SUMMARY OF PROPOSED STATEWIDE MERCURY CONTROL PROGRAM FOR RESERVOIRS

Contents

Problem Statement, Goals, and Scope

Problem Statement

Harmful levels of methylmercury in fish are a statewide and nationwide problem. Many fish in these waters have methylmercury concentrations that pose a risk for humans and wildlife that eat the fish. The number of water bodies identified as impaired by mercury is expected to increase substantially as new fish tissue monitoring data are collected and evaluated.

The Statewide Mercury Control Program for Reservoirs applies to the mercury-impaired reservoirs listed on Table S-1. Elevated fish methylmercury levels impair the following beneficial uses for consumption of reservoir fish: commercial and sport fishing (COMM), wildlife habitat (WILD), and preservation of rare and endangered species (RARE).

Goals

The Statewide Mercury Control Program for Reservoirs has three main goals:

- Reduce fish methylmercury concentrations in reservoirs that have already been determined to be mercury-impaired;
- Have a control program in place that will apply to additional reservoirs when they are determined in the future to be mercury-impaired; and
- Protect additional reservoirs from becoming mercury-impaired by maintaining low fish methylmercury levels in non-impaired reservoirs.

Program Scope

The Statewide Mercury Control Program for Reservoirs is the program of implementation to achieve proposed mercury water quality objectives in reservoir fish (see “Water Quality Objectives” section). The program includes the following:

- A total maximum daily load (TMDL) for mercury-impaired reservoirs; and
- An implementation plan for all California reservoirs. Implementation is focused on mercury-impaired reservoirs and includes actions to prevent other reservoirs from becoming impaired by mercury.

The Statewide Mercury Control Program for Reservoirs would be established via an amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California. The Program would not supersede mercury TMDLs in the Central Valley Region for Clear Lake and in the San Francisco Bay Region for Soulajule Reservoir in Walker Creek watershed and several reservoirs in Guadalupe River watershed.

Reservoir Definition

For this program, a reservoir is defined as a natural or artificial water impoundment that:

- Has constructed structures such as dams, levees, or berms to contain or otherwise manage water, and/or was excavated; and
- Provides year round habitat for fish other than those specifically introduced for vector control purposes.

Several types of impoundments are excluded, such as the following: potable water storage; industrial and mining supply water storage; wastewater treatment and storage; basins filled intermittently for flood control; and agricultural and ranching ponds.

Water Quality Objectives

There is a related but separate mercury water quality objectives project (see *link*) which will include several proposed objectives to protect human and wildlife health for consumption of fish. The proposed "sport fish objective" protects humans and most wildlife. Average methylmercury concentrations should not exceed 0.2 milligrams of methylmercury per kilogram of fish (mg/kg wet weight). This objective protects for consumption of one meal per week of fairly large fish (i.e., legal size catch). About half of all reservoirs in the State meet the proposed sport fish objective. Other objectives are also being considered to protect human health for more frequent fish consumption; few reservoirs meet these proposed objectives.

One of two prey fish objectives would also apply to each reservoir to protect wildlife that eats very small fish. If a reservoir supports California least tern habitat, then the proposed "CA least tern objective" applies; average methylmercury concentrations should not exceed 0.03 mg/kg. If a reservoir does not support California least tern habitat, then the proposed "prey fish objective" would apply; average methylmercury concentrations should not exceed 0.05 mg/kg.

Implementation Plan

Phases and Program Review

Implementation would occur over two phases. Table S-1 lists the mercury-impaired reservoirs that would be included in Phase 1 and mercury-impaired reservoirs with Federal Energy Regulatory Commission hydropower licenses that would be addressed in the future. Phase 1 is expected to last for 10 years, after which the State Water Board will conduct a program review.

This program review will determine effective and feasible reservoir management actions based on results of the reservoir pilot tests (described below) and will develop Phase 2 implementation requirements. In Phase 2, requirements would be applied to additional reservoirs and corresponding mercury sources as the reservoirs are determined to be mercury-impaired by the Water Boards. Initiating Phase 2 would require a future amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California.

Key Actions in Phase 1

Reservoirs: Pilot Tests

Owners and operators of mercury-impaired reservoirs (see Table S-1) would conduct pilot tests of methods to reduce methylmercury concentrations in reservoir fish. Hydroelectric power reservoirs (i.e., licensed by Federal Energy Regulatory Commission) would be excluded from mercury requirements in Phase 1. Coordinated pilot tests could be conducted in fewer, targeted reservoirs rather than in all impaired reservoirs. Reservoir owners and operators would convene a third-party independent Technical Review Committee to advise on pilot tests.

Reservoir owners and operators would use lessons learned from pilot tests to develop long-term reservoir and fisheries management plans. In program review after Phase 1, the Technical Review Committee and the Water Boards would evaluate results of pilot tests and proposed long-term reservoir and fisheries management plans.

Potential pilot tests

Manage reservoir water chemistry to reduce methylmercury production:

- Oxidant addition to reservoir bottom waters (near the sediment-water interface) to reduce anoxia or adjust redox potential when reservoirs are stratified to suppress methylation of mercury. Evaluate various oxidants (e.g., dissolved oxygen, ozone, nitrate, others) for (a) efficacy for methylmercury reduction, (b) multiple benefits (e.g., drinking water quality, algal controls), and (c) avoidance of adverse consequences;
- In-reservoir sediment removal or encapsulation to address inorganic mercury hotspots such as submerged or near-shore mine sites and mining waste; and
- Other management practices to reduce methylation, including enhancing demethylation.

Manage fisheries to reduce fish bioaccumulation of methylmercury:

- Intensive fishing to increase the growth rate of remaining fish;
- New or changes to fish stocking practices to increase the abundance of fish with lower methylmercury levels, such as (a) stock low-methylmercury prey fish for reservoir predator fish to consume, (b) stock more or different sport fish species, such as lower trophic level sport fish, and/or (c) stock large, old predator fish from hatcheries that supply low methylmercury fish; and
- Assess potential changes to make to fish assemblage that result in top predator fish with lower methylmercury levels.

Mine Sites Upstream of Reservoirs

The Water Boards would compel, using existing authorities, cleanup of the highest priority mine sites upstream of mercury-impaired reservoirs. Cleanup of highest priority mine sites is expected to reasonably quickly decrease reservoir mercury concentrations.

Exposure Reduction

Human health should be protected while pilot tests are underway and inorganic mercury source reductions are occurring. This would involve reservoir owners and operators, the State Department of Public Health, Office of Environmental Health Hazard Assessment, and other stakeholders, for actions such as the following:

- Post fish consumption warning signs;

- Change fish catch restrictions to reduce human consumption of larger, older fish with high methylmercury levels, e.g., "slot limits" that specify a safe size range of fish for consumption; and
- Conduct public outreach and educational activities to discourage people from consuming fish with highly elevated methylmercury.

Atmospheric Deposition

The Water Boards would work with the California Air Resources Board and USEPA to evaluate atmospheric deposition of mercury to California. California already reduced anthropogenic emissions of mercury by more than 50 percent since 2001 and is expected to achieve the proposed load allocation (see "Mercury TMDL" section) by the end of Phase 1. The Water Boards would encourage USEPA to increase its efforts to address mercury emissions from foreign countries (particularly artisanal gold mining on several continents and power plant emissions in Asia).

Other Actions in Phase 1

Urban Runoff NPDES-Permitted Dischargers Upstream of Reservoirs

"MS4 entities" are responsible for urban runoff from municipal separate storm sewer systems (MS4s) regulated by National Pollutant Discharge Elimination System (NPDES) permits. MS4 entities would monitor methylmercury in discharges upstream of or directly to mercury-impaired reservoirs. This requirement applies to highly urbanized areas that comprise a substantial amount of the reservoir watershed. In program review after Phase 1, the Water Boards would evaluate these data and determine whether methylmercury controls from MS4 entities are needed.

MS4 entities located upstream of mercury-impaired reservoirs that contain historical mercury mine sites, or gold or silver mine sites where mercury was used, would ensure that earth-moving projects will employ erosion and sediment control best management practices to prevent discharge of mercury.

NPDES-Permitted Facility Dischargers

The Water Boards would include the following in the next permit cycle for NPDES-permitted facilities that discharge upstream of or directly to impaired reservoirs:

- Mercury numeric effluent limitations no greater than waste load allocations (see "Mercury TMDL" section);
- Require dischargers to monitor total mercury in effluent; and
- Require some large dischargers to monitor methylmercury in effluent for up to two years.

In program review after Phase 1, the Water Boards will evaluate these data and determine whether methylmercury controls are needed.

Dredging and Earth-moving

The Water Boards issue certifications or permits for projects such as dredging in reservoirs and creek channels downstream of mine sites, and earth-moving projects such as construction of roads and watercourse crossings near mines. Future certifications and permits would include requirements for erosion and sediment control best management practices to prevent discharge of mercury.

Mercury Total Maximum Daily Load (TMDL)

This statewide mercury control program for reservoirs would establish a TMDL for mercury-impaired reservoirs that would include the following elements.

Numeric Targets

Three targets, one set equal to the sport fish objective, one set equal to the CA least tern objective, and one set equal to the prey fish objective. The sport fish target would apply to each reservoir and either the least tern or prey fish target would apply depending on whether a reservoir supports California least tern habitat.

Source Assessment

Mercury sources are not evenly distributed across the State and no one source type is responsible for all reservoir impairments. The most important anthropogenic sources to impaired reservoirs are historic mine sites and atmospheric deposition from global and California industrial emissions.

Mercury is naturally-occurring in many geologic formations. Natural background (pre-industrial) concentrations in soils and sediments reflect naturally-occurring mercury from native geologic formations and volcanoes. California's Coast Ranges have some of the world's most productive mercury mines, and much of this mercury was used in gold mines in the Sierra Nevada and elsewhere.

Modern background soil mercury levels are elevated above natural background because mercury emissions and associated atmospheric deposition have increased greatly since the dawn of the industrial era. "Atmospheric deposition" is the term for this source after emissions settle onto the landscape or water surface. National and global emission inventories indicate that California anthropogenic emissions have decreased substantially in recent years while emissions from Asia have increased.

Historic gold, silver, and mercury mining activities were widespread in many of California's watersheds, and most mining activities occurred upstream of reservoirs. Yet, many mercury-impaired reservoirs downstream of mines do not have elevated sediment mercury concentrations.

In contrast to mines upstream of reservoirs, the majority of California's urban areas are downstream of reservoirs. NPDES-permitted urban runoff and treated wastewater facility discharges are generally insignificant sources of mercury.

Linkage Analysis

There is a relationship between fish methylmercury concentrations and the environmental factors that control methylmercury production, bioaccumulation, and biomagnification in California reservoirs. More than 70 environmental factors have been assessed using statistical analyses and model development based on data collected from California reservoirs.

The linkage analysis indicates that no single factor explains fish methylmercury concentrations in California reservoirs. Multiple factors drive reservoir fish methylmercury levels: amount of mercury, methylmercury production, and bioaccumulation. The ratio of aqueous methylmercury to chlorophyll a, aqueous total mercury, and annual reservoir water level fluctuations explain greater than 85 percent of the variability in reservoir fish methylmercury concentrations.

TMDL and Loading Capacity

The proposed mercury TMDL and loading capacity for reservoirs is the sum of:

- Inorganic mercury waste load allocations for large and small NPDES-permitted discharges from municipal and industrial facilities;
- Inorganic mercury load allocations for mining waste, soils, and atmospheric deposition; and
- Methylmercury load allocation for in-reservoir methylmercury production.

The load allocations for soils and atmospheric deposition include natural background.

Waste Load Allocations (WLAs) for Point Sources

Facilities with individual National Pollutant Discharge Elimination System (NPDES) permits are categorized as large, small, or negligible dischargers based on a comparison of their design flows to reservoir inflows. The proposed WLAs are based on current performance and expressed as concentrations (nanograms of total mercury per liter [ng/L], calendar year average), as follows:

- Large municipal waste water treatment plants (WWTPs): 10 ng/L
- Other large facilities: 30 ng/L
- Small WWTPs: 20 ng/L
- Other small facilities: 60 ng/L

No WLAs are proposed for NPDES-permitted facilities with negligible discharges.

No WLAs are assigned to urban runoff discharged by MS4 entities and stormwater discharged by construction and industrial activities because mercury in these discharges is accounted for in the load allocations for atmospheric deposition.

Load Allocations for Nonpoint Sources

Proposed total mercury load allocations for mining waste and soils are based on mercury regions in California and expressed as concentrations (milligrams of mercury per kilogram of soil [mg/kg, dry weight, annual median]), as follows:

- 0.1 mg/kg for trace mercury areas;
- 0.3 mg/kg for mercury-enriched areas; and
- 400 mg/kg or a site-specific cleanup standard for mercury mineralized zone. (This mercury concentration is characteristic of background levels observed at mercury mine sites in the Coast Ranges.)

The proposed statewide total mercury load allocations for atmospheric deposition are expressed as loads (kilograms of mercury per year [kg/yr]), as follows:

- 1,400 kg/yr for deposition from natural sources;
- 230 kg/yr for deposition from anthropogenic sources within California; and
- 1,600 kg/yr for deposition from anthropogenic sources outside of California.

The proposed load allocation for in-reservoir methylmercury production is no detectable methylmercury in unfiltered reservoir water (calendar year median for the entire water column, including the epilimnion and hypolimnion) with a detection limit of 0.009 ng/L.

Table S-1 List of Mercury-Impaired Reservoirs to be Included in Phase 1

This table is provided as a separate document.