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

10.1 DESCRIPTION AND PURPOSE

Past activities in and around Lake Ewauna and other locations in Keno reservoir suggest that sediments in the reservoir may be contaminated with agricultural chemical residue, poly-chlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and trace metals including mercury. While it is unknown whether the Klamath Hydroelectric Project has contributed to the potential sources of sediment contaminants, it is possible that accumulation of potentially contaminated sediments in Project reservoirs has resulted in conditions conducive to bioaccumulation of such contaminants.

Both Oregon[1] and California[2] have water quality standards concerning bioaccumulation of toxic substances. Therefore, the water quality agencies of both states requested that studies be done to determine whether bioaccumulation of potentially toxic contaminants was occurring. The purpose of this study was to determine if edible fish in the Project reservoirs contain unacceptably high residues of potentially toxic contaminants.

10.2 OBJECTIVE

This study is intended to be a Tier I (screening level) study of the Project reservoirs. The primary aim of the study was to identify whether certain fish species are bioaccumulating toxic substances at levels that may adversely affect public health or wildlife via fish consumption, or be harmful to aquatic life (based on existing quality criteria/guidelines for the protection of human health, wildlife, and aquatic life). Locations were sampled where fishing is practiced, including areas where various types of fishing are conducted routinely (e.g., from a pier, from shore, or from private and commercial boats), thereby exposing a significant number of people to potentially adverse health effects. Target species included commonly consumed species that are dominant in the catch and have high bioaccumulation potential. Composites of fillets of these target fish above legal size were analyzed for levels of potentially toxic contaminants.

10.3 RELICENSING RELEVANCE AND USE IN DECISIONMAKING

The study has indirect relevance to relicensing in that it will provide useful information to the water quality agencies considering Section 401 certification. The results of the study will help guide the development of PM&E measures. In addition, the results will be useful to regulatory agencies during development of TMDLs for the Lower Klamath River basin.

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[1] Oregon Administrative Rules 340-011-0965(2)(p)(A).

[2] North Coast Regional Water Quality Control Board, 1994. Water Quality Control Plan for the North Coast Region, as amended.

10.4 METHODS AND GEOGRAPHIC SCOPE

10.4.1 Geographic Scope

Fish samples will be collected from various locations in each of the Project reservoirs: Keno (including Lake Ewauna area), J.C. Boyle, Copco, and Iron Gate. Samples will also be collected from Klamath Lake to be used as a reference for background conditions.

10.4.2 Methods

The methods used for sample collection, handling, and analysis have been developed with input from toxicologists from ODEQ, and CDFG based on chemicals known to be used on USBR's Klamath Irrigation Project.[3] They follow guidance documents issued by the EPA.[4] Tissue samples were analyzed by the CDFG Fish and Wildlife Water Pollution Control Laboratory in Rancho Cordova.

Fish were collected and handled using proper techniques and protocols recommended by the CDFG water pollution control laboratory. Fish were collected during May 2003 using a variety of methods, including electroshocking, nets, and angling. Target species included the following:

- Largemouth bass (*Micropterus salmoides),* primary target species
- Bullhead (*Ictalurus spp.*), also primary target species in Keno reservoir only

Largemouth bass are the primary target species in all reservoirs. Also, bullhead are a primary target species in Keno reservoir. Fish used for analysis included the largest specimens of at least legal size customarily caught by recreational anglers or subsistence fishers. Fish for analysis were tagged, labeled, wrapped in aluminum foil, sealed in plastic, frozen immediately in the field, and shipped overnight to the laboratory for analysis. Length and weight were recorded for all fish used in the analysis.

Two composite samples comprising six fish each of the primary target species were analyzed for each reservoir. The tissue analyzed consisted of fillets with the skin on[5] for fish caught in both California and Oregon. Tissue composites were homogenized and analyzed for total lipids, pesticides, PCBs, and selected metals. Specific target compounds are listed in Tables 10.4-1 and 10.4-2. Metals analysis included arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc. The analytical results were compared to established screening values (EPA, 2000), as detailed in Tables 10.4-3, 10.4-4, and 10.4-5, to determine if there is cause for concern with regard to chemical contaminants.[6] Table 10.4-6 lists the agricultural chemicals used on the Klamath Irrigation Project in Oregon and in Siskiyou County, California.

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[3] Chemicals known to be used on the irrigated lands in the Klamath Irrigation Project are identified in Table 10.4-6.

[4] EPA 823-B-00-007, November 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 1: Fish Sampling and Analysis Third Edition. Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency, Washington, DC.

[5] EPA Guidance recommends using skin-on fillets. The State of California prefers skin-free fillets because of the great difficulty in obtaining uniform homogenates with skin-on fillets (Gassel, pers. comm.).

[6] Neither Oregon nor California has criteria for protection of wildlife related to fish tissue concentration of organic contaminants. Some tissue quality criteria and guidelines for the protection of wildlife from other jurisdictions are presented in Table 10.4-5.

The methods proposed are intended as a screening-level analysis of existing conditions. Should any proposed mitigation or enhancement measure or change in operations lead to significant disruption of sediments in the project reservoirs, additional studies of potentially toxic contaminants will be developed in cooperation with the relevant state agencies.

10.4.3 Relationship to Regulatory Requirements and Plans

This study helps PacifiCorp address regulatory requirements and planning objectives related to Project effects on water quality. The information derived from this study will help address FERC requirements (18 CFR 4.51 and 16.8) for information on water quality in the Project area and potential effects of Project operations on water quality.

Relicensing of the Project requires certifications from relevant agencies that the Project complies with requirements of Section 401 of the federal Clean Water Act. This study provides information to help assess potential Project effects as they relate to water quality objectives and standards promulgated by these agencies.

Together with other hydrology and water quality studies conducted by PacifiCorp, this study provides information to address compliance with management objectives from various resource agencies, tribes, and other stakeholders that relate to water quality, including the following:

- Federal Clean Water Act regulations
- State of Oregon Water Quality Management Plan for the Klamath Basin (Basin Plan)
- State of California Water Quality Control Plan for the North Coast Region (Basin Plan)
- Federal ESA regulations
- Tribal natural resources goals and objectives and cultural values
- Tribal water quality standards as promulgated
- USFS and BLM Aquatic Conservation Strategy objectives under the Northwest Forest Plan
- BLM Resource Management Plans
- USFS Land and Resource Management Plans
- ODFW Fish and Wildlife Habitat Mitigation Policy
- ODFW Klamath Basin Fish Management Plan
- CDFG management goals

This study's information also will help PacifiCorp develop protection, mitigation, and enhancement measures to meet the intention of the regulations and management objectives related to water quality.

Table 10.4-1. Organochlorine compounds analyzed and their minimum detection limits (MDL) and reporting limits (RL) in tissue.

	MDL (ng/g wet wt)	RL (ng/g wet wt)
Aldrin	0.26	1.0
Chlordane, cis	0.68	2.0
Chlordane, trans	0.40	2.0
Chlordene, alpha	0.26	1.0
Chlordene, gamma	0.25	1.0
Chlorpyrifos	0.81	2.0
Dacthal	0.58	2.0
DDD, o,p'	0.71	2.0
DDD, p,p'	0.84	2.0
DDE, o,p'	0.53	2.0
DDE, p,p'	0.56	2.0
DDMU, p,p'	1.1	3.0
DDT, o,p'	1.0	3.0
DDT, p,p'	2.0	5.0
Diazinon	6.4	20
Dichlorobenzophenone, p,p'	TBD	10
Dicofol (Kelthane)	NR	NR
Dieldrin	0.40	2.0
Endosulfan I	0.74	2.0
Endosulfan II	TBD	10
Endosulfan sulfate	TBD	10
Endrin	0.71	2.0
Ethion	1.9	6.0
HCH, alpha	0.36	1.0
HCH, beta	0.56	2.0
HCH, gamma	0.27	1.0
Heptachlor	0.51	2.0
Heptachlor epoxide	0.37	1.0
Hexachlorobenzene	0.10	0.3
Methoxychlor	1.3	5.0
Mirex	0.93	3.0
Nonachlor, cis	0.96	2.4
Nonachlor, trans	0.35	1.0
Oxadiazon	0.88	3.0
Oxychlordane	0.29	1.0
Parathion, ethyl	0.64	2.0

Table 10.4-1. Organochlorine compounds analyzed and their minimum detection limits (MDL) and reporting limits (RL) in tissue.

	MDL (ng/g wet wt)	RL (ng/g wet wt)
Parathion, methyl	1.2	4.0
Tetradifon (Tedion)	0.54	2.0
Toxaphene	To be determined	20

Source: EPA, 2001.
ng/g wet wt = nanograms per gram

Table 10.4-2. PCB congeners and Aroclor mixtures analyzed and their detection limits in tissue (ng/g wet wt).

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	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 reporting limits are 0.2 ng/g wet weight.	
Aroclors	**Detection Limits ng/g wet wt.**
Aroclor 1248	25
Aroclor 1254	10
Aroclor 1260	10
Aroclor 5460 (polychlorinated terphenyl)	100

Source: EPA, 2000.

Table 10.4-3. Dose-response variables and recommended screening values (SVs) for target analytes - recreational fishers.[a]

Target analyte	Noncarcinogens RfD (mg/kg-d)	CarcinogensC SF $(mg/kg\text{-}d)^{-1}$	SV[b] (ppm)	
			Noncarcinogens[b]	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 (γ-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}

Table 10.4-3. Dose-response variables and recommended screening values (SVs) for target analytes - recreational fishers.[a]

Target analyte	Noncarcinogens RfD (mg/kg-d)	CarcinogensC SF $(mg/kg-d)^{-1}$	SV[b] (ppm)	
			Noncarcinogens[b]	Carcinogens[b] (RL=10^{-5})

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 $(mg/kg-d)^{-1}$

[a] Based on fish consumption rate of 17.5 g/d, 70kg body weight and, for carcinogens, 10^{-5} risk level and 70-year 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 SVs listed may be below analytical detection limits achievable for some of the target analytes. See Table 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.

Table 10.4-3. Dose-response variables and recommended screening values (SVs) for target analytes - recreational fishers.[a]

Target analyte	Noncarcinogens RfD (mg/kg-d)	CarcinogensC SF (mg/kg-d)$^{-1}$	SV[b] (ppm)	
			Noncarcinogens[b]	Carcinogens[b] (RL=10^{-5})

[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).

Source: EPA (2000).

Table 10.4-4. Dose-response variables and recommended screening values (SVs) for target analytes - subsistence fishers.[a]

Target analyte	Noncarcinogens RfD (mg/kg-d)	Carcinogens CSF (mg/kg-d)$^{-1}$	SV[b] (ppm)	
			Noncarcinogens[b]	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 (γ-hexachlorocyclohexane; g-HCH)[k]	3×10^{-4}	1.3	0.147	3.78×10^{-3}
Mirex	2×10^{-4}	NA[l]	0.098	-

Table 10.4-4. Dose-response variables and recommended screening values (SVs) for target analytes - subsistence fishers.[a]

Target analyte	Noncarcinogens RfD (mg/kg-d)	Carcinogens CSF $(mg/kg\text{-}d)^{-1}$	SV[b] (ppm)	
			Noncarcinogens[b]	Carcinogens[b] (RL=10^{-5})
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}

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 $(mg/kg\text{-}d)^{-1}$

[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

Table 10.4-4. Dose-response variables and recommended screening values (SVs) for target analytes - subsistence fishers.[a]

Target analyte	Noncarcinogens RfD (mg/kg-d)	Carcinogens CSF $(mg/kg\text{-}d)^{-1}$	SV[b] (ppm)	
			Noncarcinogens[b]	Carcinogens[b] (RL=10^{-5})

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

Table 10.4-4. Dose-response variables and recommended screening values (SVs) for target analytes - subsistence fishers.[a]

Target analyte	Noncarcinogens RfD (mg/kg-d)	Carcinogens CSF $(mg/kg\text{-}d)^{-1}$	SV[b] (ppm)	
			Noncarcinogens[b]	Carcinogens[b] (RL=10^{-5})

sample, using the method for estimating toxicity equivalency concentrations (TEQs).

Source: EPA (2000).

Table 10.4-5. 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	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.022	µg/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
Chlordane	0.37	µg/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.5	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
DDTs, Total	0.2	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.27	µg/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	1	µg/g	Whole fish, wet weight basis, for protection of fish consuming birds	Ontario	Environment Ontario 1984
Hexachlorobenzene	0.2	µg/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.33	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
Hexachlorocyclo-hexane (all isomers)	0.1	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.51	µg/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
Mirex	0.33	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.37	µg/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
PCBs, Total	0.11	µg/g	1 in 100 cancer risk criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.11	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987
	0.1	µg/g	Maximum concentration	British Columbia	BCMOELP 1994
Pentachlorophenol	2	µg/g	Non-carcinogenic final fish flesh criteria for piscivorous wildlife	New York	Newell et al. 1987

Table 10.4-5. A summary of the available tissue quality criteria and guidelines for the protection of wildlife.

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

Table 10.4-6. Agricultural chemicals used on the Klamath Irrigation Project in Oregon and Siskiyou County, California.

2,4-D, Dimethylamine Salt	Lambda Cyhalothrin
2,4-D, Isooctyl Ester	Lauric Acid
Acephate	Malathion
Alcohols, C4-C12, Normal	Maleic Hydrazide, Potassium Salt
Alkyl Polyethylene Glycol Ether	Mancozeb
Alkyl Polyoxy Alkylene Ether	Manganese Sulfate
Alkylaryl Polyoxyethylene Ether	Manzate
Alpha-Alkyl-Omega-Hydroxypoly (Oxyethylene)	Mcp
Aluminum Phosphide	Mcpa
Atrazine	Mcpa, Dimethylamine Salt
Azadirachtin	Mefenoxam
Chloropicrin	Metam-Sodium
Disulfoton	Methamidophos
Glyphosate, Isopropylamine Salt	Methoxychlor
Oxyfluorfen	Methyl Bromide
Phosphatidylcholine	Methyl Bromide
Triclopyr, Triethylamine Salt	Methyl Parathion
2,4-D, 2-Ethylhexyl Ester	Methyl Silicone Resins
2,4-D, Butoxyethanol Ester	Methyl Soyate
2,4-D, Dimethylamine Salt	Metribuzin
2,4-D, Isooctyl Ester 1	Metribuzin
2,6,8-Trimethyl-4-Nonanol	Mh 30
4(2,4-Db), Dimethylamine Salt	Mocap
Alkyl Polyethylene Glycol Ether	Monitor
Alkyl Polyoxy Alkylene Ether	Myclobutanil
Alkylamine, Alkyl Derived From Coconut Oil Fatty	N,N-Bis-(2-(Omega-Hydroxypoly(Oxyethylene) Ethyl)
Alkylaryl Polyoxyethylene Ether	Nonyl Phenoxy Poly (Ethylene Oxy) Ethanol
Alpha-Alkyl (C12-C15) Omega-Hydroxy Poly (Oxyethylene)	Norflurazon
Aluminum Phosphide	Octyl Phenoxy Poly Ethoxy Ethanol
Ammonium Propionate	Oleic Acid, Methyl Ester
Ammonium Sulfate	Oxamyl
Atrazine, Other Related	Oxyethylene
Azoxystrobin	Oxyfluorfen
Benomyl	Para-Nonylphenyl Polyoxyethylene
Borax	Paraquat
Bromoxynil Octanoate	Paraquat Dichloride
Captan	Parathion
Carbofuran	Pendimethalin
Chloropicrin	Permethrin

Table 10.4-6. Agricultural chemicals used on the Klamath Irrigation Project in Oregon and Siskiyou County, California.

Chlorothalonil	Petroleum Hydrocarbons
Chlorpropham	Petroleum Oil, Paraffin Based
Chlorpyrifos	Phosphatidylcholine
Chlorthal-Dimethyl	Phosphoric Acid
Citric Acid	Polyacrylamide Polymer
Clethodim	Polyacrylic Polymer
Clopyralid, Monoethanolamine Salt	Polyalkene Oxide Modified Heptamethyl Trisiloxane
Coconut Diethanolamide	Polyalkyleneoxide Modified Polydimethyl-Siloxane
Compounded Silicone	Poly-I-Para-Menthene
Copper Hydroxide	Polymerized Acrylic Acid
Cyfluthrin	Polyoxyethylene Dinonyl Phenol
Cymoxanil	Polyram
Dicamba, Dimethylamine Salt	Pounce
Diglycolamine Salt Of 3,6-Dichloro-O-Anisic Acid	Propargite
Dihydrogen Phosphate Ester	Propionic Acid 1
Dimethoate	Propylene Glycol
Dimethyl Poly Siloxane	Pymetrozine
Diphacinone	Ridomil
Diquat Dibromide	Rimsulfuron
Disulfoton	Sencor
Diuron	Sethoxydim
Esfenvalerate	Sevin
Ethoxylated Alkyl Phosphate Esters	Simazine
Fluazifop-P-Butyl	Sodium Salt
Fosetyl-Al	Strychnine
Free Fatty Acids And/Or Amine Salts	Sulfometuron Methyl
Glyphosate, Isopropylamine Salt	Systox
Heptamethyltrisiloxane Ethoxylated (8 Eo)	Tall Oil Acids
Hexazinone	Telone
Imazamethabenz	Temik
Imazapyr, Isopropylamine Salt	Triclopyr, Butoxyethyl Ester
Imazethapyr	Trifluralin 220.0000 3 133.00 A
Iprodione	Undecyl Polyoxyethylene
Isopropyl Alcohol	Velpar
	Zinc Sulfate

Sources: California Department of Pesticide Reporting; Sorenson and Schwarzbach, 1991; Dileanis et al. 1996; Johnson et al. 1968.

10.5 TECHNICAL WORK GROUP COLLABORATION

PacifiCorp has worked with stakeholders to establish a more collaborative process for planning and conducting studies needed to support Project relicensing documentation. As part of this collaborative process, Water Quality Work Group was formed and has met approximately monthly to plan and discuss water quality studies and results, including this study.

10.6 RESULTS AND DISCUSSION

10.6.1 Results of Spring 2003 Sampling

The sampling and analysis screening level determination of chemical contaminants in fish tissue in selected project reservoirs (based on the approach described in Section 10.4.2 was not completed in time for inclusion in this FTR. Results of this sampling and analysis, when available from the CDFG Fish and Wildlife Water Polluton Control Laboratory, will be presented and discussed in a separate final study report.

Klamath River Basin Fall Chinook Salmon Spawner Escapement, In-river Harvest and Run-size Estimates, 1978-2002 a/

SPAWNER ESCAPEMENT

	2002			2003			2004		
Hatchery Spawners	Grilse	Adults	Totals	Grilse	Adults	Totals	Grilse	Adults	Totals
Iron Gate Hatchery (IGH)	1,296	23,665	24,961						
Trinity River Hatchery (TRH)	1,034	3,515	4,549						
Hatchery Spawner Subtotals:	**2,330**	**27,180**	**29,510**						
Natural Spawners									
Main Stem Klamath River n/ (excluding IGH)	658	21,650	22,308						
Shasta River basin	386	6,432	6,818						
Scott River basin	47	4,261	4,308						
Salmon River basin	72	2,486	2,558						
Bogus Creek basin	305	17,529	17,834						
Misc. Klamath tributaries o/ (above Yurok Reservation)	44	1,344	1,388						
Yurok Reservation tribs. (Klamath River) p/	12	339	351						
Klamath Natural Spawner Subtotals:	1,524	54,041	55,565						
Main Stem Trinity River dd/ (excluding TRH)	2,257	11,075	13,332						
Misc. Trinity tributaries o/ (above Hoopa Reservation)	66	324	390						
Hoopa Reservation tribs. (Trinity River) p/	42	206	248						
Trinity Natural Spawner Subtotals:	**2,365**	**11,605**	**13,970**						
Natural Spawner Subtotals:	**3,889**	**65,646**	**69,535**						
Total Spawner Escapement	**6,219**	**92,826**	**99,045**						

IN-RIVER HARVEST

	2002			2003			2004		
Angler Harvest	Grilse	Adults	Totals	Grilse	Adults	Totals	Grilse	Adults	Totals
Klamath River (below Hwy 101 bridge)	274	3,285	3,559						
Klamath River (Hwy 101 to Coon Cr Falls)	283	3,269	3,552						
Klamath River (Coon Cr Falls to IGH)	93	3,216	3,309						
Trinity River basin above Weitchpec aa/	221	640	861						
Angler Harvest Subtotals:	**871**	**10,410**	**11,281**						
Indian Net Harvest e/									
Klamath River (below Hwy 101 bridge)	17	19,701	19,718						
Klamath River (Hwy 101 to Trinity mouth)	41	3,257	3,298						
Trinity River (Hoopa Reservation)	68	1,168	1,236						
Indian Net Harvest Subtotals:	**126**	**24,126**	**24,252**						
Total In-river Harvest	**997**	**34,536**	**35,533**						

IN-RIVER RUN

Totals	2002 Grilse	2002 Adults	2002 Totals	2003 Grilse	2003 Adults	2003 Totals	2004 Grilse	2004 Adults	2004 Totals
In-river Harvest and Escapement	7,216	127,362	134,578						
Angling Mortality (2% of harvest) f/	17	209	226						
Net Mortality (8% of harvest) f/	10	1,930	1,940						
Fish Die Off ee/	2,003	30,550	32,553						
Total In-river Run	**9,246**	**160,051**	**169,297**						

(continued next page)