FINAL TECHNICAL REPORT

Klamath Hydroelectric Project
(FERC Project No. 2082)

Screening Level Determination of Chemical Contaminants in Fish Tissue in Selected Project Reservoirs

PacifiCorp
Portland, Oregon

September 2004

Printed on Recycled and Recyclable Paper

SCREENING LEVEL DETERMINATION OF CHEMICAL CONTAMINANTS IN FISH TISSUE IN SELECTED PROJECT RESERVOIRS

Summary

This technical report describes the methods and results of a screening level study of chemical contaminants in fish tissue in Keno, J.C. Boyle, Copco, and Iron Gate reservoirs, and in Upper Klamath Lake. The objectives of the study are to provide information on fish tissue concentrations of potential contaminants and a conservative, screening-level analysis of whether there is a potential for concern that fish in these waterbodies are bioaccumulating toxic substances at levels that may adversely affect public health or wildlife via fish consumption or at levels that may be harmful to aquatic life.

Fish tissue samples were collected and analyzed for selected metals, organochlorine (pesticide) compounds, and PCBs. Metals analysis included arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc. Largemouth bass (*Micropterus salmoides*) was the primary target species, but black bullhead catfish (*Ameiurus melas*) were used for samples from Keno reservoir and Upper Klamath Lake, where few largemouth bass were captured.

Screening level values for protection of human health are based on EPA (2000), and suggested guidance values for protection of wildlife were obtained from MacDonald (1994). Screening level values for protection of human health used in this report are for recreational fishers and subsistence fishers. Different screening values are stated for the two fisher groups because of the greater quantity of fish consumed by subsistence fishers. Although recreational fishing occurs in Upper Klamath Lake, Keno, J.C. Boyle, Copco, and Iron Gate reservoirs, subsistence fishing is not known to occur in these same areas.

All of the measured fish tissue values for total mercury are well below the screening values for human health. Values measured in largemouth bass from Iron Gate reservoir and Copco reservoir are slightly above the screening value for wildlife exposure. All other measured mercury values are below the screening value for wildlife.

Although arsenic was detected in several samples, no value exceeded the method reporting limit[1]. Estimated values (those values between the method reporting limit and the method detection limit) for arsenic concentration in samples of largemouth bass from J. C. Boyle, Iron Gate, and Copco reservoirs are below the toxicity screening value for recreational fishers, but equal or exceed the toxicity screening value for subsistence fishers. Cadmium and selenium values are below all screening values in all samples. No screening values are available for other metals.

Fish tissue samples were analyzed for 41 pesticides and pesticide byproducts. Only two pesticide residues, DDE and hexachlorobenzene, were detected in any sample, and none of the detected levels of these two residues exceed the human health screening values. Some of the fish tissue samples from Upper Klamath Lake, Keno reservoir, J. C. Boyle reservoir, and Copco reservoir exceed the suggested wildlife screening value for total DDTs, of which DDE is a component. Hexachlorobenzene was detected in only two samples and at levels below the method reporting limit. It is not possible to state whether or not these samples exceed the suggested guidelines for wildlife, some of which are below the method reporting limit.

PCBs were detected in all samples from all of the Project reservoirs. Total PCB values are less than the screening value for recreational fishers in all samples. Total PCB values exceed the screening value for

[1] The *method detection limit* is a statistically-derived value, such that if an analyte is measured above this value the laboratory is 99 percent confident that the constituent is present at a value above this level. The *method reporting limit* is the limit at which the laboratory is confident about the measurement of the presence of the actual target analyte as determined within the sample matrix. Hence, values measured above the method detection limit but below the reporting detection limit are considered estimated values.

subsistence fishers in black bullhead from Keno reservoir, and in largemouth bass from J.C. Boyle, Iron Gate, and Copco reservoirs. Total PCB values in all the samples analyzed for this study are less than the toxicity screening value for protection of wildlife.

1. INTRODUCTION

This technical report describes the methods and results of a screening level study of chemical contaminants in fish tissue in Keno, J.C. Boyle, Copco, and Iron Gate reservoirs of the Klamath Hydroelectric Project. The Project is located in Klamath County, south-central Oregon, and Siskiyou County, north-central California. As background context, the study also includes fish tissue samples from Upper Klamath Lake, located upstream of the Project.

The primary aims of this study are to provide information on fish tissue concentrations of potential contaminants and a conservative, screening-level analysis of whether there is a potential for concern that fish in Project reservoirs are bioaccumulating toxic substances at levels that may adversely affect public health or wildlife via fish consumption or that may be harmful to aquatic life. Both Oregon[2] and California[3] have narrative water quality standards concerning bioaccumulation of toxic substances, but neither state's water quality standards currently include numeric fish tissue criteria. The rationale, approach, and methods for this study are based on a study plan developed by PacifiCorp (PacifiCorp 2003) in consultation with the Oregon Department of Environmental Quality (ODEQ), the California State Water Resources Control Board (SWRCB), the California Department of Fish and Game (CDFG), and other stakeholders to the Project's FERC relicensing process.

Stakeholders have suggested that sediments in Project reservoirs (particularly Keno reservoir) may be contaminated with agricultural chemical residue, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and trace metals including mercury. There is no reason to believe that the Project has contributed contaminants to the sediments, but it is possible that contaminants from other sources may have accumulated in the reservoir sediments and then bioaccumulated in reservoir fish.

2. METHODS

Methods of collection and analysis followed EPA approved protocols: *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1: Fish Sampling and Analysis, Third Edition* (United States Environmental Protection Agency, Office of Water EPA 823-B-00-007, November 2000). Fish samples were collected by personnel from the CDFG Fish and Wildlife Water Pollution Control Laboratory (WPCL) in Rancho Cordova, California, with supplementation from a U.S. Geological Survey (USGS) fish survey team.

Tissue samples were analyzed by the WPCL in Rancho Cordova, California. Tissue samples were analyzed for selected metals, organochlorine (pesticide) compounds, and PCBs. Metals

[2] Oregon Administrative Rules 340-041-0033(1) ("Toxic substances may not be introduced above natural background levels in waters of the state in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife, or other designated beneficial uses.").

[3] North Coast Regional Water Quality Control Board, Water Quality Control Plan for the North Coast Region, as amended 1994, p. 3-4.0.

analysis included arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc. Specific target compounds are listed in Table 1 (metals), Table 2 (organochlorine compounds), and Table 3 (PCB congeners).

Table 1. Selected metals analyzed and their method reporting limits (RL) in tissue. Values are ppm wet weight, except mercury (Hg) which is ppm dry weight.

	RL ppm
Arsenic (As)	0.30
Cadmium (Cd)	0.006
Chromium (Cr)	0.10
Copper (Cu)	0.01
Lead (Pb)	0.006
Mercury (Hg)	0.033
Nickel (Ni)	0.018
Selenium (Se)	0.30
Zinc (Zn)	0.06

Table 2. Organochlorine compounds analyzed and their method reporting limits (RL) in tissue, ng/g wet weight.

	RL ng/g wet wt.
Aldrin	1.0
Chlordane, cis	1.0
Chlordane, trans	1.0
Chlordene, alpha	0.5
Chlordene, gamma	0.5
Chlorpyrifos	1.0
Dacthal	1.0
DDBP, p,p'	10.0
DDD, o,p'	1.0
DDD, p,p'	1.0
DDE, o,p'	2.0
DDE, p,p'	2.0
DDMU, p,p'	3.0
DDT, o,p'	3.0
DDT, p,p'	5.0
Diazinon	20
Dieldrin	0.5
Endosulfan I	2.0
Endosulfan II	10
Endosulfan sulfate	10
Endrin	2.0
HCH, alpha	0.5
HCH, beta	1.0
HCH, delta	2.0
HCH, gamma	0.5
Heptachlor	1.0
Heptachlor epoxide	0.5
Hexachlorobenzene	0.3
Methoxychlor	3.0
Mirex	1.5
Nonachlor, cis	1.0
Nonachlor, trans	1.0
Oxadiazon	1.0
Oxychlordane	1.0
Parathion, ethyl	2.0
Parathion, methyl	4.0
Tetradifon (Tedion)	2.0
Toxaphene	20

Table 3. PCB Congeners and Aroclor mixtures analyzed and their minimum method reporting limits (RL) in tissue, ng/g wet weight.

NIST Congeners:

PCB Congener 8	PCB Congener 128
PCB Congener 18	PCB Congener 138
PCB Congener 28	PCB Congener 153
PCB Congener 44	PCB Congener 170
PCB Congener 52	PCB Congener 180
PCB Congener 66	PCB Congener 187
PCB Congener 87	PCB Congener 195
PCB Congener 101	PCB Congener 206
PCB Congener 105	PCB Congener 209
PCB Congener 118	

Additional Congeners:

PCB Congener 5	PCB Congener 137
PCB Congener 15	PCB Congener 149
PCB Congener 27	PCB Congener 151
PCB Congener 29	PCB Congener 156
PCB Congener 31	PCB Congener 157
PCB Congener 49	PCB Congener 158
PCB Congener 70	PCB Congener 174
PCB Congener 74	PCB Congener 177
PCB Congener 95	PCB Congener 183
PCB Congener 97	PCB Congener 189
PCB Congener 99	PCB Congener 194
PCB Congener 110	PCB Congener 201
PCB Congener 132	PCB Congener 203

All individual PCB Congener method reporting limits are 0.2 ng/g wet weight.

Aroclors:	Reporting Limits ng/g wet wt.
Aroclor 1248	25
Aroclor 1254	10
Aroclor 1260	10

2.1 Fish Tissue Sample Collection

Fish samples were collected from each of the Project reservoirs on the following sampling dates: Keno reservoir (including Lake Ewauna area) on May 29, 2003; J.C. Boyle reservoir on May 28, 2003; Copco reservoir on June 4, 2003; and Iron Gate reservoir on June 4, 2003. Samples also were collected from Upper Klamath Lake on various dates in September 2003 to be used as a reference for background conditions.

Fish taken for tissue sampling by WPCL personnel were collected using a Smith-Root electrofishing boat. Collections were made during daylight hours along the lake margins in water usually less than 10 feet deep. Largemouth bass (*Micropterus salmoides*) was the primary target species, but black bullhead catfish (*Ameiurus melas*) were used for samples from Keno reservoir and Upper Klamath Lake, where largemouth bass sampling was low. These species were chosen because they are popular game species that reside year-round in these reservoirs, and consequently represent the potentially greatest risk related to consumption.

The target minimum size for largemouth bass was 12 inches. There was no minimum size for black bullheads other than being of 'edible' size for anglers. Two composite samples of six fish each of the target species were to be taken from each reservoir or lake. The smallest fish of a species in a composite sample was to be no less than 75 percent of the length of the largest fish of that species in that sample.

Fish were held in a circulating live tank aboard the electrofishing boat. Upon return to the landing site, the fish were humanely dispatched, measured for fork and total length, packaged in heavy duty aluminum foil, and quick frozen on dry ice in heavy duty coolers. Dorsal and pectoral spines of the catfish were clipped before packaging.

Black bullhead catfish were sampled by the USGS fish survey team in Keno reservoir and Upper Klamath Lake and given to the WPCL to supplement sampling efforts in those waters. Fish were collected by the USGS fish survey team using overnight sets of anchored fyke trap nets. Fish were transferred alive to the WPCL crew or frozen (following WPCL procedures) and shipped to the WPCL in Rancho Cordova, California, for processing.

2.2 Sample Preparation

Samples were stored in TSM F2 at -15 +/-5° until sample preparation. Preparation was performed in the WPCL clean room following standard procedures (SOP PREP-F). Composites were determined following methods described in the study plan (PacifiCorp 2003). Bullheads were dissected with skin on and largemouth bass were scaled with skin on. All fish were dissected to full filets. Composites were comprised of the entire filet or equal weight portions to meet a 100.0 g sample size. Homogenization was accomplished with a Büchi B-400 Mixer with titanium blades. Samples were refrozen and stored in TSM F4 at -15 +/-5°.

2.3 Analysis of Synthetic Organic Compounds in Tissue

Ten grams of homogenized tissue was extracted by pressurized fluid extraction using a Dionex Accelerated Solvent Extractor (ASE 200). The samples were extracted with a 50/50 solution of

acetone/dichloromentane using heat and pressure. The extracts were cleaned up by gel permeation chromatography to remove lipids and other matrix. The extracts were further cleaned up and fractionated into four fractions by eluting through a Florisil column which separates the analytes based on their polarity. The extracts were analyzed by gas chromatography with electron capture detection. The gas chromatographs are configured with a single injector connected to two 60 meter capillary columns of differing polarities (DB5 and DB17).

To analyze the lipid content, a portion of the extract was removed prior to GPC cleanup. After evaporating the solvent, the remaining residue was weighed and the percent lipid was calculated.

The percent moisture was determined by weighing approximately 3 grams of tissue, heating in a 70^{o}C oven for 24 hours, cooling and reweighing the dried tissue and then calculating the moisture content.

2.4 Analysis of Trace Elements in Tissue

Tissue samples were digested with nitric acid in a Microwave Assisted Reaction System (MARS 5). After cooling, 10^{18} M-ohm water was added and the samples were transferred to pre-cleaned polyethylene bottles.

The samples were analyzed on a Perkin-Elmer Sciex Elan 6000 Inductively-Coupled Plasma Mass Spectrometer equipped with a Perkin-Elmer AS 90 Autosampler.

3. RESULTS

The analytical results were compared to recommended screening and guidance values (see Appendix A, Tables A-1, A-2, and A-3) to determine if there is a potential cause for concern for human health and wildlife with regard to chemical contaminants. Screening level values for protection of human health are based on recommended values in EPA (2000) and suggested guidance values for protection of wildlife were obtained from MacDonald (1994).

Screening level values for protection of human health used in this report are for adult recreational and subsistence fishers. It is assumed that these fisher groups represent the segment of the population that typically consumes larger quantities of fish than the general population, and often obtains the fish they consume from the same local waterbodies repeatedly over many years. Different screening values are stated for recreational fishers and subsistence fishers because of a presumed greater quantity of fish consumed by subsistence fishers. Although recreational fishing occurs in Upper Klamath Lake, Keno, J.C. Boyle, Copco, and Iron Gate reservoirs, subsistence fishing is not known to occur in these same areas.

Results are summarized in the following text, and analysis data are included in Appendix B. In the summary tables included in the body of this report, values are provided for results that exceed the method reporting limits. Results for which the analyte was detected, but at too low a concentration to be quantified, are indicated as “less than” the method reporting limits. Results for which the analyte was below the method detection limit are indicated as “ND” (i.e., non-detect).

3.1 Mercury

Most mercury in fish and shellfish tissue is present as methyl mercury. Because analysis of methyl mercury is difficult and expensive, EPA recommends for screening-level analyses that total mercury be determined on the assumption that all mercury present is in the form of methyl mercury. The recommended screening values are for methyl mercury.

Concentrations of total mercury in the fish tissue samples are summarized in Table 4. All of the measured values for total mercury are well below the recommended screening values for human health. Values measured in largemouth bass from Iron Gate reservoir and Copco reservoir are slightly above the suggested screening value for wildlife exposure[4]. Other measured values were below the suggested screening value for wildlife.

Table 4. Total mercury concentrations (ppb dry weight) in black bullhead (BB) and largemouth bass (LMB) composite tissue samples taken from Project reservoirs and Upper Klamath Lake in 2003.

Sample	Composite	Site	Species	Total Mercury (ppb dry)
L-262-03	1F	Keno Reservoir	BB	0.550
L-262-03	1F Duplicate	Keno Reservoir	BB	0.568
L-262-03	2F	J C Boyle	LMB	0.685
L-262-03	3F	J C Boyle	LMB	0.784
L-273-03	1F	Iron Gate Reservoir	LMB	2.527
L-273-03	2F	Iron Gate Reservoir	LMB	2.299
L-273-03	3F	Copco Reservoir	LMB	2.438
L-273-03	4F	Copco Reservoir	LMB	1.619
L-484-03	1F	Upper Klamath Lake	BB	0.154
L-484-04	2F	Upper Klamath Lake	BB	0.161
		Method Detection Limit (MDL)		0.015
		Method Reporting Limit (RL)		0.033
		Screening Values:		
			Recreational fishers	400
			Subsistence fishers	49
			Wildlife	2.27

3.2 Metals Other Than Mercury

Concentrations of metals other than mercury in the fish tissue samples are summarized in Table 5. Of the metals other than mercury whose concentrations were determined in this study,

[4] Available information for wildlife exposure suggests a screening level of 0.5 µg/g wet weight (based on MacDonald 1994). The analysis conducted for this study was based on dry weight. The samples collected were about 78 percent water, so a comparable screening value based on dry weight would be approximately 2.27 µg/g.

only arsenic (As), cadmium (Cd), and selenium (Se) have EPA-recommended screening values for human health protection. No recommended screening values for wildlife were available for the metals listed in Table 5, except selenium. Arsenic has been determined to be a human carcinogen. Consequently, two screening value concentrations are provided by EPA, one based on carcinogenicity and one based on toxicity. EPA recommends that the lower value, based on carcinogenicity, be included for screening purposes.

Most of the arsenic present in fish and shellfish tissue is organic arsenic, which has been shown to be metabolically inert and nontoxic. Inorganic arsenic in fish tissue typically ranges from <1 to 20 percent of the total arsenic concentration. EPA, however, recommends that total arsenic concentration be measured and used for comparison to the screening values because this is more conservative.

None of the samples exceeded the method reporting limit for arsenic; however, six of the nine samples (all consisting of largemouth bass) exceeded the method detection limit (Table 5). The lab provided estimated concentrations of arsenic (values below the method reporting limit but above the method detection limit) for these six largemouth bass composite samples (Table 6). These results indicate that samples of largemouth bass exceed the carcinogenicity-based screening values for arsenic. Although no sample of black bullhead exceeded the method detection limit, it is not possible to state whether samples of black bullhead exceed the carcinogenicity-based screening value because they are lower than the method detection limit.

Screening values for arsenic based on toxicity are 1.2 ppm for recreational fishers and 0.147 ppm for subsistence fishers. Arsenic concentrations in samples of largemouth bass from J. C. Boyle, Iron Gate, and Copco reservoirs are below the toxicity screening value for recreational fishers, but equal or exceed the toxicity screening value for subsistence fishers (Tables 5 and 6).

Cadmium was below the screening values and the method reporting limit in all samples (Table 5). Selenium was below the screening values in all samples.

3.3 Pesticides

Fish tissue samples were analyzed for 41 pesticides and pesticide byproducts. Only two pesticide residues, DDE and hexachlorobenzene, were detected in any sample. Concentrations of DDE and hexachlorobenzene in the fish tissue samples are summarized in Table 7. No sample exceeded the human health screening values for either compound. Most samples were near or below the method reporting limit.

Available tissue quality guidelines for the protection of wildlife suggest screening values ranging from 0.2 to 1.0 µg/g for total DDTs (including DDE), and 0.2 to 0.33 µg/g for hexachlorobenzene. These values are below the method reporting limits for this study. Some of the fish tissue samples from Keno reservoir, J. C. Boyle reservoir, Copco reservoir, and Upper Klamath Lake exceed the suggested wildlife screening value for total DDTs. Hexachlorobenzene was detected but did not exceed the reporting level in two samples. It is not possible to state whether or not these samples exceed the suggested wildlife screening values for hexachlorobenzene.

Table 5. Metals concentrations (ppm) in black bullhead (BB) and largemouth bass (LMB) composite tissue samples taken from Project reservoirs and Upper Klamath Lake in 2003.

Sample	Composite	Site	Species	As (ppm)	Cd (ppm)	Cr (ppm)	Cu (ppm)	Ni (ppm)	Pb (ppm)	Se (ppm)	Zn (ppm)
L-262-03	1F	Keno Reservoir	BB	ND	ND	0.79	1.76	<0.018	0.011	0.46	23.4
L-262-03	2F	J C Boyle	LMB	<0.30	ND	0.67	1.52	0.030	0.011	0.57	37.6
L-262-03	3F	J C Boyle	LMB	<0.30	ND	0.62	1.39	<0.018	0.091	0.53	44.3
L-273-03	1F	Iron Gate Reservoir	LMB	<0.30	ND	0.70	1.38	0.023	0.041	0.64	32.4
L-273-03	2F	Iron Gate Reservoir	LMB	<0.30	ND	0.63	1.29	0.020	0.059	0.51	29.1
L-273-03	3F	Copco Reservoir	LMB	<0.30	ND	0.66	1.47	0.018	<0.006	0.68	29.2
L-273-03	4F	Copco Reservoir	LMB	<0.30	ND	0.64	1.56	<0.018	0.044	0.59	35.2
L-484-03	1F	Upper Klamath Lake	BB	ND	ND	0.68	1.91	<0.018	0.014	0.42	27.1
L-484-04	2F	Upper Klamath Lake	BB	ND	ND	0.63	1.97	<.006	<0.006	0.42	32.1
		Method Detection Limit (MDL)		0.10	0.002	0.03	0.003	0.006	0.002	0.10	0.02
		Method Reporting Limit (RL)		0.30	0.006	0.10	0.01	0.018	0.006	0.30	0.06
		Screening Values:									
			Recreational fishers	0.026[5]	4					20	
			Subsistence fishers	0.003[6]	0.491					2.457	
			Wildlife							3	

[5] This is the carcinogenicity screening value. The toxicity screening value for recreational fishers is 1.2 ppm.

[6] This is the carcinogenicity screening value. The toxicity screening value for subsistence fishers is 0.147 ppm.

Table 6. Estimated arsenic concentrations (values measured above the method detection limit of 0.10 ppm, but below the method reporting limit of 0.30 ppm) in black bullhead (BB) and largemouth bass (LMB) composite tissue samples taken from Project reservoirs and Upper Klamath Lake in 2003.

Sample	Composite	Site	Species	As (ppm)
L-262-03	2F	J C Boyle	LMB	0.19
L-262-03	3F	J C Boyle	LMB	0.16
L-273-03	1F	Iron Gate Reservoir	LMB	0.19
L-273-03	2F	Iron Gate Reservoir	LMB	0.14
L-273-03	3F	Copco Reservoir	LMB	0.17
L-273-03	4F	Copco Reservoir	LMB	0.13

Table 7. Total DDE and hexachlorobenzene concentrations (ppb) in black bullhead (BB) and largemouth bass (LMB) composite tissue samples taken from Project reservoirs and Upper Klamath Lake in 2003.

Sample	Composite	Site	Species	DDE, p,p'	Hexachlorobenzene
L-262-03	1F	Keno Reservoir	BB	2.41	<0.300
L-262-03	2F	J C Boyle	LMB	<2.00	
L-262-03	2F Duplicate	J C Boyle	LMB	<2.00	
L-262-03	3F	J C Boyle	LMB	2.91	<0.300
L-273-03	1F	Iron Gate Reservoir	LMB	<2.00	
L-273-03	2F	Iron Gate Reservoir	LMB	<2.00	
L-273-03	3F	Copco Reservoir	LMB	2.16	
L-273-03	4F	Copco Reservoir	LMB	<2.00	
L-484-03	1F	Upper Klamath Lake	BB	<2.00	
L-484-04	2F	Upper Klamath Lake	BB	2.32	
		Method Detection Limit (MDL)		0.56	0.10
		Method Reporting Limit (RL)		2.00	0.300
		Screening Values:			
			Recreational fishers	117	25
			Subsistence fishers	14.4	3.07
			Wildlife	0.2-1.0[7]	0.2-0.33

[7] Based on Total DDTs.

3.4 PCBs

PCB concentration may be determined as the sum of Aroclor equivalents for screening level purposes, but EPA considers that this does not adequately represent bioconcentrated PCB mixtures found in fish tissues. Although there are some recognized methodological problems with analytical techniques, EPA recommends that for intensive studies, PCB concentration be determined as the sum of PCB congeners. For this study researchers chose to perform the more intensive analysis of PCB congeners.

Concentrations of PCBs in the fish tissue samples are summarized in Table 8. PCBs were detected in all samples from all of the Project reservoirs. For this analysis, total PCBs were determined by calculating the sum of all values greater than the method reporting limit plus one-half of the method reporting limit for each value less than the method reporting limit.

Total PCB values are less than the screening value for recreational fishers in all samples. Total PCB values exceed the screening value for subsistence fishers in black bullhead from Keno reservoir, and in largemouth bass from J. C. Boyle, Iron Gate, and Copco reservoirs. The total PCB value in one sample from Upper Klamath Lake approaches, but does not exceed, the screening value for subsistence fishers.

Available suggested guidance values for total PCBs in fish tissue to protect wildlife are about 100 ppb (0.1 µg/g wet weight; see Table A-3). Total PCB values in all the samples analyzed for this study are less than the toxicity screening value (based on these suggested guidance values) for protection of wildlife.

Table 8. Total PCB concentrations (ppb) in black bullhead (BB) and largemouth bass (LMB) composite tissue samples taken from Project reservoirs and Upper Klamath Lake in 2003.

Sample	Composite	Site	Species	Total PCB (ppb)
L-262-03	1F	Keno Reservoir	BB	2.926
L-262-03	2F	J C Boyle	LMB	0.885
L-262-03	2F Duplicate	J C Boyle	LMB	1.397
L-262-03	3F	J C Boyle	LMB	3.521
L-273-03	1F	Iron Gate Reservoir	LMB	6.574
L-273-03	2F	Iron Gate Reservoir	LMB	4.909
L-273-03	3F	Copco Reservoir	LMB	2.822
L-273-03	4F	Copco Reservoir	LMB	2.158
L-484-03	1F	Upper Klamath Lake	BB	0.846
L-484-04	2F	Upper Klamath Lake	BB	2.015
		Method Detection Limit (MDL)		varies
		Method Reporting Limit (RL)		0.200
		Screening Values:		
			Recreational fishers	20
			Subsistence fishers	2.45
			Wildlife	100

4. REFERENCES

BCMOELP (British Columbia Ministry of Environment, Land, and Parks). 1988. British Columbia approved water quality guidelines (Criteria): 1998 Edition. British Columbia Ministry of Environment, Land, and Parks. Environmental Protection Department. Water Management Branch. Victoria, British Columbia.

California Department of Pesticide Reporting, www.cdpr.ca.gov/docs/pur/purmain.htm. Viewed on12/30/02.

Dileanis, P. D., S. E. Schwarzbach, J. Bennett, and others. 1996. Detailed study of water quality, bottom sediment, and biota associated with irrigation drainage in the Klamath basin, California and Oregon, 1990-92. U.S. Geological Survey Water-Resource Investigations Report 95-4232. Sacramento, Calif.

EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition. EPA 823-B-00-008. Office of Water, United States Environmental Protection Agency. November 2000.

Environment Ontario 1984. Water management: Goals, policies, objectives, and implementation procedures of the Ministry of the Environment. Water Resources Branch, Toronto, Ontario. 70 p.

MacDonald, D.D. 1994. *Review Of Environmental Quality Criteria And Guidelines For Priority Substances In The Fraser River Basin.* Prepared by MacDonald Environmental Sciences Limited. Environmental Conservation Branch, Environment Canada. Available at http://wvlc.uwaterloo.ca/biology447/modules/module1/1g_t3.htm.

Johnson, W. C., G. L. Muth, and P. G. Godsil. 1968. Klamath Basin study: Pesticide Investigation. Federal Water Quality Administration, Pacific Southwest Region.

Newell, A.J., D.W. Johnson, and L.K. Allen. 1987. Niagara River biota contamination project: Fish flesh criteria for piscivorous wildlife. Technical Report 87-3. Division of Fish and Wildlife. Bureau of Environmental Protection. New York State Department for Environmental Conservation. New York, NY.

PacifiCorp. 2003. Final (Plenary Approved) Klamath Hydroelectric Project Study Plans (FERC Project No. 2082). 1.14 Screening Level Determination of Chemical Contaminants in Fish Tissue in Selected Project Reservoirs. PacifiCorp, Portland, Oregon. March 2003.

Sorenson, S. K. and S. E. Schwarzbach. 1991. Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the Klamath basin, California and Oregon, 1988-89. U.S. Geological Survey Water-Resource Investigations Report 90-4203. Sacramento, Calif.

APPENDIX A

SCREENING AND GUIDANCE VALUES

Table A-1. Dose-Response Variables and Recommended Screening Values (SVs) for Target Analytes - Recreational Fishers[a] (Source: EPA 2000)

Target analyte	Noncarcinogens RfD (mg/kg-d)	Carcinogens CSF $(mg/kg\text{-}d)^{-1}$	SV[b] (ppm) Noncarcinogens[b]	SV[b] (ppm) Carcinogens[b] (RL=10^{-5})
Metals				
Arsenic (inorganic)[c]	3×10^{-4}	1.5	1.2	0.026
Cadmium	1×10^{-3}	NA	4.0	-
Mercury (methylmercury)[d]	1×10^{-4}	NA	0.4	-
Selenium	5×10^{-3}	NA	20	-
Tributyltin[e]	3×10^{-4}	NA	1.2	-
Organochlorine Pesticides				
Total chlordane (sum of cis- and trans chlordane, cis- and trans-nonachlor, and oxychlordane)[f]	5×10^{-4}	0.35	2.0	0.114
Total DDT (sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD)[g]	5×10^{-4}	0.34	2.0	0.117
Dicofol[h]	4×10^{-4}	Na[i]	1.6	2.5
Dieldrin	5×10^{-5}	16	0.2	2.50×10^{-3}
Endosulfan (I and II)[j]	6×10^{-3}	NA	24	-
Endrin	3×10^{-4}	NA	1.2	-
Heptachlor epoxide	1.3×10^{-5}	9.1	5.2×10^{-2}	4.39×10^{-3}
Hexachlorobenzene	8×10^{-4}	1.6	3.2	2.50×10^{-2}
Lindane (?-hexachlorocyclohexane; g-HCH)[k]	3×10^{-4}	1.3	1.2	3.07×10^{-2}
Mirex	2×10^{-4}	Na[l]	0.8	-
Toxaphene[j,m]	2.5×10^{-4}	1.1	1.0	3.63×10^{-2}
Organophosphate Pesticides				
Chlorpyrifos[n]	3×10^{-4}	NA	1.2	-
Diazinon[o]	7×10^{-4}	NA	2.8	-
Disulfoton	4×10^{-5}	NA	0.16	-
Ethion	5×10^{-4}	NA	2.0	-
Terbufos[p]	2×10^{-5}	NA	0.08	-
Chlorophenoxy Herbicides				
Oxyfluorfen[q]	3×10^{-3}	7.32×10^{-2}	12	5.46×10^{-1}
PAHs[r]	NA	7.3	-	5.47×10^{-3}
PCBs				
Total PCBs[s]	2×10^{-5}	2.0	0.08	0.02
Dioxins/furans[t]	NA	1.56×10^{5}	-	2.56×10^{-7}

NA = Not available in EPA's Integrated Risk Information System (IRIS, 1999).
DDD = p,p'-dichlorodiphenyldichloroethane
DDT = p,p'-dichlorodiphenyltrichloroethane
DDE = p,p'-dichlorodiphenlydichloroethylene
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
RfD = Oral reference dose (mg/kg-d)
CSF = Cancer slope factor $(mg/kg\text{-}d)^{-1}$

Table A-1. (continued)

[a] Based on fish consumption rate of 17.5 g/d, 70kg body weight and, for carcinogens, 10^{-5} risk level and 70-yr lifetime. Unless otherwise noted, values listed are the most current oral RfDs and CSF in EPA's IRIS database (IRIS, 1999).

[b] The shaded screening value (SV) is the recommended SV for each target analyte. The screening values listed may be below analytical detection limits achievable for some of the target analytes.

[c] Total inorganic arsenic rather than total arsenic should be determined.

[d] Because most mercury in fish and shellfish tissue is present primarily as methylmercury and because of the relatively high cost of analyzing for methylmercury, it is recommended that total mercury be analyzed and the conservative assumption be made that all mercury is present as methylmercury. This approach is deemed to be most protective of human health and most cost-effective. The National Academy of Sciences conducted an independent assessment of the RfD for methylmercury. They concluded that "On the basis of its evaluation, the committee's consensus is that the value of EPA's current RfD for methylmercury, 0.1Fg/kg per day, is a scientifically justifiable level for the protection of human health".

[e] The RfD value listed is for tributyltin oxide.

[f] The RfD and CSF values listed are derived from studies using technical-grade chlordane for the *cis*- and *trans*-chlordane isomers or the major chlordane metabolite, oxychlordane, or for the chlordane impurities *cis*- and *trans*-nonachlor. It is recommended that total chlordane be determined by summing the concentrations of *cis*- and *trans*-chlordane, *cis*- and *trans*-nonachlor, and oxychlordane.

[g] The RfD value listed is for DDT. The CSF value (0.34) is for total DDT sum of DDT, DDE and DDD); the CSF value for DDD is 0.24. It is recommended that the total concentration of DDT include the 2,4'- and 4,4'-isomers of DDT and its metabolites, DDE and DDD.

[h] The RfD value is from Office of Pesticide Programs Reregistration Eligibility Decision (RED) for Dicofol.

[i] The CSF for dicofol was withdrawn from IRIS pending further review by the CRAVE Agency Work Group.

[j] The RfD value listed is from the Office of Pesticide Program's Reference Dose Tracking Report.

[k] IRIS (1999) has not provided a CSF for lindane. The CSF value listed for lindane was calculated from the water quality criteria (0.063 mg/L).

[l] No CSF or cancer classification is available for mirex. This compound is undergoing further review by the CRAVE Agency Work Group.

[m] The RfD value has been agreed upon by the Office of Pesticide Programs and the Office of Water.

[n] Because of the potential for adverse neurological developmental effects from chlorpyrifos, EPA recommends the use of a Population Adjusted Dose (PAD) of 3×10^{-5} for infants, children under the age of 6 years, and women ages 13 to 50 years.

[o] The RfD value is from a memorandum dated April 1, 1998, Diazinon:-Report of the Hazard Identification Assessment Review Committee. HED Doc. No. 012558.

[p] The RfD value listed is from a memorandum dated September 25, 1997; Terbufos-FQPA Requirement-Report of the Hazard Idenification Review.

[q] The CSF value is from the Office of Pesticide Programs List of Chemicals Evaluated for Carcinogenic Potential.

[r] The CSF value listed is for benzo[*a*]pyrene. Values for other PAHs are not currently available. It is recommended that tissue samples be analyzed for benzo[*a*]pyrene and 14 other PAHs, and that the order-of-magnitude relative potencies given for these PAHs be used to calculate a potency equivalency concentration (PEC) for each sample.

[s] Total PCBs may be determined as the sum of congeners or Aroclors. The RfD is based on Aroclor 1254 and should be applied to total PCBs. The CSF is based on a carcinogenicity assessment of Aroclors 1260, 1254, 1242, and 1016. The CSF presented is the upperbound slope factor for food chain exposure. The central estimate is 1.0.

[t] The CSF value listed is for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). It is recommended that the 17 2,3,7,8-substituted tetra- through octa-chlorinated dibenzo-*p*-dioxins and dibenzofurans and the 12 dioxin-like PCBs be determined and a toxicity-weighted total concentration be calculated for each sample, using the method for estimating toxicity equivalency concentrations (TEQs).

Table A-2. Dose-Response Variables and Recommended Screening Values (SVs) for Target Analytes - Subsistence Fishers[a] (Source: EPA 2000)

Target analyte	Noncarcinogens RfD (mg/kg-d)	Carcinogens CSF $(mg/kg\text{-}d)^{-1}$	SV[b] (ppm) Noncarcinogens[b]	SV[b] (ppm) Carcinogens[b] (RL=10^{-5})
Metals				
Arsenic (inorganic)[c]	3×10^{-4}	1.5	0.147	3.27×10^{-3}
Cadmium	1×10^{-3}	NA	0.491	-
Mercury (methylmercury)[d]	1×10^{-4}	NA	0.049	-
Selenium	5×10^{-3}	NA	2.457	-
Tributyltin[e]	3×10^{-4}	NA	0.147	-
Organochlorine Pesticides				
Total chlordane (sum of cis- and trans chlordane,cis- and trans-nonachlor, and oxychlordane)[f]	5×10^{-4}	0.35	0.245	1.40×10^{-2}
Total DDT (sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD)[g]	5×10^{-4}	0.34	0.245	1.44×10^{-2}
Dicofol[h]	4×10^{-4}	NA[i]	0.196	-
Dieldrin	5×10^{-5}	16	0.024	3.07×10^{-4}
Endosulfan (I and II)[j]	6×10^{-3}	NA	2.949	-
Endrin	3×10^{-4}	NA	0.147	-
Heptachlor epoxide	1.3×10^{-5}	9.1	6.39×10^{-3}	5.40×10^{-4}
Hexachlorobenzene	8×10^{-4}	1.6	0.393	3.07×10^{-3}
Lindane (?-hexachlorocyclohexane; g-HCH)[k]	3×10^{-4}	1.3	0.147	3.78×10^{-3}
Mirex	2×10^{-4}	NA[l]	0.098	-
Toxaphene[j,m]	2.5×10^{-4}	1.1	0.122	4.46×10^{-3}
Organophosphate Pesticides				
Chlorpyrifos[n]	3×10^{-4}	NA	0.147	-
Diazinon[o]	7×10^{-4}	NA	0.344	-
Disulfoton	4×10^{-5}	NA	0.019	-
Ethion	5×10^{-4}	NA	0.245	-
Terbufos[p]	2×10^{-5}	NA	0.009	-
Chlorophenoxy Herbicides				
Oxyfluorfen[q]	3×10^{-3}	7.32×10^{-2}	1.474	6.71×10^{-2}
PAHs[r]	NA	7.3	-	6.73×10^{-4}
PCBs				
Total PCBs[s]	2×10^{-5}	2.0	9.83×10^{-3}	2.45×10^{-3}
Dioxins/furans[t]	NA	1.56×10^{5}	-	3.15×10^{-8}

NA = Not available in EPA's Integrated Risk Information System (IRIS, 1999).
DDD = p,p'-dichlorodiphenyldichloroethane
DDT = p,p'-dichlorodiphenyltrichloroethane
DDE = p,p'-dichlorodiphenlydichloroethylene
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
RfD = Oral reference dose (mg/kg-d)
CSF = Cancer slope factor $(mg/kg\text{-}d)^{-1}$

Table A-2. (continued)

[a] Based on fish consumption rate of 17.5 g/d, 70kg body weight and, for carcinogens, 10^{-5} risk level and 70-yr lifetime. Unless otherwise noted, values listed are the most current oral RfDs and CSF in EPA's IRIS database.

[b] The shaded screening value (SV) is the recommended SV for each target analyte. The screening values listed may be below analytical detection limits achievable for some of the target analytes. Please see Tables 1 and 2 for detection limits.

[c] Total inorganic arsenic rather than total arsenic should be determined.

[d] Because most mercury in fish and shellfish tissue is present primarily as methylmercury and because of the relatively high cost of analyzing for methylmercury, it is recommended that total mercury be analyzed and the conservative assumption be made that all mercury is present as methylmercury. This approach is deemed to be most protective of human health and most cost-effective. The National Academy of Sciences conducted an independent assessment of the RfD for methylmercury. They concluded that "On the basis of its evaluation, the committee's consensus is that the value of EPA's current RfD for methylmercury, 0.1Fg/kg per day, is a scientifically justifiable level for the protection of human health".

[e] The RfD value listed is for tributyltin oxide.

[f] The RfD and CSF values listed are derived from studies using technical-grade chlordane for the *cis*- and *trans*-chlordane isomers or the major chlordane metabolite, oxychlordane, or for the chlordane impurities *cis*- and *trans*-nonachlor. It is recommended that total chlordane be determined by summing the concentrations of *cis*- and *trans*-chlordane, *cis*- and *trans*-nonachlor, and oxychlordane.

[g] The RfD value listed is for DDT. The CSF value (0.34) is for total DDT sum of DDT, DDE and DDD); the CSF value for DDD is 0.24. It is recommended that the total concentration of DDT include the 2,4'- and 4,4'-isomers of DDT and its metabolites, DDE and DDD.

[h] The RfD value is from Office of Pesticide Programs Reregistration Eligibility Decision (RED) for Dicofol.

[i] The CSF for dicofol was withdrawn from IRIS pending further review by the CRAVE Agency Work Group.

[j] The RfD value listed is from the Office of Pesticide Program's Reference Dose Tracking Report.

[k] IRIS (1999) has not provided a CSF for lindane. The CSF value listed for lindane was calculated from the water quality criteria (0.063 mg/L).

[l] No CSF or cancer classification is available for mirex. This compound is undergoing further review by the CRAVE Agency Work Group.

[m] The RfD value has been agreed upon by the Office of Pesticide Programs and the Office of Water.

[n] Because of the potential for adverse neurological developmental effects from chlorpyrifos, EPA recommends the use of a Population Adjusted Dose (PAD) of 3×10^{-5} for infants, children under the age of 6 years, and women ages 13 to 50 years .

[o] The RfD value is from a memorandum dated April 1, 1998, Diazinon:-Report of the Hazard Identification Assessment Review Committee. HED Doc. No. 012558.

[p] The RfD value listed is from a memorandum dated September 25, 1997; Terbufos-FQPA Requirement- Report of the Hazard Idenification Review.

[q] The CSF value is from the Office of Pesticide Programs List of Chemicals Evaluated for Carcinogenic Potential.

[r] The CSF value listed is for benzo[*a*]pyrene. Values for other PAHs are not currently available in IRIS. It is recommended that tissue samples be analyzed for benzo[*a*]pyrene and 14 other PAHs, and that the order-of-magnitude relative potencies given for these PAHs be used to calculate a potency equivalency concentration (PEC) for each sample.

[s] Total PCBs may be determined as the sum of congeners or Aroclors. The RfD is based on Aroclor 1254 and should be applied to total PCBs. The CSF is based on a carcinogenicity assessment of Aroclors 1260, 1254, 1242, and 1016. The CSF presented is the upperbound slope factor for food chain exposure. The central estimate is 1.0.

[t] The CSF value listed is for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). It is recommended that the 17 2,3,7,8-substituted tetra- through octa-chlorinated dibenzo-*p*-dioxins and dibenzofurans and the 12

dioxin-like PCBs be determined and a toxicity-weighted total concentration be calculated for each sample, using the method for estimating toxicity equivalency concentrations (TEQs).

Table A-3. A Summary of the Available Tissue Quality Criteria and Guidelines for the Protection of Wildlife.

Chemical Name	Guideline	Units	Application	Jurisdiction	Reference
Aldrin/Dieldrin	0.12	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.022	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
Chlordane	0.37	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.5	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
DDTs, Total	0.2	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.27	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	1	ug/g	Whole fish, wet weight basis, for protection of fish consuming birds	Ontario	Environment Ontario 1984
Hexachlorobenzene	0.2	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.33	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
Hexachlorocyclohexane (all isomers)	0.1	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.51	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
Mercury (total) FW	0.5	ug/g	Maximum in aquatic organisms (wet weight)	Australia	Australia Water Resources Council 1974
Mirex	0.33	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.37	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
PCBs, Total	0.11	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.11	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.1	ug/g	Maximum Concentration	British Columbia	BCMOELP 1994
Pentachlorophenol	2	ug/g	Non-carcinogenic final fish	New York	Newell et al. 1987

Table A-3. A Summary of the Available Tissue Quality Criteria and Guidelines for the Protection of Wildlife.

Chemical Name	Guideline	Units	Application	Jurisdiction	Reference
			flesh criteria for piscivorous wildlife		
Selenium (total)	3	ug/g	Maximum Criterion	British Columbia	BCMOELP 1994
T4CDD, 2,3,7,8-	0.000002	ug/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.000003	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
Tetrachlorophenol, 2,3,4,6-	0.67	ug/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987

Table A-4. Agricultural Chemicals Used on the Klamath Project in Oregon and California and in Siskiyou County California (Source: California Department of Pesticide Reporting, Sorenson and Schwarzbach 1991, Delianis et al. 1996, Johnson et al. 1968).

2,4-D, Dimethylamine Salt
2,4-D, Isooctyl Ester
Acephate
Alcohols, C4-C12, Normal
Alkyl Polyethylene Glycol Ether
Alkyl Polyoxy Alkylene Ether
Alkylaryl Polyoxyethylene Ether
Alpha-Alkyl-Omega-Hydroxypoly (Oxyethylene)
Aluminum Phosphide
Atrazine
Azadirachtin
Chloropicrin
Disulfoton
Glyphosate, Isopropylamine Salt
Oxyfluorfen
Phosphatidylcholine
Triclopyr, Triethylamine Salt
2,4-D, 2-Ethylhexyl Ester
2,4-D, Butoxyethanol Ester
2,4-D, Dimethylamine Salt
2,4-D, Isooctyl Ester 1
2,6,8-Trimethyl-4-Nonanol
4(2,4-Db), Dimethylamine Salt
Alkyl Polyethylene Glycol Ether
Alkyl Polyoxy Alkylene Ether
Alkylamine, Alkyl Derived From Coconut Oil Fatty
Alkylaryl Polyoxyethylene Ether
Alpha-Alkyl (C12-C15) Omega-Hydroxy Poly (Oxyethylene),
Aluminum Phosphide
Ammonium Propionate
Ammonium Sulfate
Atrazine, Other Related
Azoxystrobin
Benomyl
Borax
Bromoxynil Octanoate
Captan
Carbofuran
Chloropicrin
Chlorothalonil
Chlorpropham
Chlorpyrifos
Chlorthal-Dimethyl
Citric Acid
Clethodim
Clopyralid, Monoethanolamine Salt
Coconut Diethanolamide
Compounded Silicone
Copper Hydroxide
Cyfluthrin

Table A-4. Agricultural Chemicals Used on the Klamath Project in Oregon and California and in Siskiyou County California (Source: California Department of Pesticide Reporting, Sorenson and Schwarzbach 1991, Delianis et al. 1996, Johnson et al. 1968).

Cymoxanil
Dicamba, Dimethylamine Salt
Diglycolamine Salt Of 3,6-Dichloro-O-Anisic Acid
Dihydrogen Phosphate Ester
Dimethoate
Dimethyl Poly Siloxane
Diphacinone
Diquat Dibromide
Disulfoton
Diuron
Esfenvalerate
Ethoxylated Alkyl Phosphate Esters
Fluazifop-P-Butyl
Fosetyl-Al
Free Fatty Acids And/Or Amine Salts
Glyphosate, Isopropylamine Salt
Heptamethyltrisiloxane Ethoxylated (8 Eo)
Hexazinone
Imazamethabenz
Imazapyr, Isopropylamine Salt
Imazethapyr
Iprodione
Isopropyl Alcohol
Lambda Cyhalothrin
Lauric Acid
Malathion
Maleic Hydrazide, Potassium Salt
Mancozeb
Manganese Sulfate
Manzate
Mcp
Mcpa
Mcpa, Dimethylamine Salt
Mefenoxam
Metam-Sodium
Methamidophos
Methoxychlor
Methyl Bromide
Methyl Bromide
Methyl Parathion
Methyl Silicone Resins
Methyl Soyate
Metribuzin
Metribuzin
Mh 30
Mocap
Monitor
Myclobutanil
N,N-Bis-(2-(Omega-Hydroxypoly(Oxyethylene) Ethyl)
Nonyl Phenoxy Poly (Ethylene Oxy) Ethanol
Norflurazon

Table A-4. Agricultural Chemicals Used on the Klamath Project in Oregon and California and in Siskiyou County California (Source: California Department of Pesticide Reporting, Sorenson and Schwarzbach 1991, Delianis et al. 1996, Johnson et al. 1968).

Octyl Phenoxy Poly Ethoxy Ethanol
Oleic Acid, Methyl Ester
Oxamyl
Oxyethylene)
Oxyfluorfen
Para-Nonylphenyl Polyoxyethylene
Paraquat
Paraquat Dichloride
Parathion
Pendimethalin
Permethrin
Petroleum Hydrocarbons
Petroleum Oil, Paraffin Based
Phosphatidylcholine
Phosphoric Acid
Polyacrylamide Polymer
Polyacrylic Polymer
Polyalkene Oxide Modified Heptamethyl Trisiloxane
Polyalkyleneoxide Modified Polydimethyl-Siloxane
Poly-I-Para-Menthene
Polymerized Acrylic Acid
Polyoxyethylene Dinonyl Phenol
Polyram
Pounce
Propargite
Propionic Acid 1
Propylene Glycol
Pymetrozine
Ridomil
Rimsulfuron
Sencor
Sethoxydim
Sevin
Simazine
Sodium Salt
Strychnine
Sulfometuron Methyl
Systox
Tall Oil Acids
Telone
Temik
Triclopyr, Butoxyethyl Ester
Trifluralin 220.0000 3 133.00 A
Undecyl Polyoxyethylene
Velpar
Zinc Sulfate

APPENDIX B

ANALYSIS DATA

Moss Landing Marine Laboratories
Marine Pollution Studies Laboratories
7544 Sandholdt Road
Moss Landing, CA 95039

Project Manager: **Autumn Bonnema**
Phone: **831-771-4175**
Fax: **831-633-0805**
Email: bonnema@mlml.calstate.edu

Total Mercury

Project Name: FERC
Project Number: 133
Analyst: Tam Voss
Report by: Wes Heim

Report #: Hgtis04-0005

Report Date: 05/06/2004

Lab Number	Station Name	Sample Type	Date Collected	Date Received	Batch Number	HgT $(\mu g/g)_{dry}$	Flag
2004-0015	L-262-03 1F BB	Fish Tissue		01/14/2004	04THgDig 12 f050404	0.550	
2004-0015-d	L-262-03 1F BB-d	Fish Tissue		01/14/2004	04THgDig 12 f050404	0.568	
2004-0016	L-262-03 2F LMB	Fish Tissue		01/14/2004	04THgDig 12 f050404	0.685	
2004-0017	L-262-03 3F LMB	Fish Tissue		01/14/2004	04THgDig 12 f050404	0.784	
2004-0018	L-273-03 1F LMB	Fish Tissue		01/14/2004	04THgDig 12 f050404	2.527	
2004-0019	L-273-03 2F LMB	Fish Tissue		01/14/2004	04THgDig 12 f050404	2.299	
2004-0020	L-273-03 3F LMB	Fish Tissue		01/14/2004	04THgDig 12 f050404	2.438	
2004-0021	L-484-03 1F BB	Fish Tissue		01/14/2004	04THgDig 12 f050404	0.154	
2004-0022	L-484-03 2F BB	Fish Tissue		01/14/2004	04THgDig 12 f050404	0.161	
2004-0023	L-273-03 4F LMB	Fish Tissue		01/14/2004	04THgDig 12 f050404	1.619	
					MDL	0.015	
					RL	0.033	

U= Below Reporting Limit

Method: SOP-CALFED.D16

See worksheet "QA-QC" for Quality Assurance/ Quality Control.

Moss Landing Marine Laboratories
Marine Pollution Studies Laboratories
7544 Sandholdt Road
Moss Landing, CA 95039

Project Manager: **Autumn Bonnema**
Phone: **831-771-4175**
Fax: **831-633-0805**
Email: bonnema@mlml.calstate.edu

Quality Assurance/ Quality Control for Report Hgtis04-0005

Batch Number	Station Name	Type	HgT $(\mu g/g)_{dry}$	HgT ng
04THgDig 12 f050404	MB-716	Method Blank	<MDL	
04THgDig 12 f050404	MB-717	Method Blank	<MDL	
04THgDig 12 f050404	MB-718	Method Blank	<MDL	
	DORM-2	SRM (true value)	**4.64**	
04THgDig 12 f050404	Dorm-2 188	SRM	5.039	
		% Recovery	108.6%	
04THgDig 12 f050404	04-0015	Native	0.550	
04THgDig 12 f050404	04-0015-d	Duplicate	0.568	
		RPD	3.1%	
		Spike Value		4000
04THgDig 12 f050404	04-0016	Native	0.6850	140
04THgDig 12 f050404	04-0016-ms	Matrix Spike	19.469	3952
04THgDig 12 f050404	04-0016-msd	Matrix Spike Duplicate	19.417	4019
		% Recovery MS		95.0%
		% Recovery MSD		97.0%
		RPD		1.68%
		MDL	0.015	
		RL	0.033	

Moss Landing Marine Laboratories
Marine Pollution Studies Laboratories
7544 Sandholdt Road
Moss Landing, CA 95039

Project Manager: **Autumn Bonnema**
Phone: **831-771-4175**
Fax: **831-633-0805**
Email: bonnema@mlml.calstate.edu

Trace Metal Results

Project Name: **FERC Tissues** **Report #: TMtis04-0004**
Project Number: 133
Analyst: Jon Goetzl Report Date: 05/20/2004

Lab Number	Station Name	Sample Type	Date Collected	Date Received	Batch Number	As ppm	Cd ppm	Cr ppm	Cu ppm	Ni ppm	Pb ppm	Se ppm	Zn ppm	Flag
2004-0015	L-262-03 1F BB	tissue	NA	01/14/2004	05/12/2004	<.10	<.002	0.79	1.76	0.016	0.011	0.46	23.4	
2004-0016	L-262-03 2F LMB	tissue	NA	01/14/2004	05/12/2004	0.19	<.002	0.67	1.52	0.030	0.011	0.57	37.6	
2004-0017	L-262-03 3F LMB	tissue	NA	01/14/2004	05/12/2004	0.16	<.002	0.62	1.39	0.014	0.091	0.53	44.3	
2004-0018	L-273-03 1F LMB	tissue	NA	01/14/2004	05/12/2004	0.19	<.002	0.70	1.38	0.023	0.041	0.64	32.4	
2004-0019	L-273-03 2F LMB	tissue	NA	01/14/2004	05/12/2004	0.14	<.002	0.63	1.29	0.020	0.059	0.51	29.1	
2004-0020	L-273-03 3F LMB	tissue	NA	01/14/2004	05/12/2004	0.17	<.002	0.66	1.47	0.018	0.002	0.68	29.2	
2004-0021	L-484-03 1F BB	tissue	NA	01/14/2004	05/12/2004	<.10	<.002	0.68	1.91	0.009	0.014	0.42	27.1	
2004-0022	L-484-03 2F BB	tissue	NA	01/14/2004	05/12/2004	<.10	<.002	0.63	1.97	<.006	0.003	0.42	32.1	
2004-0023	L-273-03 4F LMB	tissue	NA	01/14/2004	05/12/2004	0.13	<.002	0.64	1.56	0.010	0.044	0.59	35.2	
					MDL	0.10	0.002	0.03	0.003	0.006	0.002	0.10	0.02	
					RL	0.30	0.006	0.10	0.01	0.018	0.006	0.30	0.06	

Method: modified EPA 1638

<MDL: sample value below method detection limit or value itself<.008
DNQ: sample value between detection limit and reporting limit or value in red

Moss Landing Marine Laboratories
Marine Pollution Studies Laboratories
7544 Sandholdt Road
Moss Landing, CA 95039

Project Manager: **Autumn Bonnema**
Phone: **831-771-4175**
Fax: **831-633-0805**
Email: bonnema@mlml.calstate.edu

Quality Assurance/ Quality Control for Report **TMtis04-0004**

Batch Number	Station Code	Type	As ppm	Cd ppm	Cr ppm	Cu ppm	Ni ppm	Pb ppm	Se ppm	Zn ppm
########		Digestion Blank	**<.10**	**<.002**	**<.03**	**<.003**	**<.006**	**<.002**	**<.10**	**<.02**
	Dorm2	SRM (true value)	**18.0**		**34.7**	**2.34**	**19.4**		**1.40**	**25.6**
		SRM	16.5		33.1	2.18	17.5		1.69	22.8
	2976	SRM (true value)		**0.82**				**1.19**		
		SRM		0.85				1.21		
		% Recovery	**92%**	**104%**	**95%**	**93%**	**90%**	**102%**	**121%**	**89%**
	RMP 04_04-0032	Native	3.98	<.002	0.56	1.04	0.17	0.004	1.97	14.6
	RMP 04_04-0032d	Duplicate	3.95	<.002	0.57	1.02	0.14	<.002	1.95	13.6
		RPD	**1%**	**N.D.**	**2%**	**2%**	**19%**	**at D.L.**	**1%**	**7%**
		Spike Value 1	14.5	0.58	5.78	14.5	0.58	0.58	7.23	289
		Spike Value 2	14.6	0.58	5.84	14.6	0.58	0.58	7.30	292
	RMP 04_04-0032	Native	3.98	0.000	0.56	1.04	0.17	0.004	1.97	14.6
	RMP 04_04-0032sp	Matrix Spike 1	18.9	0.57	6.83	16.8	0.74	0.58	8.7	298
	RMP 04_04-0032spd	Matrix Spike Duplicate 2	19.1	0.57	7.02	16.9	0.80	0.58	8.8	299
		% Recovery MS	**103%**	**99%**	**108%**	**109%**	**98%**	**99%**	**93%**	**98%**
		% Recovery MSD	**103%**	**98%**	**111%**	**108%**	**108%**	**98%**	**93%**	**97%**
		RPD	**1%**	**0%**	**3%**	**1%**	**7%**	**0%**	**1%**	**1%**
		MDL	0.10	0.002	0.03	0.003	0.006	0.002	0.10	0.02
		RL	0.30	0.006	0.10	0.01	0.018	0.006	0.30	0.06

E&S Environmental	Pacific Corp	Klamath Hydro Electric	FERC 2082	FERC 2082	FERC 2082	FERC 2082	FERC 2082	FERC 2082	FERC 2082
Lab Number:			L-262-03	L-262-03	L-262-03	L-262-03	L-273-03	L-273-03	L-273-03
Composite:			1F	2F	2F Dup	3F	1F	2F	3F
Water Body:			Keno Reservoir	J C Boyle	J C Boyle	J C Boyle	Irongate Reservoir	Irongate Reservoir	Copco Reservoir
Specode:			BB	LMB	LMB	LMB	LMB	LMB	LMB
Collector:			Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack
Agency:			FG WPCL	FG WPCL	FG WPCL	FG WPCL	FG WPCL	FG WPCL	FG WPCL
Date Collected:			05/29/2003	05/28/2003	05/28/2003	05/28/2003	06/04/2003	06/04/2003	06/04/2003
Date Received:			06/02/2003	06/02/2003	06/02/2003	06/02/2003	06/06/2003	06/06/2003	06/06/2003
Date Dissected:			11/04/2003	10/09/2003	10/09/2003	10/10/2003	11/06/2003	11/06/2003	11/05/2003
number in composite:			4	6	6	6	6	6	6
mean mm (fork length):			242	231	231	308	377	362	368
mean wt (gm):			247.4	234.2	234.2	599.5	1056.9	913.8	1017.7
	Fresh Weight	Method Blank BS 288							
	Reporting Limit	Fresh Weight							
	ppb (ng/g)	ppb (ng/g)	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt
aldrin	1.00	ND	ND	ND	ND	ND	ND	ND	ND
chlordane, cis	1.00	ND	ND	ND	ND	ND	ND	ND	ND
chlordane, trans	1.00	ND	ND	ND	ND	ND	ND	ND	ND
chlordene, alpha	0.500	ND	ND	ND	ND	ND	ND	ND	ND
chlordene, gamma	0.500	ND	ND	ND	ND	ND	ND	ND	ND
chlorpyrifos	1.00	ND	ND	ND	ND	ND	ND	ND	ND
dacthal	1.00	ND	ND	ND	ND	ND	ND	ND	ND
DCBP, p,p'	10.0	ND	ND	ND	ND	ND	ND	ND	ND
DDD, o,p'	1.00	ND	ND	ND	ND	ND	ND	ND	ND
DDD, p,p'	1.00	ND	ND	ND	ND	ND	ND	ND	ND
DDE, o,p'	2.00	ND	ND	ND	ND	ND	ND	ND	ND
DDE, p,p'	2.00	ND	2.41	<RL	<RL	2.91	<RL	<RL	2.16
DDMU, p,p'	3.00	ND	ND	ND	ND	ND	ND	ND	ND
DDT, o,p'	3.00	ND	ND	ND	ND	ND	ND	ND	ND
DDT, p,p'	5.00	ND	ND	ND	ND	ND	ND	ND	ND
diazinon	20.0	ND	ND	ND	ND	ND	ND	ND	ND
dieldrin	0.500	ND	ND	ND	ND	ND	ND	ND	ND
endosulfan I	2.00	ND	ND	ND	ND	ND	ND	ND	ND
endosulfan II	10.0	ND	ND	ND	ND	ND	ND	ND	ND
endosulfan sulfate	10.0	ND	ND	ND	ND	ND	ND	ND	ND
endrin	2.00	ND	ND	ND	ND	ND	ND	ND	ND
HCH, alpha	0.500	ND	ND	ND	ND	ND	ND	ND	ND
HCH, beta	1.00	ND	ND	ND	ND	ND	ND	ND	ND
HCH, delta	2.00	ND	ND	ND	ND	ND	ND	ND	ND
HCH, gamma	0.500	ND	ND	ND	ND	ND	ND	ND	ND
heptachlor	1.00	ND	ND	ND	ND	ND	ND	ND	ND
heptachlor epoxide	0.500	ND	ND	ND	ND	ND	ND	ND	ND
hexachlorobenzene	0.300	ND	<RL	ND	ND	<RL	ND	ND	ND
methoxychlor	3.00	ND	ND	ND	ND	ND	ND	ND	ND
mirex	1.50	ND	ND	ND	ND	ND	ND	ND	ND
nonachlor, cis	1.00	ND	ND	ND	ND	ND	ND	ND	ND
nonachlor, trans	1.00	ND	ND	ND	ND	ND	ND	ND	ND
oxadiazon	1.00	ND	ND	ND	ND	ND	ND	ND	ND
oxychlordane	1.00	ND	ND	ND	ND	ND	ND	ND	ND
parathion, ethyl	2.00	ND	ND	ND	ND	ND	ND	ND	ND
parathion, methyl	4.00	ND	ND	ND	ND	ND	ND	ND	ND
tedion	2.00	ND	ND	ND	ND	ND	ND	ND	ND
toxaphene	20	ND	ND	ND	ND	ND	ND	ND	ND
PCB 1248	25	ND	ND	ND	ND	ND	ND	ND	ND
PCB 1254	10	ND	ND	ND	ND	ND	ND	ND	ND
PCB 1260	10	ND	ND	ND	ND	ND	ND	ND	ND
Percent Moisture:		NA	77.5	78.3	78.6	76.5	78.0	78.0	77.8
Percent Lipid:		NA	2.57	1.20	1.15	1.40	0.856	0.741	1.17
Surrogate % Recovery		% Recovery	% Recovery	% Recovery	% Recovery	% Recovery	% Recovery	% Recovery	% Recovery
207		81.3	98.9	88.8	107	110	133	128	122
DBOB		72.1	94.4	88.1	103	108	127	125	112
DDD*, p,p'		74.7	79.7	105	89.7	95.2	93.9	99.3	92.6
DBCE		83.4	84.8	70.8	94.2	63.8	70.5	67.8	65.9

	Fresh Weight	Method Blank
	Reporting Limit	BS 288
	ppb (ng/g)	ppb (ng/g) Fresh
aldrin	1.00	ND
chlordane, cis	1.00	ND
chlordane, trans	1.00	ND
chlordene, alpha	0.500	ND
chlordene, gamma	0.500	ND
chlorpyrifos	1.00	ND
dacthal	1.00	ND
DCBP, p,p'	10.0	ND
DDD, o,p'	1.00	ND
DDD, p,p'	1.00	ND
DDE, o,p'	2.00	ND
DDE, p,p'	2.00	ND
DDMU, p,p'	3.00	ND
DDT, o,p'	3.00	ND
DDT, p,p'	5.00	ND
diazinon	20.0	ND
dieldrin	0.500	ND
endosulfan I	2.00	ND
endosulfan II	10.0	NA
endosulfan sulfate	10.0	NA
endrin	2.00	ND
HCH, alpha	0.500	ND
HCH, beta	1.00	ND
HCH, delta	2.00	ND
HCH, gamma	0.500	ND
heptachlor	1.00	ND
heptachlor epoxide	0.500	ND
hexachlorobenzene	0.300	ND
methoxychlor	3.00	ND
mirex	1.50	ND
nonachlor, cis	1.00	ND
nonachlor, trans	1.00	ND
oxadiazon	1.00	ND
oxychlordane	1.00	ND
parathion, ethyl	2.00	ND
parathion, methyl	4.00	ND
tedion	2.00	ND
toxaphene	20	ND
PCB 1248	25	ND
PCB 1254	10	ND
PCB 1260	10	ND
Percent Moisture:		NA
Percent Lipid:		NA
Surrogate % Recovery		% Recovery
207		81.3
DBOB (F1)		72.1
DDD*, p,p'		74.7
DBCE		83.4
Norm Factor		Norm Factor
207		1.23
DBOB (F1)		1.387
DDD*, p,p'		1.3393
DBCE		1.1994

	Fresh Weight	L-262-03 2F	L-262-03 2F Dup
	Reporting Limit	Surr Corrected	Surr Corrected
	ppb (ng/g)	ppb (ng/g) Fresh	ppb (ng/g) Fresh
aldrin	**1.00**	ND	ND
chlordane, cis	**1.00**	ND	ND
chlordane, trans	**1.00**	ND	ND
chlordene, alpha	**0.500**	ND	ND
chlordene, gamma	**0.500**	ND	ND
chlorpyrifos	**1.00**	ND	ND
dacthal	**1.00**	ND	ND
DCBP, p,p'	**10.0**	ND	ND
DDD, o,p'	**1.00**	ND	ND
DDD, p,p'	**1.00**	ND	ND
DDE, o,p'	**2.00**	ND	ND
DDE, p,p'	**2.00**	<RL	<RL
DDMU, p,p'	**3.00**	ND	ND
DDT, o,p'	**3.00**	ND	ND
DDT, p,p'	**5.00**	ND	ND
diazinon	**20.0**	ND	ND
dieldrin	**0.500**	ND	ND
endosulfan I	**2.00**	ND	ND
endosulfan II	**10.0**	NA	NA
endosulfan sulfate	**10.0**	NA	NA
endrin	**2.00**	ND	ND
HCH, alpha	**0.500**	ND	ND
HCH, beta	**1.00**	ND	ND
HCH, delta	**2.00**	ND	ND
HCH, gamma	**0.500**	ND	ND
heptachlor	**1.00**	ND	ND
heptachlor epoxide	**0.500**	ND	ND
hexachlorobenzene	**0.300**	ND	ND
methoxychlor	**3.00**	ND	ND
mirex	**1.50**	ND	ND
nonachlor, cis	**1.00**	ND	ND
nonachlor, trans	**1.00**	ND	ND
oxadiazon	**1.00**	ND	ND
oxychlordane	**1.00**	ND	ND
parathion, ethyl	**2.00**	ND	ND
parathion, methyl	**4.00**	ND	ND
tedion	**2.00**	ND	ND
toxaphene	**20**	ND	ND
PCB 1248	**25**	ND	ND
PCB 1254	**10**	ND	ND
PCB 1260	**10**	ND	ND
Percent Moisture:		**78.3**	**78.6**
Percent Lipid:		**1.20**	**1.15**
Surrogate % Recovery		**% Recovery**	**% Recovery**
207		**88.8**	**106.6**
DBOB		**88.1**	**102.9**
DDD*, p,p'		**104.5**	**89.7**
DBCE		**70.8**	**94.2**

	% Recovery
	LCS
	BS 288
aldrin	111
chlordane, cis	93.9
chlordane, trans	101
chlordene, alpha	93.2
chlordene, gamma	96.2
chlorpyrifos	87.0
dacthal	96.3
DCBP, p,p'	114
DDD, o,p'	102
DDD, p,p'	96.5
DDE, o,p'	102
DDE, p,p'	99.0
DDMU, p,p'	94.3
DDT, o,p'	93.0
DDT, p,p'	104
diazinon	114
dieldrin	103
endosulfan I	96.0
endosulfan II	105
endosulfan sulfate	120
endrin	96.6
HCH, alpha	98.4
HCH, beta	100
HCH, delta	68.0
HCH, gamma	95.6
heptachlor	76.4
heptachlor epoxide	94.0
hexachlorobenzene	85.8
methoxychlor	100
mirex	102
nonachlor, cis	99.9
nonachlor, trans	106
oxadiazon	114
oxychlordane	101
parathion, ethyl	57.5
parathion, methyl	65.0
tedion	121
Percent Moisture:	NA
Percent Lipid:	NA
Surrogate % Recovery	% Recovery
207	97.1
DBOB (F1)	85.6
DDD*, p,p'	93.8
DBCE	65.3

	L-262-03 3F MS	L-262-03 3F MSD
	% Recovery	% Recovery
aldrin	127	119
chlordane, cis	70.5	82.1
chlordane, trans	92.2	90.9
chlordene, alpha	95.6	98.2
chlordene, gamma	113	98.4
chlorpyrifos	90.4	90.7
dacthal	103	101
DCBP, p,p'	97.4	107
DDD, o,p'	95.2	94.9
DDD, p,p'	87.7	87.8
DDE, o,p'	112	101
DDE, p,p'	103	98.7
DDMU, p,p'	105	95.9
DDT, o,p'	99.4	90.4
DDT, p,p'	99.2	98.6
diazinon	123	121
dieldrin	96.9	88.1
endosulfan I (F3+F2)	109	116
endosulfan II (F3+F4)	116	118
endosulfan sulfate (F3+F4)	109	107
endrin	94.6	86.5
HCH, alpha	103	94.8
HCH, beta	93.0	93.3
HCH, delta	68.2	67.9
HCH, gamma	91.5	91.2
heptachlor	71.8	84.7
heptachlor epoxide	88.4	88.9
hexachlorobenzene	104	96.2
methoxychlor	95.1	94.3
mirex	104	104
nonachlor, cis	87.3	91.2
nonachlor, trans	111	105
oxadiazon	112	109
oxychlordane	94.6	93.5
parathion, ethyl	69.1	69.3
parathion, methyl	77.4	78.5
tedion	128	129
Average % Recovery:	98.3	96.8
Percent Moisture:	76.8	76.7
Percent Lipid:	1.40	1.49
Surrogate % Recovery	% Recovery	% Recovery
207	97.3	92.5
DBOB (F1)	98.7	88.4
DDD*, p,p'	109.9	127.3
DBCE	80.4	71.9

	L-262-03 3F MS	L-262-03 3F MSD	RPD
	ROUNDED	ROUNDED	
	ppb (ng/g) Fresh	ppb (ng/g) Fresh	
aldrin	4.92	4.59	6.9
chlordane, cis	2.90	3.37	15.0
chlordane, trans	3.57	3.51	1.7
chlordene, alpha	3.70	3.79	2.4
chlordene, gamma	4.37	3.80	14.0
chlorpyrifos	10.5	10.5	0.0
dacthal	3.98	3.88	2.5
DCBP, p,p'	9.42	10.3	8.9
DDD, o,p'	7.37	7.33	0.5
DDD, p,p'	7.36	7.35	0.1
DDE, o,p'	8.65	7.77	10.7
DDE, p,p'	11.0	10.5	4.7
DDMU, p,p'	16.3	14.8	9.6
DDT, o,p'	7.69	6.98	9.7
DDT, p,p'	7.68	7.61	0.9
diazinon	95.0	93.5	1.6
dieldrin	4.01	3.64	9.7
endosulfan I (F3+F2)	8.40	8.98	6.7
endosulfan II (F3+F4)	8.98	9.10	1.3
endosulfan sulfate (F3+F4)	8.86	8.67	2.2
endrin	3.66	3.34	9.1
HCH, alpha	2.00	1.83	8.9
HCH, beta	3.60	3.60	0.0
HCH, delta	2.64	2.62	0.8
HCH, gamma	1.77	1.76	0.6
heptachlor	2.78	3.27	16.2
heptachlor epoxide	3.42	3.43	0.3
hexachlorobenzene	4.13	3.83	7.5
methoxychlor	18.4	18.2	1.1
mirex	12.1	12.0	0.8
nonachlor, cis	3.38	3.52	4.1
nonachlor, trans	4.49	4.27	5.0
oxadiazon	13.6	13.2	3.0
oxychlordane	3.66	3.61	1.4
parathion, ethyl	10.7	10.7	0.0
parathion, methyl	8.99	9.09	1.1
tedion	9.92	9.93	0.1
Average RPD:			4.6
Percent Moisture:	76.8	76.7	0.1
Percent Lipid:	1.40	1.49	6.2
Surrogate % Recovery	% Recovery	% Recovery	
207	97.3	92.5	5.1
DBOB (F1)	98.7	88.4	11.0
DDD*, p,p'	109.9	127.3	14.7
DBCE	80.4	71.9	11.2

	SRM 2978		95% CI Ranges		70-130% of the 95% Confidence Interval		2978 BS 288 F1 surr corr	% Recovery
	Cert. Conc.	+/-	Lower	Upper			ppb (ng/g) Fresh	
aldrin							0.000	
chlordane, cis	15.56	0.83	14.73	16.39	10.31	21.31	13.0	83.6
chlordane, trans	11.38	0.56	10.82	11.94	7.57	15.52	9.09	79.9
chlordene, alpha							0.859	
chlordene, gamma							1.335	
chlorpyrifos							3.265	
dacthal							5.602	
DCBP, p,p'							0.000	
DDD, o,p' *	10.5	1.0	9.5	11.5	6.65	14.95	17.1	163*
DDD, p,p'	38.8	2.3	36.5	41.1	25.55	53.43	36.1	93.0
DDE, o,p'	4.41	0.56	3.85	4.97	2.70	6.46	4.65	106
DDE, p,p'	37.5	1.5	36	39	25.20	50.70	39.9	106
DDMU, p,p'							8.235	
DDT, o,p'	9.2	1.6	7.6	10.8	5.32	14.04	2.60	28.3
DDT, p,p'	3.84	0.28	3.56	4.12	2.49	5.36	4.48	117
diazinon							0.000	
dieldrin	6.3	0.67	5.63	6.97	3.94	9.06	6.45	102
endosulfan I							0.000	
endosulfan II							1.607	
endosulfan sulfate							0.962	
endrin							1.762	
HCH, alpha							1.034	
HCH, beta							0.000	
HCH, delta							0.000	
HCH, gamma							0.656	
heptachlor							0.000	
heptachlor epoxide							2.679	
hexachlorobenzene							0.000	
methoxychlor							0.000	
mirex							0.000	
nonachlor, cis	8.23	0.56	7.67	8.79	5.37	11.43	6.59	80.1
nonachlor, trans	11.5	1	10.5	12.5	7.35	16.25	12.5	109
oxadiazon							3.252	
oxychlordane	2.13	0.27	1.86	2.4	1.30	3.12	0.553	26.0
parathion, ethyl							4.303	
parathion, methyl							0.000	
tedion							-0.183	
Percent Moisture:							NA	
Percent Lipid:							6.41	
Surrogates:							% Recovery	
207							95.1	
DBOB							83.7	
DDD*, p,p'							106	
DBCE							80.5	

E&S Environmental	Pacific Corp	Klamath Hydro	FERC 2082	FERC 2082	FERC 2082	FERC 2082	FERC 2082	FERC 2082	FERC 2082	FERC 2082
Lab Number:			L-262-03	L-262-03	L-262-03	L-262-03	L-273-03	L-273-03	L-273-03	L-273-03
Composite:			1F	2F	2F Dup	3F	1F	2F	3F	4F
Water Body:			Keno Reservoir	J C Boyle	J C Boyle	J C Boyle	Irongate Reservoir	Irongate Reservoir	Copco Reservoir	Copco Reservoir
Specode:			BB	LMB	LMB	LMB	LMB	LMB	LMB	LMB
Collector:			Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack	Linn, Jack
Agency:			FG WPCL	FG WPCL	FG WPCL	FG WPCL	FG WPCL	FG WPCL	FG WPCL	FG WPCL
Date Collected:			05/29/2003	05/28/2003	05/28/2003	05/28/2003	06/04/2003	06/04/2003	06/04/2003	06/04/2003
Date Received:			06/02/2003	06/02/2003	06/02/2003	06/02/2003	06/06/2003	06/06/2003	06/06/2003	06/06/2003
Date Dissected:			11/04/2003	10/09/2003	10/09/2003	10/10/2003	11/06/2003	11/06/2003	11/05/2003	11/05/2003
number in composite:			4	6	6	6	6	6	6	6
mean mm (fork length):			242	231	231	308	377	362	368	360
mean wt (gm):			247.4	234.2	234.2	599.5	1056.9	913.8	1017.7	942.9
	Fresh Wt	Method Blank BS 288								
	Reporting Limit	Fresh Weight								
	ppb (ng/g)	ppb (ng/g)	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt	ppb (ng/g) Fresh Wt
8	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
27	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
28	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
31	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
33	0.2	ND	ND	ND	<RL	ND	ND	ND	ND	ND
44	0.2	ND	ND	ND	ND	<RL	ND	ND	ND	ND
49	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
52	0.2	ND	<RL	ND	ND	<RL	<RL	<RL	ND	0.272
56	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
60	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
66	0.2	ND	<RL	ND	ND	<RL	ND	<RL	<RL	ND
70	0.2	ND	<RL	ND	<RL	<RL	<RL	<RL	<RL	<RL
74	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
87	0.2	ND	<RL	ND	<RL	<RL	<RL	<RL	<RL	<RL
95	0.2	ND	<RL	<RL	<RL	0.211	<RL	0.203	<RL	<RL
97	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
99	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
101	0.2	ND	0.348	0.217	0.243	0.442	0.381	0.388	0.305	0.263
105	0.2	ND	<RL	ND	ND	<RL	ND	<RL	<RL	ND
110	0.2	<RL	0.401	0.262	0.292	0.445	0.287	0.345	0.362	0.298
114	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
118	0.2	ND	0.413	0.206	0.232	0.383	0.247	0.274	0.314	0.259
128	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
137	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
138	0.2	ND	0.472	<RL	0.230	0.548	0.862	0.793	0.459	0.33
141	0.2	ND	ND	ND	ND	ND	<RL	<RL	ND	ND
149	0.2	ND	<RL	ND	ND	0.240	0.540	0.492	0.201	<RL
151	0.2	ND	ND	ND	ND	ND	0.262	0.238	ND	ND
153	0.2	ND	0.392	<RL	<RL	0.552	1.10	0.959	0.481	0.336
156	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
157	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
158	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
170	0.2	ND	ND	ND	ND	ND	0.227	<RL	ND	ND
174	0.2	ND	ND	ND	ND	ND	0.205	<RL	ND	ND
177	0.2	ND	ND	ND	ND	ND	<RL	<RL	ND	ND
180	0.2	ND	<RL	ND	ND	<RL	0.747	0.598	<RL	ND
183	0.2	ND	ND	ND	ND	ND	0.202	<RL	ND	ND
187	0.2	ND	<RL	ND	ND	<RL	0.614	0.499	<RL	ND
189	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
194	0.2	ND	ND	ND	ND	ND	<RL	ND	ND	ND
195	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
200	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
201	0.2	ND	ND	ND	ND	ND	<RL	<RL	ND	ND
203	0.2	ND	ND	ND	ND	ND	<RL	<RL	ND	ND
206	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
209	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Percent Moisture		NA	77.5	78.3	78.6	76.5	78.0	78.0	77.8	76.2
Percent Lipid		NA	2.57	1.20	1.15	1.41	0.856	0.741	1.17	0.969
Surrogate % Recovery		% Recovery	% Recovery	% Recovery	% Recovery	% Recovery	% Recovery	% Recovery	% Recovery	% Recovery
207		74.4	89.5	80.5	96.9	101	122	117	111	69.7

	Fresh Wt	MB BS 288
	Reporting Limit	surr corr
	ppb (ng/g)	ppb (ng/g)
8	**0.2**	ND
18	**0.2**	ND
27	**0.2**	ND
28	**0.2**	ND
29	**0.2**	ND
31	**0.2**	ND
33	**0.2**	ND
44	**0.2**	ND
49	**0.2**	ND
52	**0.2**	ND
56	**0.2**	ND
60	**0.2**	ND
66	**0.2**	ND
70	**0.2**	ND
74	**0.2**	ND
87	**0.2**	ND
95	**0.2**	ND
97	**0.2**	ND
99	**0.2**	ND
101	**0.2**	ND
105	**0.2**	ND
110	**0.2**	<RL
114	**0.2**	ND
118	**0.2**	ND
128	**0.2**	ND
137	**0.2**	ND
138	**0.2**	ND
141	**0.2**	ND
149	**0.2**	ND
151	**0.2**	ND
153	**0.2**	ND
156	**0.2**	ND
157	**0.2**	ND
158	**0.2**	ND
170	**0.2**	ND
174	**0.2**	ND
177	**0.2**	ND
180	**0.2**	ND
183	**0.2**	ND
187	**0.2**	ND
189	**0.2**	ND
194	**0.2**	ND
195	**0.2**	ND
200	**0.2**	ND
201	**0.2**	ND
203	**0.2**	ND
206	**0.2**	ND
209	**0.2**	ND
Percent Moisture		**NA**
Percent Lipid		**NA**
Surrogate % Recovery		**% Recovery**
207		**74.4**

	L-262-03 2F	L-262-03 2F Dup	RPD
	FERC	FERC	
	ppb (ng/g)	ppb (ng/g)	
8	0	0	ND
18	0	0	ND
27	0	0	ND
28	0.03	0.088	ND
29	0	0	ND
31	0.034	0.065	ND
33	0	0.102	ND
44	0.041	0.099	ND
49	0.024	0.02	ND
52	0.013	0.099	ND
56	0.029	0.032	ND
60	0	0.023	ND
66	0.097	0.091	ND
70	0	0.128	ND
74	0	0	ND
87	0.096	0.114	ND
95	0.14	0.145	<RL
97	0.009	0.033	ND
99	0	0.037	ND
101	0.217	0.243	11.3
105	0.085	0.095	ND
110	0.262	0.292	10.8
114	0	0	ND
118	0.206	0.232	11.9
128	0.015	0.04	ND
137	0	0	ND
138	0.194	0.23	17.0
141	0	0.04	ND
149	0.068	0.096	ND
151	0.017	0.038	ND
153	0.153	0.196	<RL
156	0	0	ND
157	0	0	ND
158	0	0.004	ND
170	0	0	ND
174	0	0	ND
177	0	0	ND
180	0.017	0.038	ND
183	0	0.035	ND
187	0.042	0.006	ND
189	0	0	ND
194	0	0	ND
195	0	0	ND
200	0	0.019	ND
201	0	0	ND
203	0	0	ND
206	0	0	ND
209	0.095	0	ND
Percent Moisture	78.3	78.6	0.4
Percent Lipid	1.2	1.2	4.3
Surrogate % Recovery	% Recovery	% Recovery	
207	80.5	96.9	18.5

	Laboratory Control Spike
	BS 288
	Percent Recovery
8	102
18	79.3
27	87.1
28	99.9
29	90.3
31	86.4
33	99.4
44	103
49	94.1
52	93.3
56	91.5
60	93.4
66	99.3
70	102
74	84.4
87	102
95	104
97	98.3
99	70.8
101	102
105	96.9
110	109
114	95.9
118	104
128	95.9
137	97.3
138	101
141	100
149	102
151	101
153	98.9
156	98.4
157	98.9
158	98.2
170	101
174	102
177	101
180	101
183	97.4
187	102
189	101
194	101
195	101
200	100
201	102
203	103
206	100
209	106
Average Recovery:	97.9
Percent Moisture	NA
Percent Lipid	NA
Surrogate % Recovery	% Recovery
207	89.8

	L-262-03 3F MS	L-262-03 3F MSD
	% Recovery	% Recovery
8	122	111
18	93.8	86.2
27	102	94.0
28	114	99.7
29	110	90.0
31	102	99.0
33	113	97.3
44	109	101
49	105	97.7
52	108	99.7
56	106	86.8
60	105	91.8
66	108	96.6
70	109	98.4
74	104	88.2
87	110	99.2
95	106	101
97	106	98.7
99	89.3	79.0
101	102	98.0
105	106	88.1
110	115	100
114	106	95.3
118	112	96.8
128	103	93.6
137	106	98.2
138	103	94.3
141	105	99.9
149	105	100
151	106	102
153	101	93.8
156	107	98.1
157	101	99.6
158	107	98.0
170	103	102
174	106	104
177	105	104
180	101	97.5
183	99.7	96.6
187	105	102
189	102	100
194	104	102
195	103	102
200	103	103
201	104	105
203	104	104
206	99.6	101
209	104	107
Average Recovery:	105	97.9
Percent Moisture	76.8	76.7
Percent Lipid	1.40	1.49
Surrogate % Recovery	% Recovery	% Recovery
207	90.0	85.2

	L-262-03 3F MS	L-262-03 3FMSD	RPD
	surr corr	surr corr	
	ppb (ng/g)	ppb (ng/g)	
8	2.37	2.15	9.7
18	1.82	1.66	8.7
27	1.97	1.82	8.1
28	2.29	1.99	13.7
29	2.12	1.74	20.0
31	2.04	1.97	3.5
33	2.22	1.90	15.4
44	2.23	2.06	7.7
49	2.12	1.97	7.4
52	2.19	2.02	8.0
56	2.09	1.71	19.9
60	2.06	1.80	13.5
66	2.27	2.02	11.4
70	2.30	2.07	10.5
74	2.05	1.73	16.7
87	2.35	2.11	10.8
95	2.27	2.17	4.6
97	2.15	2.00	7.5
99	1.78	1.57	12.5
101	2.43	2.33	4.5
105	2.20	1.82	18.7
110	2.73	2.38	13.7
114	2.05	1.84	10.9
118	2.59	2.24	14.7
128	2.09	1.89	10.2
137	2.05	1.90	7.9
138	2.56	2.34	9.0
141	2.08	1.97	5.6
149	2.29	2.18	5.0
151	2.17	2.06	4.9
153	2.50	2.33	7.2
156	2.10	1.93	8.7
157	1.95	1.92	1.7
158	2.09	1.92	8.7
170	2.05	2.01	1.9
174	2.07	2.03	2.0
177	2.05	2.01	2.1
180	2.13	2.06	3.5
183	2.01	1.94	3.4
187	2.17	2.11	2.9
189	1.98	1.94	2.2
194	2.01	1.98	1.5
195	1.98	1.97	0.9
200	2.00	1.98	1.1
201	2.03	2.04	0.4
203	2.05	2.04	0.3
206	1.93	1.95	1.2
209	2.01	2.06	2.6
Percent Moisture	76.8	76.7	0.1
Percent Lipid	1.40	1.49	6.2
Surrogate % Recovery	% Recovery	% Recovery	
207	90.0	85.2	5.5
Average RPD:			7.4

		SRM 2978		95% CI		70-130% of the 95%		SRM 2978	% Recovery
				Ranges		Confidence Interval		BS 288	
		Cert. Conc.	+/-	Lower	Upper			ppb (ng/g)	
8								1.3	
18								1.9	
27								0.7	
28		7.91	0.9	7.01	8.81	4.91	11.45	7.6	96.2
29								0.0	
31		21.4	0.43	21.0	21.83	14.68	28.38	6.3	29.4*
33								2.1	
44		11.8	0.64	11.16	12.44	7.81	16.17	13.1	111
49		16.84	0.86	16.0	17.7	11.19	23.01	13.6	80.8
52		17.7	2.8	14.9	20.5	10.43	26.65	16.7	94.3
56								9.0	
60								3.5	
66		18.4	1.5	16.9	19.9	11.83	25.87	21.9	119
70								19.0	
74								10.1	
87		10.2	0.29	9.91	10.49	6.94	13.64	13.3	131
95		20.8	2.1	18.7	22.9	13.09	29.77	22.3	107
97								12.9	
99		18.84	0.44	18.4	19.28	12.88	25.06	20.4	108
101		35.9	1.6	34.3	37.5	24.01	48.75	45.1	126
105		10.8	0.45	10.35	11.25	7.25	14.63	12.1	112
110		35.34	0.71	34.63	36.05	24.24	46.87	41.5	117
114								1.0	
118		35.1	1.0	34.1	36.1	23.87	46.93	42.3	120
128		5.25	0.17	5.08	5.42	3.56	7.05	5.8	110
137								0.8	
138		35.7	1.5	34.2	37.2	23.94	48.36	48.8	137
141								0.8	
149		34.73	0.69	34.0	35.42	23.83	46.05	33.3	96
151		10.92	0.25	10.67	11.17	7.47	14.52	14.5	133
153		56.9	3.5	53.4	60.4	37.38	78.52	60.3	106
156		1.97	0.11	1.86	2.08	1.30	2.70	1.9	
157								0.8	
158								3.4	
170								1.0	
174								0.3	
177								5.8	
180		7.81	0.63	7.18	8.44	5.03	10.97	6.4	81.3
183		5.25	0.15	5.10	5.40	3.57	7.02	4.8	91.5
187		16.7	1.3	15.40	18.00	10.78	23.40	17.7	106
189								0.0	
194								0.2	
195								0.0	
200								0.5	
201								0.2	
203								0.4	
206								0.0	
209								0.0	
Average Recovery:									105
Percent Moisture								NA	
Percent Lipid								6.4	
Surrogate % Recovery								% Recovery	
207								86.4	