water column target 4 ng/L (total mercury annual average) would be used as the basis to determine which discharges need effluent limitations. For dischargers with mercury effluent concentration above 4 ng/L in the discharge, an effluent limitation and a mercury minimization plan would be required. The effluent limitation would be thresholds based on current performance of facilities from option 2 (Table 6-2). Essentially, the threshold of 4 ng/L serves as a trigger for the mercury minimization plan, while the numeric effluent limitation serves as a backstop to maintain current performance. The mercury minimization plan is explained in more detail at the end of this option. This option would include the same three exceptions from option 1: 1) small disadvantage communities, 2) insignificant discharges, and 3) site-specific water column translation.

The water column target of 4 ng/L was calculated using the U.S. EPA draft national BAF and translators. In this option, the target would not be used to calculate effluent limitations, because of the high uncertainty in the value. Instead, it would be a trigger for the mercury minimization plan. However, the water column target of 4 ng/L compares well with the targets from the Cache Creek, Bear Creek, Harley Gulch and Sacramento San Joaquin Delta TMDLs (see Appendix I).

Most tertiary plants, such as those with nitrification and denitrification processes, have mercury concentrations under 4 ng/L (annual average) in the effluent because of the enhanced filtration maximize removal of suspended solids (Central Valley Water Board 2010a). Therefore, tertiary plants are unlikely to be issued any new mercury requirements. On the other hand, most secondary treatment facilities do not achieve concentrations below 4 ng/L mercury in the effluent, since such technology is not designed to achieve this low level of mercury. Facilities with only secondary treatment would most likely need to implement the mercury minimization plan and meet the performance based limitations. Current data from discharger self-monitoring report indicate that about 27 percent of all discharges to waters included in the geographic scope of the Provisions exceed the 4 ng/L threshold, based on 2009 – 2015 data (Appendix N). Therefore, it is likely that about 27 percent of facilities in the Provisions' scope would likely need to implement the mercury minimization plan and meet the performance based effluent limitations.

An advantage of this option is that it is an economically viable method to reduce mercury in discharges to meet the water quality based water column target derived to protect all waters. Also, this approach would likely provide more of a driver to reduce mercury compared to option 2 or option 3 alone, because the threshold (4 ng/L) is the lowest threshold. Furthermore, concentrations lower than 4 ng/L may be needed to achieve the Sport Fish Water Quality Objective in lakes and reservoirs, as suggested by bioaccumulation factors for lakes (Appendix I). These advantages are important since mercury is a persistent, bioaccumulative pollutant. Mercury never degrades and it can be transported to other environmental compartments and other watersheds. Sludge from municipal wastewater facilities may be burned, composted or applied to land where mercury can enter the atmosphere (mercury is volatile metal), or it may be landfilled in another watershed, where the mercury can potentially be released back into the environment.

A second advantage is that this option is the most protective option for the environment because the threshold (4 ng/L) is the lowest compared to the other options. Option 1 may not be protective enough for waters other than rivers and streams. While most discharges are in rivers, these waters pass through estuaries which may require a lower mercury concentration to protect human health and wildlife. For example, many facilities discharge into rivers that are upstream of the Sacramento-San Joaquin Delta Estuary. Additionally, methylmercury bioaccumulation is a complex process that is not confined to the immediate vicinity of a discharge.

A disadvantage of this option is that the water column value comes with a great deal of uncertainty. The actual water column concentration necessary to achieve the objective is fish tissue may be an order of magnitude higher or lower that the water column target (4 ng/L) depending on many site-specific factors. The target was calculated with data that originated in lakes and rivers, mainly from waters outside of California (U.S. EPA national bioaccumulation factors, U.S. EPA 2001). In addition, since many discharges in California only flow into rivers, this threshold (4 ng/L) may be inappropriate for most dischargers in the state. This is because rivers are known to experience lower rates of bioaccumulation. Therefore, translating to a water concentration with BAFs for rivers yields less stringent thresholds (e.g. 12 ng/L, as calculated in option 1).

A second disadvantage is similar to a disadvantage discussed in option 2 in that there is an inconsistency with federal regulations. The effluent limitation is not water quality based. Only the target for the mercury minimization plan is based on water quality. A third disadvantage is inconsistency with the Reservoir Program. Although the numeric effluent limitations are the same as those developed for impaired reservoirs, this requires more stringent implementation for unimpaired water (with the addition of the mercury minimization plan). However, that project is still under development at this time.

A fourth disadvantage is that this option requires extra time and resources from all parties to implement the mercury minimization plan, but it is not clear that the effect to the environment would be better than the other options, since the effectiveness of mercury minimization plans is debatable (see below on mercury minimization plans). This option would add an extra step to the permitting process to implement the mercury minimization plan.

Mercury minimization plan

For the mercury minimization plan, the extent of the plan effort should be proportional to the facility discharge flow, the potential impact, and the discharger’s available resources.

Monitoring would be used to evaluate the effectiveness of the plan. The U.S. EPA recommends monitoring and a reopener clause in case the mercury minimization plan is ineffective. A mercury minimization plan could include (see U.S. EPA 2010 for more details):

- Identification of sources and methods for reducing mercury,
- BMPs/limitations of all potential sources
- Material substitution, material recovery, spill control, waste recycling, and disposal practices
- Public education on proper disposal or selecting products without mercury
- Outreach to dental offices to control dental amalgam, as may be required by U.S. EPA's proposed rule.

As an alternative to the standard requirements of a mercury minimization plan, a discharger could perform one or more of the following, depending on the facility size and population served:

- Public education on risks of eating fish.
- Activities that can reduce mercury in the watershed, such as participating in a mine clean up.
- Initiate and fund (in coordination with other appropriate authorities) a residential liquid mercury collection program, especially in areas where small scale gold mining is, or was common.
- Perform a 10 year study with isotopically labeled mercury to determine if mercury from the discharge accumulates in fish. If mercury from the discharge is not detectable in fish, then the discharger may not have additional requirements. If the mercury is detectable in the fish, then the discharger would need to develop and implement the mercury minimization plan.

The U.S. EPA has found pollution minimization programs successful in reducing mercury loadings to the environment. The reports *Mercury Study Report to Congress* (U.S. EPA 1997b) and draft *Overview of P2 Approaches at POTWs* (Publicly Owned Treatment Works, U.S. EPA 1999b) show that municipal wastewater facilities and industrial dischargers have implemented source controls, product substitution, process modification, and public education programs with great success. These minimization practices focus on sources and wastes that originate within a facility and are under the reasonable control of that facility, not on pollutants in rainwater or source water (U.S. EPA 2010). Since mercury is a bioaccumulative, persistent pollutant that can cause adverse health effects, U.S. EPA believes that it is reasonable to expect wastewater and industrial dischargers to implement cost-effective, feasible, and achievable measures to reduce the amount of mercury they discharge into the environment. Depending on the particular facts, permit writers may reasonably conclude that permit limitations that require such measures derive from, and comply with, water quality objectives as required by U.S. EPA regulations at 40 Code of Federal Regulations section 122.44(d)(1)(vii)(A) (U.S. EPA 2010).

However, the effectiveness of mercury minimization plans is debatable, particularly their ability to reduce mercury in the effluent of wastewater treatment plants. Wastewater treatment plants already trap most of the mercury in the sludge. Therefore, minor reductions of mercury in the influent may not translate to noticeable reductions in the effluent. A 2002 analysis found that mercury pollution prevention is unlikely to reduce mercury to the point of compliance with a BAF based effluent limitation, "…pollution prevention or source control are potentially effective in achieving sufficient reductions to enable POTWs to meet effluent limits that are 7.8 ng/L or greater. However, if more stringent effluent limits are in effect such as the 3.1 or 1.3 ng/L limits that have been imposed on POTWs in the Great Lakes Region, pollution prevention or source control with no treatment process modifications will not be effective in achieving these limits. Regardless of the potential for meeting effluent limits through pollution prevention and source control alone, these efforts have many benefits as described in this report and should be considered as an essential tool in any mercury reduction effort" (Larry Walker Associates 2002). Additionally, the San José-Santa Clara Wastewater Facility has shown that reduction in influent total mercury does correlate to reduction in the effluent mercury (San José-Santa Clara Regional Wastewater Facility 2014.)

6.13.4 Recommendation

Option 1: Adopt numeric effluent limitations based on water body type and BAFs (requirements would not apply automatically apply to dischargers included in a TMDL, such as discharges to the San Francisco Bay or Delta).

6.14 Issue N. Should the Provisions include a public exposure reduction program?

6.14.1 Current Conditions

There is no established policy, although two mercury TMDLs have included mercury public exposure reduction programs. These are the San Franco Bay mercury TMDL and the Sacramento San Joaquin methylmercury TMDL. In the San Francisco Bay, the public exposure reduction program also included PCBs, not just mercury. These programs were funded by dischargers included in the TMDL.

The participation of other state agencies has been an integral part of Water Board mercury public exposure reduction programs, including CDPH, and OEHHA. Part of the mandate of these agencies is protecting public health. OEHHA also issues health advisories for mercury in locally caught fish (Appendix E). A goal of current advisories and exposure reduction programs is to inform the public on the type fish that is better to eat, rather than the most hazardous fish, which can leave people confused as to which fish they should choose.

6.14.2 Issue Description

The issue is if a public exposure reduction program should be included in the Provisions or if such a program should be conducted on a statewide basis by the Water Boards. Mercury concentrations in fish are unlikely to improve much in the near future, yet people would continue to eat locally-caught fish. Public education is needed to warn people about the risk of eating fish with high levels of mercury, so that people can make better choices on which fish to eat.

The work of educating the public on health issues generally falls under the mandate of the CDPH, OEHHA, or the County Health Departments. However, for example, the County Public Health Departments have many other mandates concerning more immediate heath issues, and those mandates provide the agencies with funds to implement them.

The San Francisco Bay mercury TMDL included a public exposure reduction program that was fairly successful (CDPH 2012). The success of the San Francisco Bay program was partly attributed to the assistance provided by CDPH. However, those resources have not been available for the public exposure reduction program for the Sacramento San Joaquin Delta, and it has been a struggle to put that program into action. The Water Boards would require staff and funding to perform public education.

6.14.3 Options

1. **No action (Recommended). Recognize the role of the California Department of Public Health, and the Office of Environmental Health Hazard Assessment, continue to support these agencies with data, and recommend they continue this work.** In this option, the Water Boards would continue working with other agencies on public exposure reduction by providing data on the levels of mercury in fish in order to

generate consumption advisories and providing input on the water bodies that need health advisories the most. In this option, the Water Boards would not develop a public exposure reduction program for mercury. The State Water Board would recommend that other agencies continue to inform the public on the risks of eating fish with high levels of mercury. This work could include posting signs, public outreach, involvement of local community groups, or outreach to medical or public health professionals.

2. **Commit to develop a mercury exposure reduction program.**
   In this option, the Water Boards would commit to establish a statewide program to educate the public on which fish are safer to eat due to lower levels of mercury. This may include posting signs, public outreach, involvement of local community groups, or outreach to medical or public health professionals.

   Staff resources would be needed to coordinate such a program with other state agencies and the many communities involved, and this approach would be best accomplished with a dedicated a staff person to coordinate such a program. The Water Boards existing mercury public exposure reduction programs have depended on other agencies that normally perform public outreach activities, such as OEHHA which currently issues fish advisories, and the CDPH. A successful statewide public reduction program would depend on collaboration with these agencies and local communities. To fund the work, the water boards could rely on dischargers, however the dischargers are not the source of most of the mercury contamination. It would be more appropriate to use public funds to perform the work.

   Another consideration in developing a public education program is that the program should also consider other contaminants, such as PCBs. In many areas, mercury is not the only contaminant at levels of concern in fish tissue. For example, a species like bass may have high mercury, but a bottom feeder like catfish may have lower mercury but higher PCBs. The public education should not be based only on mercury level in fish, since it could misrepresent the risks of eating fish containing elevated levels of other contaminants.

6.14.4 Recommendation

Option 1. Recognize the role of the CDPH, and OEHHA, continue to support these agencies with data, and recommend they continue this work.

7. Reasonably Foreseeable Methods of Compliance

This section provides a description of the reasonably foreseeable methods of compliance for each element of the Provisions. The Water Boards do not specify a manner of compliance and accordingly, the actual compliance strategies would be selected by the local agencies and other permittees. Although the Water Boards do not mandate the manner of compliance, the State Water Board's SED for a proposed project is required to include an analysis of the reasonably foreseeable methods of compliance with the project (see Cal. Code Regs., tit.23, § 3777; Pub. Resources Code, § 21159). Several of the reasonably foreseeable methods of compliance are well known methods of mercury control, and a discussion of a reasonable range of these methods of compliance and design parameters is presented below. Chapter 8 contains the environmental analysis of the reasonably foreseeable methods of compliance.

Mercury is one of the basic elements. Therefore, it does not break down or dissipate over time. Once mercury is introduced into the environment it will remain within that environment unless it is either washed further downstream into another environment, entrapped within sediments, or physically removed through activities such as excavation or dredging. Once in the environment, elemental mercury does not pose a significant risk to humans and wildlife as long as it remains in its elemental form. However, under certain conditions, generally in waters that are anoxic and high in organic matter, bacteria readily convert elemental mercury into the more toxic and bioavailable compound methylmercury.

7.1 Compliance Methods

Reasonable and foreseeable methods of compliance related to mercury focus on four major components, which are discussed in greater detail as they relate to each type of potential discharger within this Chapter of the Staff Report. The major reasonably foreseeable methods of compliance for mercury control are:

- Institutional controls, such as mercury minimization plans, to keep mercury from entering into the environment.
- Mercury removal methods to remove mercury from the environment.
- Sediment controls to prevent mercury in the environment from entering the waterways.
- Water management practices to prevent or reduce the conversion of elemental mercury to methylmercury.

The methods of compliance discussed would not include methods that are not reasonably foreseeable as a result of the Provisions.

7.1.1 Institutional Controls

"Institutional controls" refers to practices and programs designed to prevent diffuse sources of mercury from entering waterbodies and treatment facilities. These programs are typically implemented by a municipal government or agency. Institutional controls for mercury include: mercury minimization programs, in which facilities limit mercury sources (described below) from entering the wastewater stream; mercury thermometer collection and disposal; waste collection of mercury-containing materials, such as thermometers and fluorescent light bulbs; and education campaigns for auto dismantlers regarding proper disposal of batteries and switches.

A mercury minimization program could be conducted by a wastewater treatment facility or an industrial facility. The first step in a mercury minimization program is identification of sources and methods for reducing mercury. For a wastewater treatment facility, sources could include dental offices (from the dental amalgam), hospitals, schools, or industrial dischargers that discharge into a municipal wastewater treatment system. Also the facility conducting the mercury minimization program should look for chemicals used in the facility that contain mercury, such as chlorine. (Mercury is used to produce chlorine, and chlorine is added to reduce bacteria in wastewater.) This identification of sources could include mercury monitoring at various places in the system to find significant inputs of mercury. Once mercury sources are identified, the facility would conduct actions to reduce the mercury from those sources. This might include issuing limitations or requirements for BMPs to the indirect dischargers (dental offices, hospitals, schools or industries). The BMPs could include material substitution, material recovery, spill control, waste recycling, and proper disposal practices. Such BMPs may also be used to control in-house sources of mercury in the facility. Also, a wastewater treatment facility may conduct actions to generally try to reduce mercury inputs such as public education on proper disposal of products containing mercury or selecting products without mercury (see U.S. EPA 2010 for more details on mercury minimization programs). Requirements for dental offices to control dental amalgam will be required by U.S. EPA's recent rule (http://water.epa.gov/scitech/wastetech/guide/dental/, 79 Fed. Reg. 63258 (Oct. 22, 2014)), but a wastewater treatment facility could opt to take more action than required by that rule, depending on the circumstances.

7.1.2 Mercury Removal Methods

In general, mercury has contaminated air, water, and soil resources. Mercury can be removed from the environment through a variety of methods, but those methods depend on the medium in which the mercury is contained. Removal methods, in the context of water quality control, are limited to removal from soil and water.

Mercury binds strongly to soil and sediment, but can be liberated when contaminated soils or sediments are disturbed. In some cases, contaminated soil and sediment can be physically removed from a site and disposed at a landfill, a hazardous material storage facility, or stored at a stabilized structure on or near the remediation site. Heavy earth-moving equipment is often involved in this process.

Wastewater treatment facilities are a potential source of mercury entering into a waterway, depending upon the sources of wastewater going to the facility. Mercury disposed into drainage systems from sources such as dental offices, industrial sources, household products, and deposition of ambient mercury in air onto areas linked to sewer systems (e.g., parking lots) can be routed to wastewater treatment facilities. In these cases, the treatment facilities can remove a significant portion of the mercury within their system by taking steps to remove solids during their treatment process. Treatment plants that install systems to upgrade from "secondary" to "tertiary" treatment remove additional materials and reduce final mercury emissions in discharges to the environment. Secondary treatment systems use biological processes to break down liquid organic waste into consolidated sludge and dissolved inert organic matter (i.e., organics that will not absorb oxygen from receiving waters). Tertiary treatment systems add chemical and physical processes to filter out suspended matter left over from earlier treatment processes (such as suspended sediments, and residual organic particles). Because mercury adheres to solids, a facility that takes additional steps to remove solids in their treatment process would also remove more of the mercury that passes through their system. Data from California's Central Valley shows that facilities that have tertiary treatment have significantly less mercury in their effluent than treatment facilities that rely on secondary treatment (Central Valley Water Board 2010a).

7.1.3 Sediment Controls

Mercury actively adheres to solids, including sediments. Sediment contaminated with diffuse mercury introduces mercury into aquatic environments when it erodes and flows into nearby waterbodies. Controlling this source of mercury is achieved by preventing the sediment, or runoff moving over the sediment from reaching waterbodies.

Sediment controls are most needed in areas contaminated by mercury from mining activities or areas where soils are naturally enriched with mercury. However, due to atmospheric deposition, all soils throughout California are potential sources of mercury contamination when eroded providing sediments that wash into our waterways.

Sediment controls can be achieved in a number of ways. Some of the more simple sediment controls involve placing absorbent barriers such as hay bales or wattles (mesh tubes filled with straw) around construction sites or along degraded slopes to prevent or minimize runoff from disturbed areas, especially in burn areas. However, these are temporary solutions intended for short term projects. More permanent solutions often involve structural controls, such as earthmoving equipment to create barriers, berms, hillside grading, and installation of riprap (barriers made of large loose rock) to direct and slow flows. Silt fences can be used to catch and help prevent sediments from washing into nearby waterbodies. Revegetation of slopes and hills in disturbed areas is an important component to preventing erosion as well as the restoration and enhancement of riparian areas, which can catch and hold silt.

Storm water capture and infiltration methods have the added benefit of reducing the amount of sediment load to nearby waterbodies. Storm water capture and infiltration methods include "settling" structures and basins designed to capture and hold storm water rather than direct storm water directly into nearby waterbodies. Sediments are trapped and held in these areas, along with any mercury that has adhered to the sediments. Sediment can then be removed, preventing it from introducing mercury into an aquatic environment. Other methods of storm water capture and infiltration include installing permeable paving materials or non-paved landscapes, such as gravel, mulch, or vegetation, which allow infiltration. Many of these methods are consider low-impact development (LID) controls and are considered in the use of green infrastructure design.

Sediment or soil contaminated with mercury can also be directly removed from or contained within a contaminated site, as described in Section 7.1.2. This is also considered a sediment control method.

7.1.4 Water Management Practices

Once elemental mercury enters an aquatic environment, it must undergo a transformation before it is readily bioavailable. Anaerobic bacteria in environments that are both low in oxygen and high in nutrients are primarily responsible for converting elemental mercury to methylmercury in aqueous environments. There is still much ongoing research on the subject of the specific conditions that enhance methylation and methods that can be employed to reduce or prevent this process. Some studies have found that seasonal wetlands are a major source of methylmercury, while permanent wetlands can work as methylmercury sinks (Appendix Q). Management practices that increase flow and aeration and reduce anthropogenic sources of nutrients into waterbodies may help reduce mercury methylation.

7.2 Methods of Compliance by Discharger

7.2.1 Mines

The Provisions specify that the Water Boards shall require dischargers subject to California Code of Regulations Title 27, section 22510 (Closure and Post Closure Maintenance of Mining Units), to implement erosion and sediment control measures to prevent or control mercury discharges (see Section 6.9). Mine owners are already responsible for discharges from their property based on existing policy. The Porter Cologne Water Quality Control Act gives the Regional Water Boards the authority to require responsible parties to cleanup and abate wastes that cause or threaten to cause pollution. Mine sites that discharge wastes may be subject to waste discharge requirements (Title 27 requirements for mine wastes and/or NPDES storm water requirements). The reasonably foreseeable methods of compliance for such mines are listed below.

Methods of compliance for mercury control at mine sites are expected to vary widely based on the individual physical characteristics of each particular mine. In general, potential mercury discharges from mines come from mobilized sediment, water flowing through contaminated or unprocessed ore, or tailings. Examples of possible methods of compliance include:

- Sediment Controls
    - Hillside grading
    - Hillside re-contouring
    - Detention ponds

- o Riprap installation
- o Re-vegetation (i.e., planting trees and shrubs).
- o BMPs to minimize sediment or ore washing off a site
- o Terracing
- o Retaining walls
- o Sediment removal

7.2.2 Nonpoint Sources

The Provisions acknowledge that the Permitting Authority has discretion under existing law to require nonpoint source dischargers to implement erosion and sediment control measures and should consider requiring such measures in areas of elevated mercury. Examples of possible methods of compliance include:

Sediment Controls:

- o Access road (sediment) maintenance
- o Hillside grading
- o Detention ponds
- o Buffer zones
- o Riprap installation
- o Re-vegetation
- o Retaining walls
- o Silt fences
- o Ongoing management of riparian buffer (seeding, mulching)
- o BMPs to minimize sediment washing off the site
- o Terracing
- o Hillside re-contouring

7.2.3 Dredging Activities

The Provisions acknowledge that the Water Boards have the discretion under existing law to require dischargers for dredging activities to implement total mercury monitoring and control procedures, and should consider requiring such measures in permits in areas with elevated mercury concentrations. These procedures may be necessary to control the disturbance and discharge of mercury-contaminated material during dredging and disposal of dredging material, particularly in areas with elevated mercury concentrations. Dredging projects are variable in size, location, frequency and scope. Typically, a dredge project would require a site-specific analysis to determine appropriate methods for sediment removal and transport, as well as environmental risks. The Water Boards would have ultimate say over the way the project is performed. The requirements of the Provisions are not expected to change the amount of dredging activities in the state. Special equipment or procedures may be required to minimize mercury-contaminated sediment releases, but as to what kinds of equipment or procedures used for future projects is speculative.

If dredging activities are involved in removing sediments, some of the mercury that is trapped in the sediment may be released into the water, where there is a greater chance of it becoming methylated. As long as the mercury remains trapped within the sediments, and not readily available for methylation, it may pose less of a risk to the environment to leave the mercury in place than to try to remove the mercury and risk releasing some of that mercury into a waterbody where it is more readily methylated.

Typically, dredged sediment is disposed of on a project site. If the Water Boards determine that sediment is contaminated with mercury, and presents a significant threat of contaminating a water body, the agency may require transport to an off-site storage facility or landfill, increasing use and distances travelled for heavy hauling equipment. However, given the variability possible projects, the amount of projects having such requirements is not reasonably foreseeable.

Mercury Monitoring

Mercury monitoring may need to be done to characterize the degree of mercury contamination and the potential for release of mercury from the dredging. If mercury monitoring is required, water and/or sediment samples would need to be regularly collected and transported by vehicle to a laboratory for analysis.

7.2.4 Wetlands

The Provisions acknowledge that the Permitting Authority (the Water Boards) has the discretion under existing law to require project applicants that are establishing or restoring wetlands by discharging dredged or fill material to include design features or management measures to reduce the production of methylmercury in wetlands, and should consider requiring such measures in areas with elevated mercury concentrations. Design features could include adding open water areas or settling ponds to reduce the transport of mercury and minimizing fluctuations in water levels to reduce wetting and drying cycles of soil. This requirement should not diminish the ecological value of the resulting wetland habitat. The Provisions should not reduce the amount of land converted to wetlands.

Earth moving activities would still be needed to create a wetland, regardless of any requirements pertaining to wetlands in the Provisions. New requirements might or might not result in greater use of vehicles or equipment. It would be difficult to estimate how much the Provisions might increase the need for earth moving or the use of heavy vehicles or construction equipment.

7.2.5 Storm Water: Municipal

The Provisions require Phase I and Phase II MS4s permits to include mercury pollution prevention and pollution control measures to reduce total mercury or methylmercury discharges. The requirements for MS4 dischargers in the Provisions are already required by permits for most MS4s, but not explicitly for mercury control or prevention. Therefore, it is anticipated that the reasonably foreseeable methods of compliance are likely already being done by Phase I

MS4s and there would be little to no change for Phase I MS4s. Phase II MS4s generally have fewer requirements, so it is estimated that some Phase II MS4s may need to add some of the activities described below.

Waste Collection Programs

The Provisions require thermometer exchange programs and fluorescent lamp recycling programs, or enhancement of household hazardous waste collection programs to better address mercury-containing waste products (potentially including thermometers and other gauges, batteries, fluorescent and other lamps, switches, relays, sensors and thermostats).

Education

The Provisions require MS4s to educate the public on disposal of household-mercury containing products or alternative products. Examples of compliance methods are: increasing disposal bins in public areas; producing and printing educational flyers; or producing radio, television, or billboard advertisements for the public. This requirement could increase vehicle use and solid waste disposal.

Educating Auto Dismantlers

The Provisions require MS4s to educate auto dismantlers on the proper removal, storage, and disposal of mercury containing switches in automobiles. Staff from MS4s may travel to auto dismantlers to provide training on the proper disposal of mercury containing items. Also, staff from MS4s may provide educational information by postal mail or electronically. This requirement could increase vehicle use and solid waste disposal.

Internal Surveys

The Provisions require MS4s to perform an in house survey on the use, handling, and disposal of mercury-containing products used by agency (the MS4 discharger). The Provisions also require MS4s to develop a policy and time schedule for eliminating the use of mercury containing products by the agency. The resulting actions would depend on the sources of mercury identified.

Sediment Controls

The methods of compliance for sediment controls in the Provisions are similar to the methods of compliance implemented by MS4 permittees to satisfy existing permit requirements, but there could be an increase in these activities and the degree of increase is unclear. The Provisions require sediment controls be included in MS4 permits in areas with elevated mercury concentrations. However, with respect to areas that do not have elevated mercury concentrations, the Provisions provide that the Permitting Authority (the Water Boards) has discretion to include BMPs to control sediment. Methods of compliance could be either structural controls or management practices. Examples that involve some degree of earth moving or construction are:

retaining walls, grading hillsides, installing riprap, and adding vegetation (trees or shrubs). Management practices could include maintaining a vegetated riparian buffer next to waterbodies, use of silt fences, rolled erosion control products, seeding, and mulching.

7.2.6 Storm Water: Industrial Activities

Exceedance Response Actions

The Provisions would lower the numeric action level (NAL) for mercury contained in the NPDES Industrial General Permit from 1400 ng/L to 300 ng/L or lower. The Industrial General Permit requires that if the NAL is exceeded then the permittee must take to address the source of the mercury. These actions, called Exceedance Response Actions, may be BMPs such as general housekeeping, covering mercury sources at the facility, or proper containment of sources. In general, the methods of compliance are not anticipated to change from the existing methods. Instead, the Exceedance Response Actions may need to be performed more frequently, because the Provisions lower the NAL. However, a review of storm water monitoring data found most mercury measurements in storm water were below the 300 ng/L threshold (Appendix P). Also, in the few instances that the measured mercury concentration was higher than the 300 ng/L NAL, it was often higher than the current NAL as well. Therefore, the statewide increase in Exceedance Response Actions is anticipated to be small.

Mercury Monitoring

Storm water must be sampled and analyzed to evaluate compliance with the NAL. Samples would likely be sent or shipped via motor vehicle to a laboratory, where the mercury concentration in the storm water sample would be measured. Mercury Monitoring is already required by the existing permit. The Provisions would not change what is already required by the existing permit. It is possible that monitoring may increase if more dischargers need to address exceedances and ensure they can attain compliance with a lower NAL. The change in the NAL may result in a slight increase in vehicle use, lab supply use, and waste generation.

7.2.7 Wastewater Treatment Plants and Industrial Dischargers – Requirements for Sport Fish and Wildlife Water Quality Objectives in Flowing Water Bodies

For waste water and industrial discharges into flowing water bodies, the Provisions specify a water column concentration of 12 ng/L for determining whether the discharge is projected to cause or contribute to an excursion above the water quality standard (hereafter referred to as reasonable potential) and as the objective value used to calculate an effluent limitation for the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, and the California Least Tern Prey Fish Water Quality Objective, where the COMM beneficial use, the WILD beneficial use, and/or MAR beneficial uses have been designated or are existing beneficial uses.

Wastewater Treatment/Industrial Facility Upgrades

It is anticipated that major facility upgrades are unnecessary to achieve the effluent limitations in the sport fish and wildlife objectives in flowing water bodies. The Sport Fish Water Quality Objective water column concentration proposed in the Provisions is about five times more stringent than the lowest human health water quality objective promulgated in the CTR applicable to COMM (12 ng/L total mercury versus 50 ng/L). However, current information on loads of mercury in waste water suggests that the proposed objective (also 12 ng/L) is achievable based on current technology. In addition, in accordance with the Provisions, the Water Boards have the discretion to allow dilution credits in waters that currently meet the applicable water quality standards, which would make the final effluent limitations more achievable where dilution is allowed.

Recent data from discharger self-monitoring reports indicate that about 8 percent of all discharges to waters included in geographic scope of the Provisions exceeded the 12 ng/L threshold at least once during 2009 – 2015 (Appendix N). Some of the facilities that exceeded this threshold only exceeded it in one or two years within the past six years, and met the effluent limitations in other years. Therefore, it is anticipated that these facilities would be able to adapt to the effluent limitation without a major facility upgrade.

In the Eastern U.S., especially near the Great Lakes, wastewater treatment/ industrial facilities have already been achieving permit requirements for mercury based on a threshold of 12 ng/L total mercury from U.S. EPA's 1984 criterion (U.S.EPA 1985), which is much lower than California's current criterion of 50 ng/L. In Minnesota's 2007 statewide mercury TMDL, the average mercury effluent concentration from NPDES point sources was estimated as 5 ng/L (Minnesota Pollution Control Agency 2007). The median concentration for North Eastern States was 7 ng/L (Northeast states and the New England Interstate Water Pollution Control Commission 2007).

The Ohio variance suggests 12 ng/L is achievable with secondary treatment, since meeting that threshold is an expectation of facilities issued the variance. Ohio's mercury variance provides relief for discharges that must meet an effluent limitation of 1.3 ng/L (the use of mixed zones was phased out after 2010, although under certain circumstances mixing zones may be authorized (40 CFR part 132, appendix F, procedure 3)). Ohio's mercury variance guidance, issued in 2000, explains that achieving a mercury concentration *below* 12 ng/Lis anticipated to require end of pipe treatment (a facility upgrade), implying that 12 ng/L is achievable with currently technology or source control, such as a mercury minimization program (Ohio EPA 2000).

Other evidence suggests that a Mercury Minimization Program (discussed below) may be sufficient to meet the effluent limitation (12 ng/L). A study on the topic reported that "pollution prevention or source control are potentially effective in achieving sufficient reductions to enable POTWs to meet effluent limits that are 7.8 ng/L or greater.

However, if more stringent effluent limits are in effect, such as the 3.1 or 1.3 ng/L limits that have been imposed on POTWs in the Great Lakes Region, pollution prevention or source control with no treatment process modifications would not be effective in achieving these limits" (Larry Walker Associates 2002).

However, wastewater and industrial facility upgrades may be needed to comply with multiple future statewide or region-wide water quality objectives for other pollutants adopted by the Water Boards over the next several years. Currently, the State Water Board is developing statewide water quality objectives for bacteria, toxicity, nutrients, and biological integrity. These new water quality objectives, when adopted, may require more stringent effluent limitations. The effect of these anticipated effluent limitations, together with the need to achieve mercury effluent limitations, may result in facility upgrades. Facility upgrades would be a significant constriction project to a plant that only has a secondary level of treatment. The upgrade would likely add nitrification and denitrification steps to the treatment process, or add additional filtration.

Mercury Minimization Program

A Mercury Minimization Program may be needed to achieve the effluent limitations and would be the expected method of compliance before a facility considers upgrading. As stated above, a Mercury Minimization Program should allow a municipal wastewater treatment plant to achieve an effluent limitation of 12 ng/L (Larry Walker Associates 2002). Pollution prevention involves an assessment of in-house sources of mercury and indirect discharges of mercury to the facility (such as a dentist office that connects to the city sewer). The method of compliance would depend on the predominant sources of mercury. A large source of mercury to municipal wastewater treatment plants is dental amalgam. A foreseeable method of compliance is ensuring dental offices in the service area have proper mercury separators installed. This may include travel to dentist offices, inspection of equipment in the office, and mercury monitoring at various locations throughout the collection system. Therefore, the effluent limitation may result in an increase in vehicle use by the few wastewater and industrial facilities that may not be able to achieve the effluent limitation consistently. There may also be an increase in the laboratory resources used for additional monitoring to locate sources of mercury in the system. (U.S. EPA has promulgated a new rule on dental amalgam, so compliance methods to address dental amalgam will be required by U.S. EPA (http://water.epa.gov/scitech/wastetech/guide/dental/)).

Mercury Monitoring

Additional monitoring by wastewater treatment plants and industrial dischargers would be required at certain intervals during the permit term for those facilities with a mercury effluent limitation (dischargers authorized to discharge at a rate equal to or greater than five million gallons per day are required to conduct monitoring at least one time each calendar quarter, dischargers authorized to discharge at a rate less than five million gallons per day must monitor at least one time per year) and facilities without a mercury effluent limitation would be required to monitor one time per permit term. Some facilities would have new monitoring requirements.

Recent data from discharger self-monitoring reports indicate that about eight percent of all discharges to waters included in geographic scope of the Provisions exceeded the 12 ng/L threshold at least once during 2009 – 2015 (Appendix N). Some of the facilities that exceeded this threshold only exceeded it in one or two years within the past six years, and met the effluent limitations in other years. It is anticipated that these facilities could adapt to the effluent limitation without a major facility upgrade. Therefore, it is likely that about 8 percent of discharges in the Provisions' scope (25 facilities) with respect to the sport fish and wildlife objectives would be issued new effluent limitations and requirements for mercury. These dischargers would need to monitor the mercury concentration in the effluent discharging from the facility, and ensure that mercury concentration meets the effluent limitation (Staff Report section 6.13). This analysis is based on available data, and data was only available for a little over one quarter of the facilities in the in the scope of the Provisions (see Appendix N). It is unknown whether the facilities affected would be those authorized to discharge at a rate equal to or greater than five million gallons per day.
Mercury analysis is not typically done on-site at the facility, and technicians trained in the clean hands technique must perform sampling. So the monitoring and sample analysis would require additional vehicle use. Also, there would be an increase in lab supplies and waste generation.

The resulting additional miles of vehicle use was calculated with the following assumptions. An additional 25 facilities would sample quarterly and transport samples 100 miles one way (200 miles of vehicle use to return the vehicle to the starting location). The added miles were calculated by multiplying 25 facilities, times four samples per year, times 200 miles, which equates to 20,000 total additional miles per year. Quarterly sample was assumed to apply to all facilities as a worst case scenario, since it is unknown whether the facilities affected would be those authorized to discharge at a rate equal to or greater than five million gallons per day.

The Provisions include the following two exceptions to the reasonable potential analysis: 1) small disadvantaged communities and 2) insignificant discharges. More specifically, these exceptions would relieve the need for routine monitoring for small facilities that are not a threat to water quality, since mercury monitoring with sufficiently sensitive methods is expensive (Section 4.4 of Appendix P). These exceptions would also reduce the vehicle use to ship the mercury samples. These exceptions would not be automatic. The permit writer for the Water Board must review water body specific information and determine if there is information that indicates that the discharge would not cause or contribute to an exceedance of the water quality objective(s). Insignificant discharges are NPDES discharges that are determined to be a very low threat to water quality by the Water Board. Small disadvantaged communities are municipalities with populations of 20,000 persons or less, or a reasonably isolated and divisible segment of a larger municipality encompassing 20,000 persons or less, with an annual median household income that is less than 80 percent of the statewide annual median household income.

7.2.8 Wastewater Treatment Plants and Industrial Dischargers – Requirements for Sport Fish and Wildlife Water Quality Objectives in Slow Moving Water Bodies and Tribal Subsistence Fishing Water Quality Objective and Subsistence Fishing Water Quality Objective in Flowing Water Bodies

For waste water and industrial discharges into slow moving water bodies, the Provisions specify a water column concentration of 4 ng/L for determining reasonable potential and as an objective used to calculate effluent limitations for the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, and the California Least Tern Prey Fish Water Quality Objective, where commercial and sport fishing or wildlife beneficial uses have been designated or are existing beneficial uses. In flowing water bodies where the Tribal Subsistence Fishing beneficial use has been designated, the Provisions also specify a water column concentration of 4 ng/L for determining reasonable potential and as an effluent limitation for the Tribal Subsistence Fishing Water Quality Objective. The Subsistence Fishing Water Quality Objective is a narrative objective without numeric mercury targets but the effluent limit in flowing water bodies could be similar to those assigned for the Tribal Subsistence Fishing Objective.

Wastewater Treatment/Industrial Facility Upgrades

It is anticipated that major facility upgrades may be needed for some facilities to achieve the effluent limitations for the sport fish and the two wildlife objectives in slow moving water bodies, and the Tribal Subsistence Fishing Water Quality Objective in flowing water bodies. The effluent limitation could be about 15 times more stringent than previous effluent limitations (3 or 4 ng/L vs. 50 ng/L). However, if the Water Boards exercise discretion to allow dilution credits in waters achieving the applicable water quality standard(s), the effluent limitations would be much more achievable.

For the Tribal Subsistence Fishing Water Quality Objective, roughly eight treatment plant upgrades are reasonably foreseeable based on assumptions and current designations of CUL (described below), and for the Sport Fish Water Quality Objective and the two wildlife water quality objectives in slow moving waters, roughly seven treatment plant upgrades are reasonably foreseeable in the near future, as described below.

Most tertiary plants with nitrification and denitrification processes have mercury concentrations less than 4 ng/L (annual average) in the effluent because the enhanced filtration maximizes removal of suspended solids (Central Valley Water Board 2010a). Secondary treatment facilities do not achieve concentrations below 4 ng/L mercury in the effluent, since such technology is not designed to achieve a level of mercury this low. Facilities with only secondary treatment would most likely need to build additional infrastructure to be able to meet an effluent limitation of 4 ng/L or lower which would be required to meet future effluent limits based on future designations for SUB or T-SUB. Current data from discharger self-monitoring reports indicate that about 27 percent of all discharges to inland surface waters, enclosed bays and estuaries, that are not included in an existing mercury TMDL, exceed the 4 ng/L threshold, based on 2009 – 2015 data (Appendix N). Therefore, it is likely that about 27 percent of facilities assigned an effluent limitation of 4 ng/L would likely need to take action to improve their treatment process. In addition should future designations of SUB or T-SUB to slow moving waters require effluent limits below 4 ng/L the Water Boards may use compliance schedules, site-specific objectives (with extended compliance schedules), TMDLs, or variances if the effluent limitation is unachievable. In cases where variances are adopted, it is anticipated that the Water Boards would require the implementation of source control measures and tertiary treatment as a condition of the variance. (See 40 CFR § 131.14 (water quality standards variances).) Additionally, some facilities that are close to meeting the 4 ng/L may only need to implement a mercury minimization plan.

Currently, about 7 percent of waste water and industrial discharges are to waters classified as harbors, bays, estuaries, sloughs, wetlands, tidal prisms, ponds, or marshes (Appendix N). The Permitting Authority may determine that these discharges are to slow moving water bodies and assign an effluent limit of 4 ng/L for achieving the Sport Fish Water Quality Objective and the two wildlife water quality objectives. Facilities with only secondary treatment discharging into these water bodies would likely need to take action to improve their treatment process, which may include a major treatment plant upgrade. None of these waters are on the 303(d) list due to mercury, but about half of these discharges are upstream of a river in the Central Valley that is on the 303(d) list due to mercury and so these discharges may be included in a future TMDL.

In the North Coast Regional Water Board's water quality control plan, the Native American Culture beneficial use (which includes subsistence fishing) is designated to many water bodies, including reaches of the Smith River, the Klamath River Watershed, the Trinity River Watershed, the Mad River Watershed, the Eureka Plain Watershed, and the Eel River Watershed. There are municipal wastewater or industrial discharges to or upstream of the Lower Klamath River, the Lower Trinity River, the Mad River, the Eureka Pain Watershed, and the Lower Eel River. In total, there are an estimated 24 facilities that discharge to waters currently designated with Native American Culture beneficial use or upstream of those waters. Mercury monitoring data was available for five of the 24 facilities. The highest annual average was 3.5 ng/L. Based on statewide monitoring data for all facilities that may be impacted by the Provisions, it is estimated that eight facilities would not meet the new effluent limits for the Tribal Subsistence Fishing Water Quality Objective in flowing water bodies and will have to undergo a major treatment plant upgrade if they are designated with the T-SUB beneficial use in the future. The North Coast Regional Water Board does have a subsistence beneficial use definition included in their water quality control plan but it has not been designated to any of the water bodies that have been designated with their Native American Culture beneficial use. While these waters have not been designated with Tribal Subsistence Fishing beneficial use, tribes are currently using these waters for traditional practices as designated with the Native American Culture beneficial use, which includes subsistence fishing. Therefore, it is anticipated that some or all of these waters may be designated with T-SUB beneficial use in the future.

Mercury Minimization Program

A Mercury Minimization Program (described in Section 7.2.7) may be used by some facilities that are not able to achieve the effluent limitation consistently. Therefore, the effluent limitation may result in an increase in vehicle use, lab supplies and waste generation.

Mercury Monitoring

Additional monitoring by wastewater treatment plants and industrial dischargers would be required for those facilities issued effluent limitations (dischargers authorized to discharge at a rate equal to or greater than five million gallons per day are required to conduct monitoring at least one time each calendar quarter, dischargers authorized to discharge at a rate less than five million gallons per day must monitor at least one time per year), and facilities without a mercury effluent limitation would be required to monitor one time per permit term. Because the reasonable potential analysis for the sport fish and the two wildlife objectives in slow moving water bodies and the Tribal Subsistence Fishing Water Quality Objective in flowing water bodies is more stringent than for the Sport Fish Water Quality Objective and the two wildlife water quality objective in flowing water bodies (4 ng/L vs. 12 ng/L), it is anticipated that a greater percent of facilities discharging into these waters would have new monitoring requirements. This would result in an increase in vehicle use, lab supply use, and waste generation.

There are an estimated 24 facilities that discharge to waters currently designated with the Native American Culture beneficial use or upstream of those waters. Based on statewide monitoring data for all facilities that may be impacted by the Mercury Objectives Amendment, it is estimated that one third of those facilities, or approximately eight, would not meet the thresholds (Appendix N) and would have to perform compliance monitoring. There are an estimated 19 facilities that discharge into slow moving water bodies. Based on the same statewide monitoring data, an estimated one third, or approximately 7, would have to also preform compliance monitoring.

The estimated additional miles of vehicle use was calculated with the following assumptions. Combining the estimated number of facilities that would need to perform compliance monitoring to meet the tribal subsistence beneficial use, the sport fish, and the wildlife beneficial uses in slow moving waters gives us an estimated 15 facilities that will need to perform routine monitoring. The 15 facilities sample quarterly and transport samples 100 miles one way (200 miles of vehicle use to return the vehicle to the starting location). The added miles were calculated by multiplying 15 facilities, times four samples per year, times 200 miles, which equates to 12,000 total additional miles per year.

7.2.9 Wastewater Treatment Plants and Industrial Dischargers – Requirements for Tribal Subsistence Fishing Water Quality Objectives in discharges to slow moving waters.

For waste water and industrial discharges into slow moving water bodies where the tribal subsistence fishing beneficial use has been designated as a beneficial use, the Provisions recommend a water column concentration of 1 ng/L for determining reasonable potential and as objective value used to calculate effluent limitations for the Tribal Subsistence Water Quality Objective.

In the North Coast Water Board, the Native American Culture beneficial use is designated to many water bodies. Some of these water bodies may be considered "slow moving waters." However, because no waters have been designated with the subsistence fishing beneficial use, the Water Board would need to designate the beneficial use, and then the Permitting Authority would need to make the determination if the discharge is into a slow moving water, it is not possible to determine how many wastewater and industrial discharges would need to meet the 1 ng/L threshold in their effluent. Although some of the waters designated with the Native American Culture beneficial use include bays, estuaries, and sloughs, most of these waters are in areas without wastewater or industrial discharges. However, there are some wastewater and industrial discharges into slower waters around Humboldt Bay.

Wastewater Treatment/Industrial Facility Upgrades

It is anticipated that major facility upgrades may be needed for some facilities to achieve the effluent limitations for the Tribal Subsistence Fishing Water Quality Objective in slow flowing water bodies. The effluent limitation could be about 50 times more stringent than previous effluent limitations (1 ng/L vs. 50 ng/L), so it would be very difficult for some dischargers to continue to meet this limit on an annual basis. Recent data from discharger self-monitoring reports indicates that about 73 percent of all discharges to waters included in the geographic scope of the Provisions exceeded 1 ng/L, based on 2009 – 2015 data (Appendix N). This data indicates that there is a good chance that the effluent limitation of 1 ng/L would cause a facility to upgrade. However, if the Water Board exercises its discretion to allow dilution credits, the objective would be much more achievable. It is not possible to predict how many facility upgrades may be needed to achieve the Tribal Subsistence Fishing Water Quality Objective in slow-moving water bodies. Most tertiary plants with nitrification and denitrification processes have mercury concentrations less than 4 ng/L (annual average) in the effluent because the enhanced filtration maximizes removal of suspended solids (Central Valley Water Board 2010a). Secondary treatment facilities do not achieve concentrations below 4 ng/L mercury in the effluent, since such technology is not designed to achieve a level of mercury this low. Facilities with only secondary treatment would most likely need to build additional infrastructure to be able to meet an effluent limitation of 4 ng/L or lower which would be required to meet future effluent limits based on future designations for SUB or T-SUB. Current data from discharger self-monitoring reports indicate that about 27 percent of all discharges to inland surface waters, enclosed bays and estuaries, that are not included in an existing mercury TMDL, exceed the 4 ng/L threshold, based on 2009 – 2015 data (Appendix N). Therefore, it is likely that about 27 percent of facilities assigned an effluent limitation of 4 ng/L would likely need to take action to improve their treatment process. In addition should future designations of SUB or T-SUB to slow moving waters require effluent limits below 1 ng/L, the Water Boards may use compliance schedules, site-specific objectives (with extended compliance schedules), TMDLs, or variances if the effluent limitation is unachievable. In cases where variances are adopted, it is anticipated that the Water Boards would require the implementation of source control measures and tertiary treatment as a condition of the variance. (See 40 CFR § 131.14 (water quality standards variances).) Additionally, some facilities that are close to meeting the 1ng/L may only need to implement a mercury minimization plan.

<u>Mercury Minimization Program</u>
A Mercury Minimization Program (described in Section 7.2.7) may be used by some facilities that are not able to achieve the effluent limitation consistently. Therefore, the effluent limitation may result in an increase in vehicle use, lab supply use, and waste generation.

<u>Mercury Monitoring</u>
Additional monitoring by wastewater treatment plants and industrial dischargers would be required for those facilities with a mercury effluent limitation. Because the reasonable potential analysis for the tribal Subsistence Fishing Water Quality Objective in slow moving water bodies is the most stringent (1ng/L vs 4 ng/L or 12 ng/L), it is anticipated that a far greater percent of facilities discharging into waters would have new monitoring requirements. This would result in an increase in vehicle use, lab supply use, and waste generation.

7.2.10 Wastewater Treatment Plants and Industrial Dischargers – Requirements for Subsistence Fishing Water Quality Objectives in discharges to any waters and any of the Mercury Water Quality Objectives (Sports Fish, Prey Fish, Tribal Subsistence Fishing and Subsistence Fishing) for Discharges to Lakes and Reservoirs.

When the subsistence beneficial use is designated to any water body, or where waste water or industrial dischargers are discharging into a lake or reservoir, the effluent limit for mercury should be determined on a case-by-case basis.

It would be difficult to determine an appropriate water column concentration for the Subsistence Water Quality Objective, because it is a narrative objective and the fish tissue target is not specified. The Permitting Authority may require a site-specific study to determine the appropriate mercury fish tissue concentration and then use the appropriate BAF for the water body type to determine the mercury water column concentration effluent limit.

If the U.S. EPA BAF for lakes is applied to the Sport Fish Water Quality Objective, the resulting effluent limit is around 1 ng/L. However, the U.S. EPA data was for lakes mostly outside of California; only one lake was in California. Unlike with flowing waters, a California-specific study was not conducted to confirm whether the U.S. EPA BAF for lakes is appropriate for California. Therefore, the appropriate mercury effluent limit for discharges into lakes and reservoirs would need to be determined on a case-by-case basis.

Wastewater Treatment/Industrial Facility Upgrades

It is anticipated that major facility upgrades may be needed for some facilities to achieve the mercury effluent limitations for the Subsistence Fishing Water Quality Objective, the Tribal Subsistence Fishing Water Quality Objective, or for any discharges into lakes or reservoirs. Because these effluent limits are determined on a case-by-case basis, it is difficult to know how stringent they will be. However, if the Water Board exercises its discretion to allow dilution credits, the objective would be much more achievable.

No waters have been designated with a subsistence fishing beneficial use and it is difficult to anticipate which waters may be designated in the future. If, in the future, waters are designated with the subsistence fishing beneficial use, it is possible that it would lead to facility upgrades for facilities discharging to those waters. If it possible that the Water Board may grant dilution credits, which would help make any effluent limits more achievable.

Currently there are twelve wastewater and industrial discharges to lakes and reservoirs in California. Six of these discharges are to impaired waters. For impaired waters, a TMDL may grant load allocations, which can include a more manageable, load-based, effluent limit. For the six discharges to an unimpaired lake or reservoir (or future discharges), the Water Board would need to determine the most appropriate effluent limit based on site-specific factors.

Facilities with only secondary treatment would most likely need to build additional infrastructure to be able to meet an effluent limitation of 4 ng/L or lower which would be required to meet future effluent limits based on future designations for SUB or T-SUB. Current data from discharger self-monitoring reports indicate that about 27 percent of all discharges to inland surface waters, enclosed bays and estuaries, that are not included in an existing mercury TMDL, exceed the 4 ng/L threshold, based on 2009 – 2015 data (Appendix N). Therefore, it is likely that about 27 percent of facilities assigned an effluent limitation of 4 ng/L would likely need to take action to improve their treatment process. In addition should future designations of SUB or T-SUB to slow moving waters require effluent limits at or below 1 ng/L the Water Boards may use compliance schedules, site-specific objectives (with extended compliance schedules), TMDLs, or variances if the effluent limitation is unachievable. In cases where variances are adopted, it is anticipated that the Water Boards would require the implementation of source control measures and tertiary treatment as a condition of the variance. (See 40 CFR § 131.14 (water quality standards variances).) Additionally, some facilities that are close to meeting the 4 ng/L may only need to implement a mercury minimization plan.

Mercury Minimization Program

A Mercury Minimization Program (described in Section 7.2.7) may be used by some facilities that are not able to achieve the effluent limitation consistently. Therefore, the effluent limitation may result in an increase in vehicle use, lab supplies and waste generation.

Mercury Monitoring

Additional monitoring by wastewater treatment plants and industrial dischargers would be required for those facilities with mercury effluent limitations. Because the reasonable potential analysis is based on an currently unknown effluent limit for the Subsistence Fishing Water Quality Objective, which would be determined on a case-by-case basis, and because it is not known where the subsistence fishing beneficial use may be designated, it is not possible to predict the amount of additional mercury monitoring that would be required for the Subsistence Fishing Water Quality Objective.

8 Environmental Effects

8.1 Introduction

In accordance with Public Resources Code, section 21080.5, subdivision (c), the Water Boards' Water Quality Control/208 Planning Program has been certified as an exempt regulatory program by the Secretary for Natural Resources (Cal. Code Regs., tit. 14, § 15251, subd. (g); *id*., tit. 23, § 3775). The certification means the Water Boards are exempt from having to develop an environmental impact report because the environmental analysis is contained in substitute environmental documentation (SED). Chapter 27 of the California Code of Regulations (beginning with section 3720) contains the Water Boards' regulations for implementing the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000, et seq.) (referred to as the certified regulatory program). The Water Boards' certified regulatory program incorporates the CEQA Guidelines (Cal. Code Regs., tit. 14, div. 6, ch. 3 (commencing with section 15000). The State Water Board's SED must contain an environmental analysis of its proposed action. The Staff Report, which contains the SED, is being used to satisfy this requirement.

The Water Boards' certified regulatory program must still comply with CEQA's overall objectives to: inform the decision makers and the public about the potentially significant environmental effects of a proposed project; identify ways that significant adverse environmental impacts may be mitigated; and prevent significant, avoidable adverse environmental impacts by changing the proposed project or requiring mitigation measures. There are certain guiding principles that are contained in the CEQA Guidelines that help to inform the Water Board's certified regulatory process and preparation of the SED:

> Forecasting: Drafting the environmental analysis necessarily involves some degree of forecasting. While foreseeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can (Cal. Code Regs., tit. 14, § 15144).
>
> Speculation: If, after thorough investigation, a lead agency finds that a particular impact is too speculative for evaluation, the agency should note its conclusion and terminate discussion of the impact (Cal. Code Regs., tit. 14, § 15145).
>
> Specificity: The degree of specificity required in the environmental analysis will correspond to the degree of specificity involved in the underlying activity which is described in the Environmental Impact Report (Cal. Code Regs., tit. 14, § 15146.)
>
> Standards for Adequacy: The environmental analysis should be prepared with a sufficient degree of analysis to provide decision makers with information which enables them to make a decision which intelligently takes account of environmental consequences. An evaluation of the environmental effects of a proposed project need

> not be exhaustive, but the sufficiency the analysis is to be reviewed in the light of what is reasonably feasible. The courts have looked not for perfection but for adequacy, completeness, and a good faith effort at full disclosure (Cal. Code Regs., tit. 14, § 15151).

This section of the Staff Report identifies and evaluates the potential environmental impacts that may arise from the Provisions and the reasonably foreseeable methods of compliance, and contains the Environmental Checklist. It also discusses mitigation, where applicable, to avoid the identified significant or potentially significant impacts (Cal. Code Regs., tit. 23, § 3777(b)).

8.1.1 Impact Methodology

Any potential environmental impacts associated with the Provisions depend upon the specific compliance methods selected by the complying permittee, most of whom would be public agencies subject to their own CEQA obligations (see Pub. Resources Code, § 21159.2). This document identifies broad mitigation approaches that could be considered at a statewide level. Consistent with Public Resources Code section 21159 and the Water Boards' certified regulatory program, the document does not engage in speculation or conjecture, but rather considers the potential environmental impacts of the Provisions and reasonably foreseeable methods of compliance, the feasible mitigation measures, and feasible alternatives (including alternative methods of compliance) which would meet the project objectives and avoid or reduce the potentially significant impacts of the Provisions.

Within each of the subsections of Section 8.4 below, this document evaluates the potentially significant impacts of the Provisions and each implementation alternative relative to the subject resource area. The implementation alternatives evaluated in this document are evaluated on a statewide level for impacts for each resource area. Project-level analysis is expected to be conducted by the appropriate public agencies prior to implementation of project specific methods of compliance with the Provisions. The environmental analysis in this document assumes that the project specific-methods of compliance with the Provisions would be designed, installed, and maintained following all applicable state and local laws, regulations, and ordinances. Several handbooks are available and currently used by municipal agencies that provide guidance for the selection and implementation of BMPs)(California Stormwater Quality Association 2003a; 2003b, Water Environment Research Foundation 2005, Caltrans 2010).

8.1.2 Level of Analysis

The State Water Board is the lead agency for the proposed Provisions, while the responsible agencies identified in Section 1.4 (Agencies Expected to use this Staff Report in their Decision Making and Permits) may be the lead agency for CEQA compliance for approval and implementation of a project-specific method of compliance with the Provisions.

The State Water Board does not specify the actual methods of compliance by which permittees choose to comply with the Provisions. However, as required by the State Water Board's certified regulatory program, this Staff Report analyzes the potential environmental impacts of the Provisions and the reasonably foreseeable methods of compliance on a statewide level. The specificity of the "activity" described in this Staff Report related to the reasonably foreseeable methods of compliance is of a general nature and the level of analysis of the potentially significant adverse environmental effects is commensurate with that level of detail. At the time of approval of a project-specific compliance project where the detail of the method of compliance is known, a project-level environmental analysis may be performed by the local approval agency.

Project-level impacts of the reasonably foreseeable methods of compliance will necessarily vary depending on the choice of compliance and the size, location, and type of discharger and the environmental resources in and around the project site. It would be speculative to estimate the specific impacts of the Provisions caused by implementation of a project-specific compliance method. It is possible that, at a specific site with particularly sensitive environmental resources, implementation with compliance methods could cause potentially significant impacts as compared to baseline conditions. Since it is speculative to estimate the type, size, and location of any particular compliance method (e.g., type of construction activities and type of resources adversely affected by those activities), this evaluation makes no attempt to quantify the impacts associated with implementation or maintenance of a particular compliance method.

Per the requirements of the State Water Board's certified regulatory program, the resource analysis (Chapters 7 through 9) includes:

- An identification of any significant or potentially significant adverse environmental impacts of the proposed project (Provisions);
- An analysis of reasonable alternatives to the project (Provisions) and mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts; and
- An environmental analysis of the reasonably foreseeable methods of compliance, including:
    - An identification of the reasonably foreseeable methods of compliance with the project;
    - An analysis of any reasonably foreseeable significant adverse environmental impacts associated with those methods of compliance;
    - An analysis of reasonably foreseeable alternative methods of compliance that would have less significant adverse environmental impacts; and
    - An analysis of reasonably foreseeable mitigation measures that would minimize any unavoidable significant adverse environmental impacts of the reasonably foreseeable methods of compliance.

(Cal. Code Regs., tit. 23, section 3777, subds. (b)(2)-(b)(4).) The analysis does not include actions that would already be performed according to existing law or policy.

8.2 Environmental Setting

CEQA directs that the environmental setting normally be used as the baseline for determining significant impacts of a proposed project (Cal. Code Regs., tit.14, § 15125, subd. (a)). Chapter 4 and Appendix D present a broad overview of the environmental setting for the state of California related to the Provisions. As such, the environmental setting and baseline for determining impacts is presented at a general level as each of the Water Boards and permittee may address mercury with a range of treatment and institutional controls. This section and the following discussion by resource type (Section 8.4 (The Environmental Checklist)) present additional specific environmental setting information relevant to the assessment of environmental impacts of the Provisions.

In the majority of instances where the discharge of mercury into the aquatic environment is of concern (implicated by the Provisions), such discharges are related to activities currently regulated by other programs. Many of these programs require the implementation of erosion and sediment controls.

Surface Mining and Reclamation Act (SMARA)
At a minimum, surface mining operations must practice: (a) soil erosion control, including facilities such as retarding basins, ditches, streambank stabilization, and diking; (b) water quality and watershed control, including settling ponds or basins to prevent potential sedimentation of streams; and (c) protection of fish and wildlife habitat (Cal. Code Regs., tit. 14, § 3503).

SMARA also provides that reclamation plans required for surface mining include: (a) a description of the manner in which contaminates will be controlled, and mining waste will be disposed; and (b) a description of the manner in which affected streambed channels and stream banks will be rehabilitated to a condition minimizing erosion and sedimentation will occur (Pub. Resources Code, § 2772, subd. (c)(8)).

Mining Waste Management Regulations (State Water Board) (Cal. Code Regs., tit. 27 § 22470 et seq.)
The Regional Water Boards issue WDRs for the discharge of mining wastes which include requirements that facilities be designed, constructed and maintained to prevent surface erosion (Cal. Code Regs., tit. 27, § 22510, subd. (m)).

Caltrans Statewide Storm Water Permit (NPDES No. CAS000003 Order No. 2012-0011-DWQ)
The California Department of Transportation (Caltrans) is responsible for the design, construction, management, and maintenance of the State highway system, including freeways, bridges, tunnels, Caltrans' facilities, and related properties, and is subject to the permitting requirements of Clean Water Act section 402(p). Caltrans' discharges consist of storm water and non-storm water discharges from State owned rights-of-way. The Caltrans permit regulates all discharges from Caltrans MS4s, maintenance facilities, and construction activities. Caltrans' Storm Water Management Plan (SWMP) describes the procedures and practices used to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters.

The SWMP includes BMPs to be incorporated into projects for the control of erosion and sedimentation. Since erosion from roads is a significant source of nutrients, mercury, and sediment, Caltrans controls the discharge of sediment to address these pollutants.

Construction Storm Water General Permit (NPDES No. CAS000002*, Order No. 2009-0009-DWQ)*
Dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the Construction General Permit. Dischargers covered under the Construction General Permit are required, at a minimum, to implement effective wind erosion control; provide effective soil cover for inactive areas and all finished slopes, open space, utility backfill, and completed lots; establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges; and, where sediment basins are used, dischargers shall, at a minimum, design sediment basins according to the method provided in the California Stormwater Quality Association's Stormwater Best Management Practice Handbook Portal: Construction (California Stormwater Quality Association 2003c).

Dischargers at higher risk levels are also required to: implement appropriate erosion control BMPs in conjunction with sediment control BMPs for areas under active construction; apply linear sediment controls along the toe of the slope, face of the slope, and at the grade breaks of exposed slopes; ensure that construction activity traffic to and from the project is limited to entrances and exits that employ effective controls to prevent offsite tracking of sediment; ensure that all storm drain inlets and perimeter controls, runoff control BMPs, and pollutant controls at entrances and exits are maintained and protected from activities that reduce their effectiveness; and, inspect on a daily basis all immediate access roads. At a minimum daily (when necessary) and prior to any rain event, the discharger shall remove any sediment or other construction activity related materials that are deposited on the roads

Industrial Storm Water General Permit (NPDES No. CAS000001, Order No*. 2014-0057-DWQ)*
Similar to the Construction General Permit, the Industrial General Permit requires dischargers to: implement effective wind erosion controls; provide effective stabilization for inactive areas, finished slopes, and other erodible areas prior to a forecasted storm event; maintain effective perimeter controls and stabilize all site entrances and exits to sufficiently control erodible materials from discharging or being tracked off the site; divert run-on and storm water generated from within the facility away from all erodible materials; and, if sediment basins are implemented, ensure compliance with the design storm standards.

Phase II Small MS4 Storm Water General Permit (NPDES General Permit No. S000004, Order No. 2013-0001-DWQ)
Permittees subject to the Phase II Small MS4 Permit, generally cities with a population less than 100,000 and other "non-traditional" facilities such as parks and schools, are required to develop a construction site storm water runoff control ordinance that includes, at a minimum,

requirements for erosion and sediment controls, soil stabilization, dewatering, source controls, pollution prevention measures and prohibited discharges. The Phase II Small MS4 Permit also provides that: (a) Prior to issuing a grading or building permit, the Permittee shall require each operator of a construction activity within its jurisdiction to prepare and submit an erosion and sediment control plan for the Permittee’s review and written approval. The Permittee shall not approve any erosion and sediment control plan unless it contains appropriate site-specific construction site BMPs that meet the minimum requirements of the Permittee’s construction site storm water runoff control ordinance. If the erosion and sediment control plan is revised, the Permittee shall review and approve those revisions; and, (b) Require that the erosion and sediment control plan include the rationale used for selecting BMPs including supporting soil loss calculations, if necessary.

Grading and Erosion Prevention Ordinances
Local jurisdictions have adopted grading ordinances that include erosion control requirements to protect watercourses and adjacent property (e.g., the grading and erosion prevention ordinance of Placer County (Placer Co., Ord. 5056-B (part), 2000)).

Ban on Disposal of Hazardous Waste and Universal Waste in Trash
As of February 9, 2006 all universal waste items are banned from the trash because they cannot be safely disposed in class three landfills (landfills that accept municipal solid waste). Mercury containing items, such as thermostats, thermometers, electronic switches and relays, mercury gages, and fluorescent lamps and tubes are classified as either universal waste or hazardous waste and are not allowed to be disposed in the regular trash per California’s Universal Waste Rule (DTSC 2010). Most cities and counties in California have either established household hazardous waste collection programs or participate in regional household hazardous waste collection programs. These household hazardous waste collection programs also accept universal waste including mercury containing items. Each jurisdiction in California is required to complete and submit an annual report to CalRecycle to provide data on the amount of household hazardous waste collected by local programs and the methods for managing these waste streams (CalRecycle 2016).

8.3 Summary of potential environmental impacts

Section 8.4 contains the Environmental Checklist and the environmental analysis (by resource type) of the proposed Provisions.

The environmental analysis (Sections 8.4 through 8.7) found that the resource areas that may have potentially significant impacts are:

- Biological Resources (Section 8.4.4)
- Geology/Soils (Section 8.4.6)
- Greenhouse Gas Emissions (Section 8.4.7)
- Noise and Vibration (Section 8.4.12)
- Public Services (Section 8.4.14)

- Utilities/Service Systems (Section 8.4.17)

The methods of compliance that are anticipated to have the greatest potential to cause a direct or indirect physical change in the environment and cause the potentially significant impacts to the resources areas listed above are:

Wastewater Treatment/Industrial Facility Upgrades
Although unlikely, it is possible that the implementation of the effluent limitations for the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, or the California Least Tern Prey Fish Water Quality Objective could necessitate facility upgrades in order to comply with the water quality objectives. Effluent limitations for the Subsistence Fishing Water Quality Objective and Tribal Subsistence Fishing Water Quality Objective are much more likely to necessitate facility upgrades. However, Regional Water Boards have not designated Subsistence Fishing or Tribal Subsistence Fishing beneficial uses to any waters in California, so it is difficult to predict where those beneficial uses may be designated and if they would have an impact on any wastewater treatment or industrial facilities requiring upgrades (but see Section XX, which acknowledges that the North Coast Regional Water Board has designated numerous waters with the Native American Culture beneficial use). Wastewater Treatment/Industrial Facility Upgrades would involve earth moving, construction activities, and heavy vehicle/equipment use. Depending on the location and specifics of the upgrade, various construction activities resulting from such upgrades could potentially significantly impact biological resources, geological resources, greenhouse gas emissions, noise, and utilities and service systems (described more in detail in Section 8.4).

Sediment Controls
Sediment control projects may vary wildly in the size and the resulting impact. Substantial Sediment Control projects, such as re-contouring hillsides, would involve earth moving activities and use of heavy vehicles and equipment. These activities could create potentially significant impacts to biological resources, geological and soils resources, noise and vibration, and utilities and service systems (described more in detail in Section 8.4).

Cumulative Impacts to Greenhouse Gases
Many of the reasonably foreseeable methods of compliance could increase vehicle use and result in impacts to greenhouse gases. For the individual methods of compliance, these impacts are anticipated to be less than significant, but the impacts are not easy to estimate. The impacts would occur throughout the state and the total contribution to greenhouse gas emission would be the sum of all emissions throughout the state. Impacts may also continue indefinitely. The global warming effects from greenhouse gases are from emissions from all location though the world, over long time periods.

There is the potential that the impact to greenhouse gas emission from all of the Provisions' reasonably foreseeable methods of compliance could be cumulatively considerable (see Section 8.4.7). When considering other Water Board projects cumulatively with the Provisions, the increase in vehicle use and result in increased greenhouse gas emissions, then the impact to greenhouse gases is also cumulatively considerable (see Section 8.7).

Table 8-1 identifies the Provisions' primary elements and summarizes any related reasonably foreseeable methods of compliance and the actions that could have potential significant impacts. Table 8-1 also provides a brief assessment of whether significant environmental impact is anticipated.

Table 8-1. Methods of Compliance

Provisions' Element/Requirement	Reasonably Foreseeable Method of Compliance*	Activities from method of compliance with possible environmental impacts	Impact Assessment
Beneficial use definitions (CUL, T-Sub, and SUB)	None	Not applicable	Not applicable
Mercury Water Quality Objectives	None	Not applicable	Not applicable
Mercury Water Quality Objectives-Implementation: **Mines**	Increased Sediment Controls	• Unknown increase in vehicle use, • Possibly earth moving, • Possibly re-contouring landscape and revegetation • Possibly construction	POTENTIALLY SIGNIFICANT IMPACT(Geology/Soils; Biological Resources/
Mercury Water Quality Objectives-Implementation: **Nonpoint Sources**	Increased Sediment Controls	• Unknown increase in vehicle use, • Possibly earth moving, • Possibly re-contouring and revegetation, • Possibly construction	POTENTIALLY SIGNIFICANT IMPACT
Mercury Water Quality Objectives-Implementation: **Dredging**	Alternative Dredging Procedures; Increased Mercury Monitoring (Aqueous)	• Unknown increase in vehicle use • Laboratory supplies and waste • Heavy vehicle/equipment use	No potentially significant impact
Mercury Water Quality Objectives-Implementation: **Wetlands** (projects that establish or restore wetlands)	Wetland Design Features or Management Measures to Reduce Methylation	• Possibly heavy vehicle/ equipment use, • Earth moving, • Possibly re-contouring landscape and revegetation	No potentially significant impact

Provisions' Element/Requirement	Reasonably Foreseeable Method of Compliance*	Activities from method of compliance with possible environmental impacts	Impact Assessment
Mercury Water Quality Objectives-Implementatio: **Storm water: Municipal (MS4s)**	Small increase in Waste Collection and Education	• Possibly vehicle use	No potentially significant impact
	Small increase in Educating Auto Dismantlers	• Possibly vehicle use	No potentially significant impact
	Internal Surveys	• (In house activity)	No impact
	Small increase in Sediment Controls	• Unknown increase in vehicle use, • Possibly earth moving, • Possibly re-contouring and revegetation, • Possibly construction	POTENTIALLY SIGNIFICANT IMPACT
Mercury Water Quality Objectives-Implementation**:** **Storm water: Industrial Activities**	Small increase in Mercury Monitoring (Aqueous); Exceedance Response Actions	• Small Increase in vehicle use • Laboratory supplies and waste, • (In house activity)	No potentially significant impact
Mercury Water Quality Objectives-Implementation: **Wastewater treatment plants and industrial dischargers**	Relatively few Wastewater Treatment/Industrial Facility Upgrades	• Possibly vehicle use, • Heavy vehicle/equipment use, • Construction, • Earth moving	POTENTIALLY SIGNIFICANT IMPACT
	Small increase in Mercury Pollution Prevention	• Vehicle use • Laboratory supplies and waste	No potentially significant impact
	Increased Mercury Monitoring (Aqueous)	• Vehicle use • Laboratory supplies and waste	No potentially significant impact

*Each method of compliance is described in Chapter 7

8.4 Environmental Factors potentially affected (ENVIRONMENTAL CHECKLIST)

8.4.1 AESTHETICS

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☑	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☑	☐
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☑	☐
d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	☐	☐	☐	☑

Impacts and Mitigation

Reasonably foreseeable methods of compliance should not affect lighting.

Wastewater Treatment/Industrial Facility Upgrades

Existing wastewater treatment/industrial facilities may need to be upgraded in order to comply with the proposed effluent limitations. However, this is only likely to occur in previously developed areas. Therefore, it is unlikely that the aesthetics of the natural environment or scenic vistas would be adversely affected by improvements to existing infrastructure.

Sediment Controls

Land alterations may occur if sediment control structures are employed to prevent sediments in urban runoff from running directly into streams or other water bodies. This is expected to cause minimal land alteration and it is unlikely that the aesthetics of the natural environment would be significantly adversely affected.

Sediment controls that are part of mine closure activities would likely result in physical changes to the landscape at the project site. Reasonably foreseeable changes may include altered topography, slope terracing, and exposure of soils during grading and construction, and long-term changes in vegetation. These changes may be noticeable to nearby residents, workers, and visitors. However, given that the mine sites have been extensively altered and modified by mining, coupled with the subtle nature of the changes, impacts to scenic vistas would be minimal. In fact, mine remediation can improve the aesthetics of a landscape that is scared from mining. Furthermore, replanting and monitoring should be required for all mining waste cleanup projects, to continue to prevent erosion. These actions would also mitigate negative effects to aesthetics. Growth of new vegetation would lessen the impact of visual changes in the landscape. Therefore, visual impacts on scenic vistas should be less than significant.

Summary
Compliance with the Provisions is anticipated to have a less than significant effect on aesthetics.

8.4.2 AGRICULTURAL AND FOREST RESOURCES

In determining whether impacts to agricultural resources are significant environmental impacts, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board.

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping & Monitoring Program of the California Resources Agency, to non-agricultural uses?	☐	☐	☐	☑
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☑
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)) or timberland (as defined by Public Resources Code section 4526)?	☐	☐	☐	☑
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☑
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☐	☑

Impacts and Mitigation

The Provisions would not affect agriculture or farmland as the Provisions do not alter zoning laws or require conversions to different land uses. The Provisions may result in the use of sediment controls on forest lands, but this action is not anticipated to inhibit the use of the land for forestry.

Summary

There are no foreseeable impacts on agricultural or forest resources.

8.4.3 AIR QUALITY

Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations.

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a. Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☑
b. Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☑	☐
c. Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☑	☐
d. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors)?	☐	☐	☑	☐
e. Create objectionable odors affecting a substantial number of people?	☐	☐	☑	☐

Background

State Law

The California Air Resources Board (ARB) is a board within the California Environmental Protection Agency that coordinates local, state and federal air pollution control programs in California. In 1988, the State Legislature adopted the California Clean Air Act (Health & Safety Code, § 39000 et seq.), which established a statewide air pollution control program. The California Clean Air Act's requirements include annual emission reductions, increased development and use of low emission vehicles, and submittal of air quality attainment plans by air districts. The ARB has established state ambient air quality standards, also shown in Table 8.2. Additionally, the ARB has established state standards for pollutants that have no federal ambient air quality standard, including sulfate, visibility, hydrogen sulfide, and vinyl chloride.

The ARB has established state ambient air quality standards to identify outdoor pollutant levels considered safe for the public. Ambient air quality standards define clean air, and are established to protect even the most sensitive individuals in our communities. An air quality standard defines the maximum amount of a pollutant that can be present in outdoor air without harm to the public's health. In addition to state standards, the federal Clean Air Act (42 U.S.C. § 7401, et seq.) requires U.S. EPA to set national ambient air quality standards (federal standards or national standards). The ARB makes area designations for ten pollutants: ozone, suspended particulate matter (PM10 and PM2.5), carbon monoxide, nitrogen dioxide, sulfur dioxide, sulfates, lead, hydrogen sulfide, and visibility reducing particles.

After state standards are established, state law requires the ARB to designate each area as attainment, nonattainment, or unclassified for each state standard. The area designations, which are based on the most recent available data, indicate the healthfulness of air quality throughout the state. Classifications determine the applicability and minimum stringency of pollution control requirements.

The gaseous criteria pollutants, particulate matter, and toxic air contaminants, and the associated adverse health effects of these air quality contaminants are summarized below. Daily emissions and pollutant concentrations are used to quantify air pollution. The term "emissions" means the quantity of pollutant released into the air and has units of pounds per day (lbs /day). The term "concentrations" means the amount of pollutant material per volumetric unit of air and has units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$).

Carbon Monoxide

Exposure to high concentrations of carbon monoxide, a colorless and odorless gas, reduces the oxygen-carrying capacity of the blood, and therefore can cause dizziness and fatigue, impair central nervous system functions, and induce angina in persons with serious heart disease. Carbon monoxide is emitted almost exclusively from the incomplete combustion of fossil fuels. In urban areas, motor vehicles, power plants, refineries, industrial boilers, ships, aircraft, and trains emit carbon monoxide. Motor vehicle exhaust releases most of the carbon monoxide in urban areas. Vehicle exhaust contributes approximately 56 percent of all carbon monoxide emissions nationwide and up to 95 percent in cities. Carbon monoxide is a reactive air pollutant that dissipates relatively quickly. As a result, ambient carbon monoxide concentrations generally follow the spatial and temporal distributions of vehicular traffic. Carbon monoxide concentrations are influenced by local meteorological conditions; primarily wind speed, topography, and atmospheric stability. Carbon monoxide from motor vehicle exhaust can become locally concentrated when surface-based temperature inversions combine with calm atmospheric conditions.

Ozone

While ozone serves a beneficial purpose in the upper atmosphere (stratosphere) by reducing potentially harmful ultraviolet radiation, elevated ozone concentrations in the lower atmosphere can be harmful to humans and to sensitive species of plants. Short-term ozone exposure can reduce lung function and increase an individual's susceptibility to respiratory infection. Long-term exposure can impair lung defense mechanisms and lead to emphysema and/or chronic bronchitis. Ozone concentrations build to peak levels during periods of light winds or stagnant air, bright sunshine, and high temperatures. Ideal conditions for high ozone production occur during summer and early autumn. Sensitivity to ozone varies among individuals. About 20 percent of the population is sensitive to ozone, with children being particularly vulnerable, especially during exercise. Ozone is formed in the atmosphere by a complex series of chemical reactions under sunlight that involve "ozone precursors." Ozone precursors are categorized into two families of pollutants: oxides of nitrogen and reactive organic compounds. Oxides of nitrogen and reactive organic compounds are emitted from a variety of stationary and mobile sources. While oxides of nitrogen are considered a criteria pollutant, reactive organic compounds are not in this category, but are included in this discussion as ozone precursors. Ozone is the chief component of urban smog and the damaging effects of photochemical smog generally relate to the concentration of ozone. Meteorology and terrain play major roles in ozone formation. The greatest source of smog producing gases is the automobile.

Nitrogen Dioxide

The major health effect from exposure to high levels of nitrogen dioxide is the risk of acute and chronic respiratory disease. Like ozone, nitrogen dioxide typically is not directly emitted, but it is formed through a rapid reaction between nitric oxide and atmospheric oxygen. Nitric oxide and nitrogen dioxide are collectively called "oxides of nitrogen" and are major contributors to ozone formation. Nitrogen dioxide also contributes to the formation of respirable particulate matter (see discussion of particulate matter below) and fine particulate matter through the formation of nitrate compounds. At atmospheric concentrations, nitrogen dioxide is only potentially irritating. In high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility.

Sulfur Dioxide

The major health effects from exposure to sulfur dioxide are acute and chronic respiratory disease. Exposure may cause narrowing of the airways, which may cause wheezing, chest tightness, and shortness of breath. Sulfur dioxide can also react with water in the atmosphere to form acids (or "acid rain"), which can cause damage to vegetation and man-made materials. The main sources of sulfur dioxide are coal and fuel oil combustion in power plants and industries, as well as diesel fuel combustion in motor vehicles. Generally, the highest levels of sulfur dioxide are found near large industrial complexes. In recent years, sulfur dioxide concentrations have been reduced by the increasingly stringent controls placed on stationary source emissions of sulfur dioxide and by limiting the sulfur content in fuel. Sulfur dioxide concentrations in southern California have been reduced to levels well below the state and national ambient air quality standards, but further reductions in emissions are needed to attain compliance with ambient air quality standards for sulfates, respirable particulate matter, and fine particulate matter, to which sulfur dioxide is a contributor.

Particulate Matter

Particulate matter pollution consists of very small liquid and solid particles in the air, which can include smoke, soot, dust, salts, acids, and metals. Particulate matter also forms when gases emitted from industries and motor vehicles undergo chemical reactions in the atmosphere. Regulated particulate matter is classified as respirable particulate matter, or inhalable particulate matter less than ten micrometers in diameter. Respirable particulate matter has been subdivided into to sub-categories, coarse and fine fractions, where the coarse fraction is between 10 and 2.5 micrometers in diameter and the fine fraction is less than 2.5 micrometers in diameter. Major sources of coarse and fine respirable particulate matter include crushing or grinding operations; dust stirred up by vehicles; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Fine particulate matter is generated from fuel combustion (e.g., from motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. In addition, fine particulate matter can be formed in the atmosphere from gases such as sulfur dioxide, oxides of nitrogen, reactive organic compounds, and ammonia, and elemental carbon.

The health effects from long-term exposure to high concentrations of particulate matter are increased risk of chronic respiratory disease like asthma and altered lung function in children. Coarse particulate matter tends to collect in the upper portion of the respiratory system. Fine particulate matter is so small that it can penetrate deeper into the lungs and damage lung tissues. Fine particulate matter can be absorbed into the bloodstream and cause damage elsewhere in the body. Short-term exposure to high levels of particulate matter has been shown to increase the number of people seeking medical treatment for respiratory distress, and to increase mortality among those with severe respiratory problems. Particulate matter also results in reduced visibility.

Toxic Air Contaminants

Toxic air contaminants include air pollutants that can produce adverse public health effects, including carcinogenic effects, after long-term (chronic) or short-term (acute) exposure. One source of toxic air contaminants is combustion of fossil fuels or digester gas. Human exposure occurs primarily through inhalation, although non-inhalation exposure can also occur when toxic air contaminants in particulate form deposit onto soil and drinking water sources and enter the food web or are directly ingested by humans. Many pollutants are identified as toxic air contaminants because of their potential to increase the risk of developing cancer. For toxic air contaminants that are known or suspected carcinogens, it has been found that there are no levels or thresholds below which exposure is risk free. No ambient air quality standards exist for almost all toxic air contaminants, except for standards for lead, hydrogen sulfide, and vinyl chloride that are provided in California Ambient Air Quality Standards. Instead, numerous national, state, and local rules that affect both stationary and mobile emission sources regulate emissions of toxic air contaminants emission. Individual toxic air contaminants vary greatly in the risk they present. At a given level of exposure, one toxic air contaminant may pose a hazard that is many times greater than another. Where data are sufficient to do so, a "unit risk factor" can be developed for cancer risk. The unit risk factor expresses assumed risk to a hypothetical population, the estimated number of individuals in a million who may develop cancer as the result of continuous, lifetime (70-year) exposure to one µg/m^3 of the toxic air contaminants. Unit risk factors provide a standard that can be used to establish regulatory thresholds for permitting purposes. This is, however, not a measure of actual health risk to a real-world population because actual populations do not experience the extent and duration of exposure that the hypothetical population is assumed to experience. For non-cancer health effects, a similar factor called a Hazard Index is used.

Federal Law

The U.S. EPA is the federal agency charged with administering the federal Clean Air Act (42 U.S.C. § 7401 et seq.), which established a number of requirements. The U.S. EPA oversees state and local implementation of federal Clean Air Act requirements. The Clean Air Act requires the U.S. EPA to approve State Implementation Plans to meet and/or maintain the national ambient standards. The federal (and California) ambient air quality standards are shown in 8-2.

Table 8-2. Federal and California Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards	Federal Standards	
			Primary	Secondary
Ozone	1 Hour	0.09 ppm (180 µg/m^3)	-	Same as Primary Standard
	8 Hour	0.070 ppm (137 µg/m^3)	0.075 ppm (147 µg/m^3)	
Respirable Particulate Matter	24 Hour	50 µg/m^3	150 µg/m^3	Same as Primary Standard
	Annual Arithmetic Mean	20 µg/m^3	-	
Fine Particulate Matter	24 Hour	No Separate State Standard	35 µg/m^3	35 µg/m^3
	Annual Arithmetic Mean	12 µg/m^3	12.0 µg/m^3	15.0 µg/m^3
Carbon Monoxide	1 Hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	-
	8 Hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)	-	-
Nitrogen Dioxide	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)	0.053 ppm (100 µg/m^3)	Same as Primary Standard
	1 Hour	0.18 ppm (339	100 ppm (188	-

		μg/m³)	μg/m³)	
Sulfur Dioxide	Annual Arithmetic Mean	-	0.030 ppm	-
	24 Hour	0.04 ppm (105 μg/m³)	0.14 ppm (365 μg/m³)	-
	3 Hour	-	-	0.5 ppm (1300 μg/m³)
	1 Hour	0.25 ppm (655 μg/m³)	75 ppb (195 μg/m³)	-
Lead	30 Day Average	1.5 μg/m³	-	-
	Calendar Quarter	-	1.5 μg/m³	Same as Primary Standard

Local Regulations
There are 35 local air districts within California. Each district (referred to as either an Air Pollution Control District or an Air Quality Management District) is responsible for controlling emissions, primarily from stationary sources of air pollution, within their area. Each district develops and adopts an Air Quality Management Plan, which serves as the blueprint to bring their respective areas into compliance with federal and state clean air standards. Rules are adopted to reduce emissions from various sources.

Impacts

Sediment Controls
Air emissions that could result from sediment controls installed for mine closure projects or related to the requirements nonpoint source dischargers would be related to grading and earth moving (dust and vehicle exhaust) and vehicle use for installing vegetation. Previous Water Board analyses described in the Guadalupe River Watershed Mercury TMDL (San Francisco Bay Water Board 2008) found that particulate matter (PM10) is the pollutant of greatest concern with respect to construction. PM10 emissions can result from a variety of construction activities, including excavation, grading, vehicle travel on paved and unpaved surfaces, and vehicle and equipment exhaust. Temporary emissions of carbon monoxide, ozone precursors, and other vehicle exhaust byproducts would also be generated from heavy construction equipment.

Although this impact should be less than significant, the mitigation measures at the end of this section should be included in orders issued by the Water Boards.

Wetland Features or Measures to Reduce Methylation
Similar to effects described above from sediment controls, the Wetland Features or Measures to Reduce Methylation could cause a temporary increase in the use of heavy vehicles or heavy equipment and earth moving and grading. Vehicle use can releases a number of pollutants and particles into the air as described above. The provisions do not alter where a wetland project is created, rather the Provisions may prompt a different design for the wetland project. Heavy vehicle

use and earth movement would likely occur with or without the Provisions, but the Provisions could cause an increase in heavy vehicle use to create specific landscape features, such as a settling pond. The increase in this activity from the Provisions is not anticipated to be significant compared to the vehicle use that would otherwise be used to build the wetland.

Although potential impacts to air quality should be less than significant, mitigation measures are provided at the end of this section that can reduce impacts to air quality.

Wastewater Treatment/Industrial Facility Upgrades
The construction of wastewater treatment and industrial facility upgrades would have a similar impact on air quality as sediment control (described above) from the construction activities (heavy vehicle use and earth moving) and similar mitigation measures (described below) could be used to reduce the pollutants, dust and fine particles.

Alternative Dredging Procedures
For dredging activities, the Provisions could result in different procedures being used that increase the use of heavy vehicles or heavy equipment. If dredged material must be disposed of at a site further away, there would likely be an increase the use of the heavy vehicles. This in turn could release more emissions to the air. However, it is difficult to determine how much change there will be from existing methods, since heavy vehicles and equipment would already have been used for dredging. It is also uncertain how many locations would be affected. Specific calculations of the added emissions would be too speculative.

Mercury Monitoring (Aqueous)
Aqueous mercury monitoring is required for wastewater treatment plants and industrial dischargers for compliance with the effluent limitation. Impacts to air quality would be the result of increased vehicle use for the transport of samples and personnel. Vehicle use can release a number of pollutants into the air as described above.

For the Sport Fish Water Quality Objective, it is likely that few facilities would need to monitor mercury routinely. On the other hand, for the Subsistence Fishing Water Quality Objective and Tribal Subsistence Fishing Water Quality Objective, the effluent limitations would be more stringent and more facilities would likely be required to monitor mercury in the effluent. However, requirements for the Subsistence Fishing Water Quality Objective and Tribal Subsistence Fishing Water Quality Objective would not apply to very many dischargers within the next 5 to 10 year or until the Water Boards designate the beneficial uses. Foreseeable routine mercury monitoring would result in 32,000 miles driven annually (see Chapter 7).

The increase in emissions from an additional 32,000 miles per year could be estimated, however the increase in emission is not anticipated to be significant in light of the over 300 billion miles driven annually in California (U. S. Department of Transportation 2016). Additionally, the emissions can be mitigated as described below.

Waste Collection and Education

A permanent increase in the use of heavy vehicles could be due to the requirement for Waste Collection and Education. The heavy vehicles would be used to pick up waste and haul it to another location for disposal. Also, vehicle use for education would need to continue indefinitely. The magnitude of the increase is very difficult to predict. The increase is not anticipated to be significant.

Cumulative Impacts from All Methods of Compliance

Many of the methods of compliance listed above could increase vehicle use and result in impacts to air quality. For the individual methods of compliance, these impacts are anticipated to be less than significant. When considering impacts of all methods of compliance collectively, impact is still anticipated to be less than significant, since each method of compliance would occur in various locations thought the state. The resulting emissions are not anticipated to result in an exceedance of an air quality standard in any one location.

Mitigation

Measures to lessen the air emissions caused by vehicle trips or construction equipment include: (1) use of construction and maintenance vehicles with lower-emission engines; (2) use of soot reduction traps or diesel particulate filters; and (3) use of emulsified diesel fuel and (4) combining trips, if possible.

The Bay Area Are Quality Management District developed a set of Mitigation Measures contained in Table 8-2 of the 2010 District's CEQA Air Quality Guidelines (Bay Area Air Quality Management District 2010): These Mitigation Measures can be used and/or modified to fit specific situations by the implementing agencies to reduce air emissions for their activities.

1. All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day.
2. All haul trucks transporting soil, sand, or other loose material off-site shall be covered.
3. All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
4. All vehicle speeds on unpaved roads shall be limited to 15 mph.
5. All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.
6. Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points.
7. All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.

8. Post a publicly visible sign with the telephone number and person to contact at the Lead Agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District's phone number shall also be visible to ensure compliance with applicable regulations.

Summary

The reasonably foreseeable methods of compliance would not be of the size or scale to result in significant increases in air pollution. Mitigation measures are available to decrease the impacts further. The Provisions are projected to have a less than significant impact on air quality.

8.4.4 BIOLOGICAL RESOURCES

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☑	☐	☐	☐
b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☑	☐	☐	☐
c. Have a substantial adverse effect on federally-protected wetlands as defined by Section 404 of the federal Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, *etc.*) through direct removal, filling, hydrological interruption or other means?	☑	☐	☐	☐
d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory corridors, or impede the use of native wildlife nursery sites?	☐	☐	☑	☐
e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☑

f. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☑

Background (Regulatory Setting)

Federal Endangered Species Act

Pursuant to the federal Endangered Species Act (16 U.S.C. § 1531 et seq.), the U. S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration Fisheries Service, formerly National Marine Fisheries Service, have regulatory authority over federally listed species. Under the Endangered Species Act, a permit is required for any federal action that may result in "take" of a listed species. Section 9 of the Endangered Species Act defines take as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Under federal regulations, take is further defined to include the modification or degradation of habitat where such activity results in death or injury to wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Clean Water Act

Section 404 of the Clean Water Act requires project proponents to obtain a permit from the U.S. Army Corps of Engineers before performing any activity that involves discharge of dredged or fill material into "waters of the United States," including wetlands. Dredging activities involve any activity, such as construction, that results in direct modification (e.g., alteration of the banks, deposition of soils) of an eligible waterway. Waters of the United States include navigable waters, interstate waters, and other waters where the use or degradation or destruction of the waters could affect interstate or foreign commerce, tributaries to any of these waters, and wetlands that meet any of these criteria or that are adjacent to any of these waters or their tributaries (see 80 Fed. Reg. 37054 (June 29, 2015) (defining ''waters of the United States'' to include eight categories of jurisdictional waters)). Many surface waters and wetlands in California meet the criteria for waters of the United States.

In accordance with section 401 of the Clean Water Act, projects that apply for a U.S. Army Corps of Engineers permit for discharge of dredged or fill material must obtain water quality certification from the Water Boards indicating that the project would uphold state water quality standards.

Section 402 of the Clean Water Act controls water pollution by regulating, through the national pollutant discharge elimination system (NPDES) permit program, point sources that discharge of any pollutant, or combination of pollutants, into waters of the United States prior to discharge. (See 40 CFR § 122.2 for the definitions of point source, pollutant, and waters of the United States.) The State of California has been delegated the authority to administer the NPDES permitting program for implementation through the Water Boards. In California, NPDES permits are also referred to as waste discharge requirements that regulate discharges to waters of the United States.

California Endangered Species Act
Pursuant to the California Endangered Species Act (Fish & Game Code, § 2050 et seq.), a permit from the California Department of Fish and Wildlife is required for projects that could result in take of a plant or animal species that is state listed as threatened or endangered. Under the California Endangered Species Act, "take" is defined as an activity that would directly or indirectly kill an individual of a species. Authorization for take of state-listed species can be obtained through a California Fish and Wildlife Code section 2080.1 consistency determination or a section 2081 incidental take permit.

The Migratory Bird Treaty Act
The Migratory Bird Treaty Act (16 U.S.C. § 703 et seq.) includes provisions for protection of migratory birds under the authority of the U.S. Fish and Wildlife Service and California Fish and Wildlife. The Migratory Bird Treaty Act protects over 800 species including, geese, ducks, shorebirds, raptors, songbirds, and many other relatively common species. It is not reasonably foreseeable that construction activities would result in the deterioration of existing fish and or wildlife habitat.

Section 1600 of the California Fish and Wildlife Code
All diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream or lake in California that supports wildlife resources is subject to regulation by the California Department of Fish and Wildlife, under sections 1600–1603 of the California Fish and Wildlife Code. Section 1601 states that it is unlawful for any agency to substantially divert or obstruct the natural flow or substantially change the bed, channel or bank of any river, stream or lake designated by CDFW, or use any material from the streambeds, without first notifying CDFW of such activity. The regulatory definition of a stream is a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life. This includes watercourses having a surface or subsurface flow that supports or has supported riparian vegetation. Accordingly, a California Department of Fish and Wildlife Streambed Alteration Agreement must be obtained for any project that would result in diversions of surface flow or other alterations to the bed or bank of a river, stream, or lake.

Porter-Cologne Water Quality Control Act
Under the Porter-Cologne Act (Wat. Code, § 13000), "waters of the state" is defined as "any surface water or groundwater, including saline waters, within the boundaries of the state. (Wat. Code, § 13050, subd. (e).) The Water Boards regulate any activity or factor which may affect the quality of the waters of the state, including the correction and prevention of water pollution and nuisance. (Ibid., §§ 13050, subd. (i), 13100.) The Water Boards must prepare and periodically update water quality control plans. (Wat. Code, §§ 13170, 13240.) Each plan establishes numerical or narrative water quality objectives to protect established beneficial uses, which include wildlife, fisheries and their habitats. Projects that affect wetlands or waters of the state must meet discharge requirements of the Water Boards, which may be issued in addition to a water quality certification or waiver under section 401 of the Clean Water Act.

Local Regulations
Numerous California cities and counties have adopted ordinances regulations and policies for the protection and enhancement of natural resources, including heritage trees, important natural features, habitat alteration, and common and special status species.

Impacts
No impact to policy or plans concerning biological resources are anticipated (item e and item f). Some methods of compliance involve earthmoving or construction and therefore can impact habitat, as described below. Any project that alters habitat could have a small impact on the movement of wildlife.

Wetland Features or Measures to Reduce Methylation
The Provisions provide guidance to the Water Boards to require parties creating or restoring wetlands to add features or use measures that could minimize the production of methylmercury. The implementation of this requirement should provide equivalently viable habitat, and therefore should not have a significant adverse impact on habitat. If anything, this requirement would help provide healthier habitat by reducing the methylmercury levels in the food web. Possible design features that could be used to minimize methylmercury production in a wetland could be incorporating open water areas, settling ponds, or structures to minimize water level fluctuations. Additionally, wetland projects must also include an environmental analysis and consider mitigation and alternatives for any potentially significant impacts.

Wastewater Treatment/Industrial Facility Upgrades
Compliance with the Provisions could require construction for a wastewater treatment plant upgrade. Few upgrades are anticipated over all for the projects in the foreseeable future (Section 7.2.7). In general, the sites for the facility upgrades are likely located in previously developed areas and the presence of fish and wildlife species and their supporting habitat severely limited. Any watercourses, riparian habitat or wetlands downstream from the construction and maintenance activities are unlikely to be adversely impacted further by these compliance measures. Rather, in the long term, these areas would be improved by the reduction in mercury entering from upstream sources. Still, a site for a facility upgrade could be in the habitat of sensitive species. Such construction projects must also include an environmental analysis and consider mitigation and alternatives for any potentially significant impacts.

Sediment Controls
While controlling sediment in a mine impacted or other landscape is designed to benefit, enhance, restore, and protect biological resources, including fish, wildlife, and rare and endangered species, it is possible that the projects involving earthmoving activities and landscape modifications could affect sensitive or special status species, either directly or through habitat modifications. These impacts should be mitigated to less than significant levels through adherence to the conditions, specifications, and requirements of the Endangered Species Act; through avoidance of sensitive resources; and/or through the mitigation actions

described below. Such projects must include an environmental analysis and consider mitigation and alternatives for any potentially significant impacts.

In many cases, sediment controls are already being implemented as authorized by existing law. The Provisions are anticipated to result in an increase in the use of sediment controls in some cases, resulting in a small increase in the use of sediment controls statewide. Sediment controls could cause a temporary habitat disturbance, such as bringing additional vehicles to a site on a temporary basis to install new controls. However the impact is temporary, small and too speculative to calculate an amount or frequency of disturbance.

<u>All compliance methods</u>
The compliance methods listed would not foreseeably:

- Cause a substantial reduction of the overall habitat of a wildlife species.
- Produce a drop in a wildlife population below self-sustaining levels.
- Eliminate a plant or animal community.
- Have a substantial adverse effect on federally protected wetlands.
- Conflict with any local policies or ordinances protecting biological resources.

It is not reasonably foreseeable that any of the compliance methods would result in a significant long-term impact to general wildlife species adapted to developed environments. Potential construction activities would occur in previously developed areas and would not result in the removal of sensitive biological habitats.

It is not reasonably foreseeable that any of the compliance methods would result in the introduction of exotic or invasive plant species into an area. Nor would it result in a barrier to the normal replenishment of existing species. Because potential projects would be established in previously developed areas it is not expected that potential project sites would act as a travel route or regional wildlife corridor. In the case that landscaping is incorporated into the specific project design, however, there is a possibility of disruption of resident native species.

It is possible that direct or indirect impacts to special-status animal species may occur at the project level for the compliance method specifically listed in this section (mainly Wastewater Treatment/Industrial Facility Upgrades and possibly large Sediment Control projects). Because these animal species are protected by state and/or federal Endangered Species Acts, impacts to them would be considered potentially significant. Even though it is expected that potential projects would occur in previously developed areas, it is possible for special-status species to occur in what would generally be described as urban areas. If these species are present during activities such as ground disturbance, construction, and operation and maintenance activities associated with the potential projects, it could conceivably result in direct impacts to special status species including the following:

- Direct loss of individuals of a sensitive species.
- Increased human disturbance in previously undisturbed habitats.
- Mortality by construction or other human-related activity.

- Impairing essential behavioral activities, such as breeding, feeding or shelter/refugia.
- Destruction or abandonment of active nest(s)/den sites.
- Direct loss of occupied habitat.
- In addition, potential indirect impacts may include but are not limited to, the following:
- Displacement of wildlife by construction activities.
- Disturbance in essential behavioral activities due to an increase in ambient noise levels and/or artificial light from outdoor lighting around facilities.

Construction activities (mainly associated with Wastewater Treatment/Industrial Facility Upgrades and possibly large Sediment Control projects) may impact migratory avian species. These avian species may use portions of potential project sites, including ornamental vegetation, during breeding season, and may be protected under the Migratory Bird Treaty Act while nesting.

Mitigation

For construction or earth moving related activities, the following measures should be implemented to reduce or avoid potential project-level impacts to biological resources:

Assuming any unique species are present, plant number and species diversity could be maintained by either preserving them prior, during, and after the construction or by re-establishing and maintaining the plant communities post construction. When the specific projects are developed and sites identified, a search of the California Natural Diversity Database could be employed to confirm that any potentially sensitive plant species or biological habitats in the site area are properly identified and protected as necessary. Focused protocol plant surveys for special-status-plant species could be conducted at each site location, if appropriate. If sensitive plant species occur on the project site, mitigation would be required consistent with appropriate expert analysis.

Mitigation measures shall be developed in coordination with U.S. Fish and Wildlife Services and the California Department of Fish and Wildlife. Responsible agencies should endeavor to avoid compliance measures that could result in reduction of the numbers of any unique, rare or endangered species of plants, and instead opt for siting physical compliance measures sufficiently upstream or downstream of sensitive areas to avoid any impacts.

In the case that landscaping is incorporated into the specific project design, the possibility of disruption of resident native species could be avoided or minimized by using only plants native to the area. Use of exotic invasive species or other plants listed in the Exotic Pest Plant of Greatest Ecological Concern in California should be prohibited (California Exotic Pest Plant Council 1999). Responsible agencies should endeavor to avoid requiring compliance measures that could result in significant impacts to unique, rare or endangered (special-status) species, should any such species be present at locations where activities associated with such compliance measures might not otherwise be performed. Mitigation measures, however, could be implemented to ensure that potentially significant impacts to special status animal species are less than significant. When the specific projects are developed and sites identified, a search of the California Natural Diversity Database could be employed to confirm that any potentially special-status animal species in the site area are properly identified and protected as necessary. Focused protocol animal surveys for special-status animal species should be conducted at each site location.

If special-status animal species are potentially near the project site area two weeks prior to grading or the construction of facilities and per applicable U.S. Fish and Wildlife Services or California Department of Fish and Wildlife protocols, pre-construction surveys to determine the presence or absence of special-status species would be conducted. The surveys should extend off site to determine the presence or absence of any special-status species adjacent to the project site. If special-status species are found to be present on the project site or within the buffer area, mitigation should be required consistent with appropriate expert analysis. To this extent, mitigation measures would be developed in coordination with the U.S. Fish and Wildlife Services and the California Department of Fish and Wildlife to reduce potential impacts.

If construction activities occur at locations where they would foreseeably adversely impact species migration or movement patters, mitigation measures previously described could be implemented to ensure that impacts which may result in a barrier to the migration or movement of animal are less than significant. Any site-specific wildlife crossings should be evaluated in consultation with the California Department of Fish and Wildlife. If a wildlife crossing would be significantly impacted in an adverse manner, then the design of the project should include a new wildlife crossing in the same general location.

If construction occurs during the avian breeding season for special status species and/or Migratory Bird Treaty Act -covered species, generally February through August, then prior (within two weeks) to the onset of construction activities, surveys for nesting migratory avian species would be conducted on the project site following U.S. Fish and Wildlife Services or California Department of Fish and Wildlife guidelines. If no active avian nests are identified on or within 200 feet of construction areas, no further mitigation would be necessary.

Alternatively, to avoid impacts, the agencies implementing the compliance measures may begin construction after the previous breeding season for covered avian species and before the next breeding season begins. If a protected avian species were to establish an active nest after construction was initiated and outside of the typical breeding season (February – August), the project sponsor, would be required to establish a buffer of 200 feet or other measure that would result in equivalent mitigation between the construction activities and the nest site.

If active nests for protected avian species are found within the construction footprint or within the 200-foot buffer zone, construction would be required to be delayed within the construction footprint and buffer zone until the young have fledged or appropriate mitigation measures responding to the specific situation are developed in coordination with U.S. Fish and Wildlife Service or California Department of Fish and Wildlife. These impacts are highly site-specific, and assuming they are foreseeable, they would require a project-level analysis and mitigation plan.

Finally, to the extent feasible, responsible agencies should endeavor to avoid compliance measures that could result in significant barriers to the beneficial migration or movement of animals. No significant impact is anticipated after mitigation.

Summary

Adverse impacts to biological resources are not expected to occur due to the nature of the areas where potential compliance activities for the Provisions would be located. Most areas are already extensively developed or mined and the presence of significant biological resources is unlikely. However it is possible that significant impacts could occur in less developed areas or areas inhabited by endangered species. Since the State Water Board cannot guarantee that mitigation measures will be taken, the impact is determined to be potentially significant. In the event that specific construction or earth moving projects do encounter biological resources, measures have been identified to avoid or reduce potential impacts to less than significant levels, and these projects would need to have an independent environmental analysis done by the agency approving the project.

8.4.5 CULTURAL RESOURCES

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Cause a substantial adverse change in the significance of a historical resource as defined in § 15064.5?	☑	☐	☐	☐
b) Cause a substantial adverse change in the significance of an archaeological resource as defined in § 15064.5?	☑	☐	☐	☐
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☑	☐	☐	☐
d) Disturb any human remains, including those interred outside of formal cemeteries?	☑	☐	☐	☐
e) Cause a substantial adverse change in the significance of a Tribal Cultural Resource as defined in Public Resources Code § 21074?	☑	☐	☐	☐

Historic Resources

A historical resource includes resources listed in or eligible for listing in the California Register of Historical Resources. The California Register includes resources on the National Register of Historic Places, as well as California State Landmarks and Points of Historical Interest. Properties that meet the criteria for listing also include districts which reflect California's history and culture, or properties which represent an important period or work of an individual, or yield important historical information. Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts) or that have been identified as local historical resources are also considered a historical resource (California Office of Historical Preservation 2006). Based on substantial evidence within the administrative record, any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may also be considered to be an historical resource (CEQA Guidelines 15064.5(a)).

Archeological Resources

An archeological site may be considered an historical resource if it is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military or cultural annals of California (Pub. Resources Code, § 5020.1, subd. (j)) or if it meets the criteria for listing on the California Register (14 Code Cal. Regs. § 4850).

If an archeological site is not an historical resource, but meets the definition of a "unique archeological resource" as defined in Public Resources Code section 21083.2, then it should be treated in accordance with the provisions of that section.

Tribal Cultural Resources

AB 52 (Gatto, 2014) established a new category of resources in CEQA called Tribal Cultural Resources. (Pub. Resources Code, § 21074.) "'Tribal cultural resources' are either of the following: (1) Sites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American tribe that are either of the following: (A) Included or determined to be eligible for inclusion in the California Register of Historical Resources. (B) Included in a local register of historical resources as defined in subdivision (k) of Section 5020.1. (2) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Section 5024.1. In applying the criteria set forth in subdivision (c) of Section 5024.1 for the purposes of this paragraph, the lead agency shall consider the significance of the resource to a California Native American tribe." (Ibid.) Consultation with a California Native American Tribe that has requested such consultation may assist a lead agency in determining whether the project may adversely affect tribal cultural resources, and if so, how such effects may be avoided or mitigated. Whether or not consultation has been requested (no such consultation was requested for the State Water Board's development of the Provisions, see Section 2.6.6), the lead agency evaluates whether the project may cause a substantial adverse change in a site, feature, place, cultural landscape, sacred place, or object, with cultural value to a California Native American Tribe.

Impacts

Sediment Controls

Compliance projects meant to control sediments should help keep archeological, historic, and tribal cultural resources intact by preventing erosion. However, the installation of sediment control structures could also disrupt archeological, historic, or tribal cultural resources, or disturb human remains. The site-specific presence or absence of these resources is unknown because the specific locations for sediment control measures would be determined by responsible agencies at the project level. Installation of these measures could result in minor ground disturbances, which could impact cultural resources if they are sited in locations containing these resources and where disturbances have not previously occurred.

Wastewater Treatment/Industrial Facility Upgrades

If upgrades to wastewater or industrial facilities are necessary for compliance, the construction related activities would mostly occur in currently developed areas where ground disturbance has previously occurred. Because these areas are already developed it is unlikely that construction activities would cause a substantial adverse change to historical, archeological, or tribal cultural resources, destroy paleontological resources, or disturb human remains. Depending, however, on the location of facilities, potential impacts to cultural resources or tribal cultural resources could occur. Paleontological resources can be found in areas containing fossil-bearing formations. Archaeological resources have been found within urbanized areas. Historic, archeological, and tribal and cultural resources have also been found within urbanized areas. The site-specific presence or absence of these resources is unknown because the specific locations for compliance methods would be determined by responsible agencies at the project level. Installation of these systems could result in minor ground disturbances, which could impact cultural resources if they are sited in locations containing these resources and where disturbances have not previously occurred.

Mitigation

Upon determination of specific locations where construction activities will occur, responsible agencies should complete further investigation, including consultation with California tribes, to make an accurate assessment of the potential to affect tribal cultural resources, historic or archaeological resources or to impact any human remains. If potential impacts are identified, measures to reduce impacts could include project redesign, such as the relocation of facilities outside the boundaries of archeological or historical sites. According to the California Office of Historic Preservation, avoidance and preservation in place are the preferable forms of mitigation for archeological sites. When avoidance is infeasible, a data recovery plan should be prepared which adequately provides for recovering scientifically consequential information from the site. Studies and reports resulting from excavations must be deposited with the California Historical Resources Regional Information Center.

Require compliance with State Laws regarding disposition of Native American burials, if such remains are found. If human remains of Native American origin are discovered during project activities, it is necessary to comply with state laws relating to the disposition of Native American burials, which are under the jurisdiction of the Native American Heritage Commission (Pub. Res. Code Section 5097). If human remains are discovered or recognized in any location other than a dedicated cemetery, excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains will stop until:

- the county coroner has been informed of the discovery and has determined that no investigation of the cause of death is required; and
- if the remains are of Native American origin:
  - o the descendants of the deceased Native Americans have made a recommendation to the landowner or the person responsible for the excavation work, for means of treating or disposing of the human remains and any associated grave goods with appropriate dignity, as provided in Public Resources Code Section 5097.98, or
  - o the Native American Heritage Commission is unable to identify a descendant or the descendant failed to make a recommendation within 24 hours after being notified by the commission.

According to the California Health and Safety Code, six or more human burials at one location constitute a cemetery (Section 8100), and disturbance of Native American cemeteries is a felony (Section 7052). Section 7050.5 requires that construction or excavation be stopped in the vicinity of discovered human remains until the coroner can determine whether the remains are those of a Native American. If the remains are determined to be Native American, the coroner must contact the California Native American Heritage Commission.

Summary

While the potential for adverse impacts to cultural resources is low, there still exists a chance that cultural resources may occur at specific locations where related project compliance methods could be installed. Measures have been identified that could reduce potential impacts to less than significant levels and should be incorporated into site-specific projects carried out or approved by a local agency.

8.4.6 GEOLOGY and SOILS

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Rupture of a known earthquake fault, as delineated in the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines & Geology Special Publication 42.	☐	☐	☐	☑

ii. Strong seismic ground shaking?	☐	☐	☐	☑
iii. Seismic-related ground failure, including liquefaction?	☐	☐	☐	☑
iv. Landslides?	☐	☐	☐	☑
b. Result in substantial soil erosion or the loss of topsoil?	☑	☐	☐	☐
c. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☑	☐	☐	☐
d. Be located on expansive soils, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☑	☐
e. Have soils incapable of adequately supporting the use of septic tanks or alternate wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☑

Impacts and Mitigation

No method of compliance is anticipated to expose people or structures to substantial adverse effects from geologic hazards (item a). The only exception might be if a Wastewater Treatment or Industrial Facility Upgrade or a substantial project for sediment controls. Still such an upgrade or project is unlikely to have a magnitude large enough to cause such great geologic effects. The compliance method of sediment controls is explicitly to prevent erosion (item b). None of the compliance methods should affect the use of septic tanks (item e).

Wastewater Treatment/Industrial Facility Upgrades

An upgrade of a wastewater or industrial facility could result in substantial erosion (item b), create geologic instability (item c), or be located in expansive soils (item d). Such projects must complete an environmental analysis that includes mitigation and alternatives. To the extent that related construction at the wastewater or industrial facility could result in ground instability, potential impacts could be avoided or mitigated through mapping of site facilities away from areas with unsuitable soils or steep slopes; design and installation in compliance with existing regulations; standard specifications and building codes; ground improvements such as soil compaction; and groundwater level monitoring to ensure stable conditions.

Sediment Controls

Installing sediment controls involves earthmoving or construction activities, but such activities would not result in substantial soil erosion or loss of topsoil. The purpose of the sediment controls is to control and reduce erosion, not increase it. Temporary earthmoving operations could result in short-term, limited erosion. Responsible parties would be expected to incorporate erosion control measures as mitigation.

Because portions of California include seismically active areas and the sediment control projects include actions intended to stabilize unstable slopes and erosion within steam banks, some construction is likely to occur in potentially unstable areas and could create geologic instability (item c) or be located in expansive soils (item d). Any proposed work within a geologic hazard zone may need to be reviewed by the County Planning Office and/or the County Geologist.

Future compliance projects that involve earth moving and take place within a defined creek channel and between banks will be subject to, at a minimum, standard conditions in the U.S. Army Corps of Engineers' Nationwide Permits nos. 13 (Bank Stabilization) and 27 (Stream and Wetland Restoration Activities). Future applicants for permits that implicate conditions 13 and 27 will be required to ensure that earthmoving does not result in soil erosion, bank collapse, or land instability. Under federal Clean Water Act section 401 every applicant for a federal permit or license for any activity which may result in a discharge to a water body must obtain State Water Quality Certification (Certification) that the proposed activity will comply with state water quality standards. Most Certifications are issued in connection with U.S. Army Corps of Engineer Clean Water Act section 404 permits for dredge and fill discharges. Certifications often include conditions that are more stringent than the federal requirements. Federal requirements include, for example, implementation of effective construction site management and erosion control BMPs.

Dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the Construction Storm Water General Permit (as described in Section 8.2). Construction activity subject to this permit includes clearing, grading and disturbances to the ground such as stockpiling, or excavation. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must list the BMPs the discharger will use to control storm water runoff and erosion.

Summary

Possible geologic impacts from construction or earth moving activities resulting from the Provisions could be potentially significant, especially since the State Water Board cannot guarantee that mitigation measures would be followed. With the mitigation, less than significant impacts on geology and soils are anticipated.

8.4.7 GREENHOUSE GAS EMISSIONS

Would the project:	Potentially Significant Impact	Less Than Significant With	Less Than Significant Impact	No Impact

		Mitigation Incorporated		
a. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☑	☐	☐	☐
b. Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☐	☑

Background

General scientific consensus and increasing public awareness regarding global warming and climate change have placed new focus on the CEQA review process as a means to address the effects of greenhouse gas emissions from proposed projects on climate change.

Global warming refers to the recent and ongoing rise in global average temperature near Earth's surface. It is caused mostly by increasing concentrations of greenhouse gases in the atmosphere. Global warming is causing climate patterns to change. Global warming itself, however, represents only one aspect of climate change.

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.

Increases in the concentrations of greenhouse gases in the Earth's atmosphere are thought to be the main cause of human-induced climate change. Greenhouse gases naturally trap heat by impeding the exit of infrared radiation that results when incoming ultraviolet solar radiation is absorbed by the Earth and re-radiated as infrared radiation. The principal greenhouse gases associated with anthropogenic emissions are carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, perfluorocarbon, nitrogen trifluoride, and hydrofluorocarbon (Health and Safety Code, § 38505, subd. (g); CEQA Guidelines, § 15364.5). Water vapor is also an important greenhouse gas, in that it is responsible for trapping more heat than any of the other greenhouse gases. Water vapor, however, is not a greenhouse gas of concern with respect to anthropogenic activities and emissions. Each of the principal greenhouse gases associated with anthropogenic climate warming has a long atmospheric lifetime (one year to several thousand years). In addition, the potential heat trapping ability of each of these gases vary significantly from one another. Methane for instance is 23 times more potent than carbon dioxide, while sulfur hexaflouride is 22,200 times more potent than carbon dioxide (Intergovernmental Panel on Climate Change 2001). Conventionally, greenhouse gases have been reported as "carbon dioxide equivalents." Carbon dioxide equivalents take into account the relative potency of non-carbon dioxide greenhouse gases and convert their quantities to an equivalent amount of carbon dioxide so that all emissions can be reported as a single quantity.

The primary man-made processes that release these greenhouse gases include: (1) burning of fossil fuels for transportation, heating and electricity generation, which release primarily carbon dioxide; (2) agricultural practices, such as livestock grazing and crop residue decomposition and application of nitrogen fertilizers, that release methane and nitrous oxide; and (3) industrial processes that release smaller amounts of high global warming potential gases.

Executive Order S-3-05 (June 1, 2005) proclaimed that California is vulnerable to the effects of climate change. To combat those concerns, the Executive Order established a long range greenhouse gas reduction target of 80 percent below 1990 levels by 2050. Subsequently, Assembly Bill 32 (AB 32) (Nunez and Pavley), the California Global Warming Solutions Act of 2006 (Chapter 488, Statutes of 2006, adding Division 25.5 (commencing with Section 38500) to the Health and Safety Code, relating to air pollution) was signed. AB 32 requires California to reduce statewide greenhouse gas emissions to 1990 levels by 2020. AB 32 directed the ARB to develop and implement regulations that reduce statewide greenhouse gas emissions. The Climate Change Scoping Plan approved by the ARB in December 2008, outlines the State's plan to achieve the greenhouse gas reductions required in AB 32.

Senate Bill (SB) 97, signed in August 2007 (Chapter 185, Statutes of 2007, enacting § 21083.05 and 21097 of the Public Resources Code), acknowledges that climate change is a prominent environmental issue that requires analysis under CEQA. This bill directed the Office of Planning and Research to prepare, develop, and transmit guidelines for the feasible mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions to the California Resources Agency. Office of Planning and Research developed a technical advisory suggesting relevant ways to address climate change in CEQA analyses. The technical advisory also lists potential mitigation measures, describes useful computer models, and points to other important resources. In addition, amendments to CEQA guidelines implementing SB 97 became effective on March 18, 2010.

In 2007, the ARB adopted the Off-Road Diesel Vehicle Regulation (CCR, title 13, article 4.8, chapter 9) which, when fully implemented, would significantly reduce emissions from off-road, non-agricultural, diesel vehicles with engines greater than 25 horsepower—the types of vehicles typically used in construction activities. The regulation required owners to replace the engines in their vehicles, apply exhaust retrofits, or replace the vehicles with new vehicles equipped with cleaner engines. The regulation also limited vehicle idling, required sales disclosure requirements, and reporting and labeling requirements. The first compliance date for large fleets was March 1, 2010; however, amendments have been made several times to extend the deadlines. When the regulation is fully implemented, owners of fleets of construction, mining, and industrial vehicles would have to upgrade the performance of their vehicle fleets to comply with the regulation.

The California Air Resources Board Scoping Plan (California Air Resources Board 2008) proposes a comprehensive set of actions designed to achieve the 2020 greenhouse gas emissions reductions required under AB 32. While some of the regulations would not be implemented until later, when they do take effect, they would likely result in reduced emissions from construction and maintenance activities. Specific actions in the Scoping Plan that would impact construction and maintenance activities include: low carbon fuel standard (Measure Transportation-2), tire inflation regulation (Measure Transportation-4), the heavy-duty tractor truck regulation (Measure Transporation-7), and commercial recycling (Measure Recycling and Waste-3).

In addition, other efforts by the California Air Resources Board would reduce air pollutant emissions through 2020, including the Diesel Risk Reduction Plan (California Air Resources Board 2000) and the 2007 State Implementation Plan. Measures in these plans would result in the accelerated phase-in of cleaner technology for virtually all of California's diesel engine fleets including trucks, buses, construction equipment, and cargo handling equipment at ports.

Impacts

The compliance methods that are likely to increase greenhouse gas emissions are primarily those that increase vehicle use as described below

<u>Mercury Monitoring (Aqueous)</u>

An increase in vehicle use would result from the need to transport personnel and water quality samples in cases where new or stricter effluent limitations for wastewater and industrial dischargers require new or additional sampling. An additional 32,000 miles per year were estimation to result from mercury monitoring for compliance with effluent limitations (see Chapter 7). The increase in emissions from an additional 32,000 miles per year could be estimated, however they are not anticipated to be significant in light of the over 300 billion miles driven annually in California (U.S. Department of Transportation 2016).

<u>Waste Collection and Education, Educating Auto Dismantlers, Mercury Pollution Prevention</u>

Some compliance methods could potentially result in a permanent increase in vehicle use, and therefore additional greenhouse gas emissions. However, it is difficult to determine how much change there would be from existing methods of compliance statewide, since most of these compliance methods are likely already being performed (see Section 8.2).

<u>Alternative Dredging Procedures</u>

For dredging activities, the Provisions could result in different procedures being used that increase the use of heavy vehicles or heavy equipment. If dredged material must be disposed of in a site further away, that would likely increase the use of the heavy vehicles. This, in turn, could release more emissions to the air. However, it is difficult to determine how much change there would be from existing methods of compliance statewide, since heavy vehicles and equipment would already have been used for dredging. It is also uncertain how many locations would be affected, since any new requirements would depend on the professional judgement of a permit writer for a particular permit. Specific calculations of the added emissions would be too speculative.

Wetland Features or Measures to Reduce Methylation

Similar to effects described above for Alternative Dredging Procedures, the Wetland Features or Measures to Reduce Methylation could cause a temporary increase in the use of heavy vehicles or heavy equipment and earth moving and grading. Vehicle use would release greenhouse gas emissions. Heavy vehicle use and earth movement would likely occur with or without the Provisions, but the Provisions could cause an increase in heaving vehicle use to create specific landscape features, such as adding a settling pond. The increase in this activity from the Provisions is not anticipated to be significant compared to the vehicle use that would otherwise be used to build the wetland.

Sediment Controls

Greenhouse gas emissions would result from the vehicle use and heavy vehicle use from a variety of construction activities, including excavation, grading, and vehicle travel to the site. These emissions would be temporary for the duration of the construction, and are anticipated to be less than significant.

Wastewater Treatment/Industrial Facility Upgrades

The construction of a wastewater treatment plant or industrial facility upgrade would be a source of greenhouse gases. The operation of construction equipment and the operation of new maintenance equipment for the facility (or increase in the operation of maintenance equipment) would generate greenhouse gas emissions. Greenhouse gas emissions due to construction equipment would be short-term and limited to minor amounts and therefore would not significantly increase greenhouse gas levels in the environment. The new facility may require more energy to operate, which could contribute more greenhouse gas emissions from the power generation, depending on the source of energy. Greenhouse gas levels are not expected to rise significantly since mitigation measures are available to reduce greenhouse gas emissions due to construction, operation, and maintenance activities.

Cumulative impacts from all methods of compliance

Many of the methods of compliance listed above could all increase vehicle use and result in impacts to greenhouse gases. For the individual methods of compliance, these impacts are anticipated to be less than significant, but the impacts are not easy to estimate. The impacts would occur throughout the state and the total contribution to greenhouse gas emission would be the sum of all emissions throughout the state. There is the positional that the impacts to greenhouse gas emission could be cumulatively considerable.

The Provisions would not conflict with any plan, amendment, or regulation adopted for the purpose of reducing greenhouse gas emissions. Most greenhouse gas reduction plans include replacing government owned vehicles with low or zero-emission vehicles (Marin County 2006, City of Pasadena 2009, City of Citrus Heights 2011, California Department of Water Resources 2012). Implementation of greenhouse gas reduction plans would reduce greenhouse gas emissions from activities undertaken to comply with the Provisions.

The Climate Change Scoping Plan (Scoping Plan) was approved by ARB in December 2008. In particular, the Scoping Plan contains six strategies for the Water Sector to implement that are expected to reduce greenhouse gas emissions due to the fact that water use requires significant amounts of energy. The six strategies for the Water Sector to implement include Water Use Efficiency (Measure W-1), Water Recycling (Measure W-2), Water System Energy Efficiency (Measure W-3), Reuse Urban Runoff (Measure W-4), Increase Renewable Energy Production from Water (Measure W-5), and a Public Goods Charge (Measure W-6). Efficient water conveyance, treatment and use can result in reductions in greenhouse gas emissions for those activities. The Provisions are consistent with this Scoping Plan because, the Provisions are consistence with water reclamation, recycling and reuse. The Provisions do not conflict with water conservation goals. If wastewater treatment facilities must upgrade, this would likely increase the possibility of reusing or recycling the wastewater (see Section 10.3).

Mitigation

The California Department of Water Resources has developed a set of BMPs to reduce greenhouse gas emissions from California Department of Water Resources construction and maintenance activities (California Department of Water Resources 2012). These BMPs can be used and/or modified to fit specific situations by the implementing agencies to reduce greenhouse gas emissions from their activities:

BMP 1. Evaluate project characteristics, including location, project work flow, site conditions, and equipment performance requirements, to determine whether specifications of the use of equipment with repowered engines, electric drive trains, or other high efficiency technologies are appropriate and feasible for the project or specific elements of the project.

BMP 2. Evaluate the feasibility and efficacy of performing on-site material hauling with trucks equipped with on-road engines.

BMP 3. Ensure that all feasible avenues have been explored for providing an electrical service drop to the construction site for temporary construction power. When generators must be used, use alternative fuels, such as propane or solar, to power generators to the maximum extent feasible.

BMP 4. Evaluate the feasibility and efficacy of producing concrete on-site and specify that batch plants be set up on-site or as close to the site as possible.

BMP 5. Evaluate the performance requirements for concrete used on the project and specify concrete mix designs that minimize greenhouse gas emissions from cement production and curing while preserving all required performance characteristics.

BMP 6. Minimize idling time by requiring that equipment be shut down after five minutes when not in use (as required by the State airborne toxics control measure [Cal. Code Regs., tit. 13, § 2485]). Provide clear signage that posts this requirement for workers at the entrances to the site and provide a plan for the enforcement of this requirement.

BMP 7. Maintain all construction equipment in proper working condition and perform all preventative maintenance. Required maintenance includes compliance with all manufacturer's recommendations, proper upkeep and replacement of filters and mufflers, and maintenance of all engine and emissions systems in proper operating condition. Maintenance schedules shall be detailed in an Air Quality Control Plan prior to commencement of construction.

BMP 8. Implement tire inflation program on jobsite to ensure that equipment tires are correctly inflated. Check tire inflation when equipment arrives on-site and every two weeks for equipment that remains on-site. Check vehicles used for hauling materials off-site weekly for correct tire inflation. Procedures for the tire inflation program shall be documented in an Air Quality Management Plan prior to commencement of construction.

BMP 9. Develop a project specific ride share program to encourage carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes.

BMP 10. Reduce electricity use in temporary construction offices by using high efficiency lighting and requiring that heating and cooling units be Energy Star compliant. Require that all contractors develop and implement procedures for turning off computers, lights, air conditioners, heaters, and other equipment each day at close of business.

BMP 11. For deliveries to project sites where the haul distance exceeds 100 miles and a heavy-duty class 7 or class 8 semi-truck or 53-foot or longer box type trailer is used for hauling, a SmartWay[7] certified truck would be used to the maximum extent feasible.

Summary

The impact of the Provisions on greenhouse gas emissions may be relatively small compared to other sources of greenhouse gas emissions, but they still may be significant, especially when all methods of compliance are considered together cumulatively. Also, given that most of the mitigation measures listed above are optional, and not required by the Provisions or other regulations, the State Water Board cannot guarantee the mitigation will be included. Therefore, the impact is determined to be potentially significant. The incorporation of BMPs and compliance with any plans, amendments, or regulations adopted for the purpose of reducing greenhouse gas emissions, vehicle use or projects undertaken to comply with the Provisions should reduce the impact on the environment due to greenhouse gas emissions.

8.4.8 HAZARDS and HAZARDOUS MATERIALS

Would the project:	Potentially Significant Impact	Less Than Significant With	Less Than Significant Impact	No Impact

[7] The U.S EPA has developed the SmartWay truck and trailer certification program to set voluntary standards for trucks and trailers that exhibit the highest fuel efficiency and emissions reductions. These tractors and trailers are outfitted at point of sale or retrofitted with equipment that significantly reduces fuel use and emissions including idle reduction technologies, improved aerodynamics, automatic tire inflation systems, advanced lubricants, advanced powertrain technologies, and low rolling resistance tires.

			Mitigation Incorporated		
a)	Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☑	☐
b)	Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☑	☐
c)	Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within ¼ mile of an existing or proposed school?	☐	☐	☐	☑
d)	Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code § 65962.5 and, as a result, would it create a significant hazard to the public or to the environment?	☐	☐	☑	☐
e)	For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or a public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☑
f)	For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☑
g)	Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☑
h)	Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☑

Impacts and Mitigation

Some of the compliance methods may involve transporting (item a) or handling (item b) waste material that is associated with some hazard or hazardous substances. These compliance methods should not pose significant risk to the public, but are further explored below. No method of compliance should emit hazardous emission near any school (item c). Sediment Control projects may take place in a site with hazardous materials (item d), as described below. No methods of compliance will foreseeably affect the operation of airports (item e and f), emergency plans (item g), or risk of wildland fires (item h).

Waste Collection and Education, Educating Auto Dismantlers, Mercury Pollution Prevention
Consumer products with mercury are classified as universal waste, such as thermometers, light bulbs, batteries and switches sin motor vehicles. The methods of compliance would involve collecting and transporting these items for proper disposal. While there is some risk from a spill of a full disposal truck, the mercury containing items are not classified as hazardous waste and do not pose the risk to the public that hazardous waste does. Universal waste should be disposed and transported according to existing regulations, to reduce the risk of exposing the pubic and wildlife to elevated levels of mercury (Appendix E has more information on mercury universal waste).

Wastewater Treatment/Industrial Facility Upgrades
During the installation of new treatment facilities it is possible that both naturally occurring hazards and anthropogenic contaminated soils and groundwater may be encountered. Any such encounters would require site-specific mitigation measures to implement BMPs to prevent contamination of surface and ground water and to remove hazardous materials where possible. In any areas where natural hazards or contaminated soils or groundwater is anticipated or discovered local planning agencies should require proper mitigation measures, including erosion control measures and the proper removal and disposal of contaminated soils.

Additionally, any change in treatment may involve new or different hazardous materials or hazardous chemicals to operate and maintain the facility. Proper health and safety protocols should be followed to minimize the hazards.

Sediment Control
Sediment control for legacy mines sites could involve handling and management of soil and sediment that could contain high concentrations of mercury. Determining whether soil and sediment has concentrations of mercury that are high enough that the sediment should be categorized as hazardous waste and removed from the mining site is beyond the scope of the Provisions, but is within the Water Boards existing authority to issue clean up and abatement orders.

Summary
Adhering to applicable laws and regulations should mitigate any potentially significant hazard to the public.

8.4.9 HYDROLOGY and WATER QUALITY

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact

a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☑
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (*e.g.*, the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☑
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☐	☑
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☑	☐
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☑
f) Otherwise substantially degrade water quality?	☐	☐	☐	☑
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☑
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☑
i) Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☑
j) Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☑

Impacts and Mitigation

The Provisions are intended to improve water quality through the prevention or removal of mercury in surface water. The Provisions would establish water quality standards, to be implemented through waste discharge requirements (WDRs), waivers of WDRs, or Certifications and therefore would not violate any water quality standards or WDRs (item a) or otherwise degrade water quality (item f). The Provisions would not increase the use of ground water (item b), and if anything they could help increase groundwater recharge (item b). A major component of reducing mercury into water bodies from storm water runoff involves a series of potential sediment control measures. An effective method of sediment control is the construction of storm water capture basins that capture and hold storm water for infiltration into ground water. The Provisions would not increase run off, rather they should decrease run off (item e).

Compliance with the Provisions would not place housing or other structures within a 100-year flood hazard area (item g and h), nor would it expose people and structures to a significant risk of loss, injury, or death by flooding, seiche, tsunami, or mudflow (item i and j)

Sediment Controls

Possible changes to drainage patterns (item c and d) could result from the installation of erosion and sediment control measures. Temporary earthmoving operations could result in short-term, limited erosion. Changes to drainage networks would be localized and would be intended to isolate mining waste from surface water runoff and reduce overall erosion. As explained below, there are no foreseeable alterations of the course of a stream or river in a manner that would result in substantial soil erosion.

Specific compliance projects would be subject to the review and/or approval of the Water Boards, which would require implementation of routine and standard erosion control BMPs and proper construction site management. At a minimum, future projects must comply with standard permit conditions in the U.S. Army Corps of Engineers' Nationwide Permits nos. 13 (Bank Stabilization) and 27 (Stream and Wetland Restoration Activities). Under federal Clean Water Act section 401, every applicant for a federal permit or license for any activity which may result in a discharge to a water body must obtain State Water Quality Certification (Certification) that the proposed activity will comply with state water quality standards. Most Certifications are issued in connection with U.S. Army Corps of Engineer Clean Water Act section 404 permits for dredge and fill discharges. Certifications often include conditions that are more stringent than the federal requirements. Federal permit conditions require, for instance, implementation of routine and standard erosion control BMPs and proper construction site management.

Installment of sediment controls should not substantially increase impervious surface area, or peak flow releases in any part of the watershed.

Summary

The potential impacts from sediment controls in altering drainage patterns are anticipated to be less than significant. There were no other foreseeable impacts to Hydrology or Water Quality directly anticipated from the adoption and implementation of the Provisions.

8.4.10 LAND USE AND PLANNING

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Physically divide an established community?	☐	☐	☐	☑
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☑
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☑

Impacts and Mitigation

Adoption of the Provisions would not divide an established community, conflict with any land use planning, nor conflict with any conservation plans.

Wetland Features or Measures to Reduce Methylation

The Provisions include features or measures to reduce methylmercury generation in projects that create or restore wetlands, but that should not create conflict with the goal of creating new wetlands. The cost and resources involved in including these feature or measures should be relatively minor compared to the cost of the entire project, and should not prevent the project from being conducted.

Summary

Adoption of the Provisions would have no impact on land use or planning.

8.4.11 MINERAL RESOURCES

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Result in the loss of availability of a known mineral resource that would be of future value to the region and the residents of the State?	☐	☐	☐	☑
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☑

Impacts and Mitigation

Although mercury was used during gold mining in the past, mercury is no longer used on an industrial scale. Small scale miners (e.g. suction dredge miners) may still use mercury, but this project does not have any requirements that would foreseeably affect such small scale mining operations. Suction dredge mining may be permitted in the future by the Water Boards. This would be a separate project that would also include environmental analysis.

Wastewater Treatment/Industrial Facility Upgrades

A currently operating gold or mercury mine with a discharge that flows directly into surface waters may need to meet the effluent limitation for wastewater treatment and industrial dischargers. If the mine was not able to meet the effluent limitations, it may force the mine to upgrade, the cost of which may result in a shutdown of the mine. However, this is unlikely since most modern operating gold mines no longer use mercury and mercury itself is not in demand as a mineral resource in the U.S. Mercury has not been produced as a principal mineral commodity in the United States since 1992, although it has been recovered as a byproduct from processing of gold- and silver-ore at several mines in Nevada (Wilburn 2013). Mines that are significant sources of mercury pollution are usually historic and abandoned.

Summary

Implementation of the Provisions would not impact any potential mineral resources.

8.4.12 NOISE and VIBRATION

Would the project result in:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☑	☐
b) Exposure of persons to, or generation of, excessive groundborne vibration or groundborne noise levels?	☐	☐	☑	☐

c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☑	☐
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☑	☐	☐	☐
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing in or working in the project area to excessive noise levels?	☐	☐	☐	☑
f) For a project within the vicinity of a private airstrip, would the project expose people residing in or working in the project area to excessive noise levels?	☐	☐	☐	☑

Background (General Setting)

Noise

California Health and Safety Code section 46022 defines noise as "excessive undesirable sound, including that produced by persons, pets and livestock, industrial equipment, construction, motor vehicles, boats, aircraft, home appliances, electric motors, combustion engines, and any other noise-producing objects". The degree to which noise can affect the human environment range from levels that interfere with speech and sleep (annoyance and nuisance) to levels that cause adverse health effects (hearing loss and psychological effects). Human response to noise is subjective and can vary greatly from person to person. Factors that influence individual response include the intensity, frequency, and pattern of noise; the amount of background noise present before the intruding noise; and the nature of work or human activity that is exposed to the noise source.

Existing noise environments vary considerably based on the diversity of land uses and densities. In most urban environments automobile, truck, and bus traffic is the major source of noise. Traffic generally produces background sound levels that remain fairly constant with time. Individual high-noise-level events that can occur from time to time include honking horns, sirens, operation of construction equipment, and travel of noisy vehicles like trucks or buses. Air and rail traffic and commercial and industrial activities are also major sources of noise in some areas. In addition, air conditioning and ventilating systems contribute to the noise levels in residential areas, particularly during the summer months.

Sound results from small and rapid changes in atmospheric pressure. These cyclical changes in pressure propagate through the atmosphere and are often referred to as sound waves. The greater the amount of variation in atmospheric pressure (amplitude) leads to a greater loudness (sound level). Sound levels are most often measured on a logarithmic scale of decibels (dB). The decibel scale compresses the audible acoustic pressure levels which can vary from 20 micropascals (µPa), the threshold of hearing and reference pressure (0 dB), to 20 million µPa, the threshold of pain (120 dB) (Air & Noise Compliance 2006). Table 8-3 provides examples of noise levels from common sounds.

Table 8-3 Common Sound Levels

Outdoor Sound Levels	Sound Pressure (µPa)	Sound Level A-weighted decibels (dBA)	Indoor Sound Level
	6,324,555	110	Rock Band at 5m
Jet Over-flight at 300m		105	
	2,000,000	100	Inside NY Subway Train
Gas Lawn Mower at 1m		95	
	632,456	90	Food Blender at 1m
Diesel Truck at 15m		85	
Noisy Urban Area (daytime)	200,000	80	Garbage Disposal at 1m
		75	Shouting at 1m
Gas Lawn Mower at 30m	63,246	70	Vacuum Cleaner at 3m
Suburban Commercial Area		65	Normal Speech at 1m
	20,000	60	
Quiet Urban Area (daytime)		55	Quiet Conversation at 1m
	6,325	50	Dishwasher in Adjacent Room
Quiet Urban Area (nighttime)		45	
	2,000	40	Empty Theater of Library
Quiet Suburb (nighttime)		35	
	632	30	Quiet Bedroom at Night
Quiet Rural Area (nighttime)		25	Empty Concert Hall
Rustling Leaves	200	20	
		15	Broadcast and Recording Studios
	63	10	
		5	
Reference Pressure Level	20	0	Threshold of Hearing

Source: Air & Noise Compliance 2006.

To determine ambient (existing) noise levels, noise measurements are usually taken using various noise descriptors. The following are brief definitions of typical noise measurements:

Community Noise Equivalent Level

The community noise equivalent level is an average sound level during a 24-hour day. The community noise equivalent level noise measurement scale accounts for noise source, distance, single-event duration, single-event occurrence, frequency, and time of day. Humans react to sound between 7:00 p.m. and 10:00 p.m. as if the sound were actually 5 bB higher than if it occurred from 7:00 a.m to 7:00 p.m. From 10:00 p.m. to 7:00 a.m., humans perceive sound as if it were 10 A-weighted decibels (dBA) higher than if it occurred from 7:00 a.m. to 7:00 p.m. due to the lower background noise level. Hence, the community noise equivalent level noise measurement scale is obtained by adding an additional 5 dBA to sound levels in the evening from 7:00 p.m. to 10:00 p.m., and 10 dBA to sound levels in the night after 10:00 p.m. and before 7:00 a.m. Because community noise equivalent level accounts for human sensitivity to sound, the community noise equivalent level 24-hour figure is always a higher number than the actual 24-hour average.

Equivalent Noise Level

Equivalent noise level is the average noise level on an energy basis for any specific time period. The equivalent noise level for 1 hour is the energy average noise level during the hour. The average noise level is based on the energy content (acoustic energy) of the sound. Equivalent noise level can be thought of as the level of a continuous noise that has the same energy content as the fluctuating noise level. The equivalent noise level is expressed in units of dBA.

Sound Exposure Level

Sound exposure level is a measure of the cumulative sound energy of a single event. This means that louder events have greater sound exposure level than quieter events. Additionally, events that last longer have greater sound exposure level than shorter events.

Audible Noise Changes

Studies have shown that the smallest perceptible change in sound level for a person with normal hearing sensitivity is approximately 3 dB. A change of at least 5 dB would be noticeable and likely would evoke a community reaction. A 10-dB increase is subjectively heard as a doubling in loudness and would most certainly cause a community response. Noise levels decrease as the distance from the noise source to the receiver increases. Noise generated by a stationary noise source, or “point source,” would decrease by approximately 6 dB over hard surfaces and 9 dB over soft surfaces for each doubling of the distance. For example, if a noise source produces a noise level of 89 dBA at a reference distance of 50 feet, then the noise level would be 83 dBA at a distance of 100 feet from the noise source, 77 dBA at a distance of 200 feet, and so on over hard surfaces. Generally, noise is most audible when traveling along direct line-of-sight. Barriers, such as walls, berms, or buildings that break the line-of-sight between the source and the receiver greatly reduce noise levels from the source because sound can reach the receiver only by bending over the top of the barrier (diffraction). Sound barriers can reduce sound levels by up to 20 dBA. If a barrier, however, is not high or long enough to break the line-of-sight from the source to the receiver, its effectiveness is greatly reduced.

Sensitive Receptors

Land uses that are considered sensitive to noise impacts are referred to as “sensitive receptors.” Noise-sensitive receptors consist of, but are not limited to, schools, religious institutions, residences, libraries, parks, hospitals, and other care facilities.

Vibration

In contrast to airborne noise, ground-borne vibration is not a common environmental problem. It is unusual for vibration from sources such as buses and trucks to be perceptible, even in locations close to major roads. Some common sources of groundborne vibration are trains, buses on rough roads, and construction activities such as blasting, pile-driving and operating heavy earth-moving equipment. The effects of ground-borne vibration include feelable movement of the building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. In extreme cases, the vibration can cause damage to buildings. A vibration level that causes annoyance would be well below the damage threshold for normal buildings.

Major sources of groundborne vibration would typically include trucks and buses operating on surface streets, and freight and passenger train operations. The most significant sources of construction-induced groundborne vibrations are pile driving and blasting – neither of which would be involved in the installation or maintenance of structural implementation alternatives. Currently, the state of California has no vibration regulations or guidelines.

The background vibration velocity level in residential areas is usually 50 vibration decibels (VdB) or lower, well below the threshold of perception for humans which is around 65 VdB. Most perceptible indoor vibration is caused by sources within buildings such as operation of mechanical equipment, movement of people or slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steelwheeled trains, and traffic on rough roads. If the roadway is smooth, the vibration from traffic is rarely perceptible. The range of interest is from approximately 50 VdB to 100 VdB. Background vibration is usually well below the threshold of human perception and is of concern only when the vibration affects very sensitive manufacturing or research equipment. Electron microscopes and high-resolution lithography equipment are typical of equipment that is highly sensitive to vibration.

Noise Guidelines

The no longer extant California Office of Noise Control, California Department of Health Services developed guidelines showing a range of noise standards for various land use categories in the 1976 Noise Element Guidelines. These guidelines are now found in Appendix C of the State of California General Plan Guidelines (Governor’s Office of Planning and Research 2003). Cities within the state have generally incorporated this compatibility matrix into their General Plan noise elements. These guidelines are meant to maintain acceptable noise levels in a community setting based on the type of land use. Noise compatibility by different types of land uses is a range from “Normally Acceptable” to “Clearly Unacceptable” levels. The guidelines are used by cities within the state to help determine the appropriate land uses that could be located within an existing or anticipated ambient noise level.

Some of the reasonably foreseeable methods of compliance have the potential to affect noise levels. Noise within counties and cities are regulated by noise ordinances, which are found in the municipal code of the jurisdiction These noise ordinances limit intrusive noise and establish sound measurements and criteria, minimum ambient noise levels for different land use zoning classifications, sound emission levels for specific uses, hours of operation for certain activities (such as construction and trash collection), standards for determining noise deemed a disturbance of the peace, and legal remedies for violations.

Mitigation: Standard methods to address noise and vibration
Increases in noise levels during construction and/or maintenance activities would vary depending on the existing ambient levels at each site. Once a site has been selected, project-level analysis to determine noise impacts would involve: (i) identifying sensitive receptors within a quarter-mile vicinity of the site, (ii) characterizing existing ambient noise levels at these sensitive receptors, (iii) determining noise levels of any and all installation and maintenance equipment, and (iv) adjusting values for distance between noise source and sensitive receptor. In addition, the potential for increased noise levels due to construction activities is limited and short-term. Given the size of the individual projects and the fact that installation would occur in small discrete locations, noise impacts during installation would not foreseeably be greater, and would likely be less onerous than, other types of typical construction activities in urbanized areas, such as ordinary road and infrastructure maintenance activities, building activities, etc. These short-term noise impacts can be mitigated by implementing commonly-used noise abatement procedures, standard construction techniques such as sound barriers, mufflers and employing restricted hours of operation. Applicable and appropriate mitigation measures could be evaluated when specific projects are determined, depending upon proximity of construction activities to receptors.

Overall, noise levels for construction would be governed primarily by the noisiest pieces of equipment. For most construction equipment the engine is the dominant noise source. Typical maximum noise emission levels (Lmax) are summarized, based on construction equipment operating at full power at a reference distance of 50 feet, and an estimated equipment usage factor based on experience with other similar installation projects. The usage factor is a fraction that accounts for the total time during an eight-hour day in which a piece of installation equipment is producing noise under full power. Although the noise levels in Table 8-4 represent typical values, there can be wide fluctuations in the noise emissions of similar equipment based on two important factors: (1) the operating condition of the equipment (e.g., age, presence of mufflers and engine cowlings); and (2) the technique used by the equipment operator (aggressive vs. conservative).

Table 8-4. Typical Installation Equipment Noise Emission Levels

Equipment	Maximum Noise Level, (dBA) 50 feet from source	Equipment Usage Factor	Total 8-hr Leq exposure (dBA) at various distances	
			50ft	100ft
Foundation Installation			83	77
Concrete Truck	82	0.25	76	70
Front Loader	80	0.3	75	69
Dump Truck	71	0.25	65	59
Generator to vibrate concrete	82	0.15	74	68
Vibratory Hammer	86	0.25	80	74
Equipment Installation			83	77
Flatbed Truck	78	0.15	70	64
Forklift	80	0.27	74	69
Large Crane	85	0.5	82	76

Source: Los Angeles Water Board 2007

Contractors and equipment manufacturers have been addressing noise problems for many years, and through design improvements, technological advances, and a better understanding of how to minimize exposures to noise, noise effects can be minimized. An operations plan for the specific construction and/or maintenance activities could be developed to address the variety of available measures to limit the impacts from noise to adjacent homes and businesses. To minimize noise and vibration impacts at nearby sensitive sites, installation activities should be conducted during daytime hours to the extent feasible. There are a number of measures that can be taken to reduce intrusion without placing unreasonable constraints on the installation process or substantially increasing costs. These include noise and vibration monitoring to ensure that contractors take all reasonable steps to minimize impacts when near sensitive areas; noise testing and inspections of equipment to ensure that all equipment on the site is in good condition and effectively muffled; and an active community liaison program. A community liaison program should keep residents informed about installation plans so they can plan around noise or vibration impacts; it should also provide a conduit for residents to express any concerns or complaints.

The following measures would minimize noise and vibration disturbances at sensitive areas during installation:

- Use newer equipment with improved noise muffling and ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine covers, and engine vibration isolators intact and operational. Newer equipment will generally be quieter in operation than older equipment. All installation equipment should be inspected at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding).
- Perform all installation in a manner to minimize noise and vibration. Use installation methods or equipment that will provide the lowest level of noise and ground vibration

impact near residences and consider alternative methods that are also suitable for the soil condition. The contractor should select installation processes and techniques that create the lowest noise levels.

- Perform noise and vibration monitoring to demonstrate compliance with the noise limits. Independent monitoring should be performed to check compliance in particularly sensitive areas. Require contractors to modify and/or reschedule their installation activities if monitoring determines that maximum limits are exceeded at residential land uses.
- Conduct truck loading, unloading and hauling operations so that noise and vibration are kept to a minimum by carefully selecting routes to avoid going through residential neighborhoods to the greatest possible extent. Ingress and egress to and from the staging area should be on collector streets or higher street designations (preferred).
- Turn off idling equipment.
- Temporary noise barriers should be used and relocated, as practicable, to protect sensitive receptors against excessive noise from installation activities. Consider mitigation measures such as partial enclosures around continuously operating equipment or temporary barriers along installation boundaries.
- The installation contractor should be required by contract specification to comply with all local noise and vibration ordinances and obtain all necessary permits and variances.
- These and other measures can be classified into three distinct approaches as outlined in Table 8-5.

Table 8-5. Noise Abatement Measures

Type of Control	Description
Source Control	*Time Constraints* – Prohibiting work during sensitive nighttime hours *Scheduling* – performing noisy work during less sensitive time periods *Equipment Restrictions* – restricting the type of equipment used *Substitute Methods* –using quieter equipment when possible *Exhaust Mufflers* – ensuring equipment have quality mufflers installed *Lubrication and Maintenance* – well maintained equipment is quieter *Reduced Power Operation* – use only necessary power and size *Limit equipment on-site* – only have necessary equipment onsite *Noise Compliance Monitoring* – technician on-site to ensure compliance
Path Control	*Noise barriers* – semi-portable or portable concrete or wooden barriers *Noise curtains* – flexible intervening curtain systems hung from supports *Increased distance* – perform noisy activities further away from receptors
Receptor Control	*Community participation* –open dialog to involve affected parties *Noise complaint process* – ability to log and respond to noise

	complaints

Source: Adapted from Thalheimer 2000.

Impacts

The Provisions is not a project located within an airport land use plan (item e) or in the vicinity of a private airstrip (item f). The Provisions may cause an increase in noise or vibration on temporary and permanent bases (items a, b and d). The increases are anticipated to be small, as described below. No substantial permanent increase in noise is anticipated (item c).

Waste Collection and Education

Implementation of the Provisions could cause a very minor permanent increase in ambient noise levels. This would be from increasing the frequency of trucks used by municipalities to pick up mercury containing waste.

Sediment Controls, Alternative Dredging Procedures, Wetland Features or Measures to Reduce Methylation, Wastewater Treatment/Industrial Facility Upgrades

For a variety of activities, there could be a temporary increase in the use of heavy vehicles or heavy equipment for earth moving or construction. The increase in noise is anticipated to be small on a statewide level since most of these activities would occur without the Provisions. The Provisions are anticipated to cause an increase in vehicle use, which is difficult to predict, as described for air quality (Section 8.4.3).

Summary

Noise or vibration from construction and earth moving activities would be intermittent. The noise thresholds may be exceeded for limited durations depending on the location and ambient noise levels at specific sites. The State Water Board cannot guarantee that mitigation measures would be employed. The impact from temporary activities is therefore determined to be potentially significant. Measures, however, are available that should be applied to reduce and/or eliminate these impacts as described above. Permanent increases in ambient noise levels from small increases in vehicle use are expected to be less than significant.

8.4.13 POPULATION AND HOUSING

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Induce substantial population growth in an area either directly (*e.g.*, by proposing new homes and businesses) or indirectly (*e.g.*, through extension of roads or other infrastructure)?	☐	☐	☑	☐

		Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
b)	Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☑
c)	Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☑

Impacts and Mitigation

It is not reasonably foreseeable that the Provisions would directly induce population growth, affect housing, or displace individuals. Indirect effects are discussed in Section 8.6, on Growth Inducing Impacts and are anticipated to be less than significant.

Summary

Implementation of the Provisions should have a less than significant impacts on population or housing.

8.4.14 PUBLIC SERVICES

Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

		Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a)	Fire protection?	☐	☐	☑	☐
b)	Police protection?	☐	☐	☑	☐
c)	Schools?	☐	☐	☐	☑
d)	Parks?	☐	☐	☑	☐
e)	Other public facilities?	☑	☐	☐	☐

Impacts and Mitigation

The expected location of the reasonably foreseeable methods of compliance is generally not in the vicinity of schools (item c). Although it is possible that a project developed as a method of compliance for the Provisions could be located near governmental facilities. Potential effects to parks are described below. The Provisions would not require the establishment of new or altered government facilities, except that the Provisions may require construction of new wastewater treatment facilities if necessary to comply with the Provisions' implementation requirements. The Provisions may result in construction in and around public services pertaining to installation of Sediment Control measures related to storm water, such as building retaining walls, grading hillsides, installing riprap or storm water capture basins, or adding and maintaining vegetation, as further described in Section 8.4.17. Also, response times for fire and police protection may be temporarily affected during construction activities, depending on where and when they occur.

Wastewater Treatment/Industrial Facility Upgrades

There is potential for temporary delays in response times of fire and police vehicles due to road closure/traffic congestion during construction activities. To mitigate potential delays, the responsible agencies could notify local emergency and police service providers of construction activities and road closures, if any, and coordinate with the local fire and police providers to establish alternative routes and traffic control during the construction activities. Most jurisdictions have in place established procedures to ensure safe passage of emergency and police vehicles during periods of road maintenance, construction, or other attention to physical infrastructure, and there is no evidence to suggest that installation of these structural devices would create any more significant impediments than other such typical activities. Any construction activity would be subject to applicable building and safety codes and permits. Therefore, the potential delays in response times for fire and police vehicles after mitigation are less then significant.

Since construction activities would not result in development of land uses for residential, commercial, and/or industrial uses nor would the compliance methods result in an increase of growth, it is reasonably foreseeable that the compliance methods would not result in a need for new or altered fire or police protection services. In addition, Emergency Preparedness Plans could be developed in consultation with local emergency providers to ensure that the structural compliance methods would not contribute to an increase in the cumulative demand for fire and police emergency services.

Several state parks include historic gold mines and some of them have in the past had evaluated levels of mercury in the discharge from the mine. If the party responsible for the park must take actions to meet a numeric effluent limitation for mercury, it could affect the budget for the park and since parks have limited funding, the park's ability to remain open to the public could be affected. Specifically, a mine that has an individual NPDES permit (a mine with a direct discharge to surface waters) could be issued a numeric effluent limitation for mercury. Compliance with the new effluent limitations may require substantial new treatment ponds or BMPs that could be costly.

Sediment Controls

Similar to above (for Wastewater Treatment/Industrial Facility Upgrades), any construction associated with sediment controls could block traffic, but traffic disruptions can be avoided as described above.

Also, as described above, several state parks include historic gold mines and some of them have in the past had evaluated levels of mercury in the discharge from the mine. If the party responsible for the park must add sediment control to control mercury in the discharge, it could affect the ability of the patrons to use the park and view the mine. This could be due to physically blocking patrons access to the park with construction equipment or an altered landscape, or because the park cannot afford to perform the remediation and must close the park or part of the park.

In regards to compliance methods specific to sediment controls for mine closures, in most cases the Provisions are unlikely to add much beyond what would already be required by existing programs. If anything, the Provisions may keep costs down by stipulating that monitoring for mercury may not be necessary. Rather the Provisions allow that sediments controls are an appropriate bassline level of control for mercury because mercury binds to sediments. In a few cases more intensive controls may be necessary. Sediment controls may also be required for nonpoint sources and wetland projects. Many abandoned historic gold mines or mine tailings are located on public lands which may be part of state or federal parks. The installation of sediment controls is not anticipated to cause any park closures, or to significantly affect the operation of parks.

Summary

Construction and earth moving activities could result in environmental impacts with regard to public services, by potentially blocking traffic and emergency vehicles. Adhering to local regulations and ordinances, however, should reduce and/or eliminate any potential impacts, as described above. The Provisions may require construction of new wastewater treatment facilities or new storm water drainage facilities, which may have a potentially significant environmental impact, as described in Section 8.4.17.

8.4.15 RECREATION

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☑
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☑	☐

Impacts and Mitigation

The Provisions do not require construction or expansion of recreational facilities. The Provisions could have a small indirect effect on the use of regional parks as described below.

Wastewater Treatment/Industrial Facility Upgrades, Sediment Controls
If a park closed due to the cost to control mercury coming from a historic mine (see section on Public Services, above), that may affect the use of other parks, but the effects would be very small on a statewide basis and fairly speculative, and should not cause deterioration of any park.

Wastewater Treatment/Industrial Facility Upgrades and Sediment Controls
Installation of controls may temporarily impact the use of existing recreational sites. For instance, bike lanes or parking locations for recreational facilities may be temporarily unavailable during installation of structural controls. These potential impacts would be short in duration and have a less-than-significant effect on recreation.

Summary

The Provisions are anticipated to have less than significant impact on recreation. In addition, the Provisions are designed to improve the quality of the affected water bodies, to support fish and wildlife. This would likely create a positive impact and increase recreational opportunities throughout the watersheds.

8.4.16 TRANSPORTATION / TRAFFIC

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Exceed the capacity of the existing circulation system, based on an applicable measure of effectiveness (as designated in a general plan policy, ordinance, etc.), taking into account all relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	☑	☐	☐	☐
b) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	☐	☐	☐	☑

c)	Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☑
d)	Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that result in substantial safety risks?	☐	☐	☐	☑
e)	Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☑
f)	Result in inadequate emergency access?	☑	☐	☐	☐
g)	Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☑

Impacts and Mitigation

The Provisions do have the potential to increase traffic (item a) and affect emergency access (item f) as described below. Implementation of the Provisions do not conflict with any policies, plans for effective traffic circulation (item b), congestion management (item c), or programs supporting alternative transportation (item g). The Provisions would not result in a change in air traffic patterns (item d). The Provisions would not result in new design features or incompatible uses (item e).

<u>Sediment Controls, Wastewater Treatment/Industrial Facility Upgrades</u>

Sediment controls, wastewater treatment facility upgrades and industrial facility upgrades involve construction or earth moving, which could necessitate alteration or excavation of roadways or block traffic. To the extent that site-specific projects entail excavation in roadways, such excavations should be marked, barricaded, and traffic flow controlled with signals or traffic control personnel in compliance with authorized local police or California Highway Patrol requirements. These methods would be selected and implemented by responsible local agencies considering project level concerns. Standard safety measures should be employed including fencing, other physical safety structures, signage, and other physical impediments designed to promote safety and minimize pedestrian/bicyclists accidents. It is not foreseeable that the Provisions would result in significant increases in traffic hazards to motor vehicles, bicyclists or pedestrians, especially when considered in light of those hazards currently endured in an ordinary urbanized environment.

In order to reduce the impact of construction traffic, implementation of a construction management plan for specified facilities could be developed to minimize traffic impacts upon the local circulation system. A construction traffic management plan could address traffic control for any street closure, detour, or other disruption to traffic circulation. The plan could identify the routes that construction vehicles would use to access the site, hours of construction traffic, and traffic controls and detours. The plan could also include plans for temporary traffic control, temporary signage, location points for ingress and egress of construction vehicles, staging areas, and timing of construction activity which appropriately limits hours during which large construction equipment may be brought on or off site. Potential impacts could also be reduced by limiting or restricting hours of construction so as to avoid peak traffic times and by providing temporary traffic signals and flagging to facilitate traffic movement. It is anticipated that impacts after mitigation would be less than significant.

There is potential for temporary delays in response times of fire and police vehicles due to road closure/traffic congestion during construction activities. To mitigate potential delays, the responsible agencies could notify local emergency and police service providers of construction activities and road closures, if any, and coordinate with the local fire and police providers to establish alternative routes and traffic control during the construction activities. Most jurisdictions have in place established procedures to ensure safe passage of emergency and police vehicles during periods of road maintenance, construction, or other attention to physical infrastructure, and there is no evidence to suggest that installation of these structural devices would create any more significant impediments than other such typical activities. Any construction activity would be subject to applicable building and safety codes and permits. Therefore, the potential delays in response times for fire and police vehicles after mitigation are less then significant.

<u>Mercury Monitoring, Waste Collection and Public Education, Educating Auto Dismantlers, Mercury Pollution Prevention</u>

Several other compliance methods would likely or possibly increase vehicle use and therefore traffic. However they would not increase traffic to the point of causing traffic congestion or exceeding the capacity of the street system.

Summary

Construction and earth moving activities measures could impact emergency access. However, by following local ordinances and polices, impacts should be less than significant. Other compliance method would likely cause a small increase in traffic that is anticipated to be a less than significant impact.

<u>8.4.17 UTILITIES AND SERVICE SYSTEMS</u>

Would the project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact

a)	Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☑
b)	Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental impacts?	☑	☐	☐	☐
c)	Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental impacts?	☑	☐	☐	☐
d)	Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☑
e)	Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☑
f)	Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☑	☐
g)	Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☑

Impacts and Mitigation

The Provisions would not exceed wastewater treatment requirements (items a and e), but the Provisions may require construction of new wastewater treatment facilities (item b), as described below. The Provisions may result in construction of new storm water drainage facilities or expansion of existing facilities (item c). However, the implementation of the Provisions would not result in the development of any large residential, retail, industrial or any other development projects that would significantly increase the demand on the storm water infrastructure (item c) or require new water supply facilities (item d). Implementation of the Provisions would not result in the need for new, nor alterations of existing sewer or septic tank systems (item e). Implementation of the Provisions could affect solid waste disposal, but it should not result in the generation of significant amounts of solid waste (item f), as described below. The Provisions would not conflict with solid waste regulations.

<u>Sediment Controls</u>

Potential impacts related to storm water drainage facilities due to implementation of possible compliance methods include the construction of sediment controls. Construction of the new storm water sediment controls should be of a short duration and should have minimal impacts, especially if they are conducted during the dry season. Potential impacts related to construction activities are discussed above in previous sections. Sediment controls, such as earthmoving equipment to create barriers, berms, hillside grading, and installation of riprap (barriers made of large loose rock) to direct and slow flows. Silt fences can be used to catch and help prevent sediments from washing into nearby waterbodies.

Sediment controls are designed to reduce erosion. Some erosion occurs from storm water drainage. In order to comply with the Provisions, structural controls, such as barriers, berms, grading, silt fences, and vegetation may be installed to prevent excessive erosion. In some cases prior construction activities, removal of vegetation, or other land alterations have resulted in significant erosion control issues. In such cases sediment and erosion control measures may be required even without the requirements in the Provisions.

Wastewater Treatment/Industrial Facility Upgrades

Possible compliance methods include the construction of facility upgrades for wastewater treatment and industrial facilities, which is a significant impact as listed in item b. Construction of the facility upgrade would be in the vicinity of an existing facility in urban areas. Such project upgrades would need to include environmental analyses and consider alternatives and mitigation measures for any potentially significant impacts. Also, the potential impacts related to construction activities are discussed above in previous sections.

Overall, very few of the 308 facilities in the scope of the Provisions are anticipated to upgrade in the foreseeable future as result of the Provisions. No upgrades are anticipated for the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, or the California Least Tern Prey Fish Water Quality Objective, for dischargers needing to meet an effluent limitation of 12 ng/L total mercury (discharges to flowing waters). Few discharges may need to meet an effluent limitation of 4 ng/L total mercury (discharges to slow moving waters), which is more likely to prompt a facility upgrade. For the Tribal Subsistence Fishing Water Quality Objective, some upgrades would be anticipated from effluent limitations of 1 to 4 ng/L. A rough estimate suggests that 8 facilities could need to upgrade in the foreseeable future (See Chapter 7). It is too difficult to anticipate how many faculties might need to upgrade as a result of the Subsistence Fishing Water Quality Objective, as no waters have been designated with for the Subsistence Fishing beneficial use and no site-specific water quality objectives or translation of the proposed narrative objective have been assigned to any water body. Since the water quality objective for the Subsistence Fishing (SUB) beneficial use is a narrative, and site-specific water quality objectives for SUB have not been developed, data is lacking to discern potential effluent limits for dischargers. However, such effluent limits may be similar to effluent limits for the Tribal Subsistence Fishing Water Quality Objective, which, if so, would likely result in effluent limitations between 1 to 4 ng/L. Data available from 2009 through 2015 shows that about 73 percent of facilities statewide are meeting an annual average of 4 ng/L of mercury in their effluent and 27 percent of facilities statewide are meeting an annual average of 1 ng/L of mercury in their effluent (See Appendix N, Tables N-6 and N-7). Therefore, if a wastewater treatment facility must meet the Subsistence Fishing Water Quality Objective in the future, the facility may need to upgrade to tertiary treatment to achieve the objective.

Mercury Monitoring
Mercury Monitoring would likely or possibly increase the solid waste generated from conducting laboratory analysis, which would need to be disposed of in a landfill (item f). However, the increase is anticipated to be less than a significant. Although the amount of waste and resource use may increase for a given discharger, the impacts from this limited number of facilities that would see an increase in laboratory supplies and waste are expected to be less than significant overall.

Waste Collection and Education, Educating Auto Dismantlers, Mercury Pollution Prevention
Collecting and properly disposing of mercury containing items could increase solid waste disposal (item f). However, improper disposal could still include disposal in a landfill and would also have a greater environmental impact if the mercury escapes the landfill. Therefore, proper disposal of mercury contain items is not anticipated to generate waste above baseline conditions. Mercury containing waste (universal waste), however may require special disposal and there may be a limited capacity for such waste.

Summary
The main potential impacts related to utilities and services are wastewater treatment facility upgrades and sediment controls for storm water drainage facilities. Since the State Water Board cannot guarantee what those projects might be or what mitigation may be implemented the impact is determined to be potentially significant. Such project would need to include environmental analyses and, the project must consider alternatives and mitigation measures to minimize any potentially significant impact.

8.5 Mandatory Findings of Significance

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☑	☐	☐

b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)	☑	☐	☐	☐
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☑

The analysis at Sections 8.4.4 through 8.4.12 found that the Provisions may have potentially significant impacts on the following resource areas: Biological Resources, Geology/Soils, Greenhouse Gas Emissions, Noise and Vibration, Utilities/Service Systems. Cumulative impacts of the Provisions and other projects combined could be potentially significant, as described in Section 8.7. The Provisions would not, in any way, cause substantial adverse effects on human beings.

Where environmental impacts have been identified in this document (i.e., greenhouse gases from vehicle use), mitigation measures have also been identified to reduce those impacts to less-than-significant levels. These mitigation measures identified in this analysis are within the responsibility and jurisdiction of the responsible agencies subject to the Provisions and can or should be adopted by them. The State Water Board does not direct which compliance methods responsible agencies choose to adopt or the mitigation measures they employ. The State Water Board does, however, recommend that appropriate measures be applied to reduce or avoid potential environmental impacts.

<u>Significant Environmental Effects Which Cannot be Avoided</u>

While some identified potentially significant impacts could likely be reduced to less than significant with mitigation, with some specific methods of compliance projects, such as construction activities related to wastewater treatment plant upgrades or stormwater erosion controls, earth moving and grading activities to prevent erosion, and mine site clean-up activities there is the possibility that there may be significant environmental effects which cannot be avoided if the Provisions are adopted and implemented (Cal. Code Regs., tit. 14, §15126.2(b)).. These activities are likely to create noise and result in greenhouse gas emissions. In some areas there is the possibility that such activities may disturb threatened or endangered plant or animal species. For example, a very large sediment control project may have significant effects on biota by disturbing and altering a large area of habitat. In the Sierra Nevada Mountains, this could include habitat of an endangered species, the California red-legged frog (*Rana draytonii*). The overall goal of the sediment control project would be to protect biota (and humans) by reducing the mercury discharging from the mine site. If wastewater treatment or industrial facilities are required to upgrade to achieve effluent limitations the facilities may need to modify or expand their facility which may require construction or earth moving equipment. Neighbors may be affected by noise from construction and if any threatened or endangered species are located in or near the construction area they may also be affected.

Significant Irreversible Environmental Changes

Significant irreversible environmental changes which would be caused by the Provisions (Cal. Code Regs., tit. 14, §15126.2 (c)) are also possible. Again, all of the significant impacts could likely be reduced to less than significant with mitigation. An example of a significant irreversible environmental change would be consumption of fossil fuels for vehicle use or during construction projects. These effects could be minimized to less than significant with low emission vehicles and BMPs to reduce emissions. On the other hand, releasing mercury into the environment is an irreversible impact. The goal of Provisions is to reduce the amount of mercury entering California's waters.

The overall effect of the Provisions would be a reduction in the amount of mercury entering the water bodies in the State thereby improving water quality and protecting the beneficial uses of those waters.

8.6 Growth Inducing Impacts

This section describes the potential for the Provisions to cause environmental impacts through the inducement of growth, in compliance with the requirements of the CEQA Guidelines (Cal. Code of Reg., tit. 14, § 15126(d)) and CEQA (Pub. Resources Code, § 21100 (b)(5)). Growth inducement[8] occurs when projects affect the timing or location of either population or land use growth, or create a surplus in infrastructure capacity. (See also Section 8.4.13 on impact to Population and Housing.)

This analysis is organized into the primary types of growth that occur: (1) development of land, (2) population growth, and (3) the removal of existing obstacles to growth. The first two types of grown can occur either directly or indirectly, as described later, while the removal of existing obstacles to growth is an indirect impact. Economic growth, such as the creation of additional

[8] The State CEQA Guidelines describe growth-inducing impacts as follows:

> …[T]he ways in which a proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this are impacts which would remove obstacles to population growth…Increases in the population may tax existing community service facilities, requiring construction of new facilities that could cause significant environmental effects... [In addition,] the characteristics of some projects...may encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively. It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment. (14 CCR § 15126.2(d).)

job opportunities, also could occur; however, such growth generally would lead to population growth and, therefore, is included indirectly in population growth.

8.6.1 Growth in Land Development

Growth in land development considered in this analysis is the possible physical development of residential, commercial, and industrial structures in and around where implementation of the Provisions and reasonably foreseeable methods of compliance may be located. Land use growth is subject to general plans, community plans, parcel zoning, and applicable entitlements and is dependent on adequate infrastructure to support development. Direct growth in land development occurs when, for example, a project accommodates populations in excess of those projected by local or regional planning agencies.

Potential Impact:

The Provisions would not result in the construction of new housing, commercial facilities, or industries. The Provisions would not result in new roads or water supply utilities. Therefore, the Provisions would not directly induce growth. Indirect effects by removing obstacles to growth through development, however, are discussed in Section 8.6.3.

8.6.2 Population Growth

Possible population growth considered in this analysis is the possible growth in the number of persons that live and work in the areas in and around where the Provisions are implemented and reasonably foreseeable methods of compliance may be located. Population growth occurs from natural causes (births minus deaths) and net emigration from or immigration to other geographical areas. Emigration or immigration can occur in response to economic opportunities, life style choices, or for personal reasons. Although land use growth and population growth are interrelated, land use and population growth could occur independently from each other. This has occurred in the past where the housing growth is minimal, but population within the area continues to increase. Such a situation results in increasing population densities with a corresponding demand for services, despite minimal land use growth.

Indirect population growth inducement occurs when, for example, a project that accommodates unplanned growth consequently (i.e., indirectly) establishes substantial new permanent employment opportunities (for example, new commercial, industrial, or governmental enterprises). Another example of indirect population growth is if a construction project generates substantial short-term employment opportunities that indirectly stimulate the need for additional housing and services.

Overall development in the state is governed by local General Plans (developed by counties or cities), which are intended to plan for land use development consistent with California law. The

General Plan is the framework under which development occurs, and, within this framework, other land use entitlements (such as variances and conditional use permits) can be obtained.

Potential Impact:

The methods of compliance for the Provisions such as sediment controls or construction of new facilities (e.g. wastewater treatment plant upgrades to meet effluent limitations) could generate economic opportunities in an area or region, but such the methods of compliance is not expected to result in or induce substantial growth or significant growth related to population increase or land use development. The methods of compliance would be new activities that the responsible agency (or responsible party) must staff, however, the majority of the new work opportunities or duties that would be created to comply with the Provisions are expected to be filled by persons already employed by the responsible agency. This is because most of these type of duties are already being conducted, the Provisions are expected to somewhat increase the workload in some cases. Overall, the impact is anticipated to be less than significant.

The construction activities associated with methods of compliance for the Provisions may increase the economic opportunities in an area or region. However, most projects would be small (installing sediment controls) or infrequent. Therefore, this construction is not expected to result in or induce substantial or significant growth related to population increase or land use development. The majority of the new jobs that would be created by this construction are expected to be filled by persons already employed and residing in the area or region.

New economic opportunities could be maintaining a new portion of a wastewater treatment plant resulting from a treatment upgrade. Installing new treatment processes such as nitrification and denitrification may require new expertise, which would result in the hiring of new staff. The number of new staff required to maintain approximately 15 facility upgrades (Based on estimates in Section 7.2) is unlikely to be noticeable increase the population.

Implementing Mercury Minimization Plans in wastewater treatment plants or industrial facilities or implementing Mercury Pollution Prevention activities by municipal storm water is expected to be performed largely by existing staff. Most of these activities are probably already being conducted by current staff.

8.6.3 Existing Obstacles to Growth

The environmental analysis is required to discuss ways in which the proposed project could foster economic or population growth or the construction of additional housing. Included in this analysis is consideration as to whether the Provisions (or the reasonably foreseeable methods of compliance) remove obstacles to population growth or may encourage and facilitate other activities that could significantly affect the environment (see Cal. Code Regs., tit. 14, § 15126.2(d)). Obstacles to growth could include such things as inadequate infrastructure or public services, such as an inadequate water supply that results in rationing, or inadequate wastewater treatment capacity that results in restrictions in land use development. Policies that discourage either natural population growth or immigration also are considered to be obstacles to growth.

Potential Impact

The Provisions do not require an increase infrastructure or public services, or otherwise require the removal of obstacles to growth. Yet, the Provisions require a level of treatment of waste water or storm water that may result in construction of new facilities (e.g. wastewater treatment plant upgrades to meet effluent limitations). The Provisions do not require an increase in treatment capacity. However, a municipality (or responsible party) performing a construction project to comply with the Provisions, could logically consider including in the project an increase in capacity to accommodate expected increases in population. The California population is expected to grow 18 percent by 2030, compared to 2010 estimates (California Department of Finance 2014). The estimates vary from 44 percent expected growth for Imperial County to a 9 percent expected decrease in population expect for Sierra County. In this way the Provisions may encourage the development of a project that also increases the capacity of city infrastructure if the Provisions do require a municipal wastewater treatment facility to upgrade their treatment process in order to meet new water quality objectives and the facility upgrade results in an increased capacity for the facility to treat a larger volume of wastewater. Therefore, the Provisions may have a potentially significant impact through the removal of obstacles for growth.

8.7 Cumulative Impacts Analysis

8.7.1 Introduction

This section describes the potential for the Provisions to cause a considerable contribution to a cumulatively significant impact[9], to fulfil requirements of CEQA in preparing the SED. The purpose of the cumulative impacts analysis is to ensure that the potential environmental impacts of any individual project are not considered in isolation. Impacts that may be individually less than significant on a project specific basis, could pose a potentially significant impact when considered with the impacts of other past, present, and probable future projects.

The cumulative impact analysis need not be performed at the same level of detail as a "project level" analysis but must be sufficient to disclose potential combined effects that could constitute a cumulative significant adverse impact. The CEQA Guidelines direct that the cumulative impacts analysis either include a list of the past, present and probable future projects producing related or cumulative impacts or provide a summary of projections and cumulative impact analysis contained in an applicable adopted plan or related planning document. (Cal. Code Regs., tit. 14, § 15130 (b)(1)).

This section discusses whether the Provisions' incremental effect is cumulatively considerable and, where that is the case, describes the significant cumulative impacts of the proposed project in combination with past, present, and probable future projects. CEQA Guidelines direct that this cumulative impact analysis be either provided through the "list approach" of "projections approach". The cumulative impacts from implementation of the Provisions are discussed, for this statewide analysis, through analyzing the possible projects that could occur to cause impacts in combination with the Provisions in relation to existing land use planning throughout the state, in the following two sections: (1) the program level cumulative impacts, and (2) the project level cumulative impacts. On the program level, impacts from reasonably foreseeable statewide water quality actions and regional activities, including multiple TMDLs and permit requirements may in combination have cumulative impacts. It is not possible to provide a quantitative measure of the impact from all probable method of compliances from the Provisions and other projects combined. The cumulative impacts analysis entails a general consideration

[9] The State CEQA Guidelines (Cal. Code Regs., tit. 14, § 15355) define cumulative impacts as follows:

> "Cumulative impacts" refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts:
>
> (a) The individual effects may be changes resulting from a single project or a number of separate projects.
>
> (b) The cumulative impact from several projects is the change in the environment, which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time."

of the major activities that could produce cumulative impacts: construction, earth moving activities and vehicle use.

8.7.2 List of Related Statewide and Regional Projects

The State Water Board has adopted and is currently developing a wide range of Statewide Policies and Significant General Permits. The entire list of Statewide Policies and Significant General Permits can be found in the State Water Board's Executive Director's report, which is updated on a monthly basis.[10] In the August 16, 2016 Executive Director's Report, the active Statewide Policies and Significant General Permits are listed in Appendix B of the report (State Water Board 2016). While some of these actions are not yet formally proposed, they are considered reasonably foreseeable probable future projects, within the temporal scope of implementation of the Provisions.

Of the Statewide Polices and Significant General Permits, several projects have potential nexus to the methods of compliance for the Provisions. These projects could cause environmental impacts that may, in conjunction with impacts of the Provisions, cause a cumulative impact. In general, these projects would likely require either 1) higher level of wastewater treatment (wastewater treatment plants upgrades), 2) sediment controls, or 3) pollutant monitoring. These projects are described in more detail below.

Reservoir Program

Formal Title: Amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California Mercury Provisions for Reservoirs

Description: The State Water Board and Regional Water Boards are developing a project to address fish mercury impairments in about 150 reservoirs around the state (referred to as the Reservoir Program elsewhere in this report and described in Section 1.6). Some proposed requirements of the Reservoir Program are similar to requirements of the Provisions, including sediment controls for mines, and effluent limitations for wastewater treatment plants.

Additionally, the Reservoir Program may require studies on methods to manage mercury in reservoirs, referred to here as Reservoir Management Actions. These Reservoir Management Actions include oxygen addition, nutrient addition, and fisheries management decisions. Oxygen addition is achieved through automated mechanical equipment that delivers air or oxygen gas to a reservoir at a specified depth. Oxygen addition to a reservoir would involve installation of the equipment, followed by periodic maintenance and possible restocking of supplies of oxygen gas. Adding nutrients (e.g., nitrogen and phosphorus) would likely include periodic trips to deliver a payload via motor vehicle (truck) or through drops from aircraft.

[10] State Water Board Executive Director's Reports are accessible at: http://www.waterboards.ca.gov/board_info/exec_dir_rpts/

Fisheries management decisions would likely include an increase or decrease in fish stocking levels and the associated increase or decrease in vehicle trips to the reservoir as fish are physically put into a reservoir or removed. Because the effectiveness of these methods of compliance still needs to be validated with field studies (as is currently planned in the Reservoir Program), the degree to which these methods would be used is speculative.

Related Impacts: Many of the methods of compliance for the Provisions could be similar to those required for the Reservoir Program, including sediment controls, possible wastewater treatment plant upgrades, and mercury monitoring. For these methods of compliance there would be similar impacts, as described in Section 8.4. Reservoir Management Actions are different methods of compliance not required by the Provisions, but some of the impacts could be similar as the impacts of the Provisions. Installation of equipment that will add oxygen to the reservoir could affect the aesthetics permanently. The equipment would be visible above the surface of the water and would be about the size of a small boat. The installation of the oxygen addition equipment could cause a disturbance to the wildlife in and around the reservoir. Nutrient addition or oxygen addition to a reservoir would also increase vehicle use and therefore emissions of air pollutants, greenhouse gas emissions, and traffic. Some of the Reservoir Management Actions would need to be conducted indefinitely (nutrient addition or fisheries management) so any associated noise, for example, from the vehicles used to adding nutrients would be permanent. However, it may be a very small disturbance, such as one truck trip per year. In the case of fisheries management, agencies may already be performing such actions and may not need to add additional truck trips. Because these methods of compliance for the Reservoir Program have not yet been validated through field studies, the additional amount of impact is uncertain and speculative.

State Implementation Policy (SIP)
Formal Title: Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California

Description: Adopted in 2005, the State Implementation Policy (SIP) applies to discharges of toxic pollutants into the inland surface waters, enclosed bays, and estuaries of California subject to regulation under the State's Porter-Cologne Water Quality Control Act and the federal Clean Water Act. Such regulation may occur through the issuance of National Pollutant Discharge Elimination System permits or other relevant regulatory approaches. The SIP establishes a standardized approach for permitting discharges of toxic pollutants to non-ocean surface waters in a manner that promotes statewide consistency.

Related Impacts: The SIP is used to derive effluent limitations for wastewater and industrial dischargers for priority pollutants. This policy in combination with other projects and the Provisions could prompt additional upgrades to wastewater and industrial facilities.

Toxicity Provisions

Formal Title: Proposed Toxicity Amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California

Description: The State Water Board anticipates creating the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries with the adoption of Toxicity Provisions. The goals of the Toxicity Provisions include: (a) a new method to determine the toxicity of discharges, (b) statewide numeric objectives, and (c) further standardization of toxicity provisions for NPDES dischargers and facilities subject to WDR and conditional waivers.

Related Impacts: The Toxicity Provisions could demand a higher level of wastewater treatment from wastewater and industrial dischargers. The Toxicity Provisions, in combination with other projects and the Provisions could prompt additional upgrades to wastewater and industrial facilities. The Toxicity Provisions may also require an increase in vehicle use and laboratory supplies for the toxicity monitoring.

Bacteria Amendments

Formal Title: Statewide Water Contact Recreation Bacteria Objectives Amendments To Water Quality Control Plans for Inland Surface Waters, Enclosed Bays and Estuaries and the Ocean Waters Of California

Description: The State Water Board is developing proposed statewide bacteria water quality objectives and a proposed control program to protect human health in waters designated for water contact recreation (REC-1) from the effects of pathogens. The bacteria objectives are proposed to be adopted as amendments to the Statewide Inland Surface Waters, Enclosed Bays and Estuaries Plan, and the California Ocean Plan.

Related Impacts: The Bacteria Amendments could demand a higher level of wastewater treatment from wastewater and industrial dischargers. The Bacteria Amendments, in combination with other projects and the Provisions could prompt additional upgrades to wastewater and industrial facilities. Also, in some cases bacteria can be controlled by controlling sediments. Therefore, impacts from sediment controls could be cumulative, or the controls required for one project may be an acceptable method of compliance for other projects.

Biostimulatory Substances Project

Description: State Water Board staff is developing a project to address biostimulatory substances in wadeable streams, including nutrients.

Related Impacts: The Biostimulatory Substances Project could demand a higher level of wastewater treatment from wastewater and industrial dischargers. The Biostimulatory Substances Project, in combination with other projects and the Provisions could prompt additional upgrades to wastewater and industrial facilities. Also in some cases, nutrients can be controlled by controlling sediments. Therefore, impacts from sediment controls could be cumulatively considerable, or the controls required for one project may be an acceptable method of compliance for other projects.

Recycled Water Policy

Description: Adopted in 2009, the purpose of the Recycled Water Policy is to increase the use of recycled water from municipal wastewater sources that meet the definition in Water Code section 13050, subdivision (n), in a manner that implements state and federal water quality laws. The Recycled Water Policy provides direction regarding the appropriate criteria to be used by the State Water Board and the Regional Water Boards in issuing permits for recycled water projects. Additionally, the Recycled Water Policy encourages every region in California to develop a salt/nutrient management plan by 2014 that is sustainable on a long-term basis and that provides California with clean, abundant water. State Water Board staff is drafting a resolution for the State Water Board's consideration in late 2016 regarding updating the Recycled Water Policy.

Related Impacts: The Recycled Water Policy could demand a higher level of wastewater treatment from wastewater and industrial dischargers, so that the water may be reused. The Recycled Water Policy, in combination with other projects and the Provisions could prompt additional upgrades to wastewater and industrial facilities.

Procedures for Dredged and Fill Materials (Formerly the Wetlands Policy)

Formal Title: Procedures for Discharges of Dredged or Fill Materials to Waters of the State (Proposed for Inclusion in the Water Quality Control Plan for Inland Surface Waters and Enclosed Bays and Estuaries)

Description: The Procedures for Dredged and Fill Materials has the goal of developing: 1) a wetland definition; 2) wetland delineation procedures; and 3) procedures for applications, and the review and approval of Water Quality Certifications, Waste Discharge Requirements, and waivers of Waste Discharge Requirements for discharges of dredged and fill materials.

Related Impacts: Wetlands can be a source of methylmercury. The Provisions affirm that features or measures to reduce methylation may be required. Also, the Provision may result in requirements for alternative dredging procedures to be used to control mercury contaminated sediments. This requirement is not anticipated to result in significant impacts to specific resource areas (Section 8.4). While there is a nexus between the projects there should not be considerable cumulative impacts.

The Trash Amendments

Formal Titles: Amendment to the Water Quality Control Plan for the Ocean Waters of California to Control Trash and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California.

Description: The State Water Board adopted the Trash Amendments April in 2015 and Office of Administrative Law and U.S. EPA approved them in December 2015 and January 2016, respectively. The Trash Amendments include six elements: (1) a water quality objective, (2) applicability, (3) prohibition of discharge, (4) implementation provisions, (5) time schedule, and (6) monitoring and reporting requirements*.* The Trash Amendments apply to all surface waters of the state, with the exception of those waters within the jurisdiction of the Los Angeles Water Board with trash or debris TMDLs that are in effect prior to the effective date of the Trash Amendments.

Related Impacts: The Trash Amendments require dischargers to control litter and will be implemented through NPDES storm water permits (MS4s, Department of Transportation, Industrial General Permit, and Construction General Permit), Waste Discharge Requirements (WDRs), and waivers of WDRs.. Similarly, the Provisions includes requirements for MS4s that may increase household hazardous waste collection programs and education of public on proper disposal of items, which could if anything help reduce litter. Both the Trash Amendments and the Provisions identify cumulative project impacts regarding the potential increase in vehicle use for litter/solid waste collection, and the vehicle use could have a significant cumulative impact.

General Storm Water Permits

Description: Major statewide permits for storm water pertain to industry, construction, or MS4s. Municipalities serving between 100,000 and 250,000 people are required to apply for Phase I MS4 permits, while smaller municipalities and non-traditional permittees (e.g. some state parks) are enrolled in the general Phase II MS4 permit. Storm water discharges arising from projects carried out by the California Department of Caltrans are regulated under the unique statewide Caltrans Permit. Construction projects that disturb one or more acres of soil are required to enroll in the Construction General Permit. A defined set of industrial dischargers are required to enroll in the Industrial General Permit. These permits are revised every serval years and the requirements are updated. Also, requirements for recently adopted TMDLs, including mercury TMDLs are incorporated into the permits periodically.

Related Impacts: Responsible parties may be required to perform activities such as monitoring or outreach and source control, which could increase vehicle use and impacts greenhouse gases and air quality. Additionally, in light of all requirements in the revised permit, statewide projects listed above, and compliance with the Provisions, the responsible partly may decide to upgrade storm water infrastructure treatments systems. These methods of compliance would result in earth moving activities, construction and vehicle use. These activities could have impacts to biota, greenhouse gases, geology, noise and utilities, as described for “Sediment Controls” in Section 8.4. Cumulative impacts could result from statewide implementation and compliance with the Provisions. Briefly, cumulative impacts could arise from: 1) wastewater treatment plant upgrades, 2) sediment controls, and 3) methods of compliance that result in increased vehicle use, such as pollutant monitoring. A complete discussion is below in Section 8.7.3.

Regional Water Board TMDLs

Description: In addition to the State Water Board developing or adopted projects, the Regional Water Boards have recently adopted and are in the process of developing a variety of amendments to their respective basin plans including TMDLs for different pollutants, as well as issuing various permits throughout the state. Examples include: TMDL for Sediment and Temperature in the Scott River Watershed (North Coast Water Board), Napa River Watershed - Sediment TMDL (San Francisco Bay Water Board), Guadalupe River Watershed - Mercury TMDL (San Francisco Bay Water Board), Napa River Watershed – Pathogens (San Francisco Bay Water Board), TMDLs for Nitrogen Compounds and Orthophosphates in the Lower Salinas River Watershed (Central Coast Water Board), Implementation Plans for the TMDLs for Metals in the Los Cerritos Channel and for Metals and Selenium in the San Gabriel River and Impaired Tributaries (Los Angeles Water Board), Central Valley Salinity Alternatives for Long-Term Sustainability (Central Valley Water Board), Truckee River Sediment TMDL (Lahontan Water Board), Coachella Valley Storm Water Channel Bacterial Indicators TMDL (Colorado River Water Board), Recreation Standards for Inland Fresh Surface Waters (Santa Ana Water Board), Revised TMDL Daily Loads for Indicator Bacteria (San Diego Water Board), and Rainbow Creek Nitrogen and Phosphorus TMDLs (San Diego Water Board).

Related Impacts: The main goal of all of the Water Boards' actions is to protect and improve the quality of the State's waters. Implementation measures identified during the development of these policies, amendments, and basin plan amendments, as well as the reasonably foreseeable methods of compliance for these actions, may have similar potential impacts as those identified for the Provisions, for example, a higher level of treatment of wastewater, sediment controls, and pollutant monitoring.

Probable Future Mercury TMDLs

The Water Boards are likely to undertake additional mercury TMDL projects in the future. The reasonably foreseeable compliance methods for the probable future mercury TMDLs are similar to the compliance methods for the Provisions (listed below). This is because the primary mercury sources identified in the TMDL project would be similar to the sources considered in the Provisions. Major mercury sources are those from legacy mining (i.e., mine tailings and storm water runoff) and atmospheric deposition. Any probable future TMDLs for the control of mercury are anticipated to have similar requirements for those sources as those required for the Provisions, but perhaps to a greater extent.

8.7.3 Cumulative Impacts of the Provisions and Other Water Board Projects

The cumulative impacts of other developing or adopted State Water Board statewide projects in combination with the Provisions are anticipated to have cumulative impacts. The cumulative impacts are discussed below by the methods of compliance: 1) wastewater treatment plant upgrades, 2) sediment controls, and 3) methods of compliance that result in increased vehicle use, such as pollutant monitoring.

Wastewater treatment and industrial facility upgrades are less likely to result from the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, and the California Least Tern Water Quality Objective, and there may only be a handful of upgrades resulting for the Subsistence Fishing Water Quality Objective and Tribal Subsistence Fishing Water Quality Objective. However, such upgrades are much more likely a result of the cumulative effects of multiple new effluent limitations for mercury and other pollutants from other statewide projects (listed above) that are expected to be adopted and integrated into the state permitting programs over the next ten years. Additionally, in a state with a high water demand such as California, water reuse is becoming a high priority, and the State Water Board has adopted the Policy for Water Quality Control for Recycled Water (Recycled Water Policy) to aggressively pursue development of recycled water projects. This Recycled Water Policy established a mandate to increase recycled water use to 300,000 acre-feet annually by 2030, and requires that the water used be treated to tertiary standards. The combination of forthcoming statewide water quality standards, plus the demand for higher levels of water quality for new initiatives such as the Recycled Water Policy, will increase demands for tertiary treatment across the state. If every wastewater treatment plant in the state upgraded to tertiary treatment (every plant that does not already provide tertiary treatment) it would result in over a hundred construction projects and earth moving activities throughout the state.

Sediment controls can be used to control a number of pollutants, including mercury, bacteria, nutrients, and sediments (turbidity). Sediment controls may be required by a number of statewide and regional projects. The geographic location that may be the focus of each project will likely vary and it is assumed for this analysis that more sediments controls will be required throughout the state as each project develops. Therefore, impacts from sediment controls could be cumulative. When multiple projects require control of pollutants in storm water, it will put more pressure on storm water dischargers to implement a higher level of control of pollutants in the discharge. This may prompt construction of more robust permanent erosion controls or storm water treatment structures (e.g. retaining walls, culverts, detention basins). The construction and related activities could have a significant cumulative impact on biota, noise, greenhouse gases, and hydrology.

Increased vehicle use may result from a variety of methods compliance for all statewide projects. Vehicles are used to ship samples, perform maintenance and for any construction or earth moving projects. Vehicle use will also result from a wide variety of other projects occurring in the state from either new government policies or regulations that require monitoring and enforcement or from development of new housing, commercial facilities, or public infrastructure. All projects together could have a significant vehicle usage increase which could have a significant cumulative impact on air quality, increase traffic, and increase greenhouse gases. However, these effects can be decreased with fuel efficient vehicles and other measures as described in Section 8.4.

9. Project Alternatives

9.1 Alternatives Analysis

State Water Board certified regulatory programs require that the Staff Report contain "An analysis of reasonable alternatives to the project and mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts" (Cal. Code Regs., tit. 23, § 3777, subd. (b)(3)). The alternatives should feasibly meet the project objectives (stated in Section 2.2), but avoid or substantially reduce any potentially significant adverse environmental impacts (Cal. Code Regs., tit. 14, § 15126.6 (a)).

9.1.1 Alternative 1- No Project

The purpose of assessing a No Project Alternative in an environmental document such as this Staff Report is to allow decision makers and the public to compare the impacts of approving the Provisions with the impacts of not approving the Provisions. The No Project Alternative would involve the State Water Board deciding not to approve the Provisions.

The No Project Alternative would not meet any of the five project objectives of the Provisions. (See Section 2.2.) However, a consent decree does require that the U.S. EPA fulfill the second objective of protecting wildlife from the elevated levels of mercury. (See Section 1.2.) In 2014, the United States District Court for the Northern District of California issued a consent decree requiring that U.S. EPA is obligated to propose water quality criteria for wildlife by June 30, 2017, initiate required endangered species consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service within nine months of the proposal, and then promulgate a final rule within six months of the conclusion of the consultation (Consent Decree: Our Children's Earth Foundation and Ecological Rights Foundation, vs. U.S. EPA, et al., No. 3:13-cv-2857-JSW (N.D. Cal., Aug 25 2014). The U.S. EPA can also achieve the requirement to establish water quality criteria for the protection of wildlife in California if water quality objectives are adopted by the Water Boards and approved by U.S. EPA by June 30, 2017. Therefore, if the State Water Board fails to adopt a water quality objective to protect wildlife, then the U.S. EPA will promulgate such criteria (See Section 3.5).

The consent decree only requires U.S. EPA to establish water quality criteria that protect wildlife. The first project objective of the Provisions, which is to recognize the beneficial uses of water made by California Native Americans and subsistence fishers, would not be accomplished. The third objective, which is to adopt water quality objective(s) for mercury to protect recreational fishers, subsistence fishers, and California tribes from consumption of fish with elevated levels of mercury, since the consent decree does not require U.S. EPA to promulgate human health criteria, would also not be accomplished. Establishing protective criteria for wildlife would indirectly protect recreational fishing and perhaps ceremonial fish consumption by tribes, which is part of the third objective of the Provisions. This is because a meal a week of fish consumption should also be protected by criteria that protect wildlife (see Appendix K, Section K.6.7, which explains how the Prey Fish Water Quality Objective and the

California Least Tern Prey Fish Water Quality Objective are roughly consistent or perhaps slightly more protective than the Sport Fish Water Quality Objective).

The U.S. EPA would not provide a program of implementation to control mercury discharges, which is the fourth project objective of the Provisions. After the U.S. EPA promulgates new mercury criteria, the Regional Water Boards would need to implement the criteria through permits. The Regional Water Boards would likely require actions to control mercury in permits that are similar to the requirements of the Provisions. It is unlikely that consistent implementation requirements would be applied statewide since there would be no statewide policy, which would fail to meet the fifth objective of the Provisions of statewide consistency.

In terms of environmental impacts, the No Project Alternative could somewhat lessen the impact of the Provisions by omitting the beneficial uses of Tribal Subsistence Fishing, Tribal Tradition and Culture, and Subsistence Fishing, and the corresponding mercury water quality objectives, thus reducing the reasonably foreseeable methods of compliance for wastewater treatment facilities to install upgrades. However, because the Water Boards would be required to implement criteria through permits by the U.S. EPA, and implementation of those permit requirements would use the same set of implementation activities as discussed in Chapter 7. Therefore similar potential environmental impacts due to implementation would be expected, but to a lesser degree. However, this alternative would not provide statewide consistency in how mercury criteria are implemented, resulting in more uncertainty regarding the magnitude of potential environmental impacts. .

The State Water Boards cannot accurately evaluate the potential water quality criteria that U.S. EPA would ultimately establish to protect wildlife because such national criteria have not been developed. It is assumed that the wildlife criteria would be as protective as the water quality objectives that protect wildlife in the Provisions, at minimum. The U.S. EPA may include more conservative assumptions or may be able to include new information on exposure pathways that was not available at the time of development of the Provisions (e.g., additional uncertainty factors in calculating the reference dose, exposure for insectivorous wildlife). Thus, it is possible that the U.S. EPA could promulgate criteria for wildlife that are more stringent than those included in the Provisions. If the U.S EPA promulgates criteria for wildlife that are three to four times as protective as those included in the Provisions, then the criteria would be roughly as stringent as the Tribal Subsistence Fishing Water Quality Objective and the Subsistence Fishing Water Quality Objective. In this case, the potential environmental impacts due to implementation of the U.S EPA criteria would be greater since more stringent criteria would apply to all waters (designated with the wildlife beneficial use), whereas the water quality objectives in the Provisions pertaining to subsistence uses may only apply to a fraction of the surface waters in the foreseeable future. The environmental impacts would presumably primarily result from increases in the installation of upgrades to wastewater treatment facilities. Again, because U.S. EPA would not establish a statewide program of implementation, this alternative would there would not provide statewide consistency in how mercury criteria are implemented, resulting in more uncertainty regarding final potential environmental impacts. , Because the reasonably foreseeable methods of compliance for implementation through individual permits are functionally the could potentially be similar to the Provisions, similar environmental impacts would expected. However, the No Project Alternative would fail to meet most of the objectives of the Provisions. The No Project Alternative is not the preferred alternative.

9.1.2 Alternative 2 - Sport Fish and Prey Fish Water Quality Objectives Only

This alternative omits the Subsistence Fishing Water Quality Objective and the Tribal Subsistence Fishing Water Quality Objective, to reduce the environmental impacts. This alternative includes the beneficial uses of Tribal Subsistence Fishing, Tribal Tradition and Culture, and Subsistence Fishing, the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective and the California Least Tern Water Quality Objective, and the corresponding implementation requirements. The Subsistence Fishing Water Quality Objective and the Tribal Subsistence Fishing Water Quality Objective would likely result in upgrades to wastewater treatment plants and industrial facilities that need to achieve the effluent limitations (see Section 8.4.17). These upgrades could result in impacts to air quality, greenhouse gases, noise and vibration, and traffic. In Alternative 2, these impacts would not occur. Mercury monitoring of the effluent, and mercury minimization plans would decrease under this alternative. Potential impacts to air quality, greenhouse gases, and traffic (due to increased vehicle use) would decrease.

However, Alternative 2 does not meet the first and third project objectives of the Provisions (see Section 2.2) to protect human health, including populations that consume more fish than the typical recreational angler, such as subsistence fishers and tribes. The Subsistence Fishing and Tribal Subsistence Fishing beneficial uses currently occur in California (see reports in Appendix G). Therefore, with this alternative, water quality objectives to protect these uses would need to be developed in the future. Also the Water Board is developing other water quality standards and corresponding programs of implementation, such as those to control bacteria, nutrients and toxicity (Section 8.7.2) and any of these may result in the upgrades to the same facilities that would be avoided under Alternative 2. This alternative is anticipated to delay attainment of beneficial uses. Alternative 2 is not the preferred alternative.

9.1.3 Alternative 3 – Omit Implementation Requirements for Storm Water, Wetlands, Dredging Activities, Mines and Nonpoint Sources

This alternative would be the same as the Provisions, but omit the requirements for municipal and industrial storm water permittees, requirements for wetlands, dredging activities, nonpoint sources, and mines. Some of the storm water or nonpoint source discharges currently have mercury requirements through existing policies and permits (see section 6.9 through 6.11). For some dischargers, no new requirements are anticipated from the Provisions, while other dischargers would need to perform a new or enhanced version of the activities that are already being performed. These requirements could feasibly be omitted from the Provisions. Omitting these requirements could reduce some of the environmental impacts by reducing temporary noise increases due to vehicle use and possible use of construction equipment, as well as possible impacts due to the construction of new storm water drainage facilities or expansion of existing facilities. (Federal regulations require water quality based requirements for wastewater and industrial discharges, therefore the requirements for wastewater and industrial discharges cannot feasibly be omitted.)

Alternative 4 would not provide total fulfilment of the fourth project objective of the Provisions, which is to provide a program of implementation to control mercury discharges and achieve the Mercury Water Quality Objectives in California waters. (See Section 2.2.) Alternative 4 would also fail to provide the same level of statewide consistency as the Provisions, which is the fifth project objective of the provisions. The requirements in the Provisions for storm water are intended to have all MS4s conduct a similar level of mercury controls. The nonpoint sources requirements (including those for mines, wetlands and dredging activities) are also intended to provide clarity as to an appropriate level of baseline mercury control. If the Provisions were silent as to how to control mercury in nonpoint sources, then the Regional Water Boards may derive a wide range of varying requirements. Finally, considering that storm water and nonpoint sources are primary sources of mercury, achieving the water quality objectives will depend on the control of these sources. While the requirements in the Provisions may not be very different than exiting permits and polices, these requirements provide a somewhat higher level of mercury control in some cases and these requirements provide better statewide consistency. Alternative 4 lacks these requirements, and is, therefore, not the preferred alternative.

10. Other Required Considerations

This section addresses considerations required by Water Code section 13241 for the development of water quality objectives. This section also discusses the elements a program of implementation to achieve the Mercury Water Quality Objectives must include and addresses required considerations for antidegradation and the human right to water.

10.1 Considerations Required by Water Code Section 13241

In accordance with Water Code section 13241, the Water Boards are required to establish water quality objectives to "ensure the reasonable protection of beneficial uses and the prevention of nuisance[.]" In doing so, the following factors must be considered:

- Past, present, and probable future beneficial uses of water.
- Environmental characteristics and water quality of the hydrographic unit under consideration.
- Water quality conditions that could be reasonably attained through coordinated control of all factors affecting water quality.
- Economic considerations.
- The need for developing new housing.
- The need to develop and use recycled water.

(Wat. Code, § 13241, subds. (a)-(f).)

10.1.1 Past, Present and Future Beneficial Uses of Water

In general, the five Mercury Water Quality Objectives are designed to help support the past, present and future beneficial uses of water as described in Chapter 5. The Provisions would support the Water Boards' existing water quality control plans and policies, and provide additional means to ensure that any future beneficial uses that could be impaired by the presence of mercury or methylmercury are protected. However, some of the Mercury Water Quality Objectives have no applicability to either past, present, or future beneficial uses. The Subsistence Fishing Water Quality Objective and the Tribal Subsistence Water Quality Objective would not apply to any beneficial use currently in the state until designated by a Water Board. Furthermore, protecting present uses from impairments from mercury is challenging, given the nature of the sources. These topics are described below.

Past Uses

The Tribal Subsistence Fishing Water Quality Objective, if applied to a beneficial use by a Water Board, could help to protect past beneficial uses of water. The Tribal Subsistence Fishing Water Quality Objective for mercury was calculated from the amount of fish consumed currently, and the objective does not specifically aim to attain the past use. However, attaining the Tribal Subsistence Fishing Water Quality Objective would be a movement towards attaining the past uses of water (i.e., those uses practiced by California tribes). This water quality objective likely goes further in attaining past uses in comparison to attaining the COMM beneficial use protected by the Sport Fish Water Quality Objective. This is because although past fish consumption by California tribes is difficult to ascertain, it was likely significantly higher than present levels of consumption (Shilling et al. 2014). In addition, the Sport Fish Water Quality Objective could help protect past ceremonial uses involved fish consumption, although these uses are not well understood by the Water Boards (Section 6.6).

Present Uses

Elevated levels of mercury in certain fish species impair the established beneficial uses adopted in basin plans related to fish consumption by humans and wildlife, as discussed in detail in Sections 5.1 through 5.5. The Mercury Water Quality Objectives and the implementation procedures included in the Provisions are intended to protect those beneficial uses. For many areas in the state, there is doubt that the water quality objectives that correspond to the present uses are achievable due to historic mining and atmospheric deposition. Still, it is anticipated that the beneficial uses of COMM and WILD could be attainable in many areas after the coordinated control of all factors that affect mercury discharges and bioaccumulation. The beneficial uses of T-SUB and SUB WILD could be attainable after the coordinated control of all factors in some waters, but these uses will be more difficult to attain than COMM and WILD. Staff recognizes that it may take a significant period of time to attain the objectives by implementing the mercury controls in the Provisions and other water quality control programs, such as TMDLs. In addition, the levels of mercury vary greatly by fish species and some fish species, such as rainbow trout and anadromous salmonids, are safe to eat at the consumption rate included for the Sportfish Water Quality Objective. In other species, however, such as bass, the mercury levels tend to be high and the consumption of these species should be limited.

Future Uses

Waters where the COMM or WILD beneficial uses apply and are currently impaired due to elevated levels of mercury, could meet their corresponding water quality objectives in the future through efforts to reduce mercury entering into water bodies and efforts to reduce methylation of mercury within those waters. Similarly if waters are designated with either the Tribal Tradition and Culture, Tribal Subsistence Fishing, or Subsistence Fishing beneficial uses and the corresponding water quality objectives (Section 6.5 through Section 6.7), although the objectives may not be currently achievable, the designation could be used to protect future uses where not currently attained.

10.1.2 Environmental Characteristics and Water Quality of the Hydrographic Unit under Consideration

The legacy of mercury left by historic gold and mercury mining is an important factor that should be considered when developing the Mercury Water Quality Objectives or implementation programs. Human activity may prevent attaining the Mercury Water Quality Objectives for many fish species for the next century in many waters, but there is no way to know this for certain. This legacy mercury contamination is described in the environmental background in Chapter 4.   Similarly, mercury from atmospheric emissions may be a significant source of mercury that will prevent attainment of the Mercury Water Quality Objectives (also discussed in Chapter 4). Otherwise, the environmental characteristics of all hydrographic units that would be affected by the Provisions are described in Appendix D. The difficultly in achieving more protective options for the Mercury Water Quality Objectives (discussed in Sections 6.2 through Section 6.6) is due to the legacy mercury contamination and atmospheric emissions. Finally, Section 6.9 discusses how the Provisions should to address legacy mines.

10.1.3 Water Quality Conditions that Could Reasonably be Achieved through Coordinated Control of All Factors Affecting Water Quality

The Water Boards are required to ensure that all discharges, regardless of type, comply with all water quality control plans and policies. To achieve the Mercury Water Quality Objectives, the Provisions include implementation requirements for major surface water discharge types that are regulated by the Water Boards, including: historic mines (Section 6.9), nonpoint sources, wetlands, dredging activities (Section 6.10), storm water (Section 6.11), and municipal and industrial discharges (Section 6.13).

The legacy of mercury left by historic gold and mercury mining is not easily controlled and may prevent attaining the Mercury Water Quality Objectives for many fish species for the next century in many waters. In addition, mercury has been discharged from legacy mines for decades or even centuries, contaminating sediments in soils along the lengths of associated attendant water bodies. Given the absence of the original mine owners, the diffuse distribution of the mercury, and the large number of stakeholders surrounding such water bodies, coordinated control of contaminants is extremely challenging. Another factor that affects the coordinated control of water quality is mercury emissions to the atmosphere. Mercury TMDLs developed by the Water Boards have calculated atmospheric deposition from mercury on an individual water body or watershed basis. The Water Boards do not regulate mercury emission to the atmosphere, however, ARB and the federal government are working to control atmospheric mercury emissions. These federal programs and other government programs that help control mercury are listed in Appendix E.

It may take a significant period of time to attain the objectives by implementing the mercury controls in the Provisions and developing and implementing other water quality control programs, such as TMDLs. Additionally, the Tribal Subsistence Fishing Water Quality Objective and the Subsistence Fishing Water Quality Objective may be very difficult to achieve in most waters as discussed in Section 6.5. However, the levels of mercury vary greatly by fish species and in some waters some fish species, such as rainbow trout and anadromous salmonids, are safe to eat at the consumption rate included for the Tribal Subsistence Fishing Water Quality Objective and the Subsistence Fishing Water Quality Objective. Moreover, it is anticipated that the coordinated control of all factors can improve water quality in many waters.

10.1.4 Economic Considerations

Under the requirements of Water Code sections 13170 and 13241, subdivision (d), and the California Code of Regulations, title 23, section 3777, subdivisions (b)(4) and (c), the State Water Board must consider economics when establishing water quality objectives. This consideration of economics is not a cost-benefit analysis and, particularly with respect to the analysis required by the certified regulatory program, the board is not required to engage in speculation or conjecture and the consideration of economics should include consideration of potential costs of the reasonably foreseeable measures to comply with the Provisions. An economic analysis of the Provisions is included as Appendix R (hereafter referred to as the economic analysis).

The economic analysis estimated the statewide cost of the Provisions would be 9 to 15 million dollars annually, over 20 years. This estimate is based on the projected costs associated with reasonably foreseeable methods of compliance for municipal wastewater and storm water dischargers. Although the economic analysis did not directly estimate costs for compliance with effluent limits of 1 ng/L or lower, possibly driven from the Tribal Subsistence or Subsistence beneficial uses, the costs would be similar to those analyzed for compliance with the effluent limits derived from the other water quality objectives to protect COMM and WILD. It is anticipated that the Water Boards would not require treatment beyond that required to meet an effluent limit of between 1-4 ng/L and would issue either longer compliance schedules associated with a site specific objective of a variance. Appendix R recognizes that variances or site-specific compliance schedules are likely for point course dischargers subject to potentially very low effluent limits. The bulk of the costs would be for upgrades to tertiary treatment for wastewater facilities with observed mercury effluent levels above the anticipated effluent limitations. The cost estimates also include municipal wastewater and storm water dischargers conducting pollution prevention activities. See Appendix R for details. It was not possible to quantify costs to abandoned mines, dredging, wetlands, and other nonpoint sources. However, these costs are anticipated to be minor compared to the quantified costs, since the methods of compliance for abandoned mines, dredging, wetlands, and other nonpoint sources would already be conducted under existing programs in many cases.

The economic analysis analyzed data from 67 POTWs with monitoring data for mercury in effluent out of the approximately 300 facilities that would be subject to the Provisions (See Appendix N for details). Of these, 15 POTWs (22 percent) were achieving an effluent mercury concentration of 1 ng/L or less. Forty-two POTWs (63 percent) achieved an effluent concentration of 4 ng/L or less. Fifty-four POTWs (80 percent) achieved an effluent concentration of 12 ng/L or less. The remaining 13 facilities did not achieve a concentration of mercury less than 12 ng/L. The economic analysis also analyzed data for 20 industrial facilities. Of these, eight facilities (45 percent) achieved an in-effluent concentration of 1 ng/L or less. Eleven facilities (55 percent) achieved an effluent concentration of 4 ng/L or less. All 9 remaining industrial facilities discharged mercury at a concentration of greater than 12 ng/L.

Based on these samples, POTWs and industrial facilities are capable of meeting an effluent limit of 1 ng/L or less of water column mercury. A larger number are already meeting an effluent limit of 4 ng/L or less. However, to meet a 1 ng/L limit for mercury, an estimated 80 percent of all POTWs in the state and 60 percent of all industrial NPDES dischargers would have to build treatment upgrades. To meet a 4 ng/L limit, approximately 37 percent of POTWs and 45 percent of industrial facilities would have to build treatment upgrades. To achieve the highest proposed water quality objective water column concentration, 12 ng/L, approximately 20 percent of POTWs and 45 percent of industrial facilities would have to build treatment upgrades. It is unknown how many facilities will need the meet the effluent limitations of 1 ng/L and 4 ng/L, since it is unknown where the beneficial uses of SUB and T-SUB will be designated in the future and it is uncertain which water bodies will be categorized a “slow moving waters” (see discussion in Section 7.2.8 through Section 7.2.10).

While the economic analysis (Appendix R) provides details of the anticipated costs of the Provisions, cost is a consideration in many policy recommendations involved in developing the Provisions (each “Issue” discussed in Section 6). Specifically, in Section 6.4, the recommendation to adopt the T-SUB and SUB beneficial uses could focus resources on areas where there is the greatest need for very protective water quality objectives because designating waters with a tiered use of consumption of fish is tailored to those higher consumptive fishers. By comparison, the other option evaluated was to have the COMM use incorporate subsistence fishing, which would result in a very stringent water quality objective that would be applied to most waters throughout the state which are designated with the COMM use. The approach of developing separate beneficial uses (T-SUB and SUB) will reduce costs statewide, for wastewater treatment faculties that would need to meet the effluent limitations associated with the Mercury Water Quality Objectives. There are implications of the costs of the Mercury Water Quality Objectives in Section 6.2 through Section 6.5 in discussions of which options for the water quality objectives can be achieved. A main concern associated with the ability to achieve a water quality objective is the cost of doing so, although is not certain that objectives that are more difficult to achieve will result in greater costs. The economic analysis (Appendix R) is intended to identify where actual costs may be incurred.

Economic considerations were included in the development of the two prey fish water quality objectives. The California Least Tern Prey Fish Water Quality Objective only applies to that habitat of the tern and not statewide to save resources and reduce costs (Section 6.7). The need for the monitoring of the Prey Fish Water Quality Objective was limited to waters that lack trophic level 4 fish, to save resources and reduce costs. Similarly if a water body was listed based on sport fish, monitoring of prey fish is not required in order to save resources and reduce costs (Section 6.8).

The costs are also considered in the discussion on the implementation requirements for the Provisions (Section 6.9 through Section 6.13). Costs are considered in the requirements for municipal wastewater and industrial dischargers, including an exception for small disadvantaged communities and insignificant dischargers to reduce costs from monitoring for such dischargers (Section 6.13, Option 1). Also, the economic consequences for industrial storm water discharges were considered in the development of the updated Numeric Action Level (Section

6.11, option 3). The Provisions also included an option that could reduce costs for MS4s by allowing a substitute method of mercury control, instead of those listed in the Provisions, with approval of the Regional Water Board (Section 6.11, option 2). Costs are also considered with respect to the human right to water (Section 10.4).

In addition to the cost of implementing the Provisions, the economic and social impact of mercury contamination in fish should be considered. This impact may include lost revenue from sport fishing (see Section 6.3, Option 3). Another impact is to the people that have been exposed to elevated mercury as children. Detrimental health effects, especially the loss of intelligence due to neurological damage from methylmercury, causes diminished economic productivity that persists over the entire lifetime of these children. For the U.S. the cost was estimated to be $8.7 billion annually (range, $2.2–43.8 billion; in 2000 US dollars (Trasande et al. 2005). However, U.S. EPA estimated a much lower cost, a maximum of $580 million (Griffiths et al. 2006). A great deal of this estimated cost was the result of global mercury emissions. There is also a cost to California Native American tribes since locally caught fish are often used for trading, and knowledge of negative impacts to fish supplies due to water quality issues is one reason tribe members fish less frequently (Shilling et al. 2014).

10.1.5 The Need for Developing Housing

The adoption of the Provisions is not expected to constrain housing development in California. The implementation requirements do not directly affect the cost of housing, but can increase the cost of city utility services, mainly sewer. The costs associated with the requirements are anticipated to be minimal in comparison to the overall costs of housing development.

10.1.6 The Need to Develop and Use Recycled Water

The adoption of the Provisions is not expected to have a major effect on the need to develop and use recycled water. The Provisions do not include new requirements for recycled water. The intent of the Provisions is to improve water quality and reduce mercury levels in surface waters, including rivers, streams, estuaries, reservoirs, lakes, and bays. Since high quality water is better for reuse, the Provisions are consistent with the need to develop and use recycled water.

Recycled water can be put to many uses: crop or landscape irrigation, cooling, ground water replenishment and other uses. Also a possible use of recycled water is for fish hatcheries. Recycled water must meet the recycled water criteria (Cal. Code Regs., tit. 22, § 60301 et seq.). If the recycled water could eventually be used for drinking, such as for ground water replenishment, the water must meet drinking water criteria. The relevant drinking water threshold for mercury is 2 µg/L (2,000 ng/L), which is much higher than the concentrations considered for use as effluent limitations in the Provisions. The Provisions would not affect drinking water criteria.

It seems unlikely that implementation of the Provisions would change the amount of water recycled. This is because the mercury requirements for recycled water would not be more stringent than the requirements for discharge into surface water. In some cases, it may be easier to meet the requirements for recycled water than to meet the effluent limitations in the Provisions. In those cases this implementation of the Provisions may promote water recycling because treatment cost would be lower with regard to mercury. In addition, the Provisions may indirectly increase the amount of water available for recycling. This could happen if dischargers upgrade to tertiary treatment in order to consistently meet the water quality objectives. The result of more dischargers with tertiary treatment would be more high quality treated wastewater being available for reuse.

In Southern California, recycled water is used to create ponds or lakes for recreation, including fishing. An example is Santee Lakes near San Diego which are supported by recycled water from Padre Dam Municipal Water District. Santee Lakes are stocked with trout for fishing and taking, and bass for catch and release only. Although this is a recreational area where people may catch and eat fish from lakes, the lakes are officially part of the wastewater treatment facility. The lakes are not included in the San Diego Regional Water Board's basin plan or in the waters within the board's region. Therefore, the requirements from the Provisions would not apply in the Santee Lakes or the use of recycled water in the lakes. However, the discharge from the lakes to the nearby creek is regulated as an NPDES discharge, and requirements for the Provisions could apply to that discharge.

10.2 Considerations Required by Water Code Section 13242

California Water Code section 13242 requires a program of implementation for achieving a water quality objective to include: a description of the nature of the actions which are necessary to achieve the objective, time schedules for actions to be taken, and a description of surveillance to be undertaken to determine compliance with the water quality objective. (Wat. Code, § 13242, subd. (a)-(c).) In compliance with California Water Code section 13242, the Provisions includes a program of implementation in order to achieve the water quality objectives and monitoring and reporting requirements, as described in the draft Provisions (Appendix A). The time schedule for compliance would be determined on a discharge-by-discharge basis by the Water Boards. Timelines for compliance are already established by existing programs and in the State Water Board's *Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits* (Resolution 2008-0025). After the effective date of the Provisions, the requirements to implement the Provisions would be incorporated into permits and Certifications as they are adopted, reissued, or modified. Most existing permits should have all applicable new mercury requirements incorporated within five to ten years after the date of adoption of the Provisions. This is because NPDES permits and waivers of Waste Discharge Requirements expire every five years and the new requirements should be added to each permit at the time of their renewal. However, in some cases, the permits can be administratively extended which results in a delay in reissuing the permits. Also Waste Discharge Requirements are scheduled to be reissued every five, ten, or fifteen years depending on the threat to water quality, and the new requirements of the Provisions will be incorporated primarily upon reissuance.

10.3 Antidegradation

Federal and state antidegradation policies are specified in both 40 Code of Federal Regulations section 131.12 and in State Water Board Resolution No. 68-16, respectively. Antidegradation policies impose additional levels of protection for waters within the state, depending on the highest quality of the water achieved since 1968 – the year that the State Water Board adopted California's antidegradation policy. Where a receiving water is of higher quality than applicable water quality standards, that higher water quality must be maintained unless certain conditions are met.

The State Water Board does not anticipate any degradation of water quality as a result of the adoption and implementation of the Provisions. The Provisions are intended to enhance water quality. Upon adoption of the Provisions, the state would have a more protective water quality objective for mercury to support the COMM beneficial use compared to the current statewide criteria in the California Toxics Rule and, for the first time, the Mercury Water Quality Objectives would apply statewide to support the beneficial uses pertaining to wildlife habitat: WILD, MAR, WARM, COLD, EST, SAL, RARE. Additionally, once the beneficial uses of SUB, T-SUB are designated additional protection fro water quality would apply for those uses. Since the implementation requirements in the Provisions would not supersede the implementation program of adopted mercury TMDLs, the Provisions could not result in a degradation of water quality standards in waters where mercury TMDLs have been established.

Antidegradation is considered during permit issuance and reissuance. The analysis is done on a discharge-by-discharge basis. An increase in mercury in a discharge is not lawful even if the water body is meeting standards. Antidegradation provisions require that where the quality of the waters exceed levels necessary to meet water quality objectives that quality shall be maintained unless the State finds the discharge is necessary to accommodate important economic or social development (40 CFR § 131.13).

A case where the implementation requirements of the Provisions may be less stringent than existing requirements is for the municipal wastewater and industrial discharger effluent limitations (Section 6.13), since effluent limitations are derived on a case-by case basis and depend on many factors. This could occur for example if a facility is granted a dilution credit, while the facility previously had no dilution credit factored into the effluent limitation (dilution credits for bioaccumulative compounds may be restricted according to existing policy). Another example could be if a facility is granted the small disadvantaged community or insignificant discharger exception by the Regional Water Board resulting in no effluent limitation, while the facility previously had a mercury effluent limitation. However, when modifying or reissuing permits with existing water quality based effluent limitations for mercury, permit writers must ensure compliance with Clean Water Act anti-backsliding requirements. For modified or reissued permits with existing effluent limitations for mercury, any less stringent effluent limitation must be consistent with anti-backsliding requirements within the Clean Water Act section 402(o)(1), unless a specific exception applies under anti-backsliding requirements (33 U.S.C. § 1342(o)(2); 40 C.F.R. § 122.44(l)), or antidegradation requirements (33 U.S.C. §

1313(d)(4)). Therefore, if the effluent limitation that would result from the Provisions is less stringent that the existing limitation, the previous effluent limitation may need to be retained from the previous permit by the permit writer to adhere to anti-degradation or anti-backsliding requirements.

10.4 The Human Right to Water

California Assembly Bill 685 (AB 685) declares that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes" (Wat. Cod, § 106.3, subd. (a)) and promotes the adoption of policies, regulations, and grant criteria pertinent to those uses of water (ibid., § 106.3, subd. (c)). State Water Board Resolution 2016-0010 adopts the human right to water as a core value, adopts the realization of the human right to water as a top priority for the Water Boards, and directs staff, when submitting a recommendation to the board pertinent to the human right to water, to describe how the right was considered. The Provisions do not directly pertain to drinking water. The Provisions primarily concern mercury in fish tissue and the associated risk to human and wildlife that eat locally caught fish. The mercury levels that are a concern in drinking water are much higher than the mercury levels that impact fish consumption due to the bioaccumulation/ biomagnification that happens as mercury moves through the food web. Therefore, the goals of the Provisions are more protective than needed for safe drinking water. Since the Provisions do not apply to drinking water, any effects on the affordability or accessibility of safe clean drinking water would be indirect.

The requirements of the Provisions may indirectly increase accessibility of safe clean drinking water. This is because the treatment that removes mercury in wastewater treatment plants (settling, flocculation, and filtration) tends to also remove other constituents that are a concern for drinking water, such as sediments, nutrients, and bacteria. Many wastewater treatment plants discharge the effluent indirectly upstream of drinking water intake structures. Surface water that is used for drinking is usually treated before it is distributed to residents and businesses to remove pathogens and sediments. If sediments and pathogens are lower in surface water to begin with, it is easier to provide safe clean drinking water.

The requirements of the Provisions may also indirectly decrease accessibility of safe clean drinking water by increasing the costs for residential customers for the water in their home. This could happen because the Provisions would impose new requirements for wastewater treatment plants. In response to the Provisions, plants may need to perform mercury minimization programs activities or possibly add new treatment steps. The increased costs to wastewater treatment plants may be passed on to the customers. Since the municipal water and sewer service are combined in many areas, this could indirectly increase the cost of drinking water. The increased cost could make water and sewer service unaffordable for some residents, in particular, residents in small disadvantage communities.

In consideration of the financial constraints of some small communities, the Provisions include an exception for small disadvantaged communities for some of the requirements for municipal wastewater (Section 6.13.3, option 1). The development of the Provisions will also consider social and economic impacts of the implementation requirements (see Section 10.1.4).

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Appendix A. Proposed Provisions for Draft Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses

Draft Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions

Contents

[*The entirety of the following text, except the italicized annotations, is proposed to be adopted as Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and*

Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions (Part 2).[11] *Part 2 would constitute new regulatory language.]*

II. BENEFICIAL USES

[Proposed text to be added to Chapter II (Beneficial Uses) of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California (ISWEBE Plan).]

A Regional Water Quality Control Board shall use the beneficial uses and abbreviations listed below, to the extent it defines such activities in a water quality control plan after *[insert effective date of Part 2]*.

To designate the Tribal Tradition and Culture or Tribal Subsistence Fishing beneficial uses in a water quality control plan for a particular waterbody segment and time(s) of year, a CALIFORNIA NATIVE AMERICAN TRIBE must confirm the designation is appropriate. No confirmation is required to designate the Subsistence Fishing beneficial use in a water quality control plan.

The Tribal Subsistence Fishing and Subsistence Fishing beneficial uses relate to the risks to human health from the consumption of noncommercial fish or shellfish. The two subsistence fishing beneficial uses assume a higher rate of consumption of fish or shellfish than that protected under the Commercial and Sport Fishing and the Tribal Tradition and Culture beneficial uses. The function of the Tribal Subsistence Fishing and Subsistence Fishing beneficial uses is not to protect or enhance fish populations or aquatic habitats. Fish populations and aquatic habitats are protected and enhanced by other beneficial uses, including but not limited to, Aquaculture, Warm Freshwater Habitat, and Cold Freshwater Habitat, that are designed to support aquatic habitats for the reproduction or development of fish.

4) Tribal Tradition and Culture (CUL): Uses of water that support the cultural, spiritual, ceremonial, or traditional rights or LIFEWAYS of California Native American Tribes, including, but not limited to: navigation, ceremonies, or fishing, gathering, or consumption of natural aquatic resources, including fish, shellfish, vegetation, and materials.
5) Tribal Subsistence Fishing (T-SUB): Uses of water involving the non-commercial catching or gathering of natural aquatic resources, including fish and shellfish, for consumption by individuals, households, or communities of California Native American Tribes to meet minimal needs for sustenance.
6) Subsistence Fishing (SUB): Uses of water involving the non-commercial catching or gathering of natural aquatic resources, including fish and shellfish, for consumption by individuals, households, or communities, to meet minimal needs for sustenance.

III. WATER QUALITY OBJECTIVES

[*Proposed text to be added to Chapter III (Water Quality Objectives) of the ISWEBE Plan.*]

[11] The State Water Board intends to amend the Water Quality Control Plan for Enclosed Bays and Estuaries of California to create the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California Plan (ISWEBE Plan). The State Water Board intends that Part 2 will be incorporated into the ISWEBE Plan, upon the ISWEBE Plan's adoption.

D. Mercury

1. Applicability

Chapter III.D.2 establishes water quality objectives for the reasonable protection of people and wildlife that consume fish and apply to all the inland surface waters, enclosed bays and estuaries of the State that have the applicable beneficial uses. The water quality objectives that protect people who consume fish apply to waters with the COMM, CUL, T-SUB, and SUB[12] beneficial uses. The water quality objectives that protect wildlife that consume fish apply to waters with WILD, MAR, RARE, WARM, COLD, EST, and SAL beneficial uses.[13]

Mercury Water Quality Objectives

Chapter III.D.2 contains five numeric mercury fish tissue water quality objectives, which are formulated for one or more of the applicable beneficial uses, depending on the consumption pattern (which includes consumption rate, fish size, and species) by individuals and wildlife. Additionally, different sizes and species of fish contained at a water body will, in some cases, affect whether a particular water quality objective may be utilized to evaluate whether one or more beneficial uses are supported. Therefore, the fish in a particular water body would dictate which water quality objective(s) must be evaluated to ensure all the applicable wildlife beneficial uses are supported, as discussed below and illustrated in the flow chart in Attachment B. For any of the mercury fish tissue water quality objectives, measurements of total mercury concentrations in fish tissue may be substituted for methylmercury concentrations in fish tissue.

a. Sport Fish Water Quality Objective

1) <u>Application of the Sport Fish Water Quality Objective</u>
   The Sport Fish Water Quality Objective for mercury applies to waters with the beneficial uses of COMM, CUL[14], WILD, and MAR. However, in some circumstances (i.e., depending on whether TROPHIC LEVEL 3[15] or TROPHIC LEVEL 4 fish are in the water body), with respect to the WILD and MAR beneficial uses, additional water quality objectives also need to be utilized to evaluate whether consumption of fish by all wildlife species is supported (see below discussion).

   With respect to the WILD and MAR beneficial uses, the Sport Fish Water Quality Objective may be used to evaluate whether all species are supported only when applied

[12] The water quality objective applicable to the SUB beneficial use (see Section III.D.2.c) also applies to the Subsistence Fishing (FISH) beneficial use contained in the North Coast Regional Water Quality Control Board's water quality control plan. (Water Quality Control Plan for the North Coast (May 2011), p. 2-3.00.)

[13] Any explicit reference in the MERCURY PROVISIONS to the WILD and MAR beneficial uses shall hereinafter include the WARM, COLD, EST, and SAL beneficial uses.

[14] If site-specific studies indicate a consumption pattern under the CUL beneficial use higher than the consumption rate used for the objective to support the COMM beneficial use, then the Regional Water Board should consider adopting a site-specific objective to protect consumption of fish under the CUL beneficial use.

[15] Terms in "all cap" font (excepting the beneficial use abbreviations) are defined in Attachment A (Glossary).

to TROPHIC LEVEL 4 fish, except with respect to the California least tern (as discussed in Chapter III.D.2.e). If the objective is measured using TROPHIC LEVEL 3 fish, protection of all wildlife species within the WILD and MAR beneficial uses is not ensured. Therefore, if TROPHIC LEVEL 3 fish are used, then the Prey Fish Water Quality Objective (as described in Chapter III.D.2.d) shall be used, but if the water body is habitat for California least tern, then the California Least Tern Prey Fish Objective (as described in Chapter III.D.2.e) shall be used. However, if the Sport Fish Water Quality Objective is exceeded when applied to TROPHIC LEVEL 3 fish, that is sufficient evidence to indicate that the Prey Fish Water Quality Objective or, if applicable, the California Least Tern Prey Fish Objective is also exceeded without having to measure the two latter objectives (see flow chart in Attachment B).

2) Sport Fish Water Quality Objective
The Sport Fish Water Quality Objective is: The average methylmercury concentrations shall not exceed 0.2 milligrams per kilogram (mg/kg) fish tissue within a calendar year. The water quality objective applies to the WET WEIGHT concentration in skinless fillet in TROPHIC LEVEL 3 or TROPHIC LEVEL 4 fish, whichever is the HIGHEST TROPHIC LEVEL FISH in the water body. Freshwater TROPHIC LEVEL 3 fish are between 150 to 500 millimeters (mm) in total length and TROPHIC LEVEL 4 fish are between 200 to 500 mm in total length, except for sizes specified in Attachment C, or as additionally limited in size in accordance with LEGAL SIZE LIMIT for the species caught. Estuarine fish shall be within the LEGAL SIZELIMIT and greater than 150 mm, or as otherwise specified in Attachment C.

b. Tribal Subsistence Fishing Water Quality Objective

1) Application of the Tribal Subsistence Fishing Water Quality Objective
The Tribal Subsistence Fishing Water Quality Objective applies to waters with the T-SUB beneficial use.

2) Tribal Subsistence Fishing Water Quality Objective
The Tribal Subsistence Fishing Water Quality Objective is: The average methylmercury concentrations shall not exceed 0.04 mg/kg fish tissue within a calendar year. The objective applies to the WET WEIGHT concentration in skinless fillet from a mixture of 70 percent TROPHIC LEVEL 3 fish and 30 percent TROPHIC LEVEL 4 fish as detailed in Attachment C.

c. Subsistence Fishing Water Quality Objective

1) Application of the Subsistence Fishing Water Quality Objective
The Subsistence Fishing Water Quality Objective applies to waters with the SUB beneficial use or to waters with the FISH beneficial use (see footnote 2).

2) Subsistence Fishing Water Quality Objective
The Subsistence Fishing Water Quality Objective is: Waters with the Subsistence Fishing (SUB) beneficial use shall be maintained free of mercury at concentrations which accumulate in fish and cause adverse biological, reproductive, or neurological effects. The fish consumption rate used to evaluate this objective shall be derived from water

body- and population-specific data and information on the subsistence fishers' rate and form (e.g. whole, fillet with skin, skinless fillet) of fish consumption.[16]

When a water quality control plan designates a water body or water body segment with the Subsistence Fishing (SUB) beneficial use, development of a region-wide or site-specific numeric fish tissue mercury water quality objective is recommended to account for the wide variation of consumption rate and fish species encompassed by the SUB beneficial use.

d. Prey Fish Water Quality Objective

1) Application of the Prey Fish Water Quality Objective

The Prey Fish Water Quality Objective applies to waters with the WILD and MAR beneficial uses. However, the objective does not apply to water body segments where the California Least Tern Prey Fish Water Quality Objective applies (see Chapter III.D.2.e).

2) Prey Fish Water Quality Objective

The Prey Fish Water Quality Objective is: The average methylmercury concentrations shall not exceed 0.05 mg/kg in WET WEIGHT whole fish tissue of any species between 50 to 150 mm in total length during the breeding season. The breeding season is February 1 through July 31, unless site-specific information indicates another appropriate breeding period.

e. California Least Tern Prey Fish Water Quality Objective

1) Application of the California Least Tern Prey Fish Water Quality Objective

The California Least Tern Prey Fish Water Quality Objective applies to water with the WILD, MAR, and RARE beneficial uses at water bodies where the least tern or least tern habitat exists, including but not limited to the water bodies identified in Attachment D.

2) California Least Tern Prey Fish Water Quality Objective

The California Least Tern Prey Fish Water Quality Objective is: The average methylmercury concentrations shall not exceed 0.03 mg/kg fish tissue from April 1 through August 31. The objective applies to the WET WEIGHT concentration in whole fish less than 50 mm total length.

[16] U.S. EPA recommended national subsistence fishing consumption rate of 142 grams per day (4 to 5 meals per week) shall be used to translate the narrative objective unless a site-specific numeric water quality objective is developed or an external peer-reviewed consumption study uses a different methodology to translate the narrative water quality objective.

Interaction of Mercury Water Quality Objectives with Basin Plans

The MERCURY WATER QUALITY OBJECTIVES do not supersede any site-specific numeric mercury water quality objectives established in a Basin Plan, except (i) the freshwater mercury water quality objective for chronic effects to aquatic life (0.025 µg/L) established in the San Francisco Bay Basin Water Quality Control Plan (Table 3-4, and corresponding note); and (ii) the total body burden of 0.5 µg/g wet weight established for the mercury water quality objective for aquatic organisms in the Water Quality Control Plan for the Central Coastal Basin (see note accompanying Table 3-5).

IV. IMPLEMENTATION OF WATER QUALITY OBJECTIVES

[*Proposed text to be added to Chapter IV (Implementation of Water Quality Objectives) of the ISWEBE Plan.*]

D. Mercury

2. General Applicability of the Mercury Implementation Provisions

The implementation provisions of Chapter IV.D shall be implemented through NPDES permits issued pursuant to section 402 of the Clean Water Act, water quality certifications issued pursuant to section 401 of the Clean Water Act, waste discharge requirements (WDRs), and waivers of WDRs, where any of the MERCURY WATER QUALITY OBJECTIVES apply. The implementation provisions pertaining to a particular beneficial use do not apply to dischargers that discharge to receiving waters for which a mercury or methylmercury total maximum daily load (TMDL) is established pertaining to the same beneficial use or uses.[17]

Municipal Wastewater and Industrial Discharges

a. Applicability

Chapter IV.D.2 applies to dischargers issued individual non-STORM WATER National Pollutant Discharge Elimination System (NPDES) permits. The PERMITTING AUTHORITY shall incorporate the following requirements, as applicable, into NPDES permits during every permit issuance or renewal.

b. Water Column Translations

Because the Mercury Water Quality Objectives (Chapter III.D) are fish tissue based and not water column based, fish tissue based water quality objectives were converted to water column values (denoted as “C”) to be used for reasonable potential analysis and development of effluent limitations. The applicable value of C that corresponds with the water body/beneficial

[17] Such “receiving waters” are those for which a mercury or methylmercury TMDL is approved and does not include upstream water bodies even if the TMDL contains waste load allocations for the dischargers to the upstream water bodies to be implemented as effluent limitations to achieve the downstream water quality standard. For such upstream dischargers, the implementation provisions of Chapter IV.D apply. In the case where both the TMDL and application of the procedure at Chapter IV.D.2.c requires an effluent limitation, then the more stringent requirement shall apply to the discharge.

use designations in Table 1 shall be used to determine a discharger's REASONABLE POTENTIAL and any applicable effluent limitation (see Chapter IV.D.2.c). The PERMITTING AUTHORITY shall use its best judgement to assign the most appropriate water body type (in Table 1) based on the receiving water's potential for methylation during the period of discharge(s). Alternatively, a site-specific water column concentration value for C can be developed as described in Chapter IV.D.2.b.1, below.

Table 1. Values for C (water column concentration) based on water-body type and beneficial use.

Beneficial Use of the Receiving Water	**COMM, CUL, WILD, MAR, RARE**	**COMM, CUL, WILD, MAR, RARE**	**COMM, CUL, T-SUB, WILD, MAR, RARE**	**T-SUB**	**T-SUB**	**SUB**
Water body type	Flowing water bodies (generally, rivers, creeks, and streams)	Slow moving water bodies (generally, lagoons and marshes)	Lakes and reservoirs	Flowing water bodies (generally, rivers, creeks, and streams)	Slow moving water bodies (generally, lagoons and marshes)	Any
Value for "C"	12 ng/L total mercury	4 ng/L total mercury	Case-by-case*	4 ng/L total mercury	1 ng/L total mercury	Case-by-case*

*The PERMITTING AUTHORITY shall calculate C from the water quality objective, and may use available data, including U.S. EPA's recommended national bioaccumulation factors and chemical translators.

1) <u>Site-Specific Water Column Translations</u>

The PERMITTING AUTHORITY may develop a site-specific water column concentration value (C) by utilizing a site-specific BIOACCUMULATION FACTOR, linear regression model, or peer-reviewed model, derived from a study of the receiving water downstream of the discharge. The study must, at a minimum, include data from three separate time points. Data collected at each time point must all be collected on the same day from within the same vicinity and must include a minimum of: 1) four total mercury water column samples, 2) four dissolved methylmercury water column samples, and 3) ten mercury fish tissue samples. The fish tissue samples shall be from TROPHIC LEVEL 4 FISH, but if TROPHIC LEVEL 4 FISH are not the HIGHEST TROPHIC LEVEL FISH in the water body, then the samples shall be from the size of fish that corresponds with the Prey Fish Water Quality Objective or California Least Tern Prey Fish Water Quality Objective, whichever is applicable (see Chapter III.D.2). The sampling time points shall be at least 90 days apart. If TROPHIC LEVEL 4 FISH are not the HIGHEST TROPHIC LEVEL FISH in the water body, then two of the sampling time points shall occur during the breeding season for the applicable water quality objective. A site-specific BIOACCUMULATION FACTOR shall be calculated as the mean methylmercury tissue concentration in one trophic level divided by the mean methylmercury concentration in water. Multiple bioaccumulation factors from different time points or different species shall be combined using a geometric mean. To derive water column concentration in the form of total mercury, a chemical translator must also be used to convert form methylmercury to total mercury.[18]

c. Determining Whether A Discharge Requires an Effluent Limitation for Mercury

1) Reasonable Potential Analysis

A PERMITING AUTHORITY is required to apply section 1.3 of the State Water Resources Control Board's Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (generally referred to as the SIP) (pages 5-8), to determine whether a discharge has REASONABLE POTENTIAL, in which case the permit must contain a water quality-based effluent limitation.

To determine REASONABLE POTENTIAL, the PERMITTING AUTHORITY shall apply Steps 1-8 of section 1.3 of the SIP, as modified by the following:

Step 1: Replace Step 1 of the SIP with the following: Identify the applicable water column concentration (C) for the lowest (most stringent) mercury water quality objective applicable to the receiving water in accordance with Chapter IV.D.2.b.

Step 3: Replace Step 3 of the SIP with the following: Determine the mercury concentration for the effluent using the highest observed annual average effluent mercury concentration. The annual average shall be calculated as an arithmetic mean. For any sample reported as below the detection limit, one half of the detection limit shall be used to calculate the arithmetic mean. For any sample reported as below the quantitation limit and above the detection limit, the estimated concentration shall be used to calculate the arithmetic mean. The annual average concentration is used to account for the long-term nature of the methylmercury bioaccumulation process, which may not otherwise be reflected using the maximum concentration as required by the SIP.

Step 4: Apply as set forth in the SIP, but utilize the annual average mercury concentration from Step 3 (rather than an MEC) to compare to the C from Step 1.

Step 5: Apply as set forth in the SIP, but replace the determination of the "maximum" ambient background concentration for mercury (denoted as B in the SIP), with the highest observed annual average ambient background. The annual average shall be calculated as an arithmetic mean as described in Section 1.4.3.2 of the SIP.

2) Calculation of the Effluent Limitations

If, upon the completion of applying the REASONABLE POTENTIAL analysis set forth in Chapter IV.D.2.c.1, a water quality based effluent limitation is required, then the

[18] See U.S. EPA, Water Quality Criteria for the Protection of Human Health: Methylmercury (EPA-823-R-01-001, Jan. 2001), app. A, pp. A-19 to A-25 (describes the chemical translators and provides national translators to convert form methylmercury to total mercury).

PERMITTING AUTHORITY shall calculate the effluent limitation by applying section 1.4 of the SIP.

If part B of section 1.4 of the SIP applies, the PERMITTING AUTHORITY shall apply Steps 1-7 contained in part B of the SIP as modified by the following:

Step 1: Replace Step 1 of the SIP with the following: Use the same value for C as used for the REASONABLE POTENTIAL analysis in Chapter IV.D.2.c.1, Step 1, rather than the applicable fish tissue mercury water quality objective. If data are insufficient to calculate the effluent limitation, the RWQCB shall establish interim requirements in accordance with section 2.2.2 of the SIP.

Step 2: Apply as set forth in the SIP, except the ambient background concentration (referred to as B in the SIP) shall be calculated as an arithmetic mean as described in Section 1.4.3.2 of the SIP. Dilution shall be prohibited if the mercury concentration in fish tissue from fish in the receiving water exceeds the applicable MERCURY WATER QUALITY OBJECTIVES.

Steps 3-5: Skip Steps 3-5.

Step 6: Apply as set forth in the SIP but set the effluent limitation as an annual average of total mercury (rather than a monthly average) equal to the effluent concentration allowance (ECA) (from Step 2).

Step 7: Skip Step 7.

Methods, Routine Monitoring, and Compliance Schedules

1) Methods. For monitoring total mercury in effluent, the discharger shall use any U.S. EPA-approved method that has a quantitation limit lower than the effluent limitation. For monitoring receiving water, the discharger shall use any U.S. EPA-approved method that has a quantitation limit lower than 0.5 ng/L for total mercury, and lower than 0.06 ng/L for methylmercury.
2) Routine Monitoring. The following are the minimum monitoring requirements for dischargers assigned an effluent limitation, but the PERMITTING AUTHORITY may require dischargers to conduct additional monitoring. The rationale for requiring additional mercury monitoring must be documented in the NPDES fact sheet or equivalent document.
    i. Dischargers with mercury effluent limitations that are authorized to discharge at a rate equal to or greater than five million gallons per day are required to conduct routine total mercury monitoring in the effluent at a frequency no less than once each CALENDAR QUARTER for the duration of the permit.
    ii. Dischargers with mercury effluent limitations that are authorized to discharge at a rate less than five million gallons per day are required to conduct routine total mercury monitoring in the effluent at a frequency no less than once each year for the duration of the permit.
    iii. Dischargers without mercury effluent limitations are required to conduct total mercury monitoring in the effluent at a frequency of no less than once per permit cycle.

3) Compliance Determination. The annual average mercury concentration in the effluent shall be calculated as an arithmetic mean. For any sample reported as below the detection limit, one half of the detection limit shall be used to calculate the arithmetic mean. For any sample reported as below the quantitation limit and above the detection limit, the estimated concentration shall be used to calculate the arithmetic mean.
4) Compliance Schedule. The PERMITTING AUTHORITY may include a compliance schedule in NPDES permits to achieve the mercury effluent limitation in accordance with the Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits (State Water Board Resolution No. 2008-0025).

Exceptions to the Reasonable Potential Analysis

1) Small Disadvantaged Communities. The PERMITTING AUTHORITY is authorized to exempt POTWs only serving SMALL DISADVANTAGED COMMUNITIES from some or all of the provisions of Chapter IV.D.2.c if the PERMITTING AUTHORITY makes a finding that the discharge will have no REASONABLE POTENTIAL with respect the applicable MERCURY WATER QUALITY OBJECTIVES. For POTWs only serving SMALL DISADVANTAGED COMMUNITIES that do not have an effluent discharge prior to permit issuance or renewal that is representative of the quality of the proposed discharge, the PERMITTING AUTHORITY is authorized to make this determination and exempt the POTW only after the first year of effluent discharge.
   If exempt, the PERMITTING AUTHORITY shall have the discretion to assign routine monitoring as necessary. Routine monitoring schedules for POTWs only serving SMALL DISADVANTAGED COMMUNITIES shall not exceed the applicable frequency specified in Chapter IV.D.2.d.2 for the discharger's authorized rate of discharge.

2) Insignificant Discharges. The PERMITTING AUTHORITY is authorized to exempt certain dischargers from some or all of the provisions of Chapter IV.D.2 if the PERMITTING AUTHORITY makes a finding that the discharge will have no REASONABLE POTENTIAL with respect to the applicable MERCURY WATER QUALITY OBJECTIVES.
   If exempt, the PERMITTING AUTHORITY shall have the discretion to assign routine monitoring as necessary. Routine monitoring schedules for INSIGNIFICANT DISCHARGES shall not exceed the applicable frequency specified in Chapter IV.D.2.d.2 for the discharger's authorized rate of discharge.

Storm Water Discharges

d. Applicability

Chapter IV.D.3 applies to storm water dischargers regulated under general and individual NPDES STORM WATER permits issued pursuant to Clean Water Act section 402, subsection (p). The PERMITTING AUTHORITY shall include the requirements in Chapter IV.D.3.b in individual and general NPDES STORM WATER permits when adopting or re-issuing the permits.

e. Municipal Separate Storm Sewer Systems

1) Phase I and Phase II MUNICIPAL SEPARATE STORM SEWER SYSTEMS (MS4s) permits shall include a combination of the following mercury pollution prevention and pollution control measures to reduce total mercury or methylmercury discharges:[19] All of the following control measures are required, except, at the discretion of the PERMITTING AUTHORITY, additional measure(s) may be substituted for one or more measures if the substituted measure(s) would provide an equivalent level of control or prevent total mercury or methylmercury pollution. If the PERMITTING AUTHORITY substitutes other measures, the justification shall be documented in the permit fact sheet or equivalent document. The effort involved in each of the required measures shall be proportional to the size and population of the MS4.
   i. Thermometer exchange programs and fluorescent lamp recycling programs, or enhancement of household hazardous waste collection programs to better address mercury-containing waste products (potentially including thermometers and other gauges, batteries, fluorescent and other lamps, switches, relays, sensors and thermostats).
   ii. Public education and outreach on disposal of household mercury-containing products and use of non-mercury containing alternatives.
   iii. Education of auto dismantlers on how to remove, store, and dispose of mercury switches in autos.
   iv. Survey of use, handling, and disposal of mercury-containing products used by the MS4 discharger agencies and development of a policy and time schedule for eliminating the use of mercury containing products by the discharger.
2) The PERMITTING AUTHORITY may include best management practices to control erosion in MS4 permits. However, the MS4 permit shall contain best management practices for AREAS WITH ELEVATED MERCURY CONCENTRATIONS.

f. Industrial Activities

Upon reissuance, the State Water Board shall revise the existing Numeric Action Level (NAL) for total mercury in the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities (Industrial General Permit) from 1400 ng/L to 300 ng/L or lower.

Mine Site Remediation

The PERMITTING AUTHORITY shall require dischargers to implement erosion and sediment control measures to prevent or control mercury in discharges when adopting, re-issuing, or modifying WDRs or waivers of WDRs for dischargers subject to the requirements of Title 27 of the California Code of Regulations, section 22510 (closure and post-closure of mining sites), from land where mercury was mined or mercury was used during ore processing.

Nonpoint Source Discharges

The PERMITTING AUTHORITY has discretion under existing law to require dischargers to implement erosion and sediment control measures in WDRs or waivers of WDRs, and should

[19] On the effective date of the MERCURY WATER QUALITY OBJECTIVES, the Phase I and Phase II MS4 permits require pollution prevention and control measures (but not explicitly for mercury), which already may encompass one or more actions identified in Chapter IV.D.3.b.

consider requiring such measures in AREAS WITH ELEVATED MERCURY CONCENTRATIONS when adopting, re-issuing, or modifying a WDRs or waiver of WDRs.

Dredging Activities

The PERMITTING AUTHORITY has discretion under existing law to require dischargers to implement total mercury monitoring and procedures to control the disturbance and discharge of mercury-contaminated material during dredging and disposal of dredged material, and should consider requiring such measures in AREAS WITH ELEVATED MERCURY CONCENTRATIONS when adopting, re-issuing, or modifying a water quality certification, WDRs, or waiver of WDRs.

Wetland Projects

The PERMITTING AUTHORITY has discretion under existing law to require project applicants that establish (create) or restore wetlands to include design features or management measures to reduce the production of methylmercury in the wetland, including minimizing the wetting and drying of soil by keeping the wetland flooded and sediment control measures to reduce the transport of total mercury or methylmercury out of the wetland, and should consider requiring such measures in AREAS WITH ELEVATED MERCURY CONCENTRATIONS, when adopting, re-issuing, or modifying water quality certifications, WDRs, or waivers of WDRs.

3. Attachment A. Glossary

AREAS WITH ELEVATED MERCURY CONCENTRATIONS: Areas with elevated mercury concentrations include the following areas:

1) Areas located in the Coast Range mountains with naturally mercury-enriched soil or sediments with total mercury concentrations of 1 mg/kg or higher;
2) Areas located in an industrial area with soil or sediments with total mercury concentrations of 1 mg/kg or higher;
3) Areas located within historic mercury, silver, or gold mine tailings;
4) Areas located within historic hydraulic gold mining pits in the Sierra Nevada mountain range.
5) Any other area(s) determined by the PERMITTING AUTHORITY in the applicable order.

BIOACCUMULATION: A process in which an organism's body burden of a pollutant exceeds that of its surrounding environment as a result of chemical uptake through all routes of chemical exposure: dietary and dermal absorption and transport across the respiratory surface.

BIOACCUMULATION FACTOR: The ratio of the concentration of a contaminant in the tissue of the organism to the concentration of the contaminant in the surrounding ambient water (see BIOACCUMULATION). A bioaccumulation factor (BAF) can be used to estimate the concentration of the chemical in water (C_{water}) that corresponds to concentration of chemical in fish tissue (C_{tissue}) using the following equation:

$$\mathrm{BAF} = \frac{C_{tissue}}{C_{water}}$$

CALENDAR QUARTER: A period of time defined as three successive calendar months.

CALIFORNIA NATIVE AMERICAN TRIBE: A federally-recognized California tribal government listed on the most recent notice of the Federal Register or a non-federally recognized California tribal government on the California Tribal Consultation List maintained by the California Native American Heritage Commission.

HIGHEST TROPHIC LEVEL FISH: Either TROPHIC LEVEL 3 or TROPHIC LEVEL 4 fish, whichever is the highest trophic level in the water body that is caught during monitoring, assessment, or other studies, that meet applicable quality assurance requirements.

INSIGNIFICANT DISCHARGES: NPDES discharges that are determined to be a very low threat to water quality by the PERMITTING AUTHORITY.

LEGAL SIZE LIMIT: The size limits of fish species for recreational fishing, established by title 14, California Code of Regulations sections 5.00 through 5.95.

LIFEWAYS: Any customs, practices, or art of a CALIFORNIA NATIVE AMERICAN TRIBE.

MERCURY WATER QUALITY OBJECTIVES: The fish tissue mercury water quality objectives set forth in Chapter III.D.2.

MERCURY PROVISIONS: The MERCURY WATER QUALITY OBJECTIVES and the implementation of those water quality objectives contained in Chapters III and IV, respectively.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4s): Same meaning as set forth in 40 Code of Federal Regulations, section 122.26(b)(8).

PERMITTING AUTHORITY: The State Water Board or Regional Water Board, whichever issues the permit or water quality certification.

PUBLICLY OWNED TREATMENT WORKS (POTWs): Facilities owned by a state or municipality that store, treat, recycle, and reclaim municipal sewage or industrial wastes of a liquid nature.

REASONABLE POTENTIAL: A designation used for a waste discharge that is projected or calculated to cause or contribute to an excursion above a water quality standard.

SMALL DISADVANTAGED COMMUNITIES: Municipalities with populations of 20,000 persons or less, or a reasonably isolated and divisible segment of a larger municipality encompassing 20,000 persons or less, with an annual median household income that is less than 80 percent of the statewide annual median household income.

STORM WATER: Same meaning as set forth in 40 Code of Federal Regulations section 122.26(b)(13).

TROPHIC LEVEL 3 FISH (TL3): Fish that consume mainly zooplankton, benthic invertebrates, and small, phytoplankton-dependent fish. Species include rainbow and brook trout, blue gill, sunfishes, suckers, and bullhead. Examples are shown in Attachment C.

TROPHIC LEVEL 4 FISH (TL4): Fish that consume TROPHIC LEVEL 3 fish and other aquatic organisms. Species include largemouth, smallmouth, spotted, and striped bass; brown and lake trout; catfish, and Sacramento pikeminnow. Examples are shown in Attachment C.

WET WEIGHT*:* Wet weight is part of the format for expressing the concentration of methylmercury in fish tissue. The mercury water quality objectives are expressed as a mass of methylmercury per mass of fresh or “wet” fish tissue. Concentrations expressed as methylmercury in dry weight of fish are not equivalent and must be converted to concentration on a wet weight basis if being compared with the objectives and targets.

4. Attachment B. Mercury Prey Fish Decision Diagram

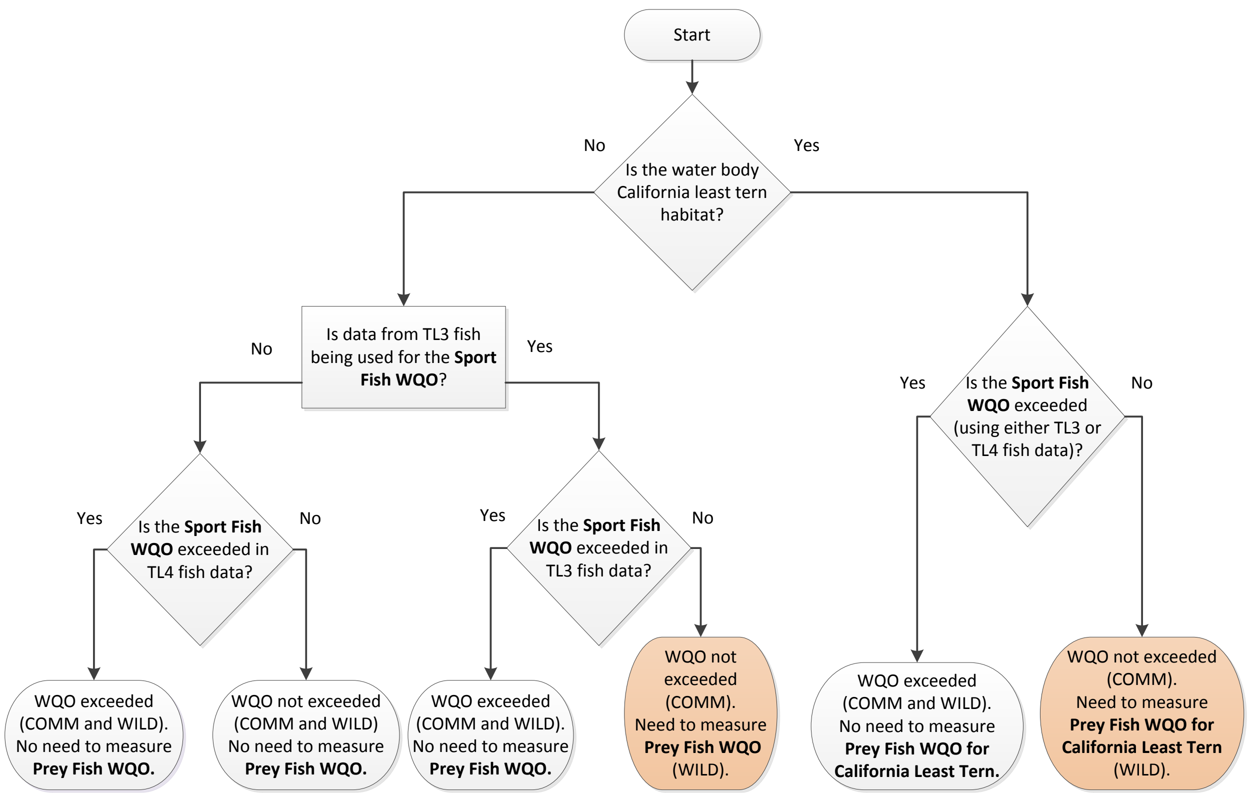


Figure B-1. Determining the need for application of mercury prey fish water quality objectives.

In some water bodies, the Sport Fish Water Quality Objective will not be sufficient to ensure wildlife beneficial uses are protected and one of the prey fish objectives needs to be measured (orange ovals, see also Chapter III.D.2.a.1). This decision depends on whether data from TROPHIC LEVEL 3 (TL3) or TROPHIC LEVEL 4 (TL4) fish are used and other factors as shown in the diagram. The wildlife-related beneficial uses are noted as WILD (Wildlife Habitat) in this diagram, but the applicable use may be Marine Habitat (MAR) or others. The Sport Fish Water Quality Objective protects beneficial use of Commercial and Sport Fishing (COMM) as well as Tribal Tradition and Culture (CUL) and wildlife beneficial uses. See Chapter III.D.2 for full details.

5. Attachment C. Fish Trophic Level Classifications

Table C-1 and Table C-2 show trophic level classifications for common species and sizes for comparison with the Sport Fish Water Quality Objective, the Tribal Subsistence Fishing Water Quality Objective, and the Subsistence Fishing Water Quality Objective. These tables do not include all possible species.

Table C-1. Freshwater trophic level classifications

Freshwater Fish Trophic Levels	
TROPHIC LEVEL 4 **Unless other size is noted, fish must be within the LEGAL SIZE LIMIT and 200 to 500 mm total length**	**TROPHIC LEVEL 3** **Unless other size is noted, fish must be within the LEGAL SIZE LIMIT and 150 to 500 mm total length**
Black Crappie	Black Bullhead
Brown Trout	Bluegill
Channel Catfish	Brook trout
Lake Trout	Brown Bullhead
Largemouth Bass	Chinook salmon*
Sacramento Pikeminnow	Common Carp
Smallmouth Bass	Crayfish (> 30 mm)
Spotted Bass	Kokanee
Striped Bass	Pumpkinseed
White Catfish	Rainbow Trout
White sturgeon*	Redear Sunfish
	Sacramento Sucker
	Tule Perch
*Acceptable if longer than 500 mm, as long as within the LEGAL SIZE LIMIT	

Table C-2. Marine and estuarine trophic level classifications

Marine/Estuarine Fish Trophic Levels	
TROPHIC LEVEL 4 **Unless size is noted, fish must be within the LEGAL SIZE LIMIT longer than 150 mm total length**	**TROPHIC LEVEL 3** **Unless size is noted, fish must be within the LEGAL SIZE LIMIT and longer than 150 mm total length**
Barred Sand Bass*	Black Perch
Gopher Rockfish*, and various other rockfish*, except Blue Rockfish	Blue Rockfish*
Kelp Bass*	Chub Mackerel
Leopard Shark	Opaleye
Spotted Sand Bass*	Pile Perch
Striped Bass	Rainbow Surfperch
Yellowfin Croaker*	Striped Mullet
	Shiner Surfperch
*Basses (Serranidae), Rockfish (Sebastidae), and Croaker (Sciaenidae) shall be within the LEGAL SIZE LIMIT and 150 to 500 mm total length for comparison with Sport Fish Water Quality Objective	

6. Attachment D. Waters Protected by the Mercury California Least Tern Prey Fish Water Quality Objective

Table B-1. Applicable waters for the California Least Tern Prey Fish Water Quality Objective

RB*	MA**	County	U.S. FWS Site Name	Applicable Inland Surfaces Waters, Enclosed Bays and Estuaries
2	A	Alameda	Alameda Naval Air Station	A water quality objective that is protective of California least tern has already been adopted for Lower San Francisco Bay
		Alameda	Alvarado Salt Ponds	
		Alameda	Oakland Airport	
		San Mateo	Bair Island	Bair Island Marsh
3	B	San Luis Obispo	Pismo Beach	Pismo Creek Estuary, Pismo Creek, Arroyo Grande Estuary, Arroyo Grande Creek, downstream (Oceano Lagoon, Meadow Creek, Pismo Marsh (Lake), Los Berros Creek), Big Pocket Lakes (Dune Lakes)
		San Luis Obispo	Oso Flaco Lake	Oso Flaco Lake, Oso Flaco Creek
3	C	Santa Barbara	Santa Maria River	Santa Maria Estuary, Santa Maria River (except Corralitos Canyon Creek, Sisquoc River, downstream), Orcutt Creek
3	D	Santa Barbara	San Antonio Creek	San Antonio Creek, San Antonio Creek Estuary
		Santa Barbara	Purisima Point (North, South)	None (only ocean waters)
		Santa Barbara	Santa Ynez River	Santa Ynez River Estuary, Santa Ynez River, downstream
4	E	Ventura	Santa Clara River	Santa Clara River Estuary, Santa Clara River Reach 1,
4	F	Ventura	Ormond Beach	Ormond Beach Wetlands
		Ventura	Mugu Lagoon	Calleguags Creek Reach 1 (also called Mugu Lagoon)
4	G	Los Angeles	Venice Beach	Ballona lagoon, Marina Del Rey (except Harbor),
		Los Angeles	Playa del Rey	Ballona Wetlands, Ballona Creek Estuary
4	H	Los Angeles	Terminal Island	Los Angeles/Long Beach Inner Harbor, Los Angeles/Long Beach Outer Harbor
		Los Angeles	San Gabriel River	Alamitos Bay: Los Cerritos Wetlands, San Gabriel Estuary, Los Cerritos Channel Estuary, Long Beach Marina
4	I	Los Angeles	Cerritos Lagoon	
		Los Angeles	Costa Del Sol	
8	J	Orange	Anaheim Bay	Anaheim Bay
		Orange	Surfside Beach	Anaheim Bay
8	K	Orange	Bolsa Chica (North, South)	Bolsa Bay, Bolsa Chica Ecological Reserve
8	L	Orange	Huntington Beach	Santa Ana River Salt Marsh, Tidal Prism of Santa Ana River (to within 1000' of Victoria Street) and Newport Slough
8	M	Orange	Upper Newport Bay	Upper Newport Bay

Table B-1. Applicable waters for the California Least Tern Prey Fish Water Quality Objective

RB*	MA**	County	U.S. FWS Site Name	Applicable Inland Surfaces Waters, Enclosed Bays and Estuaries
9	N	San Diego	San Mateo Creek	San Mateo Creek Mouth
		San Diego	Aliso Creek	Aliso Canyon (in San Onofre Creek Watershed. Not in Orange County)
		San Diego	Santa Margarita River	Santa Margarita Lagoon
9	O	San Diego	Buena Vista Lagoon	Buena Vista Creek
9	P	San Diego	Agua Hedionda Lagoon	Agua Hedionda Lagoon
9	Q	San Diego	Batiquitos Lagoon	Batiquitos Lagoon
9	R	San Diego	San Elijo Lagoon	San Elijo Lagoon
9	S	San Diego	San Dieguito Lagoon	San Dieguito Lagoon
		San Diego	Whispering Palms Encinitas	None (no longer suitable habitat)
9	T	San Diego	Los Penasquitos Lagoon	Los Penasquitos Lagoon
9	U	San Diego	FAA Island	Mission Bay
		San Diego	North Fiesta Island	Mission Bay
		San Diego	Stony Point	Mission Bay
		San Diego	South Sea World Drive	Mission Bay, San Diego River Estuary
		San Diego	Clover Leaf	Mission Bay, San Diego River Estuary
9	V	San Diego	Naval Training Center	San Diego Bay
		San Diego	San Diego Int. Airport	San Diego Bay
		San Diego	Chula Vista Wildlife Reserve	San Diego Bay
		San Diego	Sweetwater River	Sweetwater River, Hydrologic Unit Basin Number 9.21, San Diego Bay
		San Diego	North Island	San Diego Bay
		San Diego	Delta Beach	San Diego Bay
		San Diego	Coronado Cays	San Diego Bay
		San Diego	Saltworks	San Diego Bay
9	W	San Diego	Tijuana River Mouth	Tijuana River Estuary

* Regional Water Quality Control Board
**US FWS California least tern coastal management areas (US FWS 2006).

Appendix B. Abbreviations and Definitions

List of Abbreviations Used in the Staff Report

AB	Assembly Bill
ARB	California Air Resources Board
ATLs	Advisory Tissue Levels
BAF	bioaccumulation factor
Basin Plan	Regional Water Quality Control Plan
BCF	bioconcentration factor
BLM	Bureau of Land Management
BMPs	best management practices
BOG	Bioaccumulation Oversight Group
BW	body weight
C.F.R.	Code of Federal Regulations
Cal. Code of Regs.	California Code of Regulations
CALFED	California and Federal Bay-Delta Program
California tribes	California Native American tribes
Caltrans	California Department of Transportation
Caltrans Permit	Statewide Storm Water Permit Waste Discharge Requirements for State of California Department of Transportation
CAMLAG	California Abandoned Mine Lands Agency Group
CCCPWD	Contra Costa County Public Works Department
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CEDEN	California Environmental Data Exchange Network
CEQA	California Environmental Quality Act
CGP	Construction General Permit, also known as the General Permit for Discharges of Storm Water Associated with Construction Activity.
CIWQS	California Integrated Water Quality System database
CSFII	Continuing Survey of Food Intakes by Individuals
CWA	Clean Water Act
CTR	California Toxics Rule
dB	decibels
dBA	A-weighted decibels
DNQ	detected not quantified
DTSC	Department of Toxic Substance Control
DWQ	Division of Water Quality
ECHO	Enforcement and Compliance History Online database
EIR	Environmental Impact Report
ELAP	Environmental Laboratory Accreditation Program
eSMR	electronic Self-Monitoring Reports
FCG	fish contaminant goal

FCM	food chain multipliers
FI	fish intake rate for human fish consumption
FTC	fish tissue concentration
Hg	mercury
IGP	Industrial General Permit, also known as the Statewide General Permit for Storm Water Discharges Associated with Industrial Activities
Impaired Water Bodies	Water Bodies on the 303(d) List
ISWEBE	The Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries
LA	Load Allocation
LID	Low Impact Development
Lmax	maximum noise emission levels
LOAEL	lowest observed adverse effect level
LTMS	long term management strategy
MATS	Mercury and Air Toxic Standards
MCL	maximum contaminant level
MDL	minimum detect limit
MeHg	methylmercury
MS4	municipal separate storm sewer system
NAL	Numeric Action Level
ND	non-detect
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
OAL	Office of Administrative Law
ODEQ	Oregon Department of Environmental Quality
OEHHA	Office of Environmental Health Hazard Assessment
PCBs	polychlorinated biphenyls
POTW	publicly owned treatment works
ppm	parts per million
Pub. Resources Code	Public Resources Code
Regional Water Board	Regional Water Quality Control Board or Board
RfD	reference dose
RMPs	regional monitoring programs
RSC	relative source contribution
SAIC	Science Applications International Corporations
SB	Senate Bill
SED	Substitute Environmental Documentation
SFEI	San Francisco Estuary Institute
SIP	Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Implementation Policy)
SMARA	Surface Mining and Reclamation Act
SMARTS	Storm Water Multiple Application and Report Tracking System

State Water Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program
SWMPs	Storm Water Management Plans
SWPPP	Storm Water Pollution Prevention Plan
TL	trophic level
TLR	trophic level ratios
TMDL	Total Maximum Daily Load
TTWQ	Threat to Water Quality
U.S. EPA	United States Environmental Protection Agency
U.S.C	United States Code
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VdB	vibration decibels
Wat. Code	California Water Code
Water Boards	the State Water Resources Control Board and the Regional Water Quality Control Boards
WDR	Waste Discharge Requirements
Wetlands Policy	Procedures for Discharges of Dredged or Fill Materials to Waters of the State
WLA	Waste Load Allocation

Scientific Unit Abbreviations Used in the Staff Report

cm	centimeter
fww	fresh wet weight
g/day	grams per day
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
MGD	million gallons per day
mm	millimeter
ng/L	nanograms per liter
µg/g	micrograms per gram
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µPa	micropascals

Beneficial Use Abbreviations Used in the Staff Report

AGR	Agricultural supply
AQUA	Aquaculture
ASBS	Preservation of Areas of Special Biological Significance
BIOL	Preservation of Biological Habitats of Special Significance

COLD	Cold Freshwater Habitat
COMM	Commercial and Sport Fishing
CUL	Tribal Traditional and Culture
EST	Estuarine Habitat
FISH	Subsistence Fishing
FLD	Flood Peak Attenuation/Flood Water Storage
FRSH	Fresh Water Replenishment
GWR	Groundwater Recharge
IND	Industrial Service Supply
LWRM	Limited Warm Freshwater Habitat
LREC-1	Limited Water Contact Recreation
MAR	Marine Habitat
MIGR	Migration of Aquatic Organisms
MUN	Municipal and Domestic Supply
NAV	Navigation
POW	Hydropower Generation
PROC	Industrial Process Supply
RARE	Rare, Threatened, or Endangered Species
REC 1	Water Contact Recreation
REC 2	Non-Contact Water Recreation
SAL	Inland Saline Water Habitat
SAL	Saline Water Habitat
SHELL	Shellfish Harvesting
SPWN	Spawning, Reproduction, and/or Early Development
SUB	Subsistence Fishing
T-SUB	California Native American Tribal Subsistence Fishing
WARM	Warm Freshwater Habitat
WET	Wetland
WILD	Wildlife Habitat
WQE	Water Quality Enhancement

Definitions

Areas with elevated mercury concentrations: There are five definitions for this term:

6) Areas located in the Coast Range mountains with naturally mercury-enriched soil or sediments with total mercury concentrations of 1 mg/kg or higher;
7) Areas located in an industrial area with soil or sediments with total mercury concentrations of 1 mg/kg or higher;
8) Areas located within historic mercury, silver, or gold mine tailings;
9) Areas located within historic hydraulic gold mining pits in the Sierra Nevada mountain range; or

10) Any other area(s) as determined by the Water Boards in the applicable order.

Bioaccumulation: A process in which an organism's body burden of a pollutant exceeds that of its surrounding environment as a result of chemical uptake through all routes of chemical exposure: dietary and dermal absorption and transport across the respiratory surface. This process takes place when the rate of intake of a substance is greater than the rate of excretion or metabolic transformation of the substance. This process leads to increasing concentrations of the contaminant in successive levels of the food chain, and the highest concentrations of the contaminant in the organisms highest on the food chain.

Bioaccumulation factor (BAF): The ratio of the concentration of a contaminant in the tissue of the organism to the concentration of the contaminant in the surrounding ambient water. BAFs are trophic-level-specific. A BAF can be used to estimate the concentration of the chemical in water (C_{water}) that corresponds to concentration of chemical in fish tissue (C_{tissue}) using the following equation:

$$\text{BAF} = \frac{C_{tissue}}{C_{water}}$$

Calendar Quarter: A period of time defined as three successive calendar months.

California Native American Tribe (California Tribe): A federally-recognized California tribal government listed on the most recent notice of the Federal Register or a non-federally recognized California tribal government on the California Tribal Consultation List maintained by the California Native American Heritage Commission.

Dissolved mercury (or filtered mercury): The portion of mercury that passes through a filter. Often the filter has an average pore size of 0.45 µm.

Dissolved methylmercury (or filtered methylmercury): The portion of methylmercury which passes through a filter. Often the filter has an average pore size of 0.45 um.

Dry weight: The weight of a caught fish after the fish has desiccated (dried out). Dry weight does not include water that may have been in the fish's body when caught. Concentrations expressed as methylmercury in dry weight of fish are not equivalent and must be converted to concentration on a wet weight basis if being compared with the objectives and targets.

Fresh wet weight or wet weight (fww): In general, the weight of a caught fish when measured immediately after the fish has been caught and has not been allowed to dry. Fresh wet weight includes weight from water in the fish's body. For the purposes of the proposed Provisions, wet weight is defined as part of the format for expressing the concentration of methylmercury in fish tissue. The mercury water quality objectives are expressed as a mass of methylmercury per mass of fresh or "wet" fish tissue. Concentrations expressed as methylmercury in dry weight of fish are not equivalent and must be converted to concentration on a wet weight basis if being compared with the objectives and targets.

Highest Trophic Level Fish: Either trophic level (TL) 3 or trophic level (TL) 4 fish, whichever is the highest trophic level in the water body that is caught during monitoring, assessment, or other studies, that meet applicable quality assurance requirements.

Inorganic mercury: Forms of mercury including elemental mercury and mercury salts and complexes, such as mercury chloride and mercury sulfide (cinnabar). Inorganic forms of mercury are less of a concern for toxicity than organic forms, such as methylmercury. However, inorganic mercury can be transformed into methylmercury in the natural environment.

Insignificant Discharges: NPDES discharges that are determined to be a very low threat to water quality by the Water Boards.

Lifeways: Any customs, practices, or art of a California Native American Tribe.

Mercury (or total mercury, Hg): All forms of mercury, including methylmercury, other organic forms, inorganic, and elemental mercury, including both the dissolved and non-dissolved forms. All of these forms of mercury are toxic. Both inorganic and elemental mercury can be methylated in the environment to form methylmercury.

Mercury Water Quality Objectives: The fish tissue mercury water quality objectives that are set forth in Appendix A, Chapter III.D.2.

Methylmercury (MeHg): An organic form of mercury that bioaccumulates in the food chain. It is the form most readily incorporated into biological tissues, and it is much more toxic to humans and wildlife than inorganic mercury. (Other organic forms of mercury exist, but exposure to them through environmental pathways is not significant.)

Municipal Separate Storm Sewer Systems (MS4s): In general, a sewer system owned or operated by a state or local government to convey and control storm water. MS4s are regulated by specific NPDES permits. The legal definition of an MS4 is set forth in 40 Code of Federal Regulations, section 122.26(b)(8).

Organic Mercury: Mercury compounds that contain carbon and hydrogen. This includes methylmercury, the most toxic form.

Provisions: The beneficial uses, the Mercury Water Quality Objectives, and the implementation of those water quality objectives as set forth in Appendix A, Chapters II, III and IV , respectively.

Publically Owned Treatment Works (POTWs): Facilities owned by a state or municipality that store, treat, recycle, and reclaim municipal sewage or industrial wastes of a liquid nature.

Reasonable Potential: A designation used for a waste discharge that is projected or calculated to cause or contribute to an excursion above a water quality standard.

Small disadvantaged communities: Municipalities with populations of 20,000 persons or less, or a reasonably isolated and divisible segment of a larger municipality encompassing 20,000 persons or less, with an annual median household income that is less than 80 percent of the statewide annual median household income.

Total methylmercury: Dissolved methyl mercury and non-dissolved methylmercury.

Trophic Level (TL): A hierarchical level in a food chain. The food chain represents a succession of organisms that eat other organisms and are, in turn, eaten themselves. The chain starts at trophic level 1 with primary producers and culminates with apex predators at trophic level 4 or 5, depending on the length of the food chain in the particular environment.

Trophic Level 1 Organisms (TL1): Organisms at the base of the aquatic food chain, primary producers, such as phytoplankton and bacteria.

Trophic Level 2 Organisms (TL2): Organisms such as zooplankton, benthic invertebrates and some small fish that consume primary producers or TL1 organisms.

Trophic Level 3 Fish (TL3): Fish that consume mainly zooplankton, benthic invertebrates, and small, phytoplankton-dependent fish. Species include rainbow and brook trout, blue gill, sunfishes, suckers, and bullhead. .

Trophic Level 4 Fish (TL4): Fish that consume TROPHIC LEVEL 3 fish and other aquatic organisms. Species include largemouth, smallmouth, spotted, and striped bass; brown and lake trout; catfish, and Sacramento pikeminnow.

Waste Discharge Requirement (WDR): Regulations pertaining to various categories of discharges to State waters. A WDR is equivalent to the term “permit” as defined in the Federal Water Pollution Control Act.

Appendix C. List of Waters Impaired by Mercury

California water bodies that have been placed on the Clean Water Act Section 303(d) list due to mercury levels that exceed water quality standards are presented in Table C-1. Water bodies on the 303(d) list are also referred to as "impaired" waters. Waters that are impaired may require the development of a Total Maximum Daily Load (TMDL), and existing TMDLs for mercury are also listed by water body. This information is available from:
http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml.

Table C-1. Waters on the 2012 303(d) List Due to Mercury

REGION*	WATER BODY NAME	TMDL**
1	Copco Lake	-
1	Dead Lake	-
1	Eel River Hydrologic Unit, Upper Main Hydrological Area, Lake Pillsbury Hydrological Sub Area, Lake Pillsbury	-
1	Iron Gate Reservoir	-
1	Klamath River Hydrologic Unit, Lost River Hydrologic Area, Tule Lake and Mt Dome HSAs	-
1	Russian River Hydrologic Unit, Middle Russian River HA, Laguna HSA, mainstem Laguna de Santa Rosa	-
	Russian River Hydrologic Unit, Middle Russian River HA, Santa Rosa HSA, tributaries to Santa Rosa Creek	-
1	Russian River Hydrologic Unit, Middle Russian River Hydrologic Area, Warm Springs HSA, Lake Sonoma [Reservoir]	-
1	Russian River Hydrologic Unit, Upper Russian River Hydrologic Area, Coyote Valley Hydrological Sub Area, Lake Mendocino [Reservoir]	-
1	Ruth Lake	-
1	Shastina, Lake	-
1	Trinity Lake (was Claire Engle Lake)	-
1	Trinity River Hydrologic Unit, Upper Hydrologic Area, Trinity River, East Fork	-
2	Alamitos Creek	Yes
2	Almaden Lake	Yes
2	Almaden Reservoir	Yes
2	Anderson Reservoir	-
2	Bon Tempe Reservoir	-
2	Calaveras Reservoir	-
2	Calero Reservoir	Yes
2	Carquinez Strait	Yes
2	Castro Cove, Richmond (San Pablo Basin)	Other
2	Central Basin, San Francisco (part of SF Bay, Lower)	Yes
2	Del Valle Reservoir	-
2	Guadalupe Creek	Yes
2	Guadalupe Reservoir	Yes
2	Guadalupe River	Yes
2	Lafayette Reservoir	-
2	Lake Chabot (Alameda Co)	-
2	Lake Herman	-
2	Mission Creek	-
2	Nicasio Reservoir	-
2	Oakland Inner Harbor (Fruitvale Site, part of SF Bay, Lower)	Yes

Table C-1. Waters on the 2012 303(d) List Due to Mercury

REGION*	WATER BODY NAME	TMDL**
2	Oakland Inner Harbor (Pacific Dry-dock Yard 1 Site, part of SF Bay, Lower)	Yes
2	Pacific Ocean at Pillar Point	-
2	Richardson Bay	Yes
2	Sacramento San Joaquin Delta	Yes
2	San Francisco Bay, Central	Yes
2	San Francisco Bay, Lower	Yes
2	San Francisco Bay, South	Yes
2	San Leandro Bay (part of San Francisco Bay, Lower)	Yes
2	San Pablo Bay	Yes
2	San Pablo Reservoir	-
2	Shadow Cliffs Reservoir	-
2	Soulajule Reservoir	Yes
2	Stege Marsh	Yes
2	Stevens Creek Reservoir	-
2	Suisun Bay	Yes
2	Suisun Marsh Wetlands	-
2	Tomales Bay	Yes
2	Walker Creek	Yes
3	Chesbro Reservoir	-
3	Clear Creek (San Benito County)	Yes
3	Hernandez Reservoir	Yes
3	Nacimiento Reservoir	Other
3	San Antonio Reservoir	-
3	Uvas Reservoir	-
4	Calleguas Creek Reach 1 (was Mugu Lagoon on 1998 303(d) list)	Yes
4	Casitas, Lake	-
4	Castaic Lake	-
4	El Dorado Lakes	Yes, NP
4	Lake Sherwood	Yes, NP
4	Los Angeles Harbor - Fish Harbor	Yes
4	Los Angeles Harbor - Consolidated Slip	Yes
4	Puddingstone Reservoir	Yes, NP
4	Pyramid Lake	-
4	Triunfo Canyon Creek Reach 1	-
4	Triunfo Canyon Creek Reach 2	-
5	Almanor Lake	-
5	American River, Lower (Nimbus Dam to confluence with Sacramento River)	-
5	American River, North Fork	-
5	American River, South Fork (below Slab Creek Reservoir to Folsom Lake)	-
5	Beach Lake	-
5	Bear Creek (Colusa County)	Yes
5	Bear River, Lower (below Camp Far West Reservoir)	-
5	Bear River, Upper (from Combie Lake to Camp Far West Reservoir, Nevada and Placer Counties)	-
5	Berryessa, Lake	-
5	Big Chico Creek (Butte and Tehama Counties)	-
5	Black Butte Reservoir	-
5	Britton Lake	-
5	Butte Creek (Butte County)	-
5	Cache Creek, Lower (Clear Lake Dam to Cache Creek Settling Basin near Yolo	Yes

Table C-1. Waters on the 2012 303(d) List Due to Mercury

REGION*	WATER BODY NAME	TMDL**
	Bypass)	
5	Cache Creek, North Fork (below Indian Valley Reservoir, Lake County)	Yes
5	Calaveras River, Lower (from Stockton Diverting Canal to the San Joaquin River; partly in Delta Waterways, eastern portion)	-
5	Camanche Reservoir	-
5	Camp Far West Reservoir	-
5	Clear Creek (below Whiskeytown Lake, Shasta County)	-
5	Clear Lake	Yes
5	Colusa Basin Drain	-
5	Combie, Lake	-
5	Davis Creek (downstream from Davis Creek Reservoir, Yolo County)	-
5	Davis Creek (upstream from Davis Creek Reservoir, Yolo County)	-
5	Davis Creek Reservoir	-
5	Deer Creek (from Deer Creek Reservoir to Lake Wildwood, Nevada County)	-
5	Delta Waterways (central portion)	Yes
5	Delta Waterways (eastern portion)	Yes
5	Delta Waterways (export area)	Yes
5	Delta Waterways (northern portion)	Yes
5	Delta Waterways (northwestern portion)	Yes
5	Delta Waterways (southern portion)	Yes
5	Delta Waterways (Stockton Ship Channel)	Yes
5	Delta Waterways (western portion)	Yes
5	Don Pedro Lake	-
5	Duck Creek (San Joaquin County)	-
5	Dunn Creek (Mt Diablo Mine to Marsh Creek)	-
5	East Park Reservoir	-
5	Englebright Lake	-
5	Feather River, Lower (Lake Oroville Dam to Confluence with Sacramento River)	-
5	Feather River, North Fork (below Lake Almanor)	-
5	Folsom Lake	-
5	Gold Run (Nevada County)	-
5	Harley Gulch	Yes
5	Hell Hole Reservoir	-
5	Hensley Lake	-
5	Hetch Hetchy Reservoir	-
5	Humbug Creek	-
5	Indian Valley Reservoir (Lake County)	-
5	James Creek	-
5	Kaweah Lake	-
5	Little Deer Creek	-
5	Marsh Creek (Dunn Creek to Marsh Creek Reservoir)	-
5	Marsh Creek (Marsh Creek Reservoir to San Joaquin River; partly in Delta Waterways, western portion)	-
5	Marsh Creek Reservoir	-
5	McClure Reservoir (Mariposa County)	-
5	Mendota Pool	-
5	Merced River, Lower (McSwain Reservoir to San Joaquin River)	-
5	Mile Long Pond (Butte County)	-
5	Millerton Lake	-
5	Modesto Reservoir	-

Table C-1. Waters on the 2012 303(d) List Due to Mercury

REGION*	WATER BODY NAME	TMDL**
5	Mokelumne River, Lower (in Delta Waterways, eastern portion)	-
5	Mosher Slough (downstream of I-5; in Delta Waterways, eastern portion)	-
5	Natoma, Lake	-
5	Natomas Cross Canal (Sutter County)	-
5	Natomas East Main Drainage Canal (aka Steelhead Creek, downstream of confluence with Arcade Creek)	-
5	New Bullards Bar Reservoir	-
5	New Hogan Lake (Calaveras County)	-
5	New Melones Reservoir	-
5	ONeill Forebay	-
5	Oroville, Lake	-
5	Oxbow Reservoir (Ralston Afterbay, El Dorado and Placer Counties)	-
5	Panoche Creek (Silver Creek to Belmont Avenue)	-
5	Pardee Reservoir	-
5	Pine Flat Reservoir	-
5	Putah Creek (Solano Lake to Putah Creek Sinks; partly in Delta Waterways, northwestern portion)	-
5	Robinsons Riffle Pond (Butte County)	-
5	Rollins Reservoir	-
5	Sacramento River (Cottonwood Creek to Red Bluff)	-
5	Sacramento River (Red Bluff to Knights Landing)	-
5	Sacramento River (Knights Landing to the Delta)	-
5	Sacramento Slough	-
5	Salt Slough (upstream from confluence with San Joaquin River)	-
5	San Carlos Creek (downstream of New Idria Mine)	-
5	San Joaquin River (Bear Creek to Mud Slough)	-
5	San Joaquin River (Mud Slough to Merced River)	-
5	San Joaquin River (Merced River to Tuolumne River)	-
5	San Joaquin River (Tuolumne River to Stanislaus River)	-
5	San Joaquin River (Stanislaus River to Delta Boundary)	-
5	San Luis Reservoir	-
5	Scotts Flat Reservoir	-
5	Shasta Lake	-
5	Slab Creek Reservoir (El Dorado County)	-
5	Solano, Lake	-
5	Stanislaus River, Lower	-
5	Stony Gorge Reservoir	-
5	Sulphur Creek (Colusa County)	Yes
5	Sutter Bypass	-
5	Thermalito Afterbay	-
5	Tulloch Reservoir	-
5	Tuolumne River, Lower (Don Pedro Reservoir to San Joaquin River)	-
5	Turlock Lake	-
5	Whiskeytown Lake (areas near Oak Bottom, Brandy Creek Campgrounds and Whiskeytown)	-
5	Wildwood, Lake (Nevada County)	-
5	Woodward Reservoir	-
5	Yuba River, Lower	-
5	Yuba River, Middle Fork	-
5	Yuba River, North Fork	-

Table C-1. Waters on the 2012 303(d) List Due to Mercury

REGION*	WATER BODY NAME	TMDL**
5	Yuba River, South Fork (Spaulding Reservoir to Englebright Reservoir)	-
6	Arrowhead, Lake	-
6	Bodie Creek	-
6	Gregory, Lake	-
6	Littlerock Reservoir	-
6	Mammoth Creek (Old Mammoth Road to Highway 395)	-
6	Mammoth Creek (Twin Lakes outlet to Old Mammoth Road)	-
6	Mammoth Creek, unamed tributary (confluence is near Old Mammoth Rd)	-
6	Silverwood Reservoir	-
6	Susan River (Headwaters to Susanville)	-
6	Susan River (Litchfield to Honey Lake)	-
6	Susan River (Susanville to Litchfield)	-
6	Topaz lake	-
6	Twin Lake, Upper (East Walker River Hydrologic Unit)	-
7	New River (Imperial County)	-
8	Big Bear Lake	-
8	Rhine Channel	Yes, NP
9	Hodges, Lake	-
9	San Diego Bay Shoreline, between Sampson and 28th Streets	Other

Explanations:

*Region refers to the regions of the nine Regional Water Quality Control Boards in California.

**For TMDL:

“Yes” indicates impairment is being addressed by an adopted TMDL.

“Yes, NP” indicates there is an adopted TMDL, without an implementation plan.

“Other” indicates impairment is being addressed by U.S. EPA as a superfund site or by a cleanup and abatement order.

Appendix D. Description of the Nine Water Board Regions

For the purposes of water quality management, section 13200 of the Porter-Cologne Water Quality Control Act divides the State into nine different hydrologic regions. Brief descriptions of these Regions and the water bodies addressed by this Staff Report are presented below. The information provided in this section is derived from the ten Regional Water Quality Control Plans (Basin Plans).

North Coast Region (Region 1)

The North Coast Region comprises all regional basins (including Lower Klamath Lake and Lost River Basins) draining into the Pacific Ocean from the California-Oregon state line at the Region's northern boundary to Bodega Bay at the Region's southern boundary and includes the watershed of the Estero de San Antonio and Stemple Creek in Marin and Sonoma Counties (Figure 1). The North Coast Region is divided by two natural drainage basins, the Klamath River Basin and the North Coastal Basin. This Region covers all of Del Norte, Humboldt, Trinity, and Mendocino Counties, as well as major portions of Siskiyou and Sonoma Counties and small portions of Glenn, Lake, and Marin Counties. It encompasses a total area of approximately 19,390 square miles, including 340 miles of coastline and remote wilderness areas, as well as urbanized and agricultural areas.

Beginning at the Smith River in northern Del Norte County and heading south to the Estero de San Antonio in northern Marin County, the North Coast Region incorporates a large number of major river estuaries. Other North Coast streams and rivers with significant estuaries include the Klamath River, Redwood Creek, Little River, Mad River, Eel River, Noyo River, Navarro River, Elk Creek, Gualala River, Russian River, and Salmon Creek (this creek mouth also forms a lagoon). Northern Humboldt County coastal lagoons include Big Lagoon and Stone Lagoon. The two largest enclosed bays in the North Coast Region are Humboldt Bay and Arcata Bay (both in Humboldt County). Another enclosed bay, Bodega Bay, is located in Sonoma County near the southern border of the Region.

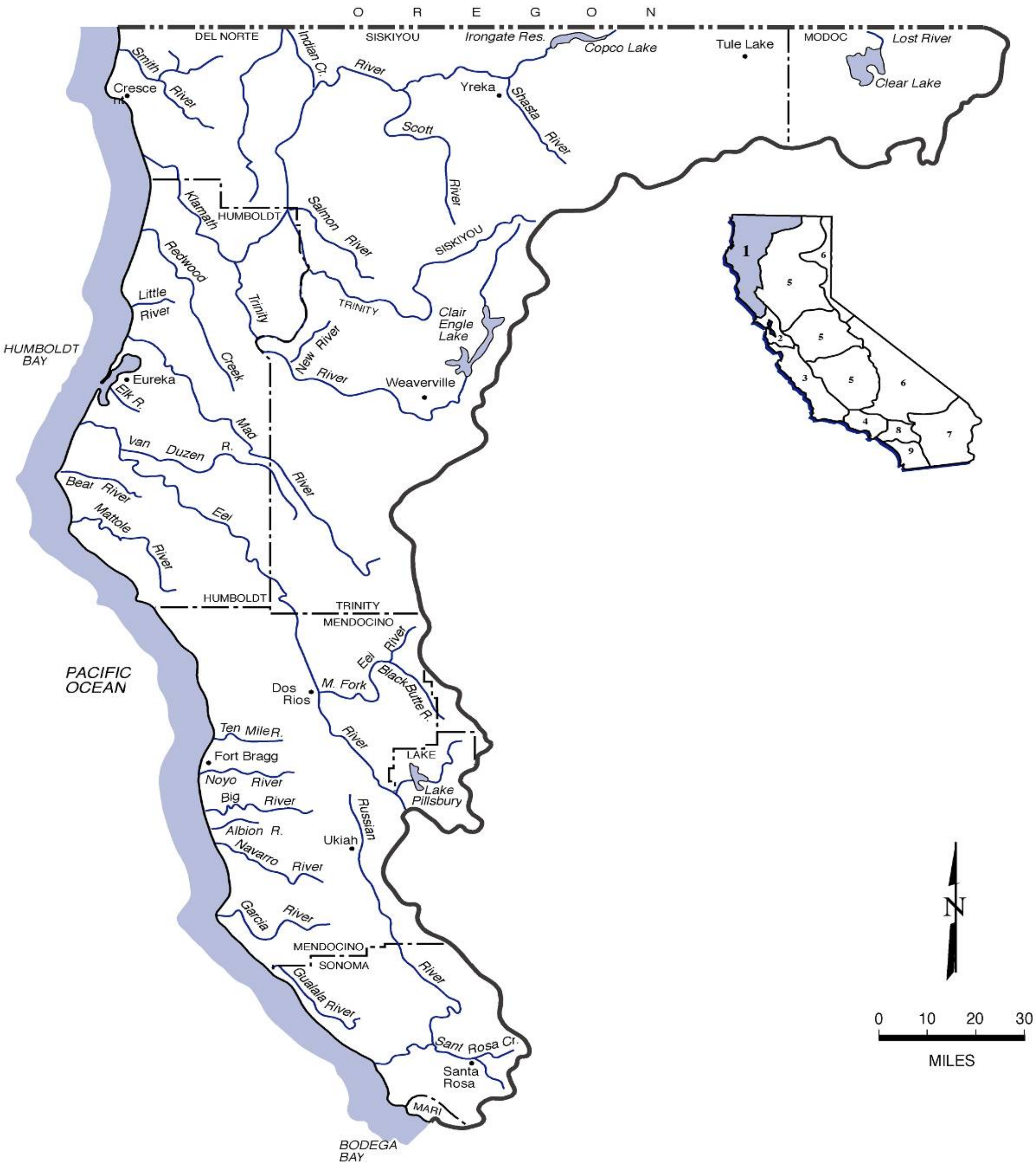
Distinct temperature zones characterize the North Coast Region. Along the coast, the climate is moderate and foggy with limited temperature variation. Inland, however, seasonal temperature ranges in excess of 100°F have been recorded. Precipitation is greater here than any other part of California, and damaging floods are frequent hazards. Particularly devastating flooding occurred in the North Coast area in December 1955, December 1964, and February 1986. Ample precipitation in combination with the mild climate found over most of the North Coast Region has provided a wealth of fish, wildlife, and scenic resources.

The mountainous nature of the Region, with its dense coniferous forests interspersed with grassy or chaparral covered slopes, provides shelter and food for deer, elk, bear, mountain lion, fur bearers, and many upland bird and mammal species. The numerous streams and rivers of the Region contain anadromous fish and the reservoirs, although few in number, support both cold water and warm water fisheries.

Tidelands and marshes are extremely important to many species of waterfowl and shore birds, both for feeding and nesting. Cultivated land and pasturelands also provide supplemental food for many birds, including small pheasant populations. Tideland areas along the north coast provide important habitat for marine invertebrates and nursery areas for forage fish, game fish, and crustaceans. Offshore coastal rocks are used by many species of seabirds as nesting areas.

Major components of the economy are tourism and recreation, logging and timber milling, aggregate mining, commercial and sport fisheries, sheep, beef and dairy production, and vineyards and wineries. In all, the North Coast Region offers a beautiful natural environment with opportunities for scientific study and research, recreation, sport, and commerce.

North Coast Region (1)
NORTH COAST HYDROLOGIC BASIN PLANNING AREA (NC)



Base map prepared by the Division of Water Rights, Graphics Services Unit

San Francisco Bay Region (Region 2)

The San Francisco Bay Region comprises San Francisco Bay, Suisun Bay beginning at the Sacramento River, and the San Joaquin River westerly, from a line which passes between Collinsville and Montezuma Island (Figure 2). The Region's boundary follows the borders common to Sacramento and Solano Counties and Sacramento and Contra Costa Counties west of the Markely Canyon watershed in Contra Costa County. All basins west of the boundary, described above, and all basins draining into the Pacific Ocean between the southern boundary of the North Coast Region and north of the southern boundary of the watershed of Pescadero Creek in San Mateo and Santa Cruz Counties are included in the Region.

The Region comprises most of the San Francisco Estuary to the mouth of the Sacramento-San Joaquin Delta. The San Francisco Estuary conveys the waters of the Sacramento and San Joaquin Rivers to the Pacific Ocean. Located on the central coast of California, the Bay system functions as the only drainage outlet for waters of the Central Valley and it marks a natural topographic separation between the northern and southern coastal mountain ranges. The Region's waterways, wetlands, and bays form the centerpiece of the fourth largest metropolitan area in the United States, including all or major portions of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

The San Francisco Bay Regional Water Board has jurisdiction over the part of the

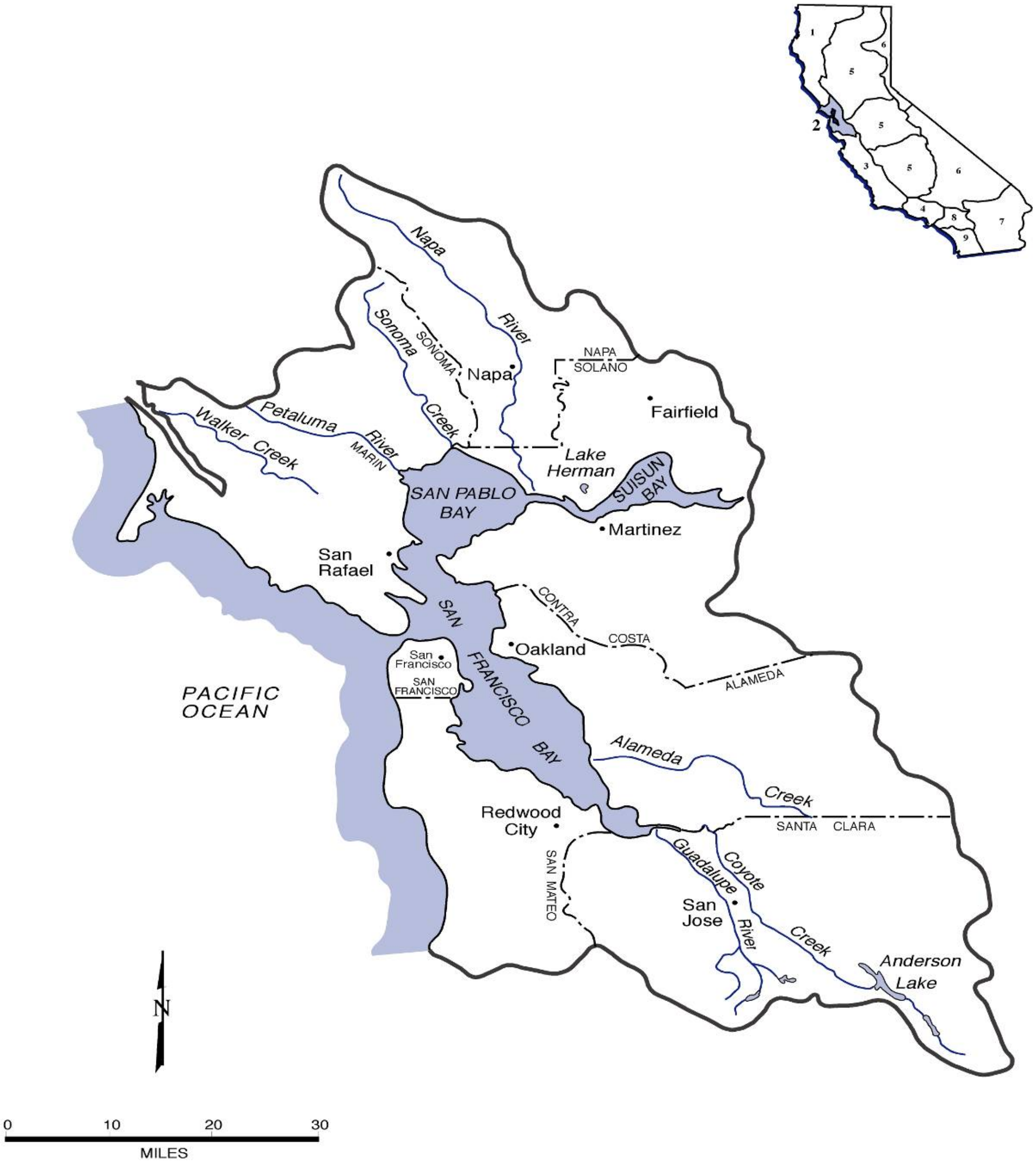
San Francisco Estuary that includes all of the San Francisco Bay segments extending east to the Delta, including Winter Island near Pittsburg. The San Francisco Estuary sustains a highly dynamic and complex environment. Within each section of the Bay system lie deepwater areas that are adjacent to large expanses of very shallow water. Salinity levels range from hypersaline to freshwater, and water temperature varies widely. The Bay system's deepwater channels, tidelands, marshlands, and freshwater streams and rivers provide a wide variety of habitats within the Region. Coastal embayments, including Tomales Bay and Bolinas Lagoon, are also located in this Region. The Central Valley Regional Water Board has jurisdiction over the Delta and rivers extending further eastward.

The Sacramento and San Joaquin Rivers enter the Bay system through the Delta at the eastern end of Suisun Bay and contribute almost all of the freshwater inflow into the Bay. Many smaller rivers and streams also convey freshwater to the Bay system. The rate and timing of these freshwater flows are among the most important factors influencing physical, chemical, and biological conditions in the Estuary. Flows in the region are highly seasonal, with more than 90% of the annual runoff occurring between November and April.

The San Francisco Estuary is made up of many different types of aquatic habitats that support a great diversity of organisms. Suisun Marsh in Suisun Bay is the largest brackish-water marsh in the United States. San Pablo Bay is a shallow embayment strongly influenced by runoff from the Sacramento and San Joaquin Rivers.

The Central Bay is the portion of the Bay most influenced by oceanic conditions. The South Bay, with less freshwater inflow than the other portions of the Bay, acts more like a tidal lagoon. Together, these areas sustain rich communities of aquatic life and serve as important wintering sites for migrating waterfowl, and spawning areas for anadromous fish.

San Francisco Bay Region (2)
SAN FRANCISCO BAY HYDROLOGIC BASIN PLANNING AREA (SF)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Central Coast Region (Region 3)

The Central Coast Region comprises all basins (including Carrizo Plain in San Luis Obispo and Kern Counties) draining into the Pacific Ocean from the southern boundary of the Pescadero Creek watershed in San Mateo and Santa Cruz Counties along the Region's northern boundary, to the southeastern boundary of the Rincon Creek watershed, located in western Ventura County (Figure 3) at the Region's southern boundary. The Region extends over a 300-mile long by 40-mile wide section of the state's central coast. Its geographic area encompasses all of Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara Counties as well as the southern one-third of Santa Clara County, and small portions of San Mateo, Kern, and Ventura Counties. Included in the region are urban areas such as the Monterey Peninsula and the Santa Barbara coastal plain; prime agricultural lands such as the Salinas, Santa Maria, and Lompoc Valleys; National Forest lands; extremely wet areas such as the Santa Cruz Mountains; and arid areas such as the Carrizo Plain.

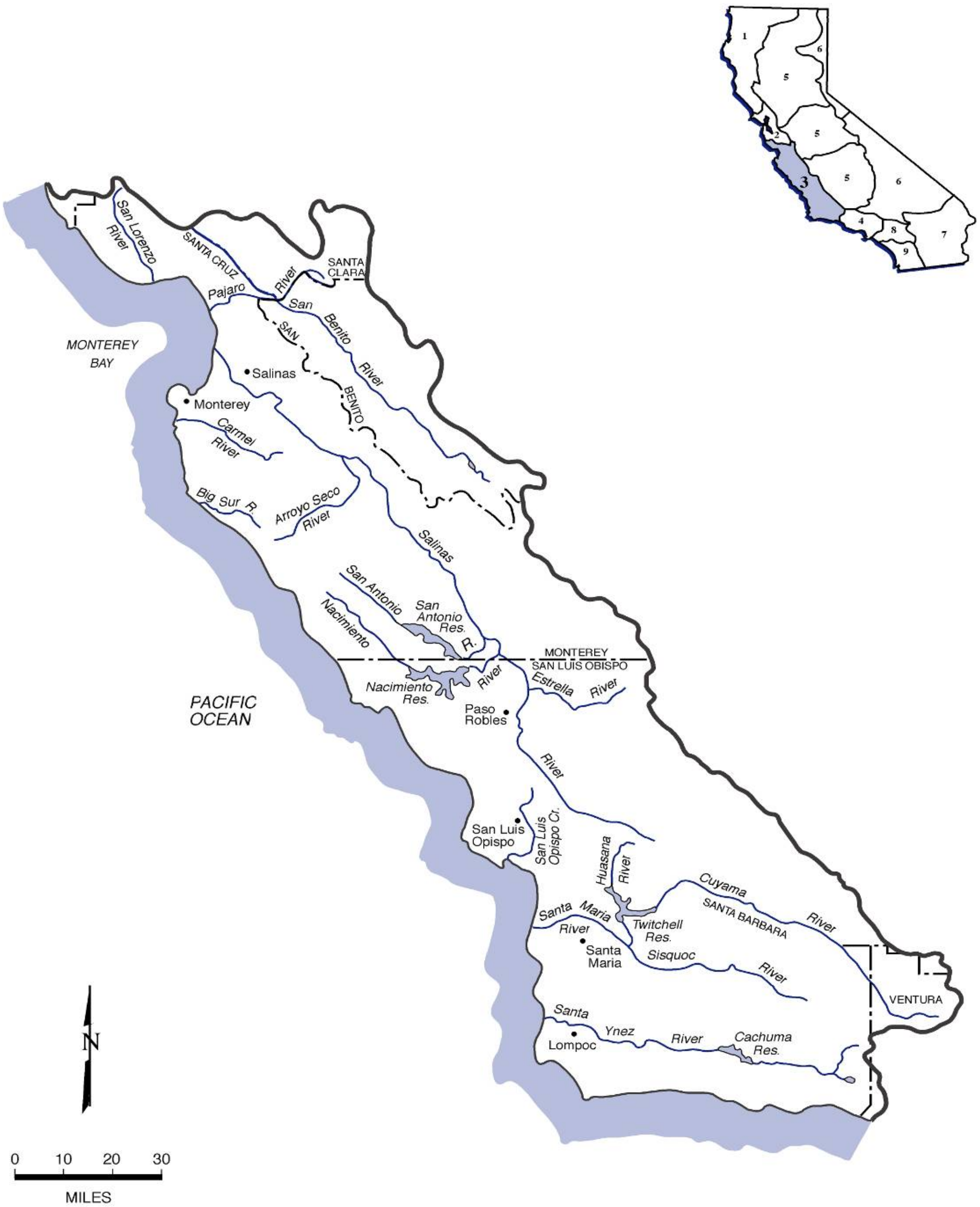
Water bodies in the Central Coast Region are varied. Enclosed bays and harbors in the Region include Morro Bay, Elkhorn Slough, Tembladero Slough, Santa Cruz Harbor, Moss Landing Harbor, San Luis Harbor, and Santa Barbara Harbor. Several small estuaries also characterize the Region, including the Santa Maria River Estuary, San Lorenzo River Estuary, Big Sur River Estuary, and many others. Major rivers, streams, and lakes include San Lorenzo River,

Santa Cruz River, San Benito River, Pajaro River, Salinas River, Santa Maria River, Cuyama River, Estrella River and Santa Ynez River, San Antonio Reservoir, Nacimiento Reservoir, Twitchel Reservoir, and Cuchuma Reservoir. The economic and cultural activities in the basin have been primarily agrarian. Livestock grazing persists, but it has since been combined with hay cultivation in the valleys. Irrigation, using local groundwater, is very significant in intermountain valleys throughout the basin. Mild winters result in long growing seasons and continuous cultivation of many vegetable crops in parts of the basin.

While agriculture and related food processing activities are major industries in the Region, oil production, tourism, and manufacturing contribute heavily to its economy. The northern part of the Region has experienced a significant influx of electronic manufacturing, while offshore oil exploration and production have heavily influenced the southern part.

Water quality problems frequently encountered in the Central Coastal Region include excessive salinity or hardness of local groundwater. Increasing nitrate concentration is a growing problem in a number of areas, in both surface water and groundwater. Surface waters suffer from bacterial contamination, nutrient enrichment, and siltation in a number of watersheds. Pesticides are a concern in agricultural areas and associated downstream water bodies.

Central Coast Region (3)
CENTRAL COAST HYDROLOGIC BASIN PLANNING AREA (CC)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Los Angeles Region (Region 4)

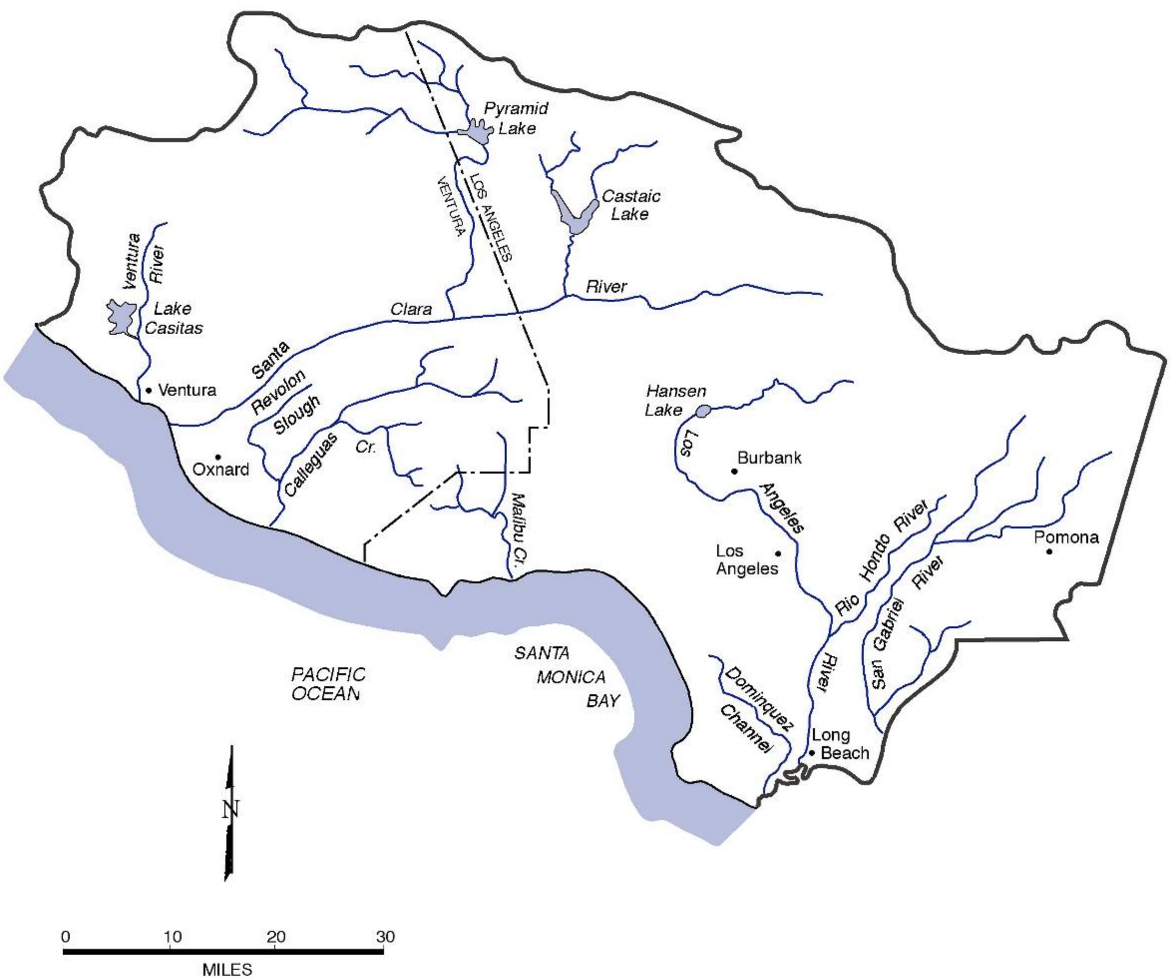
The Los Angeles Region comprises all basins draining into the Pacific Ocean between the southeastern boundary of the watershed of Rincon Creek, located in western Ventura County, and a line which coincides with the southeastern boundary of Los Angeles County, from the Pacific Ocean to San Antonio Peak, and follows the divide between the San Gabriel River and Lytle Creek drainages to the divide between Sheep Creek and San Gabriel River drainages (Figure 4).

The Region encompasses all coastal drainages flowing into the Pacific Ocean between Rincon Point (on the coast of western Ventura County) and the eastern Los Angeles County line, as well as the drainages of five coastal islands (Anacapa, San Nicolas, Santa Barbara, Santa Catalina and San Clemente). In addition, the Region includes all coastal waters within three miles of the continental and island coastlines. Two large deepwater harbors (Los Angeles and Long Beach Harbors) and one smaller deepwater harbor (Port Hueneme) are contained in the Region. There are small craft marinas within the harbors, as well as tank farms, naval facilities, fish processing plants, boatyards, and container terminals. Several small-craft marinas also exist along the coast (Marina del Ray, King Harbor, Ventura Harbor); these contain boatyards, other small businesses, and dense residential development.

Several large, primarily concrete-lined rivers (Los Angeles River, San Gabriel River) lead to unlined tidal prisms which are influenced by marine waters. Salinity may be greatly reduced following rains since these rivers drain large urban areas composed of mostly impermeable surfaces. Some of these tidal prisms receive a considerable amount of freshwater throughout the year from POTWs discharging tertiary-treated effluent. Lagoons are located at the mouths of other rivers draining relatively undeveloped areas (Mugu Lagoon, Malibu Lagoon, Ventura River Estuary, and Santa Clara River Estuary). There are also a few isolated brackish coastal water bodies receiving runoff from agricultural or residential areas.

Santa Monica Bay, which includes the Palos Verdes Shelf, dominates a large portion of the open coastal water bodies in the Region. The Region's coastal water bodies also include the areas along the shoreline of Ventura County and the waters surrounding the five offshore islands in the Region.

Los Angeles Region (4)
LOS ANGELES HYDROLOGIC BASIN PLANNING AREA (LA)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Central Valley Region (Region 5)

The Central Valley Region includes approximately 40% of the land in California stretching from the Oregon border to the Kern County/Los Angeles County line. The Region is divided into three basins. For planning purposes, the Sacramento River Basin and the San Joaquin River basin are covered under one Basin Plan, and the Tulare Lake Basin is covered under another.

The Sacramento River Basin covers 27,210 square miles and includes the entire area drained by the Sacramento River (Figure 5). The principal streams are the Sacramento River and its larger tributaries: the Pitt, Feather, Yuba, Bear, and American Rivers to the East; and Cottonwood, Stony, Cache, and Putah Creek to the west. Major reservoirs and lakes include Shasta, Oroville, Folsom, Clear Lake, and Lake Berryessa.

The San Joaquin River Basin covers 15,880 square miles and includes the entire area drained by the San Joaquin River (Figure 6). Principal streams in the basin are the San Joaquin River and its larger tributaries: the Consumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers. Major reservoirs and lakes include Pardee, New Hogan, Millerton, McClure, Don Pedro, and New Melones.

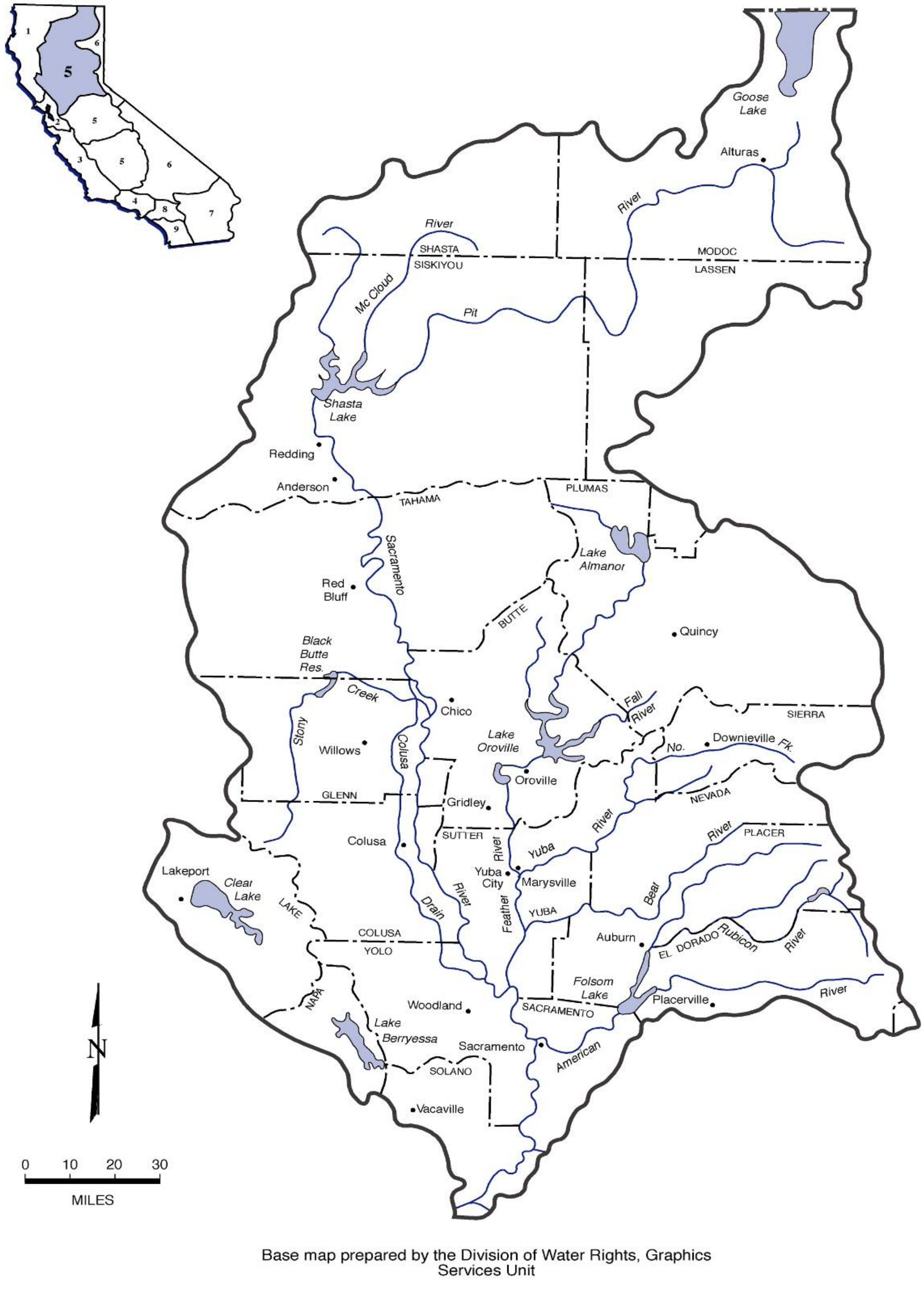
The Tulare Lake Basin covers approximately 16,406 square miles and comprises the drainage area of the San Joaquin Valley south of the San Joaquin River (Figure 7). The planning boundary between the San Joaquin River Basin and the Tulare Lake Basin follows the southern watershed boundaries of the Little Panoche Creek, Moreno Gulch, and Capita Canyon to the boundary of the Westlands Water District. From here, the boundary follows the northern edge of the Westlands Water District until its intersection with the Firebuagh Canal Company's Main Lift Canal. The basin boundary then follows the Main Lift Canal to the Mendota Pool and continues eastward along the channel of the San Joaquin River to Millerton Lake in the Sierra Nevada foothills, and then follows along the southern boundary of the San Joaquin River drainage basin. Main Rivers within the basin include the King, Kaweah, Tule, and Kern Rivers, which drain to the west face of the Sierra Nevada Mountains. Imported surface water supplies enter the basin through the San Luis Drain- California Aqueduct System, Friant- Kern Channel, and the Delta Mendota Canal.

The two northern most basins are bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. They extend about 400 miles from the California-Oregon border southward to the headwaters of the San Joaquin River. These two river basins cover about one fourth of the total area of the State and over 30% of the State's irrigable land. The Sacramento and San Joaquin Rivers furnish roughly two-thirds of the State's water supply. Surface waters from the two drainage basins meet and form the Delta, which ultimately drains into the San Francisco Bay.

The Delta is a maze of river channels and diked islands covering roughly 1,150 square miles, including 78 square miles of water area. Two major water projects located in the South Delta, the Federal Central Valley Project and the State Water Project, deliver water from the Delta to Southern California, the San Joaquin Valley, Tulare Lake Basin, and the San Francisco Bay Area, as well as within the Delta boundaries. The legal boundary of the Delta is described in the Water Code section 12220.

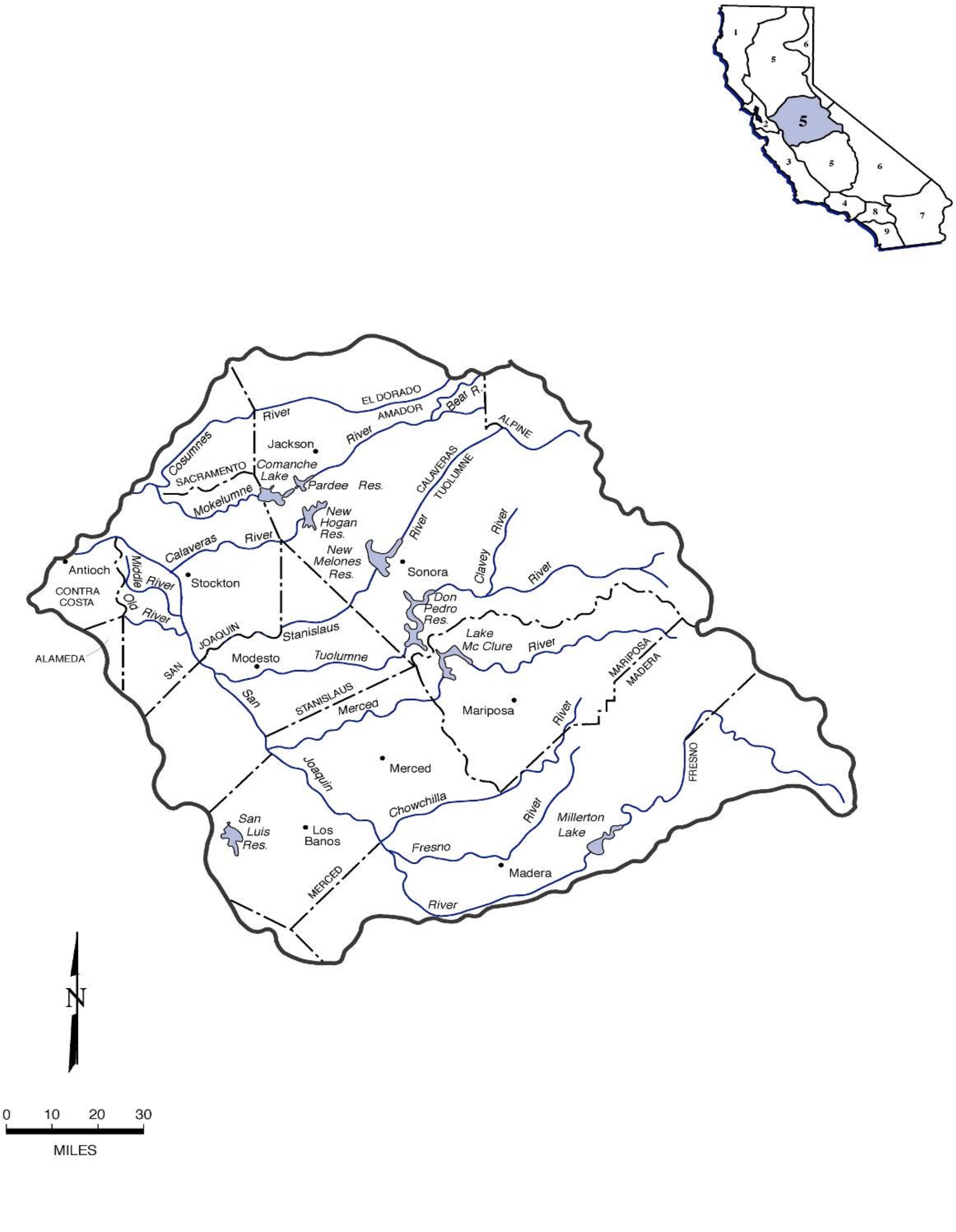
Central Valley Region (5)

SACRAMENTO HYDROLOGIC BASIN PLANNING AREA (SB)



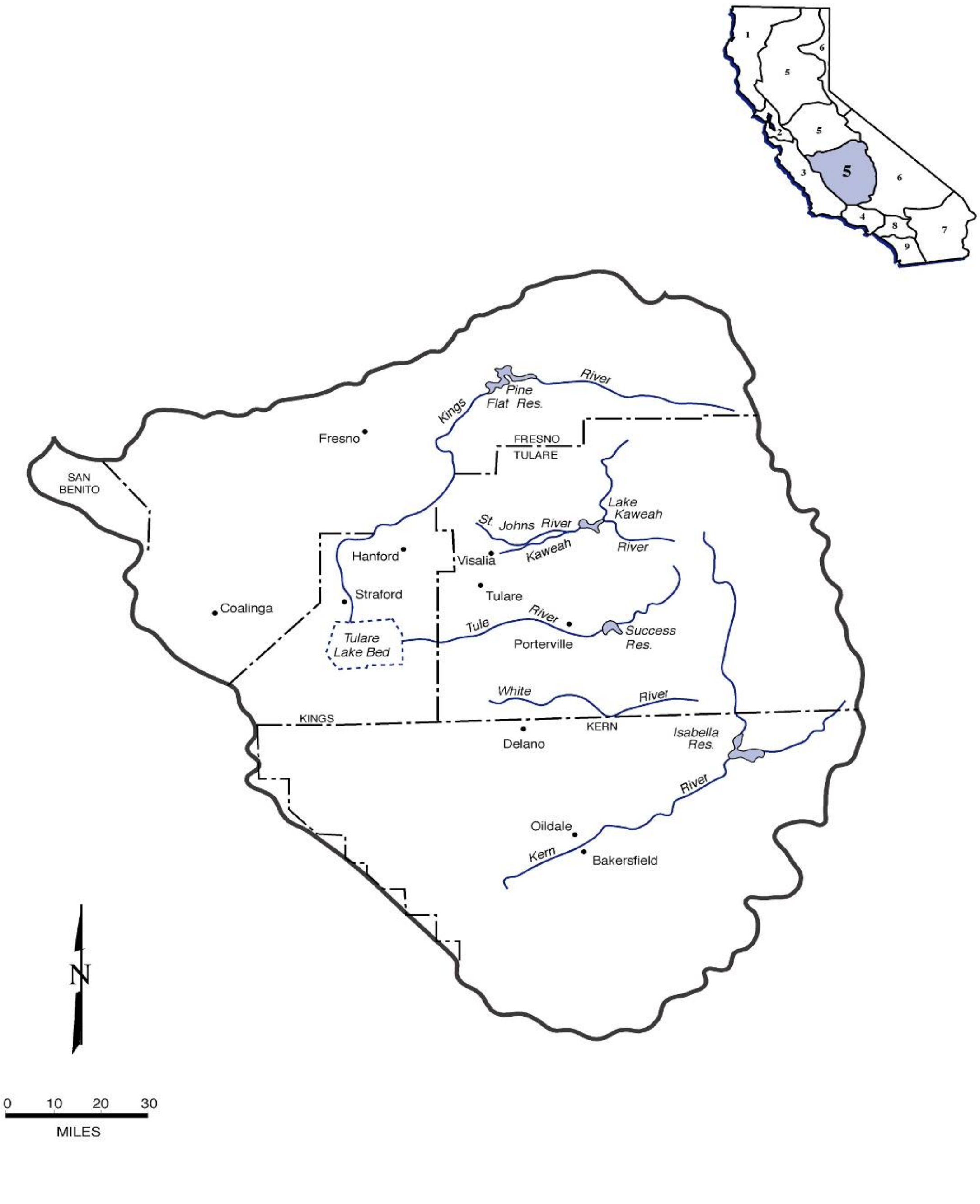
Base map prepared by the Division of Water Rights, Graphics Services Unit

Central Valley Region (5)
SAN JOAQUIN HYDROLOGIC BASIN PLANNING AREA (SJ)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Central Valley Region (5)
TULARE LAKE HYDROLOGIC BASIN PLANNING AREA (TL)



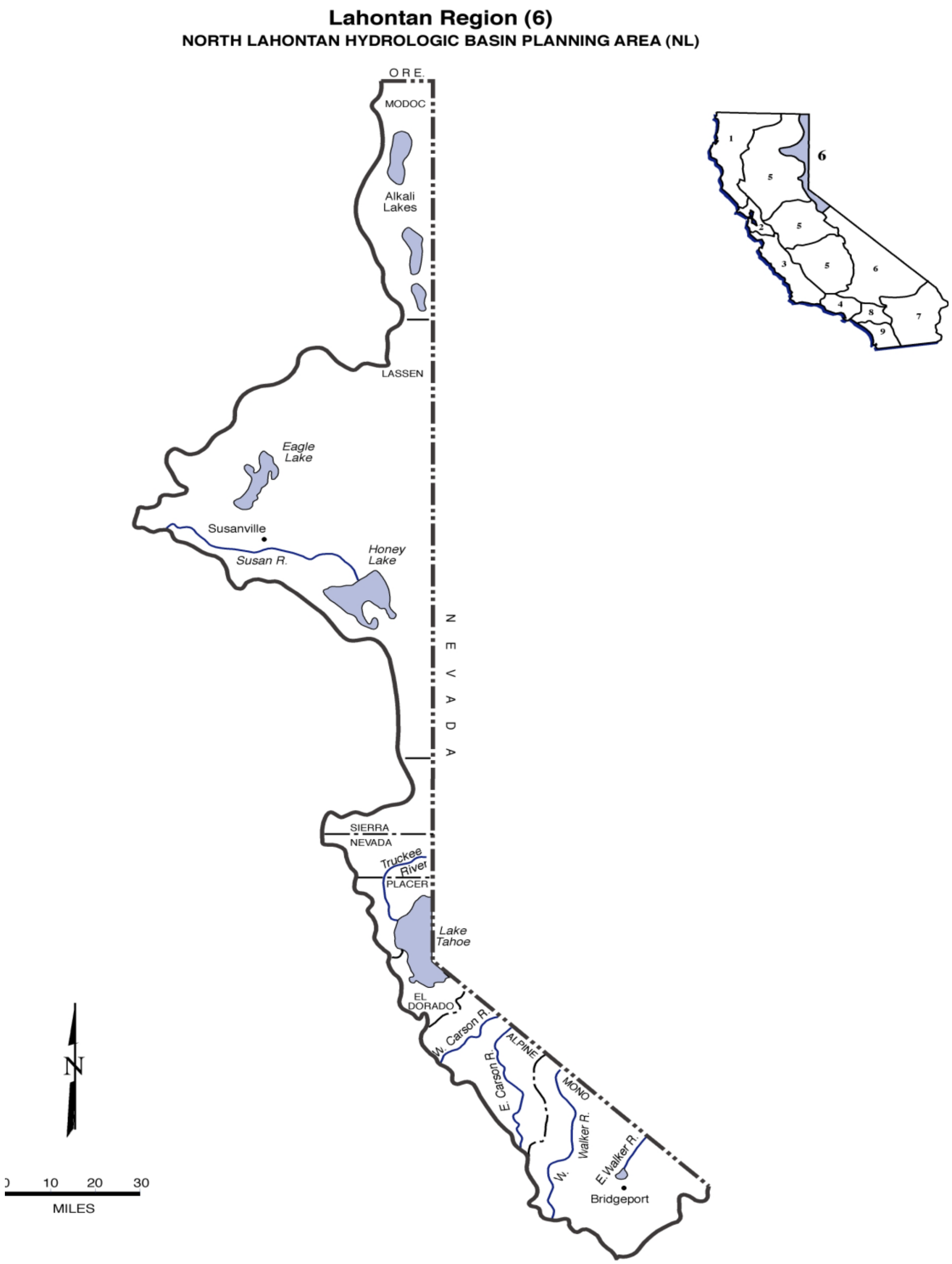
Base map prepared by the Division of Water Rights, Graphics Services Unit

Lahontan Region (Region 6)

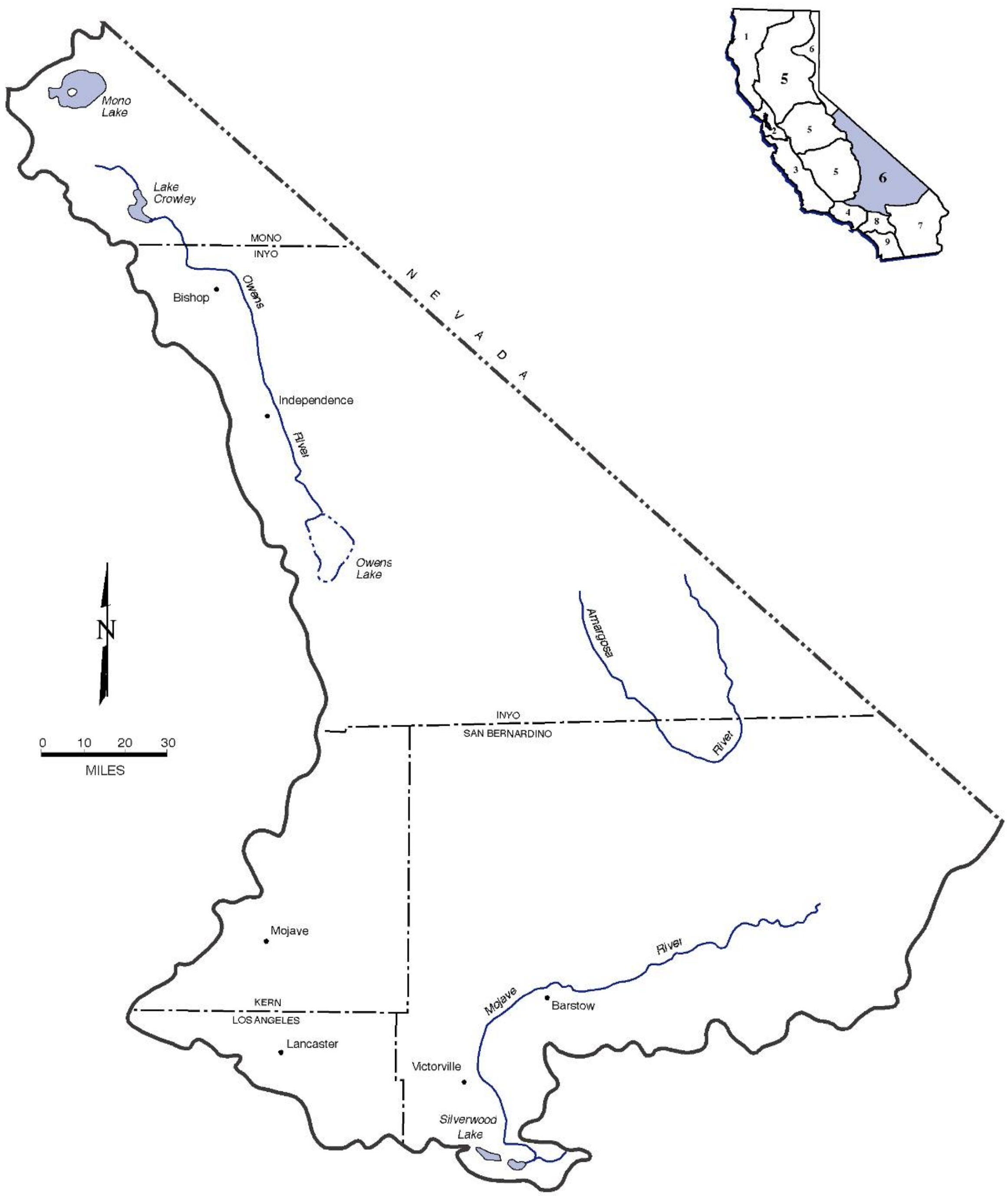
The Lahontan Region contains both of California's waterbodies that are designated as Outstanding Natural Resource Waters: Lake Tahoe and Mono Lake. The Region has historically been divided into North and South Lahontan Basins at the boundary between the Mono Lake and East Walker River watersheds (Figures 8 and 9). It is about 570 miles long and has a total area of 33,131 square miles. The Lahontan Region includes the highest (Mount Whitney) and lowest (Death Valley) points in the contiguous United States. The topography of the remainder of the Region is diverse, and includes the eastern slopes of the Warner, Sierra Nevada, San Bernardino, Tehachapi and San Gabriel Mountains, and all or part of other ranges including the White, Providence, and Granite Mountains. Topographic depressions include the Madeline Plains and the Surprise, Honey Lake, Bridgeport, Owens, Antelope, and Victor Valleys.

The Region is generally in a rain shadow; however, annual precipitation amounts can be significant (up to 70 inches) at higher elevations. Most precipitation in the mountainous areas falls as snow. Desert areas receive relatively little annual precipitation (less than 2 inches in some locations) but this can be concentrated and lead to flash flooding. Temperature extremes recorded in the Lahontan Region range from – 45^{o}F at Boca (Truckee River watershed) to 134^{o}F in Death Valley. The varied topography, soils, and microclimates of the Lahontan Region support a corresponding variety of plant and animal communities. Vegetation ranges from sagebrush and creosote bush scrub in the desert areas to pinyon-juniper and mixed conifer forest at higher elevations. Subalpine and alpine communities occur on the highest peaks. Wetland and riparian plant communities (including marshes, meadows, "sphagnum" bogs, riparian deciduous forest, and desert washes) are particularly important for wildlife, given the general scarcity of water in the Region.

The Lahontan Region is rich in cultural resources (archaeological and historic sites), ranging from remnants of Native American irrigation systems to Comstock mining era ghost towns such as Bodie, and 1920s resort homes at Lake Tahoe and Death Valley (Scotty's Castle). Much of the Lahontan Region is in public ownership, with land use controlled by agencies, such as the U.S. Forest Service (USFS), the National Park Service (NPS), the Bureau of Land Management (BLM), various branches of the military, the California State Department of Parks and Recreation, and the City of Los Angeles Department of Water and Power. While the permanent resident population (about 500,000 in 1990) of the Region is low, most of it is concentrated in high-density communities in the South Lahontan Basin. In addition, millions of visitors use the Lahontan Region for recreation each year. Rapid population growth has occurred in the Victor and Antelope Valleys and within commuting distance of Reno, Nevada. Principal communities of the North Lahontan Basin include Susanville, Truckee, Tahoe City, South Lake Tahoe, Markleeville, and Bridgeport. The South Lahontan Basin includes the communities of Mammoth Lakes, Bishop, Ridgecrest, Mojave, Adelanto, Palmdale, Lancaster, Victorville, and Barstow. Recreational and scenic attractions of the Lahontan Region include Eagle Lake, Lake Tahoe, Mono Lake, Mammoth Lakes, Death Valley, and portions of many wilderness areas. Segments of the East Fork Carson and West Walker Rivers are included in the State Wild and Scenic River system.



Lahontan Region (6)
SOUTH LAHONTAN HYDROLOGIC BASIN PLANNING AREA (SL)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Both developed (e.g. camping, skiing, day use) and undeveloped (e.g. hiking, fishing) recreation are important components of the Region's economy. In addition to tourism, other major sectors of the economy include resource extraction (mining, energy production, and silviculture), agriculture (mostly livestock grazing), and defense-related activities. There is relatively little manufacturing industry in the Region, in comparison to major urban areas of the State. Economically valuable minerals, including gold, silver, copper, sulfur, tungsten, borax, and rare earth metals either have been, or are being mined at various locations within the Lahontan Region.

The Lahontan Region includes over 700 lakes, 3,170 miles of streams, and 1,581 square miles of groundwater basins. There are 12 major watersheds in the North Lahontan Basin. Among these are the Eagle Lake, Susan River/Honey Lake, Truckee, Carson, and Walker River watersheds. The South Lahontan Basin includes three major surface water systems (the Mono Lake, Owens River, and Mojave River watersheds) and a number of separate closed groundwater basins. Water quality problems in the Lahontan Region are largely related to nonpoint sources (including erosion from construction, timber harvesting, and livestock grazing), storm water, and acid drainage from inactive mines and individual wastewater disposal systems.

Colorado River Basin Region (Region 7)

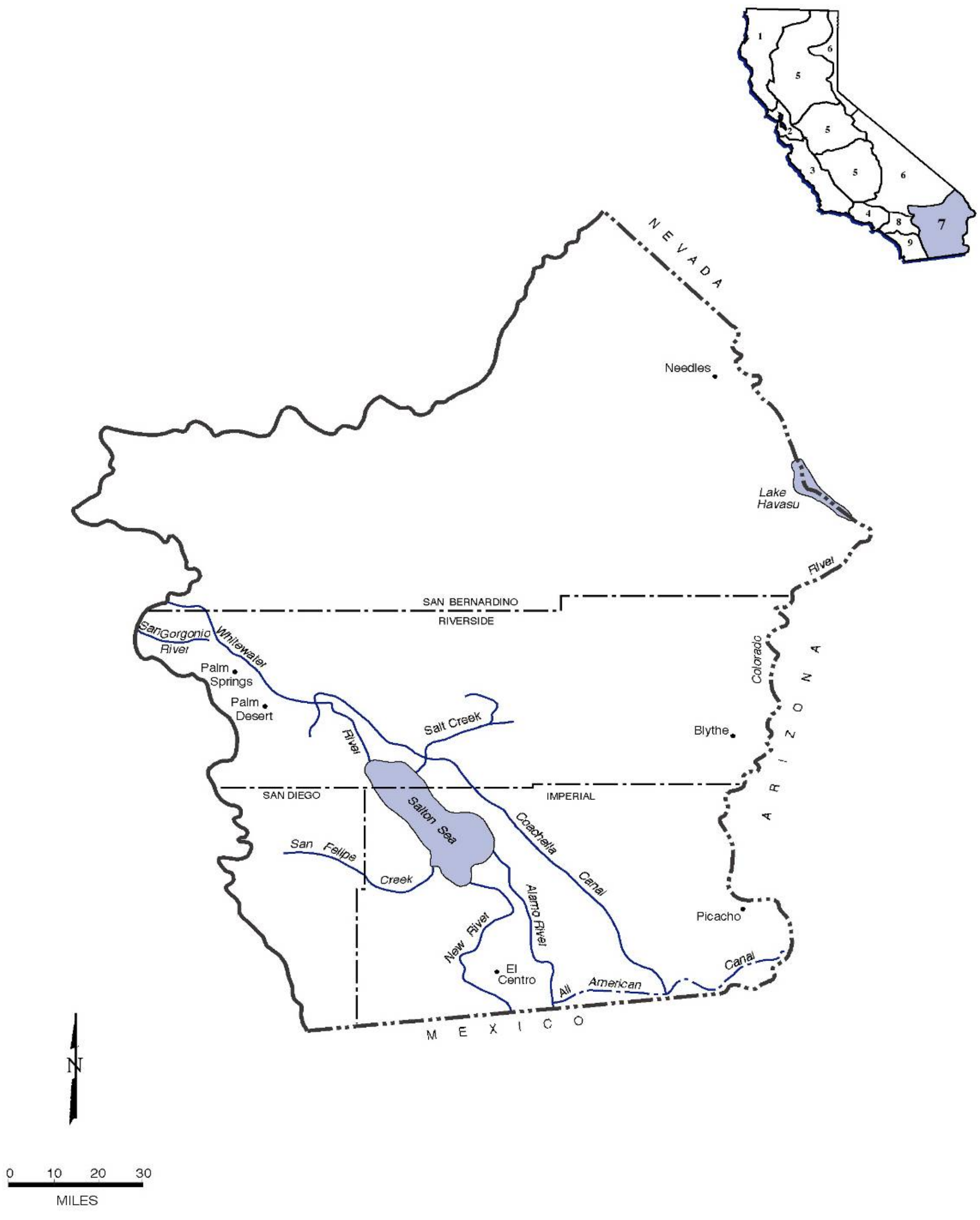
The Colorado River Basin Region covers approximately 13 million acres (20,000 square miles) in the southeastern portion of California (Figure 10). It includes all of Imperial County and portions of San Bernardino, Riverside, and San Diego Counties. It shares a boundary for 40 miles on the northeast with the State of Nevada; on the north by the New York, Providence, Granite, Old Dad, Bristol, Rodman, and Ord Mountain ranges; on the west by the San Bernardino, San Jacinto, and Laguna Mountain ranges; on the south by the Republic of Mexico; and on the east by the Colorado River and State of Arizona. Geographically, the Region represents only a small portion of the total Colorado River drainage area, which includes portions of Arizona, Nevada, Utah, Wyoming, Colorado, New Mexico, and Mexico. A significant geographical feature of the Region is the Salton Trough, which contains the Salton Sea and the Coachella and Imperial Valleys. The two valleys are separated by the Salton Sea, which covers the lowest area of the depression. The trough is a geologic structural extension of the Gulf of California.

Much of the agricultural economy and industry of the Region is located in the Salton Trough. There are also industries associated with agriculture, such as sugar refining, as well as increasing development of geothermal industries. In the future, agriculture is expected to experience little growth in the Salton Trough, but there will likely be increased development of other industries (such as construction, manufacturing, and services). The present Salton Sea, located on the site of a prehistoric lake, was formed between 1905 and 1907 by overflow of the Colorado River. The Salton Sea serves as a drainage reservoir for irrigation return water and storm water from the Coachella Valley, Imperial Valley, and Borrego Valley, and also receives drainage water from the Mexicali Valley in Mexico. The Salton Sea is California's largest inland body of water and provides a very important wildlife habitat and sport fishery. Development along California's 230 mile reach of the Colorado River, which flows along the eastern boundary of the Region, includes agricultural areas in Palo Verde Valley and Bard Valley; urban centers at Needles, Blythe, and Winterhaven; several transcontinental gas compressor stations; and numerous small recreational communities. The Fort Mojave, Chemehuevi, Colorado River, and Yuma Indian Reservations are located along the river. In addition, mining operations are located in the surrounding mountains.

This Region has the driest climate in California. The winters are mild and summers are hot. Temperatures range from below freezing to over 120°F. In the Colorado River valleys and the Salton Trough, frost is a rare occurrence and crops are grown year round. Snow falls in the Region's higher elevations, with mean seasonal precipitation ranging from 30 to 40 inches in the upper San Jacinto and San Bernardino Mountains. The lower elevations receive relatively little rainfall. An average of four inches of precipitation occurs along the Colorado River, with much of this coming from late summer thunderstorms moving north from Mexico. Typical mean seasonal precipitation in the desert valleys is approximately 3.2 inches at Indio, and three inches at El Centro. Precipitation over the entire area occurs mostly from November through April, and August through September, but its distribution and intensity are often sporadic. Local thunderstorms may contribute the entire average seasonal precipitation at one time or only a trace of precipitation may be recorded at any locale for the entire season.

The Region provides habitat for a variety of native and introduced species of wildlife. Increased human population and its associated development have adversely affected the habitats of some species, while conversely enhancing others. Animals tolerant of arid conditions, including small rodents, coyotes, foxes, birds, and a variety of reptiles, inhabit large areas within the Region. Along the Colorado River and in the higher elevations of the San Bernardino and San Jacinto Mountains, where water is more abundant, deer, bighorn sheep, and a diversity of small animals exist. Practically all of the fishes inhabiting the Region are introduced species. The most abundant species in the Colorado River and irrigation canals include largemouth bass, smallmouth bass, flathead and channel catfish, yellow bullhead, bluegill, redear sunfish, black crappie, carp, striped bass, threadfin shad, red shiner, and, in the colder water above Lake Havasu, rainbow trout. Grass carp have been introduced into sections of the All American Canal system for aquatic weed control. Fish inhabiting agricultural drains in the Region generally include mosquito fish, mollies, red shiners, carp, and tilapia, although locally significant populations of catfish, bass, and sunfish occur in some drains. A considerable sport fishery exists in the Salton Sea, with orangemouth corvina, gulf croaker, sargo, and tilapia predominating. The Salton Sea National Wildlife Refuge and state waterfowl management areas are located in and near the Salton Sea. The refuge supports large numbers of waterfowl in addition to other types of birds. Located along the Colorado River are the Havasu, Cibola and Imperial National Wildlife Refuges. The Region provides habitat for certain endangered/threatened species of wildlife including desert pupfish, razorback sucker, Yuma clapper rail, black rail, least Bell's vireo, yellow billed cuckoo, desert tortoise, and peninsular bighorn sheep.

Colorado River Basin Region (7)
COLORADO RIVER HYDROLOGIC BASIN PLANNING AREA (CR)

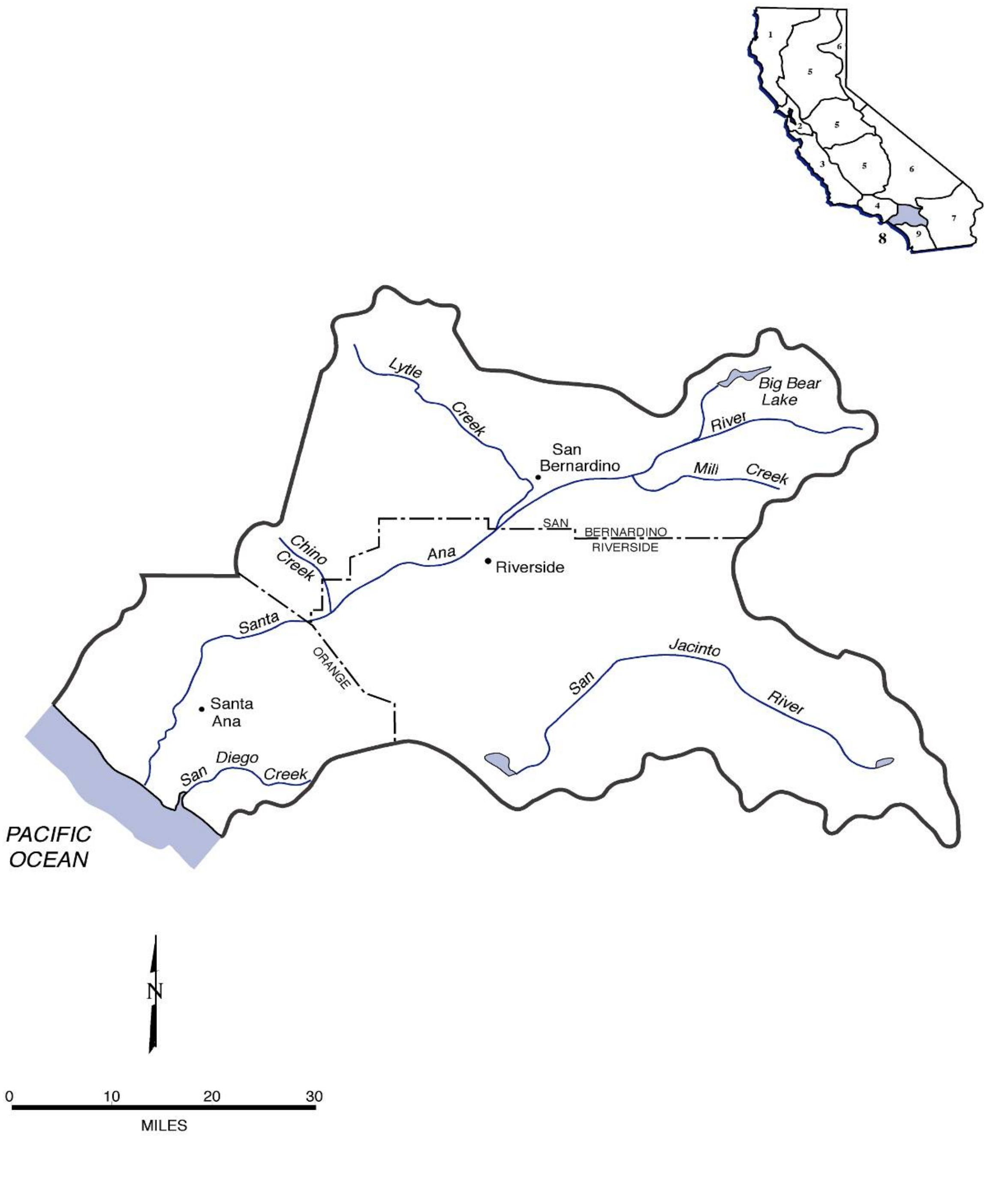


Base map prepared by the Division of Water Rights, Graphics Services Unit

Santa Ana Region (Region 8)

The Santa Ana Region comprises all basins draining into the Pacific Ocean between the southern boundary of the Los Angeles Region and the drainage divide between Muddy and Moro Canyons; from the ocean to the summit of San Joaquin Hills; along the divide between lands draining into Newport Bay and Laguna Canyon to Niguel Road; along Niguel Road and Los Aliso Avenue to the divide between Newport Bay and Aliso Creek drainages; along the divide and the southeastern boundary of the Santa Ana River drainage to the divide between Baldwin Lake and Mojave Desert drainages; and to the divide between the Pacific Ocean and Mojave Desert drainages (Figure 11). Geographically, the Santa Ana Region is the smallest of the nine regions in the state (2,800 square miles) and is located in southern California, roughly between Los Angeles and San Diego. The climate of the Santa Ana Region is classified as Mediterranean: generally dry in the summer with mild, wet winters. The average annual rainfall in the Region is about 15 inches, with most precipitation occurring between November and March. The enclosed bays in the Region include Newport, Bolsa (including Bolsa Chica Marsh), and Anaheim Bay. Principal rivers include Santa Ana, San Jacinto and San Diego. Lakes and reservoirs include Big Bear, Hemet, Mathews, Canyon Lake, Lake Elsinore, Santiago Reservoir, and Perris Reservoir.

Santa Ana Region (8)
SANTA ANA HYDROLOGIC BASIN PLANNING AREA (SA)



Base map prepared by the Division of Water Rights, Graphics Services Unit

San Diego Region (Region 9)

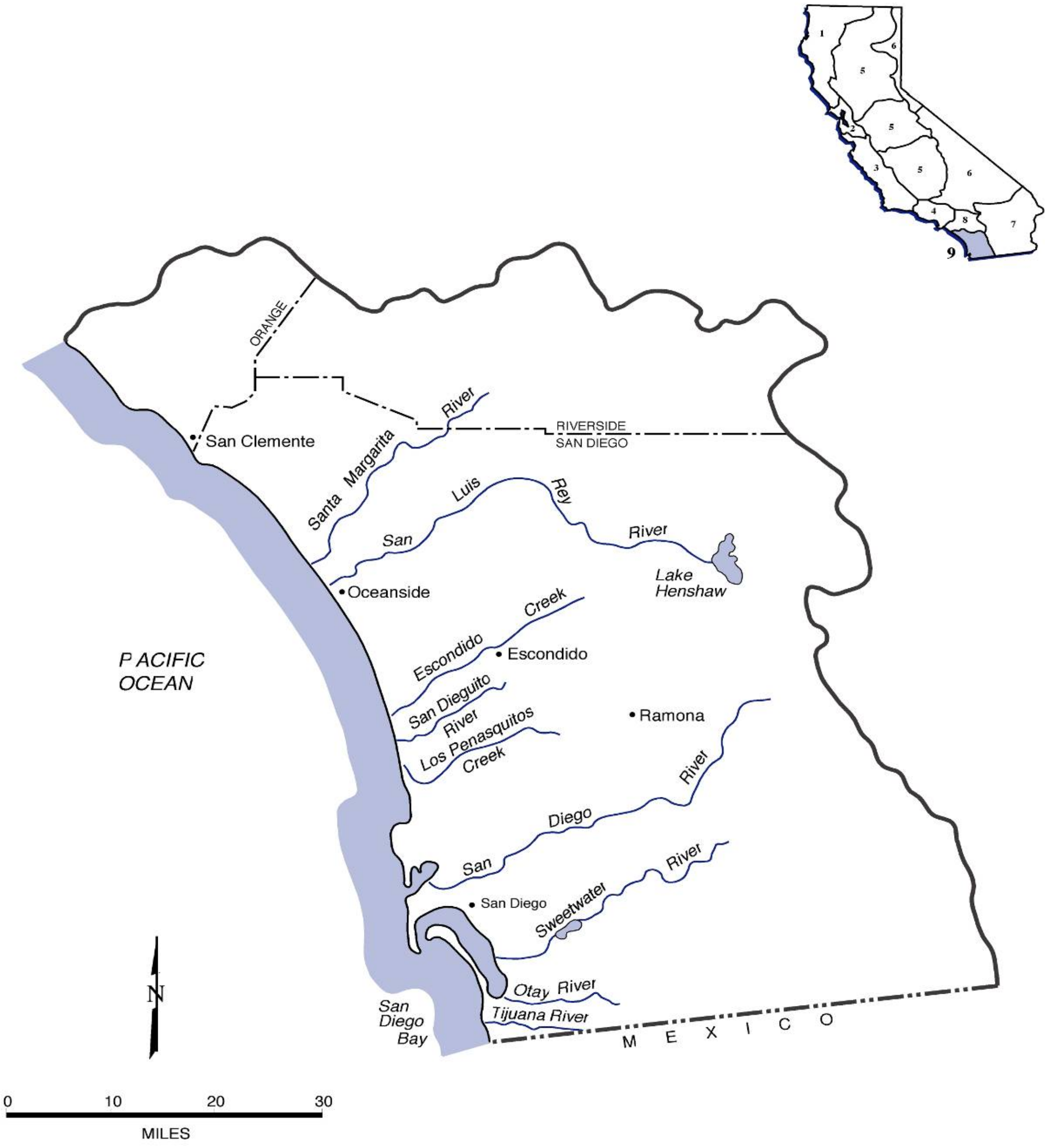
The San Diego Region comprises all basins draining into the Pacific Ocean between the southern boundary of the Santa Ana Region and the California-Mexico boundary (Figure 12). The San Diego Region is located along the coast of the Pacific Ocean from the Mexican border to north of Laguna Beach. The San Diego Region is rectangular in shape and extends approximately 80 miles along the coastline and 40 miles eastward towards the crest of the mountains. This Region includes portions of San Diego, Orange, and Riverside Counties, and the population of the Region is heavily concentrated along the coastal strip. Two harbors, Mission Bay and San Diego Bay, support major recreational and commercial boat traffic. Coastal lagoons are found along the San Diego County coast at the mouths of creeks and rivers.

Weather patterns are Mediterranean in nature with an average rainfall of approximately ten inches per year occurring along the coast during the winter. The Pacific Ocean generally has cool water temperatures due to upwelling, and this nutrient-rich water supports coastal beds of giant kelp. The cities of San Diego, National City, Chula Vista, Coronado, and Imperial Beach surround San Diego Bay in the southern portion of the Region.

San Diego Bay is long and narrow; 15 miles in length and approximately one mile across. A deep-water harbor capable of mooring up to 9,000 vessels, San Diego Bay has experienced waste discharge from former sewage outfalls, industries, and urban runoff. San Diego Bay also hosts four major U.S. Navy bases with approximately 80 surface ships and submarines. Coastal waters include bays, harbors, estuaries, beaches, and open ocean. Deep draft commercial harbors include San Diego Bay and Oceanside Harbor, and shallower harbors include Mission Bay and Dana Point Harbor. Tijuana Estuary, Sweetwater Marsh, San Diego River Flood Control Channel, Kendal-Frost Wildlife Reserve, San Dieguito River Estuary, San Elijo Lagoon, Batiquitos Lagoon, Agua Hedionda Lagoon, Buena Vista Lagoon, San Luis Rey Estuary, and Santa Margarita River Estuary are the important estuaries of the Region.

There are thirteen principal stream systems in the Region originating in the western highlands and flowing to the Pacific Ocean. From north to south these are Aliso Creek, San Juan Creek, San Mateo Creek, San Onofre Creek, Santa Margarita River, San Luis Ray River, San Marcos Creek, Escondido Creek, San Dieguito River, San Diego River, Sweetwater River, Otay River, and the Tijuana River. Most of these streams are interrupted in character having both perennial and ephemeral components due to the rainfall pattern in the Region. Surface water impoundments capture flow from almost all the major streams.

San Diego Region (9)
SAN DIEGO HYDROLOGIC BASIN PLANNING AREA (SD)



Base map prepared by the Division of Water Rights, Graphics Services Unit

Appendix E. Related Government Mercury Programs

The state and federal government have created many other programs to control mercury pollution. Many of these programs were enacted recently and will help to reduce mercury in fish in California. Some of the major programs are summarized here. Also, state health advisories on fish consumption are described in this appendix. Other programs to address mines and mining are described in a separate appendix.

E.1 Global Programs

United Nations Environment Programme Global Mercury Partnership

The overall goal of the United Nations Environment Programme Global Mercury Partnership is to protect human health and the global environment from the release of mercury and its compounds by minimizing and, where feasible, ultimately eliminating global, anthropogenic mercury releases to air, water and land. The Partnership works closely with stakeholders to assist in the timely ratification and effective implementation of the Minamata Convention on Mercury.

The Minamata Convention on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury. It was ratified at the fifth session of the Intergovernmental Negotiating Committee in Geneva, Switzerland at 7 a.m. on the morning of Saturday, 19 January 2013. As of August 14, 2015, the treaty has 128 signatures from different countries, including the United States.

E.2 National Regulations

Mercury and Air Toxics Standards (MATS)

On February 16, 2012, the United States Environmental Protection Agency (U.S. EPA) issued a regulation that placed emissions standards for hazardous air pollutants from certain fossil-fuel based power plants. (40 C.F.R. §§ 60, 63, 77 Fed.Reg. 9304, amended April 24, 2013, 78 Fed.Reg. 24073.) The rule established, among other regulations, the Mercury and Air Toxics Standards (MATS) to reduce emissions from new and existing coal and oil-fired electric utility steam generating units. This rule is the first to regulate mercury emissions from coal- fired power plants and will ultimately decrease the amount of mercury released by 90% (40 C.F.R. § 63). (https://www.epa.gov/mats).

Mercury Emissions Regulations

U.S. EPA has issued several regulations addressing the major contributors of mercury to the air, including, for example, municipal waste combustors; hospital, medical, and infectious waste incinerators; chlor-alkali plants; and hazardous waste combustors (www.epa.gov/mercury/regs.htm#air or http://www.epa.gov/ttn/oarpg/t3pfpr.html). U.S. EPA issued regulations for these source categories under different sections of the Clean Air Act (42 U.S.C. § 7401 et seq.), including sections 111, 112, and 129. As the result of U.S. EPA's regulatory efforts, the United States achieved a 79 percent reduction in domestic mercury air emissions between 1990 and 2011 (U.S. EPA 2015, U.S. EPA 2016). For cement plants, U.S. EPA issued a final rule On August 9, 2010, to limit emissions of mercury and other toxics from Portland cement plants. (40 C.F.R. §§ 60, 63.).

For petroleum refineries, there is no regulation on mercury in the emissions. The United Nations Environment Programme estimates of emissions to air from human activities show that artisanal and small-scale gold mining is the largest single contributor to mercury emissions (37%), followed by coal combustion (24%), while oil and gas industry emissions from refining and the combustion of oil and natural gas constitute less than 1% of total anthropogenic emissions (United Nations Environment Programme 2013). A U.S. EPA report on mercury emissions from production and processing of petroleum and natural gas estimated that the total amount of mercury released exceed 10,000 Kg yearly in the U.S., but there was a high degree of uncertainly due to lack of data (U.S. EPA 2001).

Mercury Export Ban Act of 2008

The United States enacted the Mercury Export Ban Act on October 14, 2008, and the act went into effect on January 1, 2013. (15 U.S.C. § 2611.) This Act directed federal agencies to permanently store stockpiles of elemental mercury, prohibited the sale, distribution or transfer of mercury by all public agencies in the country, banned exports of mercury from the United States, and established a storage system for stockpiles of mercury. According to the United States Geological Survey (USGS), exports of mercury from the United States dropped from 103 metric tons in 2012 to less than 500 kilograms in 2013; imports also declined from 249 metric tons in 2012 to an estimated 15 metric tons in 2015 (USGS 2016). The decline in imports is likely being driven by technological advancements in LED lighting technology, which has substantially offset demand for elemental mercury in florescent and compact florescent light bulbs. Because the United States is ranked as one of the world's top exporters of mercury, implementation of the act was anticipated remove a significant amount of mercury from the global market. (www.epa.gov/mercury/regs.htm#ban).

Mercury-Containing and Rechargeable Battery Management Act of 1996

The Mercury-Containing and Rechargeable Battery Management Act of 1996 (Battery Act) phases out the use of mercury in batteries, and provides for the efficient and cost-effective disposal of used nickel cadmium (Ni-Cd) batteries, used small sealed lead-acid (SSLA) batteries, and certain other regulated batteries. The statute applies to battery and product manufacturers, battery waste handlers, and certain battery and product importers and retailers (www.epa.gov/mercury/regs.htm#act).

The Frank R. Lautenberg Chemical Safety for the 21st Century Act)

On June 22, 2016, President Barack Obama signed the Frank R. Lautenberg Chemical Safety for the 21st Century Act into law. This act was designed to amend and modernize the 37-year-old Toxic Substances Control Act (TSCA, 15 U.S.C. § 2601 et seq.). Most notably, the Chemical Safety Act requires the U.S. EPA to determine whether a new chemical achieves a health-based safety standard before the chemical can be sold in commercial markets. All newly developed chemicals containing any mercury will fall under the requirements of this Act. In addition, the Chemical Safety Act included new reporting requirements for private entities that manufacture of mercury, and requires U.S. EPA to produce an inventory of mercury supply, use and trade in the United States.

E.3 State Regulations

California's Mercury Reduction Act

California's Mercury Reduction Act (SB 633) effective January 1, 2003 restricts mercury containing products in several ways (DTSC 2002). This act prohibits any school from purchasing devices and materials containing mercury for use in classrooms and labs, except measuring devices when no adequate alternative exists. The act bans the sale or distribution of fever thermometers containing mercury without a prescription from a doctor, dentist, veterinarian or podiatrist. This act also prohibits the manufacture, sale, or distribution of mercury added novelty items in California, such as jewelry, games, maze toys, or toys that light up or make noise. In automobiles, this act encourages removal and recovery of switches containing mercury, i.e., convenience lights under the hood or in the trunk, from vehicles before disposal or recycling of the vehicle. This act bans the sale of vehicles manufactured on or after January 1, 2005, if they have light switches containing mercury.

California's Safer Consumer Products Regulations

The California legislature and Governor Schwarzenegger implemented the California Green Chemistry Initiative (CGCI) in 2008 by passing "joined" bills, AB 1879 and SB 507. A component of the CGCI authorizes and requires the Department of Toxic Substances Control (DTSC) to adopt regulations to establish a process to identify and prioritize chemicals in consumer products and to establish a process for evaluating chemicals of concern in consumer products and their potential alternatives.

As directed by regulation, the DTSC's started the Safer Consumer Products program on October 1, 2013 and is phasing in regulatory measures and program elements for the last three years. The overall goals of the program are to reduce toxic chemicals in consumer products, create new business opportunities in the emerging safer consumer products economy, and reduce the burden on consumers and businesses struggling to identify chemicals in products bought for families and customers. To date, the Safer Consumer Products program has developed a Candidate Chemical List of over 2,000 chemicals of concern, including mercury and several groups of mercury compounds (DTSC 2016). In addition, the Safer Consumer Products program has developed alternatives analyses for Priority Products containing some chemicals of concern. Following an anticipated rulemaking, businesses that manufacture such products will be required to report on chemically safer alternatives for their production processes. (http://www.dtsc.ca.gov/SCP/).

Local Programs

The DTSC is also tasked with implementing regulations regarding Universal Waste (DTSC 2010) and California's Mercury Reduction Act (DTSC 2002). Universal Waste is lower risk waste than hazardous waste. A wide variety of people generate universal waster vs. hazardous waste which is mainly generated by industrial businesses. These programs require recycling and proper disposal of mercury containing products, such as batteries, compact florescent lights (CFLs), by businesses and individual households. There are local programs in many cities to contain mercury in consumer products and prevent the mercury from ending up in run off or sewer systems from improper disposal. Households should check the following web-sites for a location nearest them to take their wastes: CIWMB database, eRecycle.org or Earth911.org.

Mercury-containing items that should be taken to a Universal Waste drop off are:

Batteries. Universal waste batteries include rechargeable nickel-cadmium batteries, silver button batteries, mercury batteries, small sealed lead acid batteries (burglar alarm and emergency light batteries), most alkaline batteries, carbon-zinc batteries, and any other batteries that exhibit a characteristic of a hazardous waste.

Lamps. Universal waste lamps include fluorescent tubes and bulbs, high intensity discharge lamps, sodium vapor lamps, and any other type of lamps that exhibit a characteristic of a hazardous waste. Also, any electric lamp that contains added mercury, whether or not it exhibits a hazardous waste characteristic, is a universal waste.

Mercury thermostats. These thermostats contain small glass capsules with mercury, a shiny liquid metal, to make electrical contact. (Modern electronic thermostats do not contain mercury.)

Mercury switches. Two different types of mercury switches are universal wastes:

1) Motor vehicle switches that contain mercury. Any mercury switch that is removed from a vehicle is a universal waste. When they are to be crushed for scrap, vehicles that contain mercury light switches are also universal waste until the mercury light switches are removed.
2) Non-automotive mercury switches and products that contain them. These switches include thermostats and tip switches in portable heaters, washing machine out-of-balance switches, silent wall switches, and other mercury-containing switches and products containing them. All discarded products that contain mercury switches are universal wastes.

Mercury thermometers, including fever thermometers.

Pressure or vacuum gauges that contain mercury, such as U-tube manometers, barometers, and sphygmomanometers (blood pressure meters.)

Dilators and weighted tubing. These medical devices contain mercury.

Rubber flooring that contains mercury. Some older gymnasium floors that were poured in place to form indoor tracks and gymnastic areas contain mercury.
Mercury-Added Novelties. This category includes practical joke items, figurines, jewelry, toys, games, cards, ornaments, yard statues and figures, candles, holiday decorations, and footwear that contain mercury or mercury batteries. Effective January 1, 2003, the California Mercury Reduction Act banned sale of mercury-added novelties in this state, but some people still have them in their homes.
Mercury gas flow regulators. These older gas flow regulators are managed exclusively by natural gas utilities.
Counterweights and dampers, including devices that use mercury's high density to dampen shaking on hunting bows and snow skis or to absorb recoil on shotguns.
Dental amalgam tooth filling materials including waste amalgam, bits and pieces from chair side traps, and spent wastewater filters.
Gauges. Vacuum and pressure gauges that contain mercury, including blood pressure gauges, barometers, and manometers

Mercury Recycling Pilot Project

The State Water Board, DTSC, U.S. EPA, United States Forest Service (USFS), and Bureau of Land Management (BLM) teamed up in 2000 to go door-to-door collecting mercury in Nevada, Sierra, and Placer Counties. Four hundred pounds of mercury were collected at no charge to residents. USFS and BLM assisted with the cost. (Presentation slides: waterboards.ca.gov/water_issues/programs/cwa401/docs/suctiondredge/mercury_recycle.pdf)

California Bay Area Air District Board - Portland Cement Rule 2012

Regulation 9, Rule 13 Nitrogen Oxides, Particulate Matter and Toxic Air Contaminants from Portland Cement Manufacturing includes strict emissions limits for nitrogen oxides, particulate matter and toxic air contaminants, such as mercury, benzene and hydrochloric acid. Under the new rule, all emissions at the facility must be monitored and must not pose a significant threat to the neighboring community, as demonstrated by a health risk assessment. When the rule was established, there were 10 Portland cement facilities in California. One of these facilities is located in the Bay Area - the Lehigh facility in Cupertino. The rule is expected to lead to dramatic reductions in toxic emissions at the Lehigh facility, such as a 93 percent reduction in mercury emissions, a 90 percent reduction in benzene and a 70 percent drop in hydrochloric acid. The rule will also generate a significant reduction in emissions of NOx, which is an ozone precursor.

E.4 State Health Advisories

Fish Contaminant Goals

The California Office of Environmental Health and Hazard Assessment (OEHHA) developed a methylmercury Fish Contaminant Goal (FCG) that recommends 0.22 mg/kg in fish tissues as a safe concentration for consumption at a rate of one 8 ounce meal a week (32 g/day, Klasing and Brodberg 2008). This is calculated using the same calculation as in the sport fish water quality objective (in the Provisions), using a reference dose (described in Section 3.9) of 0.0001 µg/kg, a body weight of 70 kg, except that OEHHA did not subtract an amount from the reference dose to account for exposure from commercially bought fish.

FCGs were developed using an 8-ounce (227 g) serving size (prior to cooking; approximately six ounces after cooking). FCGs are based solely on public health considerations relating to exposure to each individual contaminant, without regard to economic considerations, technical feasibility, or the counterbalancing benefits of fish consumption.

Advisory Tissue Level

OEHAA also calculated Advisory Tissue Levels (ATLs, Klasing and Brodberg 2008). These guides present similar information as the in the FCG, but in a way that people can more easily understand. The ATLs recommend an amount of fish that is safe for people to eat. These numbers have an additional goal of encouraging consumption of the least contaminated spices. OEHHA Methylmercury ATLs are as follows: Fish with methylmercury concentration of 0.150-0.440 ppm are suitable for one 8-ounce serving a week (equivalent to 32 g/day) for Women aged 18-45 years and children aged 1-17 years. Fish tissue concentrations of 0.070 -0.015 ppm and ≤ 0.070 correspond to two and three meals a week, respectively. ATLs are also provided for the remainder of people (women over 45 and men) that are 3 times as high. ATLs were calculated using the same general formulas as those used to calculate FCGs, with some adjustments in order to incorporate the health benefits of fish consumption. Therefore, the acceptable mercury concentrations in each category range from mercury concentrations above the FCG to mercury concentrations below the FCG. ATLs are not meant to indicate an acceptable concentration of mercury in fish.

Public Education Programs

OEHHA and the California Department of Public Health (CDPH) along with the Water Boards and other local agencies have provide information to the public through multi-lingual signs and pamphlets indicating safer (fish with lower level of contaminant including mercury) fish to eat and suggesting limits for the amount to consume of the more contaminated species.

The Fish Mercury Project was led by the San Francisco Estuary Institute (SFEI) and funded by California and Federal Bay-Delta Program (CALFED). This was a $4.5 million project to examine mercury in fish in the Bay-Delta watershed. The project increased public awareness of fish contamination issues and monitored mercury concentrations around marsh restoration projects in the Delta. Partners in this project included the UC Davis, the California Department of Fish and Wildlife (CDFW), Moss Landing Marine Lab, the CDPH, and OEHHA.

Similarly, the San Francisco Bay Fish Project was a two year project to reduce human exposure to mercury and polychlorinated biphenyls from eating contaminated fish in San Francisco Bay. It was coordinated by CDPH in partnership with the Aquatic Science Center, OEHHA, and the

San Francisco Bay Regional Water Quality Control Board. Primary funding for the project was provided by the Bay Area Clean Water Agencies, the Western States Petroleum Association, the Bay Area Stormwater Management Agencies Association, and U.S. EPA.

The Central Valley Regional Water Quality Control Board is currently working on a public exposure reduction program for anglers in the Sacramento-San Joaquin Delta. This is being done as part of the Sacramento-San Joaquin Delta Estuary Total Maximum Daily Load for Methylmercury.

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Appendix F. Abandoned Mines and Suction Dredge Mining

The Water Boards have several programs under which discharges from mines can be regulated, described in Section 6.9. This appendix contains information on other program related to 1) abandoned mines and 2) suction dredge mining.

F.1 Abandoned Mines Programs

California has an estimated 47,000 abandoned mines, about half of which include gold, silver or mercury mines (Marsh 2014, Department of Conservation 2013). Mercury was historically used in the extraction of gold and silver from rock and sand and was commonly either spilled or improperly disposed of around gold and silver mines. The Office of Mine Reclamation at the California Department of Conservation is a major state agency involved in addressing these mines. Many other agencies can be responsible for mine remediation projects or involved in such projects, including State Mining and Geology Board, California Geological Survey, Department of Toxic Substances Control, California State Lands Commission, Bureau of Land Management, Mine Safety and Health Administration, Office of Surface Mining, U.S. Environmental Protection Agency, U.S. Forest Service, U.S. Geological Survey, U.S. Army Corps of Engineers, National Parks Service, State Parks, the Water Boards, Counties, tribes, and community groups such as the Sierra Nevada Conservancy or the Sierra Fund.

The California Abandoned Mine Lands Agency Group (CAMLAG) was formed to coordinate the efforts of the many agencies involved. These agencies deal with a broad range of concerns associated with abandoned mines. Many mines pose a physical hazard with open pits and shafts that can result in death or serious injury. In addition to mercury, Acid mine drainage and arsenic contamination are other water quality concerns.

F.2 Moratorium on Suction Dredge Mining in California

The California Department of Fish and Wildlife (CDFW) was the main agency regulating suction dredge mining since the 1980's, issuing permits for the activity. Lawsuits concerning possible negative effects of suction dredge mining and the disturbed sediments on salmonid fisheries prompted revisions to the regulations. CDFW was not able to finalize new regulations by the deadline, so the state legislature established a moratorium to prohibit suction dredge mining in 2009 (SB 670).

The State Water Board wrote a letter to the Office of Administrative Law supporting this moratorium dated June 20, 2013. The Water Boards and U.S. Geological Survey investigations have found that although suction dredge mining can remove much of the mercury from sediments, mercury is remobilized by the activity exacerbating the hazard (Humphreys 2005, Fleck et al. 2011, Marvin-DiPasquale et al. 2011).

The legislature extended the moratorium on suction dredge mining indefinitely (AB 120 and SB 1018), until CDFW establishes a permit system that fully mitigates all identified significant environmental impacts identified in its *Final Subsequent Environmental Impact Report (EIR)* and a fee system to cover the regulatory costs of its suction dredge permitting program. For more details see the State Water Board website on suction dredge mining with links to CDFW website: www.waterboards.ca.gov/water_issues/programs/cwa401/suction_dredge.shtml.

On February 27, 2015, SB 637 was introduced in the state legislature which will amend the state water code to require Waste Discharge Requirements (permits from the Water Boards) for suction dredge mining and related mining activities. On October 11, 2015 this bill was signed into law. This bill requires, the State Water Resources Control board to establish a permitting process for suction dredge mining and related mining activities in rivers and streams in the state by July 1, 2017
(https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB637).

If the State Water Board develops a permit for suction dredge mining, any such permits should consider prohibiting suction dredge mining in mercury impaired waters or up stream of impaired waters. For example, in 2013, the Oregon Department of Environmental Quality renewed a permit in which suction dredging is prohibited on any stream segment that is listed as water quality limited for sediment, turbidity, or toxics, including mercury. Suction dredging is also not allowed in state scenic waterways, on or adjacent to tribal lands (Oregon Department of Environmental Quality 2014). Also in certain waters a moratorium on suction dredge mining will go into effect in 2016 pursuant to Section 2 of SB 838 (Oregon Department of Environmental Quality 2015). The moratorium prohibits dredging in all streams above the lowest extent of spawning habitat in rivers and tributaries containing Essential Salmon Habitat or naturally reproducing populations of bull trout. The Oregon moratorium also prohibits dredging in upland areas within 100 yards of these streams if the mining results in the removal or disturbance of vegetation in a manner that may affect water quality.

A recent detailed analysis of waters in the Sierra Nevada Mountains has been conducted to predict which rivers and streams have fish with elevated mercury form legacy mercury in the streams (Alpers et al. 2016).

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Appendix G. Fish Consumption Studies

G.1 Summary

This appendix is a summary of all California fish consumption studies identified to date. Table G-1 lists studies that provide numeric fish consumption rates in a format that is conducive for deriving water quality objectives (expressed as a rate in in units of grams per day (g/day)). Table G-2 and Table G-3 (Section G.3) summarizes results related to subsistence fishing. Section G.3 also includes descriptions of other studies not included in Table G-1, because they did not report the same type of statistics as in Table G-1. Finally, Table G-4 summarizes the studies in terms of the fish species that were consumed, if studies reported such information.

G.2 Consumption Rates

Table 1 shows all California locally-caught sport fish consumption studies with rates expressed in grams per day, which is useful in deriving water quality objectives (studies with rates that could be easily converted to g/day are also included). Better studies have large sample sizes (roughly 1000 or more participants) and are well- documented. The San Francisco Bay Seafood Consumption Study (San Francisco Estuary Institute 2000), shown in bold in Table G-1, is probably one of the highest-quality studies done to date. This particular study provided the fish consumption rate of 32 g/day (1 meal per week), which has been used to represent fish consumption statewide. This rate was the basis of the site-specific objectives for mercury/methylmercury, as well as the Office of Environment Health Hazard Assessment's (OEHHA) choice of consumption rate for their Fish Contaminant Goal. The Santa Monica Bay study is another higher-quality study because of the high number of participants (>1000) and because of its detailed analyses. Other good studies are Shilling et al.'s 2005 Delta study (Shilling et al. 2009, Shilling et al. 2010) and 2014 Tribes study (Shilling et al. 2014), and Allen and colleague's 2005 Ventura and LA County Study (Allen et al. 2008). An additional 15 studies are included in Table G-1. These studies have one or more of the following limitations: a small number of participants, they have not yet been published, or they have not been written into a report form (some studies are just spreadsheets with no supporting information).

Additional notes about the data presented in this summary

Sport/locally-caught consumption data only

All data shown in the tables below is for sport fish/locally-caught only, except as noted in footnote "e" of Table G-1, for the 2005 Women's Health Survey (Silver et al. 2008). Commercial fish consumption rates are reported in many of the studies and many people who consume sport fish also report eating commercial fish; however this data is not shown in the tables. Commercial fish consumption is not the primary activity that the Provisions are meant to protect, but this information is considered as part of other sources of mercury exposure when the objectives are calculated (the "relative source contribution", see Appendix H).

Various statistics reported

Authors report fish consumption rates using a variety of measurements, making side-by-side comparisons difficult. Four types of measures are shown in the following tables: geometric means (geomeans), means (arithmetic means or "averages"), medians (50th percentile), or upper percentile (i.e.: 90th or 95th percentile). The United States Environmental Protection Agency (U.S. EPA) has recommended the use of higher values upper percentile values (i.e.: 90th or 95th percentile; U.S. EPA 2000) for water qualify objectives, and the Water Boards and OEHHA have used these upper percentile values for water quality objectives and fish contaminant goals. However, some studies only report estimates of the central tendency of the data (mean, median, geomeans). Generally, for fish consumption rates, geomeans and medians are lower than mean rates. This is because there are generally many more respondents with low consumption rates than with high consumption rates. For instance, in the San Francisco Bay study, the geomean was 0, the median was 0, the arithmetic mean was 6, and the upper 95th percentile was 32 g/day.

Two major differences in the calculation of rates

Many studies only ask about consumption during a specific time period in the past, for example the previous 30 days ("*recall*" studies). Some people who eat fish in general, will have happened to not eat fish during that period, resulting in consumption rates of zero. This can provide a confusing result of a consumption rate of 0 g/day for a population that says they eat fish. Furthermore, combining these consumption rates of zero with other data can artificially lower the overall consumption rates. Study authors deal with these data in different ways. In the San Francisco Bay, Contra Costa, and Sacramento River studies, rates of zero consumption for respondents who said they ate fish but not in the recall period were used together with the other data to calculate the final statistics. Other studies only used data from people who had eaten fish during the recall period as noted in tables below. However, this later approach can artificially raise consumption rates.

The San Francisco Bay study and the Santa Monica study were also *avidity-adjusted* so that the rates do not overestimate fish consumption. The avidity adjustment is an adjustment made to the consumption rate to account for bias because surveyors are more likely to encounter people who fish more often ("avid" fishers) rather than infrequent fishers. These avid fishers will have higher consumption rates (because they fish often), and since they are fishing often, the avid fishers are more likely to be surveyed. Therefore, these avid fishers will bias the final consumption rates to be higher. The consumption rates that are avidity-adjusted are lower than the non-adjusted rates. Besides the San Francisco Bay study and the Santa Monica study, no other studies appeared to be avidity-adjusted, although some authors make other adjustments (as noted in tables). On the other hand, there several factors why rates from surveys may be biased to underestimate true consumption, and therefore some authors choose not to adjust the rates further downward. For example, some fishers may not report all they really eat out of a concern for an actual or perceived infringement of fishing regulations. Also reluctance to report actual consumption may come from a fisher's cautious attitude toward revealing personal information to the government or to people with a different cultural identity.

Table G-1. California Fish Consumption Surveys – Rates for Sport/Locally-Caught Fish

Survey (Source)	Target Population	Study Method[a], # Participants and/or # Consumers	Consumption Rates in g/day			
			Geomean	Median	Mean	Upper Level (percentile)
California Tribes (Shilling et al. 2014)	California Tribes: community members and tribe staff.	796 participants. Contemporary use: 30 day recall, 580 participants, (consumers and non-consumers) Traditional: Recall, number participants for traditional use 216.				Current: 142 (95^{th}) 240 (99^{th}) Traditional: 223 (95^{th})
2009-10 Gold Country Anglers (Sierra Fund 2011)	All anglers shore and boat ramps	Angler 30 day recall; 159 participants, 123 fish consumers			30	
2005-08 Delta (Shilling et al. 2010)	Shore anglers. Surveyed areas popular among anglers and had high mercury	Angler recall; 373 participants used for rates. Surveyed areas popular among anglers and areas with high mercury		17	27	127 (95^{th})
(Same as above)	Fishers in Asian community	137 community members		21	55	
2005 Ventura and LA Country (Allen et al. 2008)	All shore anglers	Angler creel/4 wk recall; 1243 fishers observed, 495 participants, 238 consumers, 140 used for rates		16	35	71 (90^{th})
2005 Women's Health Survey (Silver et al. 2008)	California women	30 day recall. Est. 700 sport consumers[e]. Results weighted to represent entire population of CA[e]	8			
2005 Delta angler pilot study (CDHS *unpublished*)	Shore anglers	Angler 30 d recall, 97 participants	22			
2005 Contra Costa Boaters (CCCPWD *unpublished*)	All boaters (not all boaters eat fish)	Angler recall, 1310 participants, 567 consumers. Rates from all participants				≥ 32 (95^{th}) [i]
2004 Delta, low-income women (Silver et al. 2007)	low-income women	Low-income nutrition program participants, 30 d recall; 500 participants, 80 sport consumers	11			
2003 Sacramento River Anglers (CDHS *unpublished*)	All anglers: boat or shore	Recall 4 wk recall. 140 participants, 37 consumers. Rates estimated from data from all participants				≥ 32 (95^{th}) [j]
1998-99 women in 12 states (Anderson et al. 2004) [b]	Women of childbearing age	Telephone survey, 12 mo. recall: 179 participants, 15 sport fish consumers (showing only CA results)		3[b]	8[b]	
1998-99 San Francisco Bay	**All anglers: boats and**	**Angler recall 4 wk; 1331 participants, 1152 consumers**	**0**	**0**	**6.3**	**32 (95^{th})**

Table G-1. California Fish Consumption Surveys – Rates for Sport/Locally-Caught Fish

Survey (Source)	Target Population	Study Method[a], # Participants and/or # Consumers	Consumption Rates in g/day			
			Geomean	Median	Mean	Upper Level (percentile)
(San Francisco Estuary Institute 2000)	**piers.**	**(1080 final rates)[f], 537 recent (4 wk) consumers. Avidity adjusted [g]**				
1992 Clear Lake[c] (Harnly et al. 1997)	Native American community	Community members, 6 mo. recall; 63 participants, 23 consumers			60	
1991-92 Santa Monica Bay[d] (Allen et al. 1996)	All anglers: boats and beaches	Angler recall; 1243 participants, 555 recent consumers (at least 1 meal/mo) used for rates. Data later avidity adjusted[g] (ATES/OEHHA 2000)		21 15[g]	50 31[g]	107 (90th) 161 (95th) [k] 85 (95th) [g]
1988-89 San Diego Bay (San Diego County Department of Health Services 1990)	All anglers: boats, piers and shore	Angler recall; 369 participants, 59 year round consumers used for rates, adjusted[h]			31	73 (95th)
1980 Los Angeles (Puffer et al. 1982)	All anglers: boats, piers and shore	Angler creel; 1059 participants. Interviewed those with fish in hand. Used catch and frequency of fishing for rates, not recall.		37		225 (90th)

Notes:

[a] "Recall" generally involved asking participant about past consumption, e.g. in the past 4 weeks. Creel generally indicates the catch in possession at the time of the interview.

[b] Anderson et al. 2004 reports meals per yr. To convert to g/ day, the rate of 4 meals a month was assumed to equate to 32g/day (1 meal being about 8 oz). This study also presented rates for cooked fish, so rates will be lower (about 25% lower) than those for raw fish. Mercury objective will be for raw fish.

[c] Authors reported that advisories were in effects for Clear Lake and the 1991-92 Santa Monica Bay study, and likely in others areas too.

[d] Santa Monica is not an enclosed bay and some of the people used charter boats for ocean fishing. This data may not reflect freshwater/bay fishing, although state agency authorities argue freshwater fishing patterns are not that different (OEHHA 2001). Fish in hand were also counted in rates, which is atypical for these studies.

[e] The reference is a fact sheet more than a full report. In this fact sheet, it is not clear how many sport consumers there were. Authors report 3624 fish consumers (commercial and sport). The report also states that 84% of respondents ate commercial fish and 17% of respondents ate sport fish. To present this information in this summary it was assumed that commercial and sport fish consumption will overlap somewhat, and so approximately 20% of fish consumers ate sport fish, which equates to about 700 people. Also, the report states that the results were weighted to represent entire population of CA. It is not clear what effect this had or how this calculation was done.

[f] Rate calculations included people who ate fish in last 4 weeks and fish eaters who did not eat recently. This is a big difference in Santa Monica bay and other studies compared to the San Francisco Bay study. The San Francisco Bay study used data from people who ate fish in general, NOT just those who at fish in last 30 days (or 4 weeks).

[g] Avidity adjusted: adjusted to reduce bias from avid anglers (ATES/OEHHA 2000).

[h] Average consumption rates were based upon the subset of the population that caught and ate fish. These rates were adjusted to account for the percentage of interviewed anglers who had not caught fish at the time of the interview.

[i] Rates as g/day were not calculated. This report states that 8% ate ≥ 1 meal/wk, so 1 meal/wk or greater was roughly equated to the 95th percentile.

[j] Rates as g/day were not calculated. This report states that 5% of all anglers reported eating fish 4 or more times in the last 4 weeks. This was equated to a 95th percentile for this summary. Among the *fish consumers* (all anglers do not eat fish), 19% ate one meal per week or more. Any consumption in the last four weeks are defined as “high consumers” n= 37, (26%).

[k] Calculated by OEHHA 2001.

G.3 Subsistence Results

Taken as a whole, these studies generally indicate that some ethnic groups have higher fish consumption rates compared to the general population, but not always. The relationship between consumption and demographics seems to be particular to a water body or regional scale. Drawing conclusions about subsistence fishers was challenging because it is hard to define what exactly makes a person a subsistence fisher. Several studies examine fish consumption rates by ethnic group or income. Others define subsistence fishers simply as people with high rates of fish consumption.

Tables 2 and 3 examine the subsistence aspects of the studies listed in Table G-1. Both Table G-2 and Table G-3 report rates of consumption by ethnicity and/or income, but the studies in Table G-2 are larger, while those in Table G-3 are smaller pilot-type studies with sample sizes of roughly 100 participants. The studies that did not present information that could easily be tabulated are described in a list located below Table G-3.

Table G-1. Larger Fish Consumption Studies - Results for Income or Ethnicity

<table>
<tr><th>Survey (Source)</th><th>Target population of study and subsistence aspect</th><th>No. of Participants</th><th>Main Conclusions for Subgroups

Rates are for sport fish /locally caught only.</th></tr>
<tr><td>California Tribes (Shilling et al. 2014)</td><td>California Tribes</td><td>580 for contemporary

216 for traditional</td><td>The entire survey was on California tribes. The results showed this population consumed more fish than the population in many other surveys. The rate of fish use (frequency and consumption rate) was suppressed for many tribes compared to traditional rates, which most tribes attributed to primarily water quantity and quality issues. Contemporary: 142 g/day (95th) vs. Traditional: 223 g/day (95th), with a statistically significant difference in the frequency distribution.

By tribe, the 95th percentile rates of consumption of caught-fish varied ranged between 30 g/day (Chumash) and 240 g/day (Pit River).

Rates broken down by Regional Water Board:
<table>
<tr><th>Region (n)</th><th>Salmon (95th)</th><th>Caught Fish (95th)</th></tr>
<tr><td>North Coast (107)</td><td>119</td><td>162</td></tr>
<tr><td>Central Valley (288)</td><td>43</td><td>83</td></tr>
<tr><td>Lahontan (135)</td><td>20</td><td>72</td></tr>
<tr><td>Central Coast (12)</td><td>8</td><td>30</td></tr>
</table></td></tr>
<tr><td>2005-08 Delta (Shilling et al. 2010)</td><td>All anglers, broken down by ethnicity

Asian community members (separate)</td><td>373 participants used for angler rates.

137 community members</td><td>Native American and whites had the lowest rates (means of 7 and 24 g/day respectively; and 95th percentile for whites of 139 g/day), while Lao had the highest average rate of 58 g/day and a 95th percentile rate of 310 g/day. However, differences were not statistically different. Mean for all 373 participants was 27 g/day and the 95th percentile was 127 g/day. The 95th percentile for all Southeast Asians (286 people including the community members separately) was 129 g/day.

The mean consumption rate for the Asian community member survey was 55 g/day.</td></tr>
<tr><td>2005 Ventura and LA Country (Allen et al. 2008)</td><td>All anglers, broken down by ethnicity</td><td>1243 fishers observed, 495 participants, 238 consumers, 140 used for rates</td><td>African American and “no data” had high rates compared to White and Hispanics were in the middle (tabulated below). For other groups too few individual were surveyed.
<table>
<tr><th>Ethnic Group (N)</th><th>Mean</th><th>Median</th><th>Upper Perc.(90th)</th></tr>
<tr><td>No Data (7)</td><td>92</td><td>32</td><td>250</td></tr>
<tr><td>African American/Black (27)</td><td>42</td><td>32</td><td>97</td></tr>
<tr><td>Latino/Hispanic (31)</td><td>31</td><td>16</td><td>51</td></tr>
<tr><td>White, Non-Hispanic (52)</td><td>28</td><td>16</td><td>56</td></tr>
<tr><td>All anglers</td><td>35</td><td>16</td><td>71</td></tr>
</table></td></tr>
</table>

Table G-1. Larger Fish Consumption Studies - Results for Income or Ethnicity

Survey (Source)	Target population of study and subsistence aspect	No. of Participants	Main Conclusions for Subgroups Rates are for sport fish /locally caught only.
1998-99 San Francisco Bay (San Francisco Estuary Institute 2000)	All anglers, broken down by ethnicity, income, education, fishing mode	1331 participants, 1152 consumers (1080 used for final rates), 537 recent (4 wk) consumers. Avidity adjusted[8]	Income, education and fishing mode (boat or shore) were not good predictors of rates. There are some differences by ethnicity- 49% of Asians and 24% of Caucasians were above advisory, while 26% of Asians and 46% of Caucasians were below advisory. "Above advisory" equated to more than two meals per month, with meal size adjusted for body weight. (Rates for ethnicity were calculated for *recent* consumers (who ate fish in the previous 4 weeks), but the final results were calculated for *all* consumers, so the values for "Overall" do not match those shown in Table G-1.) **Group (n)** — **Geomean** — **Upper Percentile (95h)** African American (41) — 18 — 23 Latino (52) — 13 — 17 Caucasian (158) — 12 — 14 Asian: all subgroups (190) — 15 — 18 Chinese (26) — 15 — 23 Filipino (70) — 17 — 23 Vietnamese (51) — 15 — 19 Pacific Islander (12) — 22 — 45 Other Asian (31) — 13 — 18 Other (7) — 28 — 55 **Overall** (448) — 14 — 15
1991-92 Santa Monica Bay (Allen et al. 1996, SCCWRP and MBC 1994)	All anglers, broken down by ethnicity, income	1243 participants, 555 recent consumers (at least 1 meal/month) used for rates	Consumption rates similar across income (40-59 g/day) with the highest income earners having the highest consumption rate. According to ethnic group break down, consumption was highest for 'other' followed by white (tabulated below). **Ethnicity (n)** — **Mean rates** — **Upper Percentile (90th)** White (217) — 58 — 113 Hispanic (137) — 28 — 64 Black(57) — 49 — 87 Asian(122) — 51 — 116 Other (14) — 137 — 174 All anglers (555) — 50 — 161
1980 Los Angeles (Puffer et al. 1982)	Anglers. Results broken down by ethnicity	1059 consumers	Median consumption rates: Asian/Samoan: 71 g/day Whites: 46 g/day Mexican-Americans: 33 g/day Blacks: 24 g/day

Table G-2. Smaller Fish Consumption Studies - Results for Income or Ethnicity

Survey (Source)	**Target Population / Subsistence Aspect**	**No. of Participants**	**Main Conclusions for Subgroups** Rates are for sport fish /locally caught only, unless noted.
2009-10 Gold Country Anglers (Sierra Fund 2011)	Survey fishing spots were chosen based on likely use by low income anglers, proximity to low-income communities, and absences of entrance fees.	159 participants , 123 fish consumers	No subgroups, but likely to include many low income participants. Mean rate: 30 g/day
2005 Delta angler pilot study (CDHS *unpublished*)	Shore anglers. One goal of study was to look at demographic differences and consumption rates	97 participants,	Blacks had the highest sport consumption: All groups: Geomean 22 g/day White: Geomean 17 g/day Black: Geomean 38 g/day
2004 Delta, low-income women (Silver et al. 2007)	low-income women	500 participants, 80 sport consumers	Minorities are more likely to eat sport fish, eat more sport fish, and are 2 – 3 times more likely to exceed consumption advisories.
2003 Sacramento River Angler Survey (CDHS *unpublished*)	All anglers: boat or shore, conducted by boat Results broken down by ethnicity	140 participants 37 "high consumers"	Any consumption in the last four weeks was defined as "high consumers" The ethnicity of "high consumers" is similar to all anglers. Yet, Hmong made up half the respondents who ate fish once per week or more often, although the n was very small (n=7).
1992 Clear Lake, CA[2] (Harnly et al. 1997)	Californian Tribal community members near Clear Lake	63 participants, 23 consumers	60 g/day mean rate for Clear Lake Tribes

Studies from Table G-1 that seem to address subsistence, but were not included in Table 2 or Table 3

The reason why these studies were not included in Tables 2 or 3 is described below. More details on the studies may be found in Table G-1.

2005 Women's Health Survey (Silver et al. 2008)
Data was broken down by ethnicity, but included commercial fish. There were 3,624 fish consumers, 17% of which ate sport fish. For all consumers, ethnicity was also a strong predictor of sport fish consumption (P = .01) among White (7 g/day), Black/African Americans (11 g/day), Hispanics (9 g/day), and Asians/Others (9.5 g/day).

2005 Contra Costa Boater Survey (CCCPWD unpublished)
This was a boater Survey with 1310 participants. The study included no ethnicity or income information and no rates in the typical manner (units of g/day). A small portion of participants (8%) reported consuming more than 1 meal per week.

1998-99 Women in 12 States (Anderson et al. 2004)
This study included 75% Caucasian participants and a variety of income, but results were not reported or broken down into ethnic/income sub categories. There were not that many participants: 179 participants, 82 fish eaters, 15 people ate 'sport fish'

*1988-89 San Diego Bay (*San Diego County Department of Health Services *1990, OEHHA 2001)*
In this study, the sample sizes were inadequate to break down by sub groups. There were 369 participants, but data from only 59 participants were year round consumers and only those data were used to calculate consumption rates.

G.4 Other Fish Consumption Studies

These additional studies did not include a fish consumption rate (and not enough information was provided to calculate one from the report). Therefore, these studies were not included in Tables G-1 through 3.

Survey of Fishers on Piers in San Diego Bay (Environmental Health Coalition 2005)
The survey population of 109 fishers from South Bay piers was primarily people of Latino or Filipino descent, with smaller numbers of Native American, African American, and European Americans. Of all of the fishers surveyed: 25% fish daily or almost daily (4 to 7 times a week), while 31% fish weekly. Most fishers (61%) eat the fish they catch, and 73% of fishers eat other types of seafood in addition to what they catch.

Fish Consumption and Methylmercury Contamination in Contra Costa (Ma'at Youth Academy)
This study does not report consumption rates per se, but it discusses the fishing habits and the frequency that the catch is eaten among the local population in Contra Costa County, including some highly contaminated fishing spots. The authors report that 73% of all respondents (n = 105) eat some or all of the fish they catch from local fishing spots. Many anglers (57%)fish at the surveyed fishing spot (Richmond Harbor or San Pablo Reservoir) between 1-3 times per month (n = 96). Forty-three percent (43%) of those surveyed, however, fish at this location four or more times per month. Many anglers indicated that they also frequently fish in other local

spots, with 50% of them fishing there between 1-3 times per month, and 50% four or more times per month (n = 98). Species information is also provided.

State of the River 2: The Fish Study (Friends of the Los Angeles River 2008)
The aim of the study was threefold: 1) survey fish present in LA River (with seines); 2) gauge fish health; and 3) interview anglers about their fishing practices. The following species were caught by seine (number caught indicated in parentheses): mosquitofish (668), tilapia (271), green sunfish (92), fathead minnow (83), carp (58), black bullhead (24), Amazon sailfin catfish (7), largemouth bass (1). This study does not indicate that people eat these fish, but is a representation of the fish present in the River. No known native species were collected.

Several anglers (16) were interviewed and the results were presented in a narrative form. The authors divided anglers into two categories: 1) fly fishermen, mostly "Anglo," who mostly practice catch and release, and 2) "subsistence fishermen," who were mostly Latino. Subsistence fishers were defined in the report as fishermen who eat the fish. There was not a discussion of economic need, although the authors report that one fisherman sells his catch to a lady in the Frogtown neighborhood, and another said he sells the fish in Chinatown for fifty cents a pound. The report goes on to describe the habits of fly fishers and subsistence fishers. There has been a somewhat surprising recent surge of interest in fly fishing for carp in the LA River. Subsistence fishers are generally less willing to talk to interviewers. Many anglers report being asked by police to leave or being cited for violating an L.A. City code that forbids loitering along the river. To date, however, every such case that has come before a judge has been immediately thrown out.

Fish Contamination: Environmental and Health Risk (Brown-Williams 2008)
This is not a fish consumption survey, but outlines impacts on communities who fish in contaminated waters. This report also presents data from Silver et al. 2007.

G.5 Fish Species Information from Fish Consumption Surveys

Table G-4. Fish Species Consumed and Trophic Level (TL)

Survey (Source)	Species (percent of respondents who ate this species)	TL*
California Tribes (Shilling et al. 2014)	Tribes used 26 freshwater/anadromous fin-fish species, 23 marine fin-fish species, and 18 other invertebrate, and plant species and groups of species. The single most commonly caught and/or eaten fish species group among all tribes was "salmon", which could include chinook or coho salmon. Catfish and trout were also important as well as smaller amounts of bass, perch, bluegill, carp, and sucker and many other species in smaller amounts (see report).	3,4,3, 4,3,3,3,4 (and many others see report)
Gold Country Anglers 2009-10 (Sierra Fund 2011)	Rainbow/brown trout (77%), any species of bass(65%, largemouth bass 47%, striped bass 45%, small mouth bass 39%) catfish/bullhead (39%), Kokannee (39%), Crappie (28%), Crawdads (26%), sunfish/bluegill (24%), chinook (12%), other (11%), sturgeon (11%), clams(11%).	3/4,4, 4/3,3,4, 3,3,3, (NA),4,2
Delta (Shilling et al. 2010)	"Creel survey data collected by the California Department of Fish and Game (CDFG) indicate that the primary target fish species for all anglers, regardless of ethnicity, in the Northern region of the Central Valley Delta were striped bass, salmon, shad, and catfish (Murphy et al. 1999, 2000; Schroyer et al. 2001)." Summarizing tabulated information on preferences: Striped bass and catfish most popular, while sturgeon, sunfish, Chinook, largemouth bass, and carp were also in the top angler choices.	CDFG Creel: 4,3,3,4 This study: 4,4, 4,3,3,4,3,
Ventura and LA Country (Allen et al. 2008)	"Stocked rainbow trout, channel catfish, bluegill, and common carp were the most frequently consumed species."	3,4,3,3
Delta, low-income women (Silver et al. 2007)	"The most common sport fish species that women reported ever consuming were catfish (43% of 158 sport fish consumers), striped bass (38%), salmon (25%), bluegill/perch (21%), crawdad/crayfish (18%), crab (17%), and trout (17%).	4,4,3,3,3, 3,3
Delta angler pilot study 2005 (CDHS *unpublished*)	catfish (72%), striped bass (72%), bluegill (49%), and largemouth bass (45%), although there were some differences in species consumption by ethnic group.	4,4,3,4
Contra Costa Boater Survey 2005 (CCCPWD *unpublished*)	Striped Bass (39%), Catfish (26%), Sturgeon (20%), Salmon (15%), Black Bass (12%), and 1% or less of Crappie, Bluegill/Sunfish, Crawdad, Sucker, Shark, Trout.	Top 5: 4,4,4,3,4

Survey (Source)	Species (percent of respondents who ate this species)	TL*
Sacramento River Angler Survey Report 2003 (CDHS *unpublished*)	Anglers most often reported striped bass (39% of anglers) and king salmon (25% of anglers). High consumers most often reported consuming either catfish (30%), striped bass (26%), or carp (17%) in the previous 4 weeks. There were differences in target species by fishing method and ethnicity. Boat anglers most often targeted king salmon (49%), but only 8% of shore anglers targeted this species (Table 7). Shore anglers most often targeted striped bass (43%) followed by "any" species (24%). Boat anglers also targeted striped bass (33%). Only 5% of boat anglers targeted "any" species. Over 80% of Caucasian anglers targeted king salmon (45%) or striped bass (36%) (Table 8). Asian/Pacific Islander (API) anglers mostly targeted striped bass (40%) or "any" species (26%)	All: 4,3 High consumer: 4,4,3
San Francisco Bay (San Francisco Estuary Institute 2000)	Top 5 species consumed (% recent consumers reporting consumption): Striped bass (54%), halibut (24%), jacksmelt (17%), sturgeon (17%), white croaker (16%). Also black perch, leopard shark, salmon, brown rockfish, walleye surfperch, shiner surfperch, Pacific Sandabs, Smoothhound Shark, Pacific Sardines. Consumption practices for white croaker, leopard shark, and striped bass were of particular interest due to the higher levels of contaminants found in these species (organochlorine compounds in white croaker, and mercury in leopard shark and striped bass).	Top 5: 4,4,3,4,4
1992 Sulphur Bank Mercury Mine/ Clear Lake, CA (Harnly et al. 1997)	Species consumed (% recent consumers reporting consumption): Catfish (83%), hitch (17%), perch (17%), bass (9%), carp (4%)	4 3,3,4,3
1991-92 Santa Monica Bay Seafood Consumption (Allen et al. 1996, SCCWRP and MBC 1994)	Species with consumption rates: Chub mackerel, barred sand bass, kelp bass, rock fishes, Pacific bonito, white croaker, Pacific barracuda, California halibut, surfperches, jacksmelt (Allen et al. 1996).	3,4,4,4,4, 4,4,4,3,3
Fish Consumption and Methylmercury Contamination In Contra Costa County (Ma'at Youth Academy)	Anglers reported (n=105) that they most frequently catch bass (70%), trout (58%), and catfish (47%). Other species caught with moderate frequency are salmon (31%), halibut (26%), perch (19%), and kingfish (15%).	Frequent: 4,3,4 Moderate: 3,4,3,(NA)

*TL notes the Trophic Level from Table G-5. NA: not applicable or could not be determined from given information.

Table G-5. Trophic Level Categories for Fish Species

Trophic Level 3 (TL3)	Trophic Level 4 (TL4)
Freshwater Fish	
Bullhead (Brown, Black)	Crappie (Black, White, > 150 mm)
Bluegill	Catfish (White, Channel, > *200mm*)
Carp	Largemouth Bass
Crayfish/Crawdad	Sacramento Pikeminnow
Hitch	Smallmouth Bass
Kokannee	Spotted Bass
Perch	Striped Bass
Pumpkinseed	
Rainbow Trout	
Redear Sunfish	
Sacramento Sucker	
Salmon (Chinook or Coho)	
Tule Perch	
Estuarine Fish	
American Shad	Barred Sand Bass
Black Perch	California halibut
Chub Mackerel	Kelp Bass
Crabs	Leopard Shark
Crayfish	Pacific Bonito
Jacksmelt	Pacific Barracuda
Opaleye	Rockfish (Brown)
Pile Perch	Spotted Sand Bass
Surfperch (Rainbow, Shiner)	Striped Bass
Striped Mullet	Sturgeon
	White Croaker
	Yellowfin Croaker

Sources: Most freshwater TL classifications from the Delta methylmercury TMDL staff report (Table B1, Central Valley Water Board 2010). Catfish and crappie are TL3 if > 200 mm. Since the human health objective will apply to a specific size of fish (150mm at minimum) and most fish caught by SWAMP are well above this size, these species were categorized as TL4. Estuary species classifications partly from Davis et al. 2012. Also, for estuarine species, the San Francisco Bay TMDL Staff Report (San Francisco Bay Water Board 2006) was used for species in the San Francisco Bay Study: jacksmelt was trophic level 3, and striped bass, halibut, sturgeon, and white croaker were trophic level 4. American shad eat mostly invert and fish larvae according to Moyle (2002), so shad were characterized as TL3. Salmon (data often do not refer to a specific type of salmon) were also categorized as TL3. Crayfish and crabs were classified as TL3. In the USFWS wildlife analysis (USFWS 2003, p 29), some species were classified as TL3, but some TL2. U.S. EPA classified crabs as TL 3.3 (U.S. EPA 1995). Clams were classified as TL2.

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Appendix H. Calculation of the Human Health Objectives

This appendix provides the equations used to derive the water quality objectives to protect human health. This includes different options for the water quality objective that were considered in the issues analysis (Chapter 6 of the Staff Report) for recreational fishing and subsistence fishing. More specifically, in this appendix, calculations are shown for the 1) Sport Fish Water Quality Objective, 2) the Subsistence Fishing Water Quality Objective, and 3) Native American Tribal Subsistence Fishing Water Quality Objective. Also information on the calendar year averaging period is at the end of this appendix (Section H.4).

H.1 Calculation of the Methylmercury Water Quality Objective to Protect Human Health

The water quality objective for human health was calculated using United States Environmental Protection Agency's (U.S. EPA) equation for calculating the fish tissue criterion (U.S. EPA 2001):

$$FTC = \frac{BW*(RfD-RSC)}{FI} \quad (1)$$

where,

FTC = fish tissue concentration in milligrams (mg) methylmercury (MeHg) per kilogram (kg) fish. **The FTC value is the methylmercury water quality objective.**

BW = human body weight, default value of 70 kg

RfD = reference dose of 0.0001 mg MeHg/kg body weight-day. The value was derived from a study of mothers and their children in the Faroe Islands, where fish and whale is a large part of the diet. The blood mercury concentration in the umbilical cord was correlated to cognitive effects in the children.

RSC = relative source contribution, estimated at 2.7 x 10^{-5} mg MeHg/kg body weight-day. This value is subtracted from the reference dose to account for other sources (e.g., store bought marine fish).

FI = fish intake (kg fish/day), which is the consumption rate of locally caught fish (see Section H.2).

H.2 Fish Consumption Rate

The U.S. EPA provided values for all parameters in equation 1 including a fish intake rate of 17.5 grams per day (g/day) based on national data to derive the methylmercury criterion of 0.3 mg/kg. However, the U.S. EPA encourages modification of the fish intake rate to protect the population of concern (U.S. EPA 2001). Also, the U.S. EPA "strongly believes that States and authorized Tribes should … develop criteria, on a site-specific basis, that provide additional protection appropriate for highly exposed populations" (U.S. EPA 2000). Therefore, alternative fish consumption rates for the water quality objectives for California were considered. To protect the majority of the population U.S. EPA recommends using the 90 and 95th percentiles from fish consumption surveys, as opposed to average rates (e.g. arithmetic mean, median, geometric mean).

At least two dozen fish consumption studies have been carried out in California. For a complete list of California fish consumption studies, see Appendix G. Table H-1 shows fish consumption rates used as options for the statewide mercury objectives and other consumption rates used by U.S. EPA and other state are shown for comparison (discussed in the Staff Report, Sections 6.2 and 6.5).

U.S. EPA derived the recommended methylmercury water quality criterion using a default fish intake rate for the general population of 17.5 g/day (U.S. EPA 2001). The data was originally from surveys, titled, *Continuing Survey of Food Intakes by Individuals* (CSFII), which are conducted annually by the United States Department of Agriculture. U.S. EPA summarized the methods and results of the 1994-1996 and 1998 CSFII surveys in a report titled, *Estimated per capita fish consumption in the United States* (U.S. EPA 2002). The rate of 17.5 g/day represents general U.S. consumption (90th percentile) for people who do and do not eat fish. From that same data set U.S. EPA derived a default fish subsistence consumption rate of 142 g/day (Table H-1).

Table H-1 also includes California's most often used fish consumption rate from the San Francisco Bay Seafood Consumption Survey (San Francisco Estuary Institute 2001). This study recognized as one of the best and largest surveys to date in California, and is the basis of the one meal a week fish consumption rate that has been used in the past by Water Boards and other agencies. This study was used to derive Fish Contaminant Goals by the Office of Environmental Health Hazard Assessment (described in Appendix E). The one fish meal a week rate has also been used to establish a site-specific water quality objective for San Francisco Bay and the Sacramento-San Joaquin Delta. The San Francisco Bay study did not specifically target recreational fishers or subsistence fishers, but surveyed anyone fishing at the time of the survey.

Also included in Table H-1 is the recently established fish consumption rate for Oregon and rates proposed for Washington and Maine, which are much higher rates (five to nine meals per week) than has been used in the past. Another study listed in Table H-1 is the Santa Monica Bay study, which was considered the best study to date in California (Office of Environmental Health Hazard Assessment 2001) until the San Francisco Bay study was published. The Santa Monica Bay study includes more ocean fish, while the geographic scope of this project does not include ocean waters.

Table H-1. Selected Fish Consumption Rates

Type/Source	Fish consumption rate in grams per day (g/day)	Equivalent 8 oz. meals/week of locally caught fish	Resulting Water Quality Objective (mg MeHg/kg fish)
General U.S. population (U.S. EPA 2000)	17.5	0.5**	0.3*
San Francisco Bay anglers (San Francisco Estuary Institute 2001),	32*	1**	0.2*
1991-92 Santa Monica Bay (Allen et al. 1996)	107	3**	0.05*
Subsistence, U.S. population (U.S. EPA 2000)	142*	4.4	0.05
California Tribes - contemporary (Shilling et al. 2014)	142*	4.4**	0.04*
California Tribes: two generation ago (Shilling et al. 2014)	223	7	0.03
Oregon, including Columbia River Tribes (Oregon Department of Environmental Quality 2011)	175	5-6	0.04
Proposed by U.S. EPA for Washington State (80 FR 55063, September 14, 2015)	175	5-6**	0.03*
Proposed by U.S. EPA for Maine (81 FR 23239, April 20, 2016)	286	9	0.02***

*Included in the options analysis in Sections 6.2 and 6.5 of the Staff Report.

**Indicates an additional small portion of store bought fish is included in the relative source contribution (equation 1), which is not included in the estimate of "Equivalent 8 oz. meals/week of locally caught fish".

***For Maine, the U.S. EPA proposed to use trophic-specific fish consumption rates of 103 g/day (trophic level 2), 114 g/day (trophic level 3), and 68.6 g/day (trophic level 4).

Table H-2A. Variables Used for Calculation of the Mercury Objective and the Possible Resulting Objectives

FI (kg/day)	Rfd (mgMeHg/ kg bw *day)	RSC (mgMeHg/ kg bw *day)	BW (kg)	Resulting Water Quality Objective (mg MeHg/kg fish)	Aprox. Meals Per Week Protected
0.0175	0.0001	0.000027	70	0.29	0.5*
0.032	0.0001	0.000027	70	0.16[1]	1*
0.142	0.0001	0	70	0.049[2]	4.4
0.142	0.0001	0.000027	70	0.036[3]	4.4*
0.182	0.0001	0	70	0.038	5.6
0.223	0.0001	0	70	0.031	7
0.175	0.0001	0	70	0.040	5
0.107	0.0001	0.000027	70	0.048	3*

*also includes an additional moderate amount of store-bought fish that is not included in the "Aprox. Meals Per Week Protected".

[1] The Sport Fish Water Quality Objective in the Provisions

[2] The Subsistence Fishing Water Quality Objective in the Provisions

[3] The Native American Tribal Subsistence Fishing Water Quality Objective in the Provisions

Table H-2B. The Effect of a Greater Body Weight Value on the Possible Resulting Objectives

FI (kg/day)	Rfd (mgMeHg/ kg bw *day)	RSC (mgMeHg/ kg bw *day)	BW (kg)	Resulting Water Quality Objective (mg MeHg/kg fish)	Aprox. Meals Per Week Protected
0.0175	0.0001	0.000027	80	0.33	0.5*
0.032	0.0001	0.000027	80	0.18	1*
0.142	0.0001	0	80	**0.056**	4.4
0.142	0.0001	0.000027	80	0.041	4.4*
0.182	0.0001	0	80	0.044	5.6
0.223	0.0001	0	80	**0.036**	7
0.175	0.0001	0	80	**0.046**	5
0.107	0.0001	0.000027	70	0.0546	3*

Table H-2A shows all values used to derive possible water quality objectives based on the various consumption rates from Table H-1. The resulting values used for the water quality objectives in the Provisions are indicated by footnotes. For some of the calculations the relative source contribution (see equation 1) was set at zero because it was assumed that the population was not consuming store bought fish, such as for some subsistence fishing values. If the reference suggested that the population also bought a smaller portion of fish, then the standard value used by U.S. EPA for the relative source contribution was included in the calculation of the possible resulting water quality objective and is shown in Table H-2A.

U.S. EPA has recently revised some of the standard parameters used for calculating human health water quality criteria. They have increased the body weight from 70 to 80 kg to reflect the increasing weight of the U.S. population. U.S. EPA has not yet updated the national recommended mercury criterion with the change in body weight. To test how this change would affect the resulting possible objective, the 80 kg body weight was used to re-calculate the possible water quality objectives in Table H-2B. Overall, the resulting possible objectives did not change much when using the 80 kg body weight vs. 70 kg. Only the results for three of the eight possible values for the objective slightly increased (shown in bold in H2-B). The comparison was made considering that the final objective will be expressed with only one significant digit as is the U.S. EPA criterion. For more information on the increase of the average weight of a person to 80 kg. see http://water.epa.gov/scitech/swguidance/standards/criteria/health/.

Of the options listed in Table H-2A, the issues analysis (Section 6 of the Staff Report) only considers the first four options. For the objective for tribal subsistence fishing, the contemporary rate for tribes was used, which is the same as the U.S. EPA nationally recommended subsistence rate. With store bought fish included, the objective calculated from the contemporary rate (0.04 mg/kg) was close to the objective calculated from the traditional rate (0.03 mg/kg). The last four values, including those from Oregon and an older California study (Allen et al. 1996) are provided for comparison.

H.3 Application of the Objective to Mixed Consumption Patterns

H.3.1 Trophic Level Averaging During Data Assessment

The way that the water quality objective is applied to trophic level 3 and trophic level 4 fish affects how stringent the objective will be. This is because trophic level 4 fish species, such as bass and catfish, accumulate more mercury than trophic level 3 species, such as trout, anadromous salmon, and carp (Figures H-1 and Figure H-2), since these species are highest on the food chain (see Section 4.2 of the Staff Report). Applying the objective to only trophic level 4 fish is more stringent than applying the objective to only trophic level 3 fish, because trophic level 4 fish have higher concentrations of mercury in the tissue than trophic level 3 fish. Applying the objective to a mixture of trophic level 3 and trophic level 4 fish is a middle level of stringency. Using a mixed consumption (a mixture of trophic level 3 and trophic level 4 fish) may better represent the population being protected and could save valuable resources by making the objective easier to achieve (making the objective less stringent).

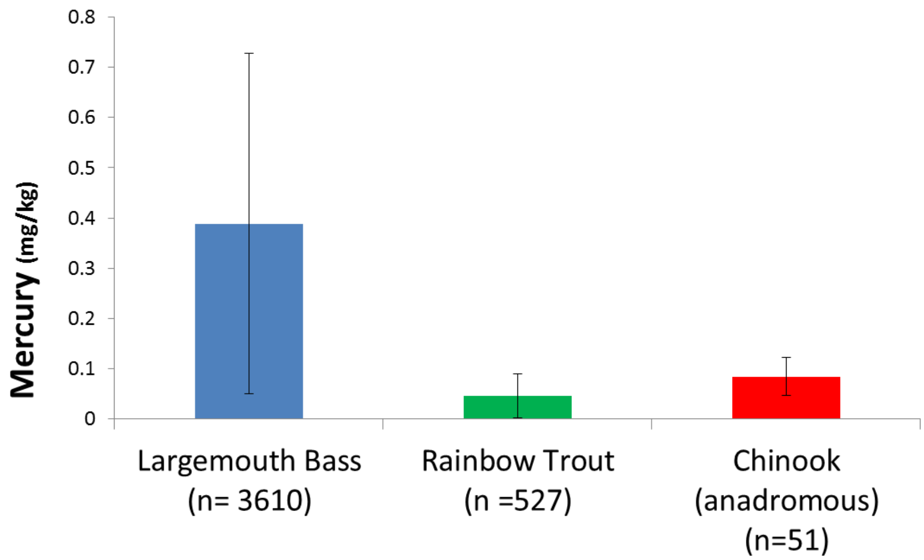

Figure H-1. Mercury concentrations in largemouth bass, rainbow trout, anadromous chinook salmon in California. Largemouth bass and trout were 150-500 mm. Chinook were 500-1000 mm. Data from ceden.org.

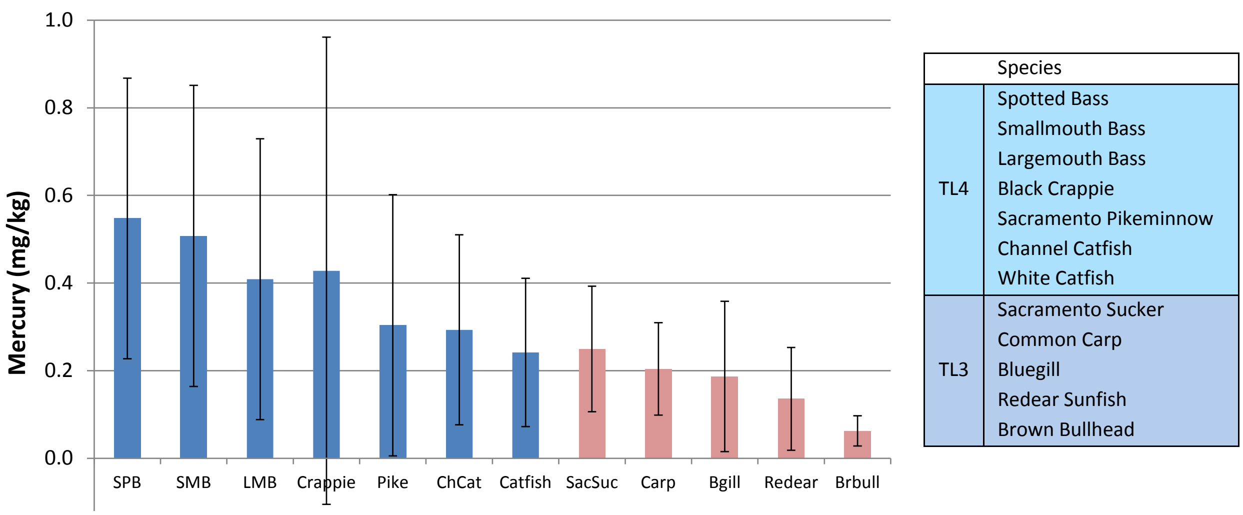

Figure H-2. Average mercury concentrations in California warm water fish. Trophic level 4 species (blue) generally have mercury concentrations that are twice as high as trophic level 3 species (pink). Data are from ceden.org and described in (Appendix L). Error bars represent standard deviation.

U.S. EPA advises “If target populations consume fish from different trophic levels, the state or authorized tribe should consider factoring the consumption by trophic level when computing the average methylmercury concentration in fish tissue. To take this approach, the state or authorized tribe would need some knowledge of the fish species consumed by the general population so that the state or authorized tribe could perform the calculation using only data for fish species that people commonly eat” (U.S. EPA 2010). This U.S. EPA advice specifically describes how to treat a data set for measuring compliance with the objective. The average fish tissue concentration (FTC_{ave}) of mercury in trophic level 3 and trophic level 4 fish would be calculated and compared to the objective using the equations:

$$([HgTL4] \times \%TL4) + ([HgTL3] \times \%TL3) = FTC_{ave} \quad (2)$$

where,

$\%TL3$ = percent of trophic level 3 fish in diet from an angler survey
$\%TL4$ = percent of trophic level 4 fish in diet from an angler survey
[Hg TL3] = average measured mercury concentration in trophic level 3 fish
[Hg TL4] = average measured mercury concentration in trophic level 4 fish
FTC_{ave} = the resulting average fish tissue concentration

Ultimately this approach is not recommended for statewide application of the objective to protect recreational fishing (the Sport Fish Water Quality Objective). This is because some people eat mostly trophic level 4 fish and it will be difficult to ensure protection of wildlife (see Staff Report, Section 6.3 and Section H.3.2 through Section H.3.6).

For a subsistence fishing-type water quality objective, this approach (incorporating a mixed consumption pattern during data assessment) is the recommended way to incorporate a mixed consumption pattern. Another approach is described in the Sections H.3.2 through – Section H.3.5, in which two objectives are derived. Section H.3.6 describes how the approach described in this section is preferable since it includes less assumptions and uncertainty vs. the approach described in Section H.3.2 through – Section H.3.5.

H.3.2 Separate Objectives for Different Trophic Levels

Evidence that people eat fish from different trophic levels can also be used with equation 2 to separate the water quality objective into two water quality objectives: one for trophic level 3 species and another for trophic level 4 species. For example, the objective for the Sacramento San Joaquin Delta was applied to a 50:50 mixture of trophic level 3 and trophic level 4 fish and different objectives were derived for the two types of fish: 0.24 mg/kg in trophic level 4 fish and 0.08 mg/kg in trophic level 3 fish.

To do this calculation, a ratio is required of the mercury concentrations trophic level 3 and trophic level 4 fish. For the Delta, the mercury concentration in trophic level 4 fish was 3 times higher than the trophic level 3 fish, so the ratio was 3 (Central Valley Water Board 2010). Objectives can be derived for specific trophic levels with the following equations, (equation 3 is similar to equation 2):

$$FTC_{ave} = ([HgTL4] \times \%TL4) + ([HgTL3] \times \%TL3) \qquad (3)$$

substituting [HgTL4] = (R4/3) × [HgTL3]

$$FTC_{ave} = ([HgTL3] \times (R4/3) \times \%TL4) + ([HgTL3] \times \%TL3) \qquad (4)$$

solving for [HgTL3]

$$[HgTL3] = FTC_{ave} / [(\%TL4) \times (R4/3) + ((\%TL3)\ ] \qquad (5)$$

where,

%TL3 = percent of trophic level 3 fish in diet from an angler survey
%TL4 = percent of trophic level 4 fish in diet from an angler survey
[Hg TL3] = allowable mercury concentration in trophic level 3 fish
[Hg TL4] = allowable mercury concentration in trophic level 4 fish
FTC_{ave} = Average fish tissue concentration, from equation 1, based on a given consumption rate.
R4/3 = the ratio of the average measured mercury concentration in trophic level 4 fish to the average measured mercury concentration in trophic level 3 fish.

U.S. EPA estimates trophic level 3 fish have four times less mercury than trophic level 4 fish (U.S. EPA 2001, Appendix A: Draft national methylmercury bioaccumulation factors). An analysis of California fish mercury data (using all data available for the whole state) found that trophic level 4 fish have mercury concentrations two times higher than the mercury concentration in the trophic level 3 fish in the same waters (Appendix L)[20]. However, this California ratio was based on a limited data set. Most of the data were from the Central Valley, which are warm water fisheries most suitable for species of bass, catfish, perch, crappie, and sunfish. This ratio is not very applicable to waters with trout. The proportion of waters that have trout only or a mixture of trout and bass can be estimated from existing monitoring data. Of currently monitored waters, 5% of waters have both trout and bass, while 36% have only trout. The remaining 59% of the waters sampled did not have trout, but had bass (www.ceden.org, see also Figure K-3 in Appendix K).

[20] All TL4 species data were used to calculate the ratios, which happened to be mostly bass (68% bass, 14% channel catfish, 9% pikeminnow, 8% black crappie). Generally monitoring programs have primarily caught bass if bass are available. If only data in bass are available for assessment, then the assessment will be a bit over protective compared to the way these ratios were calculated.

H.3.3 Separate Objectives for Different Trophic Levels – Recreational Fishing

Two example trophic level specific objectives were derived that would protect consumption of one fish meal per week (0.016 mg/kg in fish tissue on average, from Table H-2A) with 50% consumption from trophic level 3 and 50% consumption form trophic level 4, with the following calculations:

$$[HgTL3] = FTC_{ave} / [(\%TL4) \times (R4/3) + ((\%TL3)]$$
$$[HgTL3] = 0.16 / [(0.5) \times (2) + (0.5)]$$
$$[HgTL3] = 0.106$$
$$[Hg\ TL4] = 0.213$$

In this example, the objective for trophic level 4 fish would be 0.2 mg/kg and for trophic level 3 fish the objective would be 0.1 mg/kg. This is essentially equivalent to applying the water quality objective to trophic level 4 fish only, since the objective in trophic level 4 fish is the same value (0.2 mg/kg, when rounded to one significant figure as done in the U.S. EPA criterion). Therefore, the mixture provides no advantage in terms of achievability.

Alternatively, if we use U.S. EPA's ratio of 4, based on national data (U.S. EPA 2001, Appendix A: Draft national methylmercury bioaccumulation factors), which might better represent waters with mixture of trout and bass, the two objectives would be calculated as:

$$[HgTL3] = FTC_{ave} / [(\%TL4) \times (R4/3) + ((\%TL3)]$$
$$[HgTL3] = 0.16 / [(0.5) \times (\mathbf{4}) + (0.5)]$$
$$[HgTL3] = 0.064$$
$$[Hg\ TL4] = 0.25$$

In this example, the objective for trophic level 4 fish would be 0.3 mg/kg and the objective for trophic level 3 fish would be 0.06 mg/kg. In this scenario there is an advantage because the objective for trophic level 4 is more achievable. However, it is likely *more* difficult to achieve the trophic level 3 objective of 0.06 mg/kg. This may be difficult to achieve in warm waters, where a statewide data analysis suggests that if bass have a mercury concentration of 0.3 mg/kg, then trophic level 3 fish probably have a concentration of 0.15 mg/kg in (a factor of 2 difference, Appendix L). Overall, since the ecosystems in California vary so widely, one set ratio will not accurately represent conditions in many waters. Therefore, it may be too difficult and impractical to use this mixed consumption pattern approach to derive two sport fish objectives for trophic level 3 and trophic level 4 fish on a statewide basis.

Although the 50:50 mixture does not provide an advantage as described above, this approach was tested further using other mixture scenarios. Table H-3 shows the results of various mixtures, other than the 50:50 mixture. These are evaluated further in regards to protecting wildlife in the next section.

Table H-3. Potential Mercury Objectives Using Mixed Consumption Scenarios, Protecting One Meal per Week of Fish Consumption

Mixture		Potential water quality objectives, calculated from the trophic level ratio of 2 (California, Appendix L)		Potential water quality objectives, calculated from the trophic level ratio of 4 (Nationwide, U.S. EPA 2001)	
%TL4	**%TL3**	**TL3 Mercury (mg/kg)**	**TL4 Mercury (mg/kg)**	**TL3 Mercury (mg/kg)**	**TL4 Mercury (mg/kg)**
0	100	0.16	0.32	0.16	0.64
10	90	0.15	0.29	0.12	0.49
20	80	0.13	0.27	0.10	0.40
30	70	0.12	0.25	0.08	0.34
40	60	0.11	0.23	0.07	0.29
50	**50**	**0.11**	**0.21**	**0.06**	**0.26**
60	40	0.10	0.20	0.06	0.23
70	30	0.09	0.19	0.05	0.21
80	20	0.09	0.18	0.05	0.19
90	10	0.08	0.17	0.04	0.17
100	0	0.08	0.16	0.04	0.16

Note: values shaded grey will not protect wildlife (see text).

H.3.4 Separate Objectives for Different Trophic Levels – Wildlife

The water quality objective that will protect recreational fishing (Sport Fish Water Quality Objective, based on one meal per week) is also intended to protect most wildlife (see Staff Report Section 6.2 and Section 6.8). If the mixture scenarios cannot ensure that wildlife are protected they will not be very useful. The analysis for the wildlife targets (in Appendix K) found that 0.08 mg/kg is needed in trophic level 3 fish 150-350 mm (roughly 0.1 in trophic level 3 fish 150-500 mm) to protect merganser and grebe, which are widely distributed through the state. Also this target in trophic level 3 150-300 mm is consistent for maintaining protection for light-footed clapper rail and Yuma clapper rail that eat small fish or fish lower on the food chain. Therefore, if two objectives are used to protect mixed consumption by sport fishers, the trophic level 3 objectives should be no higher than 0.08 mg/kg in fish 150-300 mm (or an equivalent that provides the same protection for wildlife). This equates to 0.1 in trophic level 3 fish of larger size: 150-500 mm (Appendix K).

Table H-3 shows the resulting mercury concentration in the top two trophic levels of various mixture scenarios based on an objective to protect a meal a week of fish. Values shaded grey in the table are above the protective wildlife targets of 0.1 mg/kg in trophic level 3 fish 150 – 500 mm, or they are 0.4 or higher in trophic level 4 fish which is not protective of osprey and eagles (Appendix K). Table H-3 shows that when the concentration in trophic level 3 fish is 0.1 the equivalent concentration in trophic level 4 is 0.2 mg/kg, which is equivalent to applying the objective to trophic level 4 fish only. All scenarios that protect wildlife equate to 0.2 in trophic level 4 fish. Again, this approach does not improve achievability or provide much advantage over simply setting the objective as 0.2 mg/kg in trophic level 4 fish (as shown in Table H-2A).

However, if *site-specific* mercury concentrations in fish are used (versus the one statewide ratio calculated in Appendix L), this mixture approach may be useful. The results of using the ratio of 4 from U.S. EPA is shown as an example in Table H-3.

H.3.5 Separate Objectives for Different Trophic Levels –Subsistence Fishing

Below are examples of mixed consumption patterns that could be used with higher fish consumption rates to protect subsistence fishers or tribes. The calculation can also be modified to include trophic level 2, which includes shellfish. For the ratio of trophic level 2 to trophic level 3, the ratio of 5.7 from U.S. EPA national default values was used (U.S. EPA 2001). For the ratio of trophic level 3 to trophic level 4, the ratio of 2 from Appendix L was used.

Shilling et al.'s survey of California Tribes found that two generations ago tribes ate non-native, trophic level 4 species, such as catfish, bass, brown trout, but the majority of the diet is trophic level 3 species, and that the pattern of fish use is similar today (Shilling et al. 2014). Many non-native fishes were introduced to California waters in the 1870s and 1890s, including small mouth bass, largemouth bass, striped bass, channel catfish, white catfish, yellow perch, common carp, and others (Moyle 2002, Table 10). Since then, some of these non-native species have become part of the fishing habits of many tribes. Fish consumption two generations ago included 31% trophic level 4 species, on average for all tribes statewide. Shilling organized the data by Water Board regions and the North Coast Region had the lowest potion of trophic level 4 species, at 21%, and the Lahontan Region had the highest portion of trophic level 4 species, at 36% (Shilling et al. 2014, Table 4). Table H-4 shows the resulting objectives for different trophic levels, based on a variety of species compositions.

Table H-4. Potential Subsistence Objectives Using Mixed Consumption Scenarios

FTC_{ave}	%TL2	%TL3	%TL4	TL2 Objective (mg/kg)	TL3 Objective (mg/kg)	TL4 Objective (mg/kg)
0.049	0	1	0	0.0086	0.049	0.098
0.049	0	0.9	0.1	0.0078	0.045	0.089
0.049	0	0.8	0.2	0.0072	0.041	0.082
0.049	0	0.7	0.3	0.0066	0.038	0.075
0.049	0	0.6	0.4	0.0061	0.035	0.070
0.049	0.2	0.6	0.2	0.0083	0.047	0.095
0.036	0	1	0	0.0063	0.036	0.072
0.036	0	0.9	0.1	0.0057	0.033	0.065
0.036	0	0.8	0.2	0.0053	0.030	0.060
0.036	0	0.7	0.3	0.0049	0.028	0.055
0.036	0	0.6	0.4	0.0045	0.026	0.051
0.036	0.2	0.6	0.2	0.0061	0.035	0.070

The calculations in Table H-4 were done using 1) a fish consumption rate of 142 g/day and 2) the rate of 142 g/day plus the U.S. EPA relative source contribution to represent consumption of a small amount of store bought fish. These rates yielded objectives of 0.05 and 0.04 mg/kg, respectively (after the value is rounded). For example, if the diet is assumed to be 30% trophic level 4 fish, the raw value for an objective of 0.036 mg/kg could be separated into two objectives of: 0.06 mg/kg in trophic level 4 fish (bass, catfish, crappie) and 0.03 in lower trophic level 3 fish (salmon, trout, suckers, blue gill, carp). This equates to an overall diet with 0.04 mg/kg mercury.

Again, the advantage of the application of the objective to a mixed consumption pattern is that the objective is a more realistic representation of the species consumed and the objective is easier to achieve. However, in this case the two separate objectives may not improve achievability. The 0.03 value may not be currently attainable in salmon since the current average concentration in anadromous chinook is 0.08 mg/kg (Figure H-1). For anadromous salmon like chinook, the mercury is not from the water body the fish are caught in. These fish feed mostly in the ocean and mercury in ocean fish cannot be controlled though California dischargers. The mercury concentration of 0.03 mg/kg is not currently attainable in most other species. On the other hand, 0.05 or 0.04 mg/kg is attainable in waters with only rainbow trout (and other trout species, except brown trout) since 0.05 is the average concentration in trout presently (Figure H-1). Since the approach of using a mixed consumption pattern by deriving separate objectives for the different trophic levels provides no advantage in these scenarios, it is not recommended for the mercury water quality objectives.

H.3.6 Recommendations for Options to Consider for the Issues Analysis

There are two ways to apply the water quality objective to a mixed consumption pattern (a mixture of trophic level 3 and trophic level 4 fish), but only one seems worthwhile on a practical basis. The more practical approach is to calculate the average mercury concentration in the two fish types during data assessment (Section H.3.1), vs. deriving an objective for trophic level 3 species and another objective for trophic level 4 species (Sections H.3.2 through Section H.3.5). The two objectives approach did not provide the advantage of making the objectives easier to attain, and the objective became more complicated. Also, the recommended approach of averaging data during assessment will also be more accurate because the exact ratio of mercury in trophic level 3 fish to mercury in trophic level 4 fish is likely ecosystem specific. It is best to avoid unnecessary additional assumptions that would be part of calculating a ratio of mercury in trophic level 3 fish to mercury in trophic level 4 fish that would be applied statewide.

For an objective based on one meal per week (0.2 mg/kg) to protect recreational fishing (the Sport Fish Water Quality Objective), it is recommended that the objective should not be applied to a mixed consumption pattern. Conversely, it is recommended that the objective is applied to highest trophic level fish. This is because some people eat mostly trophic level 4 fish (see Staff Report, Section 6.3 or Section G.5 of Appendix G). Also, if data are averaged during assessment it will be difficult to ensure that wildlife are protected, using the water quality objective for recreational fishing. To save monitoring resources, it is preferable to establish one objective that protects both recreational fishing and wildlife, if possible (see Staff Report, Section 6.8).

If a mixed consumption approach is used to protect recreational fishing (contrary to the recommendation above), then to ensure statewide protection of wildlife, a trophic level 3 objective should be established as 0.08 mg/kg in fish 150-300 mm (or no higher), or an equivalent. This concentration of 0.08 mg/kg in trophic level 3 fish protects mergansers and grebes and ensures protection for other species such as otters (Appendix K). An equivalent objective could be 0.05 mg/kg in fish 50-150 mm, since it provides similar protection (it just applies to a different size of fish, Appendix K).

For a subsistence level fishing objective, it will be easier to attain such objective in trophic level 3 species because trophic level 3 species have lower mercury levels than trophic 4 species in the same waters. However, some subsistence fishers (e.g. tribes, communities in the delta) also consume trophic level 4 fish. For the subsistence objective to be applied to relevant species, the objective should be stated in a manner that can be adapted to the species present in a particular water body. If multiple trophic levels are present and consumed, the objective should be applied to a mixed consumption pattern. The mercury concentrations in multiple species should be averaged during the assessment procedures (as shown in Section H.3.1), because specific ratios and relationships vary across the state. The recommended default composition is 30% trophic level 4 and 70% trophic level 3 (from Shilling et al. 2014). This composition should be modified based on site-specific evidence. Site-specific information may be available for some tribes in the fish use survey (Shilling et al. 2014) or by contacting the author.

Few waters will support subsistence level of fishing, perhaps 20% of all lakes and 30% of all rivers and streams (Davis et al. 2010, Fig.3, Davis et al. 2013, Fig. 7) and these are generally waters with no trophic level 4 species. Very few coastal locations (~ 1%) would support a subsistence objective if it included trophic level 4 fish (Davis et al. 2012). However, the only way to ensure these few waters will maintain water quality that supports a subsistence level of fishing would be for Regional Water Boards (Regional Water Quality Control Boards) to designate those waters with a subsistence fishing type of beneficial use and apply a corresponding water quality objective. Regional Water Boards would need to consider other contaminants that bioaccumulate in fish tissue as well for designation of the subsistence fishing use.

H.4 Averaging Period for the Water Quality Objectives

For the mercury objectives, the averaging period is one calendar year. Averaging periods are used in evaluating whether the water quality objective is achieved. The State Water Board's assessment policy allows for the use of different averaging periods as specified by particular water quality objectives (State Water Board 2004). All fish mercury samples collected within the same averaging period (a calendar year) will be combined into a single resultant value (see section 6.1.5.6 of State Water Board 2004). Data collected during another averaging period (a different calendar year) would be combined into separate additional values. The values are then evaluated to determine if the water quality objective is being exceeded according to State Water Board's assessment policy (State Water Board 2004).

An averaging period describes the period of time during which risk due to exposure is assessed. For methylmercury, the harmful effects being addressed by the water quality objectives are caused by chronic exposure. The averaging period, therefore, is long, as is common for other bioaccumulative toxicants.

The methylmercury reference doses do not identify particular averaging periods (U.S. EPA 2001). When reporting concentrations of mercury in fish for comparison with screening values, the US Food and Drug Administration and the California Office of Environmental Health Hazard Assessment report data by year and often, by multiple years grouped to increase the sample size (U.S. Food and Drug Administration & U.S. EPA 2014; Office of Environmental Health Hazard Assessment 2014).

The frequency of sample collection may be one or more times during the averaging period, but typically the Water Board's monitoring program collects fish only once every five to ten years and typically all fish are collected on one day. Methylmercury concentrations in sport fish result from methylmercury intake over time. Although aqueous methylmercury concentrations may vary by season, slow depuration rates (i.e., removal of impurities) are expected to dampen strong fluctuations in methylmercury concentrations in fish (U.S. EPA 2010, pg. 57). Thus, allowing a sample of sport fish to be comprised of fish collected on one date is reasonable.

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Appendix I. Calculation of the Water Column Targets

This appendix provides the equations and calculations used to derive the water column targets from the Mercury Water Quality Objectives. The water column targets would be used to derive an effluent limitation that will be used in permits for discharges that contain mercury. Bioaccumulation factors are one means to derive a water column target. The results derived using bioaccumulation factors (Sections I.1 through Section I.3 and Section I.6) are compared with the results from other models later in this appendix (Section I.4 and Section I.5). Conclusions and recommendations are at the end of this appendix (Section I.8).

I.1 Bioaccumulation Factors

A *bioaccumulation factor* (BAF) is a number used to estimate the methylmercury concentration in water that corresponds to the methylmercury concentration in fish. More specifically, the BAF is the ratio (in Liters (L) per (/) kilogram (kg)-tissue) of the concentration of a substance in tissue to its concentration in the ambient water. The BAF is calculated as:

$$\mathrm{BAF} = \frac{C_{tissue}}{C_{water}} \qquad (1)$$

where:

C_{tissue} = Concentration of the chemical in wet tissue
C_{water} = Concentration of chemical in water

In situations where both the organism and its food are exposed to the substance, the ratio does not change substantially over time. Equation 1 can be rearranged to equation 2, and used to calculate a water concentration from the fish tissue concentration.

$$\frac{C_{fish\ tissue}}{\mathrm{BAF}} = C_{water} \qquad (2)$$

I.1.1 U.S. EPA Bioaccumulation Factors

U.S. EPA calculated the BAFs shown in Table I-1 for two ecosystem types based on national data. Since the Sport Fish Water Quality Objective is for trophic level 4 fish, the BAFs for trophic level 4 will be used in the calculations (for a description of trophic levels see Section 4.2 of the Staff Report). U.S. EPA first calculated separate values for river-like ecosystems (lotic), lake-like ecosystems (lentic) and estuarine ecosystems because methylmercury bioaccumulates to different degrees in the different ecosystems. Slower moving anoxic waters with high organic matter content (some lakes, reservoirs, estuaries) tend to generate the most methylmercury, while fast moving well aerated waters (rivers) tend to have less methylmercury bioaccumulation.

The U.S. EPA calculated the BAFs from multiple studies. First, a BAF was calculated for each study. Then the various BAF were combined using a geometric mean to calculate the final

BAFs (see U.S. EPA 2001 for more details). Figure 1, below, shows the uncertainly in the BAFs as represented by the 5th to the 95th percentile of the log normal distribution.

I.1.2. California BAF

A BAF was derived for California by Science Applications International Corporations (SAIC) using California specific data, from the State Water Board. This California BAF is described and compared to the U.S. EPA national BAF in a report by Sanborn and Brodberg (Sanborn and Brodberg 2006). The California BAF (for tropic level 4 fish) is shown below in Figure I-1 in comparison with U.S. EPA BAFs. In brief, the California BAF was similar to the national values that U.S. EPA calculated, but the California value is not as high quality due to data limitations, as described below.

The use of SAIC's original California BAF was not recommended because the California BAF was not as robust as the draft national BAF (Sanborn and Brodberg 2006). The California BAF was based on limited data and the data selection procedure was less rigorous than U.S. EPA's procedures. U.S. EPA only used water and biota data from the same water body and the same study to calculate a water body-specific BAF. Individual BAFs were then combined for the final BAF. Conversely, for SAIC's California BAF, all water column data were pooled to calculate a statewide average water concentration, and all fish data were pooled to calculate a statewide average fish mercury concentration. Then these two values were used to calculate the BAF. Sanborn and Brodberg described that this approach oversimplifies the data.

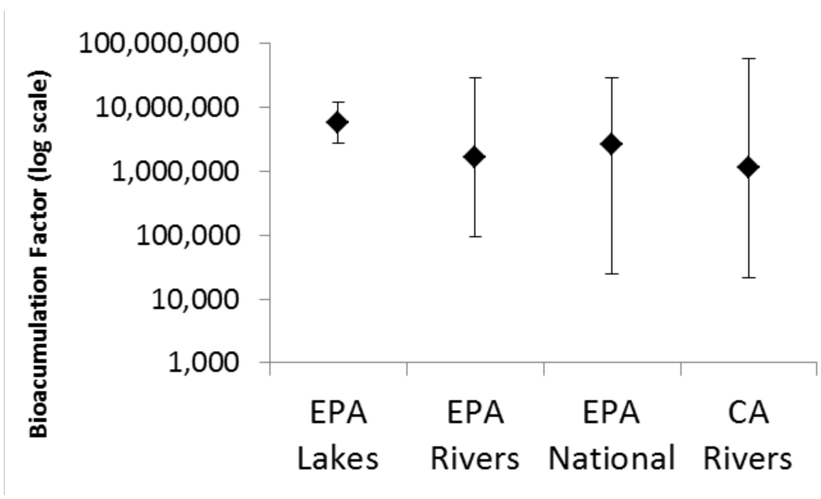

Figure I-1. Comparison of National and California Bioaccumulation Factors. Data points (diamond symbols) are geometric means from Table 31 in Sanborn and Brodberg 2006 and Table A-8, in Appendix A of U.S. EPA 2001. Vertical bars extend from the 5th to the 95th percentile of the log normal distribution.

Sanborn and Brodberg recalculated the California BAF, using the approach U.S. EPA used to calculate BAFs. Sanborn and Brodberg first calculated BAFs for each water body, then combined the water body-specific BAFs into one statewide value. Due to data limitations, there was only one final value for river systems for the California data set, and there was not enough data to calculate BAFs for lakes. Most of the California data were from the Sacramento-San Joaquin River watershed, which provided limited representation of the state as a whole. Sanborn and Brodberg also tested how well the U.S. EPA values predicted bioaccumulation in California. Sanborn and Brodberg found that U.S. EPA BAFs predicted California values well. Figure 1 shows how the U.S. EPA and California BAFs for rivers are very similar.

Sanborn and Brodberg recalculated BAFs using both geometric and arithmetic means. Sanborn and Brodberg preferred the use of arithmetic means because the BAFs are larger and therefore more protective (Sanborn and Brodberg 2006). In this appendix only BAFs calculated with geometric means are used, following U.S. EPA methodology. Also, using geometric means enables a better comparison to the U.S. EPA BAFs since U.S. EPA used only geometric means. The geometric mean equates to the 50^{th} percentile of the log normal distribution.

Geometric means can be preferable over arithmetic means when the data span multiple orders of magnitude. In this case, the geometric mean provides a better representation of where the values are clustering. For example, the geometric mean of the data set: 1,1,1,10, and 1,000 is 6. This geometric mean of 6 is much closer to 1 (where the data are clustering) than the arithmetic mean of 203.

Based on the similarity of the U.S. EPA and California values, and on the limitations of the California values, Sanborn and Brodberg recommended the U.S. BAFs as an option to derive a water column target for California (Sanborn and Brodberg 2006), either alone or in combination with the California values. (A third recommendation was to collect more data to derive more representative values.)

Table I-1: Bioaccumulation Factors (BAFs) for Dissolved Methylmercury

	U.S. EPA National BAFs						California
	BAF_2		BAF_3		BAF_4		BAF_4
	Lakes	Rivers	Lakes	Rivers	Lakes	Rivers	Rivers
Separate based on ecosystem type	130,000	110,000	1,100,000	520,000	5,700,000	1,200,000	1,100,000
Combined: Draft National BAFs	120,000		680,000		2,700,000		NA

BAFx corresponds to trophic level X. (Data from Table A-8, A-9 in U.S. EPA 2001 are expressed to two significant figures, in accordance with the U.S. EPA final BAFs in Table A-9.)

I.1.3 California Bays BAFs

Mercury BAFs for California bays and harbors were calculated from fish and water samples collected in northern California, including locations in Humboldt Bay, Bodega Bay, San Francisco Bay Area, and Morro Bay, and southern California, including locations in LA Harbor, Newport Bay, Mission Bay, San Diego Bay (Stephenson et al. 2009). Mercury BAFs were calculated by dividing the mean mercury concentration in fish by the mean total aqueous methylmercury value. Values calculated using geometric means are shown in Table I-2. Conversely, the U.S. EPA calculated their BAFs using dissolved concentrations of methylmercury, not total methylmercury.

Table I-2 Bioaccumulation Factors (BAFs) for Total Methylmercury for California Bays

	Trophic Level 3~4 BAF
Southern California Bays	3,250,000
Northern California Bays	6,010,000
Geometric Mean	4,419,559

The study authors also attempted to use linear regression to derive a relationship between mercury concentrations in water and in fish tissue, in which tissue concentrations are normalized to a standard length then plotted against ambient water concentrations for each location in the study (Stephenson et al. 2009). The authors found a lack of correlation between site-specific aqueous methylmercury and tissue concentrations in the higher trophic level species. The authors explained that unlike freshwater BAFs, a marine or estuarine BAF will be considerably more variable due to the processes that occur in these types of systems. One consideration is tidal flux and the tidal prism. Every ebb and flood of the tidal cycle can greatly diminish the ability to accurately characterize a contaminant's aqueous concentration. Another consideration is that the larger, higher trophic level species of fish are not limited in space.

Additionally, the prey fish that higher trophic level fish consume may fluctuate as different species move in and out of the harbor or estuary depending on water conditions. Estuarine systems are, by definition, regions where freshwater meets the sea. In California, many of the bays and harbors have some source of freshwater input (typically the lower course of a river) and could be considered estuarine. These systems are highly dynamic mixing zones (Stephenson et al. 2009).

I.1.4 Other California site-specific BAFs

Site-specific mercury BAFs calculated as part of established mercury Total Maximum Daily Load (TMDLs) are included in Table I-6, in Section I-5. Also, Alpers et al. calculated an overall BAF for Camp far West Reservoir from data from 2001 – 2003 (Alpers et al. 2008). The BAF for trophic level 4 fish was 10,000,000, which is almost two times larger than the U.S. EPA national BAF for lakes of 5,700,000. This is not surprising since the anoxic bottom of a reservoir is a prime area for methylmercury production. The Camp Far West Reservoir BAF is somewhat higher than found in other California reservoirs, namely Guadalupe Reservoir (Kuwabara et al. 2005, see Table I-6 below). This BAF was not used in any of the calculations since it was from only one water body.

I.2 Translators

Mercury in the water column can be measured as different forms, such as total mercury (organic and inorganic), dissolved (filtered) methylmercury and total methylmercury. A *translator* is a value used to convert between the different forms of mercury in the water column. The U.S. EPA BAF and equation 2 provides a water column concentration in the form of dissolved methylmercury (not total mercury). However, it may be appropriate to set a regulatory water concentration limitation in the form of total mercury. This is because inorganic mercury can be converted to methylmercury.

U.S. EPA derived translators to convert between concentrations of dissolved methylmercury ($MeHg_{dissolved}$) and total (unfiltered) concentrations of methylmercury ($MeHg_{total}$) and to convert between total mercury (Hg_{total}) and the dissolved concentrations of methylmercury ($MeHg_{dissolved}$), shown in Table I-3. Also, Sanborn and Brodberg, calculated translators for rivers for California (Table I-3) and found that they were not significantly different from the U.S. EPA translators for rivers (Sanborn and Brodberg 2006). U.S. EPA translators for estuaries are based on a very limited data set that included only two sites.

The bay BAF study provided data that could be used to calculate translators (Stephenson et al.2009). For each sampling station, the geometric mean total methylmercury concentration was divided by the geomantic mean total mercury concentration, to derived translators to convert from total methylmercury to total mercury. The translators for each station were combined into a regional geometric mean for northern or southern California (values shown in Table I-3).

Table I-3. Mercury Translators for Mercury in Water for Lakes, Rivers, and Estuaries

	$MeHg_{dissolved}/Hg_{total}$	$MeHg_{dissolved}/MeHg_{total}$	$MeHg_{total}/Hg_{total}$
Lakes[1]	0.032	0.61	NA
Rivers[1]	0.014	0.49	NA
Estuaries[1]	0.19*	0.61*	NA
Geomean of Lakes & Rivers[1]	0.021	0.55	NA
California Rivers Translator[2]	0.015	0.51	NA
Northern California Bays[3]	NA	NA	0.030
Southern California Bays[3]	NA	NA	0.015
Geomean of Bays[3]	NA	NA	0.021

[1]Data from Table A-10 in U.S. EPA 2001. [2]Data from Table 32 Sanborn and Brodberg 2006. [3]Derived from data from Stephen son et al. 2009. *Based on data from only two sites. NA means not available.

I.3 Water Column Concentrations Derived from Bioaccumulation Factors (BAFs)

The BAFs (Table I-1) and translators (Table I-3) were used to calculate the equivalent concentrations of dissolved methylmercury, total methylmercury, and total mercury that correspond to the Sport Fish Water Quality Objective (0.2 mg/kg), shown in Table I-4. First, equation 2 was used to calculate a water concentration from the fish tissue concentration. An example calculation using the U.S. EPA combined lakes and rivers BAF (2,700,000) is shown below:

$$\frac{C_{fish\ tissue}}{\mathrm{BAF}} = C_{water} \qquad (2)$$

$$\frac{0.2\ \mathrm{mg/kg\ \ MeHg}}{2{,}700{,}000} \times \frac{1{,}000{,}000\ ng}{1\ mg} \times \frac{1kg}{1L} = 0.074\ \ ng/L\ \ MeHg_{dissolved}$$

Next, the concentration of dissolved methylmercury was converted to total mercury using the corresponding translator from Table I-2. For example, to calculate the total mercury concentration that corresponds to 0.074 ng/L (nanograms per liter) methylmercury (for lakes and rivers combined):

$$\frac{0.074\ \mathrm{ng/l\ MeHg}_{dissolved}}{0.021\ \mathrm{ng/l\ MeHg}_{dissolved}/\mathrm{Hg}_{total}} = 4\ \mathrm{ng/L}$$

Similarly, another translator was used to derive the corresponding concentration of total methylmercury. The resulting concentrations of total mercury and total methylmercury that correspond to the water quality objective are shown in Table I-4.

Table I-4. Corresponding Water Column Concentrations for the Mercury Sport Fish Water Quality Objective

	U.S. EPA BAFs				California BAF
Matrix	Lakes	Rivers	Estuaries	Lakes & Rivers	Rivers
Trophic Level 4 Fish Tissue (mg/kg)	0.2	0.2	0.2	0.2	0.2
$MeHg_{dissolved}$ (ng/L)	0.04	0.2	NA	0.07	0.2
$MeHg_{total}$ (ng/L)	0.06	0.3	0.1*	0.1	0.4
Hg_{total} (ng/L)	1	12	0.4*	4	12

* derived from the lakes and rivers dissolved MeHg concentration of 0.074 ng/L (also shown in this table) since there was no BAF for estuaries.

Using the California rivers BAF and translator calculated by Sanborn and Brodberg (BAF of 1,100,000, translator for $MeHg_{dissolved}/Hg_{total}$ of 0.015) the resulting total mercury water column values is 12.1 ng/L. This is not significantly different than the value derived with the U.S. EPA values for rivers of 11.9 ng/L (results round to two significant figures that are shown in Table I-4).

The bay BAF study provided data that was used to calculate translators (Stephenson et al. 2009). The translator is somewhat different than those used for the U.S. EPA and California Rivers BAFs, since the bay BAF was designed to convert the fish tissue concentration to a concentration of *total* methylmercury, not *dissolved* methylmercury. The bay BAF and bay translators were used to calculate corresponding mercury concentrations for bays (Table I-5). The resulting water column concentrations for bays are close to the values for lakes and the values for lakes and rivers (combined), derived with the U.S. EPA and California BAFs.

Table I-5. Corresponding Water Column Concentrations for California Bays

	Northern California Bays	Southern California Bays	Geometric Mean
Trophic Level 3~4 BAF	6010000	3250000	4419559
Fish Tissue (mg/kg)	0.2	0.2	0.2
$MeHg_{total}$ (ng/L)	0.033	0.062	0.045
Hg_{total} (ng/L)	1.1	4.1	2.2

I.4 Other Models

Besides BAFs, other models, such as regression analysis, can be used to derive a relationship between the concentrations of mercury in fish to the mercury concentration in the water column. Table I-6 lists examples used in California. An example with national data by Brumbaugh et al. (Brumbaugh et al. 2001) is described in this section.

The U.S. Geological Survey analyzed mercury fish tissue data from 106 sites (mostly streams) across the U.S and developed a model using linear regression. A methylmercury concentration of 0.12 ng/L in water (non-filtered samples) was associated with a fish fillet mercury concentration of 0.3 mg/kg wet weight for age-3 fish when all species were considered. For age-3 largemouth bass (250 mm), a methylmercury concentration of 0.058 ng/L in water was associated with the 0.3 mg/kg fillet concentration in fish (Brumbaugh et al. 2001). Using the equation provided by Brumbaugh, in order to achieve the Sport Fish Water Quality Objective (0.2 mg/kg) in age-3 bass, the average aqueous methylmercury concentration would need to be 0.02 ng/L. This concentration is more than ten times lower than the methylmercury concentration derived from the U.S. EPA BAF for rivers and streams (0.3 ng/L MeHg, from Table I-4). This suggests that the water column concentrations derived with U.S. EPA BAF for rivers and streams maybe underprotective of many streams.

I.5 Comparison to TMDL Water Column Targets

In several established mercury/methylmercury TMDLs, water column targets were calculated with site-specific data (Table I-6). The targets can be compared to the target derived in this appendix. These TMDLs were based on targets or site-specific objectives that set a similar level of protection as the Sport Fish Water Quality Objective in the Provisions (see Section 3 of the Staff Report for more information on the TMDLs). Many of the water column targets in Table I-6 are roughly close (within an order of magnitude) to the water column target derived for lakes and rivers combined using the U.S. EPA draft national BAF (0.1 ng/L total methylmercury, shown in Table I-4).

Table I-6. Water Column Mercury or Methylmercury Targets from California TMDLs and Criteria

Water body, citation	Water Column targets (and sediment targets)	Calculation method
San Francisco Bay, San Francisco Bay Water Board 2006	No water column target	
Walker Creek, Soulajule Reservoir, and tributaries, San Francisco Bay Water Board 2008	0.04 ng/L **dissolved methylmercury** for Soulajule Reservoir. (Also 0.2-0.5 mg/kg total mercury in suspended sediment.)	U.S. EPA's national TL3 BAF of 1,300,000
Guadalupe Reservoir, San Francisco Bay Water Board 2008	1.5 ng/L **total methylmercury** as a hypolimnion seasonal maximum. (Also 0.2 mg/kg Hg in suspended sediment.)	TL3 BAF of 31,923, calculated with site specific data from the reservoir bottom (hypolimnion).
Clear lake, Central Valley Water Board 2002	No water column target (0.8-16 mg/kg dry weight sediment)	
Cache Creek, Central Valley Water Board 2005	0.14 ng/L **total methylmercury**	Linear regression of TL3 and TL4 fish tissue and water concentrations (site-specific)
Bear Creek, Central Valley Water Board 2004	0.06 ng/L **total methylmercury**	Linear regression using fish tissue and water concentrations (site-specific)
Harley Gulch, Central Valley Water Board 2004	0.09 ng/L **total methylmercury**	Site specific BAF of 570,000 for TL2/3 fish
Sacramento-San Joaquin Delta & Yolo Bypass, Central Valley Water Board 2010	0.06 ng/L **total methylmercury**	Linear regression of largemouth bass tissue and water concentrations (site-specific)
Sulfur Creek, Central Valley Water Board 2007	1,800 ng/L **total mercury** during low flow. High flow: 35 mg/kg total mercury in suspended sediment.	Estimated natural background
LA Lakes TMDL, U.S. EPA 2012	0.081 ng/L **dissolved methylmercury**	U.S. EPA national TL4 BAF of 2,700,000
Statewide, California Toxics Rule, 40 C.F.R. §131.38	51 ng/L or 50 ng/L **total mercury**	BCF* in California Toxics Rule of 7342.6

*BCF is a bioconcentration factor, which only accounts for direct absorption from water into organisms. A BCF does not account for accumulation up the food chain like a BAF.

However, none of these targets from TMDLs were used as the effluent limitation for municipal wastewater treatment plants and industrial dischargers (individual NPDES non-storm water permittees). Many of the TMDLs do not include wastewater and industrial dischargers, with the exception of mines. The only mercury/methylmercury TMDLs that include wastewater and industrial dischargers were for the San Francisco Bay, Sacramento-San Joaquin Delta & Yolo Bypass (listed above), and Calleguas Creek (Los Angeles Water Board 2006). As in the San Francisco Bay mercury TMDL, the Calleguas Creek TMDL did not translate the water quality objective into a water column concentration.

The water column targets from mercury/methylmercury TMDLs may have been derived with a site-specific BAF, regression analysis or other method (as listed in Table I-6). The methods used to calculate water column targets shown in Table I-6 generally depended on how much site specific data existed. A large amount of site-specific data enabled generation of linear models to extrapolate the water column targets or site-specific BAFs. In absence of much site-specific data, U.S. EPA's BAFs were often used.

The BAFs used in the TMDLs (listed in Table I-6) cannot be combined into one California BAF because they are based on fish from different trophic levels and some sites are exceptional. For example, Sulfur Creek is an area naturally very high in mercury. The other water column targets range from 0.06 - 0.14 ng/L for total methylmercury, except for Guadalupe Reservoir, which is 1.5 ng/L. The Guadalupe Reservoir target is much higher because the reservoir hypolimnium concentrations of methylmercury were used, which tended to be about 10 times higher than surface water concentrations. The Guadalupe Reservoir is also an exceptional case since it is extremely rich in mercury. It is located in the most productive mercury mining area in North America.

I.6 Translating the Subsistence Objectives

Water quality objectives are also being considered for tribal subsistence fishing and subsistence fishing by other communities (see Staff Report, Section 6.4 and 6.5). Table I-7 and Table I-8 show how these objectives can also be converted into water column concentrations using the U.S. EPA's BAFs and the California BAF and translators as in Sections I.3.

For tribal subsistence, the default application of the objective (0.04 mg/kg) is to 30% trophic level 4 and 70% trophic level 3 fish. Appendix H shows this is equivalent to 0.03 mg/kg in TL3 and 0.06 in TL4 fish (i.e. 70% of 0.03 mg/kg + 30% of 0.06 mg/kg = 0.04 mg/kg in the overall diet). This composition may be modified based on site-specific evidence. The subsistence objective for non-tribal subsistence fishing communities would need to be implemented on a case-by–case basis. The water column concentration should be calculated using procedures similar to the procedures shown in this appendix. Example water column concentrations are shown in Table I-8, which were calculated by applying an example water quality objective (0.05 mg/kg) to trophic level 4 fish.

Table I-7. Corresponding Water Column Concentrations for the Tribal Subsistence Mercury Objective by Ecosystem Type

	U.S. EPA BAFs				California BAF
	Lakes	Rivers	Estuaries	Lakes & Rivers	Rivers
Trophic Level 4 Fish tissue (mg/kg)	0.06	0.06	0.06	0.06	0.06
$MeHg_{dissolved}$ (ng/L)	0.010	0.050	NA	0.022	0.055
$MeHg_{total}$ (ng/L)	0.019	0.10	0.040*	0.040	0.11
Hg_{total} (ng/L)	0.33	3.6	0.12*	1.1	3.6

* derived from the lakes and rivers dissolved MeHg concentration of 0.026 ng/L (also shown in this table) since there was no BAF for estuaries.

Table I-8. Example Water Column Concentrations for the Subsistence fishing Mercury Objective by Ecosystem Type

	U.S. EPA BAFs				California BAF
	Lakes	Rivers	Estuaries	Lakes & Rivers	Rivers
Trophic Level 4 Fish tissue (mg/kg)	0.05	0.05	0.05	0.05	0.05
$MeHg_{dissolved}$ (ng/L)	0.0087	0.042	NA	0.019	0.045
$MeHg_{total}$ (ng/L)	0.016	0.085	0.034*	0.034	0.089
Hg_{total} (ng/L)	0.27	3.0	0.10*	0.88	3.0

* derived from the lakes and rivers dissolved MeHg concentration of 0.019 ng/L (also shown in this table) since there was no BAF for estuaries.

I.7 Uncertainties in BAFs

Three different approaches were used by U.S. EPA to estimate methylmercury BAFs for use in deriving national 304(a) ambient water quality criteria for mercury. All three approaches resulted in BAFs with central tendency point estimates in agreement with one another (see U.S. EPA 2001 for details). U.S. EPA acknowledged that there is at least an order of magnitude in the variability of the individual BAF estimates for a given trophic level, which leads to uncertainty in the overall central tendency estimate. This is further reflected in the range of 90 percent (5th and 95^{th} percentiles) confidence intervals (Figure I-1).

U.S. EPA recognized that the approach taken to derive mercury BAFs collapses a very complicated non-linear process, which is affected by numerous physical, chemical, and biological factors, into a rather simplistic linear process. U.S. EPA also recognized that uncertainty exists in applying a national BAF to all water bodies of the United States. Therefore, U.S. EPA encourages and provided guidance for states, territories, authorized tribes, and other stakeholders to derive site-specific field-measured BAFs when possible (U.S. EPA 2000, U.S. EPA 2010). In addition, should stakeholders believe some other type of model may better predict mercury bioaccumulation on a site-specific basis they are encouraged to use one, provided it is scientifically justifiable and clearly documented with sufficient data. Additionally, Stephenson et al. described how there is more uncertainty associated with BAFs for bays and estuaries (Section I.1.3, Stephenson et al. 2009)

I.8 Recommendations

To calculate a water column target for methylmercury objectives, site-specific models for every water body would be ideal, but are impractical. A California specific BAF (or other model) would be the next preferred alternative, although the existing California BAF, shown in Figure I-1, is not as robust as the U.S. EPA BAF as discussed above. To generate a California BAF (or other model) of comparable quality to the U.S. EPA BAFs would require significant time and resources. Generally, the Water Board's monitoring programs have not collected fish mercury data and water samples simultaneously, so new data would need to be collected throughout the state. The best options available are the existing BAFs. The water column concentration resulting from the U.S. EPA BAFs were similar to the value for California, providing assurance that these values are fairly representative, despite the uncertainties described in Section I.7.

Although U.S. EPA derived separate lakes (lentic) and rivers (lotic) BAFs and translators, the use of one value for the whole state would be ideal for statewide consistency. Using a different translation depending on the water body type would be complicated since not all water bodies will fit neatly into one of the two categories (lakes vs. rivers), and one type of water body may be adjacent or upstream of another. Additionally, the BAF values for the lakes and rivers are not so different from each other. Figure I-1 shows that the range of values in the lakes and rivers categories overlaps. The use of a single BAF and translator for the whole state would make permitting less complex and promote statewide consistency.

To obtain one statewide water column target, the combined U.S. EPA BAF value for lakes and rivers was used. A water column target based on this approach would be 0.1 ng/L total methylmercury or 4 ng/L total mercury (Table I-4). This combined approach may be the most appropriate since most discharges will flow through multiple water body types. Estuaries likely require a lower concentration of methylmercury and rivers flow through estuaries before reaching the ocean. This approach offers more protection for downstream waters. Additionally, this value (0.1 ng/L of total methylmercury), agrees best with the water column targets derived for many mercury TMDLs in California: the Delta (0.06 ng/L), Cache creek (0.14 ng/L), Bear creek (0.09 ng/L), Harley Gulch (0.09 ng/L), LA Lakes (0.081 ng/L), and Soulajule Reservoir (0.04 ng/L) as shown in Table I-6.

On the other hand, the resulting water column target is to be used for effluent limitations for discharges from municipal wastewater treatment plants and industrial dischargers, most of which discharge into rivers or streams (see Appendix N), for which BAFs suggest less stringent requirements are needed. Only about 1% of wastewater and industrial discharges flow directly into reservoirs in the state and none flow into natural lakes. (Also another project is being developed to address impaired reservoirs, see Section 1.6 of the Staff Report.) Only about 7% of discharges flow into a water body that may be considered an estuary (see Appendix N).

Therefore, the second option is to use water column targets based on water body type. Using both California and U.S. EPA BAFs, the water column target based on rivers and streams would be 0.3 ng/L total methylmercury or 12 ng/L total mercury (Table I-4 and Section I.3). Since most discharges flow into rivers, streams or creeks, this would be the water column target applicable for most discharges. Discharges to lakes and reservoirs would almost entirely be addressed by a separate project, but could be calculated on a case-by case basis until the project is adopted. For slow moving waters, such as a bay or estuary that has slow moving water or a marsh, then a different water column translation would be needed. Site-specific information or the water column target from the combined U.S. EPA BAF (0.1 ng/L total methylmercury, or 4 ng/l total mercury) would be used for such situations. The advantage of this option is that most dischargers are not subject to requirements that may be over stringent, since most discharges flow into rivers, stream, or creeks. The other advantage is that the water column target for rivers, which would be most wildly used, is well supported by both national and California data.

The BAFs for Bays were not used to derive water column targets for the Provisions since they were added to the Staff Report subsequent to the scientific peer review. Also, these values are similar to the recommended water column targets; in fact the southern California bay BAF resulted in the same total mercury concentration (4 ng/L) as the U.S EPA combined data set for lakes and rivers (4 ng/L). Additionally, the authors noted that there may be greater uncertainty in the bay BAFs relating to the dynamic nature of bays and estuaries (Section I.1.3). These values could be used for site-specific water column target or with additional data these bay BAFs may be used in the future.

The recommended water column targets based on the Sport Fish Water Quality Objective (0.2 mg/kg in trophic level 4 fish, 150-500) should also be protective of wildlife since the Sport Fish Water Quality Objective is consistent with achieving the Prey Fish Water Quality Objective (0.05 mg/kg in fish, 50-150 mm) (see Section K.6.1 through Section K.6.6 of Appendix K). The water column targets are, on the whole, likely consistent with the California Least Tern Prey Fish Objective as well, since the Sport Fish Objective's fish tissue concentration value may be consistent with the California Least Tern Objective (0.03 mg/kg in fish less than 50 mm). However, data are not available to confirm that the Sport Fish Objective will protect the tern. That is why a separate objective is needed for the tern. Also, there is only a limited amount of data available on mercury levels in prey fish, so it seems unlikely that a robust water column target could be derived based on the two prey fish water quality objectives. The uncertainly in the BAF likely outweighs the differences between the Sport Fish Water Quality Objective and the two prey fish objectives.

For waters where the Tribal Subsistence Water Quality Objective or the Subsistence Fishing Water Quality Objective applies, different water column target may be needed. One of the values calculated in Section I.6 may be appropriate, although these objectives may be modified if adopted as a site-specific water quality objective or implemented as a narrative water quality objective. At this time the tribal subsistence fishing or subsistence fishing beneficial uses are not designated to any water body, since the uses themselves are not yet established.

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Appendix J. Review of Effects on Wildlife

This is a review of the toxic effects of methylmercury on wildlife. This review includes evidence of methylmercury exposure on wildlife in California, including in threatened and endangered species. Table J-1 presents protective methylmercury thresholds for wildlife. These thresholds were compiled from the literature for comparison to the water quality objectives in the Provisions. Overall, there is more evidence of methylmercury toxicity from areas outside of California and in controlled laboratory studies. This evidence has been used to suggest that California wildlife is suffering methylmercury toxicity as well.

The most recent analyses by USFWS on the potential impact of methylmercury to threatened and endangered species included seven threatened and endangered species of concern (USFWS (2003):

Bald eagle (*Haliaeetus leucocephalus,* delisted in 2007)
California least tern (*Sterna antillarum browni*)
California Ridgeway's Rail (*Rallus obsoletus*)*
Light-Footed Ridgeway's Rail (*Rallus obsoletus levipes*)*
Yuma Ridgeway's Rail (*Rallus obsoletus yumanensis*)*
Western snowy plover (*Charadrius alexandrinus nivosus*)
Southern sea otter (*Enhydra lutris nereis*)

*Ridgeway's rails were formerly named clapper rails, *Rallus longirostris.*

The synopsis below includes studies on exposure and effects in California Ridgeway's rail and snowy plover in California, and in bald eagles outside of California. Little to no information was found on exposure and effects in the wild for the Southern sea otter, California least tern, light-footed Ridgeway's rail and the Yuma Ridgeway's rail.

J.1 Overview of Typical Toxic Effects on Wildlife

The species most at risk for methylmercury toxicity are generally piscivorous (fish-eating) wildlife, because methylmercury tends to accumulate to very high concentrations in the aquatic food web (USFWS 2003). However, some terrestrial songbirds have recently been found with higher mercury levels than fish eating birds because they feed on predatory invertebrates, like spiders, which lengthens their food chain and increases the bioaccumulation of methylmercury (Cristol et al. 2008). Methylmercury is also toxic to the fish themselves. The effects on fish, including impaired reproduction, are described at the end of this appendix.

In birds, methylmercury has been found to alter birdsongs and impair the ability to fly (Carlson et al. 2014, Hallinger et al. 2010). Chronic effects of methylmercury have been found in adult birds. For instance, in southern Florida, great white herons liver mercury levels (6 mg/kg) correlated with mortality from chronic diseases (Spalding et al. 1994). Weight loss, neurologic, and immunologic effects were observed in captive great egrets fed a diet with 0.5 mg/kg methylmercury (Spalding 2000a, Spalding 2000b). Reproduction is one of the most sensitive endpoints to methylmercury toxicity. Effects in birds include reduced hatching due to early mortality of embryos, fewer eggs laid, changes in pairing behavior and territorial behavior (Wolfe et al. 1998, Barr 1986, Heinz 1979, Frederick and Jayasena 2011).

In mammals, such as mink and otter, methylmercury toxicity is primarily manifested as central nervous system damage. These effects include sensory and motor deficits and behavioral impairment (Wolfe et al. 1998, Scheuhammer et al. 2007). The neurological effects can be followed quickly by death (Dansereau et al. 1999).

Studies have measured mercury and or methylmercury in different biological materials, such as blood, feathers, and eggs. The advantage of measuring mercury in feathers is that it does not harm wildlife. However, other measures are more closely related to the site of the toxicity and therefore they are likely a better predictor of toxicity. There is no established relationship between each of these measurements (e.g. mercury in feathers to mercury in blood), so each measurement can only be compared to the mercury concentrations in the same material.

J.2 Exposure and Effects in Wild Birds

J.2.1 California – San Francisco Bay Area

Davis et al., and Ackerman et al., recently published reviews on bioaccumulation. Both reviews include a summary of the effects in wildlife within the San Francisco Bay. The San Francisco Bay has been the subject of many studies on methylmercury bioaccumulation. Much of the information summarized in this appendix on the San Francisco Bay area is from the two reviews by Davis et al. and Ackerman et al. (Davis et al. 2012, Ackerman et al. 2014).

California least terns, a federally endangered species, are piscivores that forage extensively in the shallows of the open Bay (Ehrler et al. 2006). Limited data are available for methylmercury in eggs of California Least Terns because of their small population and endangered status. However, terns as a group may be somewhat more sensitive to methylmercury than other species (Heinz et al. 2009).

Forster's tern (*Sterna forsteri*), Caspian tern (*Sterna caspia*), American avocet (*Recurvirostra americana*), and black-necked stilt (*Himantopus mexicanus*) all feed and breed primarily in and around estuarine managed ponds in San Francisco Bay. Extensive studies of methylmercury exposure and risk in these species, including sampling of eggs and blood have been conducted (Eagles-Smith and Ackerman 2010, Eagles-Smith et al. 2009). Nearly half (48%) of breeding Forster's Terns and approximately 5% of avocets, stilts, and Caspian Terns exceeded 3 ppm of mercury in blood (Eagles-Smith et al. 2009), a concentration at which common loons (*Gavia immer*) experienced a 40% loss in reproduction (Evers et al. 2008a). Estimated reproductive risks to the terns, avocets, and stilts based on egg mercury concentrations are very similar.

Annual mean mercury concentrations in Forster's Tern eggs ranged from 0.9 to 1.6 mg/kg from 2005 to 2009. This exceeds the threshold of 0.9 mg/kg that was derived by correlating hatching and nest success with egg mercury concentrations (Eagles-Smith and Ackerman 2010). Mercury concentrations in blood and eggs have been consistently higher in Lower South Bay near the town of Alviso, which is located downstream of the New Almaden mercury mine.

California Ridgeway's rail is a federally endangered bird species that inhabits tidal marsh only in San Francisco Bay. Recovery of this endangered species may be impeded by mercury contamination. A study from 1991 to 1999 concluded that methylmercury was a likely cause of the unusually high rates (31%) of nonviable Ridgeway's Rail eggs (Schwarzbach et al. 2006). Mercury was found in rail eggs above effects thresholds (0.5–0.8 mg/kg fresh wet weight (fww); Fimreite 1971; Heinz 1979) at all of the marshes studied; mean egg mercury concentrations for each marsh ranged from 0.3 to 0.8 mg/kg (Schwarzbach et al. 2006). Egg-injection studies have indicated that hatchability in Ridgeway's Rails is relatively sensitive to methylmercury (Heinz et al. 2009).

The Pacific Coast population of snowy plover is listed as threatened by USFWS. Elevated mercury concentrations were found in failed eggs of snowy plovers at Point Reyes National Seashore. Failed snowy plover eggs at Point Reyes Beach in the 2000 breeding season contained elevated mercury concentrations when compared with snowy plovers in southern California. The egg hatchability rate of 79% for snowy plovers was unusually low. Normal egg hatchability rates for most birds, including snowy plover, are usually greater than 90%. Mercury concentrations in individual snowy plover eggs ranged from 0.25 - 3.1 mg/kg (fww). The mean mercury egg concentration of 1.07 mg/kg (fww) in nests with failed plover eggs was probably high enough to account for egg failure through direct toxic effects to plover embryos compared to thresholds in the literature (0.5–0.8 mg/kg fww; Fimreite 1971; Heinz 1979). The authors hypothesized that the high mercury may have been a result of dead marine mammals that washed ashore. Marine mammals tend to have high methylmercury concentrations in their tissues and the plovers could have foraged on the invertebrates (e.g. maggots) that lived off the decomposing carcasses. Human disturbance is also known to have a negative impact on plover reproduction by driving the adults away from the nest, leaving the chicks vulnerable.

Tidal marsh song sparrows (*Melospiza melodia*) are not piscivores, but insectivores. These birds eat aquatic insects in bays and wetlands, which can have more methylmercury than terrestrial insects because aquatic environments tend to promote methylmercury bioaccumulation. Average song sparrow blood mercury concentrations in the South Bay ranged from 0.1 to 0.6 ppm near the marsh. More than half the sparrows were above a 0.4 ppm blood mercury threshold which results in a 5% reduction in songbird reproduction (Jackson et al. 2011) in both 2007 and 2008 (Grenier et al. 2010). Sparrow methylmercury exposure also correlated with the percent of mercury in sediment that was present as methylmercury. The song sparrow is listed by the California Department of Fish and Wildlife(CDFW) as a state species of special concern (CDFW 2008).

Riparian songbirds (song sparrows) in some streams of the Bay Area have mercury levels that are associated with reduced reproductive success (Robinson et al. 2011). The greatest risk, where the mean adult song sparrow blood mercury concentration (1.66 ppm) would be associated with more than a 25% loss in reproductive success (using a threshold from Jackson et al. 2011), occurred at a site downstream of New Almaden. Sites upstream of the mercury mines also had elevated mercury in blood, though to a lesser degree.

Eggs of the piscivorous double-crested cormorant (*Phalacrocorax auritus*) have been monitored for more than a decade as an indicator of accumulation of methylmercury and other contaminants in the open areas of San Francisco Bay. While mercury concentrations in eggs from San Pablo and Suisun Bays (ranging from 0.28 to 0.70 mg/kg wet weight in composite samples) have tended to be at or below adverse effects thresholds for reproductive impairment in mallards and ring-necked pheasants (0.5–0.8 mg/kg fww; Fimreite 1971; Heinz 1979), eggs from South Bay (ranging from 0.56 to 1.05 mg/kg) have tended to exceed those levels (Grenier et al. 2011). Cormorants are relatively insensitive to methylmercury toxicity compared to other species (Heinz et al. 2009), so it does not appear likely that these concentrations are harmful to the population (Grenier et al. 2011).

J.2.2 California – Outside the San Francisco Bay Area

Ackerman et al. measured mercury in grebe blood in 25 lakes throughout California during the spring and summer of 2012 and 2013. Almost one third of the bird samples had mercury levels in the blood that put them at an elevated risk of methylmercury toxicity (>1 ppm blood, wet weight, Ackerman et al. 2015).

Around Clear Lake, California, several species were monitored for effects of methylmercury exposure from the Sulphur Bank Mercury Mine. Ospreys (*Pandion haliaetus*) were found to have the highest concentrations of mercury in their feathers (20 mg/kg) compared to five other species that were sampled. The osprey reproduction appeared unaffected, producing 1.4 fledglings per nesting attempt (Cahill et al. 1998). Long term monitoring found average mercury concentrations in osprey feathers around Clear Lake varied from 20 mg/kg to 2 mg/kg and back up to 20 mg/kg over 14 years. Changes in the tropic structure of the aquatic food web may have caused the changes in mercury concentrations in osprey feathers, rather than efforts to clear up the Sulphur Bank Mercury Mine. Reproduction in osprey still appeared unimpaired by methylmercury, but the data was confounded by human disturbance (Anderson et al. 2008).

Mercury was monitored in 23 healthy adult Western and Clark's grebes (*Aechmophorus occidentalis* and *Aechmophorus clarkii*) collected at three study sites in California, in 1992: Clear Lake, Lake County; Eagle Lake, Lassen County; and Tule Lake, Siskiyou County (Elbert and Anderson 1998). Clear Lake birds ($n = 13$) had greater mercury concentrations in kidney, breast muscle, and brain than birds from the other two lakes ($p < 0.05$), whereas liver concentrations were not statistically different ($p > 0.05$). Mean brain tissue mercury levels were near, but below, those known to cause adverse effects. Brain mercury concentrations were also negatively correlated to blood potassium and blood phosphorus levels ($n = 11$, $p < 0.05$).

Kidney mercury levels were positively correlated to percent blood heterophils and negatively correlated to percent eosinophils ($n = 13$, $p < 0.05$), suggesting that mercury levels might be affecting immune function. However, these biomarkers could not be related to an effect to the population, such as a reduction in survival.

J.2.3 Outside of California

Severely reduced reproductive success was observed in loons in northwestern Ontario. The loons fed on fish with average concentrations of mercury between 0.3-0.4 mg/kg (wet weight). This was not a controlled feeding experiment, so the data was not used to derive a reference dose, but 0.3 mg/kg is referred to in the peer reviewed literature as a threshold for birds (Barr 1986).

The Carolina wren (*Thryothorus ludovicianus*) has been used as a model system of mercury effects on songbirds (see section on song sparrows in the San Francisco Bay area above). Jackson et al. found that nesting success (i.e., the ability to fledge at least one offspring) decreased as the parents mercury exposure increased, with a 10% or more nest failure when females had blood mercury of 0.7 ppm, 20% failure at blood mercury of 1.2 ppm and 30% failure at blood mercury of 1.7 ppm (Jackson et al. 2011). Other insectivorous songbirds and bats, particularly those associated with wetland habitats, have been shown to have elevated mercury (Edmonds et al. 2010, Evers et al. 2012).

Impacts to reproduction were observed in another captive model songbird species, the zebra finch (*Taeniopygia guttata*). The finches diet was dosed with 0.3 – 2.4 mg/kg methylmercury (Varian-Ramos et al. 2014). All doses of methylmercury reduced reproductive success, with the lowest dose reducing the number of independent offspring produced in one year by 16% and the highest dose, representing approximately half the lethal dose for this species, causing a 50% reduction in offspring. Birds were exposed to methylmercury either as adults only or throughout their lives. Birds exposed throughout their lives seem to develop some methylmercury tolerance since effects on birds exposed only as adults were more severe. The resulting concentrations of mercury in the blood ranged from about 4 to 33 ppm, which is higher than the concentrations at which Jackson et al. found effects in the Carolina wren (Jackson et al. 2011).

Songbirds from a mercury-contaminated site sang simpler, shorter songs in a lower tone compared to birds from other areas (Hallinger et al. 2010). Songs are important to finding mates and guarding territory. Swallows in the same mercury-contaminated areas laid about as many eggs as uncontaminated birds, and the eggs hatched, but many of the young died within the first week outside the egg. As a result, swallows in the contaminated area produced fewer fledglings than those in reference areas. Female swallows in the contaminated site had significantly elevated blood and feather total mercury (blood: 3.56 +/- 2.41 ppm wet weight vs. 0.17 +/- 0.15 ppm reference; feather: 13.55 +/- 6.94 mg/kg vs. 2.34 +/- 0.87 mg/kg reference), possibly the highest ever reported for an insectivorous songbird (Brasso and Cristol 2008).

Methylmercury has been found to impair the ability of birds to fly. The diets of captive starlings (*Sturnus vulgaris*) were dosed with methylmercury cysteine at 0.0, 0.75, or 1.5 mg/kg wet weight. Impaired flight can have a direct impact on survival during predation events or by decreased efficiency in other critical activities (such as foraging or migration) that require efficient flight (Carlson et al. 2014).

Although both bald eagles and osprey are large piscivorous birds that experience elevated mercury exposure in some environments, these species have not been well studied with respect to potential effects of methylmercury on reproductive success or other population parameters. Of the few existing published reports, most indicate a lack of association between methylmercury exposure and productivity of free-living eagles or osprey in different locations in the Great Lakes region (Bowerman et al. 1994), James Bay and the Hudson Bay area (DesGranges et al. 1998) and British Columbia (Weech et al. 2006). This is similar to the lack of effect in California osprey discussed previously (Cahill et al. 1998, Anderson et al. 2008.) Eagles in Chesapeake Bay are also thought to have lower risk. This conclusion is based on low concentrations of methylmercury in their feathers (Cristol et al. 2012). Meanwhile, in New York and Maine, feather mercury concentrations were about 10 times higher than in the Great Lakes region (DeSorbo et al. 2008, DeSorbo et al. 2009), which may be high enough to cause adverse effects based on the results of Evers et al., who found sublethal effects in loons at 40 mg/kg mercury in the feathers (Evers et al. 2008b). Other researchers have shown that eagles may experience subclinical neurological damage in the Great Lakes Region (Rutkiewicz et al. 2011).

J.2.4 Reviews of Effects on Loons

Recent studies in the common loon have made them one of the most well studied species in regards to the effects of methylmercury in birds. Common loons are widely distributed geographically and long lived. They feed preferentially on small fish (100–150 mm in size) from lakes within established territories (Depew et al. 2012). Several thresholds for loon were derived by compiling information from many studies, as described below.

Burgess and Meyer measured mercury concentrations in small fish, blood mercury levels in adult male, female and juvenile common loons, lake pH, and loon productivity from 120 lakes in Wisconsin, USA and New Brunswick and Nova Scotia, Canada (Burgess and Meyer 2008). The fish sampled for the study were small fish (76–127 mm in length) typically consumed as prey by loons (supported by Barr 1996). Quantile regression analysis of the data set indicated that maximum observed loon productivity dropped 50% when fish mercury levels were 0.21 mg/kg (wet weight), and failed completely when fish mercury concentrations were 0.41 mg/kg. The authors did not determine a no effect threshold. However, the authors explain that this threshold is not appropriate for deriving regulatory thresholds: “The relationships between measures of loon mercury exposure and reproduction presented in this paper are correlative. Empirical dose–response studies will further define toxicity thresholds” (Burgess and Meyer 2008).

In another subsequent study on loons, screening benchmarks for use in ecological risk assessment were derived (Depew et al. 2012b). The results from Burgess and Meyer 2008 were incorporated into Depew et al. benchmarks, which were derived from a larger compilation of toxicity data. The lowest screening benchmark derived was 0.1 mg/kg (fish tissue, wet weight) for adult behavioral abnormalities, which was the midpoint of range for adverse adult behavior lowest effect level (0.05 - 0.15 mg/kg). The significant reproductive impairment threshold was 0.18 mg/kg, which included impacts to productivity and hatch success. The third threshold was for reproductive failure: 0.40 mg/kg.

Evers et al., used nearly 5,500 loon mercury measurements over an 18-year period to derive risk thresholds using the common loon (Evers et al. 2008b). The authors derived three risk categories for interpretive purposes based on mercury concentrations in blood: (1) low (<1.0 ppm), (2) moderate (1.0–3.0 ppm), and (3) high (>3.0 ppm). The risk categories were defined based on two thresholds for mercury measurements: (1) a low-exposure reference group, in which blood mercury level were all below were 1.0 ppm and (2) the authors found that 3.0 ppm in blood had a significant negative adverse effect on reproductive success. The authors used the benchmark that defined the threshold for the high risk category of 3 ppm mercury in blood as the adverse effects threshold. The authors do not assert the 3 ppm threshold or the 1 ppm threshold should be a protective criterion for loon (Evers et al. 2008b), although it was clear that a protective criterion should be no higher than 3 ppm in blood.

J.3 Exposure and Effects in Mammals

The effects of methylmercury bioaccumulation on mammalian wildlife have been the focus of only a few investigations. Piscivorous mammals include mink, otter, seals, sea lions, bears (although black bears in California do not regularly eat fish), raccoons, water shrew, and muskrat. Much of the research on mammalian wildlife has looked at the global impact of elevated mercury by focusing on polar bears (Basu et al. 2009, Dietz et al. 2011) and whales (Lemes 2011).

In California, a few studies have measured mercury in seals and sea lions. Juvenile and adult harbor seals (*Phoca vitulina*) that feed in the open San Francisco Bay had blood mercury concentrations averaging slightly over 0.3 ppm in samples from 2003 to 2005 (Brookens et al. 2007). The significance of these concentrations is unclear because effects thresholds have not yet been determined. Evidence in stranded California sea lions suggests that high mercury exposure may make seals more susceptible to the algal toxin domoic acid. Stranded California sea lions (*Zalophus californianus*) with suspected domoic acid poisoning had significantly higher liver mercury concentrations when compared to animals classified with infectious disease or traumatic mortality (Harper et al. 2007).

J.4 Exposure and Effects in Fish

The effects of methylmercury on fish species have recently been reviewed for freshwater habitats (Crump and Trudeau 2009; Sandheinrich and Wiener 2011). A great deal of evidence suggests that methylmercury in the aquatic environment impacts the reproductive health of fish (Crump and Trudeau 2009). Sandheinrich and Wiener reviewed about 20 studies of methylmercury's effect on survival and growth, behavior, reproduction, and changes in biochemical markers in fish. The authors concluded that sublethal effects of methylmercury on freshwater fish, including changes in reproductive health, occur at concentrations of 0.3-0.7 mg/kg wet weight or greater in the whole body and about 0.5-1.2 mg/kg or greater in the muscle tissue (Sandheinrich and Wiener 2011).

A whole-body mercury tissue threshold-effect level of 0.2 mg/kg wet weight (the corresponding muscle concentration would be higher) has been derived, based largely on sublethal endpoints (growth, reproduction, development, behavior) to protect juvenile and adult fish (Beckvar et al. 2005). Ten papers on eight fish species from the peer reviewed literature met the author's quality control criteria and were used to calculate the threshold. This level of mercury (0.2 mg/kg) is in the range commonly reported for top predator fish in California (see Staff Report, Section 4.5: Current Mercury Levels in the Environment), so methylmercury may be impairing reproduction in fish in California.

Depew et al. reviewed literature on toxic effects of methylmercury to fish and derived a *dietary* threshold for fish. Thresholds were about 0.05 mg/kg (wet weight) for reproductive and biochemical effects, 0.5 mg/kg for behavioral effects, 1.4 mg/kg for growth inhibition and 2.8 mg/kg for lethality (Depew et al. 2012a). These thresholds can be compared to the water quality objectives in the Provisions. To protect the top predator fish (trophic level 4 fish), mercury concentrations in prey fish (trophic level 3 fish) should meet the lowest threshold (0.05 mg/kg).

J.5 Suggested Thresholds from the Literature

Tables J-1 and J-2 summarize suggested thresholds mainly from the peer reviewed literature. These data are compiled for comparison to the water quality objectives to protect wildlife in the Provisions (see Appendix K, Section K.7 for comparison), so only concentrations in fish tissue are included. Suggested thresholds in blood, feathers or eggs are not included in the tables because such thresholds are not easily comparable to the water quality objectives in the Provisions. Note that many of the tabulated thresholds are relevant to the *prey* of the species studied, which is generally lower trophic level fish and crustaceans, and not larger fish at the top of the food chain such as a large bass. Tables J-1 and J-2 include thresholds from controlled laboratory experiments and field studies. The field studies are described in the previous sections, while the controlled laboratory studies are described in the following paragraphs.

Table J-1. Suggested dietary methylmercury thresholds from peer reviewed literature that that are most relevant to prey fish (including shellfish), unless otherwise noted.

Reference	Species; Effect(s)	Threshold in whole prey fish (mg/kg, wet weight)
Basu et al. 2007	Mink; decreases in *N*-methyl-D-aspartic acid (NMDA) receptor (involved in learning and memory)	0.1 (lowest effect level)
Barr et al. 1986	Loon; reduced reproductive success	0.3 (lowest effect level)
Burgess & Meyer 2008	Loon: reproduction	0.21 (50% drop in productivity)
Burgess & Meyer 2008	Loon: reproduction	0.41 (reproductive failure)
Carlson et al. 2014	Starling; ability to fly (starling eat insects and fruit)	0.75 (starling eat insects and fruit)
Depew et al. 2012b	Loon; adverse behavioral impacts	0.1 (screening benchmark)
Depew et al. 2012b	Loon; significant reproductive impairment	0.18 (screening benchmark)
Depew et al. 2012b	Loon; reproductive failure	0.4 (screening benchmark)
Kenow et al. 2007, Kenow 2010	Common loon; behavior changes	0.08 (no effect level)
Kenow et al. 2007, Kenow 2010	Common loon; behavior changes	0.4 (lowest effect level)
Frederick and Jayasena 2010	White ibis; reproductive and behavior changes (ibis eat mostly invertebrates and some fish)	0.05-0.3 (lowest effect level)
Varian-Ramos et al. 2014	Zebra finch; reduced reproductive success (finches eat seeds and plants)	0.3 (lowest effect level)

Effects on common loon chicks were observed after dosing them daily from hatch through day 105 with fish diets that contained control, 0.08, 0.4, or 1.2 mg/kg wet weight as methylmercury chloride. No overt signs of toxicity or significant reductions in growth or food-consumption rates were observed in any dose group, but there was evidence of reduced immune response in chicks that received ecologically relevant doses of methylmercury (0.4 mg/kg diet, wet weight, Kenow et al. 2007). Behavioral changes were also found in the loon chicks that received this same dose. Chicks were less likely to right themselves after being positioned on their backs during outdoor trials (0.4 mg/kg diet, wet weight, Kenow et al. 2010)

Table J-2. Suggested methylmercury thresholds for fish tissue from peer reviewed literature that are relevant to all finfish.

Reference	Species; Effect(s)	Threshold in whole fish (mg/kg, wet weight)	Threshold in fish fillet (mg/kg, wet weight)*
Sandheinrich and Wiener 2011	Fish, multiple species; reproduction	0.3-0.7	0.5-1.2
Depew et al. 2012a	Fish (dietary); reproductive and biochemical	0.05	0.07
Beckvar et al. 2005	Fish, multiple species; growth reproduction, development, behavior	0.2	0.3

*Calculated with equations from Peterson et al. 2007.

Juvenile captive white ibises (*Eudocimus albus*) were exposed to dietary methylmercury at three doses of 0.05, 0 1, or 0.3 mg/kg (wet weight) over 3 years, and their foraging behavior and efficiency (Adams and Frederick 2008), survival (Frederick et al. 2011), and breeding behavior (Frederick and Jayasena 2010) were examined. No negative effects on survival or foraging were observed (Adams and Frederick 2008, Frederick et al. 2011). The dietary methylmercury LOAEL (Lowest Observed Adverse Effect Level) value for a breeding behavior in white ibises exposed was 0.05 mg/kg (wet weight). The effects at the lowest doses (0.05 mg/kg) were increases in male–male pairing behavior, dose-related reductions in key courtship behaviors for males-female paring. Also, females exposed to 0.05 mg/kg fledged 34 % fewer young per female than control females, but the difference was not statically significant (Frederick and Jayasena 2010).

In mink (*Mustela vison*), dietary methylmercury exposure resulted in concentration-dependent decreases in N-methyl-D-aspartic acid (NMDA) receptors (involved in learning and memory) in the brain of wild and captive mink in Canada (Basu et al. 2007). Effects were seen in concentrations as low as 0.1 mg/kg. This concentration is close to the protective target of 0.077 mg/kg derived for mink (Appendix K).

Semi-domesticated female mink were fed daily diets containing 0.1, 0.5, and 1.0 mg/kg of total methylmercury (Dansereau et al. 1999). Piscivorous and non-piscivorous fish naturally contaminated with methylmercury were used to prepare the diets. Diets containing 0.1 mg/kg and 0.5 mg/kg were not lethal to first generation and second generation females for an exposure period of up to 704 days. Authors report that methylmercury exposure did not influence the survival and growth of neonatal kits. However, the proportion of females giving birth was low for all groups, except for the first generation females fed the 0.1 mg/kg diet. It was not clear if this effect was from methylmercury because there was not a lower exposure concentration (or control group) for comparison.

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Appendix K. Wildlife Targets

The goal for this appendix is to provide the rationale for the target methylmercury concentrations that should protect all wildlife in California. These wildlife targets will be used to establish water quality objectives for mercury to protect wildlife that will be part of the Provisions. Such wildlife targets have already been calculated as part of several different projects. This analysis (Appendix K) is partly a compilation of information from those previous projects, with frequent references to them. These previous projects are briefly described below.

In 2000, the United States Fish and Wildlife Service (USFWS) determined that the draft California Toxics Rule criteria for mercury (and other constituents) would not protect several threatened and endangered species. This decision was published in the Draft Jeopardy Ruling and Final Biological Opinion on the California Toxics Rule (USFWS & National Marine Fisheries Service (NMFS) 2000). As part of this determination, the USFWS determined protective methylmercury targets for wildlife. Later, the USFWS produced another detailed analysis of protective targets for threatened and endangered species in 2003 (USFWS 2003). This analysis was performed to determine if the United States Environmental Protection Agency's (U.S. EPA) human health criteria would provide adequate protection for threatened and endangered species (U.S. EPA 2001). The USFWS determined that the human health criteria would not be protective for California least tern, the Yuma Ridgeway's rail and possibly the light-footed Ridgeway's rail (formerly known as clapper rails).

Several California Regional Water Quality Control Boards (Regional Water Boards) have also developed protective targets for wildlife species in the development of site-specific water quality objectives as part of total maximum daily loads (TMDLs). The Central Valley Regional Water Board developed wildlife values as part of the site-specific objectives for Clear Lake, Cache Creek, and the Sacramento-San Joaquin Delta and Yolo Bypass (Central Valley Water Board 2002, 2005, 2010). The San Francisco Bay Regional Water Board developed site-specific objectives to protect wildlife for the Guadalupe River Watershed and Walker Creek (San Francisco Bay Water Board 2008a, 2008b). The USFWS reviewed the wildlife targets for Cache Creek (developed by the Central Valley Water Board) and calculated the wildlife targets for Guadalupe River Watershed. Additionally, the USFWS 2003 report incorporates information from Canada's water quality criterion (Canadian Council of Ministers of the Environment 2000), the Mercury Study Report to Congress (U.S. EPA 1997a,b), and the Great Lakes Initiative (U.S. EPA 1995).

K.1 Species of Concern

Considering the bioaccumulation and biomagnification of methylmercury in the aquatic food web, the upper trophic level wildlife species (i.e., predatory birds and mammals) are thought to have the greatest risk from exposure to methylmercury. Therefore, research into the effects of methylmercury on wildlife has generally focused on birds and mammals that prey directly on fish and other aquatic organisms. Piscivorous (fish eating) birds and mammals are generally higher order predators than, for example, aquatic-dependent reptiles and amphibians, which may result in a greater potential for dietary exposure and subsequent toxicity. This same concept of greater potential risk to higher order piscivorous species may also hold for top predators that in turn prey on piscivorous wildlife (*e.g.*, a peregrine falcon preying on piscivorous waterfowl), due to the successive trophic level biomagnification. A list of species of concern was compiled from the previous analyses (below). Marine wildlife was excluded from this analysis because the geographic scope of the Provisions does not include the ocean.

Species that were included in the USFWS evaluation of the U.S. EPA methylmercury human health criterion are listed below (USFWS 2003). All of these species are federally listed as threatened or endangered, except the bald eagle which was delisted in 2007. Figure K-1 shows geographic locations where these species have been observed in California.

Bald Eagle (*Haliaeetus leucocephalus,* delisted in 2007)
California Least Tern (*Sterna antillarum browni*)
California Ridgeway's Rail (*Rallus obsoletus*)*
Light-Footed Ridgeway's Rail (*Rallus obsoletus levipes*)*
Yuma Ridgeway's Rail (*Rallus obsoletus yumanensis*)*
Western Snowy Plover (*Charadrius alexandrinus nivosus*)
Southern Sea Otter (*Enhydra lutris nereis*)

*Note that Ridgeway's rails were formerly a clapper rails, *Rallus longirostris.*

Threatened and endangered species that were considered in the USFWS Final Biological Opinion (USFWS & NMFS 2000) were similar to the above, except that the Final Biological Opinion did not include western snowy plover, while it did include the marbled murrelet. The marbled murrelet feeds mostly in the open ocean (CDFW 1990) which is beyond the geographic scope of this objective.

The California least tern, California Ridgeway's rail, light-footed Ridgeway's rail, and Yuma Ridgeway's Rail, and bald eagle are listed as endangered species and fully protected species under the California Endangered Species Act of 1984. This legislation requires State agencies to consult with the California Department of Fish and Wildlife (CDFW) on activities that may affect a State-listed species. Western Snowy Plover and the Southern Sea Otter are not on the State's list of threatened or endangered species.

The goal of water quality objectives is not just to protect threatened and endangered wildlife but all wildlife. Regional Water Boards included several other wildlife species in the development of site-specific objectives. Development of the Cache Creek site-specific objectives (Central Valley Water Board 2005) examined values for the following species:

Mink (*Mustela vison,* recently changed to *Neovison vision*)
River Otter (*Lutra canadensis*)

Belted Kingfisher (Mega*ceryle alcyon*)
Common Merganser (*Mergus merganser*)
Western Grebe (*Aechmophorus occidentalis*)
Double-crested Cormorant (*Phalacrocorax auritus*)
Osprey (*Pandion haliaetus*)
Bald Eagle (*Haliaeetus leucocephalus*)
Peregrine Falcon (*Falco peregrinus*)

These same species were used for the Sacramento-San Joaquin Delta site-specific objectives, in addition to the California least tern and the western snowy plover (Central Valley Water Board 2010)

Development of the Clear lake and Guadalupe River Watershed site-specific objectives (Central Valley Water Board 2002, USFWS 2005) included a few of the above species, and also considered:

Great blue heron (*Ardea herodias*)
Forster's tern (*Sterna forsteri*)
Common loon (*Gavia immer*)

For this analysis, additional species of concern were sought out in CDFW's current list of threatened and endangered species in California and in a list of birds in the Salton Sea (CDFW 2013, 2012). The list was reviewed for other piscivorous wildlife that feed in California inland surface waters, enclosed bays and estuaries. No additional species were identified that were clearly at high risk, some of the species that were considered more in depth are discussed later, in Section K.10 of this appendix.

K.2 Calculation of Protective Wildlife Values

The USFWS used the following equation to calculate a protective concentration for the overall diet of a given species (USFWS 2003). This calculation is based on information about the organism's body weight and daily food consumption.

$$WV = \frac{RfD \times BW}{FIR} \quad (1)$$

where,

WV = Wildlife Value (mg/kg in diet)
RfD = Reference Dose (mg/kg of body weight/day)
BW = Body Weight (kg) for species of concern
FIR = Total Food Ingestion Rate (kg of food/day) for species of concern

The wildlife value is essentially a safe concentration of methylmercury in the diet for a particular wildlife species. More specifically, a wildlife value "represents the overall dietary concentration of methylmercury necessary to keep the daily ingested amount at or below a sufficiently protective reference dose. Reference doses (RfD) may be defined as the daily exposure to a toxicant at which no adverse effects are expected" (USFWS 2003). The reference dose used in this appendix was from a study in mallard ducks, the same as used by USFWS (USFWS 2003). The use of the mallard reference dose was also supported by data in great egrets (Bouton et al. 1999 and Spalding et al. 2000 a,b, discussed in USFWS 2003).

Equation 1 converts a protective RfD into an overall dietary concentration (in mg/kg in diet). Table K-1 shows the calculated wildlife values for all species of concern listed in the previous section.

Table K-1. Wildlife Values (mg/kg in diet)

Species	RfD (mg/kg/day)	Body Weight (kg)	FIR (kg/day)	Wildlife Value[a] (mg/kg in diet)
Mink	0.018	0.60	0.140	0.077
River otter	0.018	6.70	1.124	0.107
Belted kingfisher	0.021	0.15	0.068	0.046
Common merganser	0.021	1.23	0.302	0.085 (0.099[b])
Western grebe	0.021	1.19	0.296	0.084
Double-crested cormorant	0.021	1.74	0.390	0.094
Osprey	0.021	1.75	0.350	0.105 (0.112[b])
Bald eagle	0.021	5.25	0.566	0.195 (0.184[c])
Peregrine falcon	0.021	0.89	0.134	0.139
Southern sea otter [FT]	0.018	19.8	6.5	0.055
California least tern [FE]	0.021	0.045	0.031	0.030
California Ridgeway's rail [FE]	0.021	0.346	0.172	0.042
Light-footed Ridgeway's rail [FE]	0.021	0.271	0.142	0.040
Yuma Ridgeway's rail [FE]	0.021	0.271	0.142	0.040
Western snowy plover [FT]	0.021	0.041	0.033	0.026
Great blue heron	0.021	2.20	0.378	0.122 [b]
Forster's tern	0.021	0.16	0.071	0.047 [b]
Common loon	0.021 [d]	4 [d]	0.800 [d]	0.105

[a] from the USFWS Cache Creek Targets (USFWS 2004) and the USFWS Evaluation of the U.S. EPA Human Health Criterion (USFWS 2003), except as otherwise noted
[b] from Guadalupe River Watershed targets (USFWS 2005)
[c] the two references (USFWS 2004 and USFWS 2003) provided different values
[d] from Clear Lake analysis (Central Valley Water Board 2002)
[FT /FE] on federal list of threated or endangered species

Food ingestion rates (FIR, kg of food/day) for species of concern were taken from existing reports by the USFWS or Water Boards (see Table K-1 above). In general, food ingestion rates for birds that prey on fish are higher than food ingestion rates for birds that prey on terrestrial animals. This is because fish do not provide as much energy as birds and mammals, on an ounce-for-ounce basis (USFWS 2004).

Next, the USFWS considered the kind of fish to which the wildlife value should apply. Fish may fall into trophic level 2, 3, or 4 (TL2, TL3, or TL4) depending on their position in the food web. The methylmercury concentrations in the fish flesh will depend on the position of the fish on the food web; organisms higher on the food web accumulate more methylmercury. Trophic levels used in this evaluation were based on definitions provided in USFWS 2003, U.S. EPA 1997b:

Trophic Level 1 – Plants and detritus (*e.g.*, periphyton, phytoplankton)
Trophic Level 2 – Herbivores and detritivores (*e.g.*, copepods, water fleas)
Trophic Level 3 – Predators on trophic level 2 organisms (*e.g.*, minnows, sunfish, suckers)
Trophic Level 4 – Predators on trophic level 3 organisms (*e.g.*, bass, pikeminnow)

If a wildlife species consumes only equivalently sized fish from one trophic level, then the wildlife value may be used as the protective target for that trophic level. On the other hand, if a wildlife species consumes prey from more than one trophic level, the methylmercury in each trophic level should be considered when applying the wildlife value. Therefore, an understanding of the dietary composition for these wildlife species is needed to determine the limiting methylmercury concentrations for each trophic level to protect wildlife.

The USFWS and Regional Water Boards determined the diet for each species by reviewing the scientific literature for a particular species or by extrapolating from information about a similar species. The diets were then categorized by the relative portion from each trophic level that they consumed. The diet composition for each species is shown in Table K-2. The USFWS originally categorized diet only by trophic level (e.g. TL2, TL3 or TL4), while subsequent evaluations by the USFWS and the Regional Water Boards subdivided the diet into specific sizes ranges (e.g. TL3 less than 150 mm or TL3 150 – 500 mm, USFWS 2003). For light-footed Ridgeway's rail, California Ridgeway's rail, snowy plover and otter, all prey species that were classified as TL3 by the USFWS are still classified as simply TL3 in this analysis (USFWS 2003). These species included various species of crabs (Cancer spp.), nassa mud snails (scavengers), fish (killifish, longjaw mudsuckers), and crayfish. The diet for Californian Least tern was revised as described below. For bald eagle, the more recent diet composition from the USFWS was used (USFWS 2004), which was based on a publication by Jackman et al. (Jackman et al. 1999). However, a more recent article by Jackman et al. suggest that the proportion of TL4 fish, particularly bass, in the diet of eagles that live near reservoirs can be much higher than the previous findings, at 55% (Jackman et al. 2007).

Table K-2. Trophic Level (TL) Compositions (Expressed as Decimal Fractions) for Wildlife Species, Including Omnivorous Birds (OB), Piscivorous Birds (PB) and Other Foods (OF)

Species	TL2	TL2/3 < 50 mm	TL3 < 150 mm	TL3 150 – 500 mm	TL4 150 – 500 mm	OB	PB	OF
Mink			1.00					
River otter			0.80		0.20			
Belted kingfisher			1.00					
Common Merganser				1.00				
Western grebe				1.00[a]				
Double-crested cormorant			1.00					
Osprey				0.90	0.10			
Bald eagle				0.58	0.13	0.13	0.05	0.11
Peregrine falcon						0.10	0.05	0.85
Southern sea otter	0.80		0.20					
California least tern		1.00						
California Ridgeway's rail	0.85		0.05					
Light-footed Ridgeway's rail	0.82		0.18					
Yuma Ridgeway's rail	0.23		0.72					0.05
Western snowy plover	0.25							.75
Great blue heron			1.00 [b]					
Forster's tern		1.00 [b]						
Common loon				0.80 [c]				

Note: most data are from the USFWS evaluation of the U.S. EPA human health criterion (Table 4, USFWS 2003), the USFWS Cache Creek targets (Table 4, USFWS 2004) and the Sacramento-San Joaquin Delta targets (Table 4.1 and Table 4.3, Central Valley Water Board 2010), except as otherwise noted.

[a] The U.S. Geological Survey grebe study team caught fish 18 – 123 mm as representative grebe prey (Ackerman et al. 2015). Also, fish found in the stomachs of western grebes were 27 – 88 mm (1 – 3.5 in) long (CDFW 1990). In any case, the larger size (used in Table K-2) is more protective.

[b] from Guadalupe River Watershed targets (Table 4 and 5, USFWS 2005).

[c] from Clear Lake targets (Table C-3, Central Valley Water Board 2002), reclassified based on the 200 – 400 mm size and CDFW 1990. Clear Lake report has the loon diet as "TL2" but "200 – 400 mm". Because of the size the fish are shown here as TL3. The CDFW life history account for loon: "Diet varies; usually about 80% fish, with crustaceans the next largest item… Most fish eaten are not sought by humans…" Burgess and Meyer report "We sampled small fish (76 – 127 mm in length) typically consumed as prey by loons (Barr 1996)"

For the California least tern, an additional diet category was developed by the USFWS. The USFWS recommended a protective target for terns for TL3 less than 50 mm based on the very small fish this species preys upon (USFWS 2004). This category was also used in the Guadalupe River Watershed target for Forster's tern (USFWS 2005), and this category is included in this analysis (Table K-2). In the environment it may be difficult to distinguish if a small fish is TL2 or TL3; therefore, the category was defined as TL2/3 less than 50 mm.

The Yuma Ridgeway's rail primarily preys upon crayfish (estimated to be 90% of the diet) along with small contribution from other TL2 organisms (isopods, damselfly nymphs, mollusks) and some non-aquatic organisms (USFWS 2003). The USFWS classified the crayfish as trophic level (TL) 2.8 and the whole diet was categorized as 72 % TL3 and 23 % TL2, with another 5% in non-aquatic plants or animals (USFWS 2003). This classification is shown in Table K-2. Yuma Ridgeway's rail is one of the more sensitive species that may influence the final recommended water quality objectives.

K.3 Calculation of Targets for Species that Eat from only One Trophic Level

The information on the diet of each species (Table K-2) was used to identify the species that only consumed prey from one trophic level. For these species the wildlife value (Table K-1) was used as the target. Targets for mink, belted kingfisher, double crested cormorant, great blue heron, Forster's tern, California least tern, and western snowy plover were derived this way. The resulting values are shown in Table K-3. The USFWS considered that food other than fish or birds ("other foods") had negligible amounts of methylmercury (USFWS 2003). For example, for western snowy plover the wildlife value was assigned to the TL2 portion of the diet and the "other food" portion was ignored.

K.4 Calculation of targets for species that consume prey from multiple trophic levels

K.4.1 Approaches for Including Multiple Trophic Levels

For wildlife that consume prey from *more than one trophic level* the analysis is more complex. As mentioned above, the wildlife value represents an average concentration of methylmercury in the overall diet necessary to keep the organism's daily ingested amount at or below the reference dose. Considering that the wildlife species may feed on organisms in multiple tropic levels, the wildlife value can also be expressed using Equation 2 (USFWS 2003):

$$WV = (\%TL2 \times [Hg]TL2) + (\%TL3 \times [Hg]TL3) + (\%TL4 \times [Hg]TL4) \qquad (2)$$

where,

%TL2 = Percent of trophic level 2 biota in diet
%TL3 = Percent of trophic level 3 biota in diet
%TL4 = Percent of trophic level 4 biota in diet
[Hg]TL2 = concentration in food from trophic level 2
[Hg]TL3 = concentration in food from trophic level 3
[Hg]TL4 = concentration in food from trophic level 4

[Hg]TL2, [Hg]TL3 and [Hg]TL4 can be related using values derived from the relationships of bioaccumulation and biomagnification between trophic levels, expressed as **food chain multipliers (FCM)**.

FCM2/3= Food chain multiplier from TL2 to TL3 biota
FCM3/4 = Food chain multiplier from TL3 to TL 4 biota

The [Hg]TL3 and [Hg]TL4 terms can then be expressed as functions of [Hg]TL2:

$$[Hg]TL3 = [Hg]TL2 \times FCM3/2 \qquad (3)$$

$$[Hg]TL4 = [Hg]TL2 \times FCM3/2 \times FCM4/3 \qquad (4)$$

This allows Equation 2 to be rearranged, substituting food chain multiplier equivalents, as:

$$WV = (\%TL2 \times [Hg]TL\ 2) + (\%TL3 \times [Hg]TL2 \times FCM\ 3/2) + (\%TL4 \times [Hg]TL2 \times FCM\ 3/2 \times FCM4/3) \qquad (5)$$

This equation can then be solved for the mercury concentration in the lowest trophic level:

$$[Hg]TL2 = WV / [(\%TL2) + (\%TL3 \times FCM3/2) + (\%TL4 \times FCM3/2 \times FCM4/3)] \qquad (6)$$

Once the concentration in TL2 is determined, the concentration in the remaining trophic levels can be calculated by rearranging equations 3 and 4 above.

To translate between methylmercury concentrations in the different trophic levels one can use food chain multipliers, as described above, or **trophic level ratios (TLR)**. Trophic level ratios represent the concentration relationship between similarly sized fish feeding at different positions in the food web (also referred to as a food chain). Food chain multipliers on the other hand, assume that there is a direct predator-prey relationship between the trophic levels, with methylmercury concentrations in the higher trophic level fish resulting from ingesting the methylmercury found in fish from the next lower trophic level. However, as an example, the Cache Creek TMDL staff report points out, a 350 mm sunfish (TL3) is too large to be consumed by a 350 mm smallmouth bass (TL4). That is why this relationship is not described by food chain multipliers (Central Valley Water Board 2005).

The USFWS pointed out that trophic level ratios provide an equally valid way to develop fish tissue targets, with the following caveats: 1) the fish prey of the wildlife species of concern must be approximately the same size, regardless of trophic level, and 2) the resultant limiting concentrations calculated with these trophic level ratios are applied to the appropriate size classes of fish (*i.e.*, using the example of bass and sunfish provided above, the limiting concentration for TL3 must be applied to fish 250 mm or larger, *not* to the small individuals that would be preyed upon by large TL4 fish). Both caveats stem from the general trend of increasing tissue methylmercury concentrations with increasing fish size (Davis et al. 2010, Davis et al. 2013).

While California TLRs were derived for this analysis, California specific FCMs could not be calculated, since sufficient data were not available on fish < 150 mm or TL2 organisms. The FCMs are only used for a few species where a California TLR could not be used, including: river otter, southern sea otter, California Ridgeway's rail and light-footed Ridgeway's rail. Additionally, when possible, targets from site-specific projects and from site-specific data were included in Table K-3, such as for river otter. A range of values form various California projects, as well as targets derived from national values are included in Table K-3, to show some of the uncertainly in these values. However, this does not include all the uncertainly in these targets (see section K.9).

K.4.2 River Otter (Food Chain Multiplier Approach)
For river otter, the USFWS suggested the use of a food chain multiplier since prey comes from mainly TL3 less than 150 mm, and otters also catch larger TL4 fish, so there would be a predator-prey relationship between the two categories of fish. Site-specific data were used to derive a food chain multiplier of 5 for Cache Creek, and a food chain multiplier of 8.1 for the Sacramento-San Joaquin Delta. These food chain multipliers were used to calculate the protective target for river otter (shown in Table K-3). For this analysis, the U.S. EPA national food chain multiplier of 4 was also used to calculate targets for river otter (Table K-3).

K.4.3 Southern Sea Otter, California Ridgeway's Rail and Light-Footed Ridgeway's Rail (Food Chain Multiplier Approach)
For the small threatened and endangered species that eat from TL2 and TL3 the food chain multiplier approach was also used. These species were southern sea otter, California Ridgeway's rail, and light-footed Ridgeway's rail. The USFWS used the U.S. EPA food chain multiplier of 5.7 for TL2 to TL3 (FCM2/3), since California data were not available to calculate a California specific value. The same food chain multiplier of 5.7 was used for this analysis. The targets for each trophic level are shown in Table K-3.

K.4.4 Osprey (Trophic Level Ratio Approach)
Ospreys (and bald eagles) prey on fish from TL3 and TL4, and the fish preyed on from the two trophic levels are likely to be similarly sized fish, mostly above 150 mm. The USFWS 2005 had a more detailed account of the size of fish eaten by ospreys and recommended the target for osprey be applied to fish in the size range of 150 – 350 mm, although it was noted that ospreys will occasionally take larger and smaller fish. Bald eagles generally consume fish over 300mm, however some are over 500 mm (USFWS 2003). Following the rational from the USFWS, a trophic level ratio is more appropriate for calculating methylmercury concentrations in the prey of these species.

There were no existing national or statewide trophic level ratios. The trophic level ratios used in previous analyses were calculated based on site-specific data (for Cache Creek, the Sacramento-San Joaquin Delta and Clear Lake), and these trophic level ratios (relating TL3 to TL4) ranged from 1.7 to 3. The resulting protective targets calculated with these site-specific trophic level ratios are shown in Table K-3. These can be used as a range of possible conditions in California. However, the trophic level ratios are all based on data from one geographic area of California, the California Central Valley. Different areas of Northern California outside the Central Valley are not well represented and no Southern California areas are represented.

As part of this analysis, a statewide trophic level ratio for California was calculated (see Appendix L for calculation). The goal was to collect data from all over the state, but the available data were again mostly from the Central Valley (see map in Figure L-1 and Figure L-2 in Appendix L). The data used to calculate the ratios were collected from 35 locations throughout the state, including 17 rivers, 11 sloughs, and 7 lakes and reservoirs and 4 other water bodies (see Appendix L). This 'statewide' data set likely included more recent data not included in past analyses. The trophic level ratio for TL4 fish 150 – 350 mm to TL3 fish 150 – 350 mm was 2.1.

An example calculation of osprey targets using equation 5 (above) with the statewide trophic level ratio is shown below, and the resulting values are also shown in Table K-3. Since osprey do not eat from TL2 the equation can be reduced, and solved for [Hg]TL3:

[Hg]TL3 = WV / [(%TL3) + (%TL4 × TLR4/3)]
[Hg]TL3 = 0.105 mg/kg/ [(0.9) + (0.1 × 2.1)]
[Hg]TL3 = 0.09545 = **0.09 mg/kg**

The target for [Hg] TL3 can then be used to find the osprey target for [Hg] TL4:

[Hg]TL4 = [Hg]TL3 × TLR4/3
[Hg]TL4 = 0.09545 × 2.1 = 0.1909 = **0.20 mg/kg**

K.5 Calculation of Targets for Species that Eat Fish and Piscivorous Birds

K.5.1 Peregrine Falcon

Developing wildlife targets for the two remaining species of concern, bald eagle and peregrine falcon, required further modifications to the approach used above because both eagles and falcons can consume a wide variety of avian prey. Avian prey that is aquatic-dependent, may be omnivorous or piscivorous. Methylmercury biomagnification from the aquatic food web into these prey birds can be a significant source of dietary exposure for eagles and falcons, and must be incorporated into the equations to calculate protective targets. Non aquatic-dependent avian prey is considered as part of "other foods" which USFWS assumed to have insignificant levels of mercury (Section K.3). To include the aquatic-dependent avian prey, Equation 2 must be modified with additional terms, presented below as Equation 7 (equation 7 from USFWS 2004):

$$WV = (\%TL3 \times [Hg]TL3) + (\%TL4 \times [Hg]TL4) + (\%OB \times [Hg]OB) + (\%PB \times [Hg]PB) \quad (7)$$

where,
%OB = percent of omnivorous birds (TL2-consumers) in diet
%PB = percent of piscivorous birds (TL3 fish-consumers) in diet
[Hg]OB = methylmercury concentration in omnivorous bird prey
[Hg]PB = methylmercury concentration in piscivorous bird prey

And:
$[Hg]OB = [Hg]TL2 \times MOB$
$[Hg]PB = [Hg]TL2 \times FCM3/2 \times MPB$

where,
MOB = biomagnification factor representing biomagnification into omnivorous bird prey
MPB = biomagnification factor representing biomagnification into piscivorous bird prey

Substituting in the new terms and solving for [Hg]TL2:

$$[Hg]TL2 = WV / [\ (\%TL3 \times FCM3/2) + (\%TL4 \times FCM3/2 \times TLR4/3) + (\%OB \times MOB) + (\%PB \times FCM3/2 \times MPB)] \quad (8)$$

FCM3 = 5.7 from the U.S. EPA national BAF (used in USFWS 2003, Cache Creek targets (Central Valley Water Board 2005, USFWS 2004), and the Sacramento-San Joaquin Delta targets (Central Valley Water Board: 2010))
TLR = 1.7 from Cache Creek (USFWS 2004), 3 for the Sacramento-San Joaquin Delta (Central Valley Water Board 2010), 2.1 for California (Appendix L)
MOB = 10 (USFWS 2003)
MPB = 12.5 (USFWS 2003)

For peregrine falcon, the resulting targets in the previously published wildlife target reports were all the same (Table K-3). A value for the food chain multiplier is needed, but a value for the trophic level ratio is not needed, since this species does not eat fish from TL4 (see equation 7). The food chain multiplier used in the USFWS and Central Valley Regional Water Board analyses was the U.S. EPA national food chain multiplier since the habitat of the birds that the falcon preys upon is most likely larger than a single water body (unlike prey fish, which are confined to a water body). This species has a lower risk compared to others since it consumes a fair amount of omnivorous birds.

Calculation of peregrine falcon targets using equation 8 is shown below:

[Hg]TL2 = WV / [(%TL3 × FCM3/2) + (%TL4 × FCM3/2 × TLR4/3) + (%OB × MOB) + (%PB × FCM3/2 × MPB)]

A majority (85%) of the diet of the peregrine falcon is "other foods", including terrestrial avian prey (Table K-2), and USFWS assumed terrestrial avian prey to be an insignificant source of mercury (Section K.3) and is, therefore, not included in the equation. The calculation (below) includes the other portion of the peregrine falcon's diet, which is 10% ominous bird and 0.5 % piscivorous birds). Peregrine falcon does not eat from TL3 or TL4, so the equation reduces to:

[Hg]TL2 = 0.139 mg/kg / [(0.10 × 10) + (0.05 × 5.7 × 12.5)]
[Hg]TL2 = 0.03047 mg/kg

[Hg]TL3 = [Hg]TL2 × FCM3/2
[Hg]TL3 = 0.03047 × 5.7 = 0.1737 = **0.17 mg/kg**

[Hg]TL4 = [Hg]TL3 × TLR4/3
[Hg]TL4 = 0.1737 × 2.0 = 0.3473 = **0.35 mg/kg**

[Hg]OB = [Hg]TL2 × MOB
[Hg]OB = 0.03047 × 10 = 0.3047 = **0.30 mg/kg**

[Hg]PB = [Hg]TL2 × FCM3/2× MPB
[Hg]PB = 0.03047 × 5.7 ×12.5 = 2.171 = **2.17 mg/kg**

K.5.2 Bald Eagle

For bald eagle, the USFWS 2004 and Central Valley Regional Water Board analyses used the U.S. EPA national food chain multiplier to translate between TL2 and TL3, and site-specific trophic level ratios to translate from TL3 to TL4, ranging from 1.7 to 3 (the same as used for the osprey analyses). The resulting targets calculated for bald eagle with the different trophic level ratios are shown in Table K-3 along with targets calculated using the statewide trophic level ratio of 2.1 calculated in Appendix L.

An example calculation of bald eagle targets using equation 8 and the statewide trophic level ratio is shown below:

$[Hg]_{TL2}$ = WV / [(%TL3 × FCM3/2) + (%TL4 × FCM3/2 × TLR4/3) + (%OB × MOB) + (%PB × FCM3/2 × MPB)]

$[Hg]_{TL2}$ = 0.195 mg/kg / [(0.58 × 5.7) + (0.13 × 5.7 × 2.0) + (0.13 × 10) + (0.05 × 5.7 × 12.5)]
$[Hg]_{TL2}$ = 0.02021 mg/kg

$[Hg]_{TL3}$ = $[Hg]_{TL2}$ × FCM3/2
$[Hg]_{TL3}$ = 0.02021 × 5.7 = 0.1152 = **0.11 mg/kg**

$[Hg]_{TL4}$ = $[Hg]_{TL3}$ × TLR4/3
$[Hg]_{TL4}$ = 0.1152 × 2.0 = 0.2303 = **0.24 mg/kg**

$[Hg]_{OB}$ = $[Hg]_{TL2}$ × MOB
$[Hg]_{OB}$ = 0.02021 × 10 = 0.2021 = **0.20 mg/kg**

$[Hg]_{PB}$ = $[Hg]_{TL2}$ × FCM3/2× MPB
$[Hg]_{PB}$ = 0.02021 × 5.7 ×12.5 = 1.440 =**1.43 mg/kg**

Table K-3. Protective Wildlife Targets (in mg/kg, wet weight) in Various Trophic Levels (TL), Omnivorous Birds (OB) or Piscivorous Birds (PB), and the Most Sensitive Species in Each TL Category (Shaded Gray)

Species	TL2	TL2/3 < 50 mm	TL3 < 150 mm	TL3 150 – 500 mm	TL4 150 – 500 mm	OB	PB
Mink			0.077 [a,b]				
River Otter			0.04 [a] 0.059 [b] 0.067 [g]		0.30 [b] 0.36 [a] 0.27 [g]		
Belted Kingfisher			0.046 [a,b,c]				
Common Merganser				0.085 [a,b] 0.099 [c] (150 – 300 mm)			
Western Grebe				0.084[a,b,] (150 – 300 mm)			
Double-crested Cormorant			0.094 [a,b]				
Osprey				0.09 [a, d,g] 0.10 [b, c, e]	0.26 [a] 0.17 [b] 0.20 [c, g] 0.19 [d] 0.18 [e]		
Bald Eagle				0.11[a, g] 0.12 [b, e] 0.09 [d] 0.08 [f]	0.31[a] 0.20 [b] 0.22[d] 0.23 [e,] 0.28 [f] 0.24 [g]	0.19 [a] 0.21 [b] 0.20 [g]	1.35 [a] 1.50 [b] 1.29 [d] 1.43 [g]
Peregrine Falcon				(0.17) [a, b, e]		0.30 [a,b,e]	2.17 [a,b,e]
Southern sea otter [FT]	0.028 [f]		0.16 [f]				
California least tern [FE]		0.03 [b]					
California Ridgeway's rail [FE]	0.037 [f]		0.21 [f]				
Light-footed Ridgeway's rail [FE]	0.022 [f]		0.12 [f]				
Yuma Ridgeway's rail [FE]	0.009 [f]		0.050 [f]				
Western snowy plover [FT]	0.104 [f]						
Great blue heron			0.12 [c]				
Forster's tern		0.047 [c]					
Common loon				0.11[d]			

[a] from Sacramento-San Joaquin Delta targets (Table 4.3, Central Valley Water Board 2010)
[b] from the Cache Creek targets (USFWS 2004, Table 5 and Table 6)
[c] from Guadalupe River Watershed targets (Table 5, USFWS 2005)
[d] from Clear Lake analysis (Table C-3,C-4 Central Valley Water Board 2002).
[e] from Cache Creek targets (Central Valley Water Board 2005)
[f] calculated from information in the USFWS evaluation of the human heath criterion (USFWS 2003)
[g] calculated as part of this report for California, see text above.
[FT/ FE] on federal list of threated or endangered species

K.6 Suggested protective targets

K.6.1 Approach to Determine Targets to Use as Water Quality Objectives

Table K-3 shows protective targets for each species. Multiple values are shown, including values derived for this analysis and values derived from previously published analyses, as indicated in the table. It would be ideal to have only one water quality objective to protect wildlife and human health, as opposed to setting multiple water quality objectives for each fish trophic level and size category shown in Table K-3. One objective would be much easier to implement and monitor. Past monitoring has been directed at TL4 fish to assess common sport fish and the worst case scenario for human consumers. The final recommended human health water quality objective will most likely be applied to TL4 fish 150 – 500 mm, thus the goal was to derive the final wildlife target in terms of the TL4 fish 150 – 500 mm.

A reasonable approach for deriving a target to protect all wildlife species would be to identify the species with the lowest target and use that target to protect all wildlife. However, it is not obvious which species is the most sensitive from Table K-3. The targets in Table K-3 apply to different categories of fish, so they are not directly comparable to one another as they are shown. All targets must be converted to the same trophic level and size of fish for comparison.

In the following section, one final target for TL4 150 – 500 mm fish was derived by first identifying the lowest target (most sensitive species) in each trophic level and size category. These targets are highlighted in gray in Table K-3. Then, estimates of the corresponding TL4 concentration are made using ratios (trophic level ratio or food chain multiplier) or other information. The resulting lowest estimated TL4 concentration should protect all species. The final recommendations are rounded to one significant figure since the mercury water quality objective(s) will be expressed with one significant figure (based on U.S. EPA 2001).

Top predator birds like bald eagle could be most at risk because methylmercury bioaccumulates up the food chain. However, this analysis suggests that some species that feed lower on the food chain such as the terns and rails may need a higher degree of protection because of their small body size and their complete dependence on aquatic prey. No targets are recommended for avian prey species, although Table K-3 includes values for avian species. This is because the USFWS concluded that meeting the appropriate targets in fish tissue would adequately reduce methylmercury levels in the avian prey species that eat fish or invertebrates from these watersheds.

K.6.2 Target for Wildlife That Prey on TL4 Fish, 150 – 500 mm Long

Osprey had the lowest targets in the TL4 category with values ranging from 0.17 to 0.26 mg/kg (Table K-3). For bald eagle, targets were a little higher ranging from 0.20 to 0.31 mg/kg. The osprey targets apply to fish 150 – 350, while bald eagle targets apply to larger fish (150 – 500) which will have higher methylmercury concentrations. Since bald eagle prey is already categorized as TL4 150 – 500 mm this target does not need converting.

To determine the concentration in 150 – 500 mm TL4 fish that would provide concentrations in 150 – 350 mm TL4 fish to protect osprey, a ratio of methylmercury in fish tissue for TL4 150 – 500 mm to TL4 150 – 350 mm was calculated in Appendix L. The ratio of 1.2 was used to estimate from the concentration in larger TL4 fish to smaller TL4 fish: (0.3 mg/kg)/(1.2) = 0.25 mg/kg. From this estimation it seems that 0.3 mg/kg in TL4 Fish 150 – 500 mm is not clearly protective for osprey, because it may equate to 0.25 mg/kg in TL4 150 – 350 mm, but it is close to achieving the targets for osprey which are 0.20 mg/kg on average. **A target of 0.2 mg/kg TL4 fish 150 – 500 mm (total length) is recommended to protect bald eagle and osprey.**

<u>K.6.3 Target for Wildlife That Prey on TL3 Fish, 150 – 500 mm Long</u>

Common merganser and western grebe have the lowest targets in the TL3 150 – 500 mm category. The targets actually apply to smaller TL3 fish that are 150 – 300 mm (see Table K-3). To protect these species, **TL3 fish between 150 – 300 mm (total length) should have methylmercury concentrations no greater than 0.08 mg/kg, wet weight**.

To relate this concentration in TL3 150 – 300 mm fish back to a methylmercury concentration in TL4 150 – 500 mm fish, a ratio of 2.5 for TL4 150 – 500 mm vs. TL3 150 – 350 mm fish was used (Appendix L). The corresponding TL4 concentration is: 2.5 * 0.08 mg/kg = 0.20 mg/kg. **To maintain 0.08 mg/kg in TL3 150 – 350 mm (total length) fish, mercury concentrations in TL4 fish 150 – 500 mm should not be higher than 0.2 mg/kg.**

<u>K.6.4 Target for Wildlife That Prey on TL3 Fish, Less Than 150 mm Long</u>

The most sensitive wildlife species for the TL3 less than 150 mm category are the river otter with values of 0.04 and 0.06 mg/kg, and 0.05 mg/kg for belted kingfisher (Table K-3). To protect these species, TL3 fish less than 150 mm should have methylmercury concentrations no greater than 0.05 mg/kg, wet weight.

To relate the target concentration in TL3 less than 150 mm fish back to TL4 150 – 500 mm fish, information in the USFWS analysis can be used. The USFWS concluded that **attainment of the 0.08 mg/kg in TL3 150 – 300 mm fish is likely to result in attainment of 0.05 mg/kg target in TL3 less than 150 mm fish** (USFWS 2003)**.** And to achieve 0.08 mg/kg in TL3 fish 150 – 350 mm, as described above, **0.2 mg/kg in TL4** is recommended.

An alternative way to relate the concentration back to TL4 is by using a food chain multiplier. A food chain multiplier can be used because there can be a predatory prey relationship between these two fish classifications (TL3 less than 150 mm and TL4 150 – 500 mm). Three food chain multiplies were found. The USFWS used the U.S. EPA national food chain multiplier of 4 in their 2003 analysis. For Cache Creek, the USFWS recommended a food chain multiplier of 5 for the relationship between TL4 fish larger than 180 mm and TL2/TL3 fish less than 105 mm. For the Sacramento-San Joaquin Delta a food chain multiplier of 8 was derived for TL3 50 – 150 mm fish to TL4 150 – 350 mm fish. The results using these three food chain multipliers were 0.16, 0.20 and 0.32 mg/kg in TL4 fish. Since there is a fair bit of uncertainty as to which food chain multiplier is more appropriate and the resulting estimates have a fair range, the average is recommended (0.23 mg/kg). (There was not a good data set available to calculate a state wide ratio of fish less than 150 mm and TL4 fish 150 – 500 mm. See Appendix L.) **To achieve the targets in TL3 less than 150 mm (total length), mercury concentrations in TL4 fish 150 – 500 mm should not be higher than 0.2 mg/kg.**

K.6.5 Target for Wildlife that Prey on TL3 Fish, 0 – 500 mm

Yuma Ridgeway's rail has the lowest values in this category of small and large TL3 fish. This size range of TL3 fish can be related back to TL4 fish with the U.S. EPA national food chain multiplier of 4, giving: 0.05 mg/kg x 4 = 0.2 mg/kg in TL4 fish. A food chain multiplier (instead of a trophic level ratio) can be used because there is a predatory-prey relationship between these two fish classifications: Yuma Ridgway's rail prey on crayfish, and bass will eat crayfish. **To maintain 0.05 mg/kg in TL3 fish 0 – 500 mm, mercury concentrations in TL4 fish 150 – 500 mm should not be higher than 0.2 mg/kg.**

K.6.6 Target for Wildlife that Prey on TL3 Fish, Less Than 50 mm

To protect California least tern, fish less than 50 mm (total length) should have methylmercury concentrations no greater than 0.03 mg/kg (Table K-3). This target was the most difficult to relate back to TL4 concentrations, because of a lack of data to derive a ratio. Also maintaining this target is very important because the California least tern is an endangered species. Therefore, for this target is recommended as a separate site-specific water quality objective.

This target is probably not that inconsistent with the other targets, given the trend of decreasing mercury with decreasing fish length and trophic level, and given the decreasing mercury concentrations for the targets for each successive smaller fish size/ trophic level category that are consistent with achieving 0. 2 mg/kg in TL4 fish (0.08 mg/kg in TL3 fish 150 – 300 mm, and 0.05 mg/kg in TL3 fish less than 150 mm).

K.6.7 Target for Wildlife That Prey on TL2 Fish

All of the TL2 targets should be met if the TL3 targets are met. This is because the three lowest TL2 targets (Table K-3) were calculated directly from the TL3 targets by dividing by the national food chain multiplier of 5.7. The corresponding TL3 targets (southern sea otter, California Ridgeway's rail and light-footed Ridgeway's rail) are all higher than the lowest target in the TL3 150 – 500 mm category (0.08 mg/kg). **The TL2 target should be met if the TL3 150 – 500**

mm target is met (0.08 mg/kg)**, which according to rational above, should be met if the TL4 150 – 500 mm target of 0.2 mg/kg is met.**

K.7 Comparison of Suggested Targets to Recent Information

K.7.1 Grebe in California

A further comparison of the wildlife targets was made to Ackerman et al.'s. recent study on mercury concentrations in grebe blood. This study also characterized the relationship between mercury in prey fish and mercury in sport fish. The comparison suggests that the 0.2 mg/kg sport fish target correlates to about 1 mg/kg wet weight in grebe blood (Ackerman et al. 2015a,b). The concentration of 1 mg/kg mercury in blood is the boundary concentration from low risk to moderate risk category in a study of loons (Evers et al. 2004).

Ackerman et al. suggested that the State Water Resources Control Board could consider lowering this target value of 0.2 mg/kg in sport fish to ensure protection of all individual grebes, but did not suggest a specific target (Ackerman et al. 2015a). However, while the 1 mg/kg in blood is associated with some risk, the authors who derived that threshold, Evers et al., did not derive a "no risk" threshold (the "low risk" category was 0 – 1 mg/kg mercury in blood), making the value of 1 mg/kg the lowest threshold (other than 0). Also, the same researchers, Evers et al., used the benchmark that defined the threshold for their "high risk" category of 3 mg/kg mercury in blood as their adverse effects threshold (Evers et al. 2004, pg 56, Evers et al. 2008b). Evers et al. did not assert the 3 ppm threshold or the 1 ppm threshold should be a protective criterion for loon (Evers et al. 2008), although it was clear that a protective criterion should be no higher than 3 ppm in blood.

Ackerman et al. did not derive a threshold for prey fish that would be protective of grebes. But data in Ackerman et al.' report suggests that the concentration of 1 mg/kg in grebe blood correlates to about 0.048 mg/kg in prey fish 10 – 123 mm (weight wet, Ackerman et al. 2015a). This is similar to our recommended target for fish smaller than 150 mm, which is 0.05 mg/kg. For this comparison, mercury on a wet weight basis (HgWw) was calculated from the value 0.2 mg/kg mercury dry weight (HgDw, 1 mg/kg in grebe blood corresponded to 0.2 mg/kg in prey fish dry weight in Figure 5, Ackerman et al. 2015a) using 76% moisture for prey fish (Ackerman et al. 2015a) and the equation:

$$HgWw = HgDw*(1 - \text{proportion moisture})$$

K.7.2 Common Loon

Recent studies in the common loon have made them one of the most well studied species in regards to the effects of methylmercury in birds. Common loons are widely distributed geographically and long lived. They feed preferentially on small fish (100–150 mm in size) from lakes within established territories (Depew et al. 2012). Several thresholds for loon are shown in Tables J-1 (Appendix J), which are close to the wildlife targets and are discussed below.

Burgess and Meyer measured mercury concentrations in small fish, blood mercury levels in adult male, female and juvenile common loons, lake pH, and loon productivity from 120 lakes in Wisconsin, USA and New Brunswick and Nova Scotia, Canada (Burgess and Meyer 2008). The fish sampled for the study were small fish (76–127 mm in length) typically consumed as prey by loons (supported by Barr 1996). Quantile regression analysis indicated that maximum observed loon productivity dropped 50% when fish mercury levels were 0.21 mg/kg (wet weight), and failed completely when fish mercury concentrations were 0.41 mg/kg. The authors did not determine a no effect threshold. The target for fish 50 – 150 mm (the same size as loon prey fish) is 0.05 mg/kg, which is four times lower than the threshold from Burgess and Meyer. Given that the threshold was a 50% effect threshold on reproduction, the target may not seem protective enough. However, the authors explain that this threshold is not well suited to deriving regulatory thresholds: “The relationships between measures of loon mercury exposure and reproduction presented in this paper are correlative. Empirical dose–response studies will further define toxicity thresholds” (Burgess and Meyer 2008).

Kenow et al. conducted controlled laboratory studies with common loon chicks (Kenow et al. 2007, 2010). The authors note the importance of controlled laboratory studies since quantifying the impact of contaminant exposure on wild populations is complicated by the confounding effects of other environmental stressors (Kenow 2010). No effects to the chicks behavior were found at 0.08 mg/kg in the diet (Kenow 2007, 2010), which is above the target of 0.05 mg/kg for fish 50 – 150 mm (comparable to loon prey fish).

In another subsequent study on loons, screening benchmarks for use in ecological risk assessment were derived (Depew et al. 2012b). The results from Burgess and Meyer 2008 were incorporated into Depew et al. benchmarks, which were derived from a larger compilation of toxicity data. The lowest screening benchmark derived was 0.1 mg/kg (fish tissue, wet weight) for adult behavioral abnormalities, which was the midpoint of range for adverse adult behavior lowest effect level (0.05 – 0.15 mg/kg). The significant reproductive impairment threshold was 0.18 mg/kg, which included impacts to productivity and hatch success. The third threshold was for reproductive failure: 0.40 mg/kg. All these thresholds are above the target of 0.05 mg/kg for fish 50 – 150 mm (comparable to the size of loon prey fish).

Of the three thresholds derived by Depew et al., the lowest threshold of 0.1 mg/kg (fish tissue, wet weight, Depew et al. 2012) may be the best threshold to compare to the targets. However, the authors noted: “Importantly, the degree to which these adult behavioral changes will affect adult or chick survival in the wild or population dynamics is presently unknown; therefore, the suitability of this benchmark for ecological risk assessment remains limited.” On the other hand, the remaining screening benchmarks (0.18 mg/kg and 0.4 mg/kg , wet wt) are proposed to be indicative of significant impairment. They were not meant to be protective criteria. Unfortunately, a no effect level was not derived for survival, growth, or reproduction. As stated above, the target of 0.05 mg/kg for the prey fish (the same size as loon prey on), appears protective of loon since it is lower than the lowest benchmark of 0.1 mg/kg from the study (Depew et al. 2012).

K.7.3 Ibis

The lowest mercury toxicity threshold for wildlife found in the literature was for white ibis (Table J-1 in Appendix J). White ibis (*Eudocimus albus*) do not have habitat in California, although another species within the same family, the white faced ibis do (*Plegadis chihi*) (Cornell Lab of Ornithology 2016). This threshold was 0.05 mg/kg in the diet which was the LOAEL (Lowest Observed Adverse Effect Level) for effects on breeding behavior, which came from a 3 year experiment. The results of this experiment were described in multiple papers that are summarized here briefly. White ibises were exposed to environmentally relevant dietary methylmercury concentrations (0.05 – 0.3 mg/kg wet weight) over 3 years in captivity. The lowest effect level for a breeding behavior in white ibises was 0.05 mg/kg (wet weight). The effects were increases in male–male pairing behavior and dose-related reductions in key courtship behaviors for female-male paring. Also females exposed to 0.3 mg/kg fledged 34 % fewer young per female than control females, but the difference was not statistically significant (Frederick and Jayasena 2010). There was no effect on survival (Frederick et al. 2011). A specific threshold for toxicity was not suggested. Since the data that would mostly clearly demonstrate a detrimental effect on reproduction (vs. behavior) were not statically significant, this study does not provide a strong value for deriving a water quality objective. The endpoints of survival, growth or reproduction were the focus of USFWS evaluation (USFWS 2003) and the Great Lakes Initiative (U.S. EPA 1995).

Nevertheless, the LOAEL of 0.05 mg/kg for white ibis (based on behavior, Frederick and Jayasena 2010), can be compared to the suggested targets derived in this Appendix. To approximate a no effect level for ibis, the ibis LOAEL of 0.05 mg/kg was divided by 2 (as done in Zhang et al. 2013 and U.S. EPA 1995) resulting in a no effect dietary threshold of 0.025 mg/kg for ibis. Ibis have a mixed diet of TL2 and TL3 organisms (see Section K.10). If the ibis is assumed to eat 40% TL3 fish, equation 2 can be used to estimate the resulting mercury concentration in TL3 prey fish (with U.S. EPA's FCM of 5.7, as shown below). The result is 0.05 mg/kg in fish, which is equivalent to the target of 0.05 mg/kg in prey fish (50 – 150mm). This suggests ibis could eat up to 40% TL3 fish and be protected. This estimate may be conservative since ibis may actually eat more insects and invertebrates and little fish.

[Hg]TL2 = WV / [(%TL2) + (%TL3 × FCM3/2)
[Hg]TL2 = 0.025 mg/kg / [(0.6) + (0.4 × 5.7)]
[Hg]TL2 = 0.00868 mg/kg

[Hg]TL3 = [Hg]TL2 × FCM3/2
[Hg]TL3 = 0.00868 × 5.7 = 0.04947 = **0.05 mg/kg in TL3 fish**

K.8 Recommended Targets for Use as Water Quality Objectives

After reviewing all of the information for each size and trophic level classification, 0.2 mg/kg was the best choice for a target in TL4 fish that is consistent with all the other targets. **Therefore, based on all the information together, 0.2 mg/kg in TL4 150 – 500 mm (total length) fish is recommended as the water quality objective to provide protection for most species.**

It is hardest to judge the relationship between the methylmercury concentration in TL4 fish and the methylmercury concentration in lowest trophic level prey fish (either TL2 fish or TL2/3 fish less than 50 mm). Several of the threatened or endangered species eat in these lower tropic levels. The USFWS has previously recommended a target for fish less than 50 mm (total length) to protect the California least tern, one of the sensitive endangered species. This target of 0.03 mg/kg in fish less than 50 mm has been adopted by the Water Boards as a site-specific objective in San Francisco Bay and the Sacramento-San Joaquin Delta. It is therefore recommended to set a second water quality objective for fish less than 50 mm to ensure the protection of this species. Since the California least tern lives only in select geographical areas (Figure K-1) this objective could be applied only to the water bodies in which this species feeds. Generally, California least tern inhabit San Francisco Bay down along the coast to the California border with Mexico. **The objective of 0.03 mg/kg (in fish less than 50 mm) should apply to specific water bodies listed in Section K.11, Table K-5**. The geographic areas where the California least tern live are also inhabited by other endangered species: the California Ridgeway's rail and light-footed Ridgeway's rail. This target would offer these species added protection as well. The California Ridgeway's rail is believed to be adversely affected, at least in part due to methylmercury (Schwarzbach et al. 2006).

Further analysis indicated a third water quality objective is needed to ensure protection of all wildlife. California has warm waters that support species of black bass and cold waters that are trout dominated, generally speaking (see Figure K-3). Bass are a TL4 species that accumulates higher concentrations of mercury than trout[21], which are mostly TL3 species. In waters that lack TL4 fish, the objective of 0.2 mg/kg would be applied to the TL3 fish. In these waters TL3 fish are the top of the food web in that water body, so this is protective of species that eat from the top of the food web (humans and some wildlife species such as eagles), but ultimately the application of the objective is less stringent, since TL3 accumulate less mercury. Therefore, this situation needs to be carefully considered to ensure protection of all wildlife.

Examples of water bodies that have no TL4 fish species include trout dominated waters of the Sierra Nevada Mountains and the northern most parts of California (Figure K-3). Also, the Salton Sea does not support TL4 species because of the high salinity. Tilapia, which is a TL3 fish, is the dominant species in the Salton Sea.

[21] Although, the USFWS analyses categorized trout as TL4 fish in the bald eagle diet (USFWS 2003, USFWS 2004, USFWS 2005). Either way, the objective is protective of bald eagle, because bald eagle are protected by 0.2 mg/kg in the overall diet.

Applying the objective of 0.2 mg/kg to TL3 fish in waters where TL4 fish are absent cannot ensure protection for some wildlife. This because the mercury level in TL3 fish (0.2 mg/kg) would exceed the targets for merganser, grebe and belted king fisher and osprey in TL3 fish (0.05 – 0.1 mg/kg). Merganser, grebe and belted king fisher and osprey have habitat that overlaps with trout dominated waters, which lack TL4 fish (see maps in Section K.13, especially Figure K-4). Additionally, some trout are recently planted hatchery fish, which are poor indicators of the water quality and the resulting methylmercury concentrations in lower trophic level resident fish.

The recommended solution to address waters that lack TL4 fish is to establish an additional objective based on the targets in Table K-3. For example, an objective could be established of 0.08 mg/kg in fish 150 – 300 mm to protect grebe and merganser based on the targets in Table K-3. Alternatively, since belted kingfisher are more ubiquitous, **an objective could be established of 0.05 mg/kg in TL3 fish 50 – 150 mm based on the targets (Table K-3) for kingfisher.** This objective should be consistent with achieving 0.08 mg/kg in 150 – 300 mm TL3 fish (see Section K.6). Narrowing the size range from 0 – 150 mm to 50 – 150 mm will distinguish this objective from the California Least Tern Prey Fish Objective, which applies to fish 0 – 50 mm long. The more narrow size range is also more protective, since larger fish have higher mercury concentration.

This objective could be applied *only* to waters that lack TL4 fish, to save monitoring resources. Alternatively, if the objective is applied statewide, in order to save monitoring resources, monitoring could be prioritized for waters that lack TL4 fish, especially those with fish from hatcheries. Also, where data on sport fish (either TL3 or TL4) indicates that a water body is impaired, monitoring prey fish would be unnecessary to show that the water body is indeed impaired. However, data from prey fish would be needed to show that the water body is no longer impaired. Also where prey fish less than 50 mm long are monitored, it would be unnecessary to also monitor prey fish that are 50 – 150 mm long.

Another endangered species that appears to be more sensitive to methylmercury is the Yuma Ridgeway's Rail, which inhabits the Salton Sea, and the Colorado River according to the USFWS draft recovery plan (USFWS 2009, see also Figure K-1). There are no TL4 fish in the Salton Sea and so the objective of 0.2 mg/kg would be applied to TL3 fish which is less stringent. Therefore, a **second objective should also be applied to the Salton Sea and the Colorado River to ensure protection for the Yuma Ridgeway's rail.** This could be accomplished one of several ways: 1) if the objective of 0.05 in fish 50 – 150 mm is adopted statewide (recommended); 2) propose the objective of 0.03 in fish less than 50 mm apply to the Salton Sea and Colorado River; 3) propose an objective of 0.04 mg/kg in crayfish, which is the prey for Yuma Ridgeway's rail (Table K-2 and text in Section K.2).

Regional Water Boards may adopt site-specific objectives for mercury and may modify the application of the objective of 0.2 mg/kg in TL4 fish based on site-specific human consumption pattern. If the Regional Water Board does this, the Regional Water Board must also ensure protection for wildlife species. If a Regional Water Board is considering a site-specific objective or is concerned for sensitive wildlife and there are no TL4 fish species, monitoring of the target of 0.05 mg/kg in TL3 fish 50 – 150 mm could be used to ensure wildlife are protected. If the species of concern is the California least tern, then the target of 0.03 mg/kg in fish less than 50 mm should be used instead. Other targets or objectives may be developed for the particular species that feed in the affected water body.

The final objective for TL4 fish should be applied to the fillet to protect human health because most humans eat the fillet of TL4 fish. Also, monitoring programs typically measure mercury in the fillet. Mercury concentrations are slightly higher in the fillet than in the whole fish, so this provides some extra protection for wildlife and humans who eat the whole fish. On the other hand, it is recommended that the two objectives for prey fish (the objective for TL2/3 fish less than 50 mm and the objective for TL3 fish less than 150 mm) be applied to whole fish, since this objective is meant to protect wildlife only, which will likely consume the fish whole.

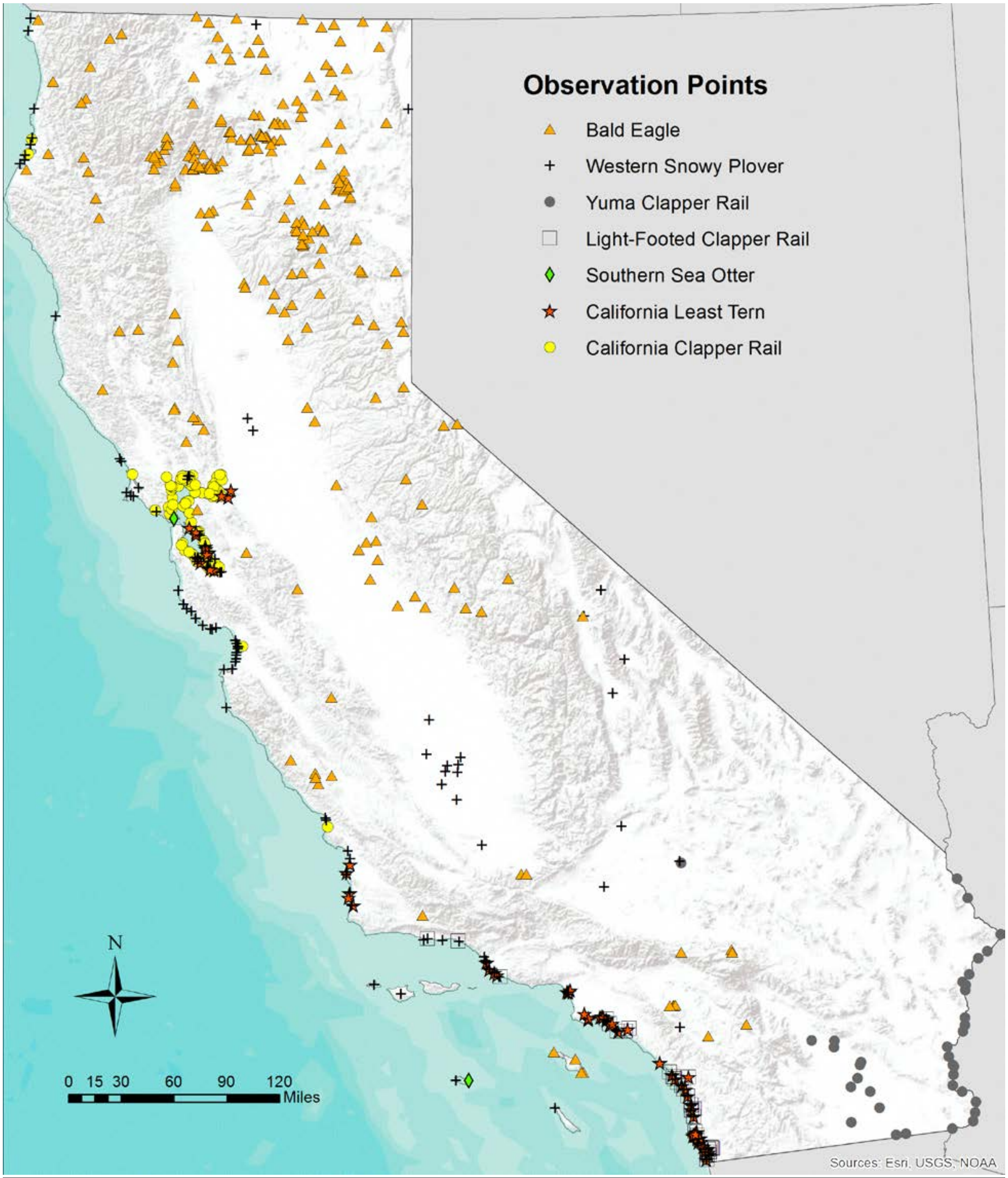


Figure K-1. Observation locations of threatened or endangered species included in this analysis and bald eagle (recently delisted).

The recommended objective for TL4 fish is shown in Table K-4 in comparison to other site-specific objectives that have been adopted by California Water Boards.

Table K-4. Comparison of Adopted Site-specific TL4 Water Quality Objectives to the Sport Fish Water Quality Objective

Geographic Area	Objective	Applicable TL4 Fish Size (mm)	Other Water Quality Objectives?	Wildlife Equally or More Sensitive Than Human Health (Human Fish Consumption Rate Used)?
Clear Lake (Central Valley Water Board 2002)	0.19	300 – 400	TL3 (no size specified)	Yes (17.5 g/day)
San Francisco Bay (San Francisco Bay Water Board 2006)	0.2	Varies by species 250 – 1350	Fish < 50 mm	No (32 g/day), only California least tern
Cache Creek (Central Valley Water Board 2005)	0.23	250 – 350	TL3 fish 250 – 350 mm	Yes (17.5 g/day)
Sacramento-San Joaquin Delta (Central Valley Water Board 2010)	0.24	150 – 500	TL3 fish 150 – 500 mm, and fish < 50 mm	No (32 g/day), only California least tern
Provisions	0.2	200 – 500	Fish < 50 mm, and TL 3 fish 50 - 150 mm	Wildlife targets require similar stringency as used for recreational fishing (32 g/day) in warm waters with black bass. However, measuring mercury in TL4 fish may not ensure objectives are met in TL3 and TL2 fish, especially in trout dominated waters (see text in Section K.8).

K.9 Limitations and Sources of Uncertainty in this Analysis

K.9.1 General Points of Uncertainty

This section reviews some of the assumptions and sources of uncertainty in these calculations. This section is broken down into two parts 1) factors that seem to suggest these calculations are conservative, and 2) factors that suggested these calculations may not be conservative enough. A few points of uncertainly that were not obviously in either category are discussed first.

The food chain multipliers (FCMs) and trophic level ratios (TLRs) are estimates that add to the uncertainty in these calculations. Some are site-specific while some were derived from national data. These values may not accurately represent all of California's waters, but a more accurate alternative is not available. More specially, FCMs could not be calculated, since sufficient data were not available for fish < 150 mm or TL2 organisms. California's statewide monitoring program has collected a great deal of data on large TL4 and TL3 fish, but much less data on fish <150 mm or TL2 organisms. While there was a large data set for large TL4 and TL3 fish, the data that could be used to derive the TLRs provided poor geographic representation of the California (see Appendix L). Since the TLRs were limited and a California FCM was not possible to calculate, values form various California projects, as well as targets derived from national values are all included in Table K-3 to provide and idea of the uncertainly in these values. However, this will not capture all of the uncertainly. If minimum and maximum values for the FMCs and TLRs were used the variation in the targets would be larger. The actual amount of mercury in fish in various waters will vary by the food web in a particular water body and other waterbody specific factors. The variation in mercury concentrations in prey fish vs. sport fish in a particular water body is exemplified in the recent USGS grebe study (Ackerman et al. 2015, Figure 5, see also Section K.7.1). Only average FCM and TLR values were used in this analysis to provide estimates for the whole state. These estimates may be either over protective or under protective for a particular water body

There are a couple of points of uncertainty associate with each wildlife value. These include the lack of long term studies for mammals, lack of a no adverse effect level for birds, and extrapolation from one species to another. More specifically, all avian wildlife values are based on one study by Heinz et al. (1979) in mallard ducks. Since then, no appropriate type of controlled dose-response study has been done on more relevant wildlife species. An uncertainty factor of three was used to derive a concentration that should cause no adverse effects in ducks, because the methylmercury concentration used in the study caused adverse effects in the ducks (a decrease in ducklings, compared to control). It is very difficult to determine how accurately the resulting wildlife values represent the wildlife species of concern.

Some conservative estimates were used by the USFWS to derive the diet for each species, but these diet estimates were revised in subsequent analyses. For example, California supports wintering and resident bald eagles with a variety of suitable foraging habitat. Because of this variation in habitat, eagle diets likely span a wide range of possible food types and trophic level combinations. To account for this variation, the USFWS used a conservative approach to establish a diet based on the highest trophic level compositions that were reasonably likely to occur (USFWS 2003). Subsequent analyses, though, revised the proportion of TL4 fish in the diet, reducing it to 13% of the diet. However, Jackman et al. observed that 55% of the prey that bald eagles brought back to their nests was bass at Shasta Lake (Jackman et al. 2007). The estimated diets may be non-conservative for some areas, such as Shasta Lake, or the estimated diets may be conservative for other areas.

The lack of available data precludes evaluating exposure to insectivorous wildlife that consume the terrestrial stages of aquatic insects and may be exposed to relatively high concentrations of methylmercury. High concentrations of methylmercury (1.66 ppm) have been measured in the blood of riparian song sparrows downstream of New Almaden, the site of a large mercury mine (Robinson et al. 2011, Section K.10.2). These concentrations were similar to those that were associated with a 25% to 30% reduction in nest success of Carolina Wrens along two mercury-contaminated rivers in Virginia (Jackson et al. 2011). Additional studies will be required to determine the relationship between mercury concentrations in prey fish and sport fish and those of aquatic insects that inhabit the same water bodies.

K.9.2 Points of Uncertainty That Suggest a Less Stringent Objective

Wildlife likely consume whole fish, while many humans often only eat the fillet of the fish. The mercury concentration in the fillet is higher than in the whole fish. Therefore, wildlife targets applied to fillet will a have some level of extra protection. The mercury concentration in the fillet can be converted to the mercury concentration in the whole-body with the formula (Peterson et al. 2007):

$$[\log (\text{fillet biopsy Hg}) = 0.2545 + 1.0623 \log (\text{whole-fish Hg})]$$

If the fillet has 0.3 mg/kg mercury then the corresponding whole fish concentration will be 0.185 mg/kg mercury. It is not recommended that this conversion be applied to the targets since the final objective will be applied to the fillet. It will then be difficult to ensure that targets in whole fish will be achieved. Doing so will add additional layers of uncertainty. In general, this information suggests that the water quality objective for TL 4 fish should be conservative for wildlife. Although, for the two prey fish objectives (fish less than 50 mm and TL3 fish 50 – 150 mm), the objective is recommended for whole fish, since these are only meant for wildlife.

The osprey seems to be a more sensitive species from this analysis and from the results of the Heinz et al. comparative study (Heinz et al. 2009). However, no adverse effects on reproduction in osprey have been observed near Clear Lake, California, which has highly elevated fish methylmercury concentrations from mercury mining (Cahill et al. 1998, Anderson et al. 2008). These results suggest that the targets in this analysis may be conservative because the targets are much lower than the concentrations observed in these studies.

K.9.3 Points of Uncertainty That Suggest a More Stringent Objective

Studies in grebe, loon and ibis contain some suggestions that toxic effect could occur near the mercury water quality objectives. However, evidence was not found that clearly indicated a lower water quality objective is needed. These studies are discussed in detail in Section K.7.

The wildlife values for all avian species were based on a reference dose for mallard ducks. Heinz et al. investigated the relative toxicity to methylmercury using 23 avian species to determine if other species are more or less sensitive than mallard ducks. They found that mallards were one of the least sensitive species, which indicates that the wildlife values calculated here are likely non-conservative. However, it is very difficult to determine more appropriate wildlife values at this time with the available information. The most sensitive of the species in the study were American kestrel (*Falco sparverius*), osprey (*Pandion haliaetus*), white ibis (*Eudocimus albus*), snowy egret (*Egretta thula*), and tri-colored heron (*Egretta tricolor*). The least sensitive species were mallards (*Anas platyrhynchos*), hooded merganser (*Lophodytes cucullatus*), lesser scaup (*Aythya affinis*), Canada goose (*Branta canadensis*), double-crested cormorant (*Phalacrocorax auritus*), and laughing gull (*Leucophaeus atricilla*). Species categorized as having medium sensitivity were the Ridgeway's rail (*Rallus longirostris*), sandhill crane (*Grus canadensis*), ring-necked pheasant (*Phasianus colchicus*), chicken (*Gallus gallus*), common grackle (*Quiscalus quiscula*), tree swallow (*Tachycineta bicolor*), herring gull (*Larus argentatus*), common tern (*Sterna hirundo*), royal tern (*Sterna maxima*), Caspian tern (*Sterna caspia*), great egret (*Ardea alba*), brown pelican (*Pelecanus occidentalis*), and anhinga (*Anhinga anhinga,* Heinz et al. 2009).

The USFWS also considered another reference dose (used to calculated wildlife values) that was three times lower; 0.007 mg/kg/day for California Ridgeway's rail, light-footed Ridgeway's rail, Yuma Ridgeway's rail and western snowy plover (USFWS 2003). This reference dose was calculated with an additional uncertainty factor to account for greater susceptibility of rail as indicated by egg injection studies, which were not final at the time of writing the USFWS analysis (USFWS 2003). The results of the egg injection studies were later published as Heinz et al. 2009. Since then, there has been no additional information on the sensitivity of rails. USFWS did not use this information to unequivocally recommend the lower reference dose for rails (0.007 mg/kg/day vs. 0.021 mg/kg/day). USFWS stated "The diet-to-egg transfer efficiency can vary widely between different species, as evidenced by the controlled feeding studies with mallards (Heinz, 1979) and pheasants (Fimreite, 1971). It would be imprudent to assume that similar sensitivities to egg concentrations between the clapper rail and the pheasant would necessarily be caused by the same dietary concentration" (see p 20 – 21of USFWS 2003). A non-conservative choice was made not to include this information in the calculations because there was little other evidence to support that rails have a significantly higher risk in the environment. Rails exposure to mercury is generally low since they eat food lower on the food chain, which puts them at lower risk of mercury toxicity.

A couple subsequent studies tried to gather more information on rails, but these two studies do not suggest a threshold for effects. On one study, the body condition of California clapper rails was negatively related to mercury concentrations within tidal marsh habitats of San Francisco Bay, California. Model averaged estimates indicated a potential decrease in body mass of 20 – 22 g (5 – 7%) over the observed range of mercury concentrations (Ackerman et al. 2012).

Later in another study in the same area, total mercury was measured in six macroinvertebrates and one fish species, representing Clapper Rail diets. The average mercury concentrations in all species was above 0.05 mg/kg (roughly 0.05 – 0.1 mg/kg wet weight for all except the eastern mudsnail, Casazza et al. 2014). Mercury concentrations in the eastern mudsnail were about 4 times higher than the other species: Baltic clam, soft-shell clam, ragworm, ribbed horse mussel, mud crab, staghorn scuplin. These organisms are TL2 and TL3. The sculpin were the only finfish included and they were 30 – 60 mm long, so the most comparable mercury water quality objective is 0.03 mg/kg in fish less than 50 mm long. This water quality objective (0.30 mg/kg in fish < 50 mm) has already been adopted as site-specific objective in San Francisco Bay. San Francisco Bay is known to be heavily impacted by mercury and is listed as impaired due to mercury. Therefore, the fact that Ackerman et al. 2012 found a small effect on body condition is not in conflict with the mercury water quality objectives. This information is not detailed enough to suggest whether or not a lower threshold is needed to protect rails.

If birds migrate or have a large feeding range, that behavior could make them less vulnerable to mercury hot spots. However, some species, including rails which are a sensitive species, are year round residents. More importantly, the exposure during breeding or nesting season may be the most significant, and movement during those times tends to be limited. Ackerman et al. noted grebes become flightless after they arrive at their summer locations. They lose feathers and wings atrophy (Ackerman et al. 2015). Terns, avocets and stilts were found to stay relatively close to their capture site in San Francisco Bay and mercury concentrations in the blood of the birds varied by location, showing that mercury hotspots can have an impact on locally breeding birds (Ackerman et al. 2007, Ackerman et al. 2008). Additionally, the assumption that “other foods” (see Section K.3) have no mercury is a non-conservative assumption.

A final point of uncertainty that is very difficult to incorporate is the combined effect of methylmercury with other contaminants and habitat loss. For example Heniz and Hoffman (1998) found that the combined treatment with selenium and methylmercury reduced survival of ducklings and produced more embryo deformities than in either treatment alone. Many areas of California also have high levels of selenium.

K.10 Other species Considered, but for Which Wildlife Values and Targets were not Calculated

K.10.1 California Brown Pelican

The California Brown Pelican was delisted from state and federal endangered status in 2009. The brown pelican feeds in the open ocean off the southern California coast, but also in the Salton Sea. Contamination of food supply by DDT and other chlorinated hydrocarbons reduced nesting productivity in California nearly to zero in 1969-71, from eggshell thinning and altered parental behavior. Since then, contamination has been reduced and productivity has increased (CDFW 1990). A separate analysis for the brown pelican is not included because most areas the pelicans inhabit are outside the geographic scope of the Provisions, except the Salton Sea. Also, pelicans should be protected by the targets for osprey. Brown pelicans primarily consume fish (vs. other types of food) and in this analysis osprey were considered to eat 100% fish. The brown pelican is probably less sensitive than ospreys based on the equations provided by the USFWS (equation 1) because brown pelicans are larger (2.75 – 5.5 kg) than ospreys (1.75 kg), although pelicans could eat more TL4 fish which would have higher mercury levels.

K.10.2 Sparrows

A recent study of riparian songbirds (song sparrows) in streams in the San Francisco Bay area found blood mercury concentrations high enough to cause reduced reproductive success (Robinson et al., 2011). Blood methylmercury concentrations were highest (1.66 ppm) downstream of New Almaden. These birds are insectivorous, not piscivorous. Song Sparrows are very small, smaller than the California least tern. Song sparrows weigh about 32 g, which according to equation 1, would make songs sparrows a more sensitive species to methylmercury toxicity. To drive a protective wildlife value for this species, a food intake rate would need to be calculated. Forster's terns were also captured in a site downstream of the New Almaden mining district. These terns had slightly higher blood mercury concentrations (averaging 2 ppm), than the sparrows (Ackerman et al. 2008). This comparison would suggest that an objective that protects Forster's tern should also protect the sparrows.

K.10.3 Marbled Murrelet

The marbled murrelet is listed by the USFWS as threatened. It is a coastal species, similar to the California least tern, but the marbled murrelet inhabits the northern California coast instead of the southern California coast. The USFWS did not have sufficient information about this species when writing their Biological Opinion to develop a suggested criterion, but stated that the criteria for the California least tern would be applicable for protection of the marbled murrelet. This species was not included in the USFWS's later evaluation (USFWS 2003). The marbled murrelet feeds in the open ocean, which is beyond the geographic scope of this objective. It feeds closer to shore during breading season, in water less than 95 ft. deep and it nests inland (CDFW 1990).

K.10.4 Ibis

White Ibis were one of the most sensitive species reported by Heinz et al. 2009 and a wildlife value for this species was lacking for this analysis. White ibis (*Eudocimus albus*) do not inhabit California (Cornell Lab of Ornithology 2016), while the white-faced Ibis (*Plegadis chihi*) do inhabit California (CDFW 1990). The white-faced ibis was a California Species of Special Concern, but is no longer on the list (Shuford and Gardali, 2008). The white-faced ibis eats earthworms, insects, crustaceans, amphibians, small fishes, and miscellaneous invertebrates (CDFW 1990). Other authorities on ibis report that white faced ibis eats mainly insects (Cornell Lab of Ornithology 2016). A threshold for ibis was the lowest found in the literature compared to thresholds found for other species (Table J-1 in Appendix J), which is discussed in Section K.7.

K.11 Locations where the Objective to Protect the California Least Tern Should be Applied

A list of water bodies where the objective of 0.03 mg/kg in fish less than 50 mm should apply is given in Table K-5, which is based on management areas defined by the USFWS (USFWS 2006). Additionally, this objective may be applied to a few other waters as described in Section K.8 to ensure protection for the Yuma Ridgeway's rail, unless another objective is adopted to protect the Yuma Ridgeway's rail (e.g. 0.05 mg/kg in fish 50 – 150mm). Other waters should be added by the appropriate Regional Water Boards based on local knowledge or as information becomes available. The applicable water bodies include only inland surface waters, enclosed bays, and estuaries. The open ocean is not part of the geographic scope of the Provisions.

Since 1970, California least tern nesting sites have been recorded from San Francisco Bay to Baja California. The nesting range in California has always been widely discontinuous, with the majority of birds nesting in southern California, from Santa Barbara County down through San Diego County. On the other hand, between the city of Santa Barbara and Monterey Bay, there are few known regularly used breeding sites (USFWS 1985).

The California least tern obtains most of its food from shallow estuaries and lagoons, and nearshore ocean waters. Feeding activity at the few sites that have been studied occurs mostly within 3.2 km (2 miles) of breeding colonies, and at many sites foraging is primarily in nearshore ocean waters less than 18.3 m (60 feet) deep. Colonies located near productive estuarine habitats appear to utilize such areas heavily, but data regarding the relative value of estuaries to feeding least terns are scarce. The increased use of freshwater marsh systems, lakes, lagoons, and estuarine areas during post-breeding dispersal suggests the special importance of such habitats during the breeding cycle, when juveniles are learning to fish for themselves (USFWS 1985).

Table K-5. Waters for the Least Tern Prey Fish Water Quality Objective and the Corresponding Regional Water Board

RB	Mgt.[1] Area	County	USFWS Site Name	Applicable inland surface water, enclosed bay[2] or estuary[3]	RARE Designation In Regional Water Quality Control Plan (Basin Plan)?
2	A	Alameda	Alameda Naval Air Station	An objective that is protective of the California Least tern has already been adopted for Lower San Francisco Bay	Yes: San Francisco Bay Region
		Alameda	Alvarado Salt Ponds		
		Alameda	Oakland Airport		
		San Mateo	Bair Island	Bair Island Marsh	Yes: San Francisco Bay Region
3	B	San Luis Obispo	Pismo Beach	Pismo Creek Estuary, Pismo Creek, Arroyo Grande Estuary, Arroyo Grande Creek, downstream (Oceano Lagoon, Meadow Creek, Pismo Marsh (Lake), Los Berros Creek), Big Pocket Lakes (Dune Lakes)	Yes: Central Coast Region
		San Luis Obispo	Oso Flaco Lake	Oso Flaco Lake, Oso Flaco Creek	Yes: Central Coast Region
3	C	Santa Barbara	Santa Maria River	Santa Maria Estuary, Santa Maria River (except Corralitos Canyon Creek, Sisquoc River, downstream), Orcutt Creek	Yes: Central Coast Region
3	D	Santa Barbara	San Antonio Creek	San Antonio Creek, San Antonio Creek Estuary	Yes: Central Coast Region
		Santa Barbara	Purisima Point (North, South)	None – (coast/open ocean)	Yes: Central Coast Region
		Santa Barbara	Santa Ynez River	Santa Ynez River Estuary, Santa Ynez River, downstream	Yes: Central Coast Region
4	E	Ventura	Santa Clara River	Santa Clara River Estuary, Santa Clara River Reach 1	Yes: Los Angeles Region
4	F	Ventura	Ormond Beach	Ormond Beach Wetlands	Yes: Los Angeles Region
		Ventura	Mugu Lagoon	Calleguags Creek Reach 1 (also called Mugu Lagoon)	Yes: Los Angeles Region
4	G	Los Angeles	Venice Beach	Ballona lagoon, Marina Del Rey (except Harbor),	Yes: Los Angeles Region
		Los Angeles	Playa del Rey	Ballona Wetlands, Ballona Creek Estuary	Yes: Los Angeles Region
4	H	Los Angeles	Terminal Island	Los Angeles/Long Beach Inner Harbor, Los Angeles/Long Beach Outer Harbor	Yes: Los Angeles Region
		Los Angeles	San Gabriel River	Alamitos Bay: Los Cerritos Wetlands, San Gabriel Estuary, Los Cerritos Channel Estuary, Long Beach Marina	Yes: Los Angeles Region
4	I	Los Angeles	Cerritos Lagoon		
		Los Angeles	Costa Del Sol		

Table K-5. Waters for the Least Tern Prey Fish Water Quality Objective and the Corresponding Regional Water Board

RB	Mgt.[1] Area	County	USFWS Site Name	Applicable inland surface water, enclosed bay[2] or estuary[3]	RARE Designation In Regional Water Quality Control Plan (Basin Plan)?
8	J	Orange	Anaheim Bay	Anaheim Bay	Yes: Santa Anna Region
		Orange	Surfside Beach	Anaheim Bay	Yes: Santa Anna Region
8	K	Orange	Bolsa Chica (North, South)	Bolsa Bay, Bolsa Chica Ecological Reserve	Yes: Santa Anna Region
8	L	Orange	Huntington Beach	Santa Ana River Salt Marsh, Tidal Prism of Santa Ana River (to within 1000' of Victoria Street) and Newport Slough	Yes: Santa Anna Region
8	M	Orange	Upper Newport Bay	Upper Newport Bay	Yes: Santa Anna Region
9	N	San Diego	San Mateo Creek	San Mateo Creek Mouth	Yes: San Diego Region
		San Diego	Aliso Creek	Aliso Canyon (in San Onofre Creek Watershed. Not in Orange County)	Yes: San Diego Region
		San Diego	Santa Margarita River	Santa Margarita Lagoon	Yes: San Diego Region
9	O	San Diego	Buena Vista Lagoon	Buena Vista Creek	Yes: San Diego Region
9	P	San Diego	Agua Hedionda Lagoon	Agua Hedionda Lagoon	Yes: San Diego Region
9	Q	San Diego	Batiquitos Lagoon	Batiquitos Lagoon	Yes: San Diego Region
9	R	San Diego	San Elijo Lagoon	San Elijo Lagoon	Yes: San Diego Region
9	S	San Diego	San Dieguito Lagoon	San Dieguito Lagoon	Yes: San Diego Region
		San Diego	Whispering Palms Encinitas	None[4]	None: San Diego Region
9	T	San Diego	Los Penasquitos Lagoon	Los Penasquitos Lagoon	Yes: San Diego Region
9	U	San Diego	FAA Island	Mission Bay	Yes: San Diego Region
		San Diego	North Fiesta Island	Mission Bay	Yes: San Diego Region
		San Diego	Stony Point	Mission Bay	Yes: San Diego Region
		San Diego	South Sea World Drive	Mission Bay	Yes: San Diego Region
		San Diego	Clover Leaf	Mission Bay	Yes: San Diego Region

Table K-5. Waters for the Least Tern Prey Fish Water Quality Objective and the Corresponding Regional Water Board

RB	Mgt.[1] Area	County	USFWS Site Name	Applicable inland surface water, enclosed bay[2] or estuary[3]	RARE Designation In Regional Water Quality Control Plan (Basin Plan)?
9	V	San Diego	Naval Training Center	San Diego Bay	Yes: San Diego Region
		San Diego	San Diego Int. Airport	San Diego Bay	Yes: San Diego Region
		San Diego	Chula Vista Wildlife Reserve	San Diego Bay	Yes: San Diego Region
		San Diego	Sweetwater River	Sweetwater River, Hydrologic Unit Basin Number 9.21	Yes: San Diego Region
		San Diego	North Island	San Diego Bay	Yes: San Diego Region
		San Diego	Delta Beach	San Diego Bay	Yes: San Diego Region
		San Diego	Coronado Cays	San Diego Bay	Yes: San Diego Region
		San Diego	Saltworks	San Diego Bay	Yes: San Diego Region
9	W	San Diego	Tijuana River Mouth	Tijuana River Estuary	Yes: San Diego Region

[1]Based on the Californian least tern coastal management areas and sites from the USFWS (USFWS 2006).
[2]"Enclosed Bays" means indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between the headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. Enclosed bays include, but are not limited to, Humboldt Bay, Bodega Harbor, Tomales Bay, Drake's Estero, San Francisco Bay, Morro Bay, Los Angeles-Long Beach Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay. Enclosed bays do not include inland surface waters or ocean waters (State Water Board 2005).
[3]"Estuaries" means waters, including coastal lagoons, located at the mouths of streams that serve as areas of mixing for fresh and ocean waters. Coastal lagoons and mouths of streams that are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters shall be considered to extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and seawater. Estuarine waters included, but are not limited to, the Sacramento-San Joaquin Delta, as defined in Water Code Section 12220, Suisun Bay, Carquinez Strait downstream to the Carquinez Bridge, and appropriate areas of the Smith, Mad, Eel, Noyo, Russian, Klamath, San Diego, and Otay rivers. Estuaries do not include inland surface waters or ocean waters (State Water Board 2005).
[4]In the USFWS list of management areas (USFWS 2006) Whispering Palms, San Diego Country, is labelled with an asterisk rather than identified as a numbered management area since it only had nesting one year and the location was developed by the following season. Therefore it is no longer a suitable site. A single least tern's nest was found on the site in 1979 on the levees of the old County sanitation ponds off of Via de la Valle. Prior to the 1980 season, the site was bulldozed and developed into the Whispering Palms Golf Course.

K.12 Considerations for Monitoring and Assessment

For monitoring and assessment of prey of the Californian Least tern, there is a long list of water bodies to which the objective should apply (Table K-5). However, certain sites could be prioritized for monitoring to save resources. The 2012 annual monitoring report reported that 74% of the breeding pairs were found at six locations: Naval Base Coronado, Point Mugu, Batiquitos Lagoon Ecological Reserve, Camp Pendleton, Huntington State Beach, and Alameda Point (Frost 2013).

The tern feeds primarily in shallow estuaries or lagoons where small fish are abundant. The tern hovers, and then plunges for fish near the surface, without submerging completely. Therefore, the relevant monitoring species are any that swim near the surface, not bottom dwelling fish. Prey in California includes anchovy (Engraulis sp.), silversides (Atherinops sp.) and shiner surfperch (*Cymatogaster aggregata*). Considerable feeding also takes place near shore in the open ocean, especially where lagoons are nearby, or at mouths of bays (CDFG 1990).

Fish tissue monitoring studies have found that fish mercury concentrations can vary by season and also suggests spring is the best time for monitoring. Eagles-Smith and Ackerman measured mercury in small fish, which are typical prey for Forester's tern in the San Francisco Bay Estuary (Eagles-Smith and Ackerman 2009). Fish mercury concentrations varied substantially over time, increasing 40% in spring (March – May) then decreasing 40% in early summer (May – July). This peak in mercury concentrations coincides with breeding. The increase in mercury concentrations may be due to seasonal changes in water quality that affect methylmercury production or changes in food web dynamics.

Fish tissue monitoring should be done during the breading season because impacts of mercury on reproduction have been frequently observed (Scheuhammer et al. 2007). The California least tern nesting season extends from approximately mid-April into early August, with the majority of nests completed by mid-June. Incubation usually lasts from 20 to 25 days. Flight stage is reached at approximately 20 days of age, but the young birds do not become fully proficient fishers until after they migrate from the breeding grounds. A second wave of nesting occurs from mid-June to early August. These are mainly re-nests after initial failures and second year birds nesting for the first time. Most authorities agree that least terns are capable of successfully raising only one brood per pair in a season (USFWS 1985).

Ackerman et al. found that the risk of mercury toxicity for waters birds is highest at hatching and fledging (Ackerman et al. 2011). Researchers examined total mercury and methyl-mercury concentrations in blood, liver, kidney, muscle, and feathers of Forster's tern (*Sterna forsteri*), black-necked stilt (*Himantopus mexicanus*) and American avocet (*Recurvirostra americana*) chicks as they aged from hatching through postfledging in San Francisco Bay. Mercury concentrations in internal tissues were highest immediately after hatching, due to maternally deposited mercury in eggs. Concentrations then rapidly declined as chicks aged and diluted their mercury concentrations through growth in size and as mercury is transferred into growing feathers. Mercury concentrations then increased during fledging when tissue growth and feather growth slowed, while chicks continued to acquire mercury through their diet. Springtime monitoring in fish should be representative of mercury in the eggs at hatching. Most chicks hatch in May or June, except in the northern sites near San Francisco they tend to hatch in June or July (Frost 2013).

Some birds have a fairly small range during breeding, which is import to consider when designing monitoring and assessment procedures. Ackerman et al. radio-marked and tracked 72 Forster's terns (*Sterna forsteri*) in San Francisco Bay to determine locations of dietary mercury uptake. The radiotelemetry data revealed that Forster's terns generally remained near their site of capture and foraged in nearby waters. On average, tern locations were 2.2 km to 7.7 km from their capture site, and mercury concentrations in blood differed among capture sites. Breeding terns are likely to be even more at risk because blood mercury concentrations more than tripled during the 45-day pre-breeding time period (Ackerman et al. 2008). In another study in San Francisco Bay, radio telemetry data for American avocets (*Recurvirostra americana*) and black-necked stilts (*Himantopus mexicanus*) showed these species had stronger site fidelity. The areas that avocets and stilts occupied half the time were 1 – 4 km^2 and the area they occupied 95% of the time was 8 – 25 km^2. Species differences in habitat use and foraging strategies may increase mercury exposure in stilts more than avocets (Ackerman et al. 2007). The fact that movement during breeding or nesting season tends to be limited is also discussed in Section K.9 on points of uncertainty.

For monitoring grebe prey, Ackerman et al. recommend sampling at least 20 individual prey fish from a minimum of two different species from each water body and analyzing total mercury concentrations on an individual, rather than a composite, basis. Prey fish should be sampled during the breeding season ("approximately April – July") when wildlife are at greatest risk to potential mercury-induced impairment (Ackerman et al. 2015). Sampling date should be standardized for annual monitoring programs because seasonal variation in prey fish mercury concentrations can be substantial (Eagles-Smith and Ackerman, 2009).

Information on relevant wildlife breeding periods was compiled in Table K-6. This information was used to recommend the averaging periods for the water quality objectives for wildlife. The recommended averaging period for the objective that applies to TL3 fish 50 – 150 mm is February 1 – July 31. The recommended averaging period for the objective that applies to fish less than 50 mm long for the California Least Tern is April 1 – August 31. Averaging periods are used in evaluating whether the water quality objective is achieved. The State Water Board's assessment policy allows for the use of different averaging periods as specified by particular water quality objectives (State Water Board 2004). All data collected within the same averaging period will be combined into a single resultant value (see section 6.1.5.6 of State Water Board 2004). Data collected during another averaging period (for example, in this case, the breeding season of the next year) would be combined into separate additional values. The values are then evaluated to determine if the water quality objective is being exceeded according to State Water Board's assessment policy (State Water Board 2004).

Table K-6 Wildlife Breeding Period for Prey Fish Collection Time

Aquatic-dependent Wildlife Species	Typical Breeding or Gestation Period	Citation
Bald eagle	February – July (a)	CDFW 1990
River otter	January – May (b)	CDFW 1990
Osprey	March – September (a)	CDFW 1990
Common merganser	Mid-April – August	Mallory and Metz 1999
Western grebe	April – September	Ackerman et al. 2015
Great blue heron	Mid-February – July	CDFW 1990
Double-crested cormorant	January – August	CDFW 1990
Mink	Late-January – May	CDFW 1990
Belted kingfisher	April – Mid-August	CDFW 1990
Forster's tern	April – Mid-August	Ackerman et al. 2014
California least tern	April – August	USFWS 1985
Western snowy plover, Pacific Coast population	March – Mid-September	USFWS 2007
Yuma Ridgeway's rail	March – July	USFWS 2009
California Ridgeway's rail	Late March – August	USFWS 2010
Light-footed Ridgeway's rail	Mid-February – Mid-July	Zembal et al. 2014

a) Timing of egg laying varies with latitude
b) Reproductive cycle of river otters is extended and includes peak breeding season of avian species of concern. Otter mating typically occurs December through April and reproductive cycle may include delay of implantation of the fertilized embryo up to eight months. Kits typically born in March and April after two months gestation (CDFW 1990).

K.13 Habitat Range Maps

The following maps are provided to support protections for wildlife, discussed in Section K.8 of this appendix. In Table K-3, some values showing the most sensitive species for each trophic level category are shaded gray. For these species, California Wildlife Habitat Relationship System range maps are shown below, as well as maps for some similarly sensitive species. More range maps can be found on the California Department of Fish and Game website (as well as downloadable GIS data http://www.dfg.ca.gov/biogeodata/cwhr/). Maps are also provided in Figure K-3 and Figure K-4 to show the general location of trout dominated waters, because the water quality objectives may be applied differently in trout dominated waters (see end of Section K.8), which could impact the level of protection for species that inhabit those waters. These maps support the discussion on the recommended water quality objectives in Section K.8.

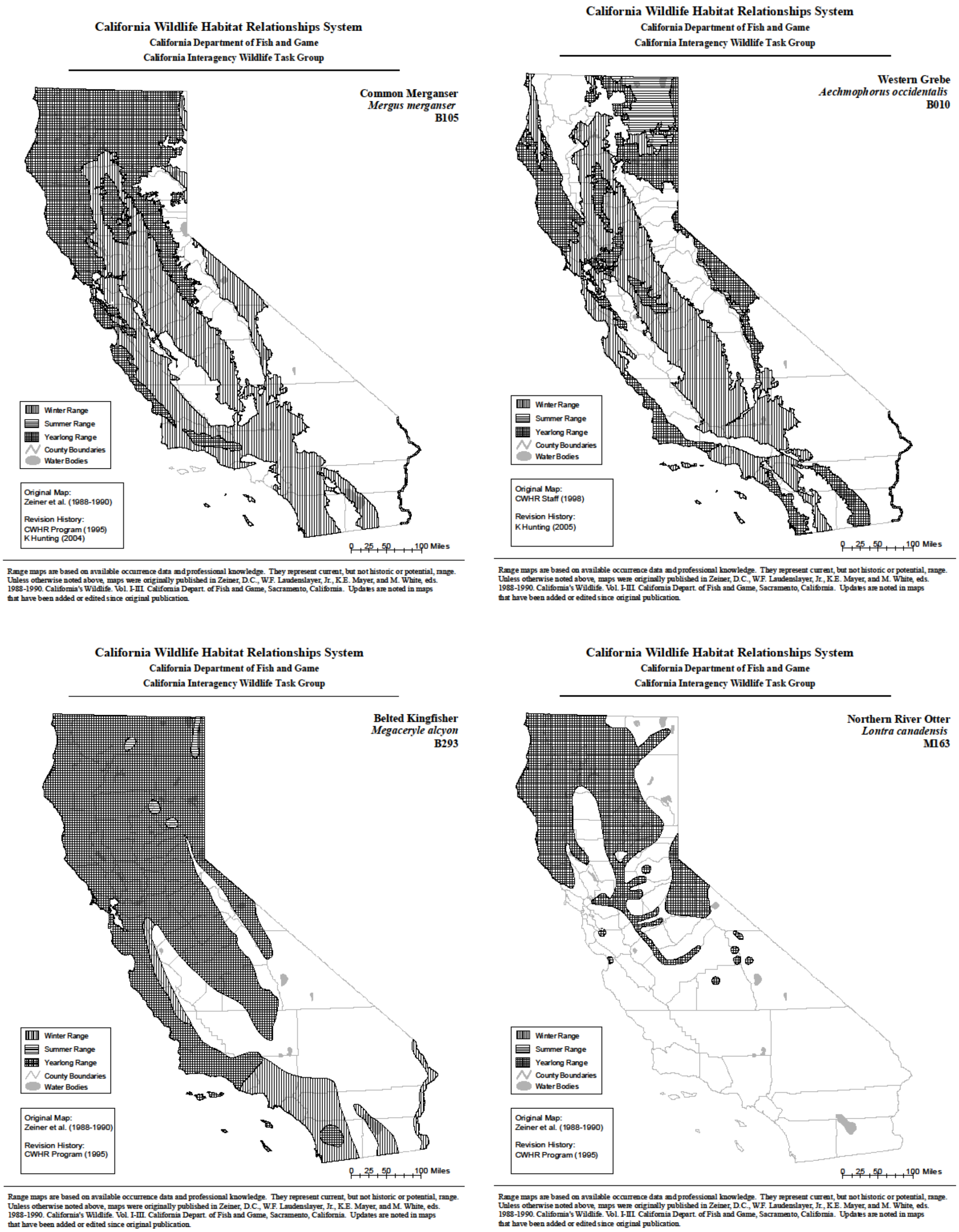
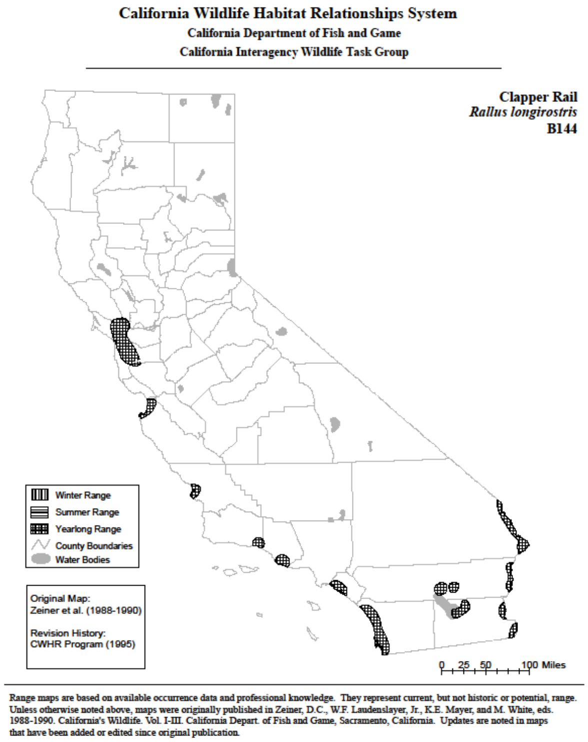
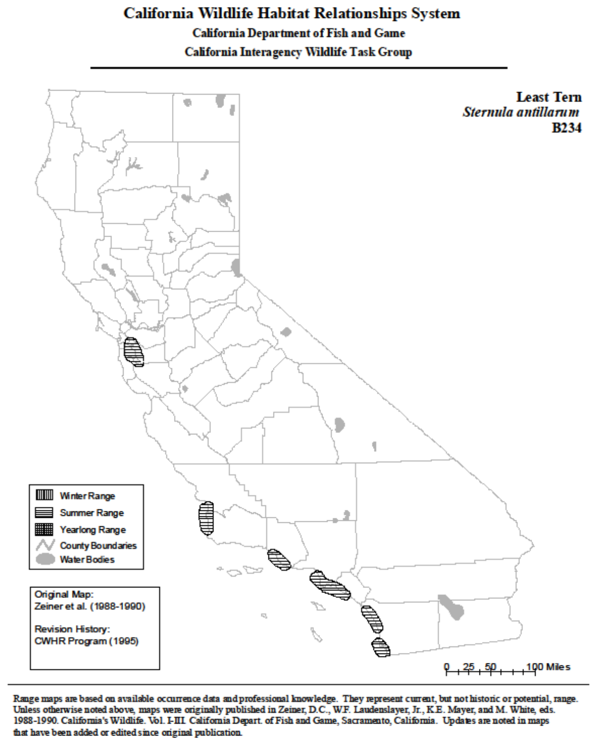
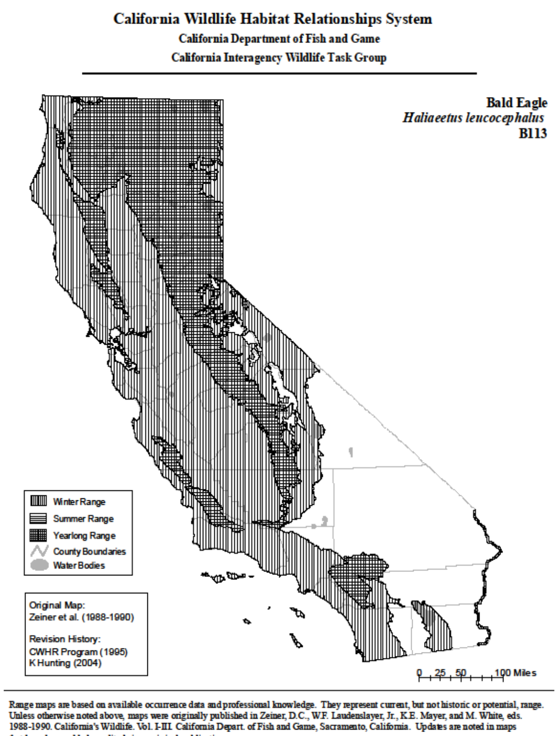


Figure K-2. California Wildlife Habitat Relationship System range maps for select wildlife species.







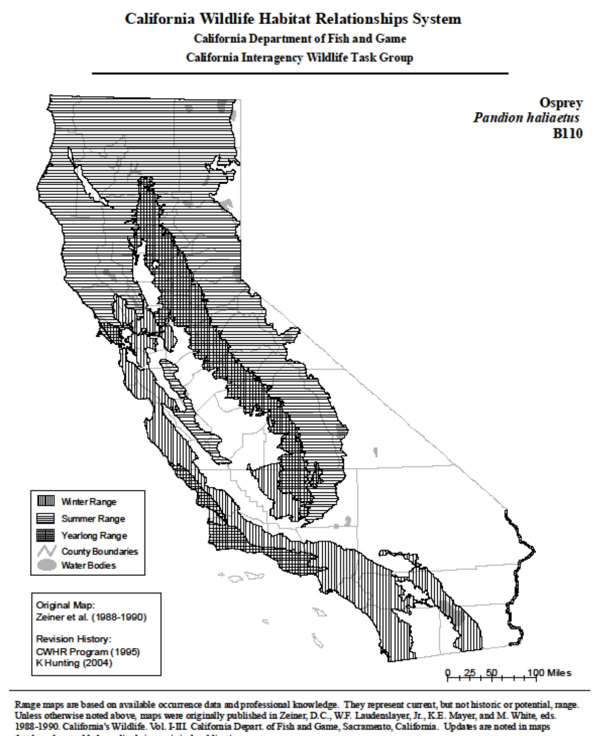


Figure K-2 (continued). California Wildlife Habitat Relationship System range maps for select wildlife species.

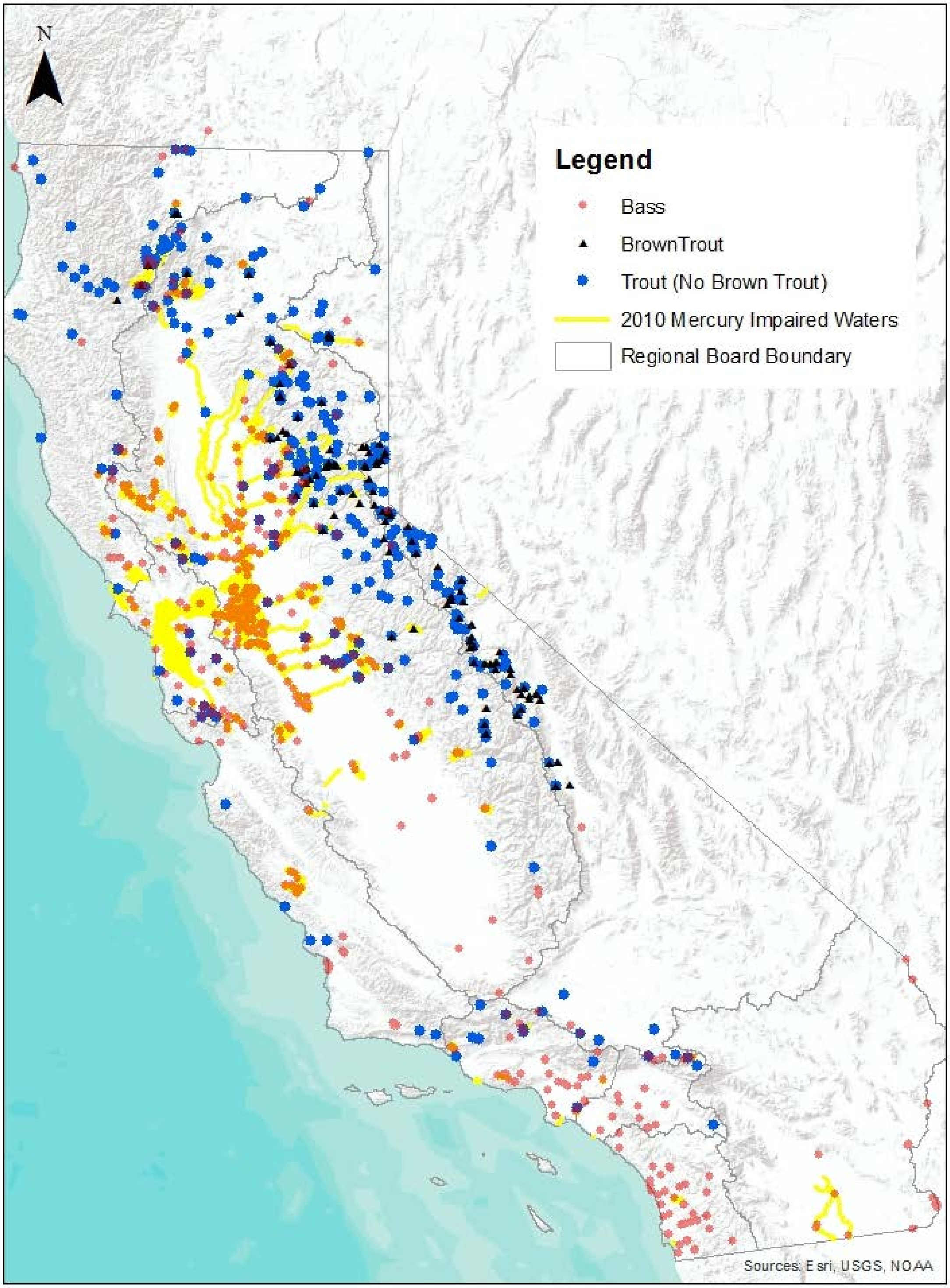


Figure K-3. Locations where Water Boards related monitoring programs have caught bass (largemouth bass, smallmouth bass and spotted bass), trout (rainbow trout, brook trout, lake trout, eagle lake trout), and brown trout. Data obtained from the California Environmental Data Exchange Network (CEDEN, www.ceden.org/).

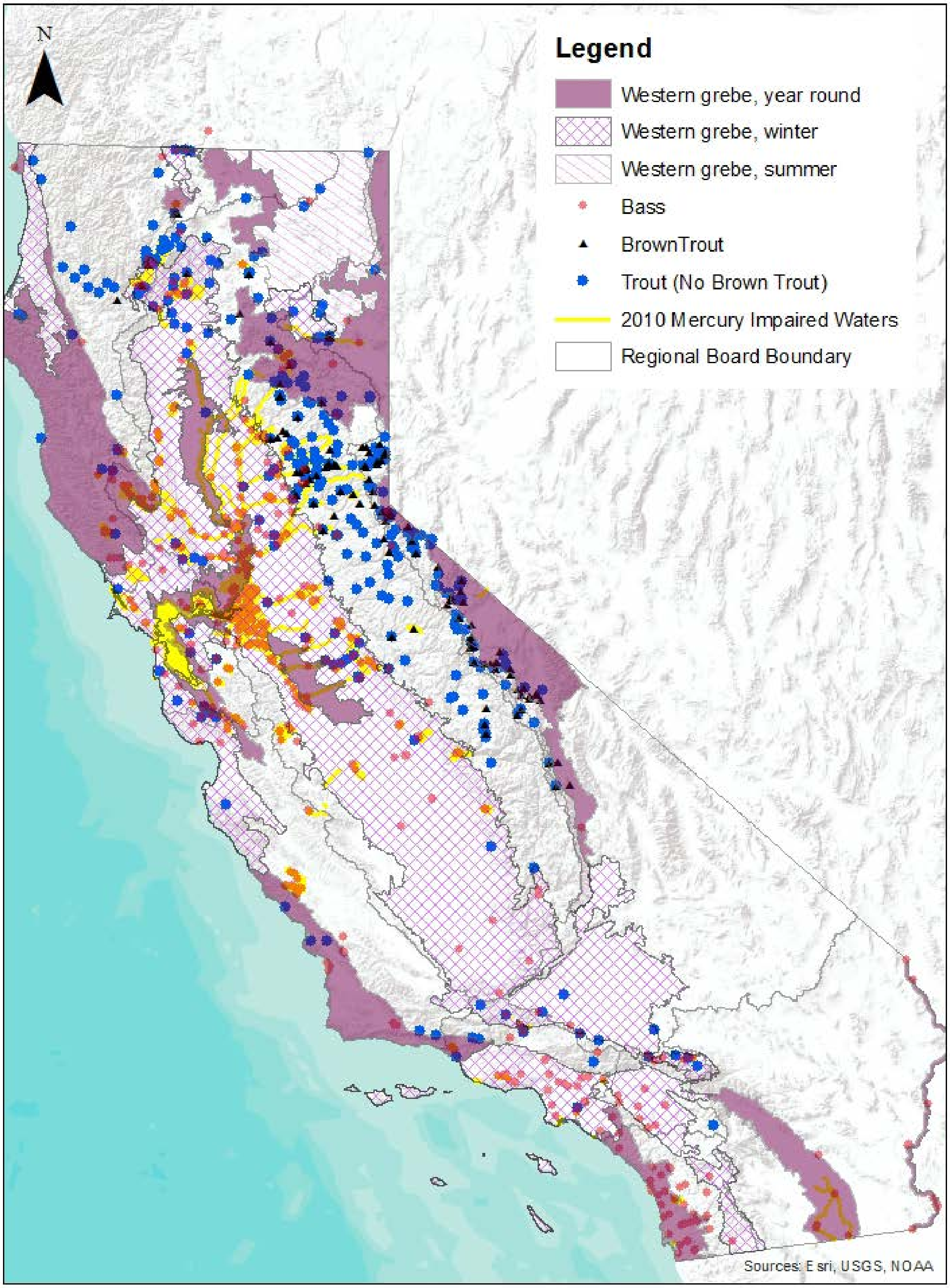


Figure K-4. Sensitive species habitat ranges that may overlap with trout dominated waters (see Figure K-3). Habitat ranges from California Wildlife Habitat Relationships (GIS shapefiles from www.dfg.ca.gov/biogeodata/cwhr/).

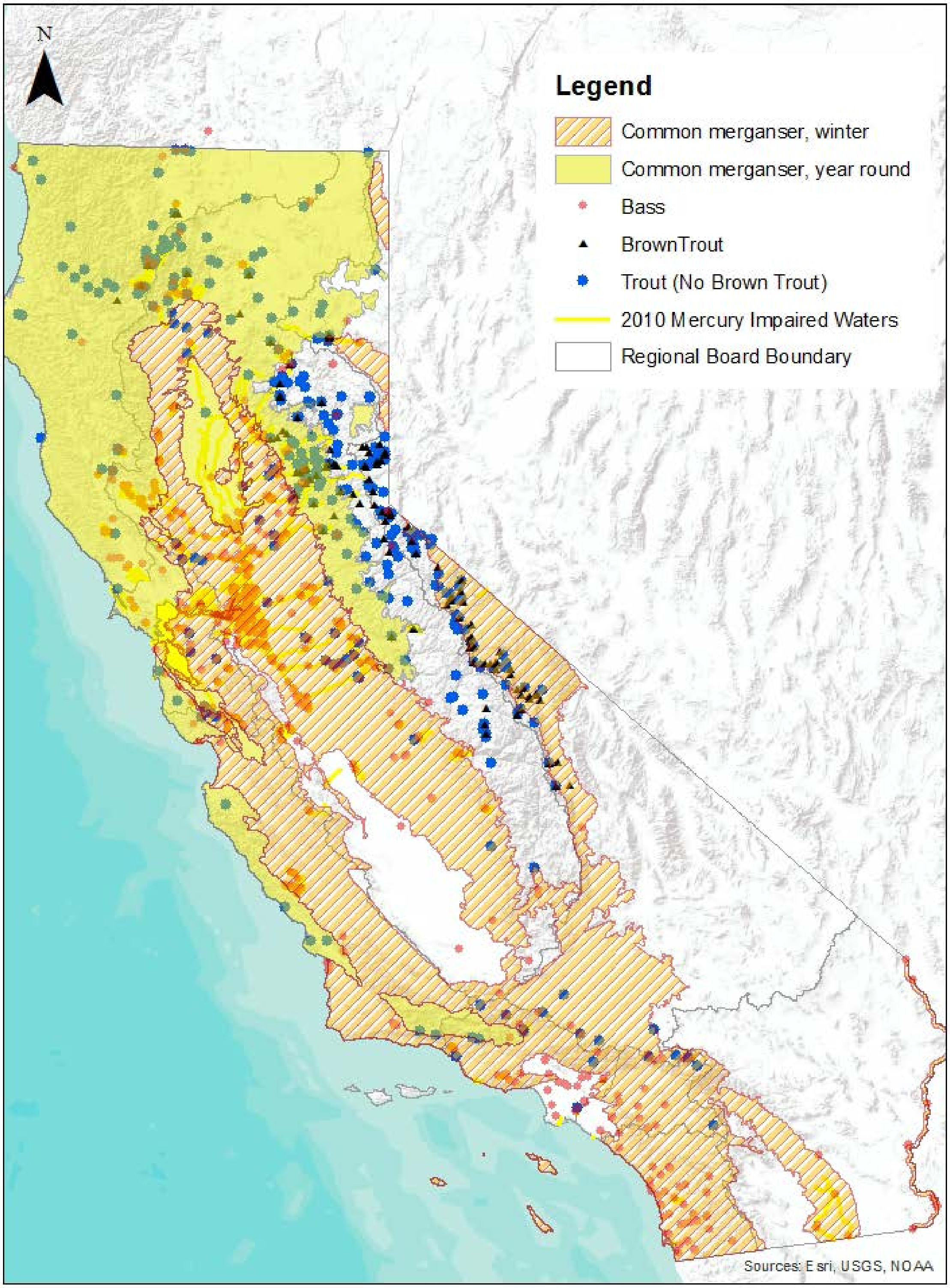


Figure K-4 (continued). Sensitive species habitat ranges that may overlap with trout dominated waters (see Figure K-3). Habitat ranges from California Wildlife Habitat Relationships (GIS shapefiles from www.dfg.ca.gov/biogeodata/cwhr/).

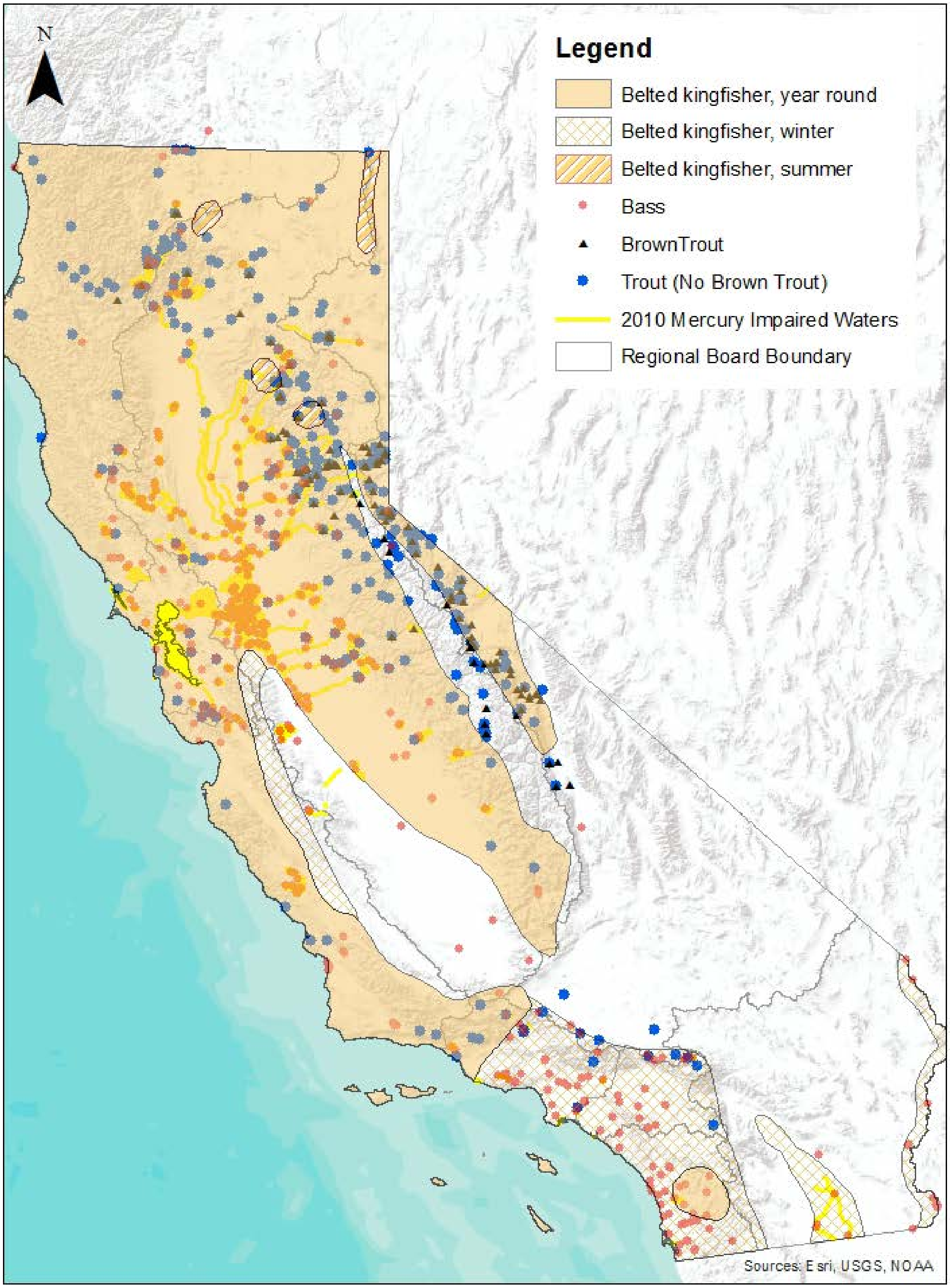


Figure K-4 (continued). Sensitive species habitat ranges that may overlap with trout dominated waters (see Figure K-3). Habitat ranges from California Wildlife Habitat Relationships (GIS shapefiles from www.dfg.ca.gov/biogeodata/cwhr/).

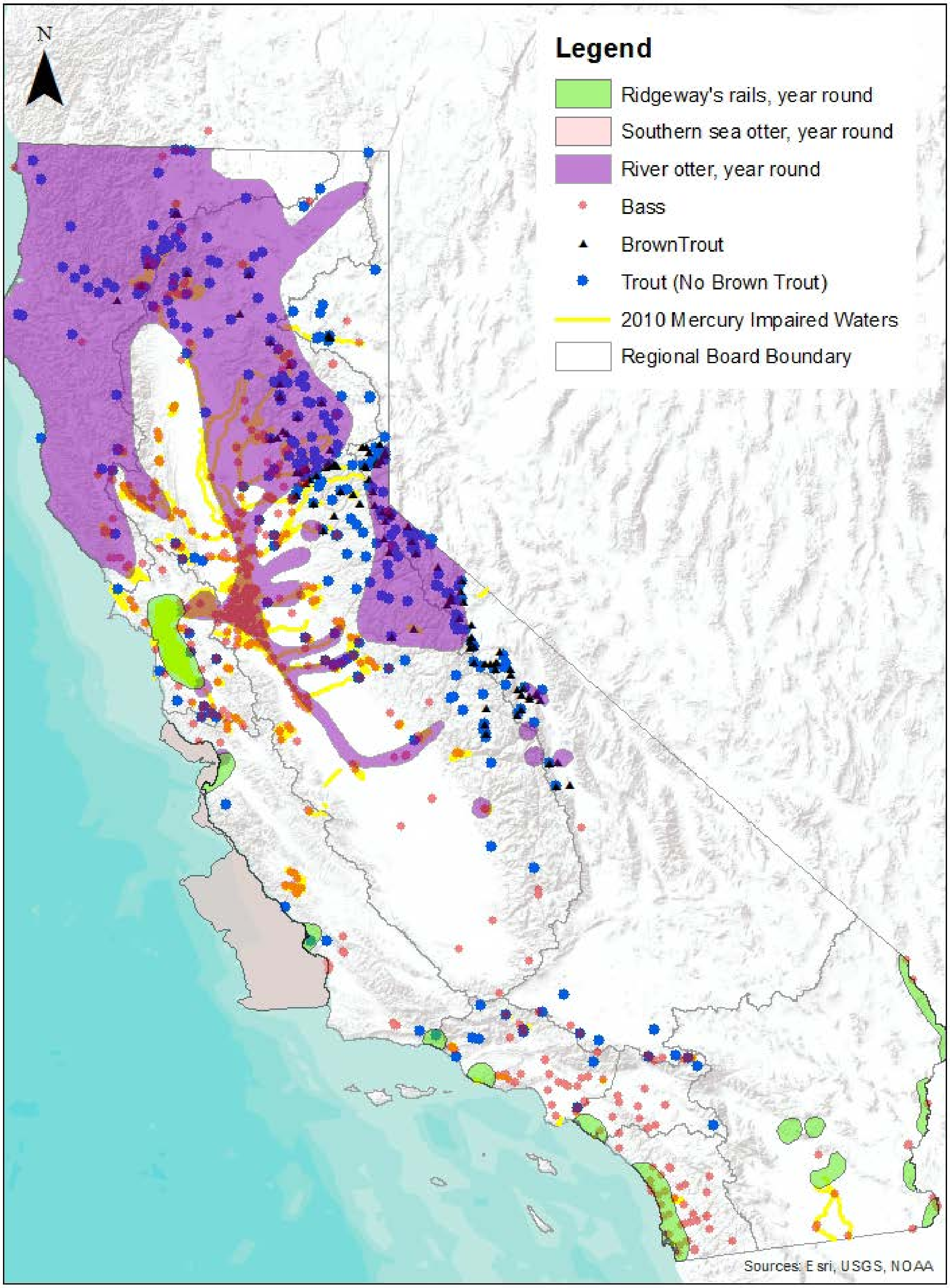


Figure K-4 (continued). Sensitive species habitat ranges that may overlap with trout dominated waters (see Figure K-3). Habitat ranges from California Wildlife Habitat Relationships (GIS shapefiles from www.dfg.ca.gov/biogeodata/cwhr/).

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Appendix L. Derivation of Trophic Level Ratios

L.1 Introduction and Purpose

The goal of this data analysis is to calculate ratios of fish tissue mercury concentrations between fish trophic levels. These ratios were used in deriving protective wildlife targets (Appendix K). The ratios are meant to represent conditions in inland surface waters, enclosed bays or estuaries, which is the geographic scope of the Provisions.

L.2 Methods

The data used to derive the ratios was downloaded from the Water Board's California Environmental Data Exchange Network (CEDEN, www.ceden.org). Total mercury and total methylmercury data from fish tissue samples dated January 1, 2000 to September 30, 2012 were compiled. Total mercury and total methylmercury were assumed to be equivalent in fish tissue, so no conversion between the two forms was made.

The data from any species that were not finfish (e.g.: mussels, clams) were removed from the data set. Sampling stations with primarily marine fish or estuarine fish were separated from freshwater sampling stations. The 'estuarine' data set was compiled from data from water bodies that are considered enclosed bays or estuaries according to State Water Resource Control Board (Appendix 1 of State Water Board 2005). Data from fish from open ocean waters were not used. Data were grouped by the size of the fish sampled to match the fish size classifications used in the wildlife analysis (150 – 500 mm, 150 - 350 mm, and <150 mm, Appendix K). Anadromous fish species were removed since they spend a portion of their lives out at sea and the resulting mercury concentration in their tissues does not represent local conditions. The fish sampled were categorized as either trophic level 3 or trophic level 4 by the fish size and species, according to Table L-1 and Table L-2.

Individual ratios were calculated by sampling station. Ratios were calculated only for the sampling stations that met the following minimum quality control criteria: (1) the data set contained at least two fish species per trophic level and (2) had a sample size greater than 5 fish sampled per trophic level. These criteria were used to create the data sets for 150-500 mm fish for each sampling station. The data sets for 150-350 mm fish for each sampling station were created using the data set for 150 -500 mm fish, but omitting data for fish larger than 350 mm. Therefore, the data sets for 150-350 mm fish are smaller and some did not meet the quality control criteria. The number of fish in each data set is shown in Table L3 and Table L-4.

Table L-1. Fish Species used in the Fresh Water Data Analysis

Freshwater Fish Trophic Levels*	
Trophic Level 3	**Trophic Level 4**
Black Bullhead *(Ameiurus melas)*	**Black Crappie** *(Pomoxis nigromaculatus)*
Bluegill *(Lepomis macrochirus)*	**Channel Catfish** *(Ictalurus punctatus)* ***> 200mm***
Brown Bullhead *(Ictalurus nebulosus)*	**Largemouth Bass** *(Micropterus salmoides)*
Common Carp *(Cyprinus carpio)*	**Sacramento Pikeminnow** *(Ptychocheilus grandis)*
Hitch *(Lavinia exilicauda)*	**Smallmouth Bass** *(Micropterus dolomieui)*
Goldfish *(Carassius auratus)*	**Spotted Bass** *(Micropterus punctulatus)*
Pumpkinseed *(Lepomis gibbosus)*	**White Catfish** *(Ictalurus catus)* ***> 200mm***
Rainbow Trout *(Oncorhynchus mykiss)***	
Redear Sunfish *(Lepomis microlophus)*	
Sacramento Sucker *(Catostomus occidantalis)*	
Tule Perch *(Hysterocarpus traskii)*	
White Catfish *(Ictalurus catus)* ***150-200mm***	

* From Appendix B of *Sacramento – San Joaquin Delta Estuary TMDL for Methylmercury* (Central Valley Water Board 2010) and *Inland fishes of California* (Moyle 2002).

**The only sampling station in Table L-3 with data on rainbow trout is Big Bear Lake.

Table L-2. Fish Species used in the Estuarine Data Analysis.

Estuarine Fish Trophic Levels*	
Trophic Level 3	**Trophic Level 4**
Black Perch *(Embiotoca jacksoni)*	**Barred Sand Bass** *(Paralabrax nebulifer)*
Chub Mackerel *(Scomber japonicas)*	**Kelp Bass** *(Paralabrax clathratus)*
Opaleye *(Girella nigricans)*	**Spotted Sand Bass** *(Paralabrax maculatofasciatus)*
Pile Perch *(Rhacochilus vacca)*	**Yellowfin Croaker** *(Umbrina roncador)*
Rainbow Surfperch *(Hypsurus caryi)*	
Striped Mullet *(Mugil cephalus)*	
Shiner Surfperch *(Cymatogaster aggregata)*	

*From Appendix A of *Contaminants in Fish from the California Coast, 2009-2010* (Davis et al. 2012) and FishBase (www.fishbase.org).

The average mercury concentration in each trophic level (trophic level 3 and trophic level 4) was calculated for each size classification. These average mercury concentrations were used to calculate ratios for each sampling station (Table L-3, Table L-4) by dividing the average mercury concentrations in trophic level 3 fish by the average mercury concentration in trophic level 4 fish at each sampling station. Then, the statewide ratios (Table L-5) were calculated as the geometric means of the individual ratios from each sampling station.

The available data enable calculation of ratios for different types of sport fish (ratios of mercury in TL3 fish to TL4 fish). However there was insufficient data in CEDEN to calculate ratios for the mercury concentrations in prey fish to sport fish (trophic level 3 fish <150 mm compared to trophic level 4 fish 150-500mm), using the minimum criterion of including only sampling stations with at least two different species.

In the freshwater data, all mercury concentration data were above the analytical reporting limit. Six of the results were "detected but not quantifiable (DNQ)". For the DNQ samples, the estimated mercury concentration reported in CEDEN was used. In the estuarine data set, there were two results of "non-detect (ND)". For the ND samples, half the minimum detection limit (MDL) was used as the resulting mercury concentration.

L.3 Results

L.3.1 Freshwater Ratios

Data from 34 sampling stations met the criteria of samples from fish 150 - 500 mm from two species per trophic level and at least five fish per trophic level. The sampling stations were predominately located in or near the Sacramento- San Joaquin River Delta with a few scattered throughout the state (Figure L-1). Sampling stations included sloughs, rivers, and lakes (Table L-6). Most of the samples were collected in 2005 - 2007. Two stations have samples from 2004 or 2011 as well. The average mercury concentrations at each sampling station and the tropic level ratios comparing the mercury concentrations in trophic level 3 fish to trophic level 4 fish are reported in Table L-3.

L.3.2 Estuarine Ratios

Overall data were very limited for estuarine sampling stations. Data from only three sampling stations met the criteria of samples from fish 150 -500 mm from two species per trophic level and at least five fish per trophic level. The average mercury concentrations at each sampling station and the tropic level ratios comparing the mercury concentrations in trophic level 3 fish to trophic level 4 fish are reported in Table L-4.

L.3.3 Statewide Ratios

The statewide trophic level ratios, calculated from all sampling stations combined (the freshwater and estuarine sampling stations) are shown in Table L-5. The statewide ratios were similar to freshwater ratios, since there were so few sampling stations with estuarine data. The estuarine ratios had little weight in the statewide ratios, and did not change the final outcome of the ratios (the first two significant digits of the ratios did not change).

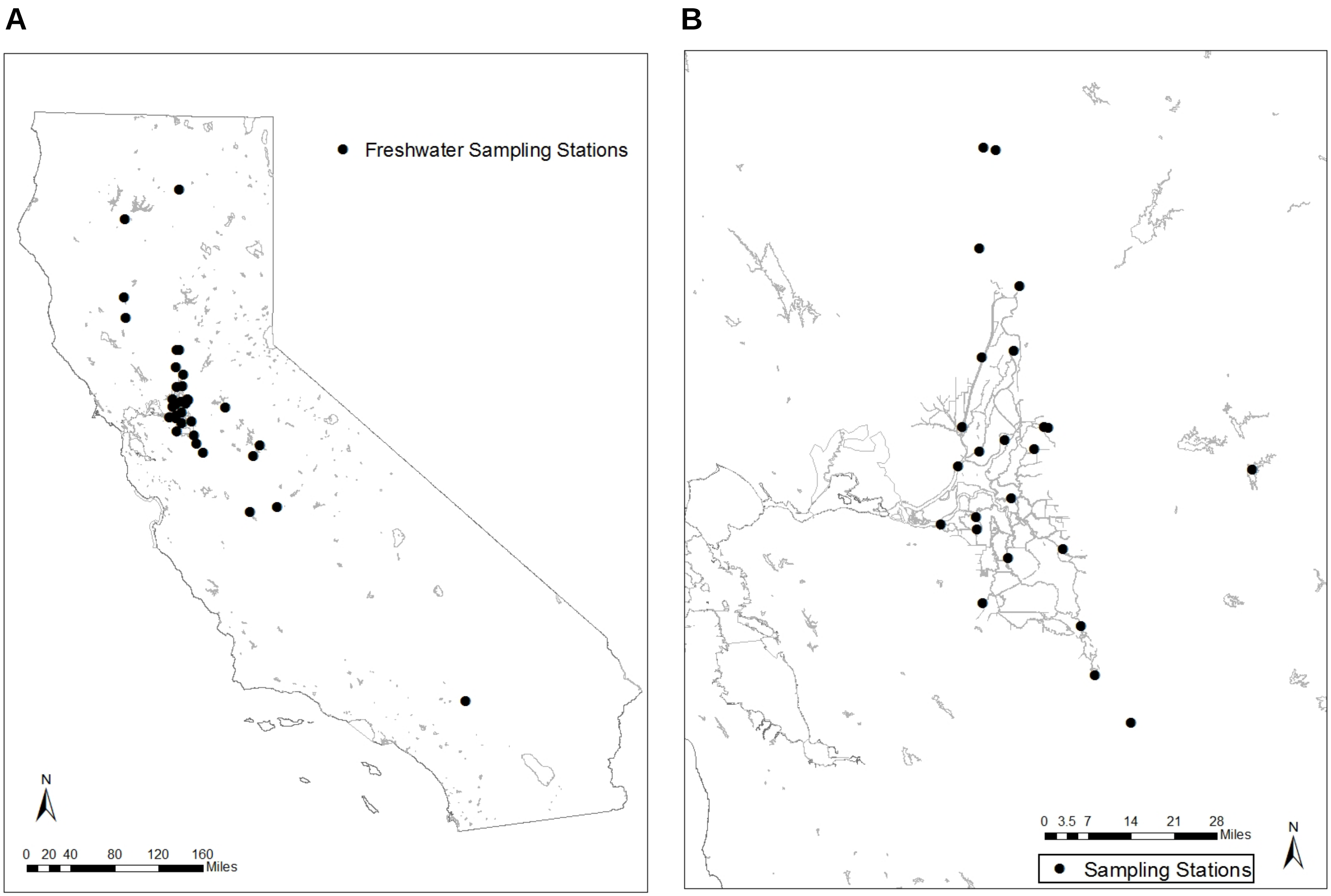

Figure L-1 . Overall distribution of sample stations used for the freshwater data analysis (A) and the cluster of freshwater sampling sites in or near the Sacramento-San Joaquin Delta (B).

Table L-3. Freshwater Average Mercury Concentrations by Trophic Level (TL) Category and Ratios

Station Name	Number of fish				Average Mercury Conc. (mg/kg)				Ratios				
	TL4 150 - 500mm	**TL4** 150 - 350mm	**TL3** 150 - 500mm	**TL3** 150 - 350mm	**TL4** 150 - 500mm	**TL4** 150 - 350mm	**TL3** 150 - 500mm	**TL3** 150 - 350mm	**TL4/TL3** 150 - 350mm	**TL4/ TL3** 150 - 500mm	**TL4** 150 -500mm **/ TL3** 150-350mm	**TL4** 150 -500mm **/ TL4** 150-350mm	**TL3** 150 -500mm **/ TL3** 150-350mm
(New) Hogan Reservoir	27	12	14	14	0.49	0.44	0.20	0.20	2.14	2.43	2.43	1.13	1.00
Beaver Slough (SF Mokelumne R.)	19	11	8	8	0.18	0.16	0.10	0.10	1.59	1.80	1.80	1.13	1.00
Big Bear Lake	29	9	34	21	0.19	0.04	0.03	0.04	1.07	5.97	4.85	4.53	0.81
Big Break – Delta waterways	31	21	24	18	0.22	0.19	0.11	0.07	2.85	2.04	3.25	1.14	1.59
Calaveras R. off Deep Water	19	15	10	10	0.14	0.11	0.05	0.05	2.11	2.82	2.82	1.33	1.00
Cosumnes R. at River Mile (RM) 1	35	21	14	11	1.26	1.39	0.57	0.63	2.20	2.21	1.98	0.90	0.89
Cosumnes R. u/s I-5	29	17	35	21	0.83	0.85	0.25	0.22	3.96	3.34	3.87	0.98	1.16
East Park Reservoir Southeast	21	9	14	8	0.22	0.21	0.14	0.08	2.76	1.56	4.00	1.07	1.89
Feather R.: Nicolaus	23	21	27	21	0.34	0.28	0.19	0.20	1.42	1.82	1.74	1.22	0.95
Frank's Tract - Delta waterways	29	15	24	24	0.16	0.13	0.07	0.07	1.79	2.17	2.17	1.21	1.00
Georgiana Slough	17	16	8	5	0.29	0.26	0.22	0.18	1.45	1.32	1.61	1.11	1.22
Italian Slough	20	15	17	16	0.22	0.21	0.08	0.08	2.64	2.80	2.71	1.03	0.97
Lake Britton	22	22	8	4	0.13	0.13	0.18	0.09	1.42	0.75	1.42	1.00	1.90
Lake McClure at Bagby	12	12	7	3	0.69	0.69	0.18	0.19	3.54	3.79	3.54	1.00	0.94
Mendota Pool/Mendota Slough	14	5	23	15	0.17	0.14	0.09	0.08	1.69	1.98	2.18	1.29	1.10
Merced R.: Hatfield State Park	17	9	16	8	0.29	0.21	0.19	0.09	2.19	1.48	3.08	1.40	2.08
Middle R.: Bullfrog	43	29	31	29	0.28	0.24	0.12	0.12	2.02	2.42	2.38	1.18	0.98
Prospect Slough (mid-Prospect)	62	58	22	11	0.28	0.28	0.22	0.21	1.35	1.27	1.35	1.00	1.06
Sacramento R.: W.Sac. RM59	17	13	13	9	0.49	0.39	0.18	0.14	2.73	2.64	3.36	1.23	1.27
Sacramento R.: Rio Vista	51	39	40	27	0.35	0.28	0.18	0.15	1.91	1.92	2.43	1.27	1.27
Sacramento R.: RM44	59	31	28	11	0.51	0.36	0.17	0.09	3.99	2.94	5.73	1.44	1.95
Sacramento R.: Veterans Bridge	27	12	16	7	0.53	0.29	0.14	0.07	4.01	3.66	7.27	1.81	1.99
Sacramento R.: Near Verona	16	13	14	7	0.37	0.36	0.21	0.17	2.07	1.81	2.18	1.05	1.20
San Joaquin R.: Hwy 99	11	7	11	11	0.10	0.09	0.04	0.04	2.17	2.40	2.40	1.11	1.00
San Joaquin R.: Mossdale	18	12	10	10	0.26	0.23	0.13	0.13	1.75	1.97	1.97	1.13	1.00
San Joaquin R.: Potato Slough	29	14	32	27	0.27	0.23	0.13	0.11	2.06	2.04	2.41	1.17	1.18
San Joaquin R.: Vernalis	45	33	22	8	0.43	0.40	0.26	0.13	3.04	1.64	3.30	1.08	2.01
San Joaquin R.: Laird Park	15	8	12	8	0.27	0.31	0.18	0.13	2.48	1.51	2.18	0.88	1.44
Sand Mound Slough	18	12	10	10	0.18	0.16	0.06	0.06	2.87	3.18	3.18	1.11	1.00
Steamboat Slough	22	17	12	7	0.50	0.41	0.26	0.18	2.26	1.94	2.78	1.23	1.43
Stony Gorge Reservoir: Dam	12	3	14	9	0.19	0.24	0.15	0.12	2.05	1.31	1.63	0.80	1.25
Sutter Bypass Below Kirkville Rd.	12	7	8	5	0.38	0.32	0.12	0.11	2.85	3.11	3.42	1.20	1.10
Toe Drain (Proposect Slough)	60	38	15	5	0.39	0.33	0.25	0.27	1.24	1.56	1.47	1.18	0.94
Whiskeytown Lake at Brandy Ck.	14	13	11	9	0.10	0.08	0.07	0.08	1.02	1.29	1.19	1.16	0.92

Geometric Mean					0.29	0.24	0.14	0.12	**2.12**	**2.09**	**2.54**	**1.19**	**1.20**

Table L-4. Estuarine Average Mercury Concentrations by Trophic Level (TL) Category and Ratios

Estuarine Station Name	Number of fish*				Average Mercury Conc. (mg/kg)				Ratios				
	TL4 150 - 500mm	**TL4** 150 - 350mm	**TL3** 150 - 500mm	**TL3** 150 - 350mm	**TL4** 150 - 500mm	**TL4** 150 - 350mm	**TL3** 150 - 500mm	**TL3** 150 - 350mm	**TL4/TL3** 150 - 350mm	**TL4/ TL3** 150 - 500mm	**TL4** 150 - 500mm **/ TL3** 150-350mm	**TL4** 150 - 500mm **/ TL4** 150-350mm	**TL3** 150 - 500mm **/ TL3** 150-350mm
Mission Bay 9170 CFCP	41 (8)	30 (6)	35 (7)	20 (4)	0.14	0.11	0.02	0.03	3.66	6.66	4.47	1.22	0.67
San Diego Bay	57(11)	49 (9)	43 (7)	43 (7)	0.14	0.12	0.10	0.10	1.23	1.45	1.45	1.17	1.00
San Diego Bay/Zuniga Jetty	13 (3)	13 (3)	32 (7)	32 (7)	0.15	0.15	0.09	0.09	1.72	1.70	1.70	0.99	1.00
Geometric Mean					0.14	0.13	0.06	0.06	**1.98**	**2.54**	**2.22**	**1.12**	**0.88**

* number of fish including composited fish (number of samples where each composite sample is counted as one sample)

Table L-5.Statewide Trophic Level (TL) Ratios

TL4/TL3 150 - 350mm	**TL4/TL3** 150 - 500mm	**TL4** 150 - 500mm **/ TL3** 150-350mm	**TL4** 150 - 500mm **/ TL4** 150-350mm	**TL3** 150 - 500mm **/ TL3** 150-350mm
2.11	2.12	2.51	1.18	1.17

Table L-6. Freshwater Water Body Types

Waterbody Type	Number of Stations
Slough, Delta Waterways, Sutter Bypass	11
River	17
Reservoir/Lake	7

L.4 Conclusions

Given the limited data, the estuarine ratios may be a poor representation of bioaccumulation in estuarine conditions. Even the freshwater ratios were limited, since they were predominately from California's Central Valley. Thus the resulting ratios may not be accurate for other areas of California outside the Central Valley. Within the Central Valley the ratio of mercury concentration in trophic level 4 fish compared to trophic level 3 fish (TL3/TL4) was about 2, which matches well with most locations since the ratios for individual sampling stations did not deviate much from this ratio. The ratios derived in this appendix were used in Appendix K to derive the wildlife targets for California.

References

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Appendix M. Summary of Mercury TMDLs

Summaries of sources and allocations from California mercury Total Maximum Daily Loads included in Table M-1, grouped by Region. Available TMDL progress reports are included at the end.

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
San Francisco Bay (San Francisco Bay Water Board, 2006)		
Bed erosion	220 kg Hg/yr (53% reduction)	None identified
Central Valley watershed	330 kg Hg/yr (24% reduction)	See Delta TMDL for details
Urban storm water	82 kg Hg/yr (48% reduction)	Monitor MeHg levels and implement source control under watershed permit for large MS4s
Guadalupe River watershed	2 kg Hg/yr (98% reduction)	See Guadalupe River TMDL for details
Atmospheric deposition	27 kg Hg/yr (current)	No mandated actions
Nonurban storm water	25 kg Hg/yr (current)	None identified
Municipal wastewater	11 kg Hg/yr (35% reduction)	Comply with watershed permit (e.g., implement source control and process optimization)
Industrial wastewater	1.3 kg Hg/yr (current)	Comply with watershed permit (e.g., implement source control and process optimization)
Other		Conduct studies to understand mercury bioavailability in dredged sediments; wetland restoration should be done to minimize methylmercury generation; public outreach regarding safe fish consumption.
Guadalupe River Watershed (San Francisco Bay Water Board, 2008a; 2014)		

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Mining waste	0.2 mg Hg/kg (dry wt., median) in erodible waste and erodible sediment from depositional areas in creeks that drain mercury mines	Identify potential for mining waste runoff and implement erosion controls
Impoundments	1.5 ng MeHg/L in the hypolimnion of impoundments downstream of mercury mines	Conduct studies on the suppression of mercury methylation in impoundments
Urban storm water	0.2 mg Hg/kg suspended sediment (dry wt., annual median)	Covered under San Francisco Bay watershed permit for MS4s
Nonurban storm water	0.1 mg Hg/kg suspended sediment (dry wt., annual median)	None
Atmospheric deposition	23.2 µg Hg/sm/yr	No mandated actions
Walker Creek (San Francisco Bay Water Board, 2008b)		
Background (areas not near Gambonini Mine)	0.2 mg Hg/kg (sediments)	None
Downstream depositional areas	0.5 mg Hg/kg in suspended particulates (d/s of creekside lands adjacent to Arroyo Sausal, Salmon and Walker creeks)	Dischargers under WDRs or waivers of WDRs to control pathogens, nutrients, or sediments or Section 401 projects must incorporate management practices or provisions that minimize Hg discharges and MeHg production. Comply with conditions of Marin County's Creek Permit Program Update Marin County's Creek Permit Guidance for Unincorporated Areas of Marin to include specific guidance for projects in areas that may contain Hg-enriched sediments

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Soulajule Reservoir	0.04 ng dissolved MeHg/L	Submit a monitoring and implementation plan and schedule to characterize fish tissue, water, and suspended sediment Hg concentrations, and develop and implement MeHg production controls necessary to achieve TMDL targets
Gambonini Mine	5 mg Hg/kg suspended sediments	Apply for coverage under the state's Industrial Storm water General Permit Submit to the Water Board for approval a SWPPP, implementation schedule, and monitoring plan
Clear Creek and Hernandez Reservoir (Central Coast Water Board, 2004)		
Clear Creek	236 g Hg/yr	Removal and/or entombment of mining wastes Capping of residual material with clean soil Revegetation of disturbed areas
Hernandez Reservoir	1015 g Hg/yr	Load reductions in Clear Creek are expected to reduce loads in Hernandez Reservoir to meet allocations

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Las Tablas Creek and Lake Nacimiento **(Central Coast Water Board, 2002)** (Postponed since Buena Vista mine became a superfund site.)		
General soils	7.67 kg Hg/yr (current loads)	None
Roads	0 kg Hg/yr (100% reduction)	San Luis Obispo County will pave road segment of Cypress Mountain road or will conduct equivalent actions to eliminate mercury runoff
Mines	4.52 kg Hg/yr (88.2% reduction)	Buena Vista Mine was added to National Priorities List. U.S. EPA planning to remediate.
El Dorado Park Lakes **(U.S. EPA, 2012)**		
Northern Lake System		
Supplemental Water Additions (ground water and potable water)	0.00962 kg Hg/yr (48% reduction)	To be determined
Runoff (nonpoint source)	0.0000057 kg Hg/yr (48% reduction)	To be determined
Parkland Irrigation	0.0000193 kg Hg/yr (48% reduction)	To be determined
Atmospheric deposition (to the lake surface)	0.00338 kg Hg/yr (48% reduction)	To be determined
Southern Lake System		
Supplemental Water Additions (ground water and potable water)	0.000368 kg Hg/yr (current)	To be determined
Runoff (nonpoint source)	0.00000199 kg Hg/yr (current)	To be determined

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Parkland Irrigation	0.0000458 kg Hg/yr (current)	To be determined
Atmospheric deposition (to the lake surface)	0.00112 kg Hg/yr (current)	To be determined

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Puddingstone Reservoir (U.S. EPA, 2012)		
Atmospheric deposition	0.0018 kg Hg/yr (47% reduction)	To be determined
Tributaries and storm drains	0.000976 kg Hg/yr (47% reduction)	To be determined
Irrigation of surrounding parklands	0.00243 kg Hg/yr (47% reduction)	To be determined
Storm water (MS4s, construction, industrial, Caltrans)	0.0166 kg Hg/yr (47% reduction)	To be determined
Lake Sherwood (U.S. EPA, 2012)		
Storm water (MS4s, Caltrans)	0.00979 kg Hg/yr (70% reduction)	To be determined
Runoff (nonpoint source)	0.00095 kg Hg/yr (70% reduction)	To be determined
Atmospheric deposition	0.00156 kg Hg/yr (70% reduction)	To be determined
Calleguas Creek/Mugu Lagoon (Los Angeles Water Board, 2007)		
Urban runoff	Suspended sediment Hg load that is dependent on flow through water body (80% reduction)	Best management practices by employed by municipal separate storm sewer systems (MS4s), Caltrans, general industrial and construction storm water permits, and Naval Air Weapons Station Point Mugu.

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Agricultural runoff, open space	Suspended sediment Hg load that is dependent on flow through water body (80% reduction)	Implemented through the State's Nonpoint Source Pollution Control Program (NPSPCP) and Conditional Waiver for Discharges from Irrigated Lands using studies and best management practices (BMPs) to control erosion and sediment discharges
POTW effluent	0.37 kg Hg/yr (current)	Limitations in permits
Consolidated Slip and Fish Harbor, Los Angeles-Long Beach Harbor (Los Angeles Water Board and U.S. EPA, 2011)		
Historically deposited pollutants in sediments, including military facilities, manufacturing, fish processing plants, wastewater treatment plants, oil production facilities, and shipbuilding or repair yards	0.15 mg Hg/kg dry sediment (86% reduction)	Remove the contaminated sediment in the harbor. Future action to be determined

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Cache Creek (Central Valley Water Board, 2004a; 2005)		
Mines	Bear Creek: 5% of existing Hg loads (Rathburn, Petray North and South, and Rathburn-Petray) Harley Gulch: 5% of existing Hg loads (Abbott and Turkey Run) Sulphur Creek: 30% of existing Hg loads (geothermal springs, soil erosion, mines, streambeds, and atmospheric deposition) Cache Creek at Yolo: 66 g MeHg/yr (46% reduction) Settling Basin: 34.7 g MeHg/yr (60% reduction) Bear Creek at gauge: 3.2 g MeHg/yr (85% reduction)	Public outreach regarding the levels of safe fish consumption and monitoring; Remediation of inactive mines; Control of erosion in mercury-enriched upland areas and in floodplains downstream of the mines and in the lower watershed; Conducting feasibility studies and evaluating possible remediation at the Harley Gulch delta; Identifying sites and projects to remediate or remove floodplain sediments containing mercury and implement feasible projects; Addressing methylmercury reductions through studies of sources and possible controls in Bear Creek and Anderson Marsh, controlling inputs from new impoundments, wetlands restoration projects, or geothermal spring development
Clear Lake (Central Valley Water Board, 2002a; 2002b)		
Atmospheric Deposition	2 kg Hg/yr (max load estimated)	None
Tributaries and Surface Water Runoff	90% of existing Hg input (about 16 kg Hg/yr)	Reduce transport of contaminated sediments from Oaks Arm into the rest of lake

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Sulphur Bank Mine	Active sediment Hg contribution reduced by 49% (about 340 kg Hg/yr)	Control and possible treatment of surface water runoff from mine; Control of groundwater flow into Clear Lake from mine; Capping of waste rock mine dam; Eliminating contributions to surficial sediment layer previously deposited due to mine related processes (e.g., dredge contaminated sediment, cap with clean sediments, or natural burial of contaminated sediments)
Sacramento-San Joaquin Delta (Central Valley Water Board, 2010)		
Tributaries (57%), Wetlands (19%), Open water sediment flux (17%), Municipal wastewater (4%), Ag return flows (2%), Atmospheric deposition (0.4%), Urban runoff (0.3 %)	Central Delta: 668 g/yr MeHg (current load) Marsh Creek: 1.6 g/yr MeHg (73% reduction) Mokelumne/Cosumnes Rivers: 53 g/yr MeHg (64% reduction) Sacramento River: 1,385 g/yr MeHg (44% reduction) San Joaquin River: 195 g/yr MeHg (63% reduction) West Delta: 330 g/yr MeHg (current load) Yolo Bypass: 235 g/yr MeHg (78% reduction)[1]	Special studies to reduce sediment bound mercury in wetlands, irrigated lands, open water, and reduce methylmercury generation, including in the Cache Creek Settling Basin. Best management practices (BMPs) to control erosion and sediment discharges; reductions from NPDES point sources and storm water. Future TMDLs for tributaries. Public outreach regarding safe fish consumption.
Rhine Channel, Newport Bay (U.S. EPA Region 9, 2002; Anchor Environmental, 2005)		
Storm water	0.0171 kg Hg/yr	None specified
Caltrans	0.0027 k Hg/yr	None specified

Table M-1. Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Boatyards	0 kg Hg/yr	None specified
Other NPDES	0.0027 kg Hg/yr	None specified
Existing sediment	0.063 kg Hg/yr	Dredge sediment and dewater prior to transporting to an approved off-site upland disposal facility; or Dredge sediment and place within an off-site nearshore confined disposal facility; or Dredge sediment and dispose of within a confined aquatic disposal area excavated near channel mouth
Undefined sources	0.0045 kg Hg	None specified
Hg = Inorganic mercury MeHg = Methylmercury MS4 = Municipal Separate Storm Sewer System TMDL = Total maximum daily load WDR = Waste Discharge Requirements 1. Allocations by subarea of Delta, not by source.		

M.1 TMDL Progress Reports

Progress reports were available for several of the TMDLs summarized in the previous table, and they are included in the following pages. These progress reports are available from the Water Boards website on performance reports:

www.waterboards.ca.gov/about_us/performance_report_1415/plan_assess/11112_tmdl_outcomes.shtml

Guadalupe River Watershed

www.waterboards.ca.gov/about_us/performance_report_1213/plan_assess/docs/fy1213/11112_r2_guadaluperiver_mercury.pdf

Walker Creek

www.waterboards.ca.gov/about_us/performance_report_1213/plan_assess/docs/fy1213/11112_r2_walkercreek_mercury.pdf

Clear Creek and Hernandez Reservoir

www.waterboards.ca.gov/about_us/performance_report_1213/plan_assess/docs/fy1213/11112_r3_clearcreek_mercury.pdf

Calleguas Creek/Mugu Lagoon

www.waterboards.ca.gov/about_us/performance_report_1213/plan_assess/docs/fy1213/11112_r4_calleguascreek_metals.pdf

Cache Creek

www.waterboards.ca.gov/about_us/performance_report_1213/plan_assess/docs/fy1213/11112_r5_cachecreek_mercury.pdf

Sacramento-San Joaquin Delta

www.waterboards.ca.gov/about_us/performance_report_1415/plan_assess/docs/fy1314/11112_r5_delta_mercury.pdf

Rhine Channel, Newport Bay

www.waterboards.ca.gov/about_us/performance_report_1213/plan_assess/docs/fy1213/11112_r8_rhinechannel_metals_organics.pdf

Total Maximum Daily Load Progress Report	
Regional Water Board	**San Francisco Bay, Region 2**
Beneficial uses affected:	REC-1, RARE, WILD
Pollutant(s) addressed:	Mercury
Implemented through:	CWC §13267, CWC §13304
Approval date:	June 1, 2010

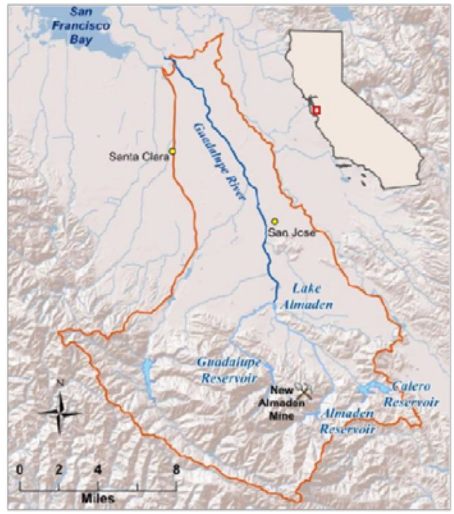
Guadalupe River Watershed Mercury TMDL	
STATUS	☐ Conditions Improving ☐ Data Inconclusive ☑ **Improvement Needed** ☐ TMDL Achieved/Water Body Delisted

TMDL Summary

Areas of the Guadalupe River Watershed downstream from the New Almaden Mine, the largest-producing mercury mine in North America, are impaired by mercury. Fish in these waters have extremely high mercury concentrations that greatly exceed the target set to protect human health. To address the high mercury levels the San Francisco Bay Regional Water Board developed the Guadalupe River Watershed Mercury TMDL, which was approved by the U.S. EPA in June 2010.

The TMDL established mercury load reductions from mine activities and aqueous methylmercury allocations for reservoirs and lakes to achieve fish tissue objectives. Phase I of TMDL implementation focused efforts at the top of the watershed; mercury mine site owners are taking actions to reduce discharges (typically involving stabilization of mercury mining wastes) and the local water district has pilot studies underway to reduce methylation of mercury in reservoirs. Phase II of TMDL implementation will address downstream areas. The TMDL calls for targets to be attained before 2029. As of September 2013, monitoring data collected by the responsible parties is thus far inconclusive regarding changes in mercury concentrations.

Guadalupe River Watershed



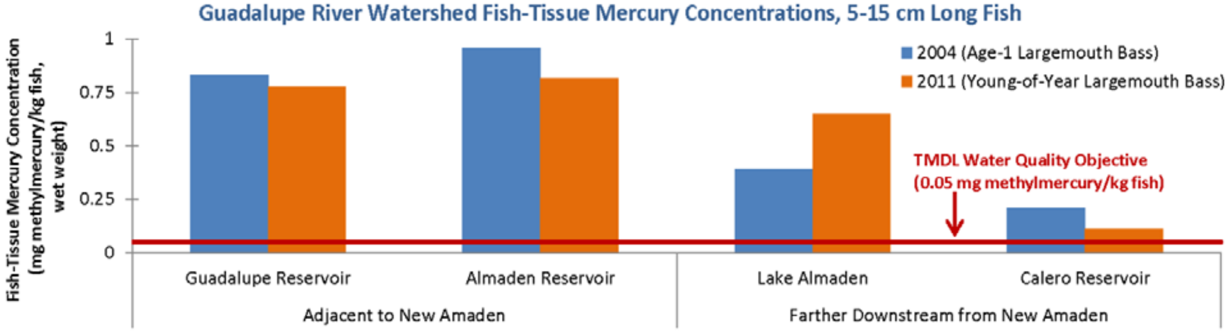
TMDL Water Quality Objectives

Fish Size	TMDL Fish-Tissue Water Quality Objectives
Whole fish, trophic level 3 5-15cm long	0.05 mg methylmercury/kg fish (wet weight, average)
Whole fish, trophic level 3 15-35 cm long	0.1 mg methylmercury/kg fish (wet weight, average)

Water Quality Outcomes

- *Implementation actions have yet to result in significant improvement in fish mercury concentrations.*
- *Water quality data show exceedances of TMDL water quality objectives; reservoirs adjacent to New Almaden Mine show highest fish-tissue mercury concentration levels.*
- *Responsible parties established a coordinated water quality monitoring program.*
- *Santa Clara Valley Water District is continuing voluntary methylmercury production and control studies; solar-powered circulators have been effective in suppressing methylmercury production at Lake Almaden but not in the Almaden or Guadalupe reservoirs.*
- *Mine property owners will continue clean-up actions to prevent mercury from eroding into surface waters.*

Guadalupe River Watershed Fish-Tissue Mercury Concentrations, 5-15 cm Long Fish



More information on 2011 Coordinated Monitoring Program efforts is available in the 2012 Annual Data Report.

Updated September 2013

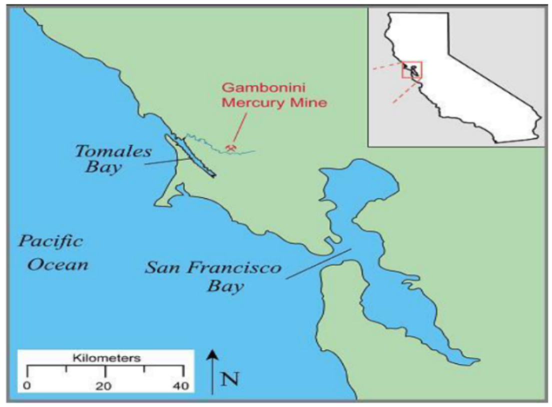
Total Maximum Daily Load Progress Report		Walker Creek Watershed Mercury TMDL	
Regional Water Board	**San Francisco Bay, Region 2**	**STATUS**	☑ Conditions Improving ☐ Data Inconclusive ☐ Improvement Needed ☐ TMDL Achieved/Waterbody Delisted
Beneficial uses affected:	COLD, RARE, REC-1, SPAWN, WILD		
Pollutants addressed:	Mercury		
Implemented through:	NPDES Permits, Waiver of WDRs, CWC §13267 Requirements, 319(h) Grants, Cleanup & Abatement		
Approval date:	September 29, 2008		

TMDL Summary

The Walker Creek Mercury TMDL addresses mercury in the creek, its floodplain, and the Soulajule Reservoir, which drains into the creek. Mercury sources in the watershed include the Gambonini Mine site, where mercury was mined beginning in the 1960's, and two former mercury mines in the Soulajule Reservoir sub-watershed. Mercury was mined in the Walker Creek watershed from the 1960s through the early 1970s. In 1982, a tailings dam at Gambonini failed catastrophically, sending large quantities of mercury-laden sediment downstream into Walker Creek and out into Tomales Bay. Discharges of mercury from the mine to Walker Creek continued until 1998-2000, when the mine site was remediated by stabilizing the waste pile, revegetation with native plants, and storm water diversion. Although the primary mine source of mercury has been cut off, there remains in-stream storage of mercury-bound sediments along Walker Creek.

The goal of the TMDL is to reduce mercury levels in Walker Creek and Soulajule Reservoir so that fish-eating wildlife and humans who consume local sport fish are protected from this bio-accumulative pollutant. The TMDL allocates discharges of mercury-laden sediment and methylmercury production to sources in the watershed.

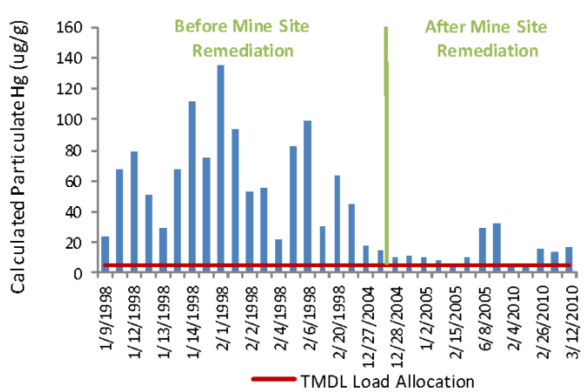
Walker Creek Watershed Map



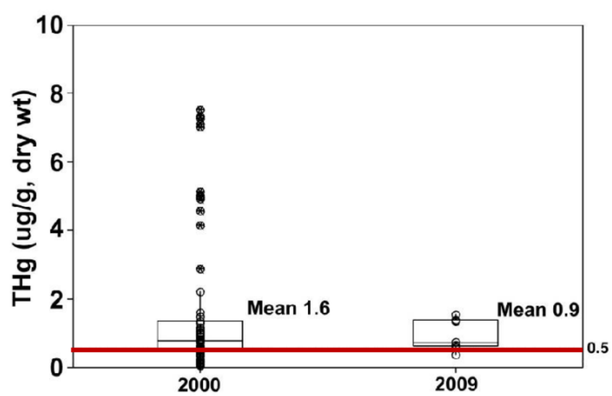
Water Quality Outcomes

- *Mercury and sediment loads to Walker Creek have been significantly reduced by mine cleanup.*
- *Inorganic mercury concentrations in sediment at the mouth of Walker Creek have also declined significantly.*
- *Grazing management practices (e.g., streambank stabilization, fencing, etc.) required under a Waiver of Waste Discharge Requirements should further limit remobilization of mercury-laden sediments along Walker Creek.*

Gambonini Mine Runoff Mercury Concentrations and TMDL Allocation



Comparison of 2000 and 2009 Mercury Concentrations at Mouth of Walker Creek



Updated March 2012

Total Maximum Daily Load Progress Report		Clear Creek and Hernandez Reservoir Mercury	
Regional Water Board	Central Coast, Region 3	**STATUS**	☑ Conditions Improving ☐ Data Inconclusive ☐ Improvement Needed ☐ TMDL Achieved/Waterbody Delisted
Beneficial uses affected:	COLD, MUN, WARM		
Pollutant(s) addressed:	Mercury		
Implemented through:	Non-regulatory Action		
Approval date:	June 21, 2004		

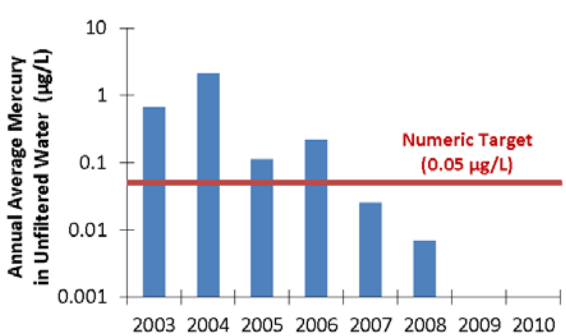
TMDL Summary

Clear Creek and Hernandez Reservoir are on California's 1998 Clean Water Act section 303(d) List as impaired by mercury. Elevated levels of mercury in the water column exceed water quality objectives for the municipal (MUN) beneficial use designation. Fish tissue from Hernandez Reservoir contains mercury at levels considered unsafe for consumption. The primary source of the mercury loading is abandoned mines managed by the United States Bureau of Land Management (USBLM). The Central Coast Regional Water Board developed the Clear Creek and Hernandez Reservoir Mercury TMDL and implementation plan, which was approved by U.S. EPA in June 2004.The TMDL is implemented through non-regulatory measures by USBLM. USBLM has implemented erosion control and other measures to reduce mercury loading from the abandoned mine sites. USBLM actions include:

1) Removal and/or entombment of mining wastes;
2) Capping of residual material with clean, native (non-mercury ore) soil; and
3) Re-vegetation of disturbed areas

Clear Creek Watershed

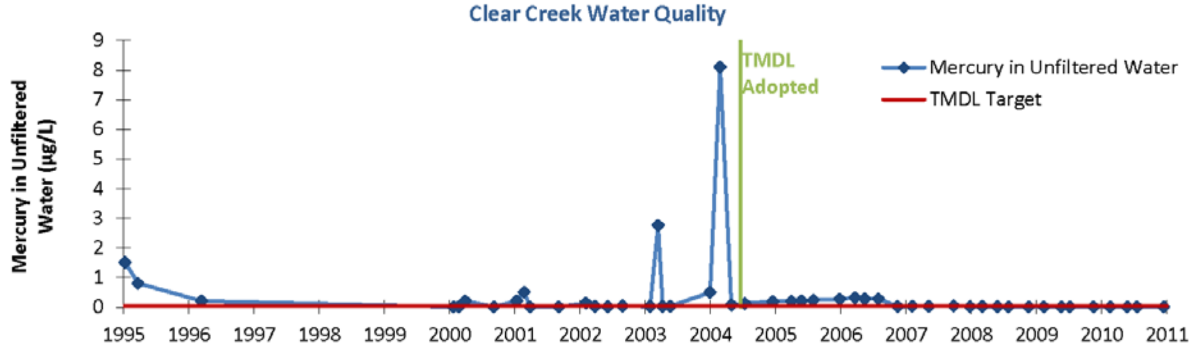
TMDL Waste Load Allocations/Load Allocations



Water Quality Outcomes

- *Clear Creek is currently meeting water quality objectives for mercury.*
- *Since mid-2007 the total mercury in Clear Creek (annual average) achieves the numeric target of 0.050 µg/L.*
- *The data also indicate that Hernandez Reservoir is currently meeting water column objectives for mercury; however, the most recent fish tissue sampled from the reservoir (2008) exceeds the TMDL numeric target of 0.3 mg/kg methylmercury in certain species.*
- *Seventeen consecutive quarterly samples achieve the water column numeric target. Twenty eight samples are required to show compliance with the numeric target to support delisting. Additional samples are being collected and delisting Clear Creek will be evaluated.*

Clear Creek Water Quality



Updated September 2011

Total Maximum Daily Load Progress Report	
Regional Water Board	**Los Angeles, Region 4**
Beneficial uses affected:	RARE, WARM, WET, WILD
Pollutant(s) addressed:	Metals and Selenium
Implemented through:	NDPES Permits, MS4 Permits, Agricultural Conditional Waiver
Approval date:	March 26, 2007

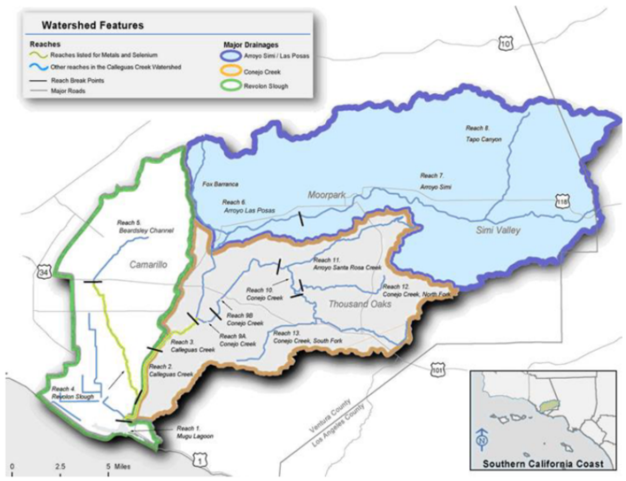
Calleguas Creek Watershed Metals and Selenium TMDL	
STATUS	☑ **Conditions Improving** ☐ Data Inconclusive ☐ Improvement Needed ☐ TMDL Achieved/Waterbody Delisted

TMDL Summary

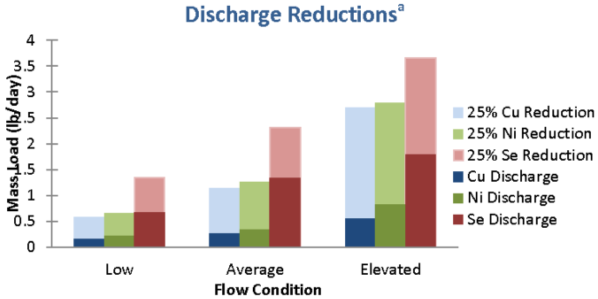
The goal of the Calleguas Creek Watershed Metals TMDL is to address water quality impairments in the Calleguas Creek Watershed due to elevated levels of metals (copper, nickel, and mercury) and selenium in water. Elevated metal and selenium levels endanger aquatic organisms and cause impairment of habitat. The TMDL was developed by the Los Angeles Regional Water Quality Board, and approved by the U.S. EPA March 26, 2007.

The TMDL requires water treatment plants, stormwater, and agricultural dischargers to reduce discharge metals and selenium loadings. TMDL implementation calls for water treatment plants to reduce loadings by 50% of the difference between current loading and target loading by March 2015 while agricultural and urban dischargers must meet 25% and 50% reductions by March 2012 and 2017, respectively. The TMDL implementation schedule called for compliance with final allocations for water treatment plants by March 2017 and for agricultural and urban dischargers by March 2022.

Calleguas Creek Watershed



Agricultural/Urban Discharge and Required Discharge Reductions[a]

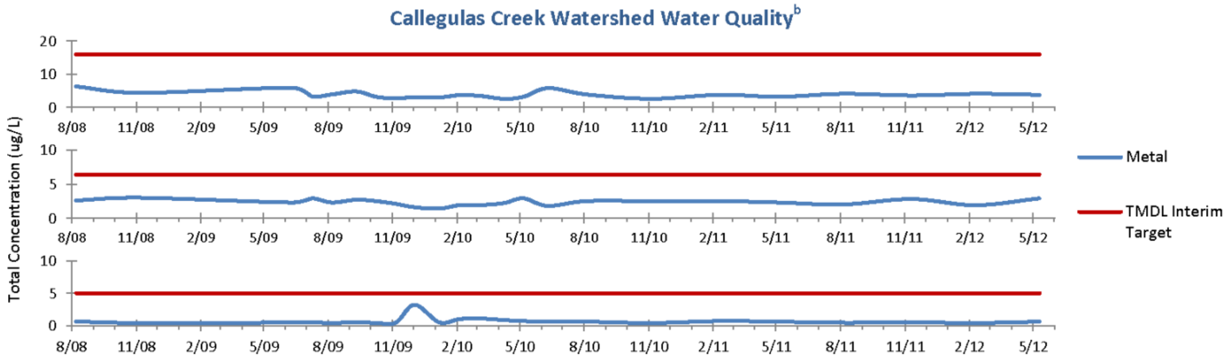


[a] At Revolon Slough. For more information on agricultural and urban discharge performance, see: 42 Cities' Annual Reports, 2010-2011 pursuant to Part 7.

Water Quality Outcomes

- *Based on 2009-2012 annual monitoring reports, metal and selenium concentration in POTWs' discharges are well below the required interim WLAs.*
- *All POTWs are on progress meeting final WLAs by March 2017.*
- *Metals concentration at most receiving water site for urban and agricultural discharges are incompliance with the interim WLAs and LAs.*
- *The required reduction of 25% by March 2012 for agricultural and urban discharges was met in receiving water.*
- *There are ongoing exceedances of selenium in Revolon Slough due to high selenium concentration in groundwater.*

Callegulas Creek Watershed Water Quality[b]



[b] Interim load allocation targets and metal concentrations at Hill Canyon Wastewater Treatment Plant. Similar interim metal and selenium concentrations are being seen at other POTWs, including Camarillo WRP and Simi Valley WQCP. For more information on POTW performance, see: Calleguas Creek Watershed TMDLs Annual Reports, 2009-2013.

Updated September 2013

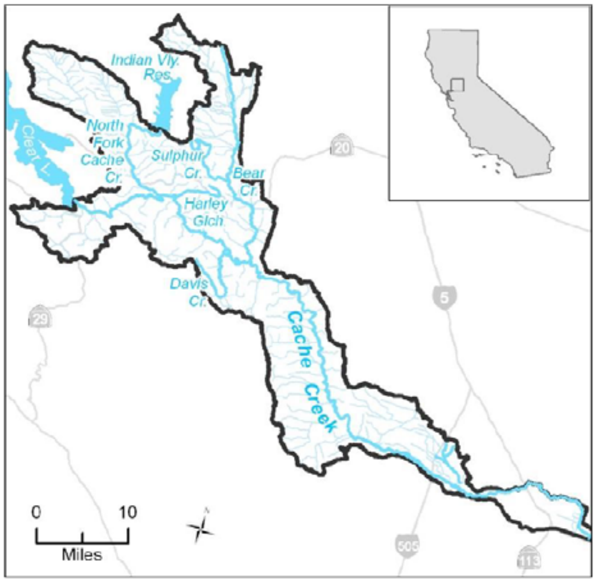
Total Maximum Daily Load Progress Report		Cache Creek Watershed Mercury TMDL
Regional Water Board	**Central Valley, Region 5**	**STATUS** ☐ Conditions Improving ☑ Data Inconclusive ☐ Improvement Needed ☐ TMDL Achieved/Water Body Delisted
Beneficial uses affected:	COMM, REC-1, WILD	
Pollutant(s) addressed:	Methylmercury and mercury	
Implemented through:	13267 Orders for Technical Reports, 401 Certifications, Cleanup and Abatement Orders, EPA Removal Action	
Approval date:	February 7, 2007	

TMDL Summary

Cache Creek and three of its tributaries (Bear Creek, Sulphur Creek, and Harley Gulch) are impaired by mercury because concentrations of mercury in fish exceed levels safe for consumption by humans and wildlife species that eat the fish. Sources of mercury are 14 inactive mercury/gold mines, naturally mercury-enriched soil, springs, and deposition of mercury transported in air. The Cache Creek Watershed Mercury TMDL establishes aqueous methylmercury allocations in Cache Creek, Bear Creek and in Harley Gulch calculated to achieve fish tissue objectives and requires load reductions from inactive mines.

The TMDL requires mine owners to submit cleanup plans and requires land managers, landowners, Caltrans, and other road managers to control and reduce erosion of mercury-contaminated soil. Entities that operate or construct impoundments and wetlands must minimize methylmercury discharges to the creeks and set erosion control requirements for work within floodplains.

Cache Creek Watershed



TMDL Remediation Goals

Methylmercury Load Reduction (as % of existing annual load)	
Cache Creek u/s North Fork confluence	30%
Harley Gulch	4%
Davis Creek	50%
Sulphur Creek	10%
Bear Creek	15%
Cache Creek at Yolo	54%

Mercury Load Reduction (as % of existing, average annual load from mining and anthropogenic activities)	
Inactive Mine Sites	95%

Water Quality Outcomes

- *Cleanup actions at the inactive Abbott and Turkey Run mercury mines controlled the most significant sources of mercury entering Harley Gulch.*
- *Central Valley Water Board issued Orders for characterization and cleanup of inactive mines in the Sulphur and Bear Creek watersheds.*
- *Colusa County Resource Conservation District and U.S. Bureau of Land Management received a 319(h) grant to prepare for stabilization of mercury-laden material that is eroding into Bear Creek. Shovel-ready design plans and environmental documentation will be completed by 2013.*
- *Central Valley Water Board staff completed an inventory of mercury in sediment in the Cache and Bear Creek canyons.*
- *Caltrans monitored mercury in soil and employed stringent sediment management practices at projects within the watershed.*

Cache Creek Watershed Water Quality

- Limited water quality data are available.
- Mercury load reductions are expected near the projects sites, but have not been fully quantified.
- For the mine sites that have been cleaned-up, vegetation is established over previously barren waste piles and observations confirm a reduction in erosion of mercury-contaminated soils into nearby water courses.

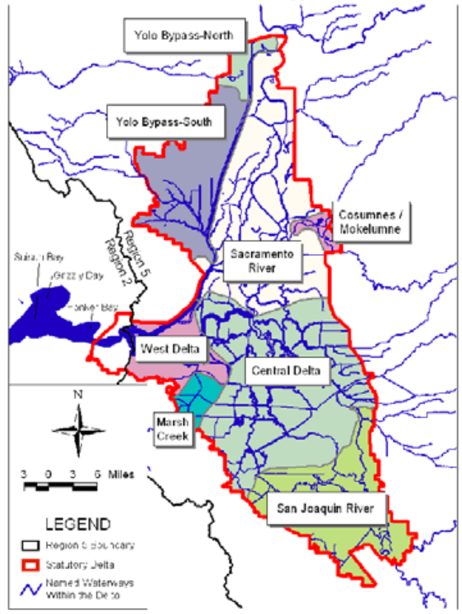
Updated June 2012

Water Quality Report Card		Methylmercury and Mercury in the Sacramento-San Joaquin Delta
Regional Water Board:	**Central Valley, Region 5**	**STATUS** ☐ Conditions Improving ☐ Data Inconclusive ☑ **Improvement Needed** ☐ Targets Achieved/Waterbody Delisted
Beneficial Uses Affected:	REC-1, COMM, WILD	
Implemented Through:	NPDES Permit, WDR, Grant, 401 Certification, Stakeholder Action	
Effective Date:	October 20, 2011	
Attainment Date:	2030	**Pollutant Type:** ☑ Point Source ☑ Nonpoint Source ☑ Legacy

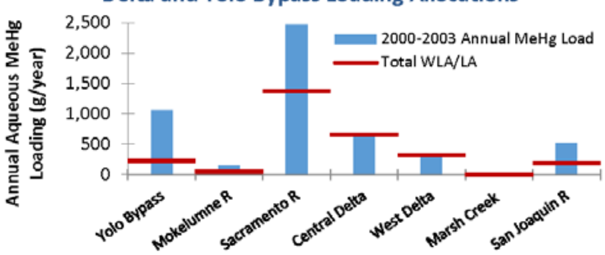
Water Quality Improvement Strategy

The Sacramento-San Joaquin Delta and Yolo Bypass are impaired due to elevated levels of mercury in some fish. Sources of mercury include legacy of the State's gold and mercury mines, naturally-enriched soil, deposition from air, springs, urban runoff, and wastewater. Methylmercury (MeHg), which accumulates in fish, is made in wet, oxygen-depleted environments. Sources of MeHg include wetlands, tributaries, Delta channel sediments, and point sources. To address the impairment, Region 5 adopted the Sacramento-San Joaquin Delta Methylmercury TMDL in 2011. The TMDL is intended to reduce concentrations of MeHg in fish by controlling sources of both MeHg and total mercury. Because MeHg levels in fish are strongly correlated with those in water, load and wasteload allocations (LA/WLA) are in the form of annual aqueous MeHg loads. The TMDL is proceeding in two phases. Major Phase 1 (2011-2020) activities are: (1) studies to develop and evaluate MeHg control measures; (2) mercury pollution prevention by municipal wastewater and storm water permittees, and development of upstream mercury TMDLs; and (3) a mercury exposure reduction program to protect people eating Delta fish. At the end of Phase 1, Region 5 will review the TMDL and adjust based on the MeHg control studies. During Phase 2 (2020-2030), dischargers must meet allocations.

Delta and Yolo Bypass



Delta and Yolo Bypass Loading Allocations[a, b]

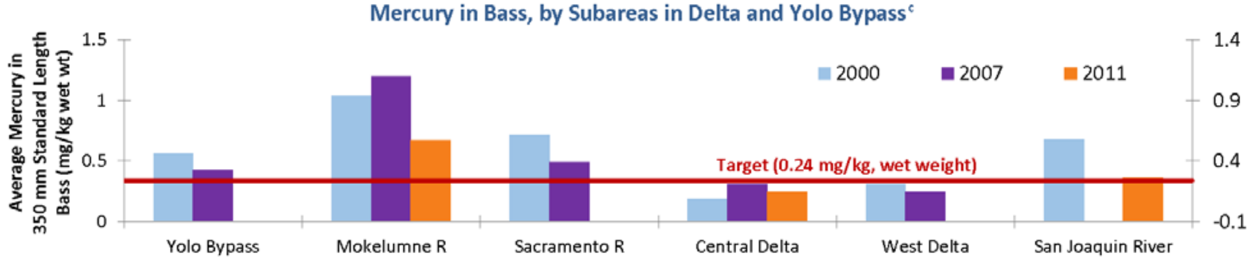


[a] Allocations apply within the legal Delta boundary and the Yolo Bypass.
[b] Wastewater treatment facilities that have done major process changes are now close to meeting facility-specific WLA.

Water Quality Outcomes

- *Monitoring data demonstrate that there are no significant trends in concentrations of mercury in fish sampled before (2000 and 2007), and since (2011), the TMDL was adopted.*
- *Studies to improve MeHg control are underway for all major source types, including managed and tidal wetlands.*
- *Hydrodynamic models are being developed that will predict the effects of flow changes and large restorations on MeHg.*
- *Significant MeHg controls within the Delta are not expected until after the 2020 TMDL review. Major tributaries (which contribute 60 percent of MeHg loads) will be addressed by the Statewide Mercury Control Program, and in future TMDLs.*

Mercury in Bass, by Subareas in Delta and Yolo Bypass[c]



[c] Recent data are available on the "Are Fish Safe to Eat" portal.

Publications relating to TMDL implementation activities:

Alpers, C.N., et al. 2013. Mercury cycling in agricultural and managed wetlands, Yolo Bypass, California: Spatial and seasonal variations in water quality. Sci Total Environ.

Eagles-Smith, C.A., et al. 2014. Wetland management and rice farming strategies to decrease methylmercury bioaccumulation and loads from the Cosumnes River Preserve, California. U.S. Geological Survey Open-File Report 2014-1172, 42 p.

Released October 2014

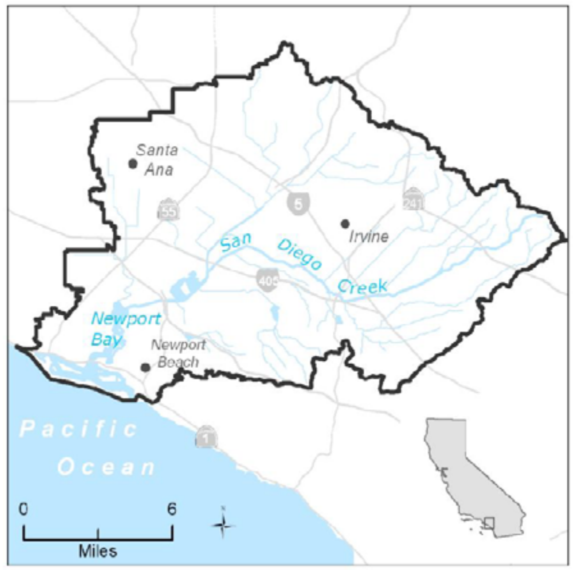
Total Maximum Daily Load Progress Report		Rhine Channel (Lower Newport Bay) Metals-Organics TMDL	
Regional Water Board	**Santa Ana, Region 8**	**STATUS**	☑ **Conditions Improving** ☐ Data Inconclusive ☐ Improvement Needed ☐ TMDL Achieved/Waterbody Delisted
Beneficial uses affected:	COMM, MAR, NAV, RARE, REC-1, REC-2, SHEL, SPWN, WILD		
Pollutant(s) addressed:	Metals, Organics		
Implemented through:	Non-regulatory Action		
Approval date:	June 14, 2002		

TMDL Summary

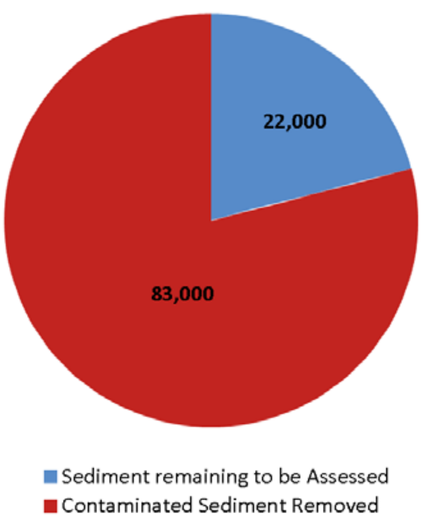
The Rhine Channel segment of Lower Newport Bay was listed impaired for organics and metals on the 1998 CWA Section 303(d) list. The pollutant levels in channel sediments and water have caused persistent sediment toxicity that exceed standards for human health protection, and are associated with bioaccumulative effects in the food web. The primary sources are historical discharges of storm water runoff and wastewater that started in the 1920s. In June 2002, the U.S. Environmental Protection Agency established TMDLs for toxic pollutants (copper, lead, zinc, chromium, mercury, chlordane, dieldrin, PCBs, DDT and selenium).

Regional Board staff determined that the channel's unique geographic configuration allowed for site-specific options to remediate the contaminated sediment and restoration of water quality standards. Although a 2006 State-funded report to investigate cleanup options for the Rhine concluded that "dredging with upland landfill disposal" costing $18.3 million would be the most feasible alternative, an opportunity to dispose of the contaminated sediments through use of a Port of Long Beach confined facility became available in 2010. A strict timeline to place the sediment spurred the City of Newport Beach, Santa Ana Water Board, and other coordinating agencies to quickly permit the project and implement dredging. One final task is to establish a new water quality baseline for the Channel.

Rhine Channel, Lower Newport Bay Watershed



Rhine Channel TMDL Compliance Dredging (cubic yards)



Water Quality Outcomes

- *Initiated spring 2010, the Rhine Channel Contaminated Sediment Cleanup Project successfully dredged the channel in November 2011.*
- *More than 100,000 cubic yards of contaminated sediment, at least 80% of the total amount, were removed.*
- *The jointly-coordinated project was a voluntary implementation effort by the City of Newport Beach, with cooperation from the Santa Ana Regional Board, CA Coastal Commission, US Army Corps of Engineers and other agencies.*
- *The sediment removal was fully funded by the City of Newport Beach in the amount of $4 million. Orange County Coastkeeper, a local non-profit organization, pushed the cleanup effort.*
- *A post-dredge monitoring program has been prepared and will soon be executed to establish a new baseline of water quality in water and sediment.*

Updated September 2012

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Appendix N. Wastewater and Industrial Discharges

This appendix provides information on the number, type and location of the facilities that could be affected by the requirements for municipal wastewater and industrial (non-storm water) discharges described in Section 6.12 and Section 6.13 of the Staff Report. This includes facility types and locations of the discharges, ambient mercury levels in water, and concentrations of mercury in the discharges (Section N.1); a summary of relative load mercury from these discharges compared to other mercury sources from mercury Total Maximum Daily Loads (TMDLs) (Section N.2); and information on Regional Monitoring Programs (Section N.3).

More specifically, the facilities described in this appendix are those with individual National Pollutant Discharge Elimination System (NPDES) permits for non-storm water discharges in California. This appendix (and Section 6.12 and 6.13 of the Staff Report) focuses on dischargers with "individual" permits, rather than dischargers that are enrolled in a general permit that includes multiple facilities. These are referred to as "wastewater and industrial discharges" in this appendix. The information in this appendix was obtained from U.S. EPA's Enforcement and Compliance History Online (ECHO database) and the State Water Board's California Integrated Water Quality System (CIWQS database), or as otherwise noted.

N.1 Information on Current Wastewater and Industrial Discharges

There are roughly 460 individually permitted dischargers, but a little less than half of those dischargers are not included in the scope of the Provisions (the Project) (Figure N-1). The Project includes "**discharges to rivers and bays**" and "**discharges to reservoirs and upstream of impaired[22] reservoirs**" (see descriptions below). The Project does not include discharges to the ocean, since the geographic scope includes only discharges to inland surface waters, enclosed bays, and estuaries. Some dischargers are not included in the Provisions because they are included in mercury TMDLs, which the Project does not intend to supersede (see Staff Report, Section 3.5). Figure N-1 shows the proportion of facilities in each of these categories. Figure N-2 shows the locations of the facilities.

<u>N.1.1 Discharges to reservoirs and upstream of impaired reservoirs</u>

There are about 50 discharges to reservoirs or upstream of mercury impaired reservoirs. A separate project is being developed to address these waters, referred to as the Reservoir Program (see Staff Report, Section 1.6). However, the Reservoir Program and the Provisions are still in the early phases of development. Discharges that would be included in the Reservoir Program may also be included in the Provisions if the Provisions are adopted by the State

[22] The term "impaired" is used as shorthand to indicate a water body that is not meeting water quality objectives and is, therefore placed on the Clean Water Act section 303(d) list (Staff Report, Section 3.4).

Water Board before the Reservoir Program is adopted. Once the Reservoir Program is adopted then those discharges will be regulated under the Reservoir Program. Therefore, in this appendix, information on these discharges is presented separately in many of the Figures and Tables. On the whole, the discharges that would be included in the Reservoir Program are smaller and there are fewer of them, as shown in the figures and tables in this appendix.

N.1.2 Discharges to rivers and bays

The largest group of discharges that may be affected by the Provisions are referred to as "discharges to rivers and bays". This category includes discharges to streams, creeks, estuaries, sloughs or similar waters, as described below. There are no wastewater or industrial discharges to natural lakes.

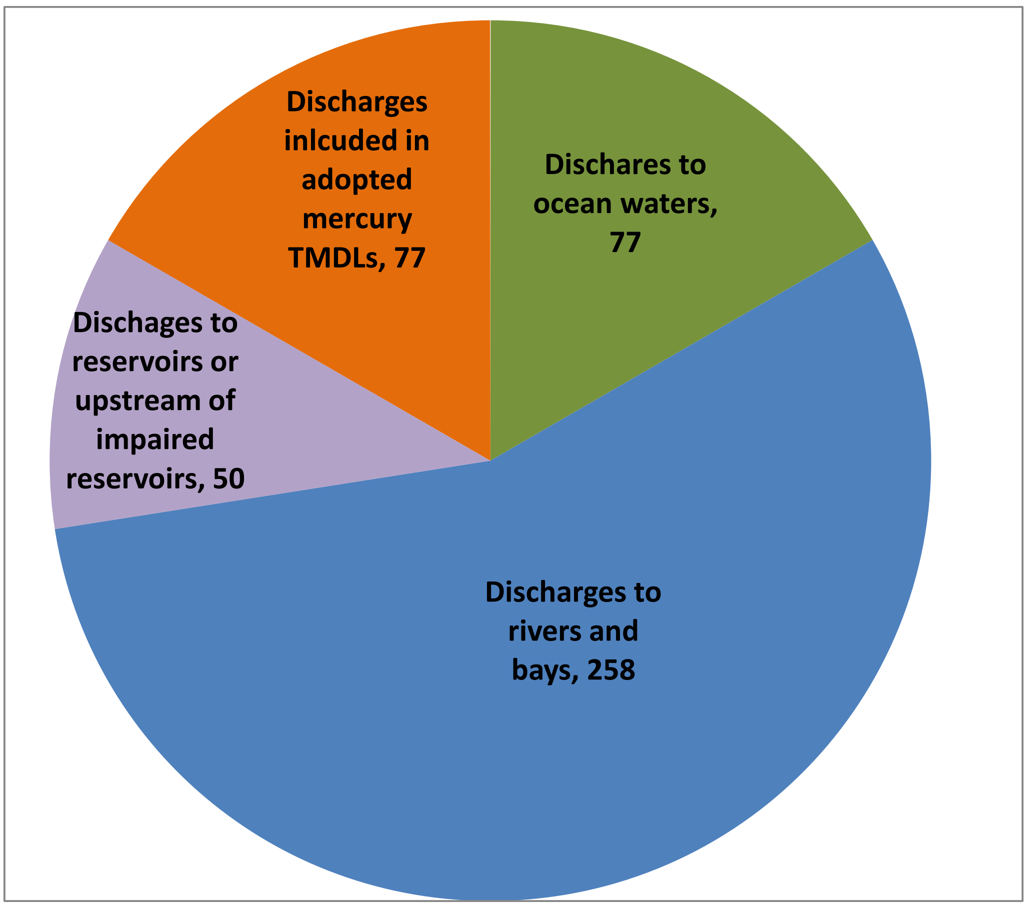

Figure N-1. California individual wastewater and industrial dischargers. A little more than half (about 307) of the dischargers in the state could be affected by the Provisions, including discharges to rivers and bays (258), and discharges to reservoirs and upstream of reservoirs (50). The total does not add up to 460 because there are three facilities with discharge points that fall into more than one category.

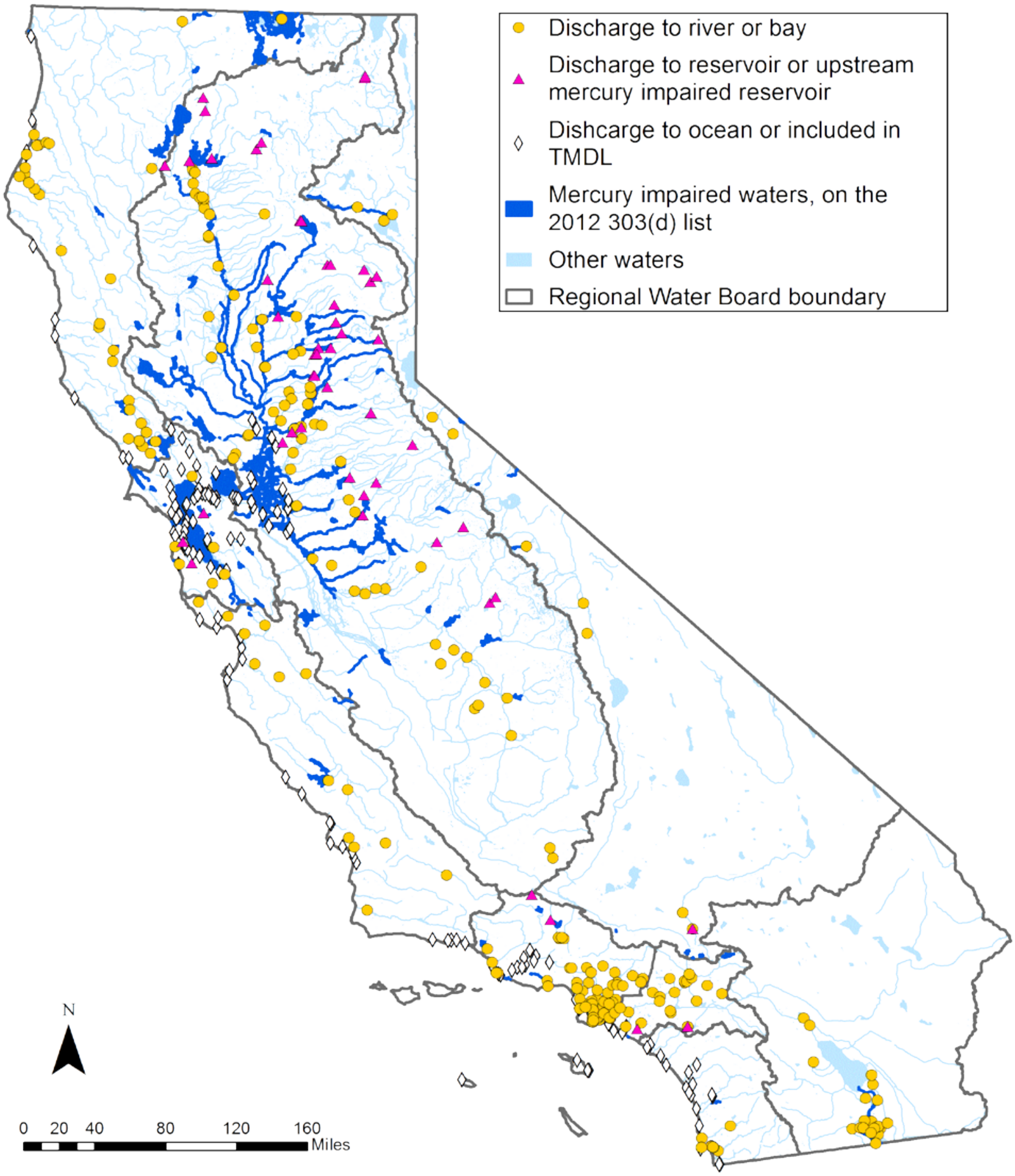

Figure N-2. Locations of the 460 wastewater and industrial dischargers and their proximity to mercury impaired waters.

N.1.3 Facility Types and Locations

Of the discharges included in the Project, the number of municipal wastewater, industrial, major and minor facilities are shown in Table N-1 and facilities by region are shown in Table N-2. Wastewater and industrial facilities are classified as major or minor depending on whether the design flow is greater than 1 MGD (million gallons per day).

Table N-1a. Individual Wastewater and Industrial Discharges to Rivers and Bays

Facility type	Major	Minor	Total
Municipal Wastewater Treatment Facility	87	39	126
Industrial, Other	20	105	125
Federal Facility	2	5	7
All types	109	149	258

Table N-1b. Individual Wastewater and Industrial Discharges to Reservoirs and Upstream Impaired Reservoirs

Facility type	Major	Minor	Total
Municipal Wastewater Treatment Facility	5	16	21
Industrial, Other	3	23	26
Federal Facility	1	2	3
All types	9	41	50

Table N-2. Number of Individual Wastewater and Industrial Discharges by Water Board Region

Water Board Region	1	2	3	4	5	6	7	8	9
Rivers and Bays	31	6	14	75	70	10	21	22	9
Reservoirs or upstream of Impaired Reservoirs	0	3	0	2	42	1	0	2	0

The types of waters the discharges flow into and the proximity to impaired waters is shown in Tables N-3a through N-3c and Figure N-3. In California, most inland discharges flow into rivers, streams, and creeks, few discharges flow directly into reservoirs.

Table N-3a. Receiving Water Type for Wastewater and Industrial Discharges to Rivers and Bays

Type of receiving water (number of individual discharges)	Number of discharges	Percent of facilities*
Creek (84), river (73), wash (3), tributary (4), spring (2), stream (1)	167	65 %
Channel (22), canal (5), drain (18), ditch (3)	48	19 %
Harbor (17), bay (10)	27	10 %
Estuary (7), slough (4), wetland (3), tidal prism (2), pond (2), marsh (1)	19	7 %
Total	261*	101%*

*The totals do not add up to 258 and 100% because a few facilities have multiple discharges that flow into two different water body types.

Table N-3b. Proximity to Impaired Waters of Individual Wastewater and Industrial Discharges to Rivers and Bays

Type of receiving water	Number of facilities	Percent of facilities
Mercury impaired water	19	7 %
Un-impaired water, upstream of mercury impaired water	71	28 %
Un-impaired water that could or sometimes flows into mercury impaired water downstream	14	5 %
Un-impaired water, upstream of un-impaired waters*	154	60%
Total	258	100 %

*Waters may be un-impaired because they have not been assessed.

Table N-3c. Receiving Water Type for Individual Wastewater and Industrial Discharges to Reservoirs and Upstream Impaired Reservoirs

Type of receiving water	Number of facilities	Percent of facilities
Mercury impaired reservoir	3	6 %
Un-impaired reservoir*	6	12 %
Discharge to river, stream, or creek, upstream a mercury impaired reservoir	41	82 %
Total	50	100 %

*Waters may be un-impaired because they have not been assessed.

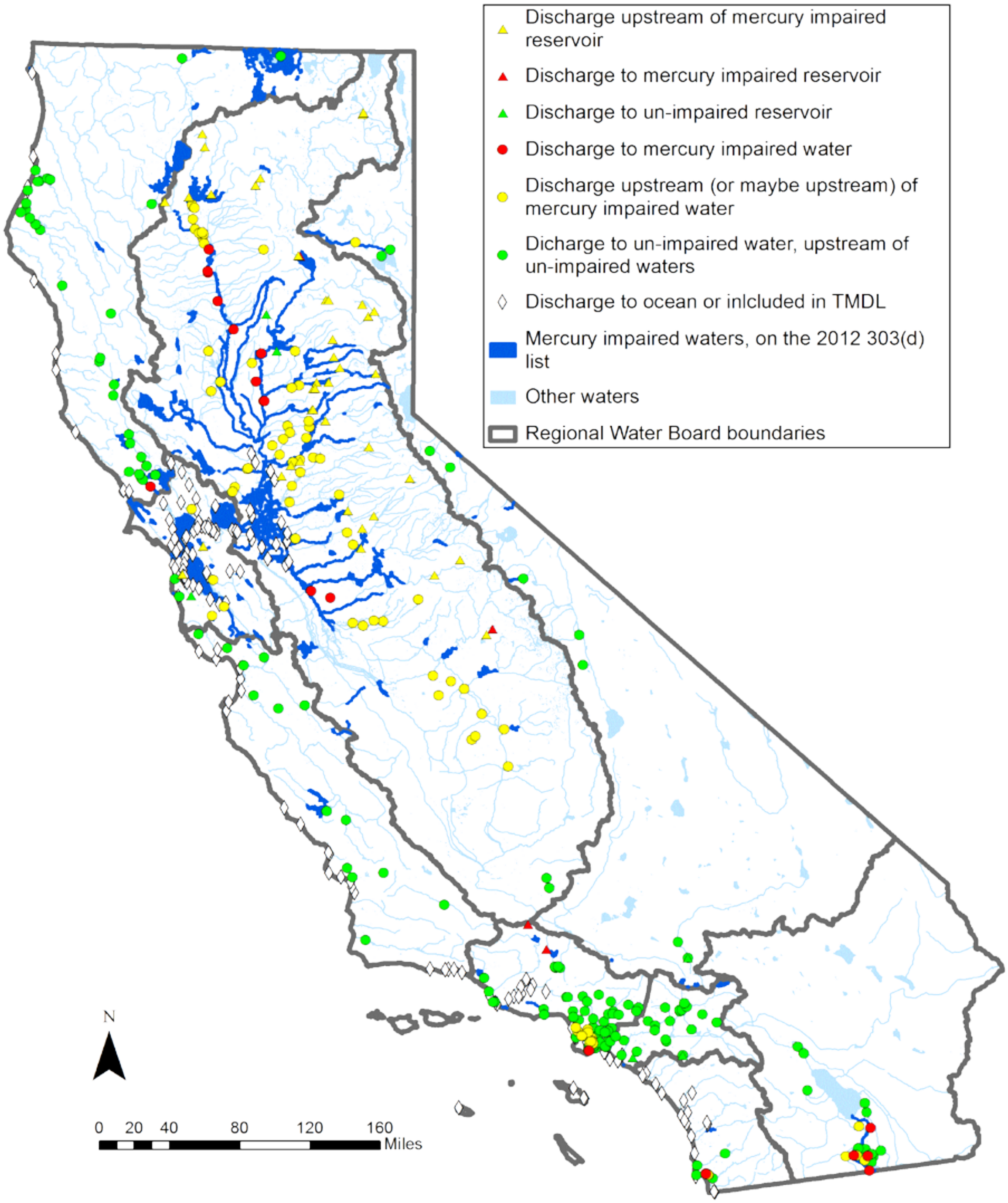

Figure N-3. Proximity of wastewater and industrial discharges to mercury impaired waters. Discharges are highlighted that 1) discharge directly into a receiving water that is mercury impaired (red); or 2) discharge upstream or might discharge upstream of mercury impaired waters (yellow).

Wastewater and industrial facilities are also classified according to the Threat to Water Quality (TTWQ). TTWQ is a relative categorization of the waste discharge's potential effect upon the surface or ground water quality and the beneficial uses of those waters. The TTWQ categories are:

- Category I includes those discharges that could cause long-term loss of a beneficial use, such as drinking water supply, aquatic habitat, etc.
- Category II includes those discharges that could impair the designated beneficial uses, cause short-term violations of water quality objectives, violate secondary drinking water standards, etc.
- Category III are those discharges that could degrade water quality without violating objectives or could cause minor impairment of beneficial uses.

Table N-4 provides the TTWQ categories for facilities discharging to rivers and bays and those that discharge to a reservoir or upstream an impaired reservoir. There are relatively few facilities in the highest threat category (6) that discharge to reservoirs or upstream of an impaired reservoir, while there are many more facilities in the highest threat category (78) discharging to rivers and bays.

Table N-4. Characteristics of Facilities

Major/Minor	Threat to Water Quality	Number of Facilities Discharging to Rivers and Bays	Number of Facilities in the Discharging to Reservoirs or Upstream Impaired Reservoirs
Major		**109**	**9**
	1	76	6
	2	29	2
	3	4	1
Minor		**149**	**41**
	1	19	6
	2	78	26
	3	51	8
	Not available	1	1
Grand Total		**258**	**50**

N.1.4 Ambient Mercury Levels

Figure N-4 shows mercury concentrations in receiving waters. This information is typically used to determine which facilities will need effluent limitations (reasonable potential analysis, see Staff Report Section 6.12). Additionally, statistics on the ambient mercury concentrations in water are in the Staff Report, in Section 4.5.1.

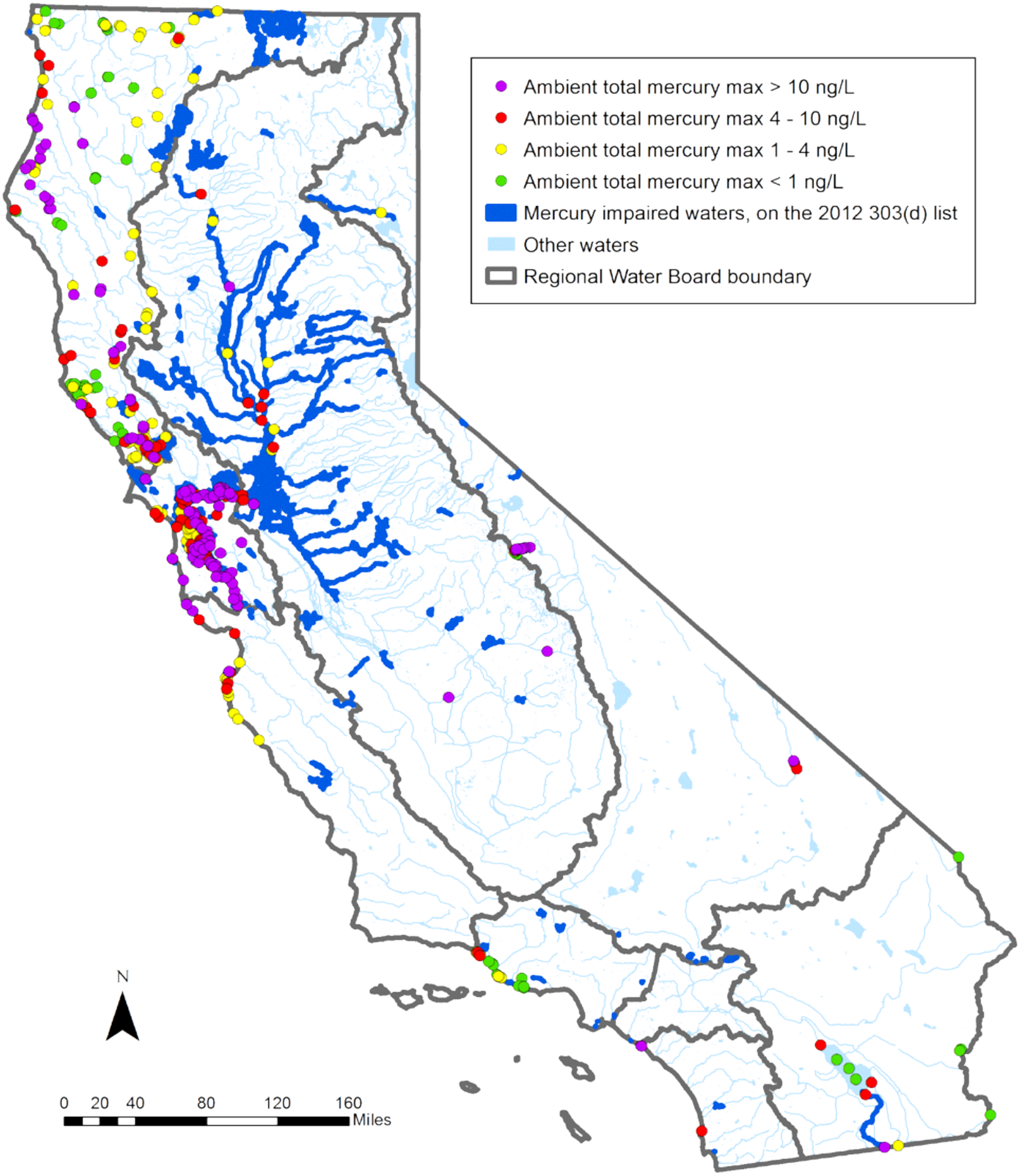

Figure N-4. Ambient mercury concentrations in receiving waters. Data from the California Environmental Data Exchange Network (www.ceden.org) for samples dated 2005-2015.

N.1.5 Effluent Mercury Concentrations

Effluent mercury concentration data were obtained from electronic Self-Monitoring Reports (eSMR) through the CIWQS eSMR Analytical Report. This public website provides analytical and calculated data provided by NPDES wastewater and industrial permit holders. "Mercury Total" and "Mercury Total Recoverable" were selected from "Parameter." Dates from January 1, 2005 to September 1, 2015 were selected. However no results were retuned for years prior to 2009. For year 2009 only two results were returned. Other fields were left with no specific parameter selected.

Several characteristics were checked to gather data suitable for the analysis. Data were not used if the detection limit was higher than 4 ng/L and the result was "non-detect (ND)" or "detected not quantified (DNQ)". Otherwise, for results that were not detected, a value of one half of the detection limit was used. For results that were qualified as detected but not quantified, the result provided was used. Other values were omitted if the results were 1,000 times higher than typical results (indicated units were reported incorrectly) or if the permit writer noted the value as an outlier and excluded the result from the reasonable potential analysis. Data from storm water or wet weather overflow discharge points were excluded since they are not issued the same requirements as NPDES non-storm water discharges (wastewater and industrial discharges). Only mercury concentration measured in effluent samples were used. Mercury concentrations from samples from other parts of the treatment process or other monitoring locations were omitted.

The annual average was calculated for every year for each facility for which there was suitable data from the years 2009 through 2015. From about 30,000 original results from the query, 9883 results met suitability criteria and were used for the analyses. The data set included results from 157 facilities, yielding 626 annual averages over the six years considered. Table N-5 summaries the number of facilities for which there was suitable data available. Table N-5 also shows how many annual averages were calculated from the six years of data. Figure N-5 shows how representative the final data set was compared to all facilities statewide.

Tables N-6, N-7, N-8, N-9 show the proportion of facilities with mercury levels exceeding proposed options for new regulatory thresholds (See Section 6.12 and Section 6.13 of the Staff Report). These tables show the percent of facilities that had one annual average above the threshold, from the data available from 2009 to 2015. In the next column, the tables show the percent of annual averages, collectively from all facilities, which were above the thresholds, from the data available from 2009 to 2015. In Table N-10, the statistics shown (e.g. average, 95^{th} percentile) were calculated from the annual averages. The range of the maximum annual average total mercury concentrations for each facility (if available) is shown on a map in Figure N-6. In this map, the maximum is the highest annual average for years 2009 - 2015.

Table N-5. Available Monitoring Data for Years 2009 to 2015

	Discharges to all waters		Discharges to rivers & bays		Discharges to rivers, bays & upstream impaired reservoirs*	
Type of discharge	# facilities with data	# annual averages	# facilities with data	# annual averages	# facilities with data	# annual averages
All	154	626	70	263	83	306
POTW	122	527	57	237	65	556
Non POTW & Federal	35	99	13	26	18	113

*No data was available for direct discharges to reservoirs. Of the 460 discharges in the state, only about ten flow directly into a reservoir.

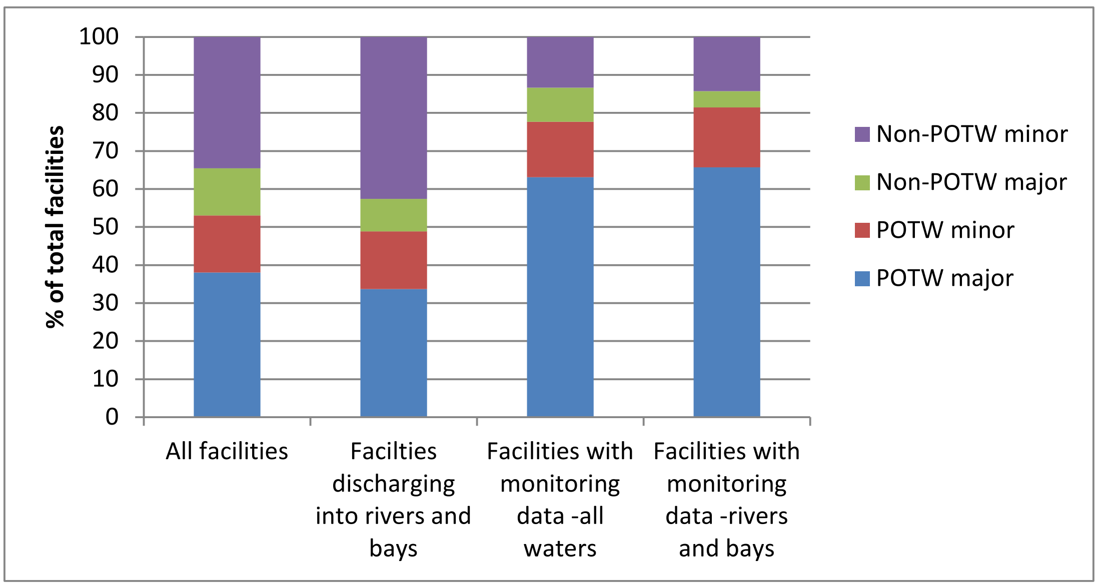

Figure N-5. Representativeness monitoring data: Comparison of the types of facilities in California vs. the types of facilities for which monitoring data was available.

Table N-6. Percent of Facilities Exceeding 12 ng/L Total Mercury

	Discharges to all waters		Discharges to rivers & bays		Discharges to rivers, bays & upstream impaired reservoirs	
Type of discharge	% facilities >12 ng/L[1]	% averages > 12 ng/L[2]	% facilities >12 ng/L	% averages > 12 ng/L	% facilities >12 ng/L	% averages > 12 ng/L
All	13	7	7	3	8	3
POTW	8	3	9	3	8	1
Non POTW & Federal	29	27	0	0	28	3

[1] The percent of facilities that had one annual average above the threshold, from the data available from 2009 to 2015. See text in Section N.1.5.
[2] The percent of annual averages, collectively from all facilities, which were above the thresholds, from the data available from 2009 to 2015. See text in Section N.1.5.

Table N-7. Percent of Facilities Exceeding 4 ng/L Total Mercury

	Discharges to all waters		Discharges to rivers & bays		Discharges to rivers, bays & upstream impaired reservoirs	
Type of discharge	% facilities > 4 ng/L[1]	% averages > 4 ng/L[2]	% facilities > 4 ng/L	% averages > 4 ng/L	% facilities > 4 ng/L	% averages > 4 ng/L
All	40	27	26	14	27	15
POTW	39	23	30	16	29	7
Non POTW & Federal	43	46	8	4	17	6

[1] The percent of facilities that had one annual average above the threshold, from the data available from 2009 to 2015. See text in Section N.1.5.
[2] The percent of annual averages, collectively from all facilities, which were above the thresholds, from the data available from 2009 to 2015. See text in Section N.1.5.

Table N-8. Percent of Facilities Exceeding 1 ng/L Total Mercury

	Discharges to all waters		Discharges to rivers & bays		Discharges to rivers, bays & upstream impaired reservoirs	
Type of discharge	% facilities >1 ng/L[1]	% averages > 1 ng/L[2]	% facilities >1 ng/L	% averages > 1 ng/L	% facilities >1 ng/L	% averages > 1 ng/L
All	83	73	73	59	73	59
POTW	87	75	79	62	80	30
Non POTW & Federal	63	68	46	31	50	15

[1] The percent of facilities that had one annual average above the threshold, from the data available from 2009 to 2015. See text in Section N.1.5.
[2] The percent of annual averages, collectively from all facilities, which were above the thresholds, from the data available from 2009 to 2015. See text in Section N.1.5.

Table N-9. Percent of Facilities Exceeding Reservoir Program Thresholds*

	Discharges to all waters		Discharges to rivers & bays		Discharges to rivers, bays & upstream impaired reservoirs	
Type of discharge	% facilities > thresholds[1]	% averages > threshold[2]	% facilities > thresholds	% averages > thresholds	% facilities > thresholds	% averages > thresholds
All	11	5	10	4	8	3
POTW	11	5	12	4	11	2
Non POTW & Federal	11	6	0	0	0	0

* Estimated with approximate categories and thresholds of: Major POTWS: 10 ng/L, Minor POTW: 20 ng/L, Major Non-POTW: 30 ng/L, Minor Non-POTW: 60 ng/L (see Staff Report Section 6.13).

[1] The percent of facilities that had one annual average above the threshold, from the data available from 2009 to 2015. See text in Section N.1.5.

[2] The percent of annual averages, collectively from all facilities, which were above the thresholds, from the data available from 2009 to 2015. See text in Section N.1.5.

Table N-10. Annual Average Total Mercury Concentrations (ng/L) in Effluent

	Discharges to all waters			Discharges to rivers & bays		
Type of discharge	average of annual averages	95th percentile of annual averages	99th percentile of annual averages	average of annual averages	95th percentile of annual averages	99th percentile of annual averages
All	4	14	35	2	8	21
POTW	3	10	17	3	8	22
Non POTW & Federal	9	33	48	1	3	4

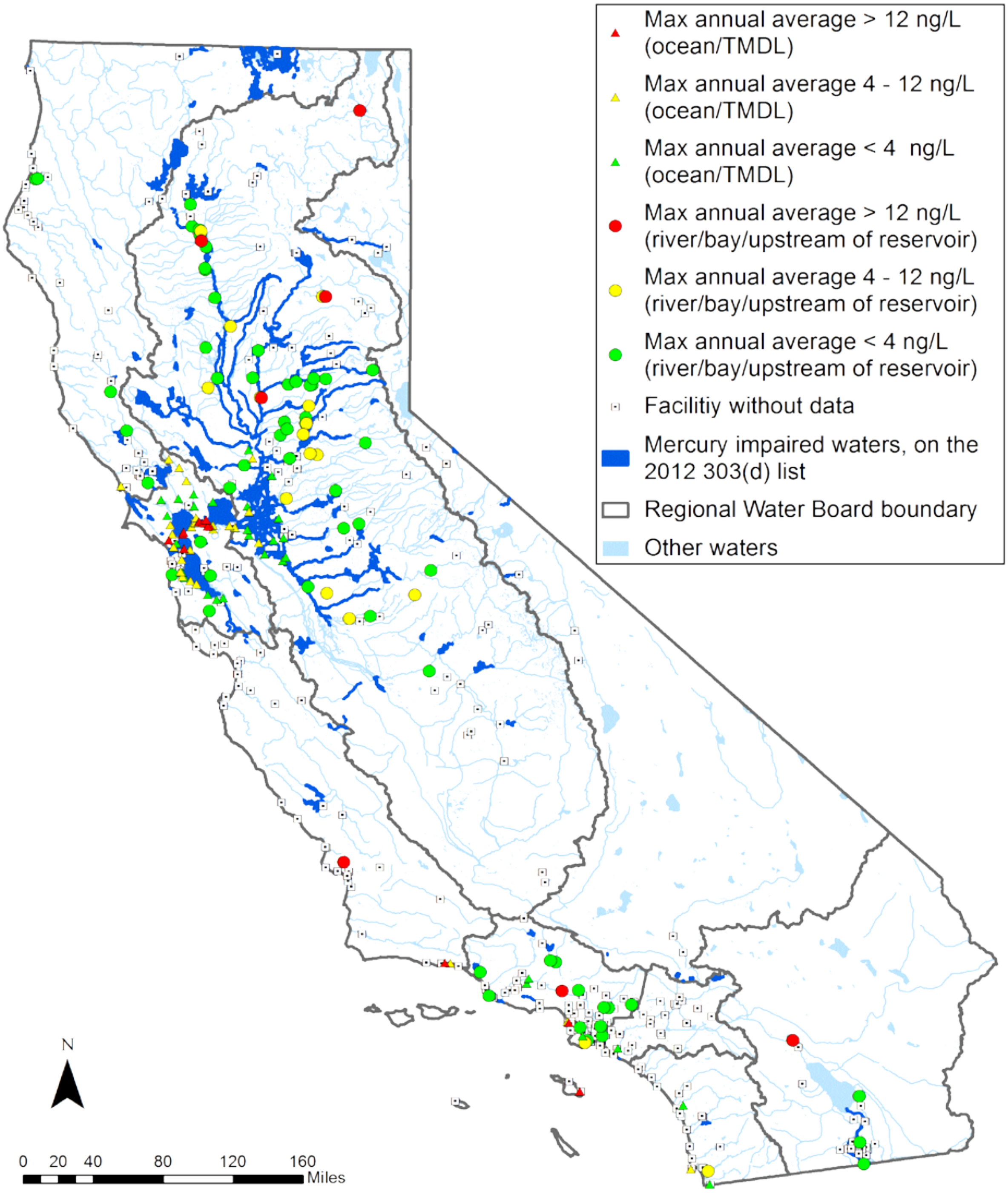

Figure N-6. Locations of wastewater and industrial dischargers in which at least one annual average total mercury concentrations during 2009-2015 was equal to or above 4 ng/L and 12 ng/L.

N.2 Relative Source Contribution of Wastewater and Industrial Discharges

Information indicating whether wastewater and industrial discharges are an insignificant mercury source statewide would help support a recommendation for the implementation requirements for wastewater and industrial discharges. Information from adopted TMDLs, Water Board databases, and a comparison to mercury deposited from atmospheric emissions is summarized below.

N.2.1 Relative Source Contribution for Wastewater and Industrial Discharges from TMDLs

Of the adopted mercury TMDLs, only three included wastewater and industrial discharges as a source of mercury. Of those three TMDLs, the Calleguas Creek/Mugu Lagoon TMDL (Los Angeles Water Board 2006) does not include a quantitative source analysis. The sources analyses form the San Francisco Bay (San Francisco Bay Water Board 2006) and the Sacramento-San Joaquin Delta TMDL (Central Valley Water Board 2010) are reproduced in Table N-11.

From the estimates in Table N-11, atmospheric deposition is not a major source of mercury. In the Sacramento-San Joaquin Delta TMDL, municipal wastewater is more significant than atmospheric deposition. If this information is used to extrapolate relative source contribution to the state as a whole, then for any watershed without historic gold or mercury mining, wastewater and industrial dischargers can be a significant source of mercury.

Table N-11. Estimated Mercury Loadings from the Sacramento-San Joaquin Delta TMDL (Delta) and the San Francisco Bay TMDL.

Sources	Delta *Methylmercury* (g/day)	San Francisco Bay *Total Mercury* (g/day)	Delta (% total)	San Francisco Bay (% total)
Tributaries (Central Valley)	8.2	1205	57	36
Guadalupe River Watershed (Historic mining, San Francisco Bay only)	-	252	-	8
Sediments in water body (Delta: open water, wetlands. San Francisco Bay: Bed erosion)	5.1	1260	36	38
Atmospheric deposition (San Francisco Bay: direct deposition only. Delta: direct and indirect, so includes atmospheric mercury carried by nonpoint source storm water, but not urban storm water)	0.06	74	0.4	2
Non-urban storm water (San Francisco Bay only: includes mercury enriched sediments and atmospheric mercury. Delta: Atmospheric mercury from non-urban storm water is included in 'atmospheric deposition')	-	68	-	2.0
Urban runoff (Caltrans, MS4s, Construction, Industrial)	0.05	438	0.3	13
Municipal wastewater and **Industrial discharges** (Delta had only municipal wastewater)	0.6	49	4	1.5
Agricultural return flows (Delta only)	0.3	-	2	-
Total	14.31	3348	100	100

N.3 Regional Monitoring Programs

Regional Monitoring Programs (RMPs) have been created in some areas to fulfill some of the ambient monitoring required of dischargers in their permits. These RMPs are the second major program involved in collecting mercury data, in addition to the Water Board's Surface Water Ambient Monitoring Program (SWAMP). RMPs are partnerships between regulators, dischargers, scientists, industry representatives and community activists to measure water quality. Each party has some input on the program. A large proportion of the funds generally come directly from dischargers.

RMPs are discussed in Section 6.12 of the Staff Report as a possible means to aid in collecting fish tissue data. However, RMPs do not cover all waters in the state, so the programs are not able to help in all locations. To provide an idea of how much of the state is monitored by RMPs and where the RMPs monitor, a map of RMPs is shown (Figure N-7). Not all RMPs currently monitor mercury in fish tissue.

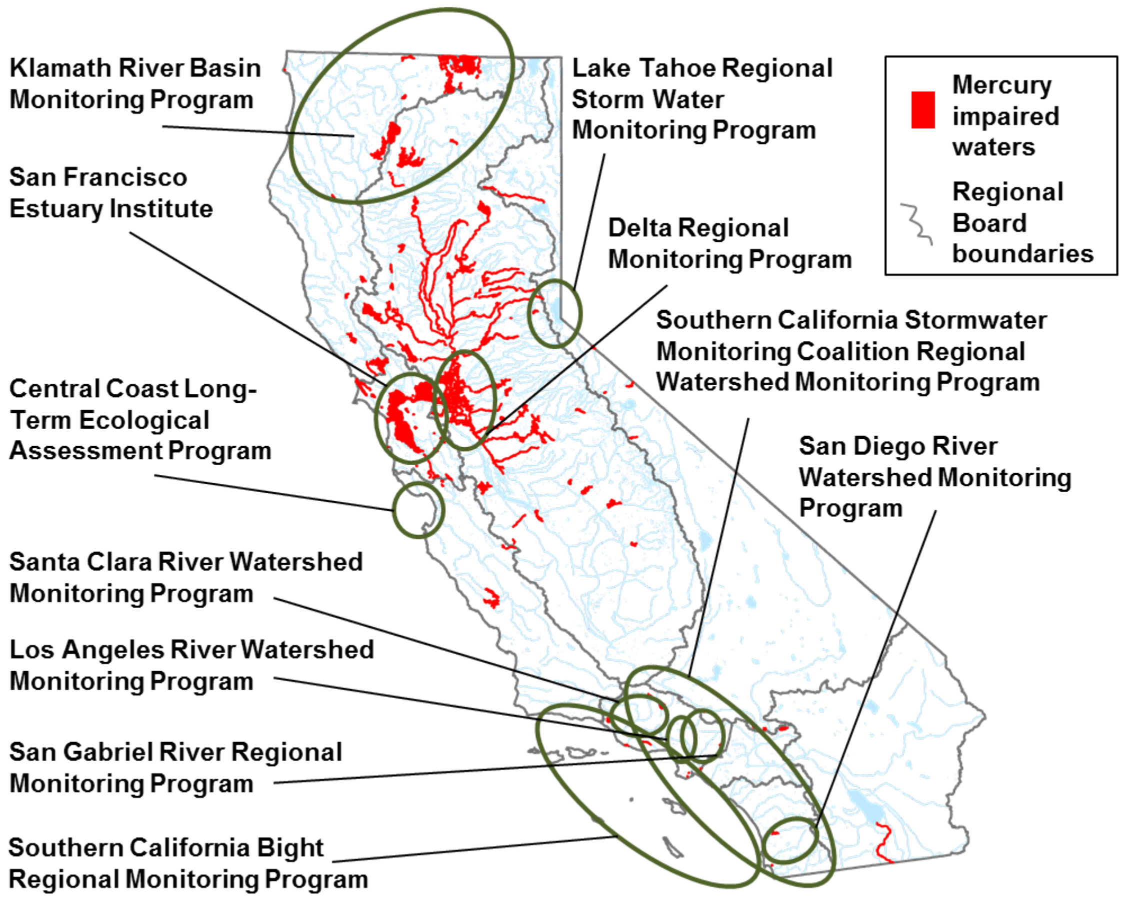

Figure N-7. Approximate waters included in Regional Monitoring Programs (information from: www.waterboards.ca.gov/water_issues/programs/swamp/contacts.shtml#rb).

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Appendix O. Methods to Measure Mercury

This appendix contains a list of common and recommended methods to measure mercury in water tissue or sediment, and information to support the methods or quantitation limits required or recommended by the Provisions. See Appendix P for details on the methods required for monitoring storm water.

Because researchers have found that nearly all mercury in fish tissue is in the form of methylmercury (U.S. EPA 2000), analysis of tissue for mercury, is recommended as a surrogate for methylmercury to reduce the cost of measurement.

The limits listed in the State Water Board's Surface Water Ambient Monitoring Program, Bioaccumulation Oversight Group (SWAMP /BOG) protocols are the same or slightly lower than the limits listed in the published U.S. EPA method, except for tissue (Method 7473) as shown in Table O-1. These thresholds were used to draft the recommended or required quantitation limits.

O.1 U.S. EPA Guidance on Methods to Measure Mercury

For analytical methods for mercury, U.S. EPA recommends "…only the most sensitive methods such as Methods 1631E and 245.7 are appropriate in most instances for use in deciding whether to set a permit limitation for mercury and for sampling and analysis of mercury pursuant to the monitoring requirements within a permit" (Hanlon 2007, U.S. EPA 2010).

Table O-1 - Summary of Quantitation and Detection Limits of Standard Methods

Method (Reference)	Form of mercury	Matrix	Method Quantitation Limit[1]	Method Detection Limit	SWAMP Protocol Quantitation Limit[2]
1631 E (U.S. EPA 2002)	Hg	Water	0.5 ng/L	0.2 ng/L	0.04 ng/L
245.7 (U.S. EPA 2005)	Hg	Water	5.0 ng/L		
245.1 (U.S. EPA 1994)	Hg	Water	200 ng/L		
245.2 (U.S. EPA 1974)	Hg	Water	200 ng/L		
1631 E (U.S. EPA 2001a)	Hg	Tissue, sediment	0.001 mg/kg[3] or 0.002 mg/kg[4]		
7473 (U.S. EPA 2007)	Hg	Tissue, sediment	0.05 ng (not concentration based)[5], But estimated as low as 0.00002 mg/kg[4]	0.01 ng (not concentration based)	0.009 - 0.012 mg/kg depending of fish size
1630 (U.S. EPA 2001b)	MeHg	Water	0.06 ng/L	0.02 ng/L	0.04 ng/L

[1]Also called the “reporting limit” or “minimum level.”

[2]Bonnema 2014, Table 27. Note: values are targets, so some analyses may have somewhat higher thresholds.

[3]USEPA 2001: Appendix A to method 1631. The detection limit and minimum level of quantitation in this Method usually are dependent on the level of interferences rather than instrumental limitations. The method detection limit (MDL; 40 CFR 136, Appendix B) for Hg has been determined to be in the range of 0.24 to 0.48 ng/g when no interferences are present (see Appendix A, Tables A3 and A4). The minimum level of quantitation (ML) has been established as 1.0 ng/g. These levels assume a sample size of 0.5 g.

[4]U.S. EPA 2010

[5]U.S. EPA 2007

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Appendix P. Storm Water Permits

Most storm water permits do not have specific implementation for mercury, except when specified by a Total Maximum Daily Load (TMDL). However, many of the existing general requirements in permits can help reduce mercury in storm water. This appendix explains how those existing requirements can control mercury, in more detail than in the Staff Report, Section 6.11. This appendix also contains more justification for the requirements in the Staff Report, Section 6.11.

While some additional requirements for some storm water discharges are included in the Provisions (Staff Report, Section 6.11), many of the requirements in the current permits are sufficient to control mercury, at least for implementation of the mercury water quality objective. For a mercury-impaired water body, a TMDL with additional controls for mercury in storm water may be necessary. Some storm water general permits have been recently revised and have new requirements that will help to control mercury.

P.1 MS4s

Phase 1 and 2 MS4s have some existing requirements for public education outreach, pollution prevention, sediment controls for construction areas, and low impact development (LID). The requirements are general and do not specify controls for "mercury or "methylmercury", but they include programs that can help reduce mercury in storm water (e.g. a municipality establishing or promoting a hazardous waste drop off, fluorescent tube and battery collections).

P.1.1 National Pollutant Discharge Elimination System (NPDES) Statewide Storm Water Permit Waste Discharge Requirements (WDRs) for State of California Department of Transportation (Caltrans); NPDES No. CAS000003

Caltrans is required to take action specifically to control mercury by the mercury TMDLs in which Caltrans has been identified as a responsible party. For these specified water bodies, Caltrans "shall implement control measures to prevent or minimize erosion and sediment discharge. This can be achieved by protecting hillsides, intercepting and filtering runoff, avoiding concentrated flows in natural channels and drains, and not modifying natural runoff flow patterns." (Section IIIB, Attachment IV, Order 2014-0077-DWQ).

Additionally the same requirements apply for waters for which there are TMDLs for sediment, nutrients, siltation and turbidity. Moreover, the North Coast Region has an additional sediment control plan because there are many sediment impaired water bodies in the region. This area is also naturally enriched in mercury and is the prime area where enhanced sediment controls are desirable to control naturally mercury enriched sediments.

In addition to TMDL requirements, Caltrans has developed a Best Management Practice (BMP) program for control of pollutants from existing facilities and for new and reconstructed facilities (Construction actives related to transportation that include less than one acre of land are not coved under the Construction Activities General Permit). Erosion control BMPs are typically used on construction sites (Order No. 2012-0011-DWQ, Section E.2.f), although some are also permanent, post-construction BMPs (*Ibid.* Section E.2.f.2). As part of the highway maintenance activities Caltrans must “identify road segments with slopes that are prone to erosion and sediment discharge and stabilize these slopes to control the discharge of pollutants” (*Ibid.* Section E.2.h.3.iii). Also, the post-construction treatment requirements in the Caltrans Permit include infiltration and Low Impact Development, if feasible (*Ibid.* Section E.2.d.2.b). Low Impact Development helps to reduce transport of mercury by reducing runoff, which can transport mercury. All of these actions will help to control mercury.

P.1.2 National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Associated with Construction and Land Disturbance Activities ; NPDES No. CAS000002

Dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the Construction General Permit (CGP) are required to develop and implement Storm Water Pollution Prevention Plans (SWPPPs) for project sites for all pollutants and their sources, including sources of sediment. Sites must implement post-construction standards that require completed sites to match pre-project hydrology, which is analogous in principle to LID requirements. LID helps reduce the transport of mercury by reducing run-off and sediment transport.

In the 2012 CGP sites are categorized as Risk Levels 1, 2 or 3, with the highest risk at sites with Risk Level 3. The Risk Levels are determined based on the potential of the site to deliver sediment to sensitive receiving waters. All sites are required to implement sediment controls with higher risk sites required to implement more stringent sediment controls. Many areas of the North Coast Region and the Coast Range have high risk receiving waters which means that sites in these areas will be at Risk Level 2 or 3. Some of these areas have high background levels of mercury and are prime areas where enhanced sediment controls will reduce sediment transport and the associated mercury transport.

The permit requires sediment controls to reduce mercury transport to receiving waters which are sufficient to implement the mercury water quality objective.

P.1.3 NPDES General Permit for Storm Water Discharges Associated with Industrial Activities ; CAS000001

Industrial storm water dischargers covered by the Industrial General Permit (IGP) are required to include a description of potential pollution sources in the Storm Water Pollution Prevention Plan. The assessment of pollution sources shall include the pollutants likely to be present in industrial storm water discharges and authorized non-storm water discharges (Order 2014-

0057-DWQ, Section X.G.2.a.ii. (p29)). All dischargers are required to implement to the extent practicable, minimum BMPs, which include good housekeeping, preventive maintenance, spill and leak prevention and response, material handling as waste management, and erosion controls.

Industrial storm water discharges enrolled in the Industrial Activities General Permit are not responsible for any pollutants from atmospheric deposition. However, if a discharger believes that atmospheric mercury is causing an exceedance of the mercury Numeric Action Level, then discharger must demonstrate that they are not the source of the mercury in order to be absolved of requirements to control the mercury. The discharger must submit a Non-Industrial Source Pollutant Demonstration as part of their Level 2 Exceedance Response Action Technical Report to demonstrate that the presence of a pollutant causing a Numeric Action Level exceedance is attributable solely to pollutants originating from non-industrial pollutant sources (e.g. aerial deposition) (Order 2014-0057-DWQ, Finding M.66.).

Monitoring requirements for dischargers include specific parameters dependent on the facility Standard Industrial Classification (SIC) code(s), which are listed in Table 1 in the Industrial Activities General Permit. For mercury, only Hazardous Waste Facilities have an automatic mercury monitoring requirement. All dischargers are required to monitor "parameters identified by the discharger on a facility-specific basis that serve as indicators of the presence of all industrial pollutants identified in the pollutant source assessment (Order 2014-0057-DWQ, section X.G.2)." Additionally dischargers are required to monitor applicable industrial parameters related to receiving waters with 303(d) listed impairments Order 2014-0057-DWQ, section XI.B.6.e.). Therefore, for a discharge to a water body that is listed as impaired for mercury, if the discharge is from a facility with potential sources of mercury (other than the atmosphere), then the discharger shall add mercury to the list of parameters that they must monitor in the storm water discharge. Essentially, any discharger with the potential to discharge significant amounts of mercury should be monitoring mercury, according to all of these requirements.

P.2 The Numeric Action Level for mercury

Any mercury monitoring data must be compared with an applicable Numeric Action Level (Table 2 in the Industrial Activities General Permit). If Numeric Action Levels are exceeded, the discharger is required perform "Exceedance Response Actions" (Order 2014-0057-DWQ, section XI.B.7 and section XII). The Exceedance Response Actions identify potential sources of the pollutant and determine BMPs for those sources that will reduce the pollutant in storm water and implement those BMPs. Monitoring is required four times per permit term (four samples in about five years, Order 2014-0057-DWQ, section XI.B.2), except if the Numeric Action Level is exceeded then more samples may be required.

The current Numeric Action Level for mercury is 1400 ng/L total mercury. This threshold and all of the Numeric Action Levels in the Industrial Activities General Permit are from the U.S. EPA 2008 Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity

(U.S. EPA 2008). The value of 1400 ng/L total mercury is originally from an outdated aquatic life criterion for mercury established in 1997 (62 FR 42169). The Numeric Action Levels in the Industrial Activities General Permit are meant to be economically feasible with current technology. They are not meant to be water quality standards, objectives or criteria. The development of the Numeric Action Levels incorporated the fact that pollutants will be diluted by large volumes of other storm water. The recent U.S. EPA recommended analytical methods for mercury are method 1631 E with a quantitation limit of 0.5 ng/L, or method 245.7 with a quantitation limit of 5.0 ng/L (Hanlon 2007, U.S. EPA 2010). However, mercury methods 1631 and 245.7 are very expensive compared to methods for other metals.

<u>P.2.1 The Recommended Criterion for Mercury</u>

A criterion of 300 ng/L is included in the Provisions because the existing Numeric Action Level (1400 ng/L) is outdated and relatively high. The concentration of 300 ng/L is the lowest the Numeric Action Level could be without changing the analytical method. Requiring the use of the newer, more sensitive mercury analytical method would be much more expensive, and Numeric Action Levels are technology based, not water quality based. The concentration of 200 ng/L is the quantitation limit of the old method (Method 245.1, U.S. EPA 1994).

Industries that can be sources of mercury emissions to the atmosphere do not have categorical Numeric Action Levels in the current Industrial Activities General Permit (Order 2014-0057-DWQ, Table 1), such as power plants, cement plants, etc. Many of these industries do have federal air emissions regulations (see Appendix E). Also the Reservoir Program (see Staff Report, Section 1.6, State Water Board 2014) is contemplating negotiating a Memorandum of Understanding (MOU) with the Air Resources Board (ARB) and U.S. EPA to monitor and model atmospheric deposition of mercury to California.

<u>P.2.2 Are Current Dischargers Likely to Exceed the Numeric Action Level (300 ng/L)?</u>

Industrial storm water data from 2013-1014 were checked for industrial dischargers that exceeded 200 ng/L (200 ng/L is the detection limit of the analytical method). Data were obtained from the State Water Board's database: Storm Water Multiple Application and Report Tracking System (SMARTS). Most storm water discharges were below 200 ng/L. Measurements of mercury above this threshold usually seemed erroneous. Three types of instances were found:

1) In several cases, another analytical method to measure mercury was used besides the method required by the Industrial Activities General Permit (Method 245.1). The method used had a higher detection limit and the detection limit is incorrectly reported as a measured concentration in SMARTS. In the annual report from the discharger, this data is reported as a non-detect.
2) In a couple cases, a concentration above 200 ng/L was measured, but the method cited is not for mercury (the method was E231.2, which appears to be the method for gold).
3) There was one instance of a refuse system reporting a very high value, but two months later the mercury level was down to below detectable levels.

Data from the peer review literature also suggested that mercury concentrations in rain should not exceed 300 ng/L. Maximum concentrations in rain and fog have been reported as 29 ng/L total mercury, with averages of 2-13 ng/L in the California Central Coast (Weiss-Penzias et al. 2012), and a maximum of 40 ng/L total mercury with averages 12 ng/L and 6 ng/L of in San Jose and Santa Cruz, respectively (Steding and Flegal 2002) 40 ng/L. A storm water catchment in the greater Toronto metropolitan area in Ontario, Canada found storm event mean concentrations up to 37 ng/L total mercury, with instantaneous mercury concentrations associated with suspended particles of up to 70 ng/L (Eckley and Branfireun 2008).

The Mercury Deposition Network provides data on mercury concentrations in rain from all over the United States in order to calculate wet deposition of mercury from the atmosphere (http://nadp.sws.uiuc.edu/MDN/). Only 0.1% of samples from the nation exceeded 200 ng/L (1998-2015). In California, only one sample exceeded 200 ng/L out of 904 data points. The sample was collected near San Jose in 2003 and the measure mercury concentration was 250 ng/L. The 99.8th percentile of mercury concentrations in rain measures in a nationwide network of 189 monitoring stations was 174 ng/L. The median and average concentrations in the United States were 9 ng/L and 13 ng/L. The median and average concentrations in California were 6 ng/L and 12 ng/L.

Additionally, the Numeric Action Level for suspended solids should provide some control for mercury, if mercury in the discharge is from contaminated sediments. The new criterion for mercury should not require more suspended solids controls than already required to meet the Numeric Action Level for suspended solids. If the discharger is meeting the 100 mg/L Numeric Action Level for suspended solids where mercury in the soil is fairly high at 1 mg/kg, the resulting mercury in the discharge would be 100 ng/L, which is sufficient to meet the new mercury criterion of 300 ng/L (calculated from 100 mg/L Hg multiplied by 1 mg Hg/kg solids).

P.2.3 Sampling Costs

Several labs were contacted by Water Board staff to obtain cost estimates for methods 245.1, 245.7 and 1631 to measure mercury in storm water. The labs were certified by the Environmental Laboratory Accreditation Program (ELAP). Estimates for method 245.1 ranged from $18-$35. Estimates for method 245.7 ranged widely. This method requires the clean hands technique to avoid sample contamination. At the lower end, large commercial laboratories reported costs ranging from $20 to $70 per sample. A smaller municipal laboratory, however, reported a cost of over $1,000, due to the low volume of samples being processed for this method versus operation and labor costs. Furthermore, there are currently few laboratories in the state that are ELAP certified for this method. Estimates for method 1631 ranged from $115 to greater than $200. Method 1631 also requires the clean hands technique that may add another $100-$150 to the sampling cost.

P.2.4 Requirements for New Dischargers Applying for Coverage Under the 2014 IGP

According to the 2014 IGP, new dischargers applying for coverage under the IGP that will be discharging to a water body on the 303(d) list due to mercury need to meet one of three conditions to be are eligible for coverage. Dischargers have to provide a demonstration of one of the following: 1) The discharger has eliminated all exposure to storm water of the pollutant(s); 2) The pollutant for which the water body is impaired is not present at the facility; 3) The discharge of any listed pollutant will not cause or contribute to an exceedance of a water quality standard (or other conditions if there is a TMDL, Order 2014-0057-DWQ, Section VII. B).

The third requirement may create a conundrum for dischargers trying to enroll in the IGP, since the Provisions do not include a water column objective for mercury. Without a water column concentration to compare monitoring data to, there is no obvious way for a discharger to show their discharge to an impaired water body is in compliance with the water quality objective. There are many mercury impaired waters throughout the state with no TMDL where this issue could come up. To avoid confusion, Section 6.11 of the Staff Report explains that compliance with the mercury criterion is sufficient for demonstration of compliance with mercury water quality objectives for coverage under the IGP. This may also need to be repeated in the regulatory language for clarity.

The tributary rule does not apply for these requirements of the IGP, so a discharge to a non-impaired water body upstream of an impaired water body does not trigger these requirements.

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Appendix Q. Wetland Studies

This appendix summarizes recent studies on potential methods to control mercury or methylmercury into or coming out of a wetland. None of these methods are formally established best management practices, but best management practices could be developed in the future from such studies.

Q.1 Types of Wetlands

Wetland can be subdivided into two general categories: natural or managed, although the distinction is not always clear. Both natural and managed wetlands can be further categorized as either permeant (flooded all year) or seasonal (flooded for part of the year).

Managed seasonal wetlands may include areas used to grow rice during the summer and used for water fowl habitat in the winter, which are often managed for hunting purposes. These areas also provide habitat for many other wildlife species. Wetlands used to grow crops, such as rice, are also known as agriculture wetlands. Discharges from these agriculture wetlands are usually regulated by the Water Boards' Irrigated Lands Regulatory Program. The requirements for dischargers in that program should take into account nearby mercury impaired waters.

"Natural wetlands" can be said to include wetland projects that provide ecological benefit (vs. agricultural benefit). The project may be undertaken to offset destruction of wetlands by development elsewhere in California. These wetland projects can: 1) establish (create) new wetlands where they did not exist before, 2) enhance existing wetlands, or 3) restore wetlands where they used to exist, or the project may have other goals. Definitions for these terms may be found in the U.S. Army Corps of Engineer's Final 2015 Regional Compensatory Mitigation and Monitoring Guidelines (U.S. Army Corps of Engineers 2015). Discharges of dredged or fill materials to waters of the United States or waters of the state are regulated under the State Water Board's Water Quality Certification and Wetlands Program under Clean Water Act section 401 (33 U.S.C.1341). In the future, dischargers of dredged or fill materials also will need to adhere to the requirements of the wetlands protection policy, which is being currently developed by the State Water Board.

Q.2 Possible Means to Control Mercury in Wetlands

Mercury controls can be subdivided into two categories. 1) Methods that aim to reduce methylmercury in fish *in the wetland* or 2) methods that aim to reduce mercury and methylmercury *coming out of the wetland* into downstream waters. Ideally methylmercury should be reduced in both areas to protect wildlife in the wetland and downstream habitat, but some proposed approaches/ studies have focused on only one of these aspects.

Q.2.1 Treatment Ponds

Slow flowing ponds can be constructed to treat the discharge from an agricultural wetland to remove mercury/methylmercury. Slow flowing open water areas encourages setting of suspended sediments. Settling can reduce methylmercury because methylmercury is often transported with sediments and organic material in the water. The mechanism of mercury / methylmercury removal is likely more complex that mere settling of solids. Extended water residence time appeared to preferentially enhance methylmercury degradation and storage (Windham-Myers 2014a). Open water also promotes photolysis of methylmercury, converting methylmercury to inorganic mercury (Fleck et al. 2014). Additionally, coagulants may be added to finishing ponds to help remove methylmercury from the outflow of a wetland, before discharging into a downstream water body (Ackerman et al. 2015).

Q.2.2 Open Water Areas in a Wetland

Similar to the treatment ponds described above, maintaining open water areas within a more natural wetland can help remove mercury. The difference here is that reduction of methylmercury takes place in the wetlands, not just in the out flow from the wetland.

Q.2.3 Seasonal vs. Permanent Wetlands (Reduce Wetting and Drying/ Water Level Fluctuation)

Seasonal wetlands, which can be used for agriculture part of the year, that will be heavily managed and experience a great number of wetting and drying cycles have been found to generate more methylmercury. On the other hand, permanent wetlands may be a sink for methylmercury (Ackerman & Eagles-Smith 2010, Alpers et al. 2014, Windham-Myers et al. 2014b).

Q.2.4 Outflow Management at Specific Times

Settling ponds can be constructed to treat the discharge of an agricultural wetland before discharging to a downstream water body. Wild rice wet harvesting and winter flooding of white rice fields are specific practices that increased methylmercury export, both presumably related to increased labile organic carbon and disturbance. Outflow management during these times could reduce methylmercury exports (Bachand et al. 2014). Alpers et al. 2014 found methylmercury concentrations in the Yolo Bypass that were among the highest ever recorded in wetlands. The highest methylmercury concentrations in unfiltered surface water were observed in drainage from wild rice fields during harvest (September 2007), and in white rice fields with decomposing rice straw during regional flooding (February 2008). Again, management of the outflow at critical times may be able to reduce methylmercury export to downstream waters.

Sediment controls

Sediment controls can limit the transport of mercury or methylmercury out of a wetland (see Settling Ponds, above). Any project that disturbs soil, which could be washed into downstream waters, likely will already be issued a Water Board permit that includes sediments controls. Sediment controls may be included to meet water quality objectives for sediment in downstream waters. Depending on the project, such controls may be an acceptable means to control mercury.

Alteration of management procedures
The use of new agricultural management practices could reduce the generation of methylmercury in the wetland. For example, Alpers et al. 2014 found the highest methylmercury concentrations in drainage from wild rice fields during harvest (September 2007), and in white rice fields with decomposing rice straw during regional flooding (February 2008). Other procedures could perhaps be used to remove the rice straw; however growers must abide by other mandates. In the past rice straw was burned, but burning the straw is now severely restricted to protect air quality.

Based on the summaries above, any practice that reduces the amount of wetting or drying a that occurs infield, or any a means to increase slow moving open water could potentially reduce the production of methylmercury in the wetland.

Q.2.5 Minimize the Delivery of New Mercury to the Wetland
If the wetland is receiving water that is high in mercury, the best way to decrease methylmercury to the wetland could be to minimize the input of inorganic mercury or methylmercury into the wetland. This decreases the amount of mercury in the water flowing into the wetland, which may be difficult for a wetland project to accomplish, but reducing upstream mercury sources may be achieved through the implementation of a Total Maximum Daily Load (TMDL) or through other projects that reduce sediment transport or air emissions of mercury..

Q.2.6 Ongoing Studies of Wetlands
The Central Valley Regional Water Board is currently working with non-point source dischargers and scientists to explore management practices that can reduce mercury methylation in the environment as part of the Sacramento-San Joaquin Delta methylmercury TMDL. New management practices to control methylation in wetlands may be developed in the future. Much of the information summarized above was the result of those studies.

Another area of study is the South Bay Salt Ponds Restoration Project in San Francisco Bay. The wetland restoration design for this project is attempting to reduce the potential for mercury methylation and other contaminant problems. The project design includes monitoring and studies to measure methylmercury production.

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Appendix R. Economic Analysis

Economic Analysis of Proposed Water Quality Objectives for Mercury in the State of California

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List of Exhibits

Abbreviations

AMEL	Average monthly effluent limit
BAF	Bioaccumulation factor
BAT	Best available technology economically achievable
BCT	Best conventional pollutant control technology
BLS CPI	Bureau of Labor Statistics Consumer Price Index
BMP	Best management practice
Caltrans	California Department of Transportation
CEDEN	California Environmental Data Exchange Network
CIWQS	California's Integrated Water Quality System
cm	centimeter
CTR	California Toxics Rule
CWA	Clean Water Act
EBMUD	East Bay Municipal Utilities District
ECA	Effluent concentration allowance
ENR CCI	Engineering News-Record Construction Cost Index
FTE	Full-time equivalent
FTO	Fish tissue objective
GIS	Geographic information systems
Hg	Inorganic mercury
ICIS-NPDES	Integrated Compliance Information System-National Pollutant Discharge Elimination System
lbs/yr	pounds per year
LID	Low impact development
MDEL	Maximum daily effluent limit
MEC	Maximum effluent concentration
MeHg	Methylmercury
MEP	Maximum extent practicable
mg	milligrams
mg/kg	milligrams per kilogram
mgd	million gallons per day
MS4	Municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OMR	Office of Mine Reclamation
ng/L	nanograms per liter
NLCD	National Land Cover Data
P2	Pollution prevention
RP	Reasonable potential
RWQCP	Regional Water Quality Control Plant

SD	Sanitation District
SIP	Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California
SWMP	Stormwater management plan
SWPPP	Stormwater Pollution Prevention Plan
TL	Trophic level
TMDL	Total maximum daily load
µg/L	micrograms per liter
U.S. EPA	United States Environmental Protection Agency
USFS	United States Forest Service
WDR	Waste discharge requirements
WLA	Wasteload allocation
WQBEL	Water quality based effluent limit
WWTP	Wastewater treatment plant

Executive Summary

The California State Water Resources Control Board (State Water Board) is considering fish tissue objectives for mercury for the protection of human health and wildlife, and implementation procedures for the objectives (November 2016 draft proposed Policy). Under a contract with the United States Environmental Protection Agency (U.S. EPA), Abt Associates provided the State Water Board with an analysis of economic factors related to the proposal, including compliance with the water quality objective options, available methods to achieve compliance with these options, and the costs of those methods.

Baseline and Proposed Policy

The proposed Policy implementation plan would not supersede implementation plans of any existing mercury TMDLs or site-specific fish tissue methylmercury objectives. The California Toxics Rule (CTR) currently establishes total recoverable mercury water quality criteria for the protection of human health of 50 nanograms per liter (ng/L) for consumption of water and organisms, and 51 ng/L for consumption of organisms only. These criteria apply to all inland waters, enclosed bays, and estuaries in the state. In addition, the Regional Water Board Basin Plans contain narrative criteria related to toxicity or bioaccumulation as well as site-specific objectives for mercury established under total maximum daily loads (TMDLs).

The proposed Policy would establish water quality objectives for mercury, as methylmercury concentrations in fish tissue, to protect human health and wildlife. The proposed policy contains the following fish tissue objectives, expressed as methylmercury concentrations, as illustrated in **Exhibit ES-1.**

Exhibit ES-1: Water Quality Objectives

Objective Type	Beneficial Use	Objective
Sport Fish	COMM, WILD, RARE	0.2 mg/kg in highest trophic level fish; 150 – 500 mm
Tribal Subsistence Fish	T-SUB	0.04 mg/kg in 70% trophic level 3 fish and 30% trophic level 4 fish; 150 – 500 mm
Subsistence Fish	SUB	0.05 mg/kg in highest trophic level fish; 150 – 500 mm
Prey Fish	WILD, MAR[1]	0.05 mg/kg in fish 50 – 150 mm
Prey Fish for the California Least Tern	California least tern habitat[2]	0.03 mg/kg in fish less than 50 mm
1. Where no trophic level 4 fish.		
2. May be designated WILD, RARE, or MAR.		

Incrementally Impaired Waters

The proposed Policy does not contain procedures for determining impairments. Under the current policy, for toxic numeric water quality objectives, a water is impaired if the number of measured exceedances supports rejection of the null hypothesis using the binomial distribution. For narrative objectives based on the bioaccumulation of pollutants in aquatic life tissue, a water is impaired if the tissue pollutant levels in organisms exceed a pollutant-specific evaluation guideline using the binomial distribution. In the past, Regional Water Boards have used evaluation guidelines published by U.S. EPA (i.e, guidelines of 0.3 mg/kg) or the Office of Environmental Health Hazard Assessment (OEHHA; i.e., a contaminant goal of 0.22 mg/kg) to determine impairments in water quality segments of receiving water bodies. Once the Policy is adopted, the new numeric water quality objectives would be the used to determined impairments. This analysis does not include an assessment of incremental impairments due to uncertainties regarding how newly developed beneficial uses are to be assigned to water quality segments.

Municipal and Industrial WWTPs

Abt Associates was provided by the State Water Board with mercury effluent data from the California integrated Water Quality System (CIWQS) database for all municipal and industrial dischargers subject to the proposed Policy with available data.

For implementation in NPDES permits, these water quality objectives would be interpreted as water column concentration targets according to the beneficial uses of the receiving water body, and the receiving waters flow regime:

Exhibit ES-2: Water Column Concentrations (C) Based on Beneficial Use and Water Body Type.

Beneficial Use	Water Body Type	Total Mercury Water Column Target (ng/L)
COMM, WILD, RARE	Flowing water bodies (generally, rivers, creeks and streams)	12
COMM, WILD, RARE	Slow moving water bodies (generally, lagoons and marshes)	4
COMM, WILD, RARE	Lakes and reservoirs	Case-By-Case[1]
T-SUB	Flowing water bodies (generally, rivers, creeks and streams)	4
T-SUB	Slow moving water bodies (generally, lagoons and marshes)	1
SUB	Any	Case-By-Case[1]
1. The permitting authority shall calculate C from the water quality objective, and may use available data, including U.S. EPA national bioaccumulation factors and translators.		

For statewide general implementation of the fish tissue objectives under the proposed Policy, a discharger has RP if there is an annual average exceedance of the water column target associated with the beneficial uses of the receiving water. Those dischargers exhibiting RP were assigned an annual average water quality-based effluent limitation (WQBEL), consistent with the procedures stipulated in the proposed Policy.

To determine whether a discharger would need to potentially reduce mercury concentrations under the proposed Policy, Abt Associates compared the maximum annual average concentration, or maximum effluent concentration (MEC) from the permit (if there are no effluent data in CIWQS), to our projected WQBEL. **Exhibit ES-3** shows the number of dischargers that would need reductions under the proposed policy.

Exhibit ES-3: Estimated Number of Municipal and Industrial Wastewater Dischargers Needing Incremental Reductions for Compliance with Projected Effluent Limits

Category	Type	Number of Affected Facilities
Municipal	Major	12
	Minor	1
Industrial	Major	6
	Minor	3
	Total	22

Abt Associates analyzed effluent data for municipal wastewater treatment plants (WWTPs) in California with secondary and tertiary treatment, Abt Associates estimated that dischargers needing reductions under the proposed Policy can meet the proposed effluent limits through pollution prevention (P2) programs or installation of tertiary filtration. In addition to compliance with effluent limitations, NPDES non-stormwater dischargers in the state may need to either increase the frequency of routine monitoring or utilize more sensitive analytical methods when monitoring.

To determine the statewide costs of compliance, Abt Associates used NPDES permits to classify existing treatment levels at major municipal WWTPs as secondary or tertiary. We assumed that dischargers with secondary treatment currently in place would install tertiary filtration for compliance and dischargers operating tertiary filtration plants that needed mercury reduction would implement P2 programs. For industrial dischargers, because detailed, site-specific information is not available for each facility to indicate the feasibility of P2/source control and advanced end-of-pipe treatment, we estimated costs based on a range of options, with the low end representing implementing P2 or process optimization and the high end representing tertiary filtration.

To capture changes in routine monitoring, Abt Associates conservatively assumed all non-stormwater NPDES permittees subject to the proposed policy would undertake quarterly monitoring and utilize clean-hands sampling methods. This likely represents a substantial overestimate of costs since not all permittees will sample at greater than required frequencies, nor does it take into account existing monitoring costs for mercury which are not attributable to the proposed Policy.

Exhibit ES-4 shows the results of the cost analysis for municipal and industrial dischargers.

Exhibit ES-4: Estimated Annual Incremental Compliance Cost for Municipal and Industrial Plants (2016$ per year).

Category	Type	Annual Incremental Cost ($millions)
Municipal	Major	$2.82
	Minor	$0.17
Industrial	Major	$0.23 - $2.7
	Minor	$0.35 - $4.4
Total		**$3.57 - $10.1**
1. All costs presented in 2016$ and annualized based on a 5% interest rate and 20 year expected project life.		

NPDES Stormwater

The State Water Board is proposing that municipal separate storm sewer systems (MS4s) and industrial stormwater dischargers implement a combination of source control and pollution prevention measures, and sediment and erosion control methods. Under the proposed Policy, MS4s would need to develop and implement programmatic controls for mercury in those communities where such control measures do not yet exist. To comply with the Policy 16 Phase I MS4s and an unknown number of Phase II MS4s would need to develop and implement new source control programs or, as is more likely, augment existing source control programs. Conservatively assuming that all permitted Phase II MS4s in the state and 16 Phase I MS4 were required to augment their pollution prevention programs, the annual incremental cost would be approximately $5.3 million per year. This likely represents a substantial overestimate since the actual number of Phase II MS4s with existing mercury control programs are unknown and the Phase I activities are likely duplicative of similar efforts at large WWTPs. In addition, there may already be controls required under an existing NPDES permit for stormwater dischargers that have not yet been implemented that would also reduce mercury loads; this could negate the need for enhanced controls under the proposed Policy.

Industrial stormwater permittees would need to meet new Numeric Action Levels for mercury (revised from 1,400 ng/L to 300 ng/L). Due to the site-specific nature of these controls, we are unable to develop specific cost estimates associated with the incremental control activities.

Abandoned Mines, Non-Point Sources, Dredging Activities & Wetlands

The proposed Policy does require the implementation of sediment and erosion control measures for all dischargers subject to Title 27 of the California Code of Regulations, section 22510.

In addition, the proposed Policy may result in the implementation of new erosions control measures for some non-point source dischargers, and the implementation of new wetland restoration and dredging management measures to minimize the production and release of methylmercury.

Due to limited available data and the site-specific nature of the control activities likely to occur at these sites, it is infeasible to estimate incremental costs attributable to the proposed Policy for these potentially affected populations. In many cases, existing requirements (e.g., existing sediment and erosion control practices at many abandoned mine sites) are expected to meet the requirements of the proposed Policy without the need to undertake additional control measures.

Summary

Exhibit ES-4 summarizes the estimated total annual incremental costs statewide under the proposed Policy. We were not able to quantify costs for all discharge types included in the Policy due to data limitations.

Exhibit ES-4: Estimated Total Annual Incremental Compliance Cost under Proposed Policy Options (2016$ per year)[1]

Category	Type	Annual Incremental Cost ($millions)
Municipal	Major	$2.82
	Minor	$0.17
	Sub-total	$2.99
Industrial	Major	$0.23 - $2.7
	Minor	$0.35 - $4.4
	Sub-Total	$0.57 - $7.0
MS4s		$5.3
Total		**$8.86 - $15.3**

1. All costs presented in 2016$ and annualized based on a 5% interest rate and 20 year expected project life.

There are a number of uncertainties and limitations associated with the data and methods we used to estimate the potential incremental costs of the proposed Policy. Data limitations or lack of data altogether resulted in the largest uncertainties. For example, two data limitations led to potential overestimation of potential costs. First, assuming all small MS4s will need to augment or make significant updates to their source control programs. Second, for municipal and industrial dischargers, comparing a single maximum value where sufficient effluent data are available to projected effluent limits that are likely to be implemented as annual averages likely overstates the reductions needed, if any. A third data limitation prevented quantification of costs for industrial stormwater dischargers, mines, dredging, wetlands other nonpoint sources. In contrast, this data limitation potentially results in an underestimation of costs.

Introduction

The California State Water Resources Control Board (State Water Board) is considering fish tissue objectives for mercury for the protection of human health and wildlife, and implementation procedures for the objectives (2016 draft proposed Policy; "the Policy"). This report presents analysis of economic factors related to the proposal, including compliance with the water quality objective options, available methods to achieve compliance with these options, and the costs of those methods.

Need for the Proposed Rule

Under the Clean Water Act (CWA), states have primary authority for establishing designated uses for water bodies, and for developing water quality criteria to protect those designated uses. Under Section 303(c)(2)(B) of the CWA, whenever a state adopts new water quality standards, or reviews or revises existing water quality standards, it must adopt numeric water quality criteria for priority toxic pollutants if the absence of such criteria could reasonably be expected to interfere with a designated use of a water body.

California had been the only state in the nation for which CWA section 303(c)(2)(B) had remained substantially unimplemented after the United State Environmental Protection Agency's (U.S. EPA's) promulgation of the National Toxics Rule in December of 1992. Section 303(c)(4) of the CWA authorizes the U.S. EPA Administrator to promulgate standards where necessary to meet the requirements of the CWA. The Administrator determined that the California Toxics Rule (CTR) was a necessary and important component for the implementation of CWA section 303(c)(2)(B) in California. In promulgating the CTR in 2000, U.S. EPA agreed to update the mercury criteria based on consultation with the U.S. Fish and Wildlife Service and the U.S. National Marine Fisheries Service, pursuant to the Endangered Species Act.

In 2001, after review of the mercury human health criteria [(pursuant to Section 304(a) which requires U.S. EPA to review water quality criteria to ensure that the criteria accurately reflect the latest scientific knowledge on the kind and extent of all identifiable effects of pollutants on human health], U.S. EPA concluded that it is more appropriate to derive a fish tissue quality criterion for methylmercury than a water column-based mercury criterion for protection of human health. A fish tissue criterion is more closely tied to the CWA goal of protecting public health because it is based directly on the dominant human exposure route for methylmercury.

Thus, the State Water Board staff is developing mercury water quality objectives consistent with the U.S. EPA's recommendation. The Policy also establishes procedures for implementing the objectives.

Scope of the Analysis

The Porter-Cologne Water Quality Act requires the Regional Water Boards to take "economic considerations," among other factors, into account when they establish water quality objectives. The other factors include the past, present, and probable future beneficial uses of water; environmental characteristics of the hydrographic unit under consideration; water quality conditions that could reasonably be achieved through the coordinated control of all factors affecting water quality in the area; the need for housing; and the need to develop and use recycled water. The objectives must ensure the reasonable protection of beneficial uses, and the prevention of nuisance.

To meet the economic considerations requirement, the State Water Board (1999; 1994) concluded that, at a minimum, the Regional Water Boards must analyze:

Whether the proposed objective is currently being attained;

If not, what methods are available to achieve compliance; and

The cost of those methods.

If the economic consequences of adoption are potentially significant, the Regional Water Boards must explain why adoption is necessary to ensure reasonable protection of beneficial uses or prevent nuisance. The Boards can adopt objectives despite significant economic consequences; there is no requirement for a formal cost-benefit analysis.[1]

Under a contract with the U.S. EPA, Abt Associates provided the State Water Board with an analysis of economic considerations. Specifically, Abt Associates identified baseline requirements, potentially affected entities, likely incremental compliance actions, and costs for these entities under the proposed Policy.

Organization of this Report

This report is organized as follows:

Section 2 – describes the current applicable objectives and requirements that provide the baseline for the analysis of the incremental impact of the Policy.

Section 3 – describes the proposed Policy.

Section 4 – identifies whether the proposed objectives are currently being met and whether there are any incremental impacts of meeting the objectives.

Section 5 – describes the methods for compliance and their costs.

Section 6 – provides estimates of potential incremental statewide costs of the proposed Policy.

[1] Water quality objectives establish concentrations protective of beneficial uses and the fishable/swimmable goals of the CWA, and thus are based on science and not economics. Economics can play a role in establishing water quality standards through the analysis of use attainability [removal of a beneficial use which is not an existing use under 40 CFR 131.10(g)]. However, the applicable economic criterion in such an analysis is not efficiency (i.e., maximizing net benefits, based on cost-benefit analysis) but distributional impacts (a determination of whether there will be substantial and widespread economic and social impacts from implementing controls more stringent than those required by sections 301(b) and 306 of the CWA). This criterion may also be employed at the local level in the evaluation of temporary variances.

Appendices provide detailed information on total maximum daily load (TMDL) implementation plans, municipal pollution prevention (P2) programs, and incremental compliance/costs associated with numeric water quality based effluent limits (WQBELs).

Baseline for the Analysis

This section describes the applicable baseline for evaluating the potential incremental costs of the proposed Policy options, including current water quality criteria for mercury, potential sources of mercury, and the current levels of mercury impairment of inland surface waters, enclosed bays, and estuaries in California.

Water Quality Objectives

The CTR establishes total recoverable mercury water quality criteria for the protection of human health of 50 nanograms per liter (ng/L) for consumption of water and organisms, and 51 ng/L for consumption of organisms only. These criteria apply to all inland water, enclosed bays, and estuaries in the state, except in waterbodies where site-specific objectives have been established or where a TMDL applies (see Section 0 for a discussion of TMDLs). In addition to these numeric criteria, most Basin Plans also contain narrative criteria related to toxicity or bioaccumulation as shown in **Exhibit 2-1.**

Exhibit Error! No text of specified style in document.**-1: Applicable Existing Basin Plan Objectives**

Region	Narrative Criteria
North Coast (Region 1)	Toxicity – All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
San Francisco Bay (Region 2)	Bioaccumulation – Controllable water quality factors shall not cause a detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life. Toxicity – All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms.
Central Coast (Region 3)	Toxicity – All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life.
Los Angeles (Region 4)	Bioaccumulation – Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels which are harmful to aquatic life or human health. Toxicity – All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Central Valley (Region 5)	Toxicity – All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.
Lahontan (Region 6)	Effluent discharged to waters of the Region shall contain essentially no mercury. Toxicity – all waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.

Exhibit Error! No text of specified style in document.-**1: Applicable Existing Basin Plan Objectives**

Region	Narrative Criteria
Colorado River (Region 7)	Toxicity – all waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Chemical Constituents – no individual chemical or combination of chemicals shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in hazardous chemical concentrations found in bottom sediments or aquatic life.
Santa Ana (Region 8)	Toxic Substances – Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health. The concentrations of toxic substances in the water column, sediments or biota shall not adversely affect beneficial uses.
San Diego (Region 9)	Toxicity – All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.

The San Francisco Regional Water Board also has the following aquatic life criteria for mercury:

Marine 4-day avg: 0.025 micrograms per liter (µg/L) (excludes San Francisco Bay)

Marine 1-hr avg: 2.1 µg/L

Freshwater 4-day avg: 0.025 µg/L

Freshwater 1-hr avg: 2.4 µg/L

The Central Coast Regional Water Board has mercury objectives for agricultural use in livestock watering of 10,000 ng/L and for cold and warm water fisheries of 0.20 µg/L maximum, 0.050 µg/L average, and maximum total mercury in aquatic organism of 500 micrograms per gram (µg/g) wet weight.

Implementation Policy

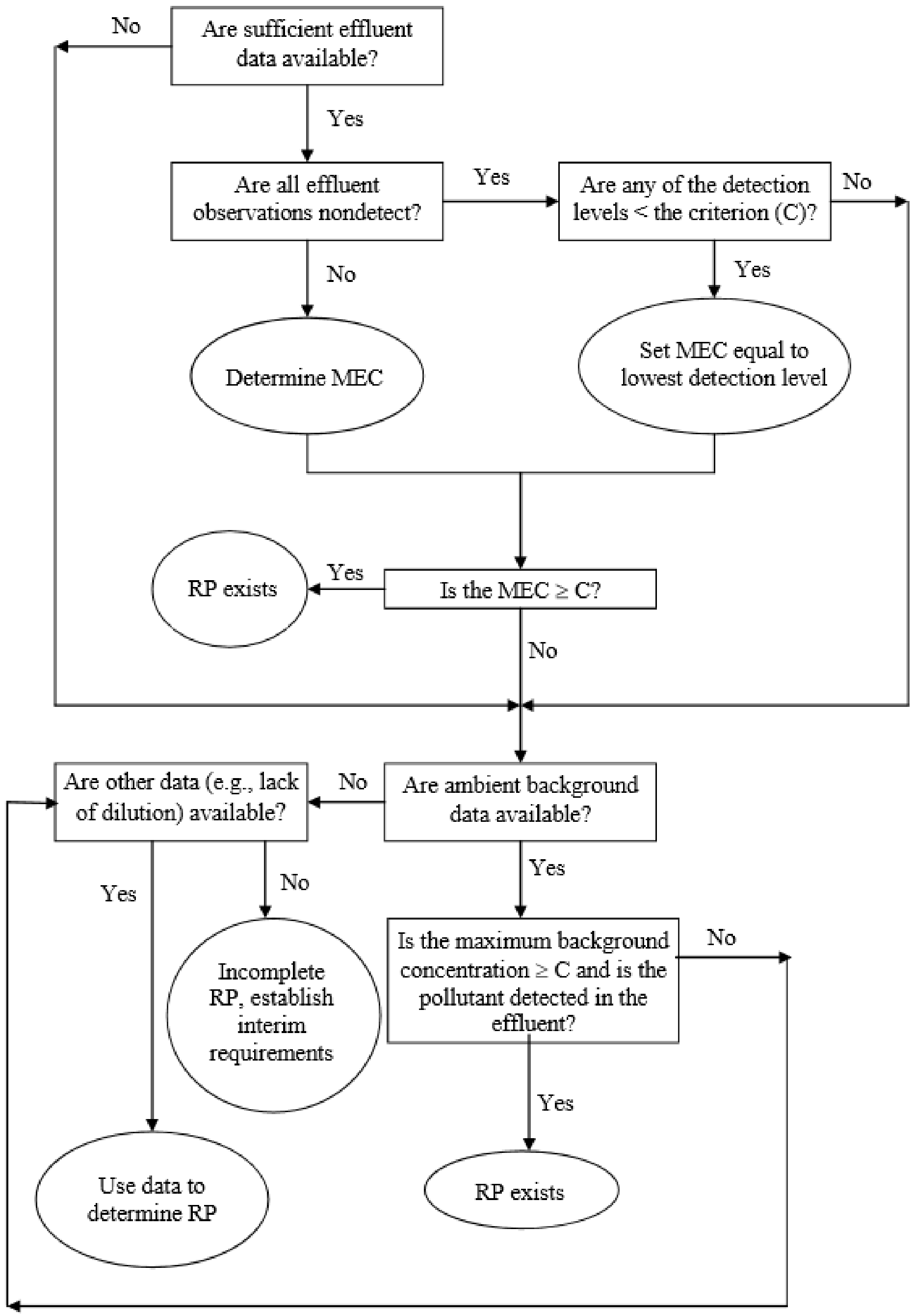
Regional Water Boards currently use the state's Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP) to implement CTR criteria in National Pollutant Discharge Elimination System (NPDES) permits. Under the SIP, a permit writer first evaluates whether a facility has reasonable potential (RP) to cause or contribute to an exceedance of the criteria and, if so, calculates effluent limits.

Under the SIP, RP exists if the maximum effluent concentration (MEC) is greater than or equal to the lowest applicable criterion.[2] RP also exists if the maximum ambient concentration is greater than the criterion and the pollutant is detected in the effluent. There is no RP if both the maximum ambient concentration and MEC are lower than the criterion. If data are unavailable or insufficient to conduct the RP analysis, or if all reported detection limits are greater than or equal

[2] If all of the effluent observations are nondetect, the SIP specifies to use the lowest detection limit as the MEC.

to the criterion, the facility receives interim requirements to collect effluent data using sensitive analytical methods. **Exhibit 2-3** shows the process for determining RP using SIP procedures.

Exhibit Error! No text of specified style in document.-**2: SIP Procedures for Determining Reasonable Potential**



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For facilities for which there is RP, the first step in the SIP procedures involves calculating the effluent concentration allowance (ECA):

$$ECA = C + D(C - B) \qquad when\ C > B$$

$$ECA = C \qquad when\ C \leq B$$

Where,

C = criterion

D = dilution (ratio of receiving water flow to effluent flow)

B = maximum ambient background concentration

For human health criteria, the average monthly effluent limit (AMEL) is equal to the ECA, and the maximum daily effluent limit (MDEL) would be calculated by multiplying the AMEL by the ratio of the MDEL multiplier to the AMEL multiplier using the following equations:

$$AMEL\ multiplier_{95} = \exp(z\sigma_n - 0.5\sigma_n^2)$$

Where,

σ_n = $[\ln(CV^2/n + 1)]^{0.5}$

σ_n^2 = $\ln(CV^2/n + 1)$

z = 1.645 for 95th percentile probability basis

n = number of samples per month (if sampling frequency is 4 times a month or less, n=4)

CV = coefficient of variation (calculated as the standard deviation divided by the mean)

$$MDEL\ multiplier_{99} = \exp(z\sigma - 0.5\sigma^2)$$

Where,

σ = $[\ln(CV^2 + 1)]^{0.5}$

σ^2 = $\ln(CV^2 + 1)$

z = 2.326 for 99th percentile probability basis

$$MDEL = AMEL * \left(\frac{MDEL_{multiplier99}}{AMEL_{multiplier95}} \right)$$

Note that the SIP specifies use of a CV of 0.6 if there are fewer than 10 samples available, or when more than 80% of the values are nondetect.

Sources of Mercury to Surface Waters

Mercury can be introduced to surface water through natural and human activities (U.S. EPA, 2000). As shown in Section 0, potential mercury sources to surface waters include municipal and industrial point source dischargers, stormwater discharges, resource extraction and mine runoff, runoff and soil erosion from agricultural lands, and air emissions. This section describes the relevant baseline requirements and activities for each of these sources.

Municipal and Industrial Facilities

A number of different industrial, commercial, and institutional facilities discharge mercury to municipal wastewater treatment plant (WWTPs). Dentists and hospitals are some of the most common commercial dischargers of mercury. Other common sources include laboratories, automobile service centers, secondary schools and universities, and potteries (AMSA, 2002). Households may also be a significant source of mercury because human waste contains mercury, as does a number of household products such as toothpaste, deodorant, soaps, household cleaners, food, condiments, contact lens solution, batteries, fluorescent light bulbs, thermometers, thermostats, over-the-counter disinfectants and nasal sprays, cosmetics, paints and coatings, and appliances (e.g., freezer lights, electric space heaters, portable phones) (Huber, 1997).

Industrial processes use or release mercury through five primary routes (Huber, 1997):

Component in equipment

Ingredient in chemicals

Contaminant in raw materials

Intentional use in manufactured products

Incidental release to a production process.

There are approximately 460 NPDES permitted municipal and industrial dischargers in the state and, of these, more than half are expected to fall within the scope of the proposed Policy. Of the potentially affected permittees, 147 are municipal dischargers, 151 are industrial dischargers, and 10 are federally-owned dischargers which primarily discharge treated sanitary waste. **Exhibit 2-3** provides a summary of these California dischargers by discharge type.

Exhibit Error! No text of specified style in document.**-3: Municipal Wastewater Treatment Plants and Industrial Discharges to Inland Surface Waters, Enclosed Bays, and Estuaries in California**

Treatment Facility Type	Major Facilities	Minor Facilities	Total
Municipal	92	55	147
Industrial	23	128	151
Federal	3	7	10
Total	**118**	**190**	**308**
Source: SWRCB (2016).			

Stormwater Discharges

Urban stormwater runoff can be a significant source of mercury to surface waters (SFBRWQCB, 2006). Regional Water Boards regulate most stormwater discharges under general permits.

General permits often require compliance with standards through an iterative approach based on stormwater management plans (SWMPs), rather than through the use of numeric effluent limits. In other words, permittees implement best management practices (BMPs) identified in their SWMPs. Then, if those BMPs do not result in attainment of water quality standards, Regional Water Boards would require additional practices until pollutant levels are reduced to the appropriate levels. Because Regional Water Boards use this iterative approach that increases requirements until water quality objectives are met, current levels of implementation may not reflect the maximum level of control required to meet existing standards (CSU Sacramento, 2005). The State Water Board has four existing programs for controlling pollutants in stormwater runoff to surface waters: municipal, industrial, construction, and California Department of Transportation (Caltrans). Municipal, Caltrans, and industrial stormwater dischargers may have requirements specific to mercury.

Municipal

The municipal program regulates stormwater discharges from municipal separate storm sewer systems (MS4s). The MS4 permits require the discharger to develop and implement a SWMP, with the goal of reducing the discharge of pollutants to the maximum extent practicable (MEP). MEP is the performance standard specified in Section 402(p) of the CWA. The management programs specify the BMPs that will be used to address public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations.

There are 22 NPDES permits for large MS4s in California that discharge, at least in part, to inland surface waters, enclosed bays, or estuaries. However, Phase I and Phase II MS4 permits do not specify particular controls for mercury and methylmercury and, instead, rely on implementation of programmatic requirements. **Exhibit 2-4** describes those MS4s with permit requirements or SWMP activities specific to mercury; all MS4s have general requirements to reduce the discharge of pollutants to surface waters.

Exhibit Error! No text of specified style in document.-**4: Permit Requirements and SWMP Activities Specific to Mercury for Large MS4s in California**

MS4 Name (NPDES No.)	Affected Water Bodies	Permit Requirements and SWMP Activities
Region 2 – Municipal Regional Stormwater Permit (CAS612008)	San Francisco Bay; Suisun Bay and Suisun Marsh	• Monitor mercury (Hg) a total of 80 samples per year. • Permittees to collaboratively meet a mercury WLA of 82 kg/year by 2028 (interim target of 120 kg/year by 2018) through a combination of source control, treatment control, and pollution prevention strategies. • Develop and implement an assessment methodology for assessing attainment of mercury load reductions by permittees. • Plan and implement green infrastructure improvements designed to assist in meeting mercury load targets. • Implement a risk reduction program to address public health impacts associated with mercury in San Francisco Bay/Delta fish.

Exhibit Error! No text of specified style in document.-**4: Permit Requirements and SWMP Activities Specific to Mercury for Large MS4s in California**

MS4 Name (NPDES No.)	Affected Water Bodies	Permit Requirements and SWMP Activities
Region 4 – Ventura County (CAS004002)	Ventura River, Santa Clara River, Calleguas Creek, Malibu Creek	• Meet interim mass-based wasteload allocations (WLAs) ranging from 1.7 pounds per year (lbs/year) to 64.4 lbs/year depending on location and flow. • Conduct a source control study, develop, and submit an Urban Water Quality Management Program, and implement program. • In cooperation with agricultural dischargers, include monitoring for mercury (and other metals) in the pesticides TMDL special study.
Region 5 - Sacramento County (CAS082597)	Sacramento-San Joaquin Delta	• Continue to implement the 2004 Hg reduction strategy. • Total Hg and MeHg monitoring in select areas/sites.
Region 5 – East Contra Costa (CAS083313)	Sacramento-San Joaquin Delta	• Meet WLA set in Delta TMDL by 2030. • Implement pollution prevention measures and BMPs to minimize total Hg discharges to meet the Delta TMDL. • Report on the results of Hg monitoring and provide a description of implemented pollution prevention measures and the effectiveness in reducing Hg discharges. • Conduct MeHg control studies to monitor and evaluate the effectiveness of existing BMPs on the control of MeHg, and develop and evaluate additional BMPs as needed to reduce Hg and MeHg discharges to the Delta. • Monitor Hg an average of four wet weather events per year. • Monitor for MeHg an average of two wet and two dry weather events per year.
Region 5 – City of Stockton and San Joaquin County (CAS083470)	Sacramento-San Joaquin Delta	• Develop and implement a Hg reduction strategy. • Total Hg and MeHg monitoring in select areas/sites.

Exhibit Error! No text of specified style in document.-**4: Permit Requirements and SWMP Activities Specific to Mercury for Large MS4s in California**

MS4 Name (NPDES No.)	Affected Water Bodies	Permit Requirements and SWMP Activities
Region 5 - Port Stockton (CAS0084077)	Central Delta and San Joaquin River	• Meet MeHg WLAs set in Delta TMDL by 2030. • Implement pollution prevention measures and BMPs to meet the MeHg WLAs. • Report annually on the results of Hg monitoring and provide a description of implemented pollution prevention measures and the effectiveness in reducing Hg discharges. • If MeHg loads are determined to be greater than the Port's WLAs, conduct control studies to monitor and evaluate the effectiveness of existing BMPs on the control of MeHg, and to develop and evaluate additional BMPs as needed. • Develop, fund, implement, and report on an Exposure Reduction Program. • Monitor for Hg and MeHg using grab samples.
Region 8 – San Bernardino County (CAS618036)	Big Bear Lake	• Participate in the development and implementation of monitoring programs and control measures, including any BMPs that the City is currently implementing or proposing to implement.
Region 8 – Orange County (CAS618030)	Rhine Channel	• Meet WLA for mercury in the Rhine Channel.
BMP = best management practice Hg = Inorganic mercury MeHg = methylmercury WLA = wasteload allocation TMDL = total maximum daily load		

In addition, there are 235 small MS4s required to reduce the discharge of pollutants and comply with any TMDL requirements.

In California, typical permit requirements that are now being included in all Phase I MS4 permits and the Phase II General Permit include:

Specific thresholds for "Priority Projects" that must include both source and treatment control BMPs in the completed projects;

A list of source control (both nonstructural and structural) BMPs and treatment control BMPs to be included or considered;

Specific water quality design volume and/or water quality design flow rate for treatment control BMPs;

A requirement for flow control BMPs when there is potential for downstream erosion; and

Adopt a standard model or template for identifying and documenting BMPs including a plan for long-term operations and maintenance of BMPs.

Caltrans

In 1996, Caltrans requested that the State Water Board consider adopting a single NPDES permit for stormwater discharges from all Caltrans properties, facilities, and activities that would cover both the MS4 requirements and the statewide construction general permit requirements. The State Water Board issued the Caltrans general permit in 1999 and a renewed permit in 2012. The permit requires Caltrans to control pollutant discharges to the MEP and implement a stormwater program designed to achieve compliance with water quality standards, over time through an iterative approach. If discharges are found to be causing or contributing to an exceedance of an applicable objective, Caltrans is required to revise its BMPs (including use of additional and more effective BMPs).

Industrial

Under the industrial program, the State Water Board issues a general NPDES permit that regulates discharges associated with ten broad categories of industrial activities. This general permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT). The permit also requires that dischargers develop a Stormwater Pollution Prevention Plan (SWPPP) and a monitoring plan. Through the SWPPP, dischargers must identify sources of pollutants, and describe the means to manage the sources to reduce stormwater pollution. For the monitoring plan, facility operators may participate in group monitoring programs to reduce costs and resources. NPDES permits applicable only to hazardous waste treatment storage or disposal facilities specifically require monitoring for mercury.

Abandoned Mines

Resource extraction (or mining) is the leading cause of mercury impairments throughout the state (see Section 0). Drainage structures and sluices associated with abandoned hydraulic gold mines are a potential source of mercury to surface waters. The California Nonpoint Source (NPS) Program Plan does not contain management measures for abandoned mines, and there is no specific, comprehensive program at either the state or federal level for cleaning up abandoned and inactive mines other than coal. Rather, abandoned and inactive mine cleanup is carried out under a variety of state, federal, and local programs.

Regional Water Boards may issue waste discharge requirements (WDRs) to the most serious sites and include implementation policies regarding mining operations in basin plans. For example, the San Francisco Bay Regional Water Board has a nonpoint source control program for mines and mineral producers. Under this mineral and mining program, the Regional Water Board intends to identify all existing and abandoned mines and mineral production sites and responsible parties, as well as any potential funding alternatives for cleanup activities. Once identified, the Regional Water Board will consider issuing individual permits or a general permit for such discharges, or will otherwise allow coverage under a general permit for stormwater discharges associated with industrial activity.

On the federal level, the Superfund Program addresses the most extreme pollution sites, such as Iron Mountain Mine. Federal land management agencies have specific, marginally funded programs for cleaning up abandoned mines on federal land, but most projects address safety hazards rather than water quality. California's Title 27 Program regulates discharges of wastes to land, and can be used to pursue mine cleanups.

As a land-managing agency, the U.S. Forest Service (USFS) also has an abandoned mine reclamation program. The program includes an inventory of abandoned mines and locations, environmental and/or resource problems present, rehabilitation measures required, and potential sources of funding. The USFS has worked with various Regional Water Boards on numerous occasions in the rehabilitation of mine sites. Restoration funding comes from USFS funds, the Comprehensive Environmental Response and Compensation Liability Act, and Resource Conservation and Recovery Act sources. All lands disturbed by mineral activities must be reclaimed to a condition consistent with resource management plans, including air and water quality requirements (SWRCB, 2000; SWRCB 2003).

Mining projects that could impair water quality or beneficial uses are also subject to NPDES permits or conditions under the CWA section 401 Water Quality Certification Program.

Enforcement actions, however, are costly and have not been effective because responsible parties can be difficult to locate (especially for abandoned mines), and current property owners either do not have or will not spend money to clean up their sites (SWRCB, 2003).

Despite these programs, however, there is no systematic, statewide approach to abandoned mine management. Typically, regulatory agencies in California address sites on a case-by-case basis, and the Office of Mine Reclamation (OMR) focuses abatement efforts on control of water exiting from abandoned mine tunnels.

Air Emissions

Coal-burning power plants are the largest human-caused source of mercury emissions to the air in the United States, accounting for over 50% of all domestic human-caused mercury emissions based on the 2005 National Emissions Inventory. U.S. EPA has estimated that about one quarter of U.S. emissions from coal-burning power plants are deposited within the contiguous United States and the remainder enters the global cycle. Burning hazardous wastes, producing chlorine, and breaking mercury products can also release mercury into the environment. Significant mercury emissions also come from international sources. However, because the State Water Board does not have authority to directly regulate air emissions, we do not include them in the analysis.

Impaired Waters

A 2004 policy establishes procedures for including California waters on the state 303(d) list as impaired. For toxic numeric water quality objectives, a water is impaired if the number of measured exceedances supports rejection of the null hypothesis using the binomial distribution.

For narrative objectives based on the bioaccumulation of pollutants in aquatic life tissue, a water is impaired if the tissue pollutant levels in organisms exceed a pollutant-specific evaluation guideline using the binomial distribution. Regional Water Boards may select evaluation guidelines published by U.S. EPA or the Office of Environmental Health Hazard Assessment (OEHHA). U.S. EPA's evaluation guidelines for mercury tissue concentrations are based on 0.3 mg/kg, and OEHHA's fish contaminant goal is 0.22 mg/kg for protection of women aged 18 to 45 years and children aged 1 to 17 years.

The 2012 303(d) list for California includes 194 inland surface water, enclosed bay, and estuary segments that exceed existing objectives for mercury. However, it is not clear if the CTR objectives or the U.S. EPA and OEHHA fish tissue guidelines are used for assessing the impairment listings. **Exhibit 2-5** summarizes the number of water bodies impaired for mercury by region.

Exhibit Error! No text of specified style in document.**-5: Summary of California 2012 303(d) List of Mercury Impairments**

Regional Water Board	Estuaries, Bays, and Harbors		Lakes /Reservoirs		Rivers /Streams		Total Segments
	Segments	Acres	Segments	Acres	Segments	Miles	
North Coast (1)	0	0	9	26,545	4	1,072	13
San Francisco Bay (2)	16	325,272	16	6,496	4	49	36
Central Coast (3)	0	0	5	12,205	1	10	6
Los Angeles (4)	3	471	6	6,243	2	6	11
Central Valley (5)	8	43,614	47	235,456	53	1,323	108
Lahontan (6)	0	0	6	3,057	7	84	13
Colorado River Basin (7)	0	0	0	0	1	65	1
Santa Ana (8)	1	20	1	2,865	0	0	2
San Diego (9)	1	53	1	1,104	0	0	2
Total	29	369,430	91	293,972	72	2,608	181

Source: SWRCB (2015).
Note: Detail may not add to total due to rounding.

There are a number of different causes of mercury impairment, including resource extraction, nonpoint sources, atmospheric deposition, natural sources, and municipal and industrial point sources. **Exhibit 2-6** summarizes the potential sources of mercury impairments as listed on the 303(d) list (SWRCB, 2015). Note that some segments have multiple potential sources.

Exhibit Error! No text of specified style in document.**-6: Sources of Mercury Impairment of Inland Waters, Enclosed Bays, and Estuaries in California**

Potential Sources	Number of Water Body Segments
Atmospheric Deposition	5
Industrial Wastewater	6
Municipal Wastewater	4
Natural Sources	9

Exhibit Error! No text of specified style in document.-**6: Sources of Mercury Impairment of Inland Waters, Enclosed Bays, and Estuaries in California**

Potential Sources	Number of Water Body Segments
Resource Extraction	13
Source Unknown	181
Unspecified Nonpoint Source	6
Unspecified Point Source	3
Urban Runoff	2
Source: SWRCB (2015).	

Exhibit 2-7 provides a summary of mercury TMDLs for inland surface waters, enclosed bays, and estuaries throughout the state. As part of the TMDL development process, Regional Water Board staff can develop site-specific objectives that are adopted by the Regional Water Board in their Basin Plans, or establish numeric targets that are not adopted in Basin Plans. The summary indicates that several TMDLs already include U.S. EPA's methylmercury fish tissue criterion (0.3 mg/kg) or lower fish tissue concentrations as a numeric target for calculating wasteload allocations (WLAs).

Exhibit Error! No text of specified style in document.-7**: Summary of Mercury TMDLs in California**

TMDL	Numeric Basis for TMDL	Mercury Objective or Target
Region 2		
San Francisco Bay	Objective	0.2 mg/kg Hg, TL3 and TL4 fish (size specified for certain species) 0.03 mg/kg Hg, 3-5 cm fish 0.025 µg/L Hg (4-d average), marine and freshwater 2.1 µg/L Hg (1-hr average), marine 2.4 µg/L Hg (1-hr average), freshwater
Tomales Bay	Target	0.2 mg/kg MeHg, legal halibut (55 cm) 0.05 mg/kg MeHg, 5-15 cm TL3 fish
Walker Creek, Soulajule Reservoir, Guadalupe River[1]	Objective	0.1 mg/kg MeHg,15-35 cm TL3 fish 0.05 mg/kg MeHg, 5-15 cm TL3 fish
Region 3		
Hernandez Reservoir and Clear Creek	Target	0.050 µg/L total Hg 0.3 mg/kg MeHg, fish tissue
Lake Nacimiento and Las Tablas Creek (not approved by State Water Board or U.S.EPA)	Target	0.050 µg/L total Hg 0.486 mg/kg Hg, sediment
Region 4		

Exhibit Error! No text of specified style in document.-7**: Summary of Mercury TMDLs in California**

TMDL	Numeric Basis for TMDL	Mercury Objective or Target
LA Lakes TMDL: El Dorado Park Lakes, Puddingstone Reservoir and Lake Sherwood	Target	0.081 ng/L dissolved MeHg 0.22 mg/kg MeHg, 350 millimeters (mm) largemouth bass
Calleguas Creek Watershed Mugu Lagoon Metals	Target	0.050 µg/L total Hg 0.3 mg/kg MeHg, fish tissue 0.1 mg/kg MeHg, 15-35 cm TL3 fish 0.05 mg/kg MeHg, 5-15 cm TL3 fish 0.03 mg/kg MeHg, fish < 5 cm < 0.5 mg/kg Hg, bird eggs
Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxics	Target	0.050 µg/L total Hg 0.15 mg/kg Hg, sediment
Region 5		
Clear Lake	Objective	0.19 mg/kg MeHg, 30-40 cm TL4 fish (largemouth bass, catfish, brown bullhead; 20-30 cm crappie) 0.09 mg/kg MeHg, TL3 fish (< 30cm catfish; otherwise no size)
Cache Creek and Bear Creek	Objective	0.23 mg/kg MeHg, 25-35 cm TL4 fish 0.12 mg/kg MeHg, 25-35 cm TL3 fish
Harley Gulch	Objective	0.05 mg/kg MeHg, 7.5 -10 cm TL2 and TL3 fish
Sacramento-San Joaquin Delta & Yolo Bypass	Objective	0.24 mg/kg MeHg, 15-50 cm TL4 fish 0.08 mg/kg MeHg, 15-50 cm TL3 fish 0.03 mg/kg MeHg, fish <5 cm
Sulphur Creek	Objective	1,800 ng/L Hg (low flow) Suspended sediment ratio: 35 mg/kg Hg (high flow)
Region 8		
Toxic Pollutants San Diego Creek and Newport Bay	Target	0.13 ppm dry weight Hg, sediment 0.3 mg/kg MeHg, fish tissue

cm = centimeter
NA = not applicable
Hg = Inorganic mercury
MeHg = methylmercury
mm = millimeters
TL = trophic level
TMDL = total maximum daily load
1. Full water body description: Walker Creek, Soulajule Reservoir and tributaries, Guadalupe River Watershed, except Los Gatos Creek and its tributaries upstream of Vasona Dam, Lake Elsman, Lexington Reservoir, and Vasona Lake.

Implementation plans for these TMDLs outline the requirements by source to meet the TMDL allocations. For example, for the San Francisco Bay Mercury TMDL, municipal and industrial wastewater dischargers are covered under a watershed-based NPDES permit that establishes individual WLAs and effluent limits for each facility, and requires the dischargers to implement source control measures and process optimization to reduce mercury loads. However, based on current effluent concentrations and flows the dischargers are in compliance with the WLAs and mercury reductions are not needed. For watersheds with urban stormwater contributions, MS4 permits include mercury-specific source control or pollution prevention requirements. Other plans require additional studies to better characterize source contributions and mercury methylation. 0 provides detailed descriptions of TMDL implementation plans.

Description of Options

This section describes the November 2016 draft proposed Policy water quality objectives and implementation procedures as outlined in the draft proposed amendment to the SIP .

Water Quality Objectives

The proposed Policy would establish water quality objectives for mercury, as methylmercury concentrations in fish tissue, to protect human health and wildlife.

The water quality objectives that protect people who consume fish apply to waters with the following beneficial uses: commercial and sport fishing (COMM); tribal tradition and culture (CUL); tribal subsistence fishing (T-SUB); and subsistence fishing (SUB).

The water quality objectives that protect wildlife that consume fish apply to waters with the following beneficial uses: wildlife habitat (WILD); marine habitat (MAR); rare, threatened, or endangered species (RARE); warm freshwater habitat (WARM); cold freshwater habitat (COLD); estuarine habitat (EST); and inland saline water habitat (SAL).

Human Health

The State Water Board has proposed three water quality objectives based on the concentration of methylmercury in fish tissue protective of varying populations depending on fish consumption rates (**Exhibit 3-1**). .

Exhibit Error! No text of specified style in document.-**8: Fish Tissue Objective to Protect Human Health**

Water Quality Objective	Protected Beneficial Uses	Calendar Year Average Methylmercury Objective (mg/kg)
Sport Fish	COMM, CUL, WILD, MAR	0.2
Tribal Subsistence Fishing	T-SUB	0.04
Subsistence Fishing	SUB	Site-Specific
mg/kg = milligram per kilogram of fish tissue		

Wildlife

The State Water Board is considering additional mercury water quality objectives to protect threatened and endangered species and other wildlife, also as fish tissue concentrations of methylmercury. The California Least Tern Prey Fish Water Quality Objective would protect sensitive endangered species based on protection of the least tern, a particularly vulnerable species of bird that feeds exclusively on fish. The Prey Fish Water Quality Objective would protect other wildlife species. These objectives would apply to much smaller fish than those consumed by humans (**Exhibit Error**! No text of specified style in document.-**9**).

Exhibit Error! No text of specified style in document.-**9: Fish Tissue Objective to Protect Wildlife**

Water Quality Objective	Protected Beneficial Uses	Methylmercury Objective (mg/kg)

Exhibit Error! No text of specified style in document.-**9: Fish Tissue Objective to Protect Wildlife**

Water Quality Objective	Protected Beneficial Uses	Methylmercury Objective (mg/kg)
Prey Fish[1]	WILD, MAR	0.05[2]
California Least Tern Prey Fish[3]	WILD, MAR, RARE	0.03[4]

1. Objective does not apply to water body segments where the California Least Tern Prey Fish Water Quality Objective applies. Must only be assessed in waters that lack black bass or other trophic level 4 fish.
2. Methylmercury concentration in wet weight fish tissue in fish between 50 to 150 mm in total length during the breeding season.
3. Only applies to habitat of the California lest tern. 4. Average during the period April 1 through August 1. Applicable to wet weight concentration in whole fish less than 50 mm in total length.

Implementation Procedures

The State Water Board is considering adopting procedures for implementing the objectives, including general procedures for all inland surface waters, enclosed bays, and estuaries. The implementation options would not supersede the implementation plans of any existing mercury TMDL.

NPDES Wastewater

Wastewater point sources typically receive numeric WQBELs following a determination of RP. Under the proposed Policy, the fish tissue water quality objectives would be interpreted as water column concentration, as shown in **Exhibit 3-3**.

Exhibit Error! No text of specified style in document.-**10: Water Column Concentrations (C) Based on Beneficial Use and Water Body Type.**

Beneficial Use	Water Body Type	Total Mercury Water Column Target (ng/L)
COMM, WILD, RARE	Flowing water bodies (generally, rivers, creeks and streams)	12
COMM, WILD, RARE	Slow moving water bodies (generally, lagoons and marshes)	4
COMM, WILD, RARE	Lakes and reservoirs	Case-By-Case[1]
T-SUB	Flowing water bodies (generally, rivers, creeks and streams)	4
T-SUB	Slow moving water bodies (generally, lagoons and marshes)	1
SUB	Any	Case-By-Case[1]

1. The permitting authority shall calculate C from the water quality objective, and may use available data, including U.S. EPA national bioaccumulation factors and translators.

Currently, the SIP contains procedures for determining RP (see Section 0). Under the proposed policy, the SIP procedures for determining RP would be modified as follows:

Step 1: Replace Step 1 of the SIP with the following: Identify the applicable water column concentration (C) for the lowest (most stringent) mercury water quality objective applicable to the receiving water (denoted as C in the SIP).

Step 2: The proposed Policy makes no changes to Step 2 of the SIP.

Step 3: Replace Step 3 of the SIP with the following: Determine the mercury concentration for the effluent (denoted as MEC in the SIP) using the highest observed annual average effluent mercury concentration. The annual average shall be calculated as an arithmetic mean. For any sample reported as below the detection limit, one half of the detection limit shall be used to calculate the arithmetic mean. For any sample reported as below the quantitation limit and above the detection limit, the estimated concentration shall be used to calculate the arithmetic mean. The annual average concentration is used to account for the long-term nature of the methylmercury bioaccumulation process, which may not otherwise be reflected using the maximum concentration as required by the SIP.

Step 4: Apply as set forth in the SIP, but utilize the annual average mercury concentration from Step 3 (rather than an MEC) to compare to the C from Step 1.

Step 5: Apply as set forth in the SIP, but replace the determination of the "maximum" ambient background concentration for mercury (denoted as B in the SIP), with the highest observed annual average ambient background. The annual average shall be calculated as arithmetic mean as described in Step 3, above.

Once a permit writer determines RP, effluent limits would be set based on procedures at section 1.4 of the SIP with the following alterations:

Step 1: Use the same value for "C" as used for the Reasonable Potential Analysis, rather than the fish tissue mercury water quality objective

Step 2: Apply as set forth in the SIP, except the ambient background concentration (referred to as B in the SIP) shall be calculated as an arithmetic mean as described Step 3 of the RPA, above. Dilution shall be prohibited if the mercury concentrations in fish tissue in the receiving water exceed the mercury water quality objectives.

Steps 3 – 5: Steps 3-5 are inapplicable because the procedures account for short-term averaging periods (1 hour or 4 days) and the exceedance frequencies for aquatic life criteria to protect organisms from toxicity though water contact or ingestion.

Step 6: Set the effluent limitation as an annual average of total mercury (rather than a monthly average) equal to ECA (the same as C). Neither a monthly average effluent limitation nor a maximum daily average effluent limitation shall be calculated because methylmercury toxicity is the result of long term processes, and shorter duration total mercury concentrations may have little significance compared to the long term average.

Step 7: Step 7 is inapplicable because it relates to Steps 3-5.

Under the proposed Policy, the permitting authority is authorized to consider the following exceptions to the RPA and WQBEL calculation process:

1. Small Disadvantaged Communities. The permitting authority is authorized to exempt POTWs serving small disadvantaged communities[3] if the regulator makes a finding that the discharge will have no reasonable potential to cause or contribute to an exceedance of the mercury water quality objectives. For POTWs only serving small disadvantaged communities that do not have an effluent discharge prior to permit issuance or renewal that is representative of the quality of the proposed discharge, the permitting authority is authorized to make this determination and exempt the POTW only after the first year of effluent discharge.
2. Insignificant Discharges. The permitting authority is authorized to exempt certain insignificant dischargers[4] from some or all of the provisions if the permitting authority makes a finding that the discharge will have no reasonable potential to cause or contribute to an exceedance of the mercury water quality objectives.

Under the proposed Policy options, all dischargers are required to use U.S. EPA-approved method that has a quantitation limit lower than 0.5 ng/L for total mercury, and lower than 0.06 ng/L for methylmercury. In addition, NPDES-permitted dischargers are required to perform routine monitoring under the following conditions:

Dischargers with mercury effluent limitations that are authorized to discharge at a rate equal to or greater than five million gallons per day are required to conduct routine total mercury monitoring in the effluent at a frequency no less than once each calendar quarter for the duration of the permit.

Dischargers with mercury effluent limitations that are authorized to discharge at a rate less than five million gallons per day are required to conduct routine total mercury monitoring in the effluent at a frequency no less than once each year for the duration of the permit.

Dischargers without mercury effluent limitations are required to conduct total mercury monitoring in the effluent at a frequency of no less than once per permit cycle.

NPDES Stormwater

Under the proposal, implementation options for NPDES-permitted stormwater dischargers include different BMPs (**Exhibit 3-4**).

[3] Municipalities with populations of 20,000 persons or less, or a reasonably isolated and divisible segment of a larger municipality encompassing 20,000 persons or less, with an annual median household income that is less than 80 percent of the statewide annual median household income.

[4] NPDES discharges that are determined to be a very low threat to water quality by the permitting authority.

Exhibit Error! No text of specified style in document.-**11: Implementation Options for NPDES Stormwater Dischargers**

Applicability	Description
Phase I and Phase II MS4s	Pollution prevention measures; requirements for erosion and sediment controls
Industrial	Revise Numeric Action Level that trigger BMP requirements from 1,400 ng/L to 300 ng/L.
MS4s = municipal separate storm sewer systems	

Pollution prevention measures which may be implemented at Phase I and Phase II MS4s include the following:

Thermometer exchange programs and fluorescent lamp recycling programs, or enhancement of household hazardous waste collection programs to better address mercury-containing waste products (potentially including thermometers and other gauges, batteries, fluorescent and other lamps, switches, relays, sensors and thermostats).

Public education and outreach on disposal of household mercury-containing products and use of non-mercury containing alternatives.

Education of auto dismantlers on how to remove, store, and dispose of mercury switches in autos.

Survey of use, handling, and disposal of mercury-containing products used by the MS4 discharger agencies and development of a policy and time schedule for eliminating the use of mercury containing products by the discharger.

Wetlands

Under the proposed Policy options, the State and Regional Water Board staff may, at their discretion, require project applicants that establish or restore wetlands to include design features or management measures to reduce the production of methylmercury in the wetland, including minimizing the wetting and drying of soil by keeping the wetland flooded and sediment control measures to reduce the transport of total mercury or methylmercury out of the wetland, particularly in areas with elevated mercury concentrations, when adopting, re-issuing, or modifying a water quality certification or WDRs or waivers of WDRs.

Mine Site Remediation

Under the proposed Policy options, the State and Regional Water Board staff shall require implementation of erosion and sediment control measures to prevent or control mercury in discharges when adopting, re-issuing, or modifying WDRs or waivers of WDRs for dischargers subject to the requirements of Title 27 of the California Code of Regulations, section 22510 (closure and post-closure of mining sites), from land where mercury was mined or mercury was used during ore processing.

Non-Point Source Discharges

Under the proposed Policy options, the State and Regional Water Board staff may, at their discretion, require dischargers to implement erosion and sediment control measures in WDRs or waivers of WDRs, particularly in areas with elevated mercury concentrations.

Dredging Activities

Under the proposed Policy options, the State and Regional Water Board staff may, at their discretion, require dischargers to implement total mercury monitoring and procedures to control the disturbance and discharge of mercury-contaminated material during dredging and disposal of dredged material, particularly in areas with elevated mercury concentrations.

Estimated Compliance

This section contains an evaluation of attainment of the water quality objectives based on available discharge data and the potential impacts to dischargers of mercury.

Incrementally Impaired Waters

The proposed Policy does not contain procedures for determining impairments, and it is not clear how the current listing procedures would be applied to the proposed objectives. In addition, no information is available at this time regarding the identities of waters to be classified as T-SUB or SUB, as to be determined by the Regional Water Boards. In the absence of more complete available information, an analysis of incremental impairments was not feasible to complete.

Municipal and Industrial Wastewater

The proposed Policy will only have incremental impacts on municipal WWTPs that are not already covered under an approved TMDL (see **Exhibit** Error! No text of specified style in document.-7Exhibit 2-7) because these waters are exempt from the Policy. The incrementally affected dischargers would be regulated through the general statewide program implementation procedures.

The State Water Board has proposed a series of several fish tissue objectives protective of specific beneficial uses for varying types of water body types, as illustrated in **Exhibit** Error! No text of specified style in document.-**10Exhibit 3-3**. Under the proposed implementation procedures described in section 3, we assess RP, probably WQBELs, and likely compliance scenarios for affected population of municipal and industrial NPDES dischargers.

0 provides the detailed RP and proposed effluent limit compliance analyses for the population of affected NPDES dischargers subject to the proposed Policy. For the incrementally affected dischargers, we used data from California Integrated Water Quality System (CIWQS) database, as available, or the MEC as reported in the facility's permit for the RP and proposed limit compliance analyses. To develop MECs, individual samples for each facility reported from 2009 – 2015 were averaged, arithmetically, on a calendar year basis. In instances where effluent data was not available from CIWQS, the single-sample MEC reported in the plant's NPDES permit were used as the MEC. Use of the MEC from the most recent permit likely results in overestimating potential incremental impacts because actual annual average effluent concentrations on which compliance with effluent limits is likely to be based may be much lower than the reported MEC. Note that effluent data are not available for 66 municipals (29 majors and 37 minors) and 130 industrials (13 majors and 117 minors) from which to estimate compliance with the proposed Policy.

Exhibit Error! No text of specified style in document.-**12Exhibit 4-1** shows the number of municipal and industrial wastewater dischargers that would need to reduce effluent mercury concentrations for compliance with projected effluent limits under the proposed Policy options. Effluent data for minor dischargers are not as readily available as data for major dischargers. However, due to their low flows, they are less likely to have the potential to cause or contribute to exceedances of water quality standards. In many cases, they are also likely to fall under the exemptions for either (1) small disadvantaged communities, or (2) insignificant dischargers.

Exhibit Error! No text of specified style in document.**-12: Estimated Number of Municipal and Industrial Wastewater Dischargers Needing Incremental Reductions for Compliance with Projected Effluent Limits**[1]

Category	Type	Number of Affected Facilities
Municipal	Major	12
	Minor	1
Industrial	Major	6
	Minor	3
	Total	22

NPDES Stormwater

Implementation under the proposed Policy may vary for MS4s, Caltrans permittees, and industrial stormwater dischargers.

MS4s

Under the proposed Policy, the State Water Board and Regional Water Boards must include permit provisions requiring MS4s to implement erosion and sediment control measures for dischargers to waters subject to the proposed Policy. In addition, MS4's would be required to implement pollution prevention measures (e.g., thermometer exchange programs). Under the Policy, Phase I and Phase II MS4s would be required to implement a mercury source reduction program. While general pollution prevention and minimization is required under existing NPDES permits, programs specifically targeting mercury are not a baseline requirement unless an implementation plan for a TMDL requires one. As shown in **Exhibit** Error! No text of specified style in document.-**4Exhibit 2-4**, there are already six large MS4s with requirements to implement mercury source control programs. Thus, municipalities in the remaining 16 large MS4 permits (all of which discharge at least in part to inland surface waters, enclosed bays, and estuaries) may incur incremental costs associated with implementing a mercury source control program under the proposed Policy. However, these MS4s are likely to work in conjunction with the WWTPs incrementally affected by the Policy to implement a municipality-wide program applicable to all sources in the service area.

Caltrans

Under the proposed policy, only municipal and industrial stormwater permittees are subject to implementation requirements. Therefore, Caltrans is not expected to experience incremental impacts or incur incremental costs as a consequence of the proposed Policy.

Industrial Stormwater

The proposed Policy requires the revision of the Numeric Action Level for mercury, which triggers additional BMP controls, to be revised from 1,400 ng/L to 300 ng/L. As described in Section 0, existing NPDES permits require dischargers to identify sources of pollutants, and describe the means to manage the sources to reduce stormwater pollution. However, these control measures may not be sufficient to meet the revised Numeric Action Level for mercury and, therefore, those dischargers affected are likely to incur incremental costs in order to come into compliance with the proposed policy. Due to the site-specific nature of these controls, we are unable to develop specific cost estimates associated with the incremental control activities.

Abandoned Mines, Non-Point Sources, Dredging Activities, & Wetlands

The proposed Policy would not supersede implementation plans of any existing mercury TMDLs. However, the proposed Policy does require the implementation of sediment and erosion control measures for all dischargers subject to Title 27 of the California Code of Regulations, section 22510. In addition, the proposed Policy may result in the implementation of new erosions control measures for some non-point source dischargers, and the implementation of new wetland restoration and dredging management measures to minimize the production and release of methylmercury.

Due to limited available data and the site-specific nature of the control activities likely to occur at these sites, it is infeasible to estimate incremental costs attributable to the proposed Policy for these potentially affected populations. In many cases, existing requirements (e.g., existing sediment and erosion control practices at many abandoned mine sites) are expected to meet the requirements of the proposed Policy without the need to undertake additional control measures.

Compliance Methods and Costs

This section describes available methods for compliance with the objectives, and the costs of those methods.

Municipal Wastewater

For the municipal WWTPs that need to reduce annual average mercury concentrations for compliance with WQBELs under the proposed Policy, control methods could include:

- Develop and implement pollution prevention (P2) programs to minimize mercury in sewage
- Optimize existing processes to further reduce particle-bound total mercury (e.g., increasing retention in aeration tanks or primary and secondary clarifiers, change chemicals in coagulation to target mercury) or identify unknown sources of mercury (e.g., chlorination chemicals may contain trace amounts of mercury)
- Upgrade to tertiary treatment (e.g., multimedia filtration) to remove a greater percentage of particulate mercury.

In addition, a WWTP can increase effluent disposal to land. Although this strategy would not help in lowering concentrations to meet a concentration-based effluent limit, it would reduce total mercury loads to receiving waters by diverting them to land disposal.

Pollution Prevention

P2 or pollution minimization strategies focus on reducing the pollutant at the source where it is more concentrated and may be more easily controlled, rather than treating larger volumes of wastewater to remove diluted contaminants. Because of the cost-effectiveness of source controls, and the lack of cost effectiveness and demonstrated performance from end-of-pipe controls for pollutants like mercury, P2 is a key strategy for compliance with very low effluent limitations.

A number of municipal dischargers have developed P2 programs that provide a basis for estimating P2 components and costs. The costs to municipalities, industries, businesses, and households associated with a municipal P2 program for mercury vary based on the community size and makeup, the extent of P2 efforts already underway, and the knowledge and experience of the municipality in this area. Municipal dischargers would likely target dentists, hospitals, medical facilities, educational institutions (primarily universities and high schools), households, and industries to reduce mercury discharges to the treatment plant. Based on program reports and information from municipalities in California currently implementing mercury P2 programs, components are likely to include:

- Wastewater characterization – sampling and analysis of mercury and methylmercury concentrations to characterize pollutant levels at the facility and track treatment effectiveness
- Program development – for source identification, materials development, program implementation, and management

Conducting site visits/inspections and holding workshops

Hazardous waste collection programs and mercury-free product replacements

Advertising – to promote and inform the community of various activities and events taking place

Website development – to provide the community with additional resources and serve as another means of promoting P2 activities.

Exhibit 5-1 provides a summary of potential P2 program components and costs for large municipal dischargers that have already implemented such programs. Appendix C provides the details on the costs of each component.

Exhibit Error! No text of specified style in document.-**13: Mercury P2 Program Components and Potential Costs of Large WWTP (> 20 mgd)**

Component	Annual Cost ($2016)[1]
Wastewater Characterization	$12,000
Program Development/Operation	$129,000
Site Visits and Workshops	$62,000
Mercury-Free Products	$4,000
Advertising	$8,000
Website Development/Maintenance	$2,000
Total	$217,000

mgd = million gallons per day
P2 = pollution prevention program
WWTP = wastewater treatment plant
1. Costs reflect experiences of large communities. Costs for a number of components (e.g., program development; site visits and workshops) may be proportionately less for smaller communities.

With total potential costs for larger municipalities approximating $220,000 per year, costs for medium-sized municipal dischargers (e.g., 5 to 20 mgd) may be in the range of $170,000 annually, and for small municipal major dischargers (e.g., 1 to 5 mgd) in the range of $110,000 annually. Minor municipal dischargers serve much smaller areas and populations than major dischargers and have fewer mercury sources to target. Thus, cost may be substantially less (e.g., half) of that for small major WWTP, or in the range of $60,000 annually. Actual costs will vary with community makeup and other factors including the ability to adopt or reuse off the efforts of other municipalities.

Process Optimization

Process optimization entails adjusting existing treatment technologies to obtain additional pollutant removals. It would likely be another low-cost means for attaining compliance with mercury effluent limitations. This option would be most feasible where relatively low pollutant reductions are needed or monitoring data indicate that pollutant loads increase throughout the treatment process as a result of chemical additions or treatment techniques.

Process optimization usually involves process analysis and process modifications. Process analysis is an investigation of the performance-limiting factors of the treatment process and is a key factor in achieving optimum treatment efficiency. Performance-limiting factors for common wastewater treatment processes (e.g., sedimentation, activated sludge, filtration) may include operator training, response to changes in wastewater quality, maintenance activities, automation, and process control testing. The cost of process analysis includes the cost of additional or continuous monitoring throughout the treatment process, and a treatment performance evaluation. These costs vary based on the number of treatment processes analyzed and the magnitude of the reductions needed.

Process modifications include activities short of adding new treatment technology units (conventional or unconventional) to the treatment train. For increasing pollutant removal efficiencies, process modifications could include adjusting coagulant doses to increase settling, equalizing flow if pollutant concentrations spike during wet weather events, increasing filter maintenance activities or backwash cycle frequency, training operators, and installing automation equipment including necessary hardware and software. Several months of adjustments may be needed to achieve a desired level of process optimization. In practice, the process modifications necessary would be determined by the process analysis study.

Treatment processes vary widely among industrial facilities. Thus, identifying specific process modifications applicable or appropriate for any particular industrial discharger is site specific. Optimizing municipal wastewater treatment for mercury removal involves maximizing solids removal because secondary and tertiary treatment technologies primarily remove particulates. Operational changes that can be made to increase solids removal include (Metcalf and Eddy, 2003):

Check for short circuiting

Modify baffling

Addition of chemicals

Reduce return flows from other processes

Modify backwash frequency for tertiary filtration.

In addition to operational changes, plant managers can also upgrade physical facilities to improve treatment performance. For example, remedial actions to address inadequate solids removal could include (Metcalf and Eddy, 2003):

Addition of chemical treatment and flocculation

Addition of high-rate clarification

Install baffles at effluent weirs

Addition of energy dissipation inlet

Modify flow distribution

Modify circular clarifier center feedwell (secondary clarifiers)

Add tube or plate settlers to secondary clarifiers

Modify effluent weir configuration

Addition of flow equalization to prevent solids washout in biological treatment or overloads.

In addition, chemicals used in wastewater treatment could contain contaminants (e.g., chlorine contaminated with low levels of mercury). Thus, switching chemicals or the source of chemicals could be another low-cost process optimization control option.

The effectiveness of process optimization largely depends on the efficiency of current operations, the existing treatment processes, and the fate and transport of the pollutant through the treatment train. For example, if a facility is already well maintained and operated, process optimization may not result in additional pollutant reductions because the existing treatment processes are already performing at their feasible limits. Also, because most conventional treatment technologies are designed to maximize removal of suspended solids, process optimization aimed at increasing those removal efficiencies may not result in significant reductions for pollutants existing primarily in dissolved form. Given the available information for the affected facilities, it is generally not possible to determine the reductions achievable with process optimization; rather, a detailed, site-specific study would be necessary.

Tertiary Treatment

In California, a number of WWTPs have installed tertiary treatment processes to comply with other NPDES requirements such as Title 22 regulations (for reuse) or numeric limits for pollutants such as ammonia. Thus, the State Water Board already considers these controls to be feasible for most treatment plants. While not typically designed to specifically remove mercury, tertiary treatment can achieve relatively low levels of mercury in the effluent because mercury is most commonly attached to particulate matter, and technologies such as filtration maximize removal of suspended solids.

For California, data from the CIWQS database provide some indication of achievable effluent concentrations from municipal dischargers using secondary versus tertiary treatment. Treatment levels are indicated in facility NPDES permits. We included dischargers with effluent data reported from 2009 through 2015 and excluded dischargers for which all values are non-detect above 200 ng/L because they are not using clean analytical methods; other non-detect values are included at the reported detection limit. Tertiary treatment consists solely of filtration; none of the facilities employ treatment technologies such as reverse osmosis or ion exchange.

When compared to the potential aqueous mercury targets, approximately 70% of secondary treatment plants have average discharge concentrations that would comply with the target of 12 ng/L. For tertiary treatment plants, approximately 70% are discharging less than the aqueous target of 4 ng/L total mercury, on average. However, only approximately 20% of tertiary treatment plants are discharging below the lowest aqueous target of 1 ng/L. **Exhibit 5-2** summarizes these results.

Exhibit Error! No text of specified style in document.-**14: Percent of Dischargers with Average Annual Mercury Concentrations Below Specified Level**

Treatment Level	No. with Sufficient Data	Aqueous Mercury Targets		
		<12 ng/L	<4 ng/L	<1 ng/L
Secondary	44	68%	50%	16%
Tertiary	59	83%	69%	20%
ng/L = nanograms per liter				

As shown in Appendix B, all municipal and industrial point source dischargers with readily available effluent mercury data are anticipated to be associated with the 12 ng/L water column concentration target. However, among the rest of the affected population, it is uncertain which specific dischargers may be assigned more stringent water column concentration targets. Consequently, incremental control costs under the proposed Policy were estimated on the basis of meeting the 12 ng/L water column target for flowing waters. As discussed below, it is anticipated that permittees which must meet more stringent targets, may feasibly do so through a combination of mercury P2 programs and tertiary treatment technologies. Since we assume similar control strategies for both the 12 ng/L target and the 4 ng/L target, incremental control costs for P2 programs and for end-of-pipe treatment (i.e., tertiary filtration) are expected to be very similar on a unit cost basis.

A detailed study of the fate and transport of mercury at the San Jose/Santa Clara Water Pollution Control Plant (WPCP) showed that total average mercury concentrations after primary treatment were 87.6 ng/L (SJSC WPCP, 2007). The secondary treatment (i.e., activated sludge with nitrification) processes further reduced the average total mercury concentrations by 94% to 5.2 ng/L (SJSC WPCP, 2007). The subsequent tertiary filtration process reduced total mercury from 5.0 ng/L to 2.2 ng/L (an additional 56% reduction) (SJSC WPCP, 2007). Note that this facility also has a mercury P2 program already in place, and is likely operating optimally.

Given these data, we assumed that most municipal WWTPs operating secondary treatment could upgrade to tertiary treatment and achieve effluent mercury concentrations of 4 ng/L or less. However, WWTPs that need reductions to meet limits corresponding to lower values, such as those derived from the tribal subsistence objective (1 ng/L), may not be able to do so with tertiary treatment. Due to limited available information on the permittees likely to be subject to this target, this analysis does not estimate costs for complying with the 1 ng/L target. The State Water Board or Regional Water Boards may use compliance schedules, site-specific objectives (with extended compliance schedules), TMDLs, or variances if the effluent limitation is unachievable. In cases where variances are adopted, it is anticipated that Regional Water Boards would require the implementation of source control measures and tertiary treatment as a condition of the variance.

Paranjape et. al (2010) estimated costs for various types of tertiary filtration for the Westside Regional WWTP in Florida. Similar to California, a number of WWTPs in Florida need tertiary filtration to meet the treatment standards for wastewater reuse. We calculated unit costs by dividing the total estimated capital and operation and maintenance (O&M) costs by the applicable flows, and escalated to 2013 dollars using the Engineering New Record (ENR) Construction Cost Index (CCI). **Exhibit 5-3** shows the unit costs for various types of tertiary filters.

Exhibit Error! No text of specified style in document.-**15: Estimated Capital and O&M Unit Cost for Tertiary Filtration ($2016)**

Filtration Technology	Peak Loading Rates (gpm/ft2)	Power Consumption (kW-hr/year)	Land Required (ft2)	Capital Unit Cost ($2016/gpd)[1]	O&M Unit Cost ($2016/MG)[2]
Deep bed granular media filters	5 - 8	66,000	12,900	$1.07	$50.18
Cloth media filters	6.5	20,000 - 30,000	4,200 - 19,000	$1.20	$59.46
High-rate disk filters	16	260,000	1,800	$0.89	$70.19
Compressible synthetic media filters	30	997,000	3,500	$1.41	$78.61

Source: Based on information in Paranjape, et al. (2010).
ft2 = square feet
gpd = gallons per day
gpm = gallons per minute
kW-hr = kilowatt hour
MG = million gallons treated
O&M = operation & maintenance
1. Includes installation (10%-25% of equipment), concrete ($650/yd3), building ($125/ft2), project contingency (10%-30%), contractor general conditions, overhead and profit, sales tax, escalation, engineering and administration. Excludes potential costs of purchasing additional land. Unit costs derived by dividing total capital cost by the facility design flow of 15 mgd, and escalating to 2016 dollars using the ENR CCI.
2. Includes energy ($0.065 kW-hr), labor ($25/hr), and media replacement (total replacement cost divided by 20 years). Unit costs derived by dividing total O&M costs by the facility average daily flow of 7.1 mgd and 365 days per year.

Based on these data, average capital unit costs could be approximately $1.14 per gallon per day, and O&M costs could be approximately $65 per million gallons treated.

Routine and Compliance Monitoring

Under the proposed Policy, prescriptive monitoring frequencies have been proposed for routine monitoring and for compliance monitoring when an effluent limitation has been established. In addition, there is a strong incentive for permittees to utilize clean-hands sampling techniques and analytical methods with low detection limits since, under the proposed policy, RP may be determined on the basis of low sensitivity analytical methods in the absence of a detection in the effluent. Since compliance and RP is determined on the basis of an annual average and not on individual sampling events, there is an additional incentive to sample more frequently in order to minimize the effect of occasional high sample values.

Therefore, we have developed estimated costs for performing total mercury monitoring which assumes the use of sensitive methods and a high test frequency (i.e., once per quarter) for all potentially affected NPDES permittees. **Exhibit 5-4** illustrates the estimated costs anticipated under these assumptions.

Exhibit Error! No text of specified style in document.-**16: Estimated Annual Total Mercury Effluent Monitoring Costs**

Discharger Type	No. of Potentially Affected Dischargers	Annual Monitoring Cost[1, 2]
Municipal Majors	95	$174,000
Municipal Minors	62	$114, 00
Industrial Majors	23	$42,000
Industrial Minors	128	$235,000
Total	**308**	**$565,000**

Source: Based on information in proposed Policy Staff Report (Appendix P)
1. Costs do not account for baseline monitoring requirements in NPDES permits and, thus, are likely to be substantial overestimates of potential costs.
2. Costs are rounded. Total results may not sum to those presented due to rounding.

Industrial Wastewater

For the industrial dischargers that need to reduce annual average mercury concentrations for compliance with WQBELs under the proposed Policy, control methods could include:

Develop and implement P2 programs to minimize mercury within industrial processes

Install end-of-pipe treatment (e.g., multimedia filtration) to remove a greater percentage of mercury.

In addition, as with municipal WWTPs, effluent disposal to land helps reduce total mercury loads, but not concentrations, unless the entire discharge to surface waters is eliminated.

Pollution Prevention

There is little information available on the cost of mercury P2 programs for industrial dischargers because facility budgets typically do not account for pollutant-specific P2 costs as an item that can be verified apart from other source control costs. For example, one industrial discharger spends between $5 and $6 million a year on waste minimization and P2 activities for a variety of pollutants and media (e.g., air, water, solid wastes), but only a small portion of that is related to mercury (Barrett, 2005). In addition, P2 activities for industrial dischargers vary greatly based on facility type, volume of wastewater discharged, existing wastewater treatment processes (if any), and the manufacturing processes and chemicals potentially responsible for mercury loads.

For example, a discharger that uses chlorine for disinfection or to prevent scaling may find that the type of chlorine used is contaminated with mercury. Reducing effluent mercury concentrations could be as simple as switching to mercury-free chlorine. However, the identification of sources and solutions may not be as straightforward at another type of industrial facility, especially those with multiple internal waste streams and industrial processes. Despite these differences though, industrial facilities will likely implement the basic components of a P2 program, including process analysis and process modifications.

During process analysis the discharger would identify pollutant uses and quantities within the facility (i.e., inventory facility), identify pollutant use and potential contamination in process streams, and identify P2 options for reducing the pollutant at the plant (e.g., on-going management of pollutants, recycling, and product and raw material substitutions). After the process analysis step, the discharger would need to implement the identified P2 options and make any necessary process modifications.

Assuming a two-month (approximately 340 hours) study to identify potential pollutant sources and sample process waste streams, and the average hourly wage in California for an environmental engineer [$49.03 per hour, including employer benefits (BLS, 2016; 2014b)], study costs may be approximately $25,000 (340 × $49.03; rounded up to $25,000).[5]

We assumed that industrial wastewater dischargers would monitor mercury and methylmercury in the influent (or internal waste stream, depending on the set up) and effluent, as discussed above for municipal wastewater dischargers. Costs for these analyses could be approximately $985 per event, or $12,000 for monthly samples over a year. Thus, total process analysis for industrial facilities would be approximately $37,000 ($25,000 + $12,000).

Process analysis costs will likely only be incurred during the first year. However, because process modifications are highly site-specific, we assumed that facilities would continue to incur the process analysis cost of $37,000 per year to monitor and evaluate any process modifications such as replacing mercury-containing equipment at the end of its useful life, product substitution, switching chemical manufacturers, or installing treatment on internal waste stream where mercury is most concentrated.

End-of-Pipe Treatment

There are a number of end-of-pipe treatment technologies that could remove mercury from industrial wastewaters. The selection of specific technologies would be facility- and process-specific. Given the performance data for tertiary filtration for municipal WWTP, we assumed that filtration would also be an effective option for industrial wastewaters as well. A detailed facility-level analysis would be needed to identify the variety of treatment controls applicable to the incrementally affected industrial dischargers in California. For example, if a facility is

[5] BLS (2013) describes an environmental engineer (standard occupations classification 17-2081) as one that can "design, plan, or perform engineering duties in the prevention, control, and remediation of environmental health hazards utilizing various engineering disciplines" and "work may include waste treatment, site remediation, or pollution control technology."

primarily discharging dissolved mercury and not particulate mercury, media filtration is not likely to have much impact on effluent concentrations; controls such as reverse osmosis may be necessary to target the dissolved fraction of mercury in the effluent.

Of the affected population with available data, no permittees are expected to be subject to the 4 ng/L target. Instead, all will likely be required to comply with the 12 ng/L target. However, we anticipate that some number of dischargers lacking available data for this analysis discharging to wetlands or marshes may be subject to the 4 ng/L target. Those permittees subject to the 4 ng/L target and unable to immediately comply would most likely adopt end-of-pipe filtration treatment in order to comply with mercury effluent limitations.

Due to limited available information on the permittees likely to be subject to the 1 ng/L target, this analysis does not estimate costs for complying with the 1 ng/L target. The State Water Board or Regional Water Boards may use compliance schedules, site-specific objectives (with extended compliance schedules), TMDLs, or variances if the effluent limitation is unachievable. In cases where variances are adopted, it is anticipated that Regional Water Boards would require the implementation of source control measures and tertiary treatment as a condition of the variance.

Costs for filtration for industrial wastewater could be similar to those presented in **Exhibit 5-3**.

NPDES Stormwater

Under the Policy, Phase I and Phase II MS4s would be required to implement a mercury source reduction program. While general pollution prevention and minimization is required under existing NPDES permits, programs specifically targeting mercury are not a baseline requirement unless an implementation plan for a TMDL requires one. As shown in Exhibit **2-4**, there are already six large MS4s with requirements to implement mercury source control programs. Thus, municipalities in the remaining 16 large MS4 permits (all of which discharge at least in part to inland surface waters, enclosed bays, and estuaries) may incur incremental costs associated with implementing a mercury source control program under the proposed Policy. However, these MS4s are likely to work in conjunction with the WWTPs incrementally affected by the Policy to implement a municipality-wide program applicable to all sources in the service area. Therefore, these costs are similar to the municipal point source costs discussed above.

If the Phase I and Phase II MS4s were to required to augment their existing pollution prevention programs we would expect them to incur costs at approximately 30 percent the rate of similar WWTP implementing a *de novo* P2 program—or approximately $66,000 per large MS4 and $18,000 for a small MS4. However, this likely represents a substantial overestimate since the actual number of Phase II MS4s with existing mercury control programs are unknown and the Phase I activities are likely to duplicative of similar efforts at large WWTPs. In addition, there may already be controls required under an existing NPDES permit for stormwater dischargers that have not yet been implemented that would also reduce mercury loads; this could negate the need for enhanced controls under the proposed Policy.

Statewide Costs

This section provides descriptions of the methods we used to estimate incremental statewide costs associated with the proposed Policy options and results.

Municipal Wastewater

To estimate total statewide incremental compliance costs, we used the following decision matrix based on the type of existing treatment train currently operating at each WWTP (**Exhibit 6-1**).

Exhibit Error! No text of specified style in document.-**17: Potential Controls Needed for Compliance with Proposed WQBELs for Municipal WWTPs**

Existing Treatment Level	Controls Needed[1]	
	Max. Annual Average < WQBEL	Max Annual Average > WQBEL
Secondary	None	Filtration[2]
Tertiary	None	P2 or Process Optimization[2]

P2 = pollution prevention program
WQBEL = water quality based effluent limit
WWTP = wastewater treatment plant
1. We compared the maximum annual average mercury concentration to the proposed WQBEL to determine compliance. If annual average data were not available, we used the MEC in the discharger's National Pollutant Discharge Elimination System (NPDES) permit.
2. For dischargers that need to meet effluent limits of 1 ng/L, the State Water Board or Regional Water Boards may use compliance schedules, site-specific objectives (with extended compliance schedules), TMDLs, or variances if the effluent limitation is unachievable. In cases where variances are adopted, it is anticipated that Regional Water Boards would require the implementation of source control measures and tertiary treatment as a condition of the variance..

For existing tertiary treatment plants, process optimization costs are highly facility-specific, and we do not have the necessary data to estimate such costs. However, the annual costs are likely much less than the cost of installing filtration. Thus, in the absence of process optimization costs we used annual P2 program implementation costs for tertiary WWTPs needing reductions to comply with WQBELs under the proposed Policy.

We estimated the annual incremental compliance costs under the proposed Policy to be approximately $2.99 million per year in total ($2,816,000 per for majors, and $174,000 per year for minors) for municipal plants. These costs are included in the costs summarized for the Policy in Exhibit 6-2 and Exhibit 6-3. Beneficial uses associated with the most stringent water column target (1 ng/L) have not been assessed. For plants discharging to waters with T-SUB or SUB beneficial, we estimate that those dischargers would install tertiary filters at unit capital costs of $1.14/gpd and unit O&M costs of $64.61/million gallon, and would be likely to pursue a variance. These costs would be in addition to the costs summarized for the Policy in Exhibit 6-2 and Exhibit 6-3. 0 shows the detailed estimated cost for each discharger needing reductions under the proposed Policy.

Industrial Wastewater

For industrial facilities, we estimated a range of potential incremental costs based on dischargers either implementing P2 programs (low cost estimate) or installing media filtration end-of-pipe (high cost estimate). Detailed data on existing treatment trains, industrial process operations, chemical usage, potential for product substitutions, and the form of mercury in effluents would be necessary for facility-specific estimates. **Exhibit Error**! No text of specified style in document.-**18** summarizes the costs for industrial dischargers with data indicating a need for reductions to comply with proposed WQBELs.

Exhibit Error! No text of specified style in document.-**18: Estimated Total Annual Incremental Compliance Cost for Industrial Dischargers ($2016 million per year)1**

Industrial Facility Type	Incremental Cost Range ($millions/year)
Majors	$0.23 - $2.7
Minors	$0.35 - $4.4
Total	$0.57 - $7.0
1. Range of costs based on dischargers implementing P2/source control programs (low cost) or filtration (high cost), and monitoring.	

MS4 Stormwater

If Phase I and Phase II MS4s were required to augment their existing pollution prevention programs we would expect them to incur costs at approximately 30 percent the rate of similar WWTP implementing a *de novo* P2 program—or approximately $66,000 per large MS4 and $18,000 for a small MS4. Assuming all Phase II MS4s and those large MS4s without existing mercury P2 programs incurred these costs, the expected incremental compliance cost is approximately $5.3 million per year. However, this likely represents a substantial overestimate since the actual number of Phase II MS4s with existing mercury control programs are unknown and the Phase I activities are likely to duplicative of similar efforts at large WWTPs. In addition, there may already be controls required under an existing NPDES permit for stormwater dischargers that have not yet been implemented that would also reduce mercury loads; this could negate the need for enhanced controls under the proposed Policy.

Total Incremental Costs

Exhibit 6-3 summarizes the total estimated annual incremental costs statewide. We were not able to quantify costs to stormwater dischargers, abandoned mines, dredging, wetlands, and other nonpoint sources due to data limitations.

Exhibit Error! No text of specified style in document.-**19: Estimated Total Annual Incremental Compliance Cost under Proposed Policy Options ($2016 per year)**[1]

Category	Type	Annual Incremental Cost ($millions)
Municipal	Major	$2.82
	Minor	$0.17
	Sub-total	$2.99
Industrial	Major	$0.23 - $2.7
	Minor	$0.35 - $4.4
	Sub-Total	$0.57 - $7.0
MS4s		$5.3
Total		**$8.86 - $15.3**
1. All costs presented in 2016$ and annualized based on a 5% interest rate and 20 year expected project life.		

Limitations and Uncertainties

There are a number of uncertainties and limitations associated with the data and methods we used to estimate the potential incremental costs of the proposed Policy. **Exhibit 6-4** provides a summary of these uncertainties and the potential impact on the cost estimates.

Exhibit Error! No text of specified style in document.-**20: Summary of Limitations and Uncertainties of the Analysis**

Assumption/Uncertainty	Potential Impact on Costs	Explanation
Compared the MEC as reported in the NPDES permit to the proposed WQBEL to determine potential reductions needed when effluent data are not available to calculate an annual average concentration,.	+	A single maximum concentration likely overestimates the long-term or annual average concentration on which compliance with effluent limits is likely to be measured.
Unable to assign newly developed beneficial uses to waterbodies.	-	Insufficient information was available to anticipate where newly developed beneficial uses will be assigned to waterbodies or to develop site-specific water column targets. These beneficial uses will likely be associated with lower water column targets than existing beneficial uses.

Exhibit Error! No text of specified style in document.-**20: Summary of Limitations and Uncertainties of the Analysis**

Assumption/Uncertainty	Potential Impact on Costs	Explanation
Unable to assign cost based on slow moving water bodies.	-	At this time, insufficient information exists regarding which waterbodies will be assigned a "slow moving" status by Regional Water Boards. Costs for complying with the 12 ng/L target and 4 ng/L target are approximately similar. Among permittees subject to the 4 ng/L target, costs are expected to increase for those permittees already complying with the 12 ng/L target but who are unable to comply with the lower 4 ng/L target.
Did not consider background in assessing reasonable potential due to limited availability of data.	-	Had complete background datasets been available, additional permittees may have received effluent limitations in the analysis.
Assumed greater frequencies for routine monitoring than required under the proposed policy, and did not account for baseline monitoring requirements in existing NPDES permits.	+	Many dischargers currently incur monitoring costs in their existing NPDES permits which are not attributable to the proposed Policy. In addition, some dischargers may not utilize greater than required monitoring frequencies even when doing so may be in their interest.
For industrial dischargers, estimated costs based on implementation of either P2/source control programs or filtration.	?	The selection of technologies would be facility- and process-specific. Detailed data on existing treatment, industrial operations, chemical usage, potential for product substitutions, and the form of mercury in effluents would be necessary for facility-specific estimates
Based urban stormwater, - and industrial stormwater unit costs on a range of potential BMPs.	?	The mix of stormwater controls that would be needed for compliance is site-specific. The incremental level of control needed also depends on existing permit requirements and level of existing BMP implementation.
Prevalence of existing pollution prevention programs at MS4s	+	Due to a lack of site-specific data, estimates are likely a substantial overestimate.
Did not estimate the incremental cost associated with the shift in abandoned mine clean-ups.	?	Lack of sufficient data for the location of abandoned mines from which to identify those potentially affecting impaired waters.
Unable to estimate cost associated with dredging, wetlands, and other nonpoint sources.	?	Lack of sufficient data on the number of sites where requirements might increase costs.

Exhibit Error! No text of specified style in document.-**20: Summary of Limitations and Uncertainties of the Analysis**

Assumption/Uncertainty	Potential Impact on Costs	Explanation
Key: "+" = potential costs likely overestimated "-" = potential costs likely underestimated "?" = impact on cost unknown		

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TMDL Implementation Plans

Exhibit A-1: Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
San Francisco Bay (SFBRWQCB, 2006)		
Bed erosion	220 kg Hg/yr (53% reduction)	None identified
Central Valley watershed	330 kg Hg/yr (24% reduction)	See Delta TMDL for details
Urban stormwater	82 kg Hg/yr (48% reduction)	Monitor MeHg levels and implement source control under watershed permit for large MS4s
Guadalupe River watershed	2 kg Hg/yr (98% reduction)	See Guadalupe River TMDL for details
Atmospheric deposition	27 kg Hg/yr (current)	No mandated actions
Nonurban stormwater	25 kg Hg/yr (current)	None identified
Municipal wastewater	11 kg Hg/yr (35% reduction)	Comply with watershed permit (e.g., implement source control and process optimization)
Industrial wastewater	1.3 kg Hg/yr (current)	Comply with watershed permit (e.g., implement source control and process optimization)
Guadalupe River Watershed (SFBRWQCB, 2008a; 2014)		
Mining waste	0.2 mg Hg/kg (dry wt., median) in erodible waste and erodible sediment from depositional areas in creeks that drain mercury mines	Identify potential for mining waste runoff and implement erosion controls
Impoundments	1.5 ng MeHg/L in the hypolimnion of impoundments downstream of mercury mines	Conduct studies on the suppression of mercury methylation in impoundments
Urban stormwater	0.2 mg Hg/kg suspended sediment (dry wt., annual median)	Covered under San Francisco Bay watershed permit for MS4s
Nonurban stormwater	0.1 mg Hg/kg suspended sediment (dry wt., annual median)	None
Atmospheric deposition	23.2 µg Hg/sm/yr	No mandated actions
Walker Creek (SFBRWQCB, 2008b)		
Background (areas not near Gambonini Mine)	0.2 mg Hg/kg (sediments)	None

Exhibit A-1: Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Downstream depositional areas	0.5 mg Hg/kg in suspended particulates (d/s of creekside lands adjacent to Arroyo Sausal, Salmon and Walker creeks)	Dischargers under WDRs or waivers of WDRs to control pathogens, nutrients, or sediments or Section 401 projects must incorporate management practices or provisions that minimize Hg discharges and MeHg production. Comply with conditions of Marin County's Creek Permit Program Update Marin County's Creek Permit Guidance for Unincorporated Areas of Marin to include specific guidance for projects in areas that may contain Hg-enriched sediments
Soulajule Reservoir	0.04 ng dissolved MeHg/L	Submit a monitoring and implementation plan and schedule to characterize fish tissue, water, and suspended sediment Hg concentrations, and develop and implement MeHg production controls necessary to achieve TMDL targets
Gambonini Mine	5 mg Hg/kg suspended sediments	Apply for coverage under the state's Industrial Stormwater General Permit Submit to the Water Board for approval a SWPPP, implementation schedule, and monitoring plan
Clear Creek and Hernandez Reservoir (CCRWQCB, 2004)		
Clear Creek	236 g Hg/yr	Removal and/or entombment of mining wastes Capping of residual material with clean soil Revegetation of disturbed areas
Hernandez Reservoir	1015 g Hg/yr	Load reductions in Clear Creek are expected to reduce loads in Hernandez Reservoir to meet allocations
Las Tablas Creek and Lake Nacimiento (CCRWQCB, 2002)		
General soils	7.67 kg Hg/yr (current loads)	None
Roads	0 kg Hg/yr (100% reduction)	San Luis Obispo County will pave road segment of Cypress Mountain road or will conduct equivalent actions to eliminate mercury runoff
Mines	4.52 kg Hg/yr (88.2% reduction)	Owner of mines must apply for new NPDES permit or WDR that will include specific permit conditions to limit the sediment and mercury load runoff from the properties. Options may change if Buena Vista Mine is added to National Priorities List
Cache Creek (CVRWQCB, 2004a; 2004b; 2005)		

Exhibit A-1: Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Mines	Bear Creek: 5% of existing Hg loads (Rathburn, Petray North and South, and Rathburn-Petray) Harley Gulch: 5% of existing Hg loads (Abbott and Turkey Run) Sulphur Creek: 30% of existing Hg loads (geothermal springs, soil erosion, mines, streambeds, and atmospheric deposition) Cache Creek at Yolo: 66 g MeHg/yr (46% reduction) Settling Basin: 34.7 g MeHg/yr (60% reduction) Bear Creek at gauge: 3.2 g MeHg/yr (85% reduction)	Public outreach regarding the levels of safe fish consumption and monitoring; Remediation of inactive mines; Control of erosion in mercury-enriched upland areas and in floodplains downstream of the mines and in the lower watershed; Conducting feasibility studies and evaluating possible remediation at the Harley Gulch delta; Identifying sites and projects to remediate or remove floodplain sediments containing mercury and implement feasible projects; Addressing methylmercury reductions through studies of sources and possible controls in Bear Creek and Anderson Marsh, controlling inputs from new impoundments, wetlands restoration projects, or geothermal spring development
Clear Lake (CVRWQCB, 2002a; 2002b)		
Atmospheric Deposition	2 kg Hg/yr (max load estimated)	None
Tributaries and Surface Water Runoff	90% of existing Hg input (about 16 kg Hg/yr)	Reduce transport of contaminated sediments from Oaks Arm into the rest of lake
Sulphur Bank Mine	Active sediment Hg contribution reduced by 49% (about 340 kg Hg/yr)	Control and possible treatment of surface water runoff from mine; Control of groundwater flow into Clear Lake from mine; Capping of waste rock mine dam; Eliminating contributions to surficial sediment layer previously deposited due to mine related processes (e.g., dredge contaminated sediment, cap with clean sediments, or natural burial of contaminated sediments)
Delta Waterways (CVRWQCB, 2008)		

Exhibit A-1: Allocations and Implementation Plans for Mercury TMDLs

Source	Allocations	Implementation Plan
Delta Waterways	Central Delta: 668 g/yr MeHg (current load) Marsh Creek: 1.6 g/yr MeHg (73% reduction) Mokelumne/Cosumnes Rivers: 53 g/yr MeHg (64% reduction) Sacramento River: 1,385 g/yr MeHg (44% reduction) San Joaquin River: 195 g/yr MeHg (63% reduction) West Delta: 330 g/yr MeHg (current load) Yolo Bypass: 235 g/yr MeHg (78% reduction)[1]	Reduce MeHg discharges to Delta and Yolo Bypass from existing MeHg sources, including the Cache Creek Settling Basin Reduce Hg discharges to comply with MeHg allocations and the San Francisco Bay TMDL Hg allocation, with particular focus on nonpoint sources in the tributary watersheds that discharge the most Hg-contaminated sediment to the Delta and Yolo Bypass
Rhine Channel (U.S. EPA Region 9, 2002; Anchor Environmental, 2005)		
Stormwater	0.0171 kg Hg/yr	None specified
Caltrans	0.0027 k Hg/yr	None specified
Boatyards	0 kg Hg/yr	None specified
Other NPDES	0.0027 kg Hg/yr	None specified
Existing sediment	0.063 kg Hg/yr	Dredge sediment and dewater prior to transporting to an approved off-site upland disposal facility; or Dredge sediment and place within an off-site nearshore confined disposal facility; or Dredge sediment and dispose of within a confined aquatic disposal area excavated near channel mouth
Undefined sources	0.0045 kg Hg	None specified

Hg = Inorganic mercury
MeHg = Methylmercury
MS4 = Municipal Separate Storm Sewer System
TMDL = Total maximum daily load
WDR = Waste Discharge Requirements
1. Sources include sediment flux, NPDES dischargers, agricultural drainage, and urban runoff.

Municipal and Industrial Discharger Estimated Compliance

The exhibits below show the analyses for each of the criteria and implementation options based on numeric WQBELs for those dischargers with effluent mercury data.

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
Municipal Dischargers									
CA0004995	Corning WWTP	Tehama	Major	Flowing Waterbody	12	3.12	N	--	--
CA0022713	Arcata City WWTF	Humboldt	Major	Flowing Waterbody	12	2.88	N	--	--
CA0022888	Ukiah City WWTP	Mendocino	Major	Flowing Waterbody	12	2.50	N	--	--
CA0022977*	**Cloverdale City WWTP**	**Sonoma**	**Major**	**Flowing Waterbody**	**12**	**27.00**	**Y**	**12**	**Y**
CA0023345*	**Windsor Town WWTP**	**Sonoma**	**Major**	**Flowing Waterbody**	**12**	**26.00**	**Y**	**12**	**Y**
CA0025135*	**Healdsburg City WWTP**	**Sonoma**	**Major**	**Flowing Waterbody**	**12**	**200**	**Y**	**12**	**Y**
CA0037788	Burlingame WWTP	San Mateo	Major	Flowing Waterbody	12	3.81	N	--	--
CA0038776	Calera Creek Water Recycling Plant	San Mateo	Major	Flowing Waterbody	12	1.40	N	--	--
CA0049224	**San Luis Obispo WWTP**	**San Luis Obispo**	**Major**	**Flowing Waterbody**	**12**	**20.00**	**Y**	**12**	**Y**

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
CA0053619	Pomona WRP	Los Angeles	Major	Flowing Waterbody	12	1.93	N	--	--
CA0053651*	**Ventura WRF**	**Ventura**	**Major**	**Flowing Waterbody**	**12**	**20**	**Y**	**12**	**Y**
CA0053856	Terminal Island WRP	Los Angeles	Major	Flowing Waterbody	12	10.30	N	--	--
CA0053911	San Jose Creek WRP	Los Angeles	Major	Flowing Waterbody	12	1.51	N	--	--
CA0053961	Ojai Valley WWTP	Ventura	Major	Flowing Waterbody	12	0.75	N	--	--
CA0054011	Los Coyotes WRP	Los Angeles	Major	Flowing Waterbody	12	1.55	N	--	--
CA0054119	Long Beach WRP	Los Angeles	Major	Flowing Waterbody	12	1.79	N	--	--
CA0054216	Valencia WRP	Los Angeles	Major	Flowing Waterbody	12	0.64	N	--	--
CA0054313	Saugus WRP	Los Angeles	Major	Flowing Waterbody	12	0.83	N	--	--
CA0055531	Burbank WRP	Los Angeles	Major	Flowing Waterbody	12	0.77	N	--	--
CA0056227	**Donald C. Tillman WRP**	**Los Angeles**	**Major**	**Flowing Waterbody**	**12**	**17.20**	**Y**	**12**	**Y**
CA0064556*	Newhall Ranch WRP	Los Angeles	Major	Flowing Waterbody	12	1.20	N	--	--
CA0077691	Easterly WWTP	Solano	Major	Flowing Waterbody	12	1.73	N	--	--
CA0077704	Anderson WWTP	Shasta	Major	Flowing Waterbody	12	5.78	N	--	--
CA0077712	Auburn WWTP	Placer	Major	Flowing Waterbody	12	10.45	N	--	--
CA0077828	Lake	Nevada	Major	Flowing Waterbody	12	2.19	N	--	--

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
	Wildwood WWTP								
CA0077836	Olivehurst WWTP	Yuba	Major	Flowing Waterbody	12	0.93	N	--	--
CA0077895	UC Davis Main WWTP	Solano	Major	Flowing Waterbody	12	1.28	N	--	--
CA0078034	Willows WWTP	Glenn	Major	Flowing Waterbody	12	1.13	N	--	--
CA0078662	Deer Creek WWTP	El Dorado	Major	Flowing Waterbody	12	4.29	N	--	--
CA0078671	El Dorado Hills WWTP	El Dorado	Major	Flowing Waterbody	12	4.00	N	--	--
CA0078891	Red Bluff WRP	Tehama	Major	Flowing Waterbody	12	0.10	N	--	--
CA0078948	Turlock WWTP	Stanislaus	Major	Flowing Waterbody	12	4.13	N	--	--
CA0078956	Hangtown Creek WRF	El Dorado	Major	Flowing Waterbody	12	1.05	N	--	--
CA0078981	Quincy WWTP	Plumas	Major	Flowing Waterbody	12	5.75	N	--	--
CA0079022	Live Oak City WWTP	Sutter	Major	Flowing Waterbody	12	2.90	N	--	--
CA0079081	Chico WWTP	Butte	Major	Flowing Waterbody	12	4.57	N	--	--
CA0079103	City of Modesto WWTP	Stanislaus	Major	Flowing Waterbody	12	2.40	N	--	--
CA0079103	City of	Stanislaus	Major	Flowing Waterbody	12	2.40	N	--	--

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
	Modesto WWTP								
CA0079235	Oroville WWTP	Butte	Major	Flowing Waterbody	12	2.90	N	--	--
CA0079260	Yuba City WWTF	Sutter	Major	Flowing Waterbody	12	8.33	N	--	--
CA0079316	Placer County Sewer Maintenance District No 3	Placer	Major	Flowing Waterbody	12	4.21	N	--	--
CA0079502	Dry Creek WWTP	Placer	Major	Flowing Waterbody	12	1.66	N	--	--
CA0079511	Shasta Lake WWTF	Shasta	Major	Flowing Waterbody	12	2.43	N	--	--
CA0079651	**Linda County Water District WWTP**	**Yuba**	**Major**	**Flowing Waterbody**	**12**	**15.70**	**Y**	**12**	**Y**
CA0079731	Clear Creek WWTP	Shasta	Major	Flowing Waterbody	12	2.38	N	--	--
CA0079898	Grass Valley City WWTP	Nevada	Major	Flowing Waterbody	12	2.68	N	--	--
CA0081434	Galt WWTP & Reclamation Facility	Sacramento	Major	Flowing Waterbody	12	4.71	N	--	--
CA0081759	El Portal WWTF	Mariposa	Major	Flowing Waterbody	12	0.50	N	--	--

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
CA0082589	Stillwater WWTF	Shasta	Major	Flowing Waterbody	12	1.59	N	--	--
CA0084476	Lincoln City WWTF	Placer	Major	Flowing Waterbody	12	0.52	N	--	--
CA0084573	Pleasant Grove WWTP	Placer	Major	Flowing Waterbody	12	1.03	N	--	--
CA0085235	**Clovis WWTF**	**Fresno**	**Major**	**Flowing Waterbody**	**12**	**75.50**	**Y**	**12**	**Y**
CA0085308	Atwater Regional WWTF	Merced	Major	Flowing Waterbody	12	4.88	N	--	--
CA0104477	**Valley SD WWTP**	**Riverside**	**Major**	**Flowing Waterbody**	**12**	**22.50**	**Y**	**12**	**Y**
CA0104493	**Coachella SD WWTP**	**Riverside**	**Major**	**Flowing Waterbody**	**12**	**27.50**	**Y**	**12**	**Y**
CA7000009	Calexico City WWTP	Imperial	Major	Flowing Waterbody	12	1.00	N	--	--
CA8000395*	**Corona WWRF No. 3**	**Riverside**	**Major**	**Flowing Waterbody**	**12**	**26.00**	**Y**	**12**	**Y**
CA8000409*	**IEUA Regional Plant No. 1**	**San Bernardino**	**Major**	**Flowing Waterbody**	**12**	**50.00**	**Y**	**12**	**Y**
CA0053176	Whittier Narrows WRP	Los Angeles	Major	Flowing Waterbody	12	1.91	N	--	--
CA0064564	Naval Facilities Engineering and	Ventura	Minor	Flowing Waterbody	12	0.37	N	--	--

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
	Expeditionary Warfare Center WWTP								
CA0077852	Lake California WWTP	Tehama	Minor	Flowing Waterbody	12	3.30	N	--	--
CA0077933	Williams WWTP	Colusa	Minor	Flowing Waterbody	12	2.28	N	--	--
CA0078999	Colusa WWTP	Colusa	Minor	Flowing Waterbody	12	2.81	N	--	--
CA0079367	Placer County No 1 WWTP	Placer	Minor	Flowing Waterbody	12	2.51	N	--	--
CA0079391	Jackson City WWTP	Amador	Minor	Flowing Waterbody	12	3.23	N	--	--
CA0079430	Mariposa WWTP	Mariposa	Minor	Flowing Waterbody	12	5.17	N	--	--
CA0079529	Colfax WWTP	Placer	Minor	Flowing Waterbody	12	5.78	N	--	--
CA0079901	Nevada City WWTP	Nevada	Minor	Flowing Waterbody	12	3.05	N	--	--
CA0081507	Cottonwood WWTP	Shasta	Minor	Flowing Waterbody	12	38.20	Y	12	Y
CA0081574	Hammonton Gold Village WWTP	Yuba	Minor	Flowing Waterbody	12	0.67	N	--	--
CA0081621	Donner Summit PUD WWTP	Nevada	Minor	Flowing Waterbody	12	2.55	N	--	--

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
CA0083241	Cascade Shores WWTP	Nevada	Minor	Flowing Waterbody	12	0.87	N	--	--
CA0084697	Thunder Valley Casino WWTP	Placer	Minor	Flowing Waterbody	12	0.64	N	--	--
CA0085201	Angels City WWTP	Calaveras	Minor	Flowing Waterbody	12	1.29	N	--	--
CA0104299	Imperial CCD WWTP	Imperial	Minor	Flowing Waterbody	12	0.01	N	--	--
CA0104451	Niland WWTP	Imperial	Minor	Flowing Waterbody	12	1.00	N	--	--
Industrial Dischargers									
CA0000809*	**Shell Oil Products US-Carson Distribution Facility**	**Los Angeles**	**Major**	**Flowing Waterbody**	**12**	**100.00**	**Y**	**12**	**Y**
CA0001309*	**Santa Susana Field Laboratory**	**Los Angeles**	**Major**	**Flowing Waterbody**	**12**	**890.00**	**Y**	**12**	**Y**
CA0004821	Pactiv Molded Pulp Mill	Tehama	Major	Flowing Waterbody	12	0.60	N	--	--
CA0055387*	**ExxonMobil Oil Corporation - Torrance**	**Los Angeles**	**Major**	**Flowing Waterbody**	**12**	**262.00**	**Y**	**12**	**Y**

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
	Refinery								
CA0057827	Inglewood Oil Field	Los Angeles	Major	Flowing Waterbody	12	350.00	Y	12	Y
CA0109169*	Naval Base San Diego	San Diego	Major	Flowing Waterbody	12	8300.00	Y	12	Y
CA0109185*	US Naval Base Coronado (NBC)	San Diego	Major	Flowing Waterbody	12	440.00	Y	12	Y
CA0053176	Whittier Narrows Water Reclamation Plant	Los Angeles	Major	Flowing Waterbody	12	1.91	N	--	--
CA0004111*	Aerojet Sacramento Facility	Sacramento	Minor	Flowing Waterbody	12	20.00	Y	12	Y
CA0030058	Bottling Group LLC	Alameda	Minor	Flowing Waterbody	12	2.06	N	--	--
CA0038342	EBMUD Orinda Filter Plant	Contra Costa	Minor	Flowing Waterbody	12	0.53	N	--	--
CA0062162	Gardena Groundwater Remediation System Facility	Los Angeles	Minor	Flowing Waterbody	12	0.38	N	--	--

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]
CA0080357	**Sierra Pacific Industries Quincy Division Sawmill**	**Plumas**	**Minor**	**Flowing Waterbody**	**12**	**17.91**	**Y**	**12**	**Y**
CA0081833	General Electric GWCS	Merced	Minor	Flowing Waterbody	12	1.16	N	--	--
CA0081957	Wheelabrator Shasta Energy Co	Shasta	Minor	Flowing Waterbody	12	1.13	N	--	--
CA0082406	**I'SOT Geothermal Project**	**Modoc**	**Minor**	**Flowing Waterbody**	**12**	**24.15**	**Y**	**12**	**Y**
CA0083046	The Vendo Company Groundwater Remediation System	Fresno	Minor	Flowing Waterbody	12	0.10	N	--	--
CA0083721	Bell Carter Industrial WWTP	Tehama	Minor	Flowing Waterbody	12	1.19	N	--	--
CA0085171	Empire Mine State Historic Park	Nevada	Minor	Flowing Waterbody	12	0.98	N	--	--
CA0108952	Sweetwater Authority Groundwater Demin	San Diego	Minor	Flowing Waterbody	12	5.65	N	--	--

Exhibit B-1: Estimated Compliance with Proposed Policy by Facility

NPDES No.	Facility	County	Major/Minor	Waterbody Type	Water Column Concentration (ng/L)	Max of Avg Annual Conc (ng/L)	RP?[1]	Annual Average WQBEL (ng/L)	Exceeds WQBEL?[2]

'--' = no data to quantify
ng/L = nanograms per liter
RP = reasonable potential
WQBEL = water quality based effluent limit
WWTP = wastewater treatment plant
WRP = water reclamation plant
* MEC from facility permit
1. Represents effluent annual average or permit MEC greater than the aqueous target.
2. Represents maximum average annual mercury concentration or MEC in exceedance of the aqueous target.

Note: All dischargers with data available and "slow moving water bodies" possessed currently applicable TMDL wasteload allocations which take precedence over the water quality objectives contained in the proposed Policy.

Municipal Pollution Prevention Costs

Pollution prevention (P2) or pollution minimization strategies focus on reducing the pollutant at the source where it is more concentrated and may be more easily controlled, rather than treating larger volumes of wastewater once diluted. Because of the cost-effectiveness of source controls, and the lack of cost effectiveness and demonstrated performance from end-of-pipe controls for pollutants like mercury, P2 is a key strategy for compliance with very low effluent limitations.

A number of municipal dischargers have developed P2 programs that provide a basis for estimating program components and costs. The costs to municipalities, industries, businesses, and households associated with a municipal P2 program for mercury vary based on the community size and makeup, the extent of P2 efforts already underway, and the knowledge and experience of the municipality in this area. Municipal dischargers would likely target dentists, hospitals, medical facilities, educational institutions (primarily universities and high schools), households, and industries to reduce mercury discharges to the treatment plant. Based on program reports and information from municipalities in California currently implementing mercury P2 programs, components are likely to include:

- Wastewater characterization – sampling and analysis of mercury and methylmercury concentrations to characterize pollutant levels at the facility and track treatment effectiveness
- Program development – for source identification, materials development, program implementation, and management
- Conducting site visits/inspections and holding workshops
- Hazardous waste collection programs and mercury-free product replacements
- Advertising – to promote and inform the community of various activities and events taking place
- Website development – to provide the community with additional resources and serve as another means of promoting P2 activities.

Wastewater Characterization

As part of the sampling and analysis task, municipal dischargers should characterize mercury and methylmercury inputs to the treatment plant and track program effectiveness. Characterization involves measuring mercury and methylmercury influent and effluent concentrations to produce a better understanding of the load entering the plant and treatment process removal efficiency. This enables the discharger to determine how much of the resulting effluent loading is due to treatment performance and removal efficiencies, and how much is the result of industrial, commercial, institutional, or residential discharges. Dischargers should address any in plant sources or issues in addition to focusing efforts on potential influent sources.

Although municipalities may sample frequently at the start of the program, they may reduce this frequency over the life of the program after developing an understanding of mercury and methylmercury behavior within the plant. Therefore, on average, municipalities would likely sample on a monthly basis using Method 1631, which requires clean sampling techniques for mercury and methylmercury determination. The Central Valley Regional Water Board (2010) estimates total sampling costs, including labor, shipping, and QA/QC, for mercury and methylmercury in the effluent of $430 per event (in 2007 dollars). Because municipalities would need to sample influent as well as effluent for the characterization, we double this cost and escalate to 2016 dollars using the Bureau of Labor Statistics Consumer Price Index (BLS CPI) as shown in **Exhibit C-1**.

Exhibit C-1: Wastewater Characterization Costs: Per Event Sampling for Mercury and Methylmercury

Component	Influent Hg and MeHg (2007$)	Effluent Hg and MeHg (2007$)	Total (2007$)	Total (2016$)[1]
Laboratory Analysis	$289	$289	$578	$673
Sampling Labor[2]	$25	$25	$50	$58
Shipping	$45	$45	$90	$104
Sampling Subtotal	$359	$359	$718	$836
QA/QC[3]	$72	$72	$144	$167
Total	$431	$431	$862	$1,003

Source: Based on CVRWQCB (2010).
1. Escalated to 2016 dollars using the BLS CPI (2016).
2. Based on paying a 2 person team $140 per hour.
3. Represents 20% of sampling subtotal.

Therefore, total sampling costs may be approximately $1,003 per month, or approximately $12,000 per year for monthly influent and effluent sampling.

Program Development

P2 program development involves identifying potential mercury sources, determining appropriate or cost-effective measures for targeting those sources, developing materials, implementing the program, and evaluating progress/effectiveness of the program.

There are a large number of potential sources of mercury to any municipal wastewater treatment plant (WWTP), but there are few data on these sources from which to accurately predict the mercury load measured at the headworks of a facility. Nevertheless, several municipal dischargers have attempted to quantify their mercury sources. For example, the Palo Alto Regional Water Quality Control Plant (RWQCP) estimates that dental offices account for 60% of its influent mercury load, human waste attributable to amalgam fillings accounts for 18.5%, permitted industries account of 9%, residential and human waste not related to amalgam fillings accounts for 8%, stormwater inflow accounts for 4%, and other sources (e.g., water supply, groundwater, and infiltration) account for 0.4% (Barron, 2002). The East Bay Municipal Utilities District (EBMUD) estimates that 34% of their influent mercury load is from dental offices, 20% from the residential sector, 12% from inflow and infiltration, 11% from known commercial dischargers, and 10% from hospitals and medical facilities (EBMUD, 2004). Both of these dischargers estimated the source loadings from a combination of available monitoring studies and actual sampling efforts. Therefore, to reduce costs, facilities could use information collected and developed from other WWTPs to identify potential sources of mercury, as well as to roughly estimate influent mercury contributions from those sources. Note, however, that the only way to truly characterize influent loads would be through site-specific sampling.

Determining which P2 efforts to pursue requires evaluation of the contribution to total mercury loadings, relative magnitude of loading, feasibility of control, and effectiveness of proposed efforts. Source control efforts could be implemented through existing pretreatment programs. P2 practices could include best management practices (BMPs), production/process changes at industrial facilities, and public outreach and education programs targeting local businesses (e.g., dentists, hospitals, and laboratories), consumers, and schools.

Currently, most municipal WWTPs initially target dental offices and the residential sector through public outreach efforts. Municipalities can develop and distribute materials for dental offices that outline BMPs they can implement to reduce the amount of mercury discharged to the treatment plant. They may also encourage or develop permit programs that require dentists to install amalgam separators, which often remove over 95% of amalgam particles prior to discharge. For example, the Central Contra Costa Sanitary District (CCCSD) developed a brochure for dentists that describes the mercury problem in the area, the role that dentists play in this problem, and measures that dentists can take to reduce their mercury contributions (CCCSD, 2005). Developing brochures may not be necessary for smaller facilities if there are relatively few dental offices in the service area. For example, the Mt. View SD was able to conduct site visits to each of the four dental offices in their area, and use a checklist developed by the Bay Area Pollution Prevention Group (BAPPG) to guide the visit and recommend actions each dentist could take to reduce mercury discharges (Engler, 2005).

In comparison, some municipalities issue pretreatment permits with treatment requirements or numeric targets for mercury. For example, the Palo Alto RWQCP implemented a sewer use ordinance that required all dental offices to install approved amalgam separators by March 31, 2005, and provide certification to the facility that they had done so. The facility also requires dentists to implement BMPs that:

- Prohibit rinsing chairside traps, vacuum screens, or amalgam separator equipment in a sink or other sanitary sewer connection
- Require staff to be trained in the proper handling and disposal of amalgam materials and fixer-containing solutions
- Prohibit the use of bleach or other chlorine containing disinfectants to clean the vacuum line system
- Prohibit the use of bulk liquid mercury; only precapsulated dental amalgam is permitted
- Require that amalgam waste be stored in accordance with recycler or hauler instructions.

The Palo Alto RWQCP developed its program in cooperation with the Mid-Peninsula Dental Society, the California Dental Association, and other stakeholders. The City also coordinated the program's work plan and implementation with the City of San Francisco and the EBMUD.

Similarly, the EBMUD regulates its indirect dischargers through permits. The permits for dental facilities required all dentists to install an ISO 11143 standard amalgam separator by June 30, 2005, and recommend implementation of specific BMPs. Dental facilities must also submit a report self-certifying installation of the separator and implementation of recommended BMPs.

The most common activities targeting the residential sector include distributing educational material in the form of brochures or billing inserts, or organizing events to collect mercury-containing equipment or products and ensure that they are properly disposed of or recycled. Some municipalities offer a mercury-free alternative in exchange for the mercury-containing one. Collection events held at easily accessible places such as schools, community centers, and grocery stores are more successful than events held at the facility. For example, the Palo Alto RWQCB collected about 2,000 mercury thermometers over a couple of years by relying on individuals to bring their thermometers to the treatment plant at their convenience. However, once the City decided to hold events at a scheduled date and time within the community, they were able to double the number of thermometers collected in a much shorter time period (Bobel, 2005).

Other potentially significant sources of mercury to a municipal WWTP are hospitals/medical facilities and educational institutions. Most of the mercury from these sources can be found in equipment such as thermometers, manometers, and blood pressure cuffs and chemical reagents. Municipalities may develop materials or conduct workshops aimed at encouraging these facilities to conduct an inventory of mercury-containing equipment, switch to mercury-free alternative equipment, and implement BMPs that prevent releases of mercury from the equipment. For example, Sacramento Regional County Sanitation District (SRCSD), with support from the Department of Health Services (DHS), teamed up with area hospitals to identify mercury-containing equipment and chemicals that are potential sources of mercury pollution and replace these items with mercury-free items. Additionally, they trained local hospitals and medical facilities on the proper disposal of mercury-containing products and improved management of mercury spills. Sampling conducted since this outreach has shown that hospitals and medical facilities are not a significant source of mercury in wastewater in the SRCSD service area.

EBMUD, under a grant from U.S. EPA, partnered with the University of California, Berkeley to develop a mercury reduction program for educational institutions. Under the program, EBMUD replaced mercury-containing laboratory equipment with mercury-free alternatives, collected elemental mercury, worked with specific departments on campus to replace any additional mercury-containing devices, and developed a template based on these experiences for use at other institutions (EBMUD, 2007). In 2007, EBMUD worked with two local school districts and one university to collect and properly dispose of 112 pounds of mercury waste and replace equipment with nonmercury alternatives (e.g., thermometers and some laboratory devices).

Costs of program development vary based on the level of effort and size of the service area. The Palo Alto RWQCP (design flow of 38 mgd) has a P2 program sector of its environmental compliance division that includes 4 staff. The staff works on various tasks and outreach efforts for a number of different pollutants including mercury. In 2005, the program director estimated that approximately a quarter of the four staff members' time was spent working on mercury-related tasks (Bobel, 2005). Similarly, at EBMUD (design flow of 79.6 mgd), one staff member spent about 80% of her time on new mercury P2 tasks (Mena, 2005). Employee labor is used to identify potential source sectors, develop and evaluate alternative P2 strategies, develop outreach and education materials, request and draft changes to sewer use ordinances, schedule and organize collection events, conduct educational workshops for specific source sectors, maintain contact information for facilities within each sector, and put together annual program status reports. Thus, these estimates of 1 full-time equivalent (FTE) staff position are likely to be representative of costs for program development for large facilities. Note that over time, the personnel requirements for P2 programs will decrease. When contacted in 2014, a representative from Palo Alto's P2 program sector stated that 3 staff work on P2 programs, with approximately 20% of one staff member's time spent on mercury-related tasks (North, 2014).

Smaller facilities have smaller service areas, and thus, fewer sources to identify and target. Smaller facilities are also more likely to partner with large facilities that have already established P2 programs or organizations such as the Department of Health Services to reduce costs. Therefore, in-house labor requirements will most likely be less than those of a larger facility.

For example, an employee of the San Mateo wastewater treatment plant (WWTP) (design flow of 13.6 mgd) estimates that in-house labor for mercury P2-related tasks equals about 0.1 FTE. The level of effort is low because the City does not have a formal P2 program for mercury, and relies heavily on partnerships with the Department of Health and other larger P2 organizations (e.g., a county-wide stormwater P2 program) to develop the outreach and educational information needed to target local businesses and residents (San Mateo Public Works, 2005). The City anticipates that more in-house labor will be needed in the coming years as the program is expanded to target dentists and other potential source sectors (San Mateo Public Works, 2005). Similarly, the P2 coordinator at Mt. View Sanitation District (SD) (average flow of 2 mgd) only spends about one week per year on mercury-related P2 tasks. However, most of the sources in the service area have already been targeted, and the facility developed numerous partnerships with other organizations, making the district's P2 program for mercury virtually self-sustaining (Engler, 2005). If the district began additional activities such as fluorescent light bulb collection events or regulatory requirements for dentists, additional in-house labor would be needed (Engler, 2005).

To estimate costs of one FTE, we assumed employees meeting the BLS definition of environmental scientists or specialists (19-2041) would do most of the work.[6] Average wage

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[6] BLS defines an environmental scientist or specialist as one that conducts research or performs investigation for the purpose of identifying, abating, or eliminating sources of pollutants or hazards that affect either the environment or the health of the population. Using knowledge of various scientific disciplines, they may collect, synthesize, study,

rates in California are $40.69 per hour; accounting for benefits using the BLS Employer Cost for Employee Compensation for state and local professional government workers (32.4% of total compensation is attributable to benefits), this rate is approximately $60.18 per hour. Thus, the cost for 1 FTE is approximately $125,000 per year (2,080 hours × $40.69 per hour).

Site Visits and Workshops

Municipal dischargers may also supplement their own employee labor with expertise from outside the municipality (e.g., consultants). For example, the Palo Alto RWQCP spends about $29,700 per year (escalated to 2016 dollars using the Consumer Price Index) on a private consultant to help them develop outreach materials and conduct mercury education workshops and seminars at schools throughout their service area (Bobel, 2005). Workshops can be used to provide target groups with sector-specific information on mercury sources, effective BMPs, and sources for alternative equipment. The need for additional assistance varies depending on the number of different sources of mercury to the plant and the size of the service area.

The Palo Alto RWQCP also hires a consultant to visit various sources and advise them on BMPs for reducing mercury or ensure that they are complying with sewer use ordinance requirements. Palo Alto spends about $19,800 year (2016 dollars) on this off-site consultant work (Bobel, 2005). Site-visits are useful to determine what BMPs, if any, are in place or could be employed at a particular site to reduce mercury discharges. Sources of mercury are usually easy to identify at dental offices. However, mercury sources at hospitals, medical centers, secondary schools, and universities are harder to identify because of the larger discharge volume and greater number of potential sources, and may require a greater amount of time.

Based on information from Palo Alto, we assumed that larger facilities may spend about $29,700 per year on tasks related to program maintenance and material development performed by persons not directly employed by the municipality, and $19,800 per year on site visits. Smaller facilities, due to the nature and size of their service areas would not likely have to spend as much. For example, San Mateo plans to spend about $23,000 (2013 dollars) on consultants to target dentists and conduct site visits (San Mateo Public Works, 2005). The facility may also need assistance in developing materials for those sources it has not yet targeted (e.g., hospitals).

Mercury-Free Products

Municipalities may need funds to provide mercury-free products to the public or commercial sectors. For example, many municipal dischargers hold collection events in which residents turn in mercury thermometers for recycling and receive either a free electronic thermometer or a coupon towards purchasing one. The Palo Alto RWQCP, EBMUD, and Mt. View SD have programs in which residents can exchange their mercury thermometers for digital thermometers free of charge. The cost to EBMUD for each digital thermometer is about $2.50, and mercury disposal costs are about $7 per pound of mercury waste through the local household hazardous waste facility (Mena, 2005). In 2005, EBMUD gave out approximately 800 digital thermometers

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report, and recommend action based on data derived from measurements or observations of air, food, soil, water, and other sources.

and collected about 20 pounds of waste (Mena, 2005), and Mt. View SD exchanged about 200 thermometers (Engler, 2005). In current dollars, digital thermometers currently cost between $1 and $4 at wholesale prices, on average (DHGate, 2014).

However, municipal dischargers may also need to provide secondary schools or hospitals with mercury-free equipment to replace all or part of their mercury-containing equipment. The Minnesota Pollution Prevention Agency (MPPA) worked with schools to eliminate mercury. The schools often conducted the mercury inventory with guidance from the MPPA. Then, MPPA gave the schools a limited amount of free mercury-free equipment (including 40 laboratory thermometers, 2 digital fever thermometers, a blood pressure unit, and a digital barometer), lines up a proper recycling facility, and covers the mercury recycling costs. Total average costs were about $400 per school (Butler, 2002).

Costs vary based on the number of exchange/collection events and the volume of equipment collected. Note that over time, the discharger will collect most mercury-containing thermometers and replace all the mercury-containing equipment at schools. However, these costs would likely still be incurred annually because facilities would just refocus their efforts on other mercury-containing products (e.g., thermostats, fluorescent lights, and mercury switches) and sectors (e.g., hospitals, medical centers, and laboratories).

Advertising

Developing public service announcements (PSAs) and a website promoting mercury P2 efforts are relatively low-cost methods for distributing information. The PSA cost is for the time spent to prepare audio PSAs for radio broadcast use. For example, the price charged by Hispanic Communications Network to produce a 60 second Spanish or English PSA under a General Services Agreement for the federal government (GSA contract GS-23F-0307M) is $2,000. Due to a large service area, large dischargers could need a number of messages targeting different sources in different languages annually. Smaller municipal dischargers would likely have fewer sources to target. Thus, we assumed larger WWTPs would need four different PSA and small WWTPs would only need one.

Website

Municipal dischargers may target commercial, industrial, and residential customers through a website devoted to mercury source control efforts (e.g., post laws and orders, collection event dates and times, links to mercury fact sheets). The cost of a website depends on its function, number of pages, and security requirements. On average, a website with a customized template and content management system could cost between $1,500 and $2,200 (CA Web Design Inc., 2014). Due to the nature of P2 programs and the need to adapt efforts based on sampling and outreach results, frequent maintenance would be needed to keep the websites up to date. Thus, over the life of a program, website development and maintenance could average close to the development costs, or approximately $1,800 per year (midpoint of range). These costs do not include the cost of the website itself. Rather, facilities would likely add information on the P2 program to a preexisting website run by the municipality or sewer district.

Total Municipal P2 Program Costs

Exhibit C-2 summarizes potential P2 program components and costs, based on the experiences of relatively large (e.g., greater than 20 mgd) major municipal dischargers that have already implemented such programs.

Exhibit C-2: Mercury P2 Program Components and Potential Costs of Large WWTP (> 20 mgd)

Component	Annual Cost ($2016)[1]
Wastewater Characterization	$12,000
Program Development	$129,000
Site Visits and Workshops	$62,000
Mercury-Free Products	$4,000
Advertising	$8,000
Website Development	$2,000
Total	$217,000
1. Costs reflect experiences of large communities. Costs for a number of components (e.g., program development; site visits and workshops) may be proportionately less for smaller communities.	

With total potential costs for larger municipalities approximating $220,000 per year, costs for medium-sized municipal dischargers (e.g., 5 to 20 mgd) may be in the range of $170,000 annually, and for small municipal major dischargers (e.g., 1 to 5 mgd) in the range of $110,000 annually. Minor municipal dischargers serve much smaller areas and populations than major dischargers and have fewer mercury sources to target. Thus, cost may be substantially less (e.g., half) of that for small major WWTPs, or in the range of $60,000 annually. Actual costs will vary with community makeup and other factors including the ability to piggy-back off the efforts of other municipalities. For example, the Association of Metropolitan Sewerage Agencies (AMSA) estimated that implementing pollutant minimization programs range between $324,000 and $453,000 per facility per year ($2013; AMSA, 2002). Costs may also be greater in the startup period than costs in subsequent years as the program becomes more established; the estimates above represent average annual program expenditures. Dischargers will likely initially target the largest or most known sources of mercury to the treatment plant, such as dentists and hospitals, and then move on to other potential sources such as automobile service stations and secondary schools. The estimates for conducting site visits and workshops reflect this sequential targeting of an equal number of sources in a given year.

Source Control of Indirect Dischargers to Municipal Facilities

In addition to the cost of developing a P2 program, municipalities may require indirect dischargers to the sewer system to implement source controls. Municipalities would likely target dentists, hospitals and medical centers, secondary schools, universities, and industrial facilities. However, the program may not address all of these sectors immediately (i.e., in certain sectors, implementation of controls may not occur for several years).

Dental Offices

PMP costs for dentists would include the installation of an amalgam separator and implementation of BMPs. Costs for amalgam separators vary depending on removal efficiency, method of separation, and purchasing option (e.g., buy or lease), and annual maintenance costs vary based on the type of separator and size of dental practice.

Exhibit C-3 shows the costs associated with a number of amalgam separators. Capital costs range from $200 to $2,600, with an average of $900, and annual maintenance costs range from $50 to $580, with an average of approximately $300.

Exhibit C-3: Amalgam Separators Description and Costs

Amalgam Separator (Flow)	Number of Chairs	Purchase Cost	Maintenance Requirements	Maintenance Cost ($/yr)	Source:
Rasch 890-1500	1-12	$695	Replace canister every 18 mos. (includes shipping and recycle)	$400	AB Dental Trends (2014)
Rasch 890-6000 (4 L/min)	1-12	$525	Replace canister every 18 mos. (includes shipping and recycle)	$400	AB Dental Trends (2014)
Asdex As-9 11"	1	$210	Replace filter ever 6 mos.	$160	American Dental Accessories (2014)
Asdex As-9 23"	4	$300	Replace filter ever 9 mos.	$236	American Dental Accessories (2014)
SOLMETEX Hg5	10	$784	Replace filter ever 6 mos.	$584	American Dental Accessories (2014)
ECO II (2 L/min)	1-6	$499	Replace canister annually for 1 chair usage plus shipping/recycle	$279	PureLife Dental (2014)
The Amalgam Collector CH 12 (batch)	1	$625	No replacement costs; office responsible for sludge recycle	$50	R & D Services, Inc. (2014)
The Amalgam Collector CE 18 (batch)	2-5	$875	No replacement costs; office responsible for sludge recycle	$50	R & D Services, Inc. (2014)
The Amalgam Collector CE 24 (batch)	6-12	$1,295	No replacement costs; office responsible for sludge recycle	$50	R & D Services, Inc. (2014)
SOLMETEX Hg5-HV (1.5 L/min)	11-20	$2,613	Replace canister every 6-9 mos. (includes recycle)	$550	MS Air Online (2014)

BMPs for dentists usually include the following:

- Ensuring chairside traps, vacuum screens, or amalgam separator equipment are not rinsed in a sink
- Recycling chairside trap, vacuum screen, and amalgam separator wastes
- Training staff in proper handling and disposal of amalgam materials
- Ensuring bleach or chlorine-containing disinfectants are not used to clean vacuum lines system because these chemicals may dissolve mercury from amalgam
- Using only precapsulated dental amalgam
- Storing amalgam in accordance with recycler or hauler instructions
- Using mercury-free alternatives to amalgam, when appropriate
- Cleaning up any mercury spills with the proper mercury spill clean-up kit.

Other than minimal staff training, these BMPs would not impose additional costs for a dental office.

Hospitals and Medical Centers

P2 measures for hospitals and medical centers include BMPs such as eliminating the use and handling of mercury-containing products and equipment through the modification of purchasing practices. Mercury-free substitutes are available for most mercury-containing chemicals and equipment. Although mercury-free products may currently be more expensive than those containing mercury, there are savings associated with eliminating the costs of hazardous waste training, storage and disposal, clean up, and potential noncompliance, and potential health risks to staff, patients, and visitors. In the case of electronic thermometers, the mercury-free alternative also has time-saving benefits since an electronic thermometer gives a quicker temperature reading than a mercury thermometer (Pollution Probe, 1996). For example, comparison of a mercury-containing sphygmomanometer to a mercury-free aneroid sphygmomanometer shows that once staff training, spill cleanup, and administrative costs are taken into account, the mercury-free alternative is actually more cost effective (Pollution Probe, 1996).

The potential cost savings from using mercury-free equipment can be substantial. For example, the University of Minnesota-Duluth reports that phasing out mercury has significantly reduced costs due to hazardous spill cleanups (Second Nature, 2003). The average wage rate of spill team members is about $100 per hour, and it takes on average about 6 hours to clean up a spill (California DHS, 2000). Spill kits range in costs from $15 to $200. Using mercury also requires administrative costs to keep procedures up to date and staff trained. In 1998, Kaiser-Permanente, which owns and operates 30 hospitals and 360 clinics, began a mercury minimization policy aimed at switching to mercury-free thermometers and sphygmomanometers, and proper disposal of fluorescent lamps, through a contract with a recycler. Kaiser-Permanente indicated that they realized cost savings from the program through having less waste to dispose of, and eliminating the need to prepare for and clean up mercury spills (which cost $250,000 per incident) and avoided medical treatment costs from exposure (TPMG Forum, 2007)

Therefore, implementing P2 activities is not likely to impose incremental costs on hospitals and medical centers.

Laboratories

P2 measures for laboratories that may reduce the amount of mercury released to the environment as a result of daily operations are similar to those implemented by hospitals and medical centers. In addition to replacing mercury containing equipment (e.g., manometers and thermometers) and chemicals containing mercury with mercury-free alternatives, laboratories can also work to minimize the amount of waste generated during experiments and testing procedures. The University of Minnesota-Duluth instituted micro-scale projects in undergraduate labs that dramatically reduced the quantities of possible mercury-containing chemicals used, purchased, and discarded (Second Nature, 2003).

Because there is a cost savings associated with a decrease in mercury spill clean ups costs, and costs for mercury free alternatives are often about the same as costs of mercury-containing chemicals, implementing P2 programs is not likely to impose incremental costs on laboratories.

Universities and Secondary Schools

There are a number of BMPs schools can implement to reduce mercury in their wastewater:

Educate students, teachers and administrators about the health hazards and environmental fate of mercury (e.g., see the Mercury in Schools Pollution Prevention project, located at http://www.mercuryinschools.uwex.edu)

Promote proper management and recycling of mercury and mercury-containing products (e.g., educate teachers and maintenance personnel on items that may contain mercury such as thermometers and laboratory chemicals, and proper disposal techniques)

Eliminate the use of mercury wherever possible and promote the use of alternative products that do not contain mercury (e.g., schools may have mercury-containing thermostats, barometers, thermometers, and wall switches that can easily be replaced with mercury-free alternatives)

Clean out plumbing (e.g., mercury builds up in plumbing over the years resulting in a constant mercury discharge even after the use of mercury is eliminated).

Universities and secondary schools would most likely take an inventory of mercury and mercury containing equipment in each building, and replace each item with a mercury-free alternative, as well as set up an educational program for professors, teachers, maintenance personnel, and students on the health effects of mercury, its environmental fate, and proper handling and clean up procedures.

The EBMUD initiated a mercury reduction program with the University of California at Berkeley (UCB) through grant funding from U.S. EPA. The program focused on identifying all mercury-containing equipment and chemicals through the campus and replacing them with mercury-free alternatives. Another main component of the program focused on outreach and education targeting professors, students, and school administrators. EBMUD also developed a template to guide other institutions on implementation of a successful mercury reduction program. UCB spent about $36,000 from 2002 through 2005 on the program (an average of $9,000 per year) for mercury waste disposal and recycling ($6,000) and program development and implementation ($30,000). However, if other universities use the template developed as part of the program development and implementation, costs would be much less.

P2 program implementation costs for secondary schools are most likely minimal because the municipality conducting the program generally conducts the mercury equipment inventory and arranges for equipment replacement and disposal (already accounted for in the direct costs). For example, MPPA does not charge schools to participate in its Mercury Free Zone program. In addition, this Agency offers free lab and medical equipment to replace the schools' mercury-containing equipment and arranges for proper mercury disposal at a recycling facility (Butler, 2002). The Oregon Association of Clean Water Agencies (ACWA), in conjunction with ODEQ, also developed a pilot program for two local school districts to eliminate the use of mercury in schools. ODEQ spent approximately $27,800 of staff time inventorying 5 schools for mercury equipment and chemicals, and an additional $6,000 on mercury replacement and disposal. All of these costs were covered by donations, City of Corvallis, City of Eugene, ACWA, and CWA 319 Nonpoint Source Grants from ODEQ (Oregon ACWA, 2005).

Based on the above examples, it is likely that municipalities will conduct mercury inventories and supply mercury-free equipment for secondary schools. Therefore, the costs to secondary schools would be minimal.

Facility-Specific Incremental Cost Estimates

The following exhibits show incremental costs by facility for each of the objectives and implementation options based on numeric WQBELs.

Exhibit D-1: Incremental Costs by Facility

NPDES No.	Facility	Major/ Minor	Flow (mgd)	Existing Treatment Level	Proposed Treatment	Capital Cost (2016$)	O&M Cost (2016$)	Annual Cost (2016$)[1]
Municipal Dischargers								
CA0022977	Cloverdale City WWTP	Major	1	Secondary	Filtration	$1,142,444	$23,582	$115,255
CA0023345	Windsor Town WWTP	Major	2.25	Tertiary	P2	--	--	$110,000
CA0025135	Healdsburg City WWTP	Major	1.4	Tertiary	P2	--	--	$110,000
CA0049224	San Luis Obispo WWTP	Major	5.1	Tertiary	P2	--	--	$110,000
CA0053651	Ventura WRP	Major	14	Tertiary	P2	--	--	$170,000
CA0056227	Donald C. Tillman WRP	Major	80	Tertiary	P2	--	--	$220,000
CA0079651	Linda Cnty Water District WWTP	Major	5	Tertiary	P2	--	--	$110,000
CA0085235	Cottonwood WWTP	Major	2.8	Tertiary	P2	--	--	$110,000
CA0104477	Clovis WWTP	Major	8.5	Secondary	Filtration	$9,710,776	$200,447	$979,665
CA0104493	Valley SD WWTP	Major	2.4	Secondary	Filtration	$2,741,866	$56,597	$276,611
CA8000395	Coachella SD WWTP	Major	1	Tertiary	P2	--	--	$110,000

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Exhibit D-1: Incremental Costs by Facility

NPDES No.	Facility	Major/ Minor	Flow (mgd)	Existing Treatment Level	Proposed Treatment	Capital Cost (2016$)	O&M Cost (2016$)	Annual Cost (2016$)[1]
CA8000409	Corona WWRF No. 3	Major	84.4	Tertiary	P2	--	--	$220,000
CA0081507	IEUA Regional Plant No. 1	Minor	0.43	Tertiary	P2	--	--	$60,000
Industrial Dischargers								
CA0000809	Aerojet Sacramento Facility	Major	5	Secondary	P2 or Filtration	$5,712,221	$117,910	$37,000 - $576,273
CA0001309*	I'SOT Geothermal Project	Major	168	Secondary	P2	--	--	$37,000
CA0055387	ExxonMobil Oil Corporation - Torrance Refinery	Major	10	Secondary	P2 or Filtration	$11,424,443	$235,820	$37,000 - $1,152,547
CA0057827	Inglewood Oil Field	Major	7.55	Secondary	P2 or Filtration	$8,625,454	$178,044	$37,000 - $870,173
CA0109169*	Naval Base San Diego	Major	NA	Secondary	P2	--	--	$37,000
CA0109185	Santa Susana Field Laboratory	Major	0.235	Secondary	P2 or Filtration	$268,474	$5,542	$27,085 - $37,000
CA0004111	Sierra Pacific Industries Quincy Division Sawmill	Minor	35.8	Secondary	P2 or Filtration	$40,899,506	$844,235	$37,000 - $4,126,117

Exhibit D-1: Incremental Costs by Facility

NPDES No.	Facility	Major/ Minor	Flow (mgd)	Existing Treatment Level	Proposed Treatment	Capital Cost (2016$)	O&M Cost (2016$)	Annual Cost (2016$)[1]
CA0080357*	Shell Oil Products US-Carson Distribution Facility	Minor	NA	Secondary	P2	--	--	$37,000
CA0082406	US Naval Base Coronado (NBC)	Minor	0.166	Secondary	P2 or Filtration	$189,646	$3,915	$19,132 -$37,000

-- = not applicable
WWTP = wastewater treatment plant
WRP = water reclamation plant
NA= not available
P2 = pollution prevention program
*Design flow not reported in NPDES permit or flow is attributable to industrial stormwater; costs represent P2 only.
1. Annualized costs based on 5 percent interest and a 20 year estimated project life.

Appendix S. Responses to the External Peer Review

Peer reviewers are as follows:

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CONTENTS

S.1 Marc W. Beutel (MWB)

Thank you for this opportunity to review the draft proposed rule for Mercury Water Quality Objectives. I would like to commend Water Board staff for developing a comprehensive and detailed proposal to protect the State's human and environmental resources from the threat of mercury pollution. My comments are presented below. Since my background is in environmental and civil engineering, I have focused my comments on addressing Concerns 5-8.

Conclusion 5 – Water column target of 12 ng/L total mercury is appropriately protective

<u>COMMENT MWB 1</u>

In reviewing the narrative in (6.11) Issue K in the draft staff report, I agree with the need for a consistent and simple method to develop effluent limitations for mercury and to draft permits. The recommended Option 1 in Section 6.11.3 of the draft staff report, with its focus on a water column target for total mercury (Figure 6-2), seems like the most appropriate approach. This contrast with Option 2 (Figure 6-3), in which effluent limitation is based on site-specific fish mercury content. I agree that the barriers to implementing Option 2 on a wide scale, which include on-going collection and evaluation of site-specific fish tissue data, are significant.

<u>RESPONSE TO MWB 1</u>

The reviewer's agreement with the approach is noted.

<u>COMMENT MWB 2</u>

One question I have regarding Option 2 [(6.12, Issue L)] and Figure 6-3 is the rationale for using ≥ 4 ng/L as an effluent threshold for potentially accepting an effluent limitation. Where did this value come from and why was it used? Was the 4 ng/L from a 0.2 mg/kg fish tissue concentration translated to a water column target using the USEPA mean lake/river bioaccumulation values as detailed in Appendix I (top of p. I-3)? And what happens in the flow chart if the effluent has a measurable total mercury concentration < 4 ng/L?

<u>RESPONSE TO MWB 2</u>

Yes, the value of 4 ng/L in Figure 6-3 (now Section 6.12) was used as an example. The value used here could be 4 or 12 ng/L or another value, depending on the effluent limitation that was chosen from the three options presented in the next section. Text has been added to clarify.

Existing text:

"Alternatively, if there is no fish tissue data then the dischargers could opt out of the fish collection obligation by agreeing to use a water column target to determine if they will be issued effluent limitations (same as option 1).

New text has been added:

"That water column target may be based on the effluent limitation ultimately chosen. The water column target could be 12 ng/L (from Option 1, Section 6.13), a value based on facility type (Table 6-1, Option 2, Section 6.13), 4 ng/L (from Option 3, Section 6.13) or another value based on the effluent limitation ultimately chosen. In Figure 6-3, the value of 4 ng/L is shown as an example."

<u>COMMENT MWB 3</u>

The logic that since ionic mercury can be transformed to methylmercury in receiving waters, total mercury should be the focus on the water column target, is sound. The rationale for making the water column target the same as the effluent limitation is also clearly described in the draft staff report. As detailed in Section 6.12.3 (p. 117), based on State and USEPA guidelines dilution credits are not appropriate for bioaccumulating compounds like mercury. Since mercury bioaccumulation is a relatively long-term process within an ecosystem, an annual average also is the appropriate time scale on which to assess any effluent limitation. That said, for an annual average to be meaningful, a suitable minimum number of samples need to be collected annually. The minimum quarterly monitoring for larger dischargers detailed in the draft amendment is appropriate.

<u>RESPONSE TO MWB 3</u>

The reviewer's agreement with the approach is noted. However, staff revised the Provisions to give the Water Boards the discretion to allow dilution. The existing California permitting policy for the relevant dischargers (the SIP), discourages using dilution for persistent bioaccumulative pollutants, such as mercury, but there may be cases with low background levels of mercury where dilution is appropriate.

<u>COMMENT MWB 4</u>

In my opinion, there is a disconnect in the presentation of the calculation of the proposed effluent limitation of 12 ng/L in Section 6.12.3 of the draft staff report and the calculations presented in Appendix I Section 1. In Section 6.12.3, the text states that the water column target was "calculated by using California bioaccumulation factors and translators based on data from river and streams only." But in Section 1 of Appendix 1 the primary calculations (i.e., Tables I-1, I-2 and I-3) are based on USEPA national values for bioaccumulation factors and translators. The USEPA-based value for rivers was 11.5 ng/L, apparently rounded up to 12 ng/L in Table I-3 (The rounding up of values in Table I-3 seems inappropriate; consider presenting data with 2-3 significant figures, as was done in Tables I-5 and I-6.)

<u>RESPONSE TO MWB 4</u>

Table I-3 (now Table I-4) was edited to match the number of significant figures used by U.S. EPA and the California bioaccumulation factor (BAF), and to include the data for the California BAF, similar to table I-5 and I-6. The U.S. EPA final BAF and the California BAFs were presented with 2 significant figures, while the water quality objectives have only one significant figure. The level of precision implied by 3

significant figures is not supported by the large uncertainty in the BAFs and the uncertainty in the water quality objective. The final effluent limitations were rounded to the nearest whole number for practicality (one or two significant figures).

COMMENT MWB 5

There is then a discussion in Section 3 of Appendix 1 of the California bioaccumulation factors and translators, and acknowledgement that the California data was not of "high quality" and "provided limited [spatial] representation of the state as a whole." Then the text includes a supporting calculation using California bioaccumulation factors and translator values for rivers (12.1 ng/L). It would be more appropriate for the narrative in section 6.12.3 to say that the water column target was estimated using the USEPA national bioaccumulation factors and translator, and that an additional calculation with California values, which apparently is not an especially rigorous data set, yielded a similar value.

RESPONSE TO MWB 5

The text (now Section 6.13.3) was updated as suggested, to better reflect the calculations. The following text was revised: "The water column target of 12 ng/L (total mercury) was calculated by using the U.S. EPA bioaccumulation factor from rivers and streams only, as shown in Appendix I. Most of the discharges from wastewater and industrial facilities flow into rivers (Appendix N). An equivalent threshold of 12 ng/L was derived using the California bioaccumulation factor. The California bioaccumulation factor was derived from data from rivers (Appendix I)."

COMMENT MWB 6

This raises the additional question of why 12 ng/L was the final water column target. Why not 11.5 ng/L or 11.8 ng/L, the average of the USEPA and California-based calculations.

RESPONSE TO MWB 6

Since the bioaccumulation factors were expressed with only two significant figures it is not appropriate to be expressing the water column target with three significant figures. The difference between 11.5, 11.8, and 12 ng/L is not significant, especially given the uncertainty in the bioaccumulation factors.

COMMENT MWB 7

Also, Tables I-1, I-2 and I-3 would be more effective if they were formatted like Tables I-5 and I-6, which included a presentation of both USEPA and California values.

RESPONSE TO MWB 7

These tables were adjusted as suggested (now Tables I-1,I-3 and I-4).

COMMENT MWB 8

Note that the California translator for $MeHg_{dissolved}/MeHg_{total}$ was never numerically presented, even though it was used for the calculations presented in the last column of Table I-6.

RESPONSE TO MWB 8

The California translator is now shown in Table I-3.

COMMENT MWB 9

That said, the narrative presentation in Step 1 on p. A-10 of the draft amendment is nicely presented. But in the interest of transparency, the text in Step 1 on p. A-10 of the draft amendment should make clear that these bioaccumulation factors are "river-based" bioaccumulation factors.

RESPONSE TO MWB 9

This section of the amendment, which is now referred to as the "Provisions", was reorganized and now there is a clear distinction between the water column values for "flowing water bodies (generally rivers, creeks and streams)" and values for other waters. .

COMMENT MWB 10

In both Appendix I (p. I-10) and the last paragraph of Section 6.12.3 Option 1 of the draft staff report, the documents state that the water column target of 12 ng/L, calculated on the basis of the sport fish objective (0.2 mg/kg in trophic level 4 fish, 150-55 mm), is also protective of wildlife, "or very close" to being so. Since this is a significant outcome, the report would benefit from an actual numerical calculation and presentation to support these claims. This could be presented in Appendix I.

RESPONSE TO MWB 10

The data to support such calculation is not available. This passage (now Section 6.13.3 Option 1) was revised as follows to explain this better:

> **"The wildlife objectives are consistent with meeting the one meal per week objective in trophic level 4 fish or very close. Data are not available to make this determination in a very exact manner, but see Section 6.1 through Section 6.6 of Appendix K for estimations. The wildlife objectives would not require a different limitation for wastewater and industrial discharges (unless a TMDL indicates otherwise)."**

COMMENT MWB 11

After reviewing the SIP and the draft amendment text, it is not clear to me what total mercury effluent limitation concentration in called for in the event that there is measurable mercury in a discharge and total mercury in the receiving water is above 12 ng/L. It appears that the effluent limitation simply defaults to 12 ng/L. Is this the case? Is this approach adequately protective of environmental quality? Or is this such a low probability scenario that it is not a concern, or perhaps other regulations or guidelines apply. Please clarify this issue.

RESPONSE TO MWB 11

Yes the effluent limitation is 12 ng/L in many cases, this had been revised somewhat to clarify and account for situations where 12 may not be protective (see the Provisions: Appendix A). The bioaccumulation factors used (described in Appendix I) suggest this water column target is consistent with meeting the sport fish water quality objectives in rivers, and therefore is protective of environmental quality for rivers. We clarified the requirements for slower moving waters (waters other than rivers or streams), waters where the tribal/ subsistence fishing water quality objectives apply and other exceptions may apply. These situations (where 12 ng/L may not be protective) are discussed in the next few comments (to Comment MBW- 12 through Comment MBW- 17). Additionally, if there is an exceedance of the water quality objectives, then a TMDL is required, and that TMDL may result in more protective requirements.

Conclusion 6 - Water column target for slower moving waters

COMMENT MWB 12

I agree that a more protective water column target is warranted for discharges to waters that are slower flowing than rivers. As detailed in Appendix I (i.e., USEPA bioaccumulation factors for rivers versus lakes) and as generally acknowledged by environmental scientist working on mercury cycling, lakes, reservoirs, wetlands and estuaries are expected to have higher potential to methylate mercury than rivers and streams. But it seems to me that the draft Mercury Water Quality Objectives do not adequately apply a more protective water column target in these cases. While I concur with the general approach and rationale used to develop the water column concentration of 12 ng/L, I am not convinced that it is appropriate to apply this standard to wastewater and industrial dischargers that discharge to water bodies close to or designated as non-river in character (i.e., near or into lakes, reservoirs, wetlands or estuaries). As noted in Attachment 2 (p. A2-8) of the request for scientific peer review, the rationale for using a river-based water column target for all discharges are twofold: we only have bioaccumulation factors for California river/streams, and most treatment facilities in the State discharge to rivers/streams (greater than 90%). These themes are echoed in Section 6.12.3 Option 1 of the draft staff report. But it seems to me that the California bioaccumulation factors and translators, as noted above, were based on limited data, and in fact the USEPA bioaccumulation factors and translators were more appropriate to use. This raises the question: if we have both river and lake bioaccumulation factors and translators from the USEPA, why not apply both? If lakes, reservoirs, and estuaries are acknowledged as ecosystems with higher methylation potential relative to rivers, and if we have compelling metrics from the USEPA national dataset to calculate a water column target for non-river systems, then why not propose a water column target for non-river dischargers so as to better protect these more vulnerable systems from mercury bioaccumulation? Since we do not have solid bioaccumulation factor and translator values for estuaries, perhaps estuaries should default to the lake water column target.

RESPONSE TO MWB 12

This requirement in the Mercury Provisions was changed to incorporate the reviewer suggestions. There are now three categories of water body types, each with a different water column concentration. For rivers and streams, the water column concentration remains 12 ng/L. Lakes and reservoirs were put in a different category. There are very few dischargers to such waters in the state, and we expect most of those will be included in a TMDL soon. In the meantime, if any of the permits for discharges to reservoirs come up for renewal we have included a case-by-case procedure for the permit writer to derive appropriate concentration for lakes/reservoirs.

For a third category of water bodies: "slow moving waters" (which could be estuaries or bays), a more stringent water column concentration (4 ng/L) has now been included. This water column concentration was based on the U.S. EPA national bioaccumulation factor (derived from combined data for lakes and rivers). For waters other than lakes, reservoirs, rivers and streams, it is somewhat difficult to determine the appropriate water column concentration, based solely on the water body name. Therefore, we have given the permit writer the discretion to determine if the water body is not a "flowing" water body similar to a river, but a "slow moving" water body. The staff report (now Section 6.13.3 Option 1) was revised accordingly and includes examples.

Additionally, subsequent to the scientific peer review, an unpublished study on bioaccumulation factors for California bays was located (Stephenson et al. 2009). This information has been added to Appendix I. The resulting water column concentration for all bays (2 ng/L) based on data in Stephenson et al. is not very different than using the U.S. EPA national bioaccumulation factor lakes and rivers combined (4 ng/L). Given that the results for bays were not much different from the U.S. EPA national data, and because these data were not included the in scientific peer review (and the study was not peer reviewed on its own), the bay study was not specifically used to alter the requirements in the Provisions. The bay study (Stephenson et al. 2009) provides additional supporting data.

COMMENT MWB 13

The argument that there are not very many treatment systems that discharge to non-river environments, or that it is difficult to distinguish between treatment systems that discharge to river-like systems and non-river like systems, as argued in Appendix I (p. I-9), do not seem compelling to me. If a treatment system discharges to an ecosystem known to be a more potent transformer of mercury into methylmercury, should it not need to meet a more stringent water column target? In addition, based on Table N-3a of Appendix N, the characteristics of treatment facility receiving waters appear to be fairly well defined. As detailed in Section III.A.2.d.3 of the daft amendment, the permitting authority may calculate alternative water column targets for non-river discharges, or may require non-river dischargers to develop site-specific bioaccumulation factor and translator values for their unique receiving water system. But it seems prudent to first have ecosystem specific (rivers/streams and lakes/estuaries) targets of an appropriate magnitude. Under the proposed scheme, rather than protecting non-river systems from the start, there is need for some additional finding and action to implement a potentially more stringent water column target other than 12 ng/L. My concern is that the default 12 ng/L value will have an inertia that could impede implementation of more protective effluent limitations for wastewater and industrial facilities discharging to non-river environments.

RESPONSE TO MWB 13

This requirement was changed as the reviewer suggested. See comment MWB 12.

COMMENT MWB 14

I have one additional question related to site-specific bioaccumulation factors. Currently the draft amendment states that the "permitting authority may require a study" to develop bioaccumulation factors. I am curious about the Water Board's perspective on whether the development of site specific bioaccumulation factors should be undertaken only if required by the permitting authority, or if dischargers should be given the explicit option in the amendment to develop site specific bioaccumulation factors if they want to

RESPONSE TO MWB 14

Agree -the dischargers should have the option to do a site-specific bioaccumulation study, although the permitting authority must review and approve the study. The Provisions were intended to allow that option. The staff report was edited to make this clearer (Section 6.13.3, option 1).

Conclusion 7 - Water column target for subsistence fishing

COMMENT MWB 15

I agree that a more protective water column target is warranted for discharges to waters that impact subsistence fishers. The draft staff report details a number of studies, some of which are recognized as limited in scope, which detail higher fish consumption rates by subsistence fishers. Presuming that other peer reviewers with expertise in public health toxicology affirm that appropriateness of the higher consumption rates for subsistence fishers, then it is appropriate to have a water column target that is more stringent than the 12 ng/L river-based target estimated using sports fish (0.2 mg/kg).

The calculation methods presented in Appendix I are appropriate and scientifically sound. But there are some acknowledged weaknesses of the method, including limited bioaccumulation metrics specific to California and specific to estuaries.

RESPONSE TO MWB 15

The reviewer's agreement with the approach is noted. The concerns for protection of estuaries are addressed in Response MWB 12.

COMMENT MWB 16

Keeping in mind the uncertainties in bioaccumulation metrics discussed above, and with the anticipated low water column targets likely to be calculated with the use of subsistence fish tissue levels (e.g., 0.05 mg/kg for subsistence fishing and 0.04 mg/kg for Native American subsistence fishing), it seems appropriate to also allow discharges to develop site-specific bioaccumulation factors when discharging to waters impact subsistence fishers. Thus, I recommend that the Water Board consider adding text to item d.4 (p. A-14) of the draft amendment, similar to that in item 3.ii (p. A-13), that allows for two potential outcomes for dischargers impacting subsistence fishing: the recalculation of a modified water column target or the develop site-specific bioaccumulation factors by the discharger.

RESPONSE TO MWB 16

Agree. The text in section IV.D.2 has been clarified by rearranging. This reorganization was also done to address Comment MWB 12.

Yes, the dischargers subject to the subsistence water quality objectives are allowed to develop site-specific bioaccumulation factors. Also, the dischargers subject to the subsistence water quality objectives could be given the small disadvantaged community exception or the insignificant discharger exception if the discharge meets the criteria.

COMMENT MWB 17

An additional question arises for both of these options: given the uncertainties in fish consumption patterns of subsistence fishers, which is a key driver of the target fish tissue limit, should dischargers be permitted to develop site-specific fish consumption metrics? Should this section of the amendment include an explicit acknowledgment of this issue and note that discharges could be required, or discharges could choose themselves, to develop site-specific fish consumption metrics?

RESPONSE TO MWB 17

The subsistence fishing water quality objective has been modified, so that the objective can be implemented in a site-specific manner. In Section 6.5 of the Staff Report, Option 6 is now recommended, which is the narrative water quality objective. Previously, a numeric water quality objective was recommended. With a narrative subsistence fishing water quality objective, dischargers could potentially fund or perform a fish consumption study to support a site-specific water quality objective, but the Regional Water Board must find such a study acceptable before it would be implemented in permits.

A narrative water quality objective has the advantage of allowing permit-specific implementation. A site-specific fish consumption rate could be used to implement the water quality objective or a provided default fish consumption rate (142 g/ day) could be used to implement the water quality objective. A permit writer could consider relative loading from the discharge compared to other sources. A permit writer could also consider other site-specific factors, such as if there are no trophic level 4 fish, requirements would not need to be as stringent as in a water with trophic level 4 fish

(This does not apply for the Sport Fish Water Quality Objective since one of the two prey fish objectives would still need to be achieved). Finally, an additional advantage of the narrative water quality objective is that these site-specific considerations could be taken into account without the lengthy regulatory process of adopting a site-specific water quality objective. On the other hand, a site-specific water quality objective must be adopted by the Regional Water Board through a regulatory process called a Basin Plan Amendment, which includes public input. This is a process similar to the process that the Provisions is undergoing. See also Comment MBS 8 and EVW 14.

Conclusion 8 – Sediment controls and transport of mercury into waters

COMMENT MWB 18

The focus on sediment and erosion control in the Storm Water Discharges section of the draft amendment, with a particular emphasis on control measures in areas where soils are naturally rich in mercury or have a history of mining activity, is appropriate.

RESPONSE TO MWB 18

The reviewer's agreement with the approach is noted.

COMMENT MWB 19

The focus on wetland restoration projects is also a commendable component of the draft amendment, since important wetland restoration efforts in the State will spatially overlap with mercury-impacted regions, such as the South San Francisco Bay for example.

RESPONSE TO MWB 19

The reviewer's agreement with the proposal is noted.

COMMENT MWB 20

One issue to keep in mind is that some BPMs, such as anaerobic components of structural BPMs used to enhance microbial denitrification, may have the potential to promote methylation of trapped mercury. Can or should this issue be acknowledged as part of the draft staff report or in the context of BMP implementation in the draft amendment?

RESPONSE TO MWB 20

Yes, BMPs for microbial denitrification could be required by other Water Boards programs and it is possible that BMPs could be anoxic and methylate mercury. Text was added to Section 4.4.6 "Conversion to Methylmercury as a Source" at the end of the first paragraph:

> **" Additionally, structural Best Management Practices used to enhance microbial denitrification, such as treatment wetlands, can have anaerobic zones and are rich in organic matter both, factors that promote mercury methylation. Also, storm water catch basins can become anaerobic. Therefore, while these Best Management Practices serve important function in controlling nutrients and**

possibly other pollutants, these Best Management Practices may also inadvertently incorporate conditions that promote mercury methylation."

COMMENT MWB 21

The proposed 300 ng/L total mercury numeric action level for industrial dischargers is far below the current level of 1,400 ng/L, which is appropriate. But I am not convinced by the rationales for the new numeric action level, as detailed in Section 6.10.3 of the draft staff report and Appendix P Section 4.1. A key rationale, as stated in the draft staff report (p. 102), is that the numeric action levels are "technology based" and that "it is not clear that a lower threshold would be achievable with currently available storm water treatment methods." Presumably the treatment methods alluded to in this statement encompass other non- structural BMPs such as good storage and handling practices. What is the basis for this statement? Is there documented studies that find that achieving industrial storm water levels below 300 ng/L is technically infeasible?

RESPONSE TO MWB 21

No documentation was found on the effectiveness of storm water treatment for removing mercury that could be included in the Staff Report. An example when a lower numeric action level may not be achievable with current technology is if the mercury is form atmospheric deposition. We also included information on typical concentrations of mercury in rain from atmospheric deposition in Appendix P: Averages were around 3-13 ng/L, storm events had mercury levels up to 70 ng/l and few samples were above 200 ng/L (See also Comments MWB 22-23). If the mercury is from atmospheric deposition and not from the industrial facility, treatment methods such as good storage and handling practices will not be sufficient to control mercury.

COMMENT MWB 22

A second rationale was the potential cost of water quality analyses. The 300 ng/L action level seems to have been selected partly because it is comfortably above the detection limit of 200 ng/L for USEPA method 245.1, which cost $18 to $35. This compares to USEPA method 1631E (quantitation limit of 0.5 ng/L), which can costs over $115. No cost was stated for the method 245.7 with the intermediate quantitation limit of 5 ng/L. Presuming method 245.7 is on the order of $75, use of this method would increase sampling costs by around $60 per sample. Noting that industrial dischargers are required to sample around once per year (Appendix P Section 4.1), this additional cost does not seem to me like a significant enough financial burden to dictate the numeric action level for mercury for industrial dischargers.

RESPONSE TO MWB 22

In general, sampling mercury with the most up to date methods is much more expensive and complicated than monitoring for other constituents, such as copper.

More information was gathered on the costs of method 245.7 and added to Appendix P. The cost for method 245.7 is more difficult to estimate since few labs perform this test. Cost estimates also ranged widely. So the cost may be roughly similar

to method 1631, because the clean hands technique is still required. The clean hands technique could increase the cost to roughly $250 for method 1631. In some instances, much of the cost of these mercury sampling methods can be attributed to the travel expense for persons qualified to perform the clean hands sampling. Since few labs perform 245.7 (possibly because there is little difference in cost compared to 1631, but 245.7 is much less sensitive), method 245.7 is a less feasible solution.

While normally industrial storm water dischargers (those enrolled in the general permit) may only be sampling one per year, a discharger with an exceedance of the Numeric Action Level may need to sample multiple times, and the cost for 1631 (or 245.7) could be over 1000$ after three or four samples. These dischargers range from small businesses to large scale industrial operations. For the small businesses dischargers this is likely a significant cost, and it does not include the cost of the actions required to reduce the mercury in the discharge.

<u>COMMENT MWB 23</u>

A third apparent rationale for not having a low action level for total mercury was that pollutants will be diluted by storm water. But, as detailed above for wastewater and industrial dischargers, mitigating effects of dilution are not appropriate for bioaccumulating substances like mercury. While acknowledging that numeric action levels “are not meant to be water quality standards, objectives or criteria,” Water Board staff should consider using a more scientifically-based method for developing a new numeric action level for industrial storm water dischargers for total mercury. The draft staff report notes that the original 1,400 ng/L numeric action level was based on outdated aquatic life criterion for mercury. Is there an updated metric related to mercury’s environmental impact that could be used to inform development of a numeric action level for industrial storm water dischargers?

<u>RESPONSE TO MWB 23</u>

Comments are understood. However, there is not clear more scientifically-based threshold to use for the numeric action level. Section 3.11 of the Staff report reviews other U.S. EPA water quality criteria for freshwater. That section lists a chronic U.S. EPA aquatic life criterion of 770 ng/L, which is higher than our proposed numeric action level. Also, there is another aquatic life criterion of 12 ng/L (U.S. EPA 1985a, U.S.EPA 1986), which is equivalent to our water quality based threshold for wastewater treatment plants To achieve this threshold (12 ng/L) requires a wastewater treatment facility.

Storm water discharges are sporadic, and the discharge is diluted by other storm water while the discharge is occurring. This is different than a continuous discharge (such as wastewater) that is constantly occurring. Hence, for storm water discharges, the numeric action level that is applied to a specific discharge is not water quality based, unlike wastewater discharges, and consideration of dilution in incorporated in a different manner for storm water.

S.2 Mark B. Sandheinrich (MS-UW)

Review of Draft for Scientific Peer Review: Amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Mercury Water Quality Objectives and Program of Implementation

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This review of the document "Draft for Scientific Peer Review: Amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Mercury Water Quality Objectives and Program of Implementation focuses on the Draft Staff Report including the Draft Amendment Language (Appendix A), Review of Effects on Wildlife (Appendix J), Wildlife Targets (Appendix K), and the Derivation of Trophic Level Ratios (Appendix L). My review is limited to evaluating the proposed water quality objectives relative to the protection of wildlife and I attempted to address those areas discussed on pages A2-6 and A2-7 of Attachment 2 from the June 16, 2016 memorandum signed by Karen Larsen: "Request for Scientific Peer Review of the Draft Proposed Rule for Mercury Water Quality Objectives."

<u>Review of data collected on various wildlife species including food intake rates, reference doses, and diet compositions from previous published reports</u>.

<u>COMMENT MS-UW 1</u>

The Draft Staff Report and USFWS (2003) based the water quality objectives on endangered and threatened freshwater piscivorous wildlife that occur in California as well as a select group of species that were included by regional water boards in the development of site-specific objectives. Food intake rates, reference doses (discussed below) and diet compositions were determined from extensive peer-reviewed literature and published reports from the USFWS and USEPA and used commonly accepted scientific practices.

<u>RESPONSE TO MS-UW 1</u>

The reviewer's agreement with the approach is noted.

<u>Review of uncertainty factors used to calculate the Reference Dose (RfD)</u>

As stated in USFWS (2003) the RfD may be determined for a given taxonomic group by adjusting the test dose (TD) through the application of uncertainty factors (UFs) to incorporate variability in toxicological sensitivity among species (UF_A), to extrapolate from subchronic studies to account for chronic exposure (UF_S) and to account for spacing in concentrations of test doses (UF_L).

For the mammalian RfD, USFWS (2003) evaluated TD, RfD and UFs from the Great Lakes Initiative (GLI) Technical Support Document for Wildlife (USEPA 1995) and the Mercury Study Report to Congress (MSRC; USEPA 1997). Though both USEPA (1995) and USEPA (1997) used different test doses from toxicity studies on mink (Wobeser 1976 a, b) and different uncertainty factors, the calculated RfDs were similar from the two reports (0.016 and 0.018 mg Hg/kg body weight/day). These RfDs were 10% to 33% of the test dose (no observed adverse effects concentration). Appendix K. (Wildlife Targets) of the Draft Staff Report for Peer Review: Provisions (hereafter referred to as the Draft Report) used a mammalian RfD of 0.018 mg Hg/kg body weight/day.

The avian RfD of 0.021 mg Hg/kg body weight/day in the Draft Report was also from USFWS (2003) and was based on a test dose of 0.064 mg/kg body weight/day from a study of mallard ducks (Heinz 1979) and uncertainty factors from the MSRC. The RfD is approximately 33% of the test dose.

COMMENT MS-UW 2

Though dated, the studies by Wobeser (1976 a,b) and Heinz (1979) likely represent the best available peer-reviewed studies that evaluated dietary concentrations of methylmercury on mammals and birds. Other studies, including those in which avian eggs were injected with methylmercury, may provide information on toxic concentrations of methylmercury but may not be germane because of different routes of exposure, toxicokinetics and toxicodynamics. USFWS (2003) reviewed and cited a number of other laboratory and field studies that supported the acceptance of the test dose determined from the studies of Wobeser (1976) and Heinz (1979). I am unaware of more recent studies that would contradict that conclusion.

RESPONSE TO MS-UW 2

The reviewer's agreement with the approach is noted.

Though different test doses and UFs were used by GLI and MSRC in determining the RfD for mammals, the final RfD values were similar. Because the Water Quality Objectives for wildlife in the Draft Report are based on the protective wildlife targets for the most sensitive species (Draft Report Table K-3) and avian species were the most sensitive species in each trophic level category, the UFs and subsequent RfD for the avian species deserve additional scrutiny. The avian test dose (0.078 mg/kg body weight/day) used by GLI and MSRC was the same. However, the cumulative UFs used by GLI (UF_A x UF_S x UF_L = 6) and MSRC (UF_A x UF_S x UF_L = 3) differed two-fold. USFWS (2003) concluded that the UFs presented in the MSRC were more appropriate for determining the avian reference dose than those from the GLI. Based on the TD from Heniz (1979) and UFs from MSRC, they calculated an RfD of 0.021 mg/kg-bw/day. This is the RfD used in the Draft Report. However, USFWS (2003) also stated (page 21) "because several of the bird species considered in this effort are not obligate piscivores, the argument presented in the MSRC for using a UF_A of 1 may not be appropriate for these species." "An alternative avian RfD of 0.007 mg/kg-bw/day was also presented for the three clapper rail subspecies and the snowy plover."

COMMENT MS-UW 3

Using the alternative RfD of 0.007 mg/kg-bw/day from USFWS (2003), I recalculated the Wildlife Values for the 3 species of rails and western snowy plover (Table 1).

Table 1. Alternative Wildlife Values (mg/kg in diet). Species body weight and FIR are from table K-1 of the Draft Report.

Species	RfD (mg/kg/day)	Body weight (kg)	FIR (kg/day)	Wildlife Value (mg/kg in diet)
California Ridgeway's rail	0.007	0.346	0.172	0.014
Light-footed Ridgeway's rail	0.007	0.271	0.142	0.013
Yuma Ridgeway's rail	0.007	0.271	0.142	0.013
Western snowy plover	0.007	0.041	0.033	0.009

Using the alternative Wildlife Values in Table 1 and the same methods as presented in the Draft Report, I then recalculated the protective wildlife targets in various trophic levels for these same species (Table 2).

Table 2. Protective wildlife targets in various tropic levels.

Species	TL2	TL2/3 < 50 mm	TL3 <150 mm	TL3 150-500 mm
California Ridgeway's rail	0.012		0.07	
Light-footed Ridgeway's rail	0.007		0.04	
Yuma Ridgeway's rail	0.003		0.017	
Western snowy plover	0.036			

The proposed water quality objectives now can be evaluated relative to protective targets for various trophic levels in which these four species feed and based on the alternative RfD presented in USFWS (2003).

Target for Wildlife That Prey of TL3 Fish, 0-500 mm. Yuma Ridgeway's rail remains as the most sensitive species in this category. However, using the same food chain multiplier of 4 (page K- 16 of Draft Report) and the protective target from Table 2 above, 0.017 mg/kg x 4 = 0.068 mg/kg in TL4 fish. Consequently, a water quality objective of 0.2 mg/kg in TL4 may not maintain 0.017 mg/kg in TL3 fish 0-500 mm based on the alternative RfD.

Target for Wildlife That Prey on TL2 Fish. Dividing the TL3 150-500 mm target (0.08 mg/kg) by the national food chain multiplier of 5.7 results in a corresponding TL2 values of 0.014. This is greater than the Table 2 recalculated targets for the California Ridgeway's rail and Light-footed Ridgeway's rail. Consequently a water quality objective of 0.2 mg/kg in TL 4 may not meet TL2 targets under this scenario.

Using the alternative RfDs presented in USFWS (2003) indicates that the water quality objective of 0.2 mg/kg in TL4 fish may not be protective of all species. The Draft Report Appendix K (pages K-26 and K-27) makes a logical argument why the alternative RfDs were not used and acknowledges points of uncertainty that suggest a less stringent or more stringent objective. In particular, the acknowledgement and discussion of the limitations and sources of uncertainty in the calculations is a strength of the Draft Report and supports the readers' assumption that best professional judgement was used in selecting UFs to calculate RfDs.

RESPONSE TO MS-UW 3

The reviewer's support of the logical argument and the discussion on uncertainties is noted. Staff appreciates the rigor with which the reviewer analyzed this issue.

Review of Trophic Level Ratios

COMMENT MS-UW 4

The Draft Report used food chain multipliers (FCM) from USFWS (2003; page 5) and/or trophic level ratios (TLR) to translate between methylmercury concentrations in different sizes of fish in different trophic levels. The FCMs and TLRs were either obtained from USEPA national data (if taken from USFWS (2003)) or from California site-specific data or California state-wide data (Appendix L). These FCMs and TLRs were used in deriving protective targets for individual species that consumed fish from multiple trophic levels. The most sensitive targets, in turn, were used to develop water quality objectives for all wildlife. In addition, the FCMs were used to calculate expected concentrations in TL 2 and TL 3 fish if the limiting methylmercury concentration is 0.2 mg/kg in TL 4 fish.

The FCMs in USFWS (2003) were calculated from Bioaccumulation Factors (BAFs) from draft National BAFs presented in the EPA's methylmercury criterion document (U. S. EPA. 2001. Water quality criterion for the protection of human health: methylmercury. EPA-823-R-01-001. Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency Washington, DC.) and are presented here for discussion (Table 3).

Table 3. Draft BAFs for methylmercury empirically derived from field data collected across the United States and reported in the open literature. Based on BAFs calculated from lotic and lentic systems.

	BAF Trophic	BAF Trophic	BAF Trophic
5th Percentile	18,000	74,000	250,000
Draft national values (approx geometric mean, 50th percentile)	120,000	680,000	2,700,000
95th Percentile	770,000	6,200,000	28,000,000

USFWS (2003) and subsequently the Draft Report used the approximate geometric mean BAF for each trophic level to calculate the food chain multipliers. The FCM for any trophic level is the ratio of the BAF for that trophic level to the BAF for the trophic level below.

FCM 4/3 = 2,700,000/680,000 = 4
FCM 3/2 = 680,000/120,000 = 5.7

From Table 1, and as the EPA acknowledges in the criterion document, it is evident that the range for BAFs for each trophic level varies by at least 10 (TL 2) to approximately 100 fold (TL 3 and TL 4). Moreover, the criterion document states "EPA fully recognizes that the approach taken to derive mercury BAFs collapses a very complicated non-linear process, which is affected by numerous physical, chemical, and biological factors, into a rather simplistic linear process.

EPA also recognizes that uncertainty exists in applying a National BAF universally to all water bodies of the United States. Therefore, in the revised 2000 Human Health Methodology (EPA , 2000) we encourage and provide guidance for States, Territories, Authorized Tribes, and other stakeholders to derive site-specific field-measured BAFs when possible. In addition, should stakeholders believe some other type of model may better predict mercury bioaccumulation on a site-specific basis they are encouraged to use one, provided it is scientifically justifiable and clearly documented with sufficient data" (page A-18 of USEPA (2001)).

Using the 5th and 95th percentiles for the BAFs instead of the geometric mean BAFs to calculate the FCM results in lower and upper bounds of the range of the FCM for any trophic level.

For FCM 4/3 the lower and upper bound of the range is at least

250,000/74,000 = 3.4

and 28,000,000/6,200,000 = 4.5.

In turn, the lower and upper bounds of the range of FCM 3/2 is at least

74,000/18,000 = 4.1

and 6,200,000/770,000 = 8

Although, the range of the calculated food chain multipliers is not as great as that of the BAFs from which they are derived, based on the EPA's admission of the limitation of the draft national BAFs and the importance of the FCMs to establishing the water quality objectives, the use of empirically derived national BAFs may or may not be appropriate. At the very least, the Draft Report should address the uncertainty associated with using these values and also address why FCMs or TLRs derived specifically from California water bodies were not used to calculate expected methylmercury concentrations in TL3 and TL2 fish if TL4 fish were limited to 0.2 mg Hg/kg.

RESPONSE TO MS-UW 4

Agree- these uncertainties should be acknowledged and these uncertainties were acknowledged in appendix K. In Appendix K there is a section on uncertainties (Section 9) and the second paragraphs says:

> **"The food chain multiplier and trophic level ratios are estimates that add to the uncertainty in these calculations. Some are site-specific while some were derived from national data. These values may not accurately represent all of California's waters, but a more accurate alternative is not available."**

New text was added:

> **"More specially, FCMs could not be calculated, since sufficient data were not available for fish < 150 mm or TL2 organisms. California's statewide monitoring program has collected a great deal of data on large TL4 and TL3 fish, but much less data on fish <150 mm or TL2 organisms. While there was a large data set for large TL4 and TL3 fish, the data that could be used to derive the TLRs provided poor geographic representation of California (see Appendix L). Since the TLRs were limited and a California FCM was not possible to calculate, values form various California projects, as well as targets derived from national values are all included in Table K-3 to provide and idea of the uncertainly in these values. However, this will not capture all of the uncertainty. If minimum and maximum values for the FMCs and TLRs were used the variation in the targets would be larger. The actual amount of mercury in fish in various waters will vary by the food chain in a particular water body and other waterbody specific factors. The variation in mercury concentrations in prey fish vs. sport fish in a particular water body is exemplified in the recent USGS grebe study (Ackerman et al. 2015, Figure 5, see also Section 7.1 of this Appendix). Only average FCM and TLR values were**

used in this analysis to provide estimates for the whole state. These estimates may be either over protective or under protective for a particular water body."

Next text was also added (at the very end of Section 4.1 of Appendix K) just after the introduction and descriptions of the TLRs and FCMs

"While California TLRs were derived for this analysis, California specific FCMs could not be calculated, since sufficient data were not available on fish < 150 mm or TL2 organisms. The FCMs are only used for a few species where a California TLR could not be used, including: river otter, southern sea otter, California Ridgeway's rail and light-footed Ridgeway's rail. Additionally, when possible, targets from site-specific projects and from site-specific data were included in Table K-3, such as for river otter. A range of values form various California projects, as well as targets derived from national values are included in Table K-3, to show some of the uncertainly in these values. However, this does not include all the uncertainty in these targets (see section 9)."

The description of the trophic level ratios (TLR) in Appendix L already discussed that the TLRs were from data based on a limited geographic representation of California.

<u>Review of the resulting three proposed water quality objectives to ensure protection of wildlife</u>

<u>COMMENT MS-UW 5</u>

Appendix J is a very good and concise review of the relevant literature on the effects of methylmercury on fish and wildlife and provides a summary of suggested dietary methylmercury thresholds in wildlife (Table J-1) and fish (Table J-2).

<u>RESPONSE TO MS-UW 5</u>

The reviewer's agreement with the approach is noted.

<u>COMMENT MS-UW 6</u>

Appendix K (pages K-17 to K-19) compares the target values to a study of mercury in grebe blood relative to mercury prey and sport fish (Ackerman et al 2015 a,b). A concentration of 1 mg /kg mercury in grebe blood correlates to approximately 0.2 mg/kg in sport fish and 0.048 mg/kg in prey fish 10-123 mm and represents the boundary between low and moderate risk in loons (Evers et al. 2004). The target of 0.05 mg/kg for fish 50-150 mm is less than the suggested benchmarks for loons (Depew et al 2012b) and, based on food chain multipliers and dietary composition, is equivalent to the LOAEL (lowest observed adverse effects level) in white ibis (altered behavior; Frederick and Jayasena 2010), a species with the lowest mercury threshold reported in the literature.

<u>RESPONSE TO MS-UW 6</u>

The reviewer's agreement with several conclusions is noted. Additionally, while the target of 0.05 mg/kg for fish 50-150 mm is equivalent to the lowest observed adverse effects level in white ibis (0.05 mg/kg, altered behavior; Frederick and Jayasena 2010), when considering the diet of the ibis, the target should be more protective of the ibis. Appendix K (section 7.3) describes how the target of 0.05 mg/kg for fish 50-150 mm is roughly equivalent to a *no observed adverse effects* level in white ibis, based on food chain multipliers and dietary composition (since ibis mainly prey on organisms with a lower trophic level status than fish 50-150 mm).

<u>COMMENT MS-UW 7</u>

Based on the assumptions in developing the RfDs for individual species (i.e., acceptance of UFs) and the use of FCMs based on nationwide rather than state-specific data, the proposed water quality objectives (0.2 mg Hg/kg in sport fish; 0.05 mg Hg/kg in prey fish 50 to 150 mm; 0.03 mg Hg/kg in prey fish < 50 mm consumed by the California least tern) may reasonably be expected to be protective of most species of piscivorous wildlife.

<u>RESPONSE TO MS-UW 7</u>

The reviewer's agreement with the approach is noted.

<u>COMMENT MS-UW 8</u>

Moreover, the Draft Staff Report recognizes that altered reproduction in birds is one of the more frequently observed effects of sublethal methylmercury exposure and that mercury concentrations in prey fish vary seasonally (Ackerman et al. 2015 a,b). Consequently, the Prey Fish Water Quality Objective and Prey Fish Water Quality Objective for California Least Tern defines the time period annually when the objective applies based on the avian breeding cycle.

<u>RESPONSE TO MS-UW 8</u>

The reviewer's agreement with the approach is noted.

<u>COMMENT MS-UW 9</u>

The lack of available data precludes evaluating the water quality objectives relative to insectivorous wildlife that consume the terrestrial stages of aquatic insects and may be exposed to relatively high concentrations of methylmercury. The Staff Report cites an unpublished study by Robinson et al. (2011) that documented concentrations of methylmercury (1.66 ppm) in the blood of riparian song sparrows downstream of New Almaden. These concentrations were similar to those that were associated with a 25% to 30% reduction in nest success of Carolina Wrens along two mercury-contaminated rivers in Virginia (Jackson et al. 2011). Additional studies will be required to determine the relation between mercury concentrations in prey fish and sport fish and those of aquatic insects that inhabit the same water bodies.

<u>RESPONSE TO MS-UW 9</u>

Agree. Text has been added to Appendix K (Section 9) stating that:

"The lack of available data precludes evaluating exposure to insectivorous wildlife that consume the terrestrial stages of aquatic insects and may be exposed to relatively high concentrations of methylmercury. High concentrations of methylmercury (1.66 ppm) have been measured in the blood of riparian song sparrows downstream of New Almaden, site of a large mercury mine (Robinson et al. 2011, Section K.10.2). These concentrations were similar to those that were associated with a 25% to 30% reduction in nest success of Carolina Wrens along two mercury-contaminated rivers in Virginia (Jackson et al. 2011). Additional studies will be required to determine the relationship between mercury concentrations in prey fish and sport fish and those of aquatic insects that inhabit the same water bodies."

S.3 Michael Bliss Singer (MBS)

Review of 'Amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Mercury Water Quality Objectives and Program of Implementation'

Michael Singer, University of St Andrews (UK) and University of California Santa Barbara, 9/19/2016

Summary

In a regulatory framework, the current standards for protection of water quality and fish from Hg contamination have been found to be inadequate given the scale of the pollution problem in California and the risks to humans and wildlife. Thus, an Amendment has been proposed to strengthen the regulation of Hg contamination and its monitoring. Below I evaluate and comment specifically on items 5-8 (Attachment 2) regarding the scientific soundness of the proposed rules. Note: I combine my discussion for the related topics of 5-7, given they are interrelated. Subsequently I provide more detailed and considered comments on broader aspects of the proposed rule as stipulated in a and b in Attachment 2. Specifically, I provide contextual information and even some suggestions for how particular options may be improved and where potentially important data and/or theoretical gaps exist. I mostly limit my discussion to matters that are within my main areas of expertise, but do provide a professional (non-expert) opinion in some cases. My comments are keyed to specific sections/issues listed in the Staff Report. Overall, I am generally supportive of the science that lies behind the amendment. I believe the report represents deep consideration of the relevant issues in light of the contamination risks to wildlife and humans across the state.

Addressing the Science

5. A water column concentration of 12 ng/L total mercury in rivers is generally consistent with meeting the Sport Fish Water Quality Objective (0.2 mg/kg methylmercury in fish tissue) in rivers based on bioaccumulation factors…

6. Consideration of a more protective water column concentration than 12 ng/L total mercury is warranted as the effluent limitation for municipal wastewater and industrial discharges to waters that are slower flowing than rivers and streams, since these waters are likely to experience higher rates of mercury methylation and bioaccumulation.

7. A more protective water column concentration than 12 ng/L total mercury is warranted as

the effluent limitation for municipal wastewater and industrial discharges to waters where more stringent water quality objectives apply for subsistence fishing or tribal subsistence fishing.

COMMENT MBS 1

[Section 6.1 (Issue A)] I support Option 2 (the fish tissue objective). Water concentrations of total and methylmercury tend to be low and are often diluted over large areas by the mixing of highly concentrated water with the disproportionately common low concentration water. Given the apparently low risk of Hg contamination by skin contact and/or by drinking water with low levels of MeHg (or even total Hg), I agree with a more modern standard of measuring MeHg in fish tissues. However, fish sampling is obviously a destructive procedure, so the monitoring efforts of such concentrations over large areas may be complicated. Nevertheless, this is the most logical standard to implement since it is the primary pathway of contamination to humans and to wildlife in areas that are not designated impaired under the Clean Water Act.

RESPONSE TO MBS1

The reviewer's agreement with the approach is noted.

COMMENT MBS 2

In the latter cases, the local TDML standards (including those for sediment) should still supersede this objective.

RESPONSE TO MBS 2

The reviewer's agreement with the approach is noted.

COMMENT MBS 3

[Section 6.1 (Issue A)] I see the complication of not being able to regulate industrial/mining discharges, but perhaps a hybrid of Options 2 and 3 is possible, where Option 3 (only for discharged water, rather than the water column of the receiving water course) can hold. If not, selection of Option 2 will obviate regulation (at the state level) of Hg-laden discharges, except in cases that are (or become) classified as 'impaired'. If the designated concentration for Option 3 were elevated for discharges only (as I have conceived of it here), this may alleviate the concerns of industry about the infeasibility of implementation.

RESPONSE TO MBS 3

Agree. This suggested "hybrid" is in a way achieved in the recommended proposal. While the water quality objectives are in fish tissue, permitting requirements are expressed as water column concentrations.

COMMENT MBS 4

[Section 6.1 (Issue A)] I don't totally agree with the supposition in Option 4 that anoxic sediments are the primary sources MeHg production. This has not been shown at the landscape scale and may instead reflect biases in sampling (of lowland wetlands, estuaries, etc). We DO know that a drop in oxygen levels is required to activate anaerobic bacteria, but this can also occur within sediments that not classified as anoxic, but are instead subjected to anoxic or even suboxic conditions temporarily (Briggs et al., 2015; Singer et al., 2016). These flood pulses have been suggested by others to induce MeHg production in hyporheic zones along streams (Bradley et al., 2012; Hinkle et al., 2014).

RESPONSE TO MBS 4

This sentence was deleted: "Moreover, the primary setting for methylation of mercury is thought to be anoxic sediments."

COMMENT MBS 5

While it may be true that atmospheric deposition of Hg is a primary source in other regions, this is not likely to be the case in most of the California water bodies (see above). This statement needs to be clarified.

RESPONSE TO MBS 5

Agree, we changed "many" to "some" in the passage: "However, sediments are not a major source of mercury for all water bodies. There are several other potential sources including atmospheric deposition, which is likely the largest source of mercury in some water bodies." The comment that atmospheric deposition is unlikely to be important in *mining impacted areas* is noted and reflected in the section on sources (4.4.3, see also comment MBS 19 & 20). However, as was noted in section 4.4.3 of the staff report:

> **"Mercury deposition from atmospheric emissions is thought to be the major source of mercury in some Southern California lakes and reservoirs (U.S. EPA 2012, Tetra Tech 2008)."**

COMMENT MBS 6

It is encouraging that the Water Board is working on a separate set of Hg objectives for sediment that would sit alongside the fish tissue objectives recommended (if adopted). Presumably the same parallel objective approach could be adopted for wastewater and industrial discharges to ensure this pollution source is regulated, but at a feasible/appropriate level?

RESPONSE TO MBS 6

The proposal at hand does include a means to control mercury from wastewater and industrial discharges (discussed in Sections 6.12 and 6.13 of the Staff Report).

COMMENT MBS 7

[Section 6.1 (Issue A)]Option 5 is not viable. In environmental science/management, we need quantitative standards to ensure regulation is consistently applied and achieves its objectives.

RESPONSE TO MBS 7

Agree.

COMMENT MBS 8

[Section 6.5 (Issue E)] I support the establishment of quantitative (numeric) guidelines for MeHg in fish tissue for subsistence and tribal subsistence use. However, given the large variations MeHg concentrations for different sites, I actually support Option 5, which would enable further study to determine more precisely what standards are required for different sites. The option would also be less controversial to water dischargers, which might limit legal challenges. Overall, without some clear metric, it would be impossible to evaluate and/or enforce water quality standards. This is not my area of expertise, but a strong case is made that quantitative standards will ultimately be necessary, so it seems that now is the time to create them.

RESPONSE TO MBS 8

Agree that option 5 has the advantages the reviewer lists. The recommendation will be changed to option 6, which is the narrative water quality objective. This option will incorporate site-specific considerations as the commenter suggests. The advantages and disadvantages of all options will be considered more during the public comment period. See Comment MWB 17 for more advantages of the narrative water quality objective (also Comment EVW 14 is related).

COMMENT MBS 9

[Section 6.11 (Issue K)] I support Option 1. Option 2 is not logical because fish can be contaminated by Hg from various sources, so this limitation would be draconian, in that it is assumes only the discharge from wastewater treatment or industry is responsible. Clearly there are legacy sources of Hg contamination in food webs of California that are not associated with these activities. In spite of the challenges in quantifying bioaccumulation factors, I still think it is preferable to use a water column concentration in the effluent. This makes monitoring and regulation more feasible.

RESPONSE TO MBS 9

The reviewer's agreement with the approach is noted.

COMMENT MBS 10

[Section 6.12 (Issue L)] I am not very familiar with the analysis of bioaccumulation factors (BAFs), but it is clearly an analysis of limited utility because it is based on so few studies, incomplete science, and the variability in the resulting metric is so high (note the log scale on Figure I-1 in the Water Column Appendix). I cannot reasonably evaluate what would constitute an appropriate water column limit for effluent, nor can I imagine that anyone can. However, another environmental scientist is probably in a much better position to evaluate this than I am. I do recognize that the limit must be higher than the current average water column concentration of 4.7 ng/L for California waters (as mentioned in the draft report). Another consideration is how and when the monitoring should proceed. The issue mentions quarterly sampling, but this may not fit with the timings of maximum concentration and/or maximum discharge. Perhaps the schedule of sampling for a particular discharge should be designed on an adaptive basis that could be determined from past discharge records of each company? Again, this is clearly not my area of expertise.

RESPONSE TO MBS 10

In line with the reviewer's suggestion, the actual monitoring frequency for a facility is determined based on the discharge volume, other facility specific variables, and the federal regulations (the Nation Pollutant Discharge Elimination System). For a typical wastewater treatment plants, often monthly samples are required. If the discharge is intermittent, sampling will only be conducting during the discharge. In the draft Provisions, a minimum frequency is set forth.

In regards to timing, the effluent limitations are derived using conservative assumptions about the variability of the discharge, so that timing the sampling to attempt to measure maximum concentrations or maximum discharges is not necessary. For example the maximum background concentration (not average concentration) is considered when assigning effluent limitations.

In regards to effluent limitations being higher than the average ambient concentration- this is not a general principle that must be followed. If waters are impaired (in other words, if pollutant levels exceed water quality objectives) then the effluent limitations that will be necessary to restore those waters may well be below the average ambient concentration. Also averages can be skewed by very high

concentrations, and many of the data are from waters where mercury concentrations are elevated (since TMDLs prompt more monitoring). New text with a reference to the figure on the spatial distribution was added to the Staff Report (Section 4.5.1):

> **"Many of the data were from areas with elevated mercury such as San Francisco Bay. See Figure N-4, in Appendix N, for the spatial distribution of samples."**

Since mercury is often bound to sediment, the use of sediment controls will effectively reduce the transport of mercury into waters, for discharges that can contain large amounts of sediment.

COMMENT MBS 11

[Section 6.8 (Issue H)] I generally agree with the recommendation for Option 2. However, I have concerns that may require more thought and revision before this option can be adopted in the Amendment. I am particularly concerned about the specific (and singular) emphasis on erosion control. I acknowledge that sediment-adsorbed Hg is the dominant source of Hg contamination of water bodies and food webs, that former mines are important contributors, and that erosion of mine tailing can move significant quantities of Hg-laden sediment to downstream locations (Singer et al., 2013). Thus, limiting erosion of Hg-laden sediment from Hg and gold mines (especially abandoned ones) is potentially important. However, this focus on future erosion does not acknowledge that most of the landscape downstream from large and/or important Hg-contributing mines (e.g., within Yuba R, Cache Cr basins, etc) is ALREADY contaminated with Hg-laden sediment over broad areas and to deep depths (e.g., (Bouse et al., 2010; Donovan et al., 2016a, b; Donovan et al., 2013; Marvin-DiPasquale et al., 2009; Singer et al., 2013)), so controlling erosion from these mines (which in and of itself may be infeasible in many locations) may only have a minor contribution in limiting further contamination to these water courses. In fact, the infrequent flooding regime that inundates previously contaminated sediments for long periods, may thus enable in situ MeHg production (in the absence of further erosion), which could drain back into rivers and become available to food webs. We have documented widespread contamination of sediment throughout the Sacramento Valley, so even though it might be helpful to control the erosion of sediment from abandoned mines, the non-point Hg source problem may be of greater concern. I would like to see this risk reflected in the language on Issue H (and others). This would put less blame/focus on owners of abandoned mines (including government agencies) and treat the problem as a legacy of former mining gone amok. This nonpoint upland contamination source is not explicitly included in Issue I.

RESPONSE TO MBS 11

Agree that the flooding of contaminated sediment is a source of methylmercury to biota. However, is not clear how this source of methylmercury could be controlled. The Provisions include "logical first order controls" as the reviewer phrased it in later comment, which is erosion control for areas enriched in mercury. Text was added to section 4.4.6 to acknowledge this source of methylmercury:

“Another potentially large source of methylated mercury is the landscape downstream from historic mining areas that are contaminated with mercury laden sediment. This sediment has become part of the landscape, covers large areas to deep depths (e.g., (Bouse et al., 2010; Donovan et al., 2016a, b; Donovan et al., 2013; Singer et al., 2013)). When occasionally flooded, methylmercury is produced, which could drain back into rivers and become available to food webs.”

That section (now Section 6.9) was reorganized to talk about historic mines first and mines tailings that are integrated into the landscape. Also new text was added at the end of Section 6.9.2:

“Another challenging aspect to the historic mining legacy is that much of the landscape downstream from mercury mines is already contaminated with mercury laden sediment over broad areas and to deep depths. These are not recognizable mine sites, rather the sediment has become part of the landscape. This type of mercury is very difficult to address and may be a more important source of methylmercury than the original mine sites. In some cases these sources could be addressed though the Clean Water Act 401 certification and wetland program and the nonpoint source program (Section 6.10).”

New text was added to Section 6.10.2:

“Also the inundation of mercury contaminated sediments from occasional flooding of land can produce methylmercury. A great deal of mercury contaminated sediment has already left mine sites and become part of the landscape as a result of historic mining. The methylation of the mercury in these contaminates sediments during occasional flooding is not a feasibly controllable process at this time. ”

Regarding sediment controls to reduce the transport of mercury into water and the comment that these sediments from mercury contaminated areas are only minor contributions- when viewed individually, each discharge is only a minor contributor. That can be said for every individual discharge that can carry mercury or methylmercury, whether it is a discharge from a mine, storm water, or wastewater. This does not mean some level of control for each discharge is inappropriate.

COMMENT MBS 12

[Section 6.9 (Issue I)] In this section, the terminology is a bit challenging to interpret. Nonpoint Hg sources include riparian zones as listed, but the discussion seems to be focused only on the lowland environment (e.g., emphasizing permanent wetlands and agricultural lands). To my mind, this is too narrowly focused and ignores the potential production and delivery to the food web of MeHg in nonpoint source areas that are only seasonally wet. I generally support Option 2 here, but with a few caveats. The language here is focused on total Hg concentrations in sediment as an indicator of MeHg risk to water bodies (and the food web). There is not necessarily a direct link, even if this is logical to first order. Lower concentrations of total Hg (below 1 ppm), but well above background, may still provide important sources of MeHg to aquatic ecosystems. There should be acknowledgement here that we need to link the hydrologic (flooding) regime to the risk of MeHg production, since even highly contaminated dry sediments won't contribute Hg to food webs. The two risks are inundation that decreases oxygen levels in contaminated sediments and enables microbial methylation, and the erosion of Hg-laden sediment for delivery to downstream areas where methylation is likely (higher risk of inundation).

RESPONSE TO MBS 12

Agree that dry mercury contaminated sediments will not contribute methylmercury to food webs. Since the Water Boards regulate contaminants in water or "discharges", the Provisions should not affect dry sediments. The Provisions incudes requirements to keep sediments out of downstream waters, including areas that are likely to be inundated (riparian zones, wetlands). This type of requirement seems consistent with the comment. Yes, another issue is that areas that may be inundated are already full of contaminated sediment. It is not obvious how the methylmercury that results from flooding uplands could be controlled and the reviewer does not make a suggestion. The Provisions include "logical first order controls" as the reviewer phrased it. TMDLs or clean up orders will likely be needed to develop additional controls in highly contaminated areas.

Nonpoint source discharges are not confined to the "lowland environments", that section stated that nonpoint sources included forests. Public forest land comprises much of the land at higher elevation in the Sierra Nevada Mountains. We added "open land" and "grazing land": and this text was clarified (second sentence of Section 6.9.1):

> **"The Nonpoint Source Policy aims to minimize nonpoint source pollution from land use activities in agriculture, grazing, urban development, forestry, recreational boating and marinas, hydromodification and wetlands. This can include lands with historic mine tailings and other open land.**

COMMENT MBS 13

Second, the spatial distribution of total Hg is not well established for most areas. We don't know the vertical distribution of Hg contamination in areas downstream of former mines, nor do we know how far this contamination extends laterally away from river courses (but is still susceptible to inundation during large floods). These aspects represent an important data gap that the Alpers study is unlikely to fill at the level of detail required to understand the nonpoint source risk of MeHg contamination.

RESPONSE TO MBS 13

Agree- this is a data gap. TMDLs or clean up orders will likely be needed to develop additional controls in highly contaminated areas.

a. In reading the Draft Staff Report and proposed rule, are there any additional scientific findings, assumptions, or conclusions that are part of the scientific basis of the proposed rule not described above?

b. Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

COMMENT MBS 14

Hg poses a long-term problem for the State of California. In addition to low-level global inputs of Hg through atmospheric deposition (pollution source: global anthropogenic emissions), California has a long history of Hg mining and its use for (most dramatically) industrial-scale gold mining. These historical processes and activities, combined with industrial activities and the subsequent redistribution of Hg attached to sediment and dissolved in water, have created pollution over landscapes and regions. Due to its historical legacy of gold and Hg mining (and to a lesser extent the industrial legacy in the estuary as well), the largest region of Hg pollution in California waterways is in the northern half of the state (e.g., San Francisco Bay region including the Bay-Delta estuary and many of its contributing streams). Some of these areas have already been designated as 'impaired waters' under the Clean Water Act, yet others are less well-regulated or monitored. It is likely that the problem of Hg contamination will persist well into the future because the Hg pollution in waters and sediments is so widespread that clean-up efforts are challenging if not intractable. Most of the historic Hg attached to sediment and in waters is in an inorganic form, and therefore not particularly dangerous to biota because it cannot be incorporated into tissues and the bloodstream. However, at many locations throughout the landscape methylmercury (MeHg), the toxic form of Hg that affects biota (including humans) may be produced by methylating bacteria in conditions of low oxygen. Unfortunately, the Hg pollution of California waters has indeed led to the production of MeHg and the subsequent contamination of food webs that depend on these waters, and the problem is compounded with higher trophic organisms such as fish. This raises a major challenge in California because fish form the basis of the diet of many forms of wildlife (waterfowl along the Pacific Flyway and migratory anadromids). Fish that are potentially contaminated with MeHg are also an important component of the diet of many California residents, and especially that of subsistence communities including tribes that have depended on this food source (and associated waters) for their entire cultural history.

RESPONSE TO MBS 14

Agree. Comment noted.

Below I provide specific responses/impressions to aspects of the Staff Report (again keyed to the relevant sections of the report).

COMMENT MBS 15

Section 4.1 There is evidence that iron-reducing bacteria (FeRB) may also play an important role in methylating Hg some systems (Alpers et al., 2014; Gilmour et al., 2013), so it may be that conventional assumptions about where and how Hg is methylated are outdated. In particular, since sulfate-reducing bacteria (SRB) have been primarily implicated in MeHg production and sulfate is limiting in most of large basins (e.g., apart from wetlands), it is often assumed that wetlands comprise the only important loci for methylation. However, it is possible that FeRB play an important role, especially in locations where iron is in high supply compared to sulfate (i.e., upland locations that are not permanently inundated).

RESPONSE TO MBS 15

This information was added to section 4.1 of the Staff Report (now part of the second paragraph):

> **"There is evidence that iron-reducing bacteria may also play an important role in methylating Hg in some systems (Alpers et al., 2014; Gilmour et al., 2013), not only sulfate-reducing bacteria. The formation of methylmercury is a complex, far from fully understood, biogeochemical process driven by factors that control the activity of methylating bacteria, such as the availability of metabolic electron donors and acceptors, and the availability of aqueous phase mercury complexes (Jonsson et al. 2012)."**

COMMENT MBS 16

Section 4.2 There is evidence that biofilms and algae also play an important role in providing MeHg at the base of food webs (Tsui et al., 2012). This is indicated elsewhere but missing here.

RESPONSE TO MBS 16

The Staff Report acknowledged that phytoplankton is a critical step in the pathway of methylmercury bioaccumulation. The information provided was added to Section 4.2 (second paragraph).

> **"Also, biofilms and algae play an important role in providing methylmercury at the base of food webs (Tsui et al., 2012). Zooplankton consumes phytoplankton, and then small fish and invertebrates consume zooplankton and algae."**

COMMENT MBS 17

Section 4.4 I suggest that there is too much emphasis on wetlands and reservoirs as the primary sources of MeHg production. It may not be the case, which really opens up a much larger regulatory question. Just because fish MeHg is higher in these environments (which is not universally the case—see below), it does not follow that all or most MeHg production occurs in wetlands. Resident fish in permanent wetlands have longer exposure times to MeHg locally produced. However, the rates of MeHg production may not be higher (especially after accounting for *in situ* demethylation).

RESPONSE TO MBS 17

The emphasis on the reservoirs and wetlands as the sources of methylations was reduced from other revisions to the Staff Report (from comments above). These revision added text on additional methylation sources. Also for wetlands, in the very beginning of section of 4.4.7, the text acknowledges that wetlands may be a sink for methylmercury, instead of a source of methylmercury.

COMMENT MBS 18

It is unreasonable to assume, in heavily Hg-contaminated environments of California (gold mining regions), that atmospheric deposition of Hg plays an important role in delivering MeHg to the food web. Recent work has shown that the isotopic signature of MeHg in food webs of Coast Ranges, Yolo Bypass, and Yuba/Feather Rivers, for example, is similar to that of the Hg stored in sediments deposited during the historical mining period (Donovan et al., 2016a, b; Gehrke et al., 2011).

RESPONSE TO MBS 18

Agree that atmospheric deposition is less important in gold mining regions, but in some water bodies it is thought to be the main source in California, as we note in Section 4.4.3. After the line:

> **"Mercury deposition from atmospheric emissions is thought to be the major source of mercury in some Southern California lakes and reservoirs (U.S. EPA 2012, Tetra Tech 2008)."**

New text was added:

> **"However, in heavily mercury contaminated environments of California (gold mining regions), atmospheric deposition of mercury is unlikely to plays an important role in delivering methylmercury to the food web. Recent work has shown that the isotopic signature of methylmercury in food webs of Coast Ranges, Yolo Bypass, and Yuba/Feather Rivers, for example, is similar to that of the mercury stored in sediments deposited during the historical mining period (Donovan et al., 2016a, b; Gehrke et al., 2011). See also Table N-11, on the estimated mercury loadings from the Sacramento-San Joaquin Delta TMDL (Delta) and the San Francisco Bay TMDL."**

COMMENT MBS 19

Also, what is the evidence that Hg from wet deposition is ‘more readily methylated’, particularly in the California setting? This seems like speculation and is perhaps based on an outdated notion (citations from 2002 and 2003), especially when applied at the landscape scale.

RESPONSE TO MBS 19

That text has been revised with updated references to provide better evidence (this section was on the issue of bioavailability of different sources.)

> **“Related, there is a limited ability to predict how an ecosystem may respond to changes in the various sources of mercury (Hsu-Kim et al. 2013). Evidence suggests some forms or sources of mercury/methylmercury are more likely to enter the food chain. The inputs of methylmercury from terrestrial and atmospheric sources have been found to bioaccumulate to a substantially greater extent than methylmercury formed *in situ* in sediment (Jonsson et al. 2012, Jonsson et al. 2014).”**

Again, while the mining legacy is important in many areas in California, in other areas, particularly in some reservoirs in Southern California, atmospheric mercury is thought to be an important source (see comments MSB 5 and MSB 18). (That passage made no assertion specifically for *wet* or *dry* deposition.)

COMMENT MBS 20

[Section 4.4.8] I’m also unconvinced of the relevance of the statement supported by the Fleck reference. I don’t understand how this establishes the importance of a wet deposition MeHg source to food webs.

RESPONSE TO MBS 20

This text was not about mercury atmospheric deposition. This section is on *bioavailability* of different types of mercury. The example in the Fleck reference is about bioavailability in the aquatic environment “…preliminarily results with isotopically labeled mercury indicate that the mercury that is taken up into food webs comes from mercury that is *dissolved in the water column,* rather than the mercury associated with the bottom sediments in a water body (Fleck et al. 2014)”

COMMENT MBS 21

Another important potential impact of climate change is increasing frequency and duration of inundation, which may enable higher net MeHg production in areas that are seasonally dry, but which contain high Hg inventories over multiple meters of depth (Singer et al., 2016). We now have good evidence that such areas may be important loci of MeHg production and uptake into food webs (Donovan et al., 2016a, b).

RESPONSE TO MBS 21

> **New text added to section 4.4.10, second paragraph:**
> **"Related to the storms, is the increasing frequency and duration of inundation of areas that contain high mercury inventories over multiple meters of depth from the historic mining legacy (Singer et al., 2016). This increase in flooding will enable higher methylmercury production in these mercury contaminated areas. Such areas may be important locations of methylmercury production and uptake into food webs (Donovan et al., 2016a, b)."**

COMMENT MBS 22

Section 4.5 It seems that this monitoring effort is probably unnecessary. Efforts could be better targeted on sampling loci that we might be expect to be disproportionately contributing to MeHg loads. In other words, we continue to operate sampling over broad spatial scales, yet mixing of highly concentrated water with water of low concentrations will tend to systematically dilute the signal and the timing of sampling is of particular importance. Similarly, the location within the water column should prioritize locations where benthic organisms, etc. might take up MeHg (at the base of the food web).

RESPONSE TO MBS 22

This comment is assumed to apply to monitoring mercury in the water column. The primary goal of the Water Boards ambient monitoring is to assess compliance with water quality objectives. If the objectives in the mercury Provisions are adopted, the focus of mercury ambient monitoring will move more towards fish tissue monitoring only, and away from monitoring mercury in the water column. Monitoring mercury in the water column may still be done for special studies or TMDLs. Monitoring mercury in the water column must also be done by dischargers for compliance with effluent limitations.

COMMENT MBS 23

Also, there appear to be major geographic biases in sampling efforts, where particularly contaminated streams are not being consistently sampled for water and/or fish (e.g., Yuba R, Cache Cr). See example from Fig. 8 in (Singer et al., 2016) below, where forage fish MeHg concentrations in the Yuba and Feather Rivers equate to an average of 0.083 mg/kg wet weight, higher than most values shown in Figs. 4-8 and 4-9:

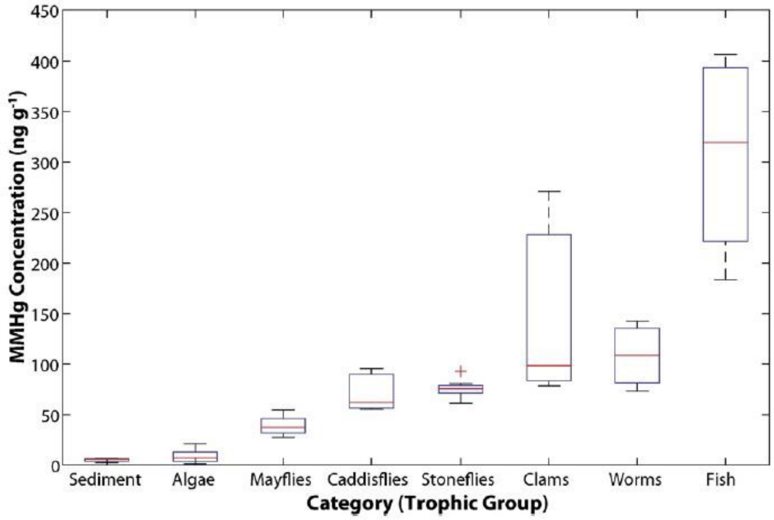

Fig. 8. Boxplots of MMHg (dry weight) in biota separated by organismal group for all samples in the Yuba-Feather system. Sampling locations are shown in Fig. 1. Sampling details provided in Donovan et al. (2016).

Other fish data from Cache Cr exhibit even higher MeHg concentrations. By contrast, the average MeHg concentrations for prey fish we analyzed from Yolo Bypass (a lowland wetland site expected to have much higher MeHg contamination) were 0.05 mg/kg. Note: the proposed MeHg limits for prey fish are 0.05 mg/kg for 50-150mm and 0.03 mg/kg for <50mm fish. Given that these fish provide a likely food source for higher trophic organisms, we may be missing important upstream sampling/monitoring locations that could better guide management and water quality control efforts. Given the migratory habits of many fish species, upland river sites represent an important data gap for understanding the regional picture of MeHg contamination, whether or not upstream reservoirs are providing a downstream MeHg supply.

RESPONSE TO MBS 23

This comment seems to be based on the data presented in Figures 4-8 and 4-9. These figures show data from prey fish not sport fish. Most of the data on prey fish to date is from special studies not from the Water Board's statewide monitoring program. So yes, the data is from only a few geographical areas. The Water Board's statewide monitoring program has just begun planning for sampling of prey fish. If the proposed water quality objectives are adopted that would provide additional justification for the statewide monitoring program to sample prey fish throughout the state.

The data in Figures 4-8 and 4-9 was taken from the Water Boards public database: the California Environmental Data Exchange Network (ceden.org). That data was fed into the data base by researchers who conducted the special studies. The data in Signer et al. 2016 was not in that database. The mercury projects staff at the Water Board encourages mercury researchers to add mercury data from their research to the public database, so it is accessible by all scientists. The Water Boards are working towards better connections of our databases with other state water quality databases and

national databases. The suggestions for monitoring designs will be shared with the statewide monitoring program.

COMMENT MBS 24

Figures 4-3 and 4-4 seem to contradict the notion that fish of 150-500mm are the most relevant to regulate for MeHg. The all sizes category on these plots is consistently higher (for both trophic levels 3 and 4). Was this designed because that is the size threshold allowed for fishing or what is typically eaten? If so, this was not made clear.

RESPONSE TO MBS 24

Yes that was not clear in the figures, and the figures were clarified. The figures show mercury concentrations in fish. There is an issue that the size of the fish is not reported in the database in many cases. Many of the fish in the "all sizes" category may well be from fish that were 150-500 mm, but it is unknown since the length of the fish was not reported in the database. If the mercury water quality objectives are adopted with the specified fish lengths, those specified lengths will guide future monitoring efforts. Additionally staff working on the mercury projects keep emphasizing the importance of reporting the length of fish in the database. The figure was clarified by adding text to the legend " 'All sizes' includes many data points for which the length was not reported."

COMMENT MBS 25

Section 4.5.5 This section is very incomplete. There are numerous studies documenting total Hg across various parts of the SF Bay Region (including contributing watersheds). Why is the information not included here? Some relevant papers include, but not an exhaustive list: (Bouse et al., 2010; Domagalski, 2001; Domagalski et al., 2004; Donovan et al., 2016a, b; Donovan et al., 2013; Singer et al., 2013). Several of these papers clearly documented that the threshold for background total Hg in various parts of the basin is ~0.08 ppm (similar to the results presented for Cache Cr). Furthermore, these studies document that concentrations an order of magnitude higher are common in many locations (including river floodplains, bypasses, and Bay-Delta bottom sediments) with some loci that are 2 or more orders of magnitude higher in total Hg. For example, our group has documented concentrations of 3-10 ppm in Yuba River sediments and up to ~200 ppm in sediments draining Hg mines in the Cache Cr basin.

RESPONSE TO MBS 25

Thank you for this additional supporting information. This was added to the report (Section 4.5.5). The Staff Report is not meant to be an exhaustive list.

"Additionally several studies in the San Francisco Bay region suggest that the threshold for background mercury (total mercury) in various parts of the basin is about 0.08 mg/kg (Bouse et al., 2010; Domagalski, 2001; Domagalski et al., 2004;

Donovan et al., 2016a, b; Donovan et al., 2013; Singer et al., 2013), similar to the findings for Cache Creek. Furthermore, these studies document mercury concentrations that are an order of magnitude higher or more in many locations (including river floodplains, bypasses, and Bay-Delta bottom sediments).”

COMMENT MBS 26

Section 4.8 I’m not convinced about the research on selenium and Hg. The interactions may be well understood in laboratory conditions and there may be negative correlations between Se and MeHg concentrations, but that does not clarify the process by which Se modulates methylation processes. Perhaps I’m just not familiar with the relevant literature on this, but I am not convinced by the references provided. Quite frankly, I’m not sure why this whole section is included in this draft report. It seems out of place because the evidence is not convincing that Se amendments would provide any benefit (and could potentially be harmful, as indicated) to ameliorate MeHg production/uptake. It is also not followed up in the development of objectives.

RESPONSE TO MBS 26

Agree. This section is included because we have received other comments suggesting that we included selenium in the development of the water quality objectives or suggestions that the Water Boards dose contaminated reservoirs with selenium. Since, as you point out, the benefits of using selenium is not clear, selenium was not included in the development of the objectives. Section 4.8.2 states: “Overall, the state of the science on selenium–mercury interaction is not close to a point at which it could be incorporated into regulatory limits for mercury.”

S.4 Edwin van Wijngaarden (EVW)

Peer review of draft proposed rule for Mercury Water Quality Objectives and Program of Implementation

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Thank you for the opportunity to review the draft proposed rule for Mercury Water Quality Objectives. I have a Ph.D. in Epidemiology and am a Fellow of the American College of Epidemiology. I have extensive experience in managing and conducting epidemiologic studies and have published 95 peer-reviewed manuscripts with a focus on neurobehavioral outcomes and environmental and occupational health. In the past decade, my primary research efforts have focused on the influence of environmental exposures (in particular mercury and lead) on cognitive outcomes in children and adults. Because of my expertise in Public Health Toxicology, I will comment on the following three conclusions of the draft proposed rule:

1. The proposed Sport Fish Water Quality Objective was derived using sound scientific information and methods;
2. The California Tribes Fish Use Study (Shilling et al. 2014) contains a sound data set to use to establish a default water quality objective to protect tribes;
3. The consumption rate of 4 to 5 meals per week (142 grams per day) is a sound basis from which to derive a subsistence fishing water quality objective that would be applied to the highest trophic level fish.

The basis for my comments are sections of the draft staff report (dated June 2016) and supplementary appendices that are relevant to the three conclusions above (as identified in the request for scientific peer review, Attachment 2), the Shilling 2014 report, the San Francisco Bay Seafood Consumption 2000 report, the US EPA 2002 report estimating fish consumption in the United States and the related 2000 methods report, and literature pertaining to the health effects of mercury. References cited in this review are provided at the end of the document.

<u>The proposed Sport Fish Water Quality Objective was derived using sound scientific information and methods</u>

The Sport Fish Water Quality Objective for mercury is intended to protect the beneficial uses of commercial and sport fishing, wildlife habitat, and marine habitat. The Sport Fish Water Quality Objective is expressed as follows: the average methylmercury concentrations shall not exceed 0.2 milligrams per kilogram (mg/kg) fish tissue within a calendar year. This fish tissue concentration (FTC) is the methylmercury water quality objective. The objective must be applied to TL3 or TL4 fish, whichever trophic level is the highest existing level in the water body.

The objective for human health was derived using U.S. EPA's equation for calculating the fish tissue criterion (US EPA 2001):

FTC = BW*(RfD - RSC)/FI (see page H-1)

where FTC is as defined above, BW = human body weight, RfD = the reference dose for methylmercury established by EPA (as described in Rice et al. 2003 and Dourson et al. 2001), RSC = the relative source distribution to account for store bought marine fish and other sources, and FI = fish intake. The FTC is affected by uncertainties in all these parameters, but RSC and especially BW do not appear to greatly impact the water quality objective, especially since the objective will be rounded to one digit (Tables H- 2A and H-2B). Therefore, my comments here will focus on the two remaining parameters of the equation: the RfD and the FI estimate.

COMMENT EVW 1

As mentioned in Appendix H, the RfD was derived from a study of maternal-child dyads in Faroe Islands reporting on the adverse association between prenatal methylmercury exposure (as measured in cord blood) and child developmental outcomes (Grandjean et al. 1997). As noted elsewhere (e.g. Dourson et al. 2001; Grandjean et al. 2001; Weihe et al. 1996; Jacobson et al. 2015), the primary source of mercury exposure in this study population was through the traditional consumption of whale meat, not fish, and co-exposure to other contaminants such as polychlorinated bi-phenyls (PCBs) are of concern. It would be helpful if the staff report could discuss the generalizability of the findings from this study for the purpose of the proposed Sport Fish Water Quality Objective.

RESPONSE TO EVW 1

A paragraph on this topic has been added to the staff report in Section 4.7 (now the 4th paragraph):

> **"In the Faroe Islands, the primary source of mercury exposure in the study population was through the traditional consumption of whale meat, not fish, and co-exposure to other contaminants such as polychlorinated bi-phenyls (PCBs) are of concern. However, in California PCBs also a contaminate fish tissue at levels that limit advised consumption (Davis et al. 2010, Davis et al. 2012). One hypothesis as to why adverse effects of mercury were not found in the Seychelles, but adverse effects were found in the Faroe Islands is that there are other neuroprotective nutrients in seafood, such as selenium and iodine, long chain polyunsaturated fatty acids, (Oken 2012, Meyers 2009). Freshwater fish do not have these nutrients in the same amounts as marine fish (Haldimann et al. 2005, Steffens 1997), and many Californians are exposed to mercury by consuming freshwater fish. While many people in the Faroe Islands and the Seychelles ate fish several times a week, in the Faroe Islands most of the methylmercury exposure was from infrequent (twice a month) consumption of pilot whale meat (Dourson 2001). Recreational fishers in California may also have infrequent high methylmercury exposure from weekend fishing trips, along with a steady methylmercury exposure from regularly purchased commercial fish. There are other theories as to why the two studies found conflicting results, such as study design (Oken et al. 2008, Debes etal . 2006). Ultimately, mercury is a known neurotoxin and the Faroes Island study provides data to support a reference dose."**

COMMENT EVW 2

Furthermore, since the derivation of the US EPA's RfD several additional studies have been published reporting on the association between prenatal methylmercury exposure and child development. There appears to be substantial uncertainty regarding the consequences of maternal consumption of fish with naturally-acquired MeHg contamination. For example, several studies in the Faroe Islands (Grandjean et al. 1997), New Zealand (Crump et al. 1998), United States (Sagiv et al. 2012) and Arctic Quebec (Jacobson et al. 2015) have reported adverse associations with cognition and behavior, but other studies in the Republic of Seychelles (van Wijngaarden et al. 2013; Strain et al. 2015), United States (Oken et al. 2016), the United Kingdom (Daniels et al. 2004), and Spain (Llop et al. 2012) have found no consistent evidence of adverse consequences of prenatal methylmercury exposure from fish consumption on children's development. It is likely that differences in study design, co-exposure to nutrients and contaminants, and genetic factors partially account for the inconsistencies in study findings which consequently may result in different RfD values (van Wijngaarden et al. 2006). RfDs vary by regulatory body and are often higher than US EPA's value; for example, it is four times higher in Alaska (https://dec.alaska.gov/water/wqsar/wqs/pdfs/FishConsumption.pdf) and the provisional tolerable intake is two times greater in Canada (http://www.hc-sc.gc.ca/fn-an/pubs/mercur/merc_fish_poisson- eng.php). Given the FTC equation, the water quality objective will increase or decrease as the RfD increases or decreases, respectively. While the lower US EPA RfD will result in a more protective FTC, the draft report could acknowledge the uncertainty and variability in determining the RfD and how this would influence the water quality objective.

RESPONSE TO EVW 2

The Staff Report does contain very brief paragraph (Section 4.7) on the conflicting evidence considered when U.S. EPA derived the reference dose –that while adverse effects were seen in the Faroe Islands, no effects were found in the Seychelles. The following sentence will be added to section 4.7: "While other studies in the Seychelles (van Wijngaarden et al. 2013; Strain et al. 2015), United States (Oken et al. 2016), the United Kingdom (Daniels et al. 2004), and Spain (Llop et al. 2012) have found no consistent evidence of adverse consequences of prenatal methylmercury exposure from fish consumption on children's development." The staff report also includes additional references that indicate adverse effects of mercury.

The references the reviewer provided on Canada and Alaska concern the development of fish consumption advisories, not water quality criteria. In the Alaska reference it states "The RfD was 2.5 times greater than EPA['s] to account for health benefits of eating fish" (slide 8). The Alaska reference also correctly states that fish consumption advisories are not equivalent to water quality criteria, and that water quality criteria "do not account for health benefits of eating fish". Therefore these references are not entirely relevant to the mercury Provisions, but to fish advisories. In California, fish consumption advisories are developed by another agency, the Office of Environmental Health Hazard Assessment, and the advisories are developed considering the beneficial effects of consuming fish (see Appendix E, Section 4).

COMMENT EVW 3

The RfD was derived based on data demonstrating adverse associations with prenatal methylmercury exposure. However, exposure occurs both prenatally and postnatally and throughout the life course. The health effects of postnatal methylmercury exposure are uncertain (Karagas et al. 2012), with no clear impact on cardiovascular disease and hypertension (e.g. Mozzafarian et al. 2011, 2012), and limited evidence of adverse associations with neurodevelopment and cognition in children (e.g. Myers et al. 2009; Boucher et al. 2016) and older adults (e.g. Weil et al. 2005; Yokoo et al. 2003). Use of evidence pertaining to risks in pregnant women and women of childbearing age results in a lower RfD and thus a more protective water quality objective. The draft report does not appear to distinguish between prenatal exposure (from fish consumption during pregnancy) and postnatal exposure (in either children or adults), and chronic vs. developmental risk. The U.S. EPA 2000 guidance document distinguishes between chronic human health risks and developmental health risks when discussing the default parameters but the water quality objective draft report is not clear on this point. Therefore, it may be informative to discuss the demographics of fish consumers targeted in the objective types (i.e. sport fish, tribal subsistence, subsistence) and the proportion of the target population that may be at the highest risk.

RESPONSE TO EVW 3

The text of the Staff Report was clarified as to how the reference dose was derived. In the section on "Methylmercury Effects on Human Health" (Section 4.7 of the Staff Report) after the sentence, "Toxicity to the developing nervous system of the fetus is considered the most critical endpoint" New text was added to clarify " The water quality objectives were derived from a the U.S. EPA reference dose, which was based on protecting the developing fetus." There was already mention in this same section of the Staff Report about possible effects on cardiovascular health. Nonetheless, U.S. EPA considers that the reference dose for the entire population, not only for women of child bearing age (U.S. EPA 2001,Rice 2003).

Additionally, another California agency, the Office of Environmental Health hazard Assessment is responsible for communicating to the public the risk of consuming mercury contaminated fish to the public and which segment of the population might be at the greatest risk of mercury toxicity.

COMMENT EVW 4

The San Francisco Bay Seafood Consumption study (hereafter called "SFEI 2000") was considered to be one of the highest-quality studies of fish consumption in California done to date. This study provided the FI estimate of 32 grams per day which has already been used a various regulatory settings. The primary goal of the study was to collect quantitative data to characterize exposures to contaminants in fish and shellfish caught in the Bay among the general fishing population of San Francisco Bay. The study included on-site personal interviews of 1,331 participants (77% response rate which is adequate) who were fishing at piers, beaches and banks, or private or party boats. Interviews were conducted over a 12-month period (summer of 1998 – summer of 1999), and asked about four-week recall of fish consumption. The recruitment approach was reasonable given the lack of a comprehensive list of anglers and the need to conduct in-person interviews to increase participation and understanding of the questions. Fish consumption rates were adjusted for avidity (i.e. how frequently anglers go fishing) in an effort to reduce bias; avidity-adjusted rates are lower than unadjusted rates. The magnitude and direction of any other biases in the fish consumption rate would be unknown. The SFEI 2000 report includes a comprehensive discussion of the study's strengths and limitations.

RESPONSE TO EVW 4

The reviewer's agreement with the approach is noted.

COMMENT EVW 5

As discussed in Appendix G of the draft report, short-term recall such as a four-week period may result in a skewed distribution as shown in Table 5 of the SFEI 2000 report, with a mean of 6.3 grams per day but a median of 0 grams per day. The SFEI 2000 report considers the 12-month recall to be less reliable because longer recall periods are more difficult for respondents to answer accurately. The rate of 32 grams per day is the 95th percentile in Table 5 and represents the rate among all consumers of Bay fish. The 95th percentile of the per-angler consumption rate in Table 6 is lower (24 grams per day) and represents consumption among all survey respondents including anglers that do not eat fish. For the purpose of the water quality objective, utilizing the results from Table 5 results in a more stringent FTC as it assumes that all anglers will eat the fish caught. (As noted in the report, it is also more conservative than utilizing the EPA default consumption rate of 17.5 grams per day apparently based on the 90th percentile of the fish intake data obtained in a national survey.) In all, the study's methods and design appear to be scientifically sound.

RESPONSE TO EVW 5

The reviewer's agreement with the approach is noted.

COMMENT EVW 6

Since the time of the SFEI 2000 report, health advisories regarding fish intake have been promulgated which may have affected fish consumption rates (e.g. Oken et al. 2003, Rehm et al. 2016). The impact of temporal trends in fish consumption, if any, on the water quality objective should be discussed, as should be the generalizability of the SFEI 2000 study to other angler communities in California.

RESPONSE TO EVW 6

Recent fish consumption studies will always be valuable, and the Water Boards are obligated to review water quality standards on a regular basis.

While public awareness of contaminants in fish and advisories may reduce fish consumption rates, the Water Boards are not mandated to revise water quality objectives to reflect artificially suppressed fish consumption rates. When agencies set environmental standards using a fish consumption rate based upon a suppressed consumption level, they may set in motion a downward spiral whereby the resulting standards permit further contamination of the fish. The mission of the Water Boards, set forth by the Porter-Cologne Water Quality Control Act, is to protect past, present, and probable future beneficial uses (in this instance the beneficial use is fish consumption). Therefore, if fish consumption rates are lower in the future, the Water Boards would need to carefully consider all information before altering the level of protection.

Rather than trying to estimate how representative the SFEI 2000 study may be, Appendix G provides data from other fish consumption studies from California for comparison to the SFEI study. Also Section 4.9 of the Staff Report summarizes these data, and Section 6.2 discusses why the data from the SFEI 2000 study was used as the fish intake parameter for California as opposed to another value.

COMMENT EVW 7

To compare methylmercury concentrations in fish tissue to the FTC, fish mercury samples are collected within a calendar year and subsequently combined into one value. The rationale for summarizing values over a longer period of time is that potential adverse consequences of methylmercury exposure are believed to be chronic in nature, and methylmercury exposure in fish are believed to not fluctuate strongly across seasons. Secondarily, combining multiple values into one result is a statistically more precise estimate of concentration. This rationale sounds reasonable, although it may be necessary to add more references to support the statements about the chronic nature of toxic effects and lack of seasonal fluctuations. If there is empirical fish tissue data available (even if the sample size is small) to provide additional support for the latter assumption, it would be good to present those.

RESPONSE TO EVW 7

Agree that more data would be helpful. However, the Water Boards do not have data that can be used to compare the mercury levels in fish in different seasons. The statewide monitoring program generally captures a group of about ten fish on one day and then the water body is not sampled again for several years. Also, the sample locations, fish sizes and years all vary. For example, for Lake Berryessa, a water body with one of our largest data sets, there is data available from only one sampling event in the summer and five sampling events in winter, from the past 30 years. Data from one summer is hardly representative of the seasons. In another example Clear Lake, the largest natural freshwater lake in California, useful data are available from just three sampling events: one for May, September and October in various years. There is

additional older data, but, it should not be used to answer this question, since there is no accompanying data on the length of the fish. The mercury levels in fish are related to the size of the fish, so size is a confounding factor in determining if mercury levels vary by season. Overall, with the small number of fish sampling events, it would be hard to attribute differences in fish mercury levels to the season, when a number of factors could have been the cause.

Staff also consulted a California researcher to attempt to find such data in the peer reviewed literature. That researcher didn't know of such data, but stated that the seasonal fluctuations of mercury concentrations in fish are unlikely to be statically significant in larger sport fish. The Staff Report includes the references that were originally found on the stability of mercury level in fish, in Section H.4.

<u>The California Tribes Fish Use Study (Shilling et al. 2014) contains a sound data set to use to establish a default water quality objective to protect tribes</u>

<u>COMMENT EVW 8</u>

To derive the Tribal Subsistence Fishing Water Quality Objective, the draft report incorporates the fish intake estimates reported in the California Tribes Fish Study report (Shilling et al. 2014) into the FTC equation shown above. In this study, participants were recruited and interviewed across California in tribal offices or at tribal or inter-tribal events from May, 2013 to June, 2014. A strength of the study is its community-based participatory research (CBPR) approach, i.e., tribes identified the need to collect tribe- specific information about fish use, and questionnaires and field methods were developed in collaboration with tribes. Despite the CBPR approach, only 24 of 147 tribes (federally- and state-recognized except for one) participated in the project (16%). A variety of reasons for non-participation were provided, but there was no in-depth discussion of how this may have impacted the generalizability of the findings, both in terms of geographic representativeness of the participating tribes (although figures were provided) and whether factors related to tribal non-participation may be correlated with actual fish consumption. An additional uncertainty about the generalizability of the data is that participants were recruited using non-random sampling methods. While obtaining a random sample is difficult in epidemiologic surveys, volunteers may be non-representative of the target populations (i.e. participating tribes) which may result in biased fish intake estimates if factors that are related to volunteering are also related to fish consumption. It is believed that incidentally a random sample of each tribe was obtained, but no data were provided to support this statement. More discussion of participation bias, at the tribal level as well as the individual level (e.g. some tribes are only represented in the study by one participant), would provide a better understanding of any uncertainty associated with the fish intake data. This appears to be potentially important because Figures 2, 7 and 8, for example, show that the number of types of aquatic organisms and the number of places as fish sources increase with an increasing number of participants interviewed.

RESPONSE TO EVW 8

Agree- Including more discussion on bias could improve the report. However, the Water Boards are not the authors of that report. The Staff Report acknowledges that the study only surveyed a portion of the tribes in California. This was repeated in the discussion on the water quality objective for tribal subsistence and subsistence fishing, in Section 6.5.

> **"The survey includes 40 California tribes, while there are more than 100 federally recognized tribes in California and many others (see Section 4.10)."**

Discussion on the generalizability of the data to all tribes would be fairly speculative and difficult to determine. Discussion on the biases / uncertainties from the study has been added included in the Staff Report. See also Comment EVW 11.

COMMENT EVW 9

In addition to collecting information about traditional fish use, thirty-day recall of fish intake was collected for contemporary use which allows for direct comparison with estimates obtained in the other surveys used in the draft report for estimating the FTC. The coding of narrative responses is not described in detail in terms of both methodology (e.g. groupings established *a priori*?) and findings. As in previous studies, the 95 th percentile was emphasized as a value that would protect most users. The 99 th percentile was also reported though inherently this does not protect all users (only the maximum value would do so), which seems to be the intended use of this value. The mean use rate was not reported because this is not being used in regulatory policies; however, by presenting the mean and median, amongst others, a better understanding of the distribution of the data would have been achieved. Given the lack of information about this distribution, it would have been especially helpful to report the sample size (i.e. the number of respondents) upon which the data in Table 6 of the Shilling report are based, because those data (142 grams per day) are the basis for the tribal subsistence water quality objective and upper percentiles may be sensitive to small sample size.

RESPONSE TO EVW 9

Agree- Including the mean fish consumption rate would aid in understanding the distribution of the data better. However, the Water Boards are not the authors of that report.

The study author is correct that the 95 th percentile is a value that would protect most users. When a 95th or a 99th percentile is used for population estimates, the goal is not literally to exclude 1 to 5 percent of the population. These estimates are often used because of the difficulty of accurately calculating a 100th percentile (a maximum value) from a limited subsample. Therefore, high end estimates are generally used (e.g. 95th, 99th percentiles) to protect the whole population.

Yes, sample size should have been reported in the tables with the 95th percentile (Table 6), but the sample size was reported earlier in the report. This information is also reported in the summary of fish consumption studies (Appendix G) included in the Staff Report.

COMMENT EVW 10

Though traditional fish consumption is not a primary variable, it would be helpful to clarify the frequencies reported (page 14 of Shilling et al. 2014) as it appears that there are missing categories (e.g. 2-3 times/month and 4-6 times/week).

RESPONSE TO EVW 10

Agree- However, the Water Boards are not the authors of that report.

COMMENT EVW 11

The research described in the Shilling report does a commendable job of addressing the study goals. However, unlike the SFEI 2000 report, its discussion and conclusion section does not provide a comprehensive discussion of the extent to which the fish consumption estimates could have been influenced by various study limitations. The draft staff water quality objective report would benefit from including such a discussion to provide a sense of uncertainty in the fish intake estimate used.

RESPONSE TO EVW 11

Agree. This study provided information beyond our expectations and the authors are to be commended for that. New text was added to the end of Section 4.9 of the Staff Report (second to last paragraph) about this study to describe some of the uncertainties/ biases. This new text follows the discussion on the uncertainty in estimates used for recreational fishing, and the difficulties in deriving a rate for subsistence fishers in general:

> **"To derive a numeric water quality objective for the Tribal Subsistence Fishing (T-SUB) beneficial use, however, the California Tribes Fish-Use study (Tribes Fish Use study) provides a significant summary of statewide fish consumption by California tribes (Shilling et al. 2014). While the Tribes Fish Use study includes data from 40 tribes throughout the state, the study cannot be assumed to represent every tribe, since there are many other tribes in California. There are 109 tribes that are recognized by the federal government and 72 more communities are petitioning for recognition (California Environmental Protection Agency 2009). This study was somewhat unique in that study participants were volunteers, which may result in biased fish intake estimates. One obvious source of bias could be that people who eat large amounts are more motivated to participate in the study. However, the study authors list reasons why some tribe members would not participate, including resistance to governmental intrusion,**

and knowledge of past failure of government to act to protect tribal interests (Shilling et al. 2014). These may be more significant for a person for whom fish use is very important (and frequently eats fish), resulting in underrepresentation of those who eat large amounts of fish. The effects of various sources of bias are complex and difficult to predict. Nevertheless, the rate of 142 g/day for contemporary fish consumption for California tribes found by Shilling matches the US. EPA recommended subsistence rate of 142 g/day (U.S. EPA 2002).

COMMENT EVW 12

As discussed above (see 1.), use of a calendar year averaging period seems reasonable but could be better supported with additional references and/or data if available.

RESPONSE TO EVW 12

See response to Comment EVW 7.

The consumption rate of 4 to 5 meals per week (142 grams per day) is a sound basis from which to derive a subsistence fishing water quality objective that would be applied to the highest trophic level fish.

COMMENT EVW 13

To derive the Subsistence Fishing Water Quality Objective, the draft report incorporates the fish intake value of 142 grams per day as recommended by U.S. EPA (2000); it appears that this value is based on analysis of the 1994-1996 Continuing Survey of Food Intakes by Individuals (CSFII) and uses the 99th percentile of freshwater/estuarine uncooked fish consumption. When the 1998 CSFII data are included, the value 99th percentile value is similar at 143 grams per day (see U.S. EPA 2002, page 5-6). The CSFII was an annual survey conducted by the United States Department of Agriculture obtained survey estimates of food consumption from nationally-representative samples of non-institutionalized U.S. individuals, using an approach to sampling design and use of survey weights that is similar to other federal government surveys (e.g. National Health and Nutrition Examination Survey). CSFII response rates varied from 75.9% in 1996 to 81.7% in 1998 which are acceptable, and non-response was accounted for in survey weights. Average daily fish consumption data were collected for two non- consecutive 24-hr days, which is a different scale than the 30-day period used in the studies discussed above and may have resulted in lower precision of the estimated daily average consumption. However, the CSFII survey methodology appears to be scientifically sound and should have resulted in reasonable estimates of fish intake *at the time the surveys were conducted* (also emphasized on the USDA website: https://www.ars.usda.gov/northeast-area/beltsville-md/beltsville-human-nutrition-research- center/food-surveys-research-group/docs/past-surveys/). It should be noted that subsequent trends in fish consumption rates in response to health advisories regarding fish intake (e.g. Oken et al. 2003, Rehm et al. 2016) may have impacted the extent to which the CSFII fish consumption estimates are representative of current fish intake in the general adult population and subsistence anglers.

RESPONSE TO EVW 13

See response to Comment EVW 6.

COMMENT EVW 14

Because it is difficult to define and identify subsistence fishing population, the 99 percentile of uncooked freshwater fish consumption estimate in the CSFII survey was used as a somewhat arbitrary cut point (the 95th percentile is 50 grams per day). This percentile is different from U.S. EPA's recommendation to use the CSFII 90th percentile for general adult population and sport fishers, from the 95th percentile in SFEI 2000 report for sport anglers, and from the 95th percentile of the SFEI 2014 study for tribal subsistence fishers. Nevertheless, the value of 142 grams per day used for the subsistence fishing water quality objective is the same as that derived for Tribal Subsistence Fishing in Schilling et al. 2014 (see above) which gives confidence that this is a reasonable estimate to use for human health protection of subsistence fishing populations and it provides consistency across beneficial use types.

RESPONSE TO EVW 14

The reviewer's agreement with the approach is noted, as well as the reviewer's concerns on the difficulty of defining and identifying subsistence fishing populations. This requirement has been modified in manner that matches some of the reviewer's (and other reviewers') concerns. A different approach is now recommended to better address the variability and uncertainty in establishing one subsistence fish consumption rate. In Section 6.5 of the Staff Report, Option 6 is now recommended, which is the narrative water quality objective. Previously, a numeric water quality objective was recommended. A narrative water quality objective has the advantage of allowing permit specific implementation. A site-specific fish consumption rate could be used to implement the water quality objective or the provided default fish consumption rate (142 g/ day) could be used to implement the water quality objective. See also Comment MWB 17 for other advantages, and MBS 8.

COMMENT EVW 15

As stated above, use of a calendar year averaging period appears reasonable but could be better supported with references and/or data if available.

RESPONSE TO EVW 15

See response to Comment EVW 7.

Staff thanks all reviewers for their comments.

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Appendix T. Development of Beneficial Uses

Tribal Traditional and Cultural Use: Uses of water that support the cultural, spiritual, ceremonial, traditional rights and/or lifeways of California Native American Tribes, including, but not limited to: navigational activities, ceremonial activities, and fishing, gathering, and/or consumption of natural aquatic resources, including fish, shellfish, vegetation, and materials, as affirmed by California Native American Tribe(s).

Tribal Subsistence Fishing Use: Uses of water that support human health involving the non-commercial catching or gathering of natural aquatic resources, including fish and shellfish, by California Native American Tribes, for consumption by tribal individuals, households, and/or communities to meet fundamental needs for sustenance.

Subsistence Fishing Use: Uses of water that support human health involving the non-commercial catching or gathering of natural aquatic resources, including fish and shellfish, by individuals for consumption by individuals, their households, or communities, to meet fundamental needs for sustenance due to cultural tradition, lack of personal economic resources, or both.

T.1 What are the goals of the new beneficial uses?

1. Question – Are the two subsistence fishing beneficial uses designed to reflect human consumption of fish (human health risk), or are they intended to ensure that there are enough fish in the water (habitat and flows) to support the higher volume or quantity of subsistence fishing?

Answer – The two subsistence fishing beneficial uses support human health and are designed to protect people who consume fish at a subsistence level (for example, 4 to 5 meals per week of locally caught fish). The subsistence fishing uses are not designed to support aquatic resources, including fish, or aquatic habitat. Fish and aquatic habitat are protected through other beneficial uses, typically Cold Freshwater Habitat (COLD) and Warm Freshwater Habitat (WARM), and water quality objectives established for those beneficial uses. (Staff's working definitions have been revised to clarify this issue.)

2. Question – The navigational, ceremonial, and spiritual activities in the Tribal Traditional and Cultural Beneficial Use definition would appear to require certain flows to support those activities. Will the Tribal Traditional and Cultural Beneficial Use require flow objectives or otherwise affect water diversions?

Answer –Pursuant to the Porter-Cologne Water Quality Control Act (Wat. Code, § 13000 et seq.), "beneficial uses" are defined, in part, as the uses "of the waters of the state that may be protected against quality degradation" and include agricultural and industrial supply, recreation, preservation of fish and wildlife, navigation, and other uses. (Wat. Code, § 13050, subd. (f).)

The State Water Board may develop a flow objective if the flow objective is necessary for the reasonable protection of a beneficial use. However, it is not anticipated that flow objectives would be developed to support the activities contained in the Tribal Traditional & Cultural beneficial use definition.

Such activities, including navigation, and to a lesser extent, ceremonial and spiritual activities, are similar to existing beneficial uses which have not required the development of flow objectives. For example, the Navigation Beneficial Use ("Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels") (NAV) has been designated to numerous waterbodies throughout the State, and no flow objective has been established for NAV.

When the State Water Board is acting on applications to appropriate water, it is required to consider water quality control plans and may subject appropriations to conditions the board deems necessary to carry out the plans. (Wat. Code, § 1258.) Finally, when acting on Clean Water Act section 401 water quality certifications, the State Water Board must include conditions deemed necessary to carry out the goals of water quality standards during the term of the permit.

3. Question – Why is staff developing two separate definitions for subsistence fishing? Is there a difference in application or health risk?

Answer – The Tribal Subsistence Fishing Beneficial Use is being developed to account for specific waterbodies where tribes fish at a high consumption rate. The general Subsistence Fishing use is for waters where other groups practice subsistence fishing. The two uses may differ significantly in the consumption rates and the species of fish being consumed. One study (Schilling et al., 2014) showed a fairly consistent consumption pattern for tribal subsistence fishing throughout the state. For other groups, there is a lot of variation in the amounts and types of fish consumed. Also, development of the Tribal Subsistence Fishing category respects tribal sovereignty and acknowledges that tribes have unique traditions in connection with the State's waters.

T.2 Why are the new beneficial uses needed?

4. Question – Are these proposed beneficial uses already being protected through other beneficial uses like sports fishing and water contact recreation and through waste discharge requirements and national pollutant discharge elimination system (NPDES) permit requirements?

Answer – Not necessarily. The Tribal Traditional and Cultural Beneficial Use would protect activities specific to the Native American Culture and their historic uses of California's waters, including practices not covered by existing beneficial uses. Both of the proposed subsistence fishing uses are related to the amount of fish consumed, which is a higher rate than is currently protected under the sports fishing beneficial use (COMM). In some cases, the current discharge requirements in waste discharge requirements and national pollutant discharge elimination system permits may protect the proposed beneficial uses. In those cases, designation of waters with the proposed new beneficial uses will not have any effect on the discharge requirements. (See question 2.) In some cases, however, current discharge requirements may not adequately protect these proposed beneficial uses. Examples include the timing of the application of aquatic herbicides so that they do not interfere with cultural practices, and reducing bioaccumulative pollutants to levels that are protective of a high rate of fish consumption.

5. Question – Is it possible to protect these uses through a total maximum daily loads (TMDL) or other means rather than through designating new beneficial uses?

Answer – Beneficial uses are the cornerstone of water quality protection. A water quality objective specifies the level of protection reasonably necessary to protect a beneficial use. Total maximum daily loads and implementation programs are typically developed to achieve water quality objectives after a waterbody is listed as impaired on the Clean Water Act section 303(d) list.

6. Question – Does the State Water Board's adoption of beneficial uses into a statewide water quality control plan streamline the incorporation into the Regional Board basin plans?

Answer – Yes. Adoption of the beneficial uses in a statewide plan will make them readily available for subsequent designation by the Regional Water Boards without the Regional Water Boards having to separately considering adopting the beneficial use definitions. However, the Regional Water Boards would still need to go through the public process to amend their basin plans to designate specific waterbodies, which includes a notice of a hearing and the opportunity to comment, adoption meeting, and approval by the State Water Board.

T.3 Specific language used in the new uses.

7. Question – What is "lifeways?" Can you make the definition and source available? Does it mean "way of life" and does it mean anything in addition to the spiritual, ceremonial, and traditional practices referenced in the definition?

Answer – The American Heritage Dictionary defines lifeways as, "1. A customary manner of living; a way of life 2. A custom, practice, or art: the traditional lifeways of a tribal society." If the proposed definition contains the term "lifeways," staff will propose to adding include a definition of "lifeways" to the glossary of the water quality control plan that will contain the beneficial uses (Inland Surface Waters, Enclosed Bays and Estuaries plan). The term "lifeways" has been advocated by tribes as being the term most commonly understood by tribes.

8. Question – Could the specific consumption rate for subsistence fishing be set forth in the beneficial use definition itself?

Answer – Consumption rates vary among tribes and ethnic groups, across geographic locations, and between types of fish. As a result, consumption rates typically comprise one component of the evidence required to develop a site specific water quality objective to protect humans that eat fish at a subsistence rate. A statewide tribal consumption study (Schilling et al., 2014) captures some consumption rate and percent ages of the different trophic levels being consumed by some tribal members. That study may be used when setting different objectives to protect the tribal subsistence fishing use. As noted above, however, consumption rates and patterns vary and need to be taken into consideration during the developments of an objective.

9. Question – These Beneficial Use definitions have changed a couple of times. Are they going to change again?

Answer – Staff may revise the definitions in accordance with input received during the public participation/comment process, the hearing, or during the adoption meeting at which the State Water Board will consider adopting the proposed beneficial uses.

T.4 Will guidance be developed regarding the designation of waterbodies?

10. Question – Will the State Board develop any guidance on the manner in which Regional Water Board would designate and use the new beneficial uses?

Answer – The staff report being developed to support the adoption of the new beneficial uses contains some examples and descriptions of activities that fall within the scope of the beneficial uses (e.g. emersion in water for ceremonies, basket weaving). However, staff is not developing a guidance document for the State Water Board to consider adopting to aid the Regional Water Boards with respect to designating waterbodies with the new beneficial uses. The Regional Water Boards may consider whether the beneficial use is existing or is a probable future use to determine when to designate a beneficial use during a basin planning process. Designation of uses occurs through the basin planning process and includes a public process, including a hearing.

11. Question – Would examples of traditional and cultural uses be provided that cover the differences in regions and how they may be applied during the waterbody specific designation process? Would examples be provided for the differences throughout the state?

Answer – The tribes have provided staff with some examples, which will be discussed in the underlying staff report (see question/answer no. 10). Traditional and cultural practices vary among the tribes throughout the State, so it is not possible to have a comprehensive list. The Regional Water Boards and local tribes will work together to determine which waters would appropriately be designated and if uses are being adequately protected. Any designations will include a public process and a board hearing.

T.5 Designating waterbodies with the new uses.

12. Question –In what instances would the Regional Water Board designate one of more of these Beneficial Uses to a water body in its Basin Plan? What are the criteria needed to designate a water body?

Answer – The Regional Water Board generally considers prioritizing designation of waters during their triennial review process. In addition, the Regional Water Board could consider designation during another basin planning activity such as the development of a total maximum daily load. The need for a designation may be brought to the attention of the Regional Water Board with a request that a beneficial use be designated to a water body. If the Regional Water Board declines to designate a water body, tribes or others may request the State Water Board to consider the designation. The Regional Water Boards may consider whether the beneficial use is existing or a probable future use to determine whether to designate.

13. Question – Is there a way to designate waters without needing to reveal the specific locations and tribal practices related to the beneficial uses?

Answer – In general, the Regional Water Boards do not designate specific locations but instead designate stretches of rivers or creeks or whole water bodies. There is no need to specify the exact location of the practice or activity. For traditional and cultural uses, information would need to be established about the practice to get an understanding of the risk involved and the nexus to water quality so the appropriate water body or water body segment may be designated. Such information would be public information and not confidential.

T.6 How would the new uses apply?

14. Question – Are the proposed tribal beneficial uses restricted to “tribal” or “sovereign” lands, or waters where tribes are located, or are they linked to treaty rights?

Answer –The designation could identify a waterbody on tribal lands, a waterbody that is on historic tribal lands or a water body that is or could be used by tribes. The specific waterbody will be identified during a public process.

15. Question – What is the timeframe of the practices and activities that would be protected under the proposed Tribal Traditional & Cultural use? Does it protect all historical cultural uses made on a waterbody, even if they are not actually occurring on that water today?

Answer – The Regional Water Boards do no designate waters with beneficial uses that occurred solely in the past (i.e., where the beneficial use is not a present or probable future use of the water). The proposed use is designed to reflect all tribal traditional and cultural uses. If tribes are striving to restore a traditional or cultural use to a water body, then the past beneficial use would be useful insofar as it informs a present or probable future use.

16. Question – Besides mercury, what other substances may require water quality objectives to protect subsistence fishing that could be applied statewide?

Answer – The subsistence fishing beneficial uses are designed to protect people from consuming bioaccumulatives or other harmful substances, in fish or shellfish at harmful levels. Besides mercury, other bioaccumulatives include polychlorinated biphenyls (PCBs) dioxins/furans, benzo(a)pyrene (BaP), hexachlorobenzene (HCB), alky-led, and a variety of pesticides. Other harmful substances include toxins produced by cyanobacteria present in some algae blooms.

T.7 Potential effects of designation.

17. Question – When the Tribal Traditional and Cultural beneficial use is designated to a water body, will information be available to the public identifying the specific tribal activity(ies) that justifies the designation? How can dischargers and water managers accomplish planning and meet goals to protect the use designation if specific information concerning such activities is not disclosed to the public?

Answer – Information concerning the specific activities that comprise the use designation would be available to the public.

18. Question – How will this impact existing total maximum daily loads?

Answer – There would be no immediate or automatic impact on existing total maximum daily loads. However, a Regional Water Board may need to reevaluate a total maximum daily load or establish a new total maximum daily load if necessary to reflect the allowable maximum amount of a pollutant that can occur in a water body to protect the newly designated beneficial use?

19. Question – The outreach document states that no water quality objectives have been established specifically to protect the proposed beneficial uses. In the absence of objectives, how are these uses going to be protected?

Answer – If the new beneficial uses are adopted by the State Water Board, the next step will be the designation of waterbodies with those uses where appropriate. Contemporaneous with or following such beneficial use designations, water quality objectives may be developed to protect the new beneficial uses. It is also possible that existing water quality objectives established to protect other uses could be utilized to protect the new uses, if appropriate. Staff has not developed water quality objectives to protect these uses and, generally, such objectives would be developed by the Regional Water Boards. (But see Question no. 21.) Existing water quality objectives that protect human health could be utilized to protect the new beneficial uses.

20. Question – Will water quality objectives or total maximum daily loads more stringent than those established to protect the recreation and/or drinking water beneficial uses have to be established to protect the activities identified in the Tribal Traditional and Cultural Beneficial Use definition?

Answer – A water quality objective established for one beneficial use may be sufficiently protective of other beneficial uses. As a result, the designation of new beneficial uses for a waterbody does not necessarily mean that additional water quality objectives, total maximum daily loads, restrictions on waste discharges, or other new or different actions will be necessary to protect the new beneficial uses. For example, water quality objectives that protect recreational activities (REC-1 or REC-2), including bacteria, chemical constitutes, or color, and those that protect drinking water, including biostimulatory substances or odor, may be sufficient to protect some activities supported by the Tribal Traditional and Cultural Beneficial Use, such as navigation, ceremonial activities, and/or collection or gathering of aquatic resources. If, however, a water quality objective established for an existing beneficial use is not sufficient to protect the proposed new beneficial use, then new water quality objectives may need to be developed specifically to protect the activity or activities supported by the Tribal Traditional and Cultural Beneficial Use.

T.8 Water quality objectives.

21. Question – Will the State Water Board adopt water quality objectives for the proposed beneficial uses at the same time the board adopts those uses?

Answer – Staff are developing water quality objectives for mercury to support both of the subsistence fishing beneficial uses. Such water quality objectives may be proposed for adoption along with the proposed beneficial uses. No other water quality objectives are currently being developed for the proposed beneficial uses.

22. Question – In order to list a water body as "impaired" on the Clean Water Act section 303(d) list for one of the new beneficial uses, would a water quality objective first need to be established?

Answer –A waterbody would have to be designated with the new beneficial use before such waterbody could be assessed. (The North Coast Regional Board's water quality control plan has one waterbody currently designated with a tribal beneficial use.) Typically, Regional Water Boards designate waterbodies with beneficial uses—and that would generally occur after the State Water Board adopts the new beneficial uses. But a new water quality objective would not necessarily also have to first be established for a new beneficial use to assessed as impaired. A waterbody designated with a new use could be assessed using a peer-reviewed guidance document to evaluate whether the water quality supports the use. For example, staff has assessed whether consumption of fish beneficial use was impaired by mercury by using peer-reviewed information from Office of Environmental Health Hazard Assessment OEHHA and US Environmental Protection Agency (EPA). In the absence of an appropriate guidance document, a water quality objective would need to be adopted to support a new beneficial use before the waterbody could be assessed for 303(d) purposes.

T.9 There additional opportunities to comment.

23. Question – Aside from the focus group meetings staff has coordinated with interested parties between February and August 2016 regarding the developing beneficial uses, will there be additional opportunities for interested parties to submit feedback?

Answer – Yes, there will be numerous additional opportunities to submit comments on the developing beneficial uses. First, staff brought an item to the State Water Board to provide an update on the input received during the focus group meetings that occurred between February and August 2016 regarding the developing beneficial uses. That item occurred at the September 20, 2016 State Water Board meeting. In addition, it is anticipated that the proposed beneficial uses will be included within the draft statewide water quality control plan amendment that will establish mercury water quality objectives (Mercury Objectives Amendment). The draft Mercury Objectives Amendment and draft staff report will be distributed to the public for a formal written comment period in January

2017. A public workshop will occur on January 9, 2017, and a public hearing will occur on February 7, 2017. An adoption meeting necessary for the State Water Board to consider adopting the Mercury Objectives Amendment (including the proposed beneficial uses) is anticipated to occur in spring 2017, which will provide additional opportunities for oral comment.

Appendix U. Overriding Considerations

Adverse environmental impacts may result from implementation of the Provisions. The majority of these effects can be mitigated to less than significant levels, but mitigation measures lie within the jurisdiction of agencies implementing site-specific projects. Still, the environmental benefits of the Provisions outweigh the potentially unavoidable adverse environmental effects, and such adverse environmental effects are acceptable under the circumstances in order to protect the health of wildlife and humans who consume locally caught fish.

Over the long term, the implementation of the Provisions will result in overall improvement in water quality in California and will have significant positive impacts to the environment by enabling humans and wildlife to safely consume fish. Beneficial uses that are impaired due to elevated methylmercury levels in fish are consumption of fish and aquatic organisms by humans and wildlife species. Fully achieving these beneficial uses will have positive health benefits and social and economic effects by decreasing the exposure of methylmercury to humans and wildlife. In addition, wildlife habitat carries a significant non-market economic value. Enhancement of wildlife habitat beneficial uses will not only be beneficial to wildlife species that consume fish, but it also will have positive indirect economic and social benefits. Implementation of the Provisions is both necessary and beneficial. If the Provision are not adopted, the elevated levels of mercury in fish tissue would continue to remain and likely worsen.

Mercury-contaminated fish is an environmental justice and tribal concern. There are people in California who consume local fish because of need or custom, or to supplement their diet. Mercury is a toxin that can have lasting effects on the neurological development and abilities of persons exposed *in utero* and as children. Studies of people exposed to methylmercury through consumption of fish by their mothers and/or themselves showed deficits in memory, attention, language, fine motor control and visual-spatial perception that can be translated to decrements in intelligence quotient (IQ) (National Research Council 2000; Trasande *et al.* 2005). Under existing conditions, consumption of some fish species more than one or two times per month may cause adverse health effects, which affects peoples' livelihoods and standard of living.

California's fisheries are a valuable resource worth tens of millions of dollars (see Section 6.3, Option C). Although it is difficult to estimate the economic value of all California inland fisheries, the Delta Protection Commission produced an economic report for the Sacramento-San Joaquin Delta, in which expenditure estimates were calculated for recreational activities, including fishing, for the local economy in 1994. According to the report, anglers on average spent an estimated 186 million dollars inside the Delta and an estimated 206 million dollars outside of the Delta associated with sport-fishing activities in the Delta (Goldman *et al.*, 1998).

To reduce the environmental impact of the Provisions, the State Water Board does not have legal authority to specify the manner of compliance with its orders (Wat. Code §13360), and thus cannot specify particular implementation projects nor dictate that specific mitigation measures be implemented by any particular project. The selection of compliance projects and mitigation measures are all within the jurisdiction and authority of the entities that will be responsible for implementing the Basin Plan amendments, and those entities can and should employ mitigation measures as necessary to reduce any impacts as much as feasible (14 Cal. Code Regs., tit.14 §15091(a)(2)). These mitigation measures in most cases are routine measures to ease the expected and routine impacts attendant with ordinary construction and earthmoving projects.

Still, the Provisions includes aspects to reduce unnecessary environmental impact and alternatives to the Provisions were considered to reduce the environmental impact, in Section 9. For some aspects of the Provisions, environmental impact should be reduced since the required controls have multiple benefits. One multi-benefit control in the Provisions is sediment controls (used to control mercury). Sediments can also carry other pollutants including pesticides, nutrients, fertilizer, oil and grease, and litter. In addition, the sediment can be a pollutant itself. Using one action to control several pollutants will reduce the environmental impact. This requirement also instructs that mercury monitoring is likely unnecessary as a baseline level of control. Omitting unnecessary mercury monitoring will reduce the impacts associated with consuming lab supplies, waste generation, and vehicle use.

A primary source of environmental impact is the effluent limitations for wastewater and industrial dischargers for the Sport Fish Water Quality Objective, the Prey Fish Water Quality Objective, and the California Least Tern Prey Fish Water Quality Objective, since these effluent limitations would apply to roughly 308 dischargers throughout the state. The environmental impact would be from the associated construction and earth moving activities of potential upgrades to wastewater and industrial facilities. The effluent limitations in the Provisions were designed to achieve the water quality objectives by water body type; flowing waters in rivers and streams, slow moving waters, like some estuaries and sloughs, and reservoirs and lakes. Specifying effluent limits by receiving water body type would result in effluent limitations that are less stringent for most dischargers than if the one effluent limitation was used statewide (for lakes and rivers combined). This was done recognizing that most dischargers in California flow into rivers, where requirements do not need to be as stringent as those designed to protect lakes. This approach was also chosen recognizing that most of the mercury in California is the result of the historic mining legacy and atmospheric deposition, not wastewater and industrial dischargers. Basing the effluent limitations on rivers will reduce the number of needed upgrades for wastewater and industrial facilities to meet effluent requirements. Otherwise, as described in Alternative 3 in Section 9, roughly one third of facilities statewide may need to upgrade to meet the effluent limitation. This approach reduces the impact of the construction and earth moving activities required to install facility upgrades. While many of the impacts can be mitigated, these activities could potentially impact biological resources, utilities, public resources, and create noise.

Additionally, recognizing the economic and environmental impact of the mercury monitoring requirements, two exceptions were included to reduce unnecessary impacts (including environmental impacts). These are the exceptions for small disadvantaged communities and insignificant dischargers (see Section 6.13). These exceptions can relieve the monitoring requirements for low volume discharges that should not cause an exceedance of the objectives. These exceptions can decrease the use of laboratory supplies, laboratory waste generation and vehicle use, and the resulting air emissions, greenhouse gas emissions, and increased traffic.

Wastewater treatment plant upgrades may be necessary in certain cases to comply with the Provisions. However, such upgrades offer multi-benefit controls since the upgrades will also reduce a number of pollutants in addition to mercury, such as bacteria and other pathogens, nitrogen, phosphate, suspended organic material, and other nutrients, and synthetic pollutants, like medications and pesticides. Also, as the water quality of the wastewater is improved through better treatment, the ability to reuse the wastewater will increase. Some areas of California suffer from water shortage, and water reuse will decrease the demand on the water supply. Many communities suffer because the water demand is growing with increasing population, but the water supply has recently been shrinking from drought. Water use in California has led to the collapse of California's salmon fishing industry, and perhaps the entire Bay-Delta ecosystem. For California, the ability to reuse water is a significant environmental benefit.

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