

HEALTH ADVISORY AND GUIDELINES FOR EATING FISH FROM CAMANCHE RESERVOIR

**(Amador, Calaveras, and
San Joaquin Counties)**

November 2014



**Office of Environmental Health Hazard Assessment
California Environmental Protection Agency**

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LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife
DDTs	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyl dichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE)
EBMUD	East Bay Municipal Utility District
FMP	Fish Mercury Project
OEHHA	Office of Environmental Health Hazard Assessment
MDL	method detection limit
mm	millimeters
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
US EPA	United States Environmental Protection Agency

PREFACE

The Office of Environmental Health Hazard Assessment (OEHHA), a department in the California Environmental Protection Agency, is responsible for evaluating potential public health risks from chemical contamination of sport fish. This task includes issuing fish consumption advisories, when appropriate, for the State of California. OEHHA's authorities to conduct these activities are based on mandates in the:

- California Health and Safety Code
 - Section 59009, to protect public health
 - Section 59011, to advise local health authorities
- California Water Code
 - Section 13177.5, to issue health advisories

The health advisories are published in the California Department of Fish and Wildlife Sport Fishing Regulations in the section on public health advisories.

This report presents guidelines for eating fish from Camanche Reservoir in Amador, Calaveras, and San Joaquin Counties. The report provides background information and a description of how the guidelines were developed. The resulting advice is summarized in the illustrations after the Table of Contents and List of Figures and Tables.

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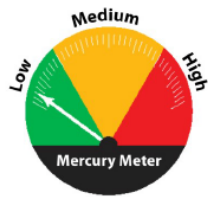
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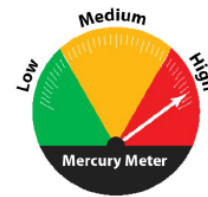
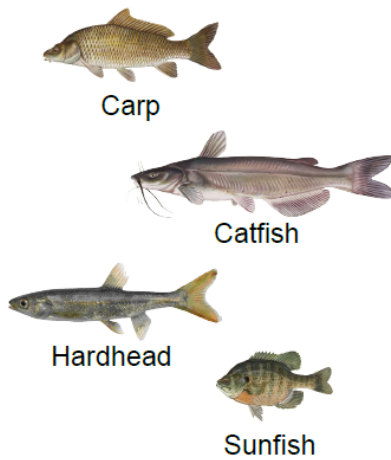
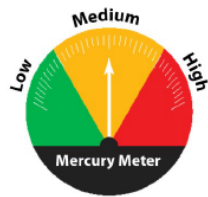
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A Healthy Guide to Eating Fish from Camanche Reservoir

Women 18- 45 Years and Children 1-17 Years



There are no fish in this group

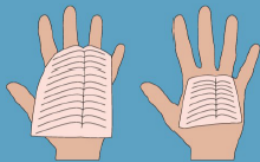


2 servings a week

1 serving a week

Do not eat

What is a serving?



For Adults For Children

The recommended serving is the size and thickness of your hand. Give children smaller servings.

Why eat fish?

Eating fish is good for your health.

Fish have Omega-3s that can reduce your risk for heart disease and improve how the brain develops in unborn babies and children.

What is the concern?

Some fish have high levels of mercury. Mercury can harm the brain, especially in unborn babies and children.

A Healthy Guide to Eating Fish from Camanche Reservoir

Women over 45 Years and Men



Sunfish



Carp



Catfish



Black bass



Hardhead

3 servings a week

OR

2 servings a week

OR

1 serving a week

What is a serving?



For Adults For Children

The recommended serving is the size and thickness of your hand. Give children smaller servings.

Why eat fish?

Eating fish is good for your health.

Fish have Omega-3s that can reduce your risk for heart disease and improve how the brain develops in unborn babies and children.

What is the concern?

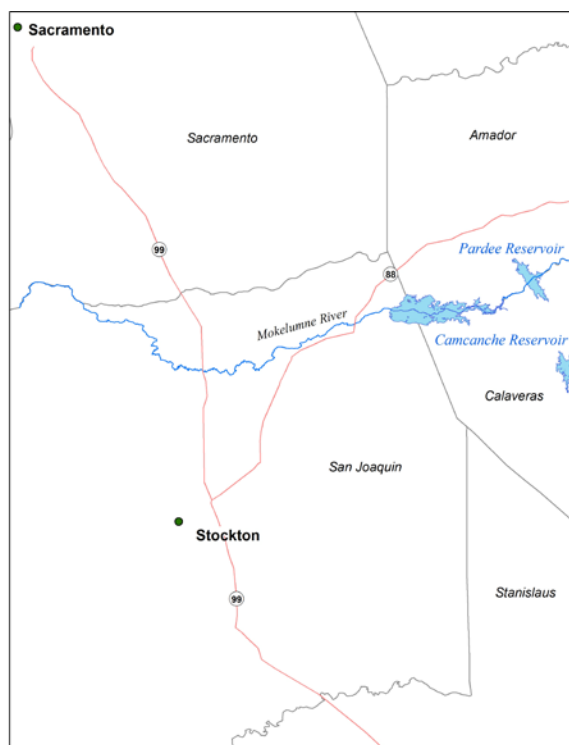
Some fish have high levels of mercury. Mercury can harm the brain, especially in unborn babies and children. Women over 45 years and men have lower risk and can eat more fish.

INTRODUCTION

This report presents guidelines for eating fish from Camanche Reservoir located at the intersection of Amador, Calaveras, and San Joaquin Counties, California (Figure 1). The reservoir resulted from construction of Camanche Dam, completed in 1963, on the Mokelumne River. The reservoir flooded the towns of Camanche, Lancha Plana, and Poverty Bar. The East Bay Municipal Utility District (EBMUD) gets most of its water from the upstream Pardee Reservoir and uses Camanche Reservoir to store water for flood control. EBMUD also owns and operates a hydroelectric plant at Camanche Reservoir to produce hydropower.¹

Camanche Reservoir is popular for recreation, including fishing. It is known for bass fishing, and both bass and trout are regularly stocked by the reservoir concessionaire. Other fish species include catfish, kokanee, crappie, bluegill, and other sunfish species.²

FIGURE 1. LOCATION OF CAMANCHE RESERVOIR IN CALIFORNIA



¹ www.ebmud.com/water-and-wastewater/project-updates/dam-safety-program. Camanche Dam is also under the jurisdiction of the Federal Energy Regulatory Commission.

² www.camancherecreation.com/fishing/index.php, www.norcalfishing.com/fishing_tips/

OEHHA used the results from two monitoring projects described in this report to develop the advisory for Camanche Reservoir. The basic OEHHA process to develop consumption advice involves these steps:

- 1) Selection of the chemical data and fish species to be evaluated
- 2) Calculation of average chemical concentrations and other descriptive statistics as appropriate for the selected fish species
- 3) Comparison of the chemical concentrations with the OEHHA Advisory Tissue Levels (ATLs) for each chemical of concern

The ATLs (Appendix I) are acceptable exposure levels in fish tissue, based on chemical toxicity, for a range of consumption rates. Development of the ATLs also included consideration of health benefits associated with including fish in the diet (OEHHA, 2008).

CHEMICALS OF POTENTIAL CONCERN

All fish samples from Camanche Reservoir were analyzed for mercury (as a measure of methylmercury). Mercury, a metal, is widely found in California in rock and soil. Its presence in the aquatic environment is the result of mining activities and releases into the environment from industrial sources, including the burning of fossil fuels and solid wastes. Mercury in the sediment is transformed by bacteria to the more toxic organic form, methylmercury. Methylmercury is then absorbed by fish when they eat small aquatic organisms. High levels of methylmercury can harm the brain, especially in fetuses and children as they grow.

Polychlorinated biphenyls (PCBs) and the persistent pesticides dieldrin, chlordane, and DDTs (dichlorodiphenyltrichloroethane and metabolites) were analyzed only in one composite sample of largemouth bass, comprised of 15 of the individual bass analyzed for mercury.

PCBs are man-made chemicals previously used in electrical transformers, lubricating oils, and plastics, for example as flame retardants and electrical insulation. Depending on the exposure level, PCBs can cause cancer and other health effects in humans. Chlordane, DDTs, and dieldrin are pesticides that were banned from use many years ago but have persisted and accumulated in some fish from certain water bodies in California. These pesticides may cause cancer or adverse effects on the nervous system. Detailed discussion of the toxicity of these chemicals is presented in OEHHA (2008).

DATA SOURCES

The guidelines for eating fish from Camanche Reservoir were based on chemical analysis of fish samples by the two studies described below. These two projects had

adequate documentation of sample collection, fish preparation, chemical analyses, and quality assurance, and had low detection limits.

FISH MERCURY PROJECT (FMP)

The FMP was a three-year (2005 to 2007) sampling program funded by CALFED³. Monitoring of sport fish for mercury contamination from Central Valley water bodies was planned and conducted by staff from OEHHA, the California Department of Fish and Wildlife (CDFW), the California Department of Public Health, the University of California at Davis, and the San Francisco Estuary Institute. Tasks included sport fish monitoring, public outreach activities, and development of consumption advice and educational materials for various water bodies in the Central Valley. Fish samples were collected for mercury analysis from various reservoirs in the study area, including Camanche Reservoir, in 2005.

SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP)

The SWAMP, operated by the State Water Resources Control Board, monitors water quality in California's surface waters. In 2007 and 2008, the program performed a statewide survey of inland water bodies. The survey collected largemouth bass from Camanche Reservoir in 2008 and analyzed them for mercury, PCBs, chlordane, dieldrin, and DDTs.

Table 1 shows the type and number of fish sampled from Camanche Reservoir, the project under which they were collected, and the year sampled. The fish from which samples were taken (shown in Table 1) either met CDFW's legal size requirements (for largemouth bass; CDFW, 2014-2015), or OEHHA's criteria for minimum "edible" size based on species size at maturity and professional judgment (OEHHA, 2005).

³ CALFED (<http://www.calwater.ca.gov/>) is made up of California and federal agencies whose objectives are water quality, water supply, ecosystem restoration, and levee integrity of the Sacramento-San Joaquin Delta.

TABLE 1. FISH COLLECTED FROM CAMANCHE RESERVOIR

Common Name	Scientific Name	Number of Fish Collected ^a	Project	Year
Black bass (largemouth bass)	<i>Micropterus salmoides</i>	9	FMP	2005
		22	SWAMP	2008
Carp	<i>Cyprinus carpio</i>	5	FMP	2005
Catfish, channel	<i>Ictalurus punctatus</i>	22	FMP	2005
Crappie, black	<i>Pomoxis nigromaculatus</i>	2	FMP	2005
Hardhead	<i>Mylopharodon conocephalus</i>	6	FMP	2005
Sunfish (bluegill)	<i>Lepomis macrochirus</i>	10	FMP	2005

^a Only fish meeting minimum size criteria are shown.

FMP = Fish Mercury Project, SWAMP = Surface Water Ambient Monitoring Program

CHEMICAL CONCENTRATIONS

Fish samples were prepared as skinless fillets and analyzed for total mercury as individual fish. Samples were combusted and analyzed by DMA (direct mercury analyzer), a combination of thermal decomposition and atomic absorption, at the CDFW Moss Landing Marine Laboratories. Results are reported in parts per billion (ppb) wet weight. Total mercury analyzed was assumed to be 100% methylmercury because almost all mercury present in fish is the more toxic form methylmercury (Bloom, 1992).

For analysis of legacy pesticides and PCBs (54 congeners⁴), 15 individual largemouth bass samples were combined to make one composite sample. Composite samples are prepared from equal amounts of tissues from several individual fish, all of the same species. Composite sampling is usually done to reduce the cost of analysis for samples to be analyzed for organochlorine contaminants. The analytical result from a composite sample represents an average concentration. Pesticides and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. The method detection limits (MDL) and reporting limits (RL)⁵ for all chemicals analyzed are shown in Appendix II.

⁴ Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54 are generally reported.

⁵ The MDL is the lowest concentration at which a chemical can be identified in a sample. The RL is the lowest concentration of a chemical that can be accurately quantified in a sample.

OEHHA used the arithmetic mean (average) of the chemical concentrations for each fish species to represent average human exposure. Table 2 shows the mean mercury concentrations and total lengths⁶ for each species.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM CAMANCHE RESERVOIR

Common Name	Number of Samples ^a	Mean Total Length (mm)	Range of Lengths (mm)	Mercury	
				Mean (ppb)	Range (ppb)
Black bass	31	394	312-516	494	179-870
Catfish	22	587	490-649	350	125-711
Crappie	2	282	265-299	336	265-406
Hardhead	6	457	430-485	433	370-525
Carp	5	436	398-503	401	206-694
Combined	11	447	398-503	419	206-694
Sunfish	10	156	117-200	179	78-411

^a All samples were of individual fish

For PCBs, chlordanes, and DDTs, each of the concentrations presented was the sum of the detected parent compound, congeners, or metabolites, where applicable. Since the MDLs or RLs were relatively low, ≤ 3 ppb, individual congeners or metabolites with concentrations reported as non-detects were assumed to have no residue. This is a standard method of handling non-detect samples for PCBs and other chemicals with multiple congeners or metabolites when detection levels are adequate (US EPA, 2000a).

The mean length of the largemouth bass in the composite sample was 370 mm total length. Chlordanes and dieldrin were not detected, and DDTs and PCBs were less than 1 ppb. The concentrations of the pesticides were lower than the ATL threshold value for daily consumption (OEHHA, 2008). Therefore, pesticides and PCBs were not considered further for developing consumption advice. The guidelines for eating fish from Camanche Reservoir are based solely on mercury concentrations.

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM CAMANCHE RESERVOIR

GENERAL INFORMATION

The OEHHA advisory process considers the health benefits of fish consumption as well as the risk from exposure to chemical contaminants that may be found in fish. Benefits are included in the advisory process because there is considerable evidence and scientific consensus that fish constitutes part of a healthy, well-balanced diet. Fish

⁶ Total length is the maximum length of the fish, with the mouth closed and the tail fin pinched together.

contain many nutrients that are important for general health and, in particular, help promote optimal growth and development of babies and young children and may reduce the incidence of heart disease in adults (FDA/US EPA, 2014; American Heart Association, 2014; OEHHA, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish is a significant source of the specific omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), thought to be associated with many of these beneficial effects (USDA/USDHHS, 2010; Weaver et al., 2008).

The 2010 U.S. Dietary Guidelines recommend that consumers eat at least eight ounces of cooked seafood⁷ per week (“young children need less depending on age and calorie needs”) and that “women who are pregnant or breastfeeding consume eight to twelve ounces of seafood per week from a variety of seafood types” (USDA/USDHHS, 2010). However, the particular fish that people eat is an important factor in determining the net beneficial effects of fish consumption. For example, studies have shown that children of mothers who ate low-mercury fish during pregnancy scored better on cognitive tests compared to children of mothers who did not eat fish or ate high-mercury fish (Oken et al., 2005, 2008). Accordingly, because of the high mercury content of these fish species, the Dietary Guidelines recommend that women who are pregnant or breastfeeding do not consume shark, swordfish, tilefish, or king mackerel, and limit consumption of albacore tuna to six ounces per week (USDA/USDHHS, 2010).

Catching and eating sport fish (i.e., fish and shellfish that people catch for themselves, friends or family) can be an important and economical way for consumers to meet the seafood consumption recommendations of the Dietary Guidelines. However, the mercury (and other contaminant) content of sport fish can vary widely by species and location. In order to address the potential health concerns associated with consuming contaminants in sport fish, OEHHA has established ATLS (Advisory Tissue Levels, i.e., acceptable exposure levels) for chemicals that are known to accumulate in the edible tissues of fish. ATLS consider both the toxicity of the chemical and potential benefits of eating fish. OEHHA uses the ATLS to determine the maximum number of servings per week that consumers can eat, for each species and at each location, to limit their exposure to these contaminants. Consumers can use OEHHA’s guidance when choosing which fish and how much to eat as part of an overall healthy diet.

There are two sets of ATLS for methylmercury in fish because of the age-related toxicity of this chemical (OEHHA, 2008). The fetus and children are more sensitive to the toxic effects of methylmercury. Thus, the ATLS for women who might become pregnant

⁷ “Seafood is a large category of marine animals that live in the sea and in freshwater lakes and rivers. Seafood includes **fish**, such as salmon, tuna, trout, and tilapia, and **shellfish**, such as shrimp, crab, and oysters” (USDA/USDHHS, 2010).

(typically 18 to 45 years of age) and children (the sensitive population) are lower than for women over 45 years and men. The lower ATL values for the sensitive population provide protection to allow for normal growth and development of the brain and nervous system of unborn babies and children. Detailed discussion about the toxicity of common fish contaminants and health benefits of fish consumption, as well as derivation of the ATLs, are available in OEHHA, 2008. A list of ATLs used in this report is presented in Appendix I.

Data for fish species may be combined as a single group based on their taxonomy (i.e., they are in the same taxonomical Family and/or genus) and other considerations when specified in the following discussion of the water-body specific advice. For each fish species or group of related species in this advisory⁸, OEHHA compared the average concentration of each chemical detected in fish fillet to the ATL for that chemical in order to establish the maximum number of servings per week that could be consumed. When there is more than one chemical of concern, OEHHA provides advice based on the chemical that leads to the most restrictive consumption advice (i.e., the lowest number of servings per week). In addition, because mercury and PCBs cause similar adverse effects in the sensitive population (developmental neurotoxicity), OEHHA uses multiple chemical exposure methodology (US EPA, 1989 and 2000b) to minimize potential additive effects of these chemicals. Thus, consumption advice may be more restrictive for the sensitive population when both chemicals are present in the same fish than it would be for either chemical alone.

OEHHA recommends that individuals strive to meet the U.S. Dietary Guidelines seafood consumption recommendations, while also adhering to federal and OEHHA recommendations to limit the consumption of high-contaminant fish. The advice discussed in the following section represents the maximum recommended number of servings per week for different fish from this water body. People should eat no more than the recommended number of servings for each fish species or species group. Consumption advice should not be combined. That is, if a person chooses to eat a fish from the “one-serving-a-week” category, then they should not eat any other fish from any source until the next week. If a person chooses to eat a fish from the “two-servings-per-week” category, they can combine fish species from that category for a total of two servings in that week. Then they should not eat any other fish from any source until the next week.

⁸ A species group includes related species. Fish species within the same genus are most closely related, and Family is the next level of relationship.

SAMPLE EVALUATION

Sample sizes were sufficient for bluegill, channel catfish, and largemouth bass. Only two black crappie were collected. Therefore, this species did not meet OEHHA's criterion for at least nine fish of a species to represent the population in the water body. OEHHA did not include crappie in the advisory.

BLACK BASS

Based on the mean mercury concentration in largemouth bass, 494 ppb, OEHHA recommends no consumption for the sensitive population and one serving a week for women over 45 years and men. OEHHA evaluated mercury concentrations in three black bass species in California (largemouth, smallmouth, and spotted bass) and found a similar range of concentrations when two or more of these species were present in the same water body. Therefore, the advice for largemouth bass can be extended to other black bass species.

CATFISH

The mean mercury concentration in channel catfish was 350 ppb. OEHHA recommends one serving a week of catfish for the sensitive population and two servings a week for women over 45 years and men.

HARDHEAD AND CARP

Hardhead and carp are in the same family Cyprinidae (Minnows) and had similar concentrations of mercury. The two species were considered together to develop advice based on the combined sample size of 11 fish. The mean mercury concentration was 419 ppb. OEHHA recommends one serving a week of hardhead or carp for the sensitive population and two servings a week for women over 45 years and men.

SUNFISH

The mean mercury level in bluegill was 179 ppb. OEHHA surveyed the mercury levels in sunfish species in California including bluegill, redear sunfish, and green sunfish, and found the concentrations within a water body were similar between species. Therefore, OEHHA extended the advice for bluegill to the other sunfish species. OEHHA recommends one serving a week of sunfish for the sensitive population and three servings a week for women over 45 years and men.

MAXIMUM RECOMMENDED NUMBER OF SERVINGS

The maximum recommended numbers of servings per week for fish from Camanche Reservoir are shown in Table 3.

TABLE 3. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM CAMANCHE RESERVOIR

Fish Species	Women 18–45 years and Children 1–17 years	Women over 45 years and Men
Black bass	0	1
Catfish	1	2
Carp	1	2
Hardhead	1	2
Sunfish	1	3

REFERENCES

American Heart Association (2014). Fish and Omega-3 Fatty Acids.

<http://www.americanheart.org/presenter.jhtml?identifier=4632>

Bloom, N.S. 1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. *Can. J. Fish. Aquat. Sci.* 49(5):1010-1017.

CDFW. 2014-2015. California Department of Fish and Wildlife. 2013-2014 Freshwater Sport Fishing Regulations. Online at: <https://www.wildlife.ca.gov/Regulations>

FDA/US EPA. 2014. Fish: What Pregnant Women and Parents Should Know. Draft Updated Advice by FDA and EPA/June 2014. Online at:

<http://www.fda.gov/downloads/Food/FoodborneIllnessContaminants/Metals/UCM400358.pdf>

IOM. 2007. Seafood choices, balancing benefits and risks. Committee on Nutrient Relationships in Seafood: Selections to Balance Benefits and Risks. Institute of Medicine, Food and Nutrition Board. The National Academies Press, Washington, D.C.

Kris-Etherton, P.M., W.S. Harris, and L.J. Appel (2002). Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation* 106:2747-2757.

OEHHA. 2005. General Protocol for Sport Fish Sampling and Analysis. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California. Online at:

<http://www.oehha.ca.gov/fish/pdf/fishsampling121406.pdf>

OEHHA. 2008. Development of fish contaminant goals and Advisory Tissue Levels for common contaminants in California sport fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California. Online at: <http://www.oehha.ca.gov/fish/gtllsv/pdf/FCGsATLs27June2008.pdf>

Oken, E.; Wright, R.O.; Kleinman, K.P.; Bellinger, D.; Amarasiriwardena, C.J.; Hu, H., Rich-Edwards, J.W.; Gillman, M.W. 2005. Maternal fish consumption, hair mercury, and infant cognition in a U.S. cohort. *Environ. Health Perspect.* 113(10):1376-1380.

Oken, E.; Radesky, J.S.; Wright, R.O.; Bellinger, D.; Amarasiriwardena, C.J.; Kleinman, K.P.; Hu, H., Rich-Edwards, J.W.; Gillman, M.W. 2008. Maternal fish intake during pregnancy, blood mercury levels, and infant cognition at age 3 years in a U.S. cohort. *Am. J. Epidemiol.* 167(10):1171-1181.

USDA/USDHHS. 2010. Dietary Guidelines for Americans, 2010. 7th Edition, Washington, DC: U.S. Government Printing Office, December 2010.
<http://www.health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf>

US EPA. 1989. Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) Interim Final. EPA/5401-89/002, December 1989. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Online at: <http://www.epa.gov/oswer/riskassessment/ragse/index.htm>

US EPA. 2000a. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1. Fish Sampling and Analysis. 3rd Ed. EPA 823-B00-007. Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

US EPA. 2000b. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2. Risk Assessment and Fish Consumption Limits, 3rd Edition. EPA 823-B-00-007. Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

Weaver, K.L., P. Ivester, J.A. Chilton, M.D. Wilson, P. Pandey, and F.H. Chilton (2008). The content of favorable and unfavorable polyunsaturated fatty acids found in commonly eaten fish. J. American Dietetic Association 108:1178-1185.

APPENDIX I. ADVISORY TISSUE LEVELS

Advisory Tissue Levels (ATLs) guide the development of advice for people eating sport fish. ATLs show maximum numbers of recommended fish servings that correspond to the chemical levels found in fish. OEHHA uses ATLs to provide advice to prevent consumers from being exposed to:

- more than the average daily reference dose⁹ for chemicals not known to cause cancer, such as methylmercury, or
- for cancer-causing chemicals, a risk level greater than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime. This cancer endpoint is the maximum acceptable risk level recommended by the US EPA (2000b) for fish advisories.

For each chemical, ATLs were determined for both cancer and non-cancer risk, if appropriate, for one to seven eight-ounce servings per week. The most health-protective ATLs for each chemical, selected from either cancer or non-cancer based risk, are shown in the table below for zero to three servings per week. Exposure to chemicals in fish from Camanche Reservoir would be at or below the average daily reference dose or the cancer risk probability of one in ten thousand if the guidelines for eating fish from Camanche Reservoir are followed.

Advisory Tissue Levels (ATLs) Based on Cancer or Non-Cancer Risk Using an 8-Ounce Serving Size				
Chemical	Consumption Frequency Categories^a and ATLs^b (in ppb)			
	Three Servings per Week	Two Servings per Week	One Serving per Week	No consumption
Chlordanes	>140-190	>190-280	>280-560	>560
DDTs	>390-520	>520-1,000	>1,000-2,100	>2,100
Dieldrin	>11-15	>15-23	>23-46	>46
Methylmercury (Women 18 to 45 years and children 1 to 17 years of age)	>55-70	>70-150	>150-440	>440
Methylmercury (Women over age 45 years and men)	>160-220	>220-440	>440-1,310	>1,310
PCBs	>15-21	>21-42	>42-120	>120

^a Serving sizes (prior to cooking, wet weight) are based on an average 160 pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts.

^b When residue data are compared to this table, they should also first be rounded to the second significant digit.

⁹ The reference dose is an estimate of the maximum daily exposure to a chemical likely to be without significant risk of harmful health effects during a lifetime.

APPENDIX II. METHOD DETECTION LIMITS AND REPORTING LIMITS

Concentrations are in ppb wet weight

Analyte	FMP MDL	FMP RL	SWAMP MDL	SWAMP RL
Mercury	18 or 19	18 or 19	12	12
Chlordanes	NA	NA	0.187-0.457	0.970
DDTs	NA	NA	0.093-0.463	0.970-2.90
Dieldrin	NA	NA	0.417	0.480
PCBs	NA	NA	0.2-0.3	0.6 or 0.9

MDL Method Detection Limit RL Reporting Limit

NA Not applicable because these chemicals were not analyzed in the FMP