RISK ASSESSMENT FOR 2378-TCDD AND 2378-TCDF CONTAMINATED RECEIVING WATERS FROM U.S. CHLORINE-BLEACHING PULP AND PAPER MILLS

August 1990

Prepared for:

U.S. Environmental Protection Agency

Office of Water Regulations and Standards

Assessment and Watershed Protection Division

Washington, D.C.

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EXECUTIVE SUMMARY

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA), acting under a consent decree with the Environmental Defense Fund and the National Wildlife Federation, assessed both human health and environmental risks from the contaminants 2,3,7,8-tetrachloro dibenzo-*p*-dioxin (2378-TCDD) and 2,3,7,8-tetrachloro dibenzofuran (2378-TCDF) that are discharged from 104 pulp and paper mills located in the United States using chlorine or its derivatives to bleach pulp. As a part of this program, the Office of Water Regulations and Standards (OWRS) was responsible for estimating the potential human health and aquatic life risks associated with exposures via surface water pathways based on mill-specific effluent sample results.

This report presents a generalized uniform approach for assessing impacts from the discharges of the 104 mills to support the decision by EPA to either regulate or not regulate discharges of 2378-TCDD and 2378-TCDF from pulp and paper mills that use chlorine to bleach pulp. It should be noted that in some respects, the approach for assessing risks presented in this report may differ from approaches used by the States. For example, States may use different cancer potency factors (either FDA's or their own), fish consumption rates, or bioconcentration factors. In some cases States do not use models to predict risks, but rather use actual fish tissues data. In other cases, States do not use the "toxicity equivalence" procedure as a means of predicting the combined risk from 2378-TCDD and 2378-TCDF as was used in this report. As a result of the differences in approaches taken by various States for assessing risks and the approach presented in this report, estimated risks may be over- or underestimated in comparison to the States' adopted or proposed water quality standards. A summary of State assumptions used to develop 2378-TCDD water quality standards is presented in Appendix R.

Effluent sampling results for each of the 104 pulp and paper mills were provided by the joint EPA/paper industry 104-mill study. The 104-mill data, however, are now over two years old, and since the time the 104-mill study was conducted, conditions at some mills may have changed due to mills taking actions to install or incorporate activities identified as necessary to reduce the formation of dioxins or furans, or more recent information may be available that would alter some of the exposure and risk estimates developed in the present study. However, because this study was designed to provide a snapshot of exposure and risk estimates at one point in time, for the most part, no attempt was made to include effluent data from sources other than the 104-mill study. The only exception to the use of 104-mill study effluent data was the use of plant flow data for several mills that were provided by the EPA Regions and which differed from the flow values identified in the 104-mill study.

The purpose of this analysis was to develop estimates of exposures and risks to human health and aquatic life associated with 2378-TCDD and 2378-TCDF discharges from chlorine-bleaching pulp and paper mills. This study was not designed to rank the exposure or human health and aquatic life risks associated with specific mills, but rather to estimate the risk potential posed by the entire chlorine-bleaching pulp and paper industry. This analysis focused on the highest estimated in-stream contaminant concentrations immediately downstream of each mill discharge point (assuming steady-state, fully mixed conditions) and the potential human health impacts resulting from the consumption of 2378-TCDD and 2378-TCDF contaminated fish and drinking water associated with these exposures. Because no comprehensive studies on 2378-TCDD and 2378-TCDF build-up in sediments and bioaccumulation up the food chain exist, only the water column was investigated as a potential route of exposure and uptake of 2378-TCDD and 2378-TCDF by fish. However, a sensitivity analysis is presented to look at bioconcentration in fish both before and after particulate 2378-TCDD and 2378-TCDF settle to the sediment. Carcinogenic and non-carcinogenic effects in humans were considered, as were potential adverse effects to aquatic life.

One result of this analysis is an understanding of the potential upper bound human cancer risk to a hypothetically exposed individual eating contaminated fish and drinking contaminated water near the mills. These results are presented as the estimated risk of cancer incidence during the exposed individual's lifetime. No attempt was made to characterize or estimate the human population potentially at risk. For these risk estimations, reasonable worst-case ambient and effluent characterizations were used, as well as best estimates of the physical and chemical properties of 2378-TCDD and 2378-TCDF. Because not all of the parameter values used in this assessment are "worst case," the hypothetically exposed individual is not considered the "most exposed individual."

Long-term animal studies of 2378-TCDD have provided clear evidence that the contaminant is an animal carcinogen (Kociba et at., 1978; NTP, 1982a; NTP, 1982b). Based on these animal studies as well as other considerations, EPA has concluded that 2378-TCDD should be regarded as a probable human carcinogen (U.S. EPA, 1985). EPA has assigned 2378-TCDD a qualitative weight-of-evidence designation of "B2" for its carcinogenic potential. This designation indicates that 2378-TCDD is an agent for which there is sufficient evidence of carcinogenicity based on animal studies but inadequate data regarding its carcinogenicity from human epidemiologic studies (U.S. EPA, 1986).

APPROACH

In this investigation, two approaches were used to estimate and compare exposures to 2378-TCDD and 2378-TCDF resulting from surface water effluent discharges from pulp and paper mills. The first approach consisted of a simple dilution calculation conducted to estimate the in-stream concentration of the contaminants after the effluent is mixed with the receiving water. This calculation assumes 100% of the in-stream contaminants (both dissolved and adsorbed to suspended solids) are bioavailable. In the second approach, the Exposure Assessment Modeling System (EXAMS II) was used to partition in-stream steady-state concentrations of the contaminants between dissolved and particulate forms. EXAMS II is able to account for the high affinity of 2378-TCDD and 2378-TCDF for solids and, therefore, the likelihood that a percentage of the contaminants will be associated with suspended and benthic solids. It is assumed that the particulate form of the contaminants will not be available for uptake across fish gills nor available to humans through ingestion of contaminated drinking water.

Both the simple dilution and EXAMS II approaches were used to estimate and compare the potential human health risks associated with ingestion of contaminated fish tissue and drinking water. Since the simple dilution approach assumes 100% of the in-stream contaminants to be bioavailable to fish, this approach effectively includes exposure through uptake across fish gills (dissolved form) as well as through ingestion of suspended solids (particulate form). The simple dilution approach is also considered to represent the upper bound for bioaccumulation since a bioconcentration factor based on dissolved contaminants was applied to the particulate contaminants as well. In the EXAMS II model analysis, however, only the dissolved contaminant concentration is assumed to be bioavailable to fish.

Although EXAMS II predicts contaminant concentrations associated with both suspended and benthic solids, no attempt was made to separately estimate fish exposure to contaminants associated with suspended particulates, bed sediments, or the food chain. These exposure routes were not directly addressed due to a lack of adequate information concerning the bioaccumulation of these contaminants through the food chain and the sediment-to-fish partition coefficient needed to predict uptake through contact with contaminated sediments. In addition, it is generally believed that 2378-TCDD and 2389-TCDF tend to adsorb to very fine suspended sediments which would be transported out of the immediate area of the discharge and therefore beyond the area under consideration. (These sediment-associated contaminants would, however, pose a potential risk to fish inhabiting those areas further downstream where the fine sediments are eventually deposited.) For these reasons, and because uptake of 2378-TCDD and 2378-TCDF through the water column has been more thoroughly investigated, exposure to dissolved contaminants in the water column was the basis for estimating fish tissue contamination using the EXAMS II approach.

Using exposure estimates from both approaches (simple dilution and EXAMS II water column), fish tissue contaminant residue levels were estimated by employing fish bioconcentration factors (BCFs) for 2378-TCDD

and 2378-TCDF. From fish tissue contaminant concentrations, average daily lifetime exposures (or chronic daily intake, CDI) for humans consuming 6.5, 30 and 140 g/day were calculated. These calculations took into consideration factors that adjust for lower contaminant concentrations in fish muscle (filet) and fatty/oily food bioavailability in humans of 95% of oral exposure. Receiving water concentrations were also used to estimate the average daily lifetime 2378-TCDD and 2378-TCDF exposure associated with drinking water ingestion, assuming a 2 L/day consumption rate.

Multiplying average daily lifetime doses by the EPA carcinogenic potency factor for 2378-TCDD yielded a conservative (upper bound) estimate of the expected rate of cancer incidence above background incidence rates due to 2378-TCDD exposure. Combined 2378-TCDD/-TCDF cancer risk was estimated using the "toxicity equivalence" (TEQ) procedure, in which the cancer potency of 2378-TCDF is assumed to be one tenth that of 2378-TCDD. It should be noted that, although in this report TEQ represents only the contributions of 2378-TCDD and 2378-TCDF to risk, there are likely to be additional risk contributions from other chlorinated dibenzo-p-dioxins and furans associated with discharges from chlorine-bleaching pulp and paper mills. However, 2378-TCDD and 2378-TCDF account for greater than 90% of the TEQ from chlorinated dioxins and furans found in the effluents of these mills.

Mill-specific contaminant concentration estimates were also used to calculate the exposure level associated with a single ingestion of a 0.25 lb. (115 g) contaminated fish portion. This dose was evaluated against a 2378-TCDD Health Advisory threshold value for protection against liver effects, estimated by EPA for this investigation following appropriate guidelines.

The mill-specific, simple dilution contaminant concentrations for 7Q10 low flow receiving water conditions (based on the lowest consecutive seven-day average flow during any ten-year period) were compared to EPA's preliminary chronic exposure levels for the protection of aquatic life to predict whether chronic toxicity to aquatic organisms from 2378-TCDD and 2378-TCDF would result under the assessment scenarios.

ASSUMPTIONS USED IN ANALYSIS

The following is a list of assumptions used in this investigation:

1) Mill-specific, five-day effluent composite contaminant concentrations collected during the 104-mill study were multiplied by mean plant flow rates to determine contaminant load. This resulting load to the receiving stream was assumed to be continuous. The representativeness of the sample effluent as reflecting long-term mill operations is unknown; since then, the mills may have made plant process or operation changes to reduce dioxin and furan formation. This assumption may overestimate human health and aquatic life risks.

2) The highest estimated steady-state in-stream concentrations in the immediate downstream vicinity of the discharges (assuming fully mixed conditions) were considered for fish exposure. Fish are likely to move in and out of the area of maximum concentration, but these estimates assumed that fish remain exposed to the highest concentration. Consequently, this assumption is likely to overestimate fish exposure and overestimate human health and aquatic life risks.

3) Receiving water stream flow rates for estimating human health risks were calculated using the harmonic mean of historic flow measurements from nearby stream gaging stations. 7Q10 receiving water flow rates were used for estimating aquatic life impacts. These flows may not be the same as those used by specific States to assess risks. Therefore, these assumptions may over- or underestimate risks compared to State assumptions.

4) Three bioconcentration factor (BCF) values were used for estimating 2378-TCDD and 2378-TCDF concentrations in edible fish tissue (the filet): two for 2378-TCDD and one for 2378-TCDF. The resulting fish tissue concentrations were used to estimate human exposure to the contaminants through consumption of fish tissue. For 2378-TCDD, a BCF of 5,000 was used in combination with a human consumption rate of fish tissue of 6.5 g/day, and a BCF of 50,000 was used in combination with consumption rates of 30 g/day and 140 g/day. The 6.5 g/day fish tissue consumption

rate in combination with the BCF of 5,000 reflects the assumptions in EPA's ambient water quality criterion for 2378-TCDD and 2378-TCDF and is considered a reasonable estimate for an average consumer of locally-caught fish. The 30 and 140 g/day consumption rates in combination with the BCF of 50,000 are used as sensitivity comparisons and represent more extreme exposure scenarios for recreational and subsistence fishermen or other high rate consumers of fish. A single BCF for 2378-TCDF of 1,950 was used in combination with each of the three consumption rates. BCFs are species-specific and highly variable. This study did not take species variability or degree of bioconcentration into account. Also, actual fish consumption rates vary by locale. State assumptions for BCF, consumption rates, and also cancer potency may vary from those used in this assessment. Therefore, this assessment may overestimate or underestimate risks compared to State assessments.

5) A drinking water ingestion rate of 2L/day was used to estimate human exposures through ingestion of contaminated drinking water. It was assumed that the water consumed was taken from the point of highest in-stream pollutant concentration after the effluent was fully mixed in the receiving stream, and no treatment of the water was undertaken to remove contaminants prior to ingestion. This assumption likely overestimates human health risks from drinking water.

6) Fish tissue bioavailability for humans was assumed to be 95% of oral dose. Contaminants in water were assumed to be 100% bioavailable to both fish and humans. This reflects the most current information EPA has on bioavailability, but the assumptions may overestimate the risk to humans.

7) Fish were assumed to be exposed to contaminants only in the water column. No food chain or sediment associated exposures were considered, other than for the simple dilution method in which the total in-stream contaminant level (both dissolved and adsorbed to suspended solids) were bioavailable.

8) The estimates of risk apply only to a hypothetically exposed individual in the immediate vicinity of the mills, and not to the entire population of fish consumers.

SUMMARY OF RESULTS

The results of the human health risk and aquatic life impact analyses for the 104 mills included in this investigation are summarized below. It should be noted that sufficient information was not available for all of the mills to allow complete evaluation and comparison of results for each of the 104 facilities. For example, for several of the mills discharging to open waters (i.e., lakes, open ocean), no information was available on receiving stream zone of initial dilution, which was necessary for calculating effluent dilution. For a few other mills, data were questioned as to their accuracy and new samples were being taken, but the results of the new sample evaluations were not available for inclusion in this study. In addition, for some facilities, there was sufficient information to predict risks based on the simple dilution method, but insufficient information to predict risk based on the EXAMS II method. Also, either harmonic mean flow or 7Q10 flow data were not available for several facilities.

Cancer Risk Associated with Consumption of Contaminated Fish Tissue

Figures A through D present the predicted distribution of the number of mills for which discharges would result in a given range of estimated upper bound lifetime cancer risks to the hypothetically exposed individual due to the consumption of contaminated fish tissue based on the simple dilution exposure assessment method and the EXAMS II water column exposure assessment method.

The results of calculations using the 6.5 g/day fish tissue consumption rate in combination with the BCF of 5,000 reflect the assumptions in EPA's ambient water quality criterion for dioxin and are considered reasonable exposures for average consumers of locally-caught fish. The results of these calculations are presented separately from the results of calculations using the 30 and 140 g/day consumption rates and BCF of 50,000, which are considered more extreme exposure scenarios (for example, for recreational and subsistence fishermen) to be used for sensitivity comparisons.

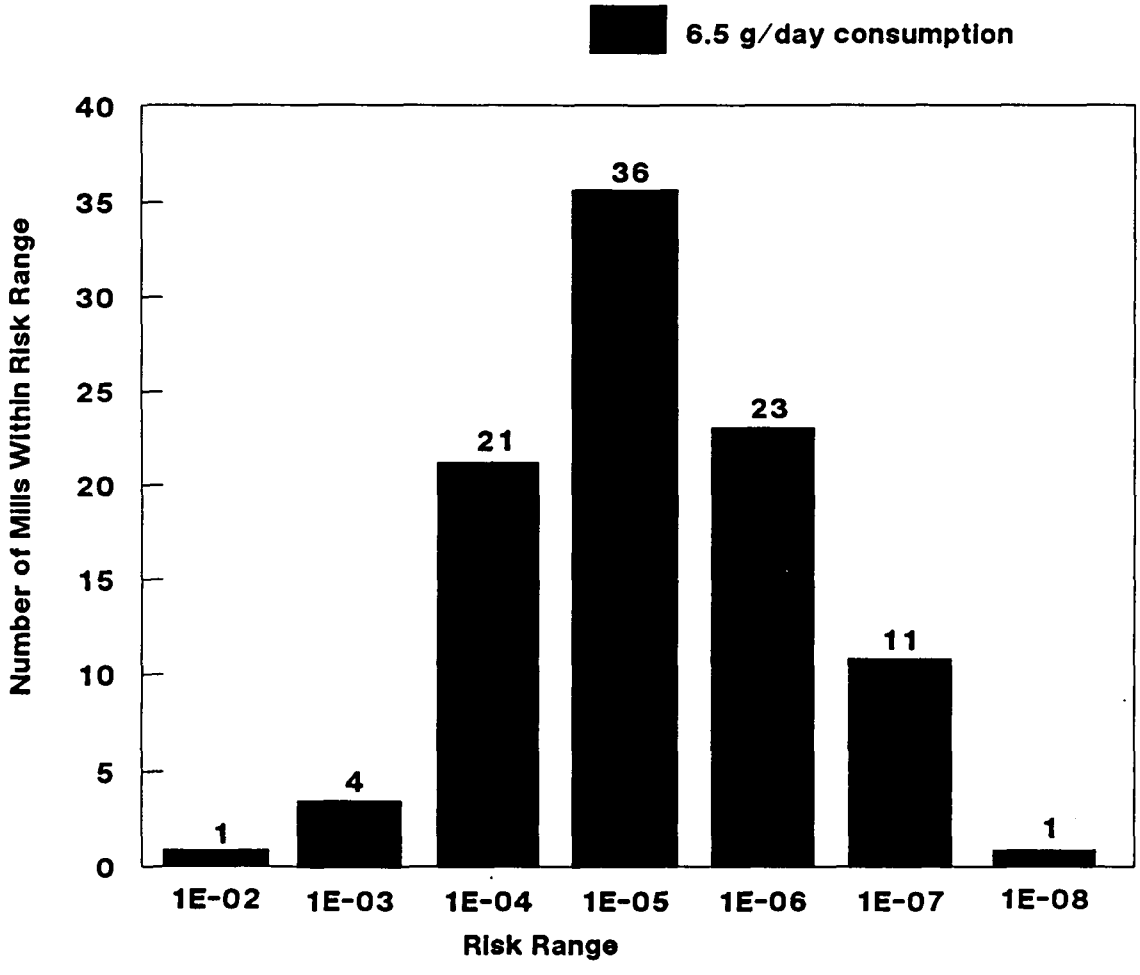

Figure A. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the simple dilution method (6.5 g/day consumption rate and BCF of 5,000 for 2378-TCDD*).

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-4	1E-5	1E-6	1E-7
TCDD	2	7	4	3
TCDF		1		1
TCDD & TCDF		2	2	1

*** Recent laboratory evidence indicates that a BCF higher than 5,000 for 2378-TCDD (e.g., 50,000) more accurately reflects uptake of 2378-TCDD by fish. Use of a BCF of 50,000 for 2378-TCDD would increase risk by an order of magnitude.**

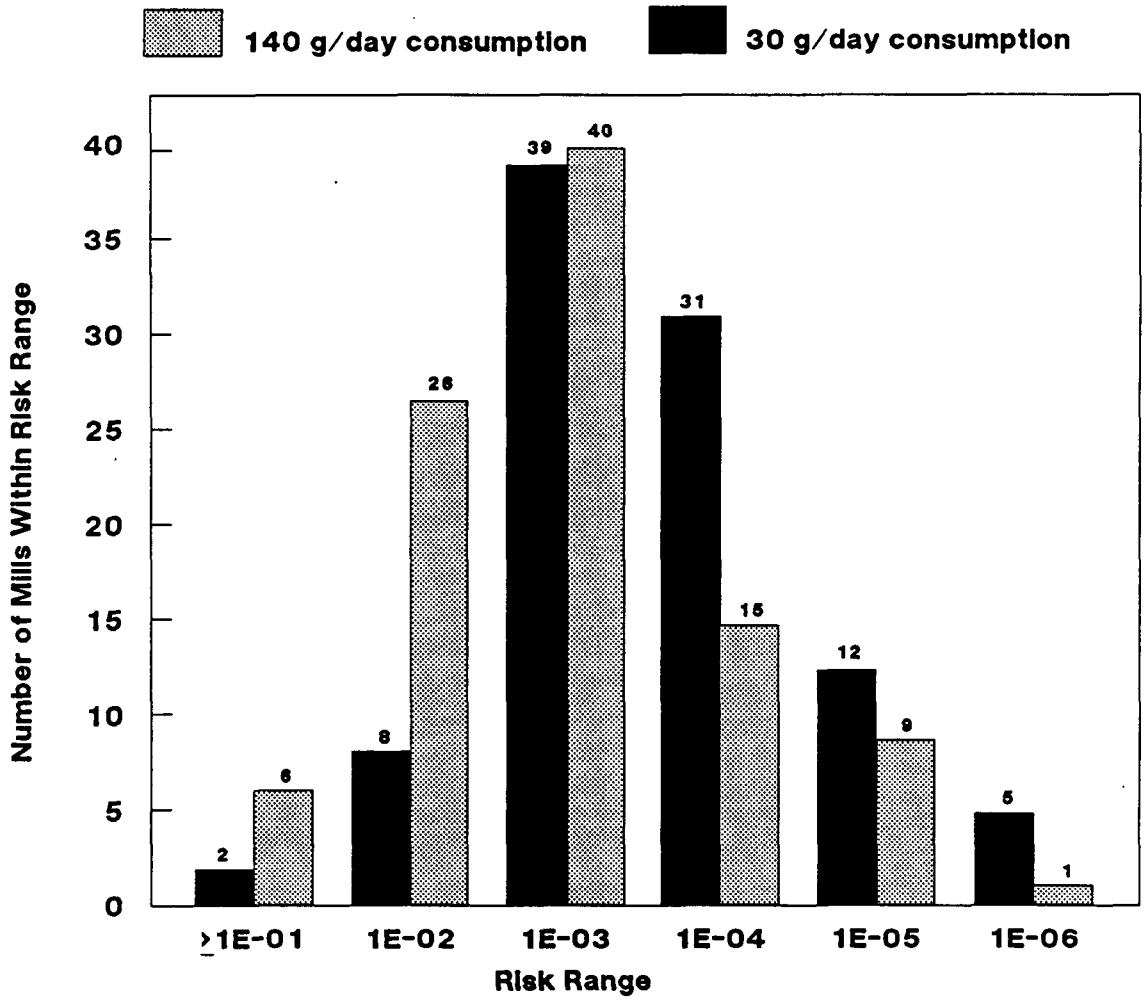

Figure B. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the simple dilution method (30 and 140 g/day consumption rates and BCF of 50,000 for 2378-TCDD).

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-2	1E-3	1E-4	1E-5	1E-6
30g/day					
TCDD		7	4	3	2
TCDF		1		1	
TCDD & TCDF		1	3		1
140g/day					
TCDD	4	4	5	3	
TCDF		1	1		
TCDD & TCDF		3	1	1	

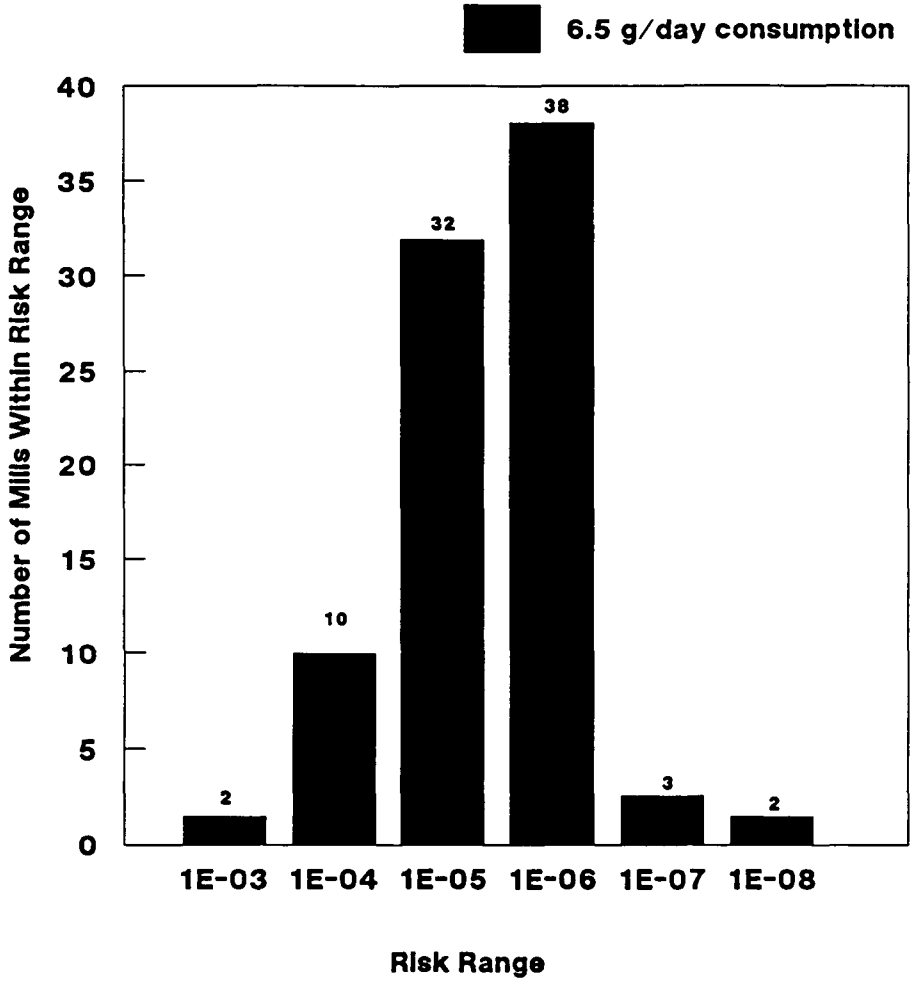

Figure C. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the EXAMS II method (6.5 g/day consumption rate and BCF of 5,000 for 2378-TCDD*).

Notes:

Total number of mills evaluated = 87.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-4	1E-5	1E-6	1E-7	1E-8
TCDD	1	6	5	2	1
TCDF		1		1	
TCDD & TCDF		1	3		1

*** Recent laboratory evidence indicates that a BCF higher than 5,000 for 2378-TCDD (e.g., 50,000) more accurately reflects uptake of 2378-TCDD by fish. Use of a BCF of 50,000 for 2378-TCDD would increase risk by an order of magnitude.**

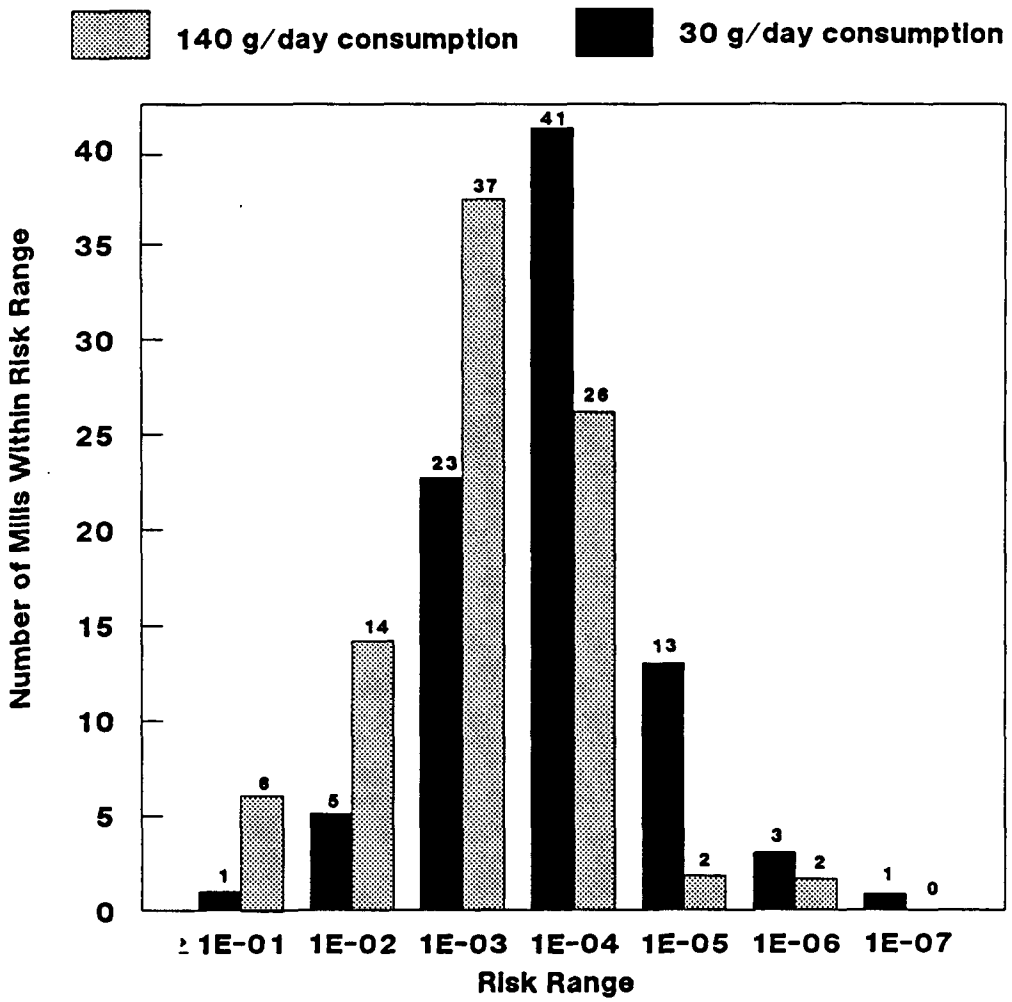

Figure D. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the EXAMS II method (30 and 140 g/day consumption rates and BCF of 50,000 for 2378-TCDD).

Notes:
Total number of mills evaluated = 87.
Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-2	1E-3	1E-4	1E-5	1E-6	1E-7
30g/day						
TCDD		4	6	2	2	
TCDF			1		1	
TCDD & TCDF			2	2		1
140g/day						
TCDD	1	7	4	1	1	
TCDF		1		1		
TCDD & TCDF		1	3		1	

1. Simple Dilution Exposure Assessment Method

Using the simple dilution exposure assessment estimates, the 6.5 g/day fish tissue consumption rate, and fish filet contaminant concentrations based on a BCF of 5,000 for 2378-TCDD, the upper bound mill-specific cancer rates for the hypothetically exposed individual ranged from the 10^{-2} to 10^{-8} risk levels (Figure A). Risk levels associated with discharges from 80 of the 97 mills evaluated (82%) fell within the 10^{-4} to 10^{-6} risk levels, with 36 mills within the 10^{-5} risk level.

Mill-specific cancer rate estimates using the 30 g/day fish tissue consumption rate and fish filet contaminant concentrations based on a BCF of 50,000 ranged from the $\geq 10^{-1}$ to 10^{-6} risk levels (Figure B). Seventy of the 97 mills (72%) were associated with risk levels between 10^{-3} to 10^{-4}, and 39 of these 70 fell within the 10^{-3} range. Using the 140 g/day fish tissue consumption rate and fish filet contaminant concentrations based on the 50,000 BCF, risk levels ranged from $\geq 10^{-1}$ to 10^{-6} (Figure B). Sixty-six out of the 97 mills (68%) were associated with risk levels between 10^{-2} to 10^{-3}, with 40 within the 10^{-3} range.

2. EXAMS II Exposure Assessment Method

Mill-specific upper bound cancer rate estimates for the hypothetically exposed individual using the EXAMS II water column exposure assessment method, 6.5 g/day fish tissue consumption rates, and fish filet contaminant concentrations based on a BCF of 5,000 for 2378-TCDD ranged from the 10^{-3} to 10^{-8} risk levels (Figure C). Seventy of the 87 mills evaluated (80%) were associated with risk levels between 10^{-5} (32 mills) to 10^{-6} (38 mills).

Using the 30 g/day consumption rate and fish filet contaminant concentrations based on the 50,000 BCF, mill-specific cancer rates ranged from the 10^{-1} to 10^{-7} risk levels (Figure D). Sixty-four of the 87 mills (74%) were associated with risk levels within the 10^{-3} to 10^{-4} range, and 41 of these fell within the 10^{-4} range. Cancer rate estimates using the 140 g/day fish tissues consumption rate and 50,000 BCF ranged from the $\geq 10^{-1}$ to 10^{-6} risk levels (Figure D). Sixty-three of the 87 mills (72%) were associated with risk levels between the 10^{-3} and 10^{-4} range, and 37 of these fell within the 10^{-3} range.

Cancer Risks Associated with Ingestion of Contaminated Drinking Water

Figures E and F present the distribution of the number of mills for which discharges were estimated to result in a given range of upper bound lifetime cancer risks to the hypothetically exposed individual due to the ingestion of contaminated drinking water. Only those facilities discharging to fresh water lakes, rivers, and streams were included in this analysis. No discharges to marine or estuarine waters were included, since these water bodies would not be used as drinking water sources.

Use of the simple dilution method estimated that the cancer risks associated with the 69 mills evaluated ranged from the 10^{-4} to 10^{-9} risk levels (Figure E). The greatest percentage of these mills (44, or 64%) were associated with risk levels within the 10^{-6} (23 mills) to 10^{-7} (21 mills) range. Use of the EXAMS II water column method estimated that the risk levels associated with the 64 mills evaluated would range from the 10^{-5} to 10^{-9} levels (Figure F). Fifty of these mills (78%) were associated with risk levels between the 10^{-6} (18 mills) to 10^{-7} (32 mills) range.

Non-Cancer (Short-Term Exposure) Risks

Figures G through H present the distribution of the number of mills for which discharges would result in a given range of human dose due to the single portion consumption of 115 grams of contaminated fish tissue. The concentrations of fish tissue contaminants used for this assessment were based on a BCF of 50,000 for 2378-TCDD and 1,950 for 2378-TCDF in the edible portion of the fish (the filet). Results are reported in pg/kg/day for comparison to a one-day Health Advisory for protection against liver effects (100 pg/kg/day), estimated by EPA for this investigation.

Based on the simple dilution method results (Figure G), the dose associated with discharges from 25 out of 97 mills evaluated (27%) would equal or exceed the one-day HA dose for protection from liver effects (100

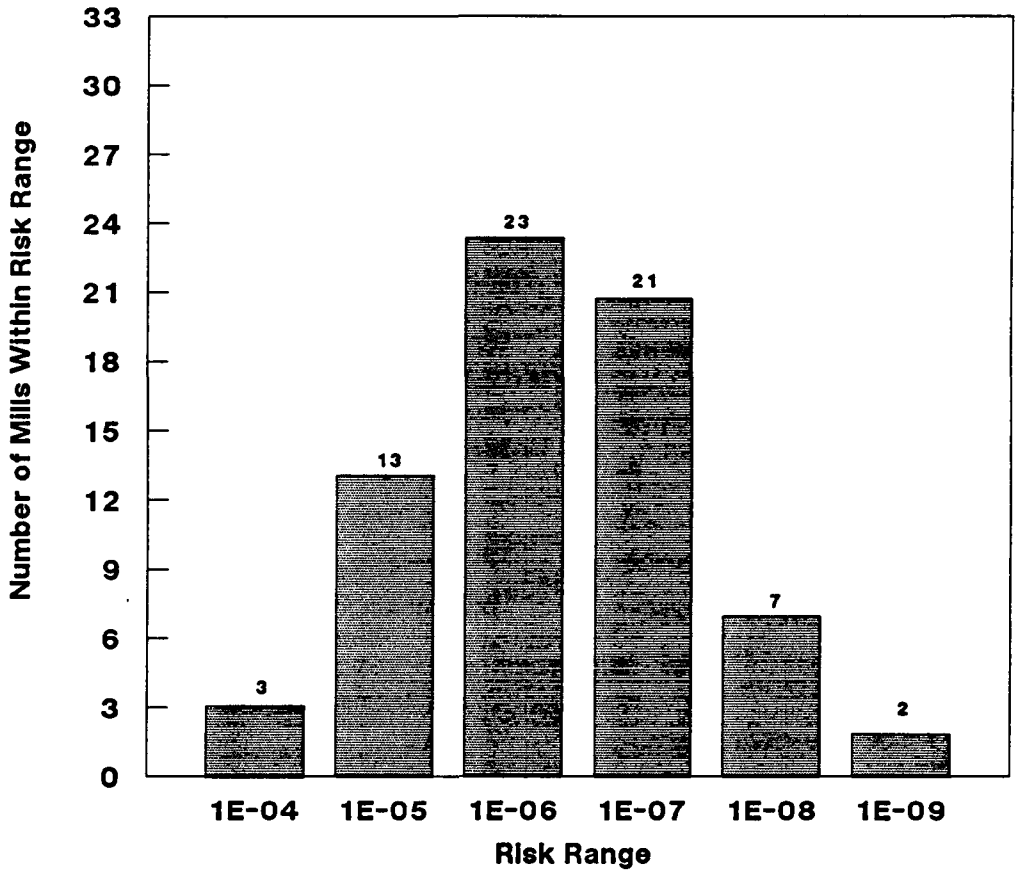

Figure E. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the ingestion of contaminated drinking water as estimated by the simple dilution method.

Notes:

Total number of mills evaluated = 69.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Based on a 2 L/day ingestion rate.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-5	1E-6	1E-7	1E-8	1E-9
TCDD	1	3	3	3	
TCDF		1		1	
TCDD & TCDF		1	2		1

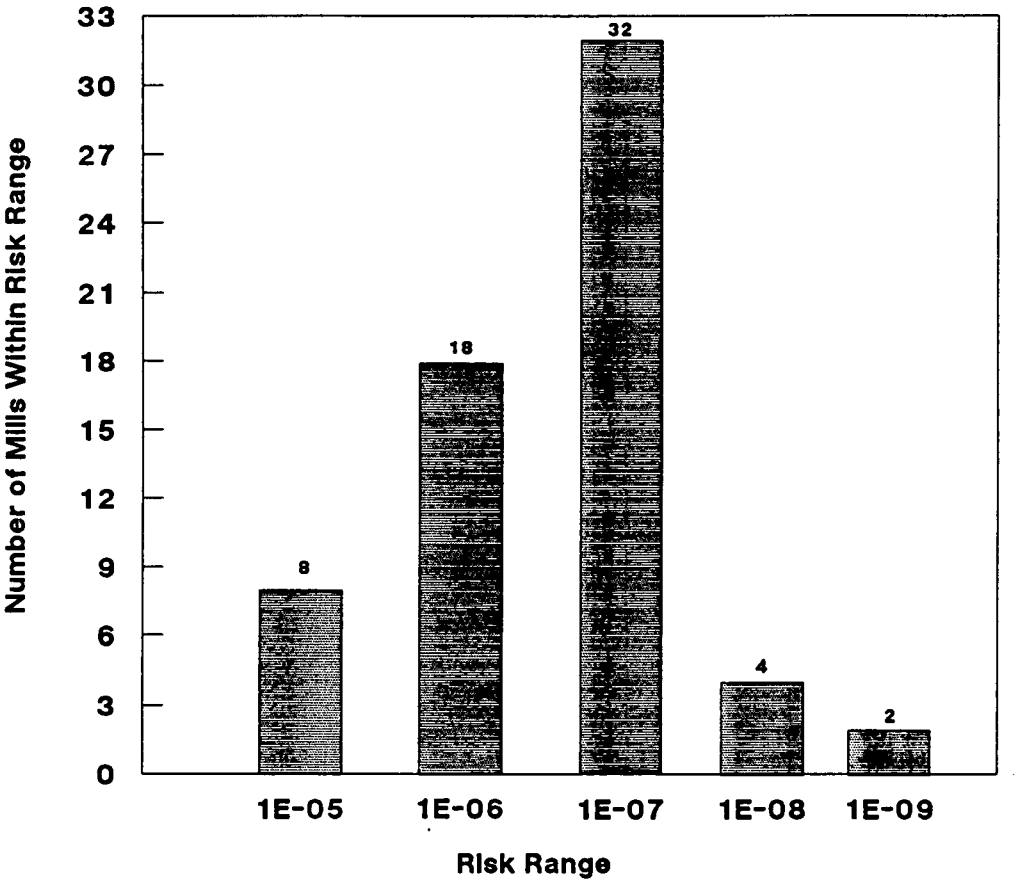

Figure F. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the ingestion of contaminated drinking water as estimated by the EXAMS II method.

Notes:

Total number of mills evaluated = 64.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Based on a 2 L/day ingestion rate.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-5	1E-6	1E-7	1E-8	1E-9
TCDD	1	2	4	2	1
TCDF			1	1	
TCDD & TCDF			3	1	1

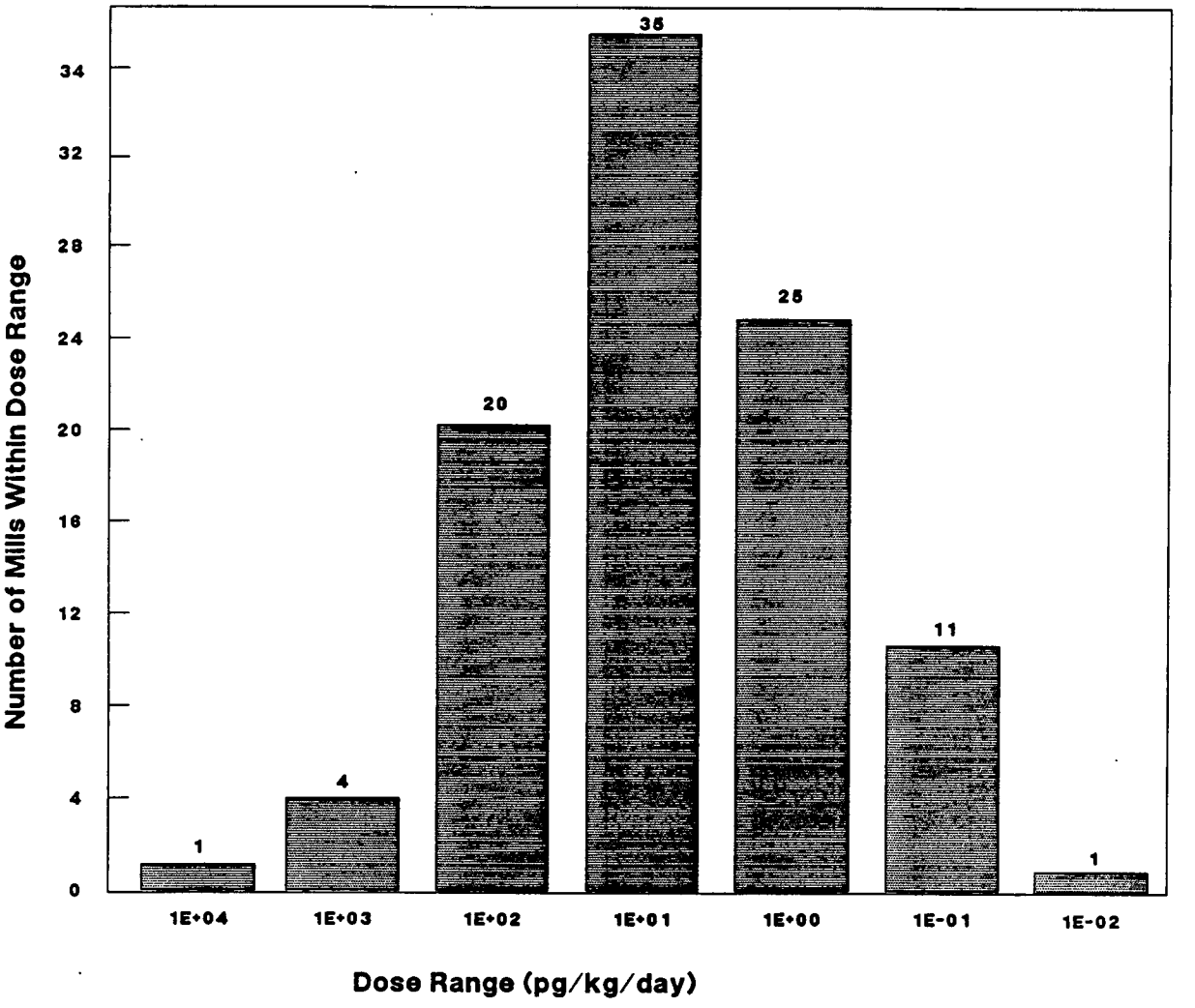

Figure G. Distribution of the number of mills for which discharges would result in a given range of human doses from a one-time exposure to contaminated fish tissue as estimated by the simple dilution method.

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF dose predicted using TEQ.

Based on the consumption of a single 115 g portion of contaminated fish tissue and using a fish filet BCF of 50,000 for 2378-TCDD.

Number of mills within dose ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore dose estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+1	1E+0	1E-1
TCDD	1	7	4	3
TCDF		1		1
TCDD & TCDF		2	3	1

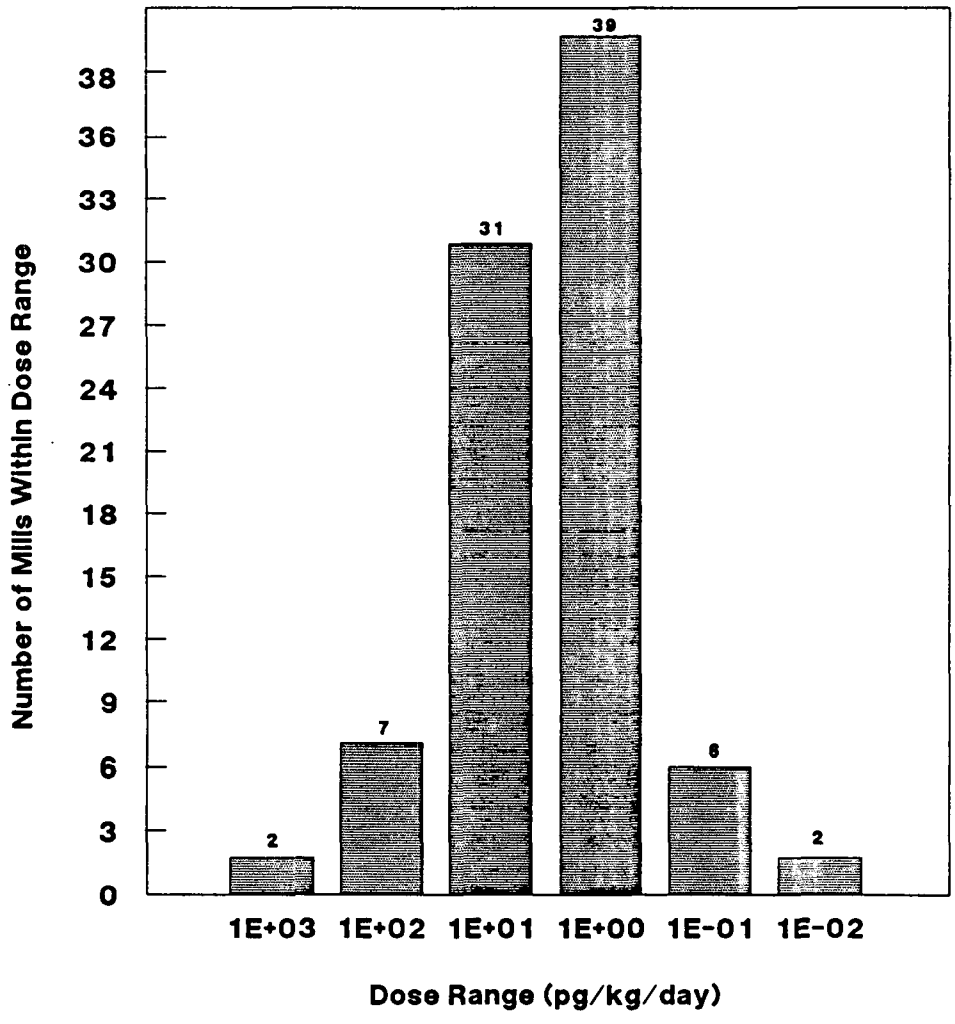

Figure H. Distribution of the number of mills for which discharges would result in a given range of human doses from a one-time exposure to contaminated fish tissue as estimated by EXAMS II method.

Notes:

Total number of mills evaluated = 87.

Combined 2378 -TCDD/-TCDF dose predicted using TEQ.

Based on the consumption of a single 115 g portion of contaminated fish tissue and using a fish filet BCF of 50,000 for 2378-TCDD

Number of mills within dose ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore dose estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+1	1E+0	1E-1	1E-2
TCDD	1	5	5	2	1
TCDF		1		1	
TCDD & TCDF		1	3	1	1

pg/kg/day). Use of the EXAMS II method (Figure H) estimates that the dose associated with discharges from 9 mills out of 87 (10%) would equal or exceed the 100 pg/kg/day dose level.

Aquatic Life Impacts

Aquatic life impacts were estimated based on a comparison of predicted in-stream concentrations of 2378-TCDD and 2378-TCDF (in pg/l) to EPA's preliminary chronic exposure levels for the protection of aquatic life (0.038 pg/l for 2378-TCDD and 0.41pg/l for 2378-TCDF). The simple dilution method, using 7Q10 low flow conditions, predicted that water column concentrations of 2378-TCDD immediately downstream of 80 out of 90 mills (89%) would exceed the chronic exposure level of 0.038 pg/l (Figure I). Seventy-four mills (82%) would exceed the 0.41 pg/l level for 2378-TCDF.

DISCUSSION OF RESULTS

The results of this study indicate that, taking into consideration the effects of the assumptions and simplifications used in this analysis, there is a potential for high level contamination of the water column by 2378-TCDD and 2378-TCDF from the effluent discharges of many of the chlorine-bleaching pulp and paper mills investigated. For each of the mills analyzed, use of the simple dilution exposure assessment method resulted in higher estimated water column contaminant concentrations and greater estimated aquatic life impacts and human health risks than the EXAMS II water column method. This is because the simple dilution method assumes that all contaminants in the water column, both dissolved and adsorbed to suspended solids, are bioavailable. The EXAMS II water column method, on the other hand, only considers those contaminants in the dissolved phase. In those cases where the receiving water TSS (total suspended solids) was relatively low, the simple dilution and EXAMS II water column results are comparable. When suspended solids concentrations were high, however, the EXAMS II water column method estimated risks significantly lower than those predicted by the simple dilution method. Therefore, for those water bodies included in this study with relatively high suspended solids content, the EXAMS II water column method likely underestimated human health risk from consumption of contaminated fish tissues, since fish exposure to sediment-adsorbed contaminants was not considered.

The primary reason for ignoring the exposure routes through contaminated sediments using EXAMS II was the lack of acceptable and appropriate fish bioaccumulation factors for this exposure scenario as well as the tendency for the contaminants to associate with the very fine sediment fraction which is typically transported and deposited well downstream of the immediate discharge vicinity. As a check and a sensitivity comparison on this approach, however, the results of the simple dilution calculation are considered to provide an upper bound on fish tissue contaminant levels.

In addition to the absence of consideration of sediment and food chain exposure routes in the EXAMS II method, a number of other simplifications and assumptions have influenced the results of this study, including the selection and use of BCFs and fish tissue ingestion rates for the evaluation. BCFs are highly variable depending on the species, and this study did not take into account inter-species variability in the rate and degree of contaminant bioconcentration. Actual fish tissue consumption rates also vary over time, with individuals, and in different parts of the country. For example, risk estimates based on the 6.5 g/day consumption rate and fish filet BCF of 5,000 for 2378-TCDD were established on the basis of EPA's water quality criteria assumptions. The 6.5 g/day rate applies to a national average consumption rate of fish and shellfish; however, this rate may not be representative of fish consumption rates for recreational or subsistence fishermen. Also, the 50,000 BCF for 2378-TCDD used in conjunction with fish consumption rates of 30 and 140 g/day for recreational and subsistence fishermen was based on the assumption that only the filet portion of the fish is consumed. However, some subpopulations of subsistence fishermen and certain ethnic groups eat whole fish and crabs in which the concentration of contaminants is likely to be higher than in the filet alone. Therefore, the use of a 50,000 BCF for 2378-TCDD may underestimate risks to these subpopulations.

It should also be noted that, if multiple discharges to the same waterbody are present, the actual risk associated with a waterbody may be substantially greater than estimated in this study. For example, there are several chlorine-bleaching pulp and paper mills that discharge to the Columbia River basin. Calculations

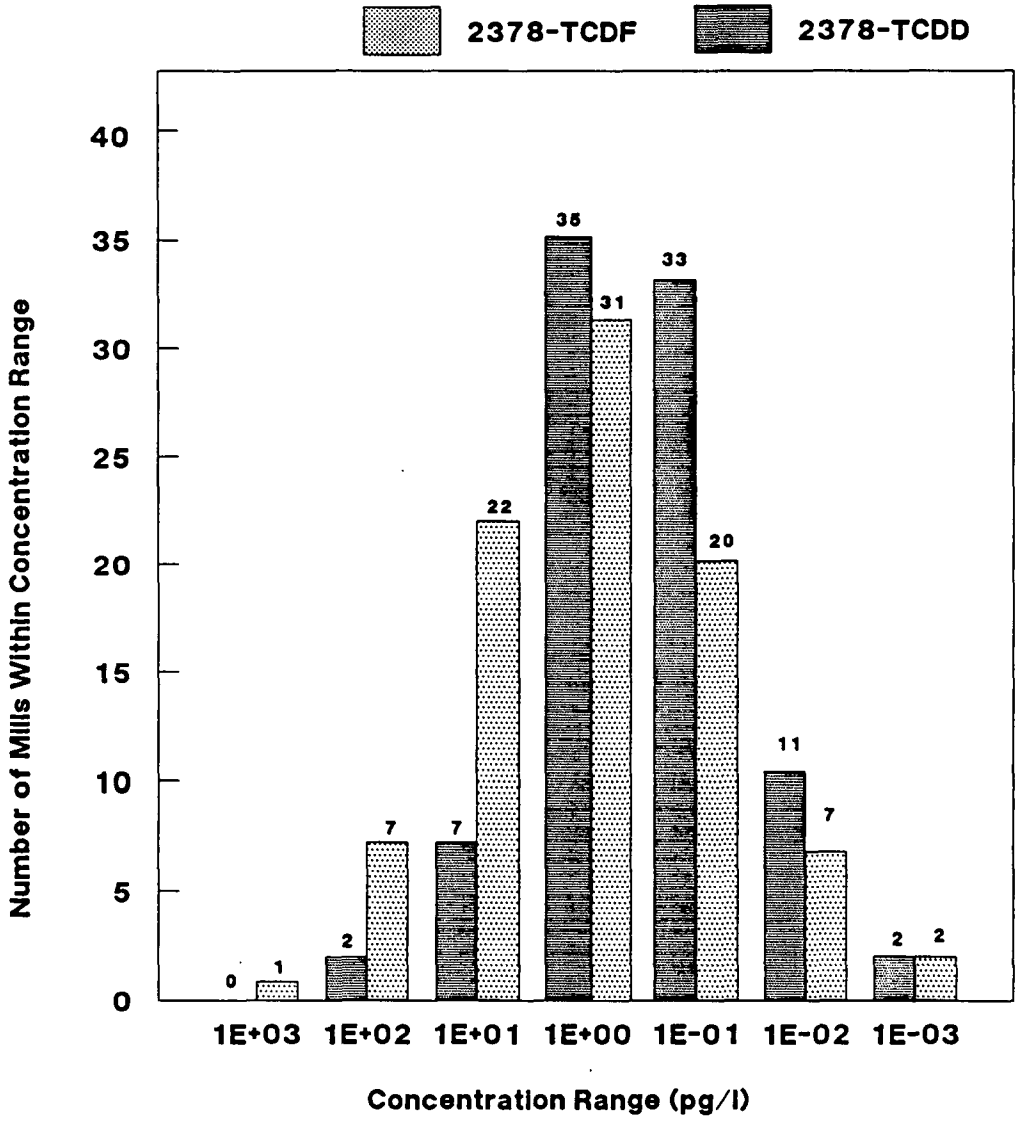

Figure I. Distribution of the number of mills for which discharges would result in a given range of water column contaminant concentrations as estimated by the simple dilution method using 7Q10 low flow conditions.

Notes:
Total number of mills evaluated = 90.
Estimates based on 7Q10 flow values for receiving waters.

Number of mills within concentration ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore water column concentration estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+0	1E-1	1E-2	1E-3
TCDD		5	9	5	1
TCDF	1	2	2	2	1

in this report assume that each mill discharges to a receiving stream with no background level of contamination. Therefore, in the case of multiple discharges to a receiving stream, estimating risks from one mill alone can result in a significant underestimate of risk.

Finally, no assessment of local fish patterns or actual commercial or recreational fishing practices were conducted as part of this evaluation. Therefore, it is not known whether or not commercially or recreationally valuable species occur or are taken in the vicinity of the discharges that were included in this evaluation.

A comparison of predicted cancer versus non-cancer human health risk was also conducted to determine which of the two end points is the most sensitive. Cancer health risks were estimated to occur for more mills than non-cancer risks. The results also indicate a potentially greater risk of cancer due to the consumption of contaminated fish tissue than through the ingestion of contaminated drinking water. It should be pointed out that this conclusion may only be true for the hypothetically exposed individual and may not be true for the entire exposed population. Determining which exposure route poses the greatest risk to the entire population would require knowledge of the number of persons eating contaminated fish tissue versus the number of persons who use contaminated surface water as a drinking water source. More of the population would likely be exposed to a single dose of contaminated fish tissue than to a lifetime of exposure to contaminated fish tissue or drinking water taken from the vicinity of certain mills. Such a population assessment was not conducted for this investigation.

Each of the exposure assessment approaches used in this analysis predict upper bound risks that should be carefully considered by risk managers while assessing potential impacts associated with the discharge of 2378-TCDD and 2378-TCDF in chlorine-bleaching pulp and paper mill effluents.

1. INTRODUCTION

1.1 BACKGROUND

The U.S. Environmental Protection Agency (EPA), acting under a consent decree with the Environmental Defense Fund and the National Wildlife Federation, assessed both human health and environmental risks from the contaminants 2,3,7,8-tetrachloro dibenzo-*p*-dioxin (2378-TCDD) and 2,3,7,8-tetrachloro dibenzofuran (2389-TCDF) that are discharged from 104 pulp and paper mills located in the United States using chlorine or its derivatives to bleach pulp. The Office of Toxic Substances (OTS) coordinated this multi-media risk assessment. As a part of this program, the Office of Water Regulations and Standards (OWRS), Assessment and Watershed Protection Division (AWPD) was responsible for estimating the potential human health and aquatic life risks associated with exposures via surface water pathways based on mill-specific effluent sample results.

This report presents a generalized uniform approach for assessing impacts from the discharges of the 104 mills to support the decision by EPA to either regulate or not regulate discharges of 2378-TCDD and 2378-TCDF from pulp and paper mills that use chlorine to bleach pulp. It should be noted that in some cases, the approach for assessing risks presented in this report differs from approaches used by States. For example, States may use different cancer potency factors (either FDA's or their own), fish consumption rates, or bioconcentration factors. In some cases, States do not use models to predict risks, but rather use actual fish tissue data. In other cases, States do not use the "toxicity equivalence" procedure as a means of predicting the combined risk from 2378-TCDD and 2378-TCDF as was used in this report. As a result of the differences in approaches taken by various States for assessing risks and the approach presented in this report, estimated risks may be over- or underestimated in comparison to the States' adopted or proposed water quality standards. A summary of State assumptions used to develop 2378-TCDD water quality standards is presented in Appendix R.

Effluent sampling results for each of the 104 pulp and paper mills were provided by the joint EPA/paper industry 104-mill study. The 104-mill data, however, are now over two years old, and since the time the 104-mill study was conducted, conditions at some mills may have changed due to mills taking actions to install or incorporate activities identified as necessary to reduce the formation of dioxins or furans, or more recent information may be available that would alter some of the exposure and risk estimates developed in the present study. However, because this study was designed to provide a snapshot of exposure and risk estimates at one point in time, for the most part, no attempt was made to include effluent data from sources other than the 104-mill study. The only exception to the use of 104-mill study effluent data was the use of plant flow data for several mills that were provided by the EPA Regions and which differed from the flow values identified in the 104-mill study.

The focus of this report was to estimate the potential human health and aquatic life impacts resulting from chlorine-bleaching pulp and paper mill effluent discharges to surface waters. This study was not designed to rank the exposure or human health and aquatic life risks associated with specific mills, but rather to estimate the risk potential posed by the entire chlorine-bleaching pulp and paper industry. Because no comprehensive studies on 2378-TCDD and 2378-TCDF build-up in sediments and bioaccumulation up the food chain exist, only the water column was investigated as a potential route of exposure and uptake of 2378-TCDD and 2378-TCDF by exposed fish. However, a sensitivity analysis is presented to look at bioconcentration in fish both before and after particulate 2378-TCDD and 2378-TCDF settle to the sediment. Carcinogenic and non-carcinogenic effects in humans are considered, as are adverse effects to aquatic life. The chapters that follow present the methods selected to conduct the investigation, the results of the investigation, and an analysis of the results.

1.2 PURPOSE AND SCOPE

The purpose of this analysis was to develop estimates of exposures and risks to human health and aquatic life from 2378-TCDD and 2378-TCDF discharges from chlorine-bleaching pulp and paper mills. This analysis focused on the highest estimated in-stream contaminant concentrations immediately down-stream of each mill discharge point, assuming steady-state, fully mixed conditions.

In this investigation, two approaches were used to estimate and compare exposures to 2378-TCDD and 2378-TCDF resulting from surface water effluent discharges from pulp and paper mills. In the first approach, a simple dilution calculation was conducted to estimate the in-stream contaminant concentrations after the effluent is mixed in the receiving water. This calculation assumes 100% of the in-stream contaminants (both dissolved and adsorbed to suspended solids) are bioavailable to fish. In the second approach, the Exposure Assessment Modeling System (EXAMS II) (Burns et al., 1982; Burns and Cline, 1985; Harrigan and Battin, 1989) was used to partition in-stream steady-state water column contaminant concentrations between dissolved and particulate forms. However, only the dissolved contaminant concentration predicted by EXAMS II was considered in determining exposure and risk. Both the simple dilution and EXAMS II in-stream exposure methods were used to estimate the potential human health risks associated with ingestion of contaminated fish and drinking water.

No attempt was made in the EXAMS II approach to estimate fish exposure to contaminants associated with suspended particulates, bed sediments, or the food chain. This was due to lack of sufficient and appropriate data and understanding of the bioaccumulation of these contaminants through the food chain and appropriate sediment-to-fish partition coefficients to predict uptake through exposure to contaminated sediments. In addition, it is generally believed that 2378-TCDD and 2378-TCDF tend to adsorb to very fine sediments that settle out of the water column slowly. Therefore, it was assumed that much of the sediment associated contaminants would be transported out of the immediate area of the discharge and would be deposited further downstream. Although there is no doubt that food and sediment provide exposure routes to fish downstream where the amount of 2378-TCDD and 2378-TCDF available (i.e,, dissolved) for uptake across gills becomes much less, the assumption that fish remain in the area immediately downstream from the point of discharge is probably sufficiently conservative to compensate for any lack of food chain or sediment associated exposure components. In addition, under the simple dilution method, all of the in-stream contaminants are assumed to be available for uptake by fish and therefore both the dissolved and adsorbed fractions are considered in this method, providing an upper-bound estimate of fish tissue contamination. The EXAMS II method, on the other hand, provides a more reasonable estimate of the direct exposure of fish to the contaminants from water only.

One result of this analysis is an upper bound estimate of the potential risk of cancer over the lifetime of a hypothetically exposed individual. No attempt has been made to characterize the human population potentially at risk. For these risk estimations, reasonable worst-case ambient and effluent characterizations were used, along with best estimates of physical and chemical properties of 2378-TCDD and 2378-TCDF. Because not all of the parameter values used in this assessment are "worst-case," the hypothetically exposed individual is not considered the "most exposed individual."

The probability of an individual developing cancer in a lifetime due to the ingestion of contaminated fish or drinking water was calculated based on exposure estimates and the EPA carcinogenic potency factor. Also, the data for exposure to 2378-TCDD and 2378-TCDF from bleached paper mills were screened for exposure scenarios exceeding an average of 100 pg/kg/day, the one-day Health Advisory for TCDD for protection against human liver effects. Exposure scenarios exceeding this level were examined in more detail to determine whether the cancer or non-cancer endpoint is the most sensitive indicator of risk. Exposure data were also screened for comparison against EPA's preliminary chronic exposure levels for protection against adverse impacts on aquatic life.

This report presents the approach used to conduct the exposure and risk assessments (Chapter 2), the results of the investigation (Chapter 3), and a discussion of the results (Chapter 4). Investigation results are presented in two parts. The first part addresses potential exposure concentrations of 2378-TCDD and

2378-TCDF found in the water and in the fish tissue ingested by humans. The second part presents the potential human dose of these contaminants resulting from ingestion of contaminated fish tissue and drinking water, and the potential human health risks associated with each of the routes of exposure.

2. EXPOSURE AND RISK ASSESSMENT APPROACH

This chapter presents a description of the approach used to assess contaminant exposure levels and the resulting potential human health risks and aquatic life impacts associated with discharges of 2378-TCDD and 2378-TCDF from the 104 chlorine-bleaching pulp and paper mills under investigation. A flow chart depicting this approach is presented in Figure 2.1. This chapter also describes the critical factors that were considered during the development of the study approach. A more detailed description of these factors is presented in Appendix A.

2.1 REQUIREMENTS OF TECHNICAL APPROACH

The approach taken was designed to incorporate an appropriate balance between the difficulty (detail) of the analysis and the accuracy of the results. The critical factors considered in the development of the analytical approach were: 1) in-stream chemical transformation processes, 2) applicability of calculation methods, 3) availability of environmental data, and 4) model sensitivity. Each of these factors is briefly discussed below.

The chemical/physical processes thought to most significantly influence the fate of 2378-TCDD and 2378-TCDF in the aquatic environment are dilution and adsorption of the contaminants to particulates. Other processes, such as volatization, hydrolysis, photolysis, and biotransformation do not appear to significantly affect the fate of the contaminants. Because of the tendency of the contaminants to adsorb to particulates, it was necessary to calculate the partitioning of 2378-TCDD and 2378-TCDF between the dissolved and solid phases in the receiving waters. This required consideration of suspended solids concentrations in receiving streams.

A simple dilution calculation method for estimating water column concentrations of 2378-TCDD and 2378-TCDF provides total in-stream contaminant concentrations without consideration of the effects of adsorption to particulates and eventual sedimentation or other fate processes. This method of predicting exposure results in worst-case water column exposure estimates. Because 2378-TCDD and 2378-TCDF appear to have a high affinity for adsorption to particulates, other methods of estimating contaminant fate and transport are necessary to consider partitioning between the dissolved and solid forms of the contaminants. The Exposure Assessment Modeling System (EXAMS II), a state-of-the-art surface water contaminant modeling system, is capable of estimating the partitioning of a contaminant between its dissolved form in the water column and that portion that associates with suspended and benthic solids.

Many parameters describing the physical/chemical properties of 2378-TCDD and 2378-TCDF and mill-specific effluent and receiving water characteristics are required to operate EXAMS II. Therefore, an effort was undertaken to assess the availability and quality of data accessible through existing data sources. Both EPA's Canonical Environmental Data Base (CEDB) and STORET were considered as potential data sources. CEDB data are only available for a small fraction of the receiving waters for the mills under investigation, and a majority of the parameters necessary to operate EXAMS II were not available for any of the mills' receiving waters. However, STORET (a water quality data base maintained by EPA's Office of Water that can access water quality sampling data from monitoring stations around the country) provides access to data on flow, total suspended solids (TSS), pH, and other parameters required to operate EXAMS II for most of the mills' receiving waters. It was concluded that STORET could provide data of sufficient quality and for enough of the mill receiving waters to conduct the EXAMS II assessment.

A model sensitivity analysis was conducted to determine which environmental data parameter variations had the greatest influence on EXAMS II contaminant concentration estimation results under steady-state conditions and given known 2378-TCDD and 2378-TCDF physical/chemical properties. During the sensitivity analysis, environmental data parameters (e.g., temperature, stream compartment geometry, TSS) were varied

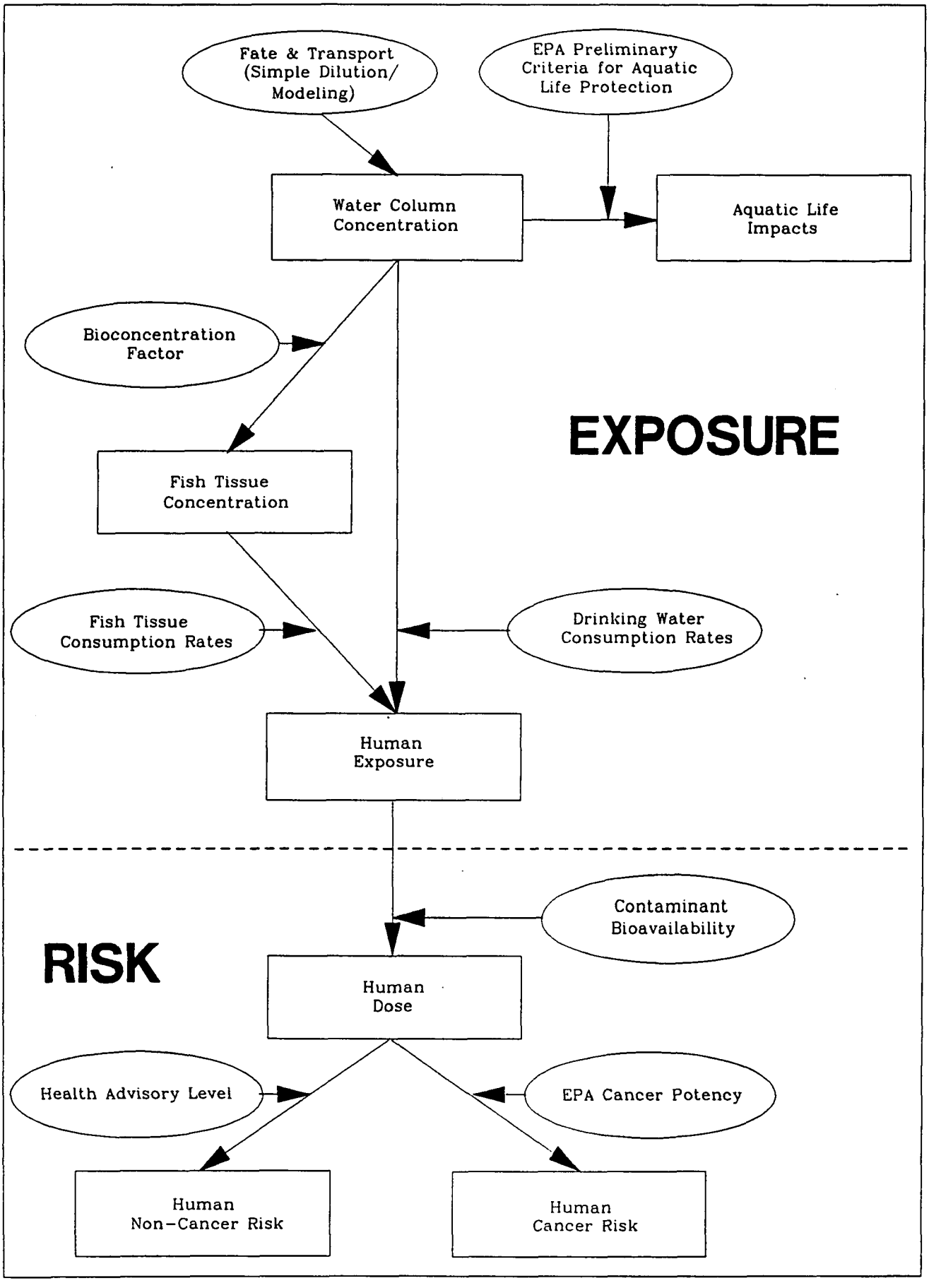

Figure 2.1. Exposure and Risk Assessment Approach

individually over wide ranges. Resulting in-stream dissolved concentration variations were noted, if any. Variations in receiving water total suspended solids levels produced the greatest variations in resulting in-stream dissolved contaminant concentrations. Therefore, mill-specific values for receiving water suspended solids were obtained and used in the EXAMS II analyses. For discharges to open waters (i.e., oceans, lakes, reservoirs), suspended solids values were not available and, therefore, a default value of 10 mg/l was used for the EXAMS II analyses. All other environmental parameters, except for mill-specific contaminant loadings and receiving water flow rates, were assigned default values. For those effluent samples from the 104-mill study for which 2378-TCDD and 2378-TCDF concentrations were below the detection limit of the analytical method, the value used in this assessment was 1/2 the detection limit. The evaluations of some of the mills conducted in this study were based on 1/2 the detection limit for both 2378-TCDD and 2378-TCDF, 1/2 the detection limit for 2378-TCDD in combination with detected concentrations of 2378-TCDF, or 1/2 the detection limit for 2378-TCDF in combination with detected concentrations of 2378-TCDD.

Methods used for obtaining all data points used in this analysis are described in detail in Appendix B. The three tables presented in Appendix C display: 1) receiving water flow rates, effluent contaminant concentrations and loadings, and TSS values for each mill, 2) default values used in EXAMS II, and 3) the physical/chemical properties data for 2378-TCDD and 2378-TCDF which were used in EXAMS II modeling runs.

2.2 EXPOSURE ASSESSMENT

2.2.1 In-Stream Contaminant Concentrations

In this investigation, two approaches were used to estimate and compare exposures to 2378-TCDD and 2378-TCDF resulting from surface water effluent discharges from pulp and paper mills. The first approach consisted of a simple dilution calculation conducted to estimate the total, steady-state in-stream concentration of the contaminants after the effluent is mixed in the receiving water. This calculation assumes 100% of the in-stream contaminants (both dissolved and adsorbed to suspended solids) are bioavailable to fish. In the second approach, the Exposure Assessment Modeling System (EXAMS II) was used to partition in-stream steady-state concentrations of the contaminants between dissolved and particulate forms.

EXAMS II is able to account for the high affinity of 2378-TCDD and 2378-TCDF for solids and, therefore, the likelihood that a percentage of the contaminants will be associated with suspended and benthic solids. Both the simple dilution and EXAMS II approaches were used to estimate and compare the potential human health risks associated with ingestion of contaminated fish tissue and drinking water. As mentioned previously, for the EXAMS II predictions of in-stream contaminant concentrations, only the dissolved concentration was assumed to be bioavailable to fish.

The following simple dilution equation was used to provide an estimate of the concentration of a contaminant downstream from a point source release into a flowing water body after dilution of the substance by the receiving water (U.S. EPA, 1988b):

$$C = \frac{C_e Q_e}{Q_t}$$

where,

C	=	concentration of substance in stream (mass/volume),
C_e	=	concentration of substance in effluent (mass/volume),
Q_e	=	effluent flow rate (volume/time), and
Q_t	=	combined effluent and stream flow rate (volume/time).*

* assumes wastewater was not originally drawn from the receiving stream

Although this calculation is easily executed and provides a quantitative estimate of in-stream contaminant concentration which is limited in precision only by the precision of the input parameters, this calculation provides only the total in-stream contaminant concentration attributable to the point source. It does not

provide a distribution of the contaminant between the dissolved and adsorbed states or the downstream pollutant concentration gradient.

EXAMS II, on the other hand, is a sophisticated computer modeling system capable of computing the following parameters:

1) "Exposure: the expected... environmental concentrations due to a user-specified pattern of chemical loads,

2) Fate: the distribution of the chemical in the system and the relative dominance of each transport and transformation process, and

3) Persistence: the time required for effective purification of the system... once the chemical loadings terminate." (Burns and Cline, 1985)

Once input parameters describing the environment (temperature, stream compartment geometry, receiving water flow, solids, organic carbon fraction, etc.), the chemical contaminant characteristics (molecular weight, vapor pressure, Henry's Law constant, K_{ow}, K_{oc}, solubility, etc), and the loadings are entered, the model produces a report detailing the three sets of computations described above.

For each mill, the calculated water column concentrations were used as the basis for further calculations. The estimated concentrations were considered 100% available to the aquatic organisms living in the receiving waters, 100% available to humans using the water as a drinking water source, and 95% available to humans through fish tissue consumption.

The mills being investigated in this study can be grouped into one of three categories: direct dischargers to free flowing streams, direct dischargers to open waters (e.g, oceans, lakes, reservoirs), and indirect dischargers (dischargers to POTWs) to either free flowing streams or open waters. Contaminant concentrations resulting from direct discharges to free flowing streams were calculated directly using the simple dilution and EXAMS II water column methods when adequate environmental data were available for the site.

Contaminant concentrations resulting from direct discharges to open water bodies were calculated using the simple dilution method, based on zone of initial dilution factors for the mills that were provided by EPA Regions (Table 2.1) (Albright, 1990; Davis, 1989; Derose, 1989; Fisher, 1989; Greenburg, 1989; Greenfield, 1990; Hall, 1989; Hangarden, 1989; Henry, 1989; Hyatt, 1989; Keefler, 1989; Loster, 1989; Menzardo, 1989; Tingperg, 1989; and Weeks, 1989). The zone of initial dilution is the region of initial mixing surrounding or adjacent to the end of the outfall pipe in which aquatic inhabitants may be chronically exposed to concentrations of pollutants in excess of water quality standards. Initial dilution is defined by EPA (1982) as the flux-averaged dilution (averaged over the cross section area of the plume) achieved during the period when dilution is primarily a result of plume entrainment, and is not dominated by ambient conditions. Because EXAMS II requires stream flow data as input to calculate in-stream contaminant concentrations, and because flows for open water bodies are not available, it was necessary to back-calculate "surrogate" water body flows for direct dischargers to open water bodies based on known mill plant flows, and the dilution factors for the mills. The following calculation was used to determine surrogate water body flows for direct open water discharges:

$$F_o = (D * F_p) - F_p$$

where,

F_o = surrogate open water body flow
F_p = mill plant flow
D = dilution factor

The resulting estimated flow values were then used as input for the EXAMS II assessments. This procedure allowed for the use of EXAMS II to estimate partitioning of the contaminant between dissolved and solid forms in open water discharge cases. In addition, for several mills located on free-flowing streams for which flow

Table 2.1.
Dilution Factors and Surrogate Flows in the Zones of Initial Dilution
for Discharges to Open Waters and for Discharges to Some Free-Flowing Streams for Which Flow Data Were Not Available

NPDES NUMBER	COMPANY	CITY	RECEIVING WATER NAME	ZID DILUTION FACTOR	SURROGATE FLOW IN m3/Hr.
Region II					
NY0004413	International Paper Co.	Ticonderoga	Lake Champlain	18.00	39755
Region III					
PA0026301	International Paper	Erie	Lake Erie	ND*	--
Region IV					
AL0000396	Champion International	Courtland	Wheeler Reservoir	465.00	4325625
FL0000701	ITT-Rayonier, Inc.	Fernandina Beach	Amelia River	50.00	136266
FL0002631	Stone Container Corp.	Panama City	St. Andrew Bay	50.00	166461
FL0002763	Georgia-Pacific Corp.	Palatka	Rice Creek	1.70	4092
GA0001953	Gilman Paper Co.	St. Marys	North River	17.00	101125
GA0003654	Brunswick Pulp and Paper	Brunswick	Turtle River	22.00	172545
MS0002674	International Paper Co.	Moss Point	Escatawpa River	10.00	24460
NC0000680	Weyerhaeuser Co.	Plymouth	Welch Creek	10.00	55461
SC0000868	International Paper Co.	Georgetown	Sampit River	2.00	4424
Region VI					
TX0053023	Champion International	Houston	Houston Shipping Channel	3.33	5729
Region IX					
AZ-------	Stone Container Corp.	Snowflake	A playa lake	ND*	--
CA0005282	Simpson Paper Co.	Fairhaven	Pacific Ocean	46.00	149317
CA0005894	Louisiana Pacific Corp.	Samoa	Pacific Ocean	69.00	172342
Region X					
AK0000531	Alaska Pulp Corp.	Sitka	Silver Bay	7.00	22753
AK0000922	Ketchikan Pulp & Paper 1	Ketchikan	Ward Cove	31.00	149317
AK0000922	Ketchikan Pulp & Paper 2	Ketchikan	Ward Cove	11.00	49772
WA0000621	Scott Paper Co. 1	Everett	Port Gardner Bay	ND*	--
WA0000795	ITT-Rayonier, Inc.	Port Angeles	Port Angeles Harbor/Strait of Juan de Fuca	100.00	563140
WA0000809	Weyerhaeuser Co.	Cosmopolis	Chehalis River	5.00	13905
WA0000850	Simpson Paper Co.	Tacoma	Commencement Bay	90.00	405006
WA0001091	Georgia-Pacific Corp.	Bellingham	Whatcom Waterway	100.00	578783
WA0003000	Weyerhaeuser Co.	Everett	Snohomish River	20.00	66047
WA0003077	ITT-Rayonier, Inc.	Hoquiam	Chehalis River	20.00	60043

* ND = data not available

data were not available, dilution ratios provided by the EPA Regions were used to estimate stream flow using the same procedure as was used for open water discharges (see Table 2.1).

Contaminant concentrations resulting from indirect discharges to either free flowing streams or open water bodies were calculated using the same methods described above, except that loadings were decreased to 2 and 25% of the total to account for the effects of treatment on the discharge effluent stream.

In-stream contaminant concentrations were calculated using the harmonic mean flow for the receiving water for use in the human health risk analysis. These concentrations were used to calculate human exposures to the contaminants through fish tissue and drinking water ingestion. The harmonic mean flow is defined as the reciprocal of the mean value of the reciprocal of individual values.

2.2.2 Whole-Body And Fish Filet Contaminant Concentrations

Tissue residue levels for fish exposed to the in-stream contaminant concentrations estimated above were calculated by multiplying the contaminant concentration by estimated bioconcentration factors (BCFs) for 2378-TCDD and 2378-TCDF. Estimated fish tissue residue levels resulting from exposure to these contaminants in the water column were based on BCFs of 5,000 (2378-TCDD, filet only), 100,000 (2378-TCDD, whole body), and 3,900 (2378-TCDF, whole body).

For example, assuming a 2378-TCDD water column concentration of 2.2×10^{-8}ng/l, and a BCF of 5,000, the contaminant concentration in the fish filet would be calculated as follows:

$$\text{(water column concentration) (BCF)} = \text{filet concentration}$$
$$(2.2 \times 10^{-8}\text{ng/l})(5{,}000) = 1.1 \times 10^{-4}\text{ng/kg}$$

The BCF for 2378-TCDD of 5,000 was used to estimate uptake by fish through exposure to the dissolved contaminant in the water column. This value is the average bioconcentration potential that was exhibited by the aquatic organisms used to develop human health criteria for 2378-TCDD for exposure through the consumption of contaminated fish tissue (USEPA, 1984). This value is based on fish filet residue levels, not whole body levels. This BCF, in combination with a comparatively moderate fish tissue consumption rate (6.5 g/day), was the basis for estimating human health impacts from the consumption of contaminated fish tissue based on EPA's ambient water quality criteria assumptions for 2378-TCDD.

A second BCF of 100,000 used to estimate 2378-TCDD taken up by fish through the water column was developed primarily from the results of the EPA Duluth Laboratory's most recent studies on the bioconcentration of 2378-TCDD by fish (Cook, 1990). During these investigations, BCFs for carp and fathead minnows were determined through laboratory studies with exposures of up to 71 days in duration. The whole body BCF values presented in the Cook et al. study ranged from 65,900 $\pm$ 9,300 (for carp with 9% lipid content) to 159,000 $\pm$ 40,000 (for fathead minnows with 19% lipid content). The Cook study is preliminary and has not been peer reviewed. Based on this information, the present assessment selected a reasonably conservative BCF value of 100,000 to represent a more extreme bioaccumulation potential that, in combination with higher fish tissue consumption rates, result in higher estimated human health risks. These higher estimated risks are used for sensitivity comparisons to results using the lower BCF and consumption rates.

Results of a recent literature review by Nabholz et al. (Unpublished) were used as the basis for selecting BCF values to determine whole body contaminant concentrations in fish exposed to 2378-TCDF in the water column. Only three measured fish BCF values for 2378-TCDF were identified, two from water exposures and one from a dietary source. The geometric mean of the measured BCF values for water exposure (3,900) was used in the present study.

Once taken up by fish, contaminants are generally distributed unequally among the tissues in the fish. For example, for many contaminants, high concentrations accumulate in the fish liver, generally an inedible portion of the fish. Also, whole body residue levels include the viscera, which contain significant quantities of sediments ingested during feeding. Because of the affinity of 2378-TCDD and 2378-TCDF for sediment, high concentrations of contaminants would be found in this inedible portion. Therefore, using the estimated

whole-body concentration of a contaminant would not accurately reflect the human exposure to the contaminant resulting from the consumption of the edible portion of the fish (the filet). In general, the concentration of 2378-TCDD in fish muscle is about 50% of whole fish concentration (Branson et al, 1985). To compensate for the unequal partitioning of contaminants between the edible and inedible fish tissues, the estimated whole-body BCFs of 100,000 (for 2378-TCDD) and 3,900 (for 2378-TCDF) were multiplied by 0.5 to arrive at estimated BCFs for the edible portion of the fish of 50,000 (for 2378-TCDD) and 1,950 (for 2378-TCDF). The 5,000 BCF for 2378-TCDD is based on fish filet residue levels, and, therefore, no adjustments in the fish tissue 2378-TCDD concentration estimates was necessary. It should be pointed out that for some species of shellfish (e.g., mollusks) the whole body (minus the shell) is consumed by humans, and, therefore, the whole-body contaminant concentration would more accurately reflect human exposure.

Recent laboratory studies support the use of 50,000 as a reasonable BCF to estimate 2378-TCDD concentration in edible fish tissue (Cook, 1990: Merhle et. al., 1988). These studies indicate that this value represents a mid-range prediction of freshwater exposure situations for fish averaging 7% lipid content, a reasonable average lipid content for the edible portion of freshwater fish potentially consumed by humans (Cook, 1990). This value is applicable to the total 2378-TCDD amount present in the water (not only that fraction dissolved in the water).

2.2.3 Drinking Water Concentration

Drinking water contaminant concentrations were assumed to be the same as the in-stream receiving water concentrations which were calculated using the simple dilution and EXAMS II water column (i.e., dissolved) approaches. It was assumed that the water that is ingested is taken from the point of highest in-stream contaminant concentration after the effluent is fully mixed in the receiving stream. It was also assumed that the water is untreated, that is, it is ingested as raw stream water with no removal of contaminants.

2.2.4 Human Exposures From Ingestion Of Contaminated Fish Tissue And Drinking Water

Human exposure to 2378-TCDD and 2378-TCDF from the consumption of contaminated fish tissue was estimated based on fish tissue consumption rates of 6.5, 30, and 140 g/day. The 6.5 g/day consumption rate is equivalent to less than two 1/4 lb meals per month and is cited by EPA (1980) as an average level of fish and shellfish consumption in the United States, based on both fish eating and non-fish eating populations (per capita rate). The 6.5 g/day consumption rate was used in combination with the fish filet 2378-TCDD concentration estimates based on a BCF of 5,000 for fish exposed to the contaminant in the water column to arrive at an average daily lifetime human exposure to 2378-TCDD based on EPA's ambient water quality criteria assumptions.

The 30 g/day consumption rate is equivalent to approximately eight 1/4 lb meals per month and is considered applicable for typical recreational fisherman. The 140 g/day consumption rate is equivalent to approximately thirty-eight 1/4 lb meals per month and is considered a high consumption rate applicable for subsistence fishermen and other subpopulations known to have high fish ingestion rates, such as many Orientals and Native American Indians. The 30 and 140 g/day consumption rates are values that can be used to represent consumption rates for recreational fishermen in any area where there is a large water body present and widespread contamination is evident (EPA, 1989a). These consumption rates were used in combination with the fish filet 2378-TCDD concentration estimates based on a BCF of 50,000 for fish exposed to the contaminant in the water column. Exposure estimates based on the higher BCF and consumption rates represent more extreme exposure scenarios.

Estimates of human exposure to 2378-TCDF through the consumption of contaminated fish tissue were based on the three consumption rates (6.5, 30, and 140 g/day) in combination with fish filet 2378-TCDF concentration estimates based on a single BCF (1,950) for fish exposed to the contaminant in the water column.

The average daily lifetime exposure (mg of contaminant/kg of body weight/day over a 70-year lifetime) was calculated by multiplying the chemical concentration in the edible fish tissue by the ingestion rate and dividing by an average adult body weight of 70 kg. For example, if the estimated level of 2378-TCDD in fish

filets is 1.4×10^{-7} mg/kg and the daily fish consumption rate is 6.5 g, the contaminant exposure to a 70 kg adult is:

$$\frac{(1.4 \times 10^{-7} mg/kg)\ (6.5 \times 10^{-3} kg/day)}{70\ kg\ body\ weight} = 1.3 \times 10^{-11} mg/kg/day$$

The average daily lifetime human exposure to 2378-TCDD and 2378-TCDF from the ingestion of contaminated drinking water was based on a 2 liter/day average lifetime ingestion rate (NAS, 1977). The average daily lifetime exposure for a 70 kg adult was determined by multiplying in-stream chemical concentrations by a 2 liter/day average lifetime ingestion rate and then dividing by 70 kg.

2.2.5 Aquatic Life Impacts

Sufficient data are not currently available concerning the chronic effects of 2378-TCDD and 2378-TCDF on aquatic life to allow EPA to derive national water quality or sediment criteria for these contaminants (EPA, 1984). However, several exposures that have been conducted for other purposes do provide some information concerning the chronic effects of 2378-TCDD and 2378-TCDF on aquatic life. EPA has developed preliminary chronic exposure levels for 2378-TCDD and 2378-TCDF based on these existing exposure studies (EPA, 1989b).

Potential aquatic life impacts were determined by comparing estimated in-stream concentrations of 2378-TCDD and 2378-TCDF to EPA's preliminary chronic exposure levels for protection of aquatic organisms: 0.038 pg/l for 2378-TCDD and 0.41 pg/l for 2378-TCDF. Water column contaminant concentrations were calculated using the simple dilution exposure assessment approach and hydrologically-based 7Q10 flow.

2.3 RISK ASSESSMENT

2.3.1 Bioavailable Dose From Ingestion Of Contaminated Fish Tissue And Drinking Water

Not all of the contaminants that are ingested with fish tissue are available for uptake by humans. Results of a recent study conducted by Boyer (1989) suggest that 85%-95% absorption is a reasonable estimate of 2378-TCDD bioavailability in humans from the ingestion of fatty or oily foods, especially milk, fish, and meats. For the present study, the conservative upper limit of this range of bioavailability (95%) was used. Therefore, the estimated exposure of humans to 2378-TCDD and 2378-TCDF from the consumption of contaminated fish was multiplied by .95 to arrive at an estimated human dose. Further characterizations of doses to specific target organs, via a pharmacokinetic analysis, were not conducted.

Boyer (1989) also investigated bioavailability of 2378-TCDD from water. Although the author could find no data that specifically addressed the bioavailability of 2378-TCDD from drinking water, he assumed that the contaminant would be present at its maximum solubility in water and, therefore, would be 100% bioavailable for absorption to the gastrointestinal tract. The present study also assumes that contaminants in drinking water are 100% bioavailable.

2.3.2 Estimated Cancer Risk From Ingestion Of Contaminated Fish Tissue And Drinking Water

Long-term animal studies of 2378-TCDD have provided clear evidence that the contaminant is an animal carcinogen (Kociba et al., 1978; NTP, 1982a; NTP, 1982b). Based on these animal studies as well as other considerations, EPA has concluded that 2378-TCDD should be regarded as a probable human carcinogen (U.S. EPA, 1985). EPA has assigned 2378-TCDD a qualitative weight-of-evidence designation of "B2" for its carcinogenic potential. This designation indicates that 2378-TCDD is an agent for which there is sufficient evidence of carcinogenicity based on animal studies but inadequate data regarding its carcinogenicity from human epidemiologic studies (U.S. EPA, 1986).

The average daily lifetime bioavailable dose (for both fish tissue and drinking water contamination) was multiplied by the EPA carcinogenic potency factor for 2378-TCDD to calculate a conservative (upper bound) estimate of the hypothetically exposed individual's cancer incidence rate above background incidence rates due to 2378-TCDD. The probability of developing cancer in a lifetime due to a given dose of contaminant is

represented by the following formula, which estimates a plausible upper limit to excess lifetime risk of cancer at low doses:

$$R = \beta (d)^{*}$$

where,

R	=	cancer risk,
β	=	the EPA carcinogenic potency factor, and
d	=	dose.

* this formula may not be appropriate for use in high dose/high risk situations where there may not be a direct relationship between the observed effect and dose.

For example, the EPA upper bound carcinogenic potency factor for 2378-TCDD is 1.6×10^{5} $(mg/kg/day)^{-1}$ [B2] (EPA, 1985) and if the dose is 6.0×10^{-11} (mg/kg/day) then the probability of an individual developing cancer in a lifetime is:

$$R = (1.6 \times 10^{5})(6.0 \times 10^{-11})$$
$$= 1.0 \times 10^{-5} \text{ ["B2"]}$$

The actual risk is likely to be lower than the predicted upper limit and could even be zero in some cases.

Combined 2378-TCDD/-TCDF cancer risk was estimated by converting 2378-TCDF doses to 2378-TCDD toxicity equivalences (TEQs). The TEQ value was then multiplied by the carcinogenic potency factor for 2378-TCDD to obtain the combined 2378-TCDD/2378-TCDF risk. The TEQ was generated by using the toxicity equivalency factor (TEF) recommended in "Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-*p*-Dioxins and Dibenzofurans (CDDs and CDFs) and 1989 Updated, Part II" (Barnes et al., 1989). For example, assuming a 2378-TCDD dose of 6.0×10^{-8} mg/kg/day, a 2378-TCDF dose of 2.2×10^{-8} mg/kg/day, and the 2378-TCDF TEF of 0.1, the total TEQ for the 2378-TCDD/-TCDF mixture is calculated as follows:

$$((1)(6.0 \times 10^{-8})) + ((0.1)(2.2 \times 10^{-8})) = 6.2 \times 10^{-8}$$

Combined risk is calculated by multiplying the resulting TEQ by the carcinogenic potency factor:

$$6.2 \times 10^{-8} \times 1.6 \times 10^{5} = 9.9 \times 10^{-3} \text{ ["B2"]}$$

In this study TEQ represents only the contribution of 2378-TCDD and 2378-TCDF to risk. There are likely to be additional risk contributions from other chlorinated dibenzo-p-dioxins and furans associated with discharges from chlorine-bleaching pulp and paper mills that are not addressed here. However, 2378-TCDD and 2378-TCDF account for greater than 90% of the TEQ from chlorinated dioxins and furans found in the effluents of chorine bleaching pulp and paper mills.

2.3.3 Non-Cancer Health Risks From Ingestion Of Contaminated Fish Tissue

In assessing the risk associated with 2378-TCDD and 2378-TCDF exposures, cancer is generally considered the most sensitive endpoint. It is assumed that if individuals are protected from significant concern for cancer, they will also be protected from other endpoint risks such as developmental toxicity, reproductive effects, liver toxicity, immunotoxicity, etc. However, cancer risks are computed assuming an average daily dose over a lifetime of exposure. If individuals were exposed infrequently to relatively high doses over a short period of time, the risks associated with that level of exposure, when averaged over a lifetime, might not be significant in terms of carcinogenic risk. However, the individual could be at risk for other health effects from the short-term exposure.

EPA has developed a number of methods for evaluating the non-cancer effects of exposure to potentially toxic pollutants. These include the concept of the Reference Dose (RfD) and Health Advisories (HAs). The RfD is an estimate of the lifetime daily dose to the human population likely to be without any appreciable risk

of deleterious effect. RfDs are generally based on studies involving lifetime exposures of animals and are formally defined for comparison with lifetime average dose rates in humans. The endpoints of concern in RfDs developed for 2378-TCDD are reproductive and teratogenic effects. HAs are developed for exposure associated with less-than-lifetime exposures of relatively large doses. HA dose levels are appropriate for comparison with single doses or short-term exposures. HAs for 2378-TCDD have been developed for reproductive/teratogenic effects as well as for other toxic endpoints, such as hepatic effects.

Both RfDs and HAs are derived from the "No Observed Adverse Effect Level" (NOAEL) determined in the critical toxicological study, divided by an uncertainty factor selected based on specific attributes of the study. The uncertainty factor takes into account differences in sensitivity between animals and humans, variability in susceptibility within human populations, and other factors. The level of uncertainty associated with RfDs and HAs can have a range of an order of magnitude or greater.

Although the EPA has determined that reproductive and developmental toxicity in animals are the most critical or sensitive noncarcinogenic effects to consider for the risk assessment of 2378-TCDD, some uncertainty arises as to whether these values are applicable to people of nonreproductive age (e.g., children or post-menopausal women), or people who are not reproducing for other reasons. Therefore, because this assessment is concerned with risks to the general public and because it is designed to assess risks to individuals exposed infrequently to relatively high doses over a short period of time, neither RfDs nor HAs developed for reproductive or teratogenic effects were used. Rather the HAs developed for protection against liver effects from exposures to 2378-TCDD were used for comparison to estimated exposures.

EPA has developed one-day and ten-day HAs for protection against liver effects: 1 day - 100pg/kg/day, and 10 day - 10pg/kg/day (Lee, 1989). For this analysis, the data for exposures to 2378-TCDD and 2378-TCDF from the paper mills were screened for exposure scenarios exceeding an average of 100 pg/kg/day (one-day HA for protection against liver effects). Exposure scenarios exceeding this level were examined in more detail to determine whether the cancer or non-cancer endpoint was the more sensitive indicator of risk.

3. RESULTS

The results of this investigation are presented in two parts. The first part addresses exposure estimates and compares the results of the in-stream contaminant concentration calculations that were performed using the two exposure assessment approaches (simple dilution and EXAMS II water column). From these concentrations, filet residue levels in fish were estimated by applying fish bioconcentration factors (BCFs) and human exposure levels from fish tissue ingestion (at three consumption rates) and drinking water ingestion (at a single consumption rate) were estimated. The exposure assessment also compares the estimated concentrations to which fish are exposed to EPA's preliminary chronic life standards for 2378-TCDD and 2378-TCDF. The fish exposure levels were calculated using the simple dilution method with hydrologically-based 7Q10 low flow conditions and were used as the basis for estimating potential chronic impacts to aquatic life.

For indirect dischargers (dischargers to POTWs), the in-stream contaminant concentrations were based on the results of using an estimated 75% removal efficiency during treatment of the discharge stream. The results for both 75% and 98% removal efficiencies are provided in the appendices.

The second part of the results presents estimated human health risks associated with the ingestion of 2378-TCDD and 2378-TCDF contaminated fish tissue and drinking water. Bioavailable human doses were estimated and used to estimate the risk to a hypothetically exposed individual. Cancer risk results are reported as expected incidence rate of cancer above background rate of cancer incidence associated with site-specific exposure scenarios. Non-cancer risks are also assessed by comparing estimated human doses to EPA's one-day Health Advisory dose for protection against 2378-TCDD induced liver damage.

It should be noted that sufficient information was not available for all of the mills investigated to allow a complete evaluation and comparison of results for each of the 104 facilities. For example, for several of the mills discharging to open waters (i.e., lakes, open ocean), no information was available on receiving stream zone of initial dilution, which was necessary for calculating effluent dilution. For a few other mills, data were questioned as to their accuracy and new samples were being taken, but the results of the new sample evaluations were not available for inclusion in this study. In addition, for some facilities there was sufficient information to predict risks based on the simple dilution method, but insufficient information to predict risk based on the EXAMS II method. Also, either harmonic mean flow or 7Q10 flow data were not available for several facilities. Although not evaluated as part of this study, actual fish tissue concentration data from the National Bioaccumulation Study (NBS) (U.S.EPA, 1989c) are presented in Appendix Q. The data presented are from fish tissue samples taken close to some of the mills evaluated as part of the present study. The number of facilities included in the Appendix was dependent on the number and location of samples taken as part of the NBS.

As was noted previously, an effluent 2378-TCDD and 2378-TCDF concentration of 1/2 the detection limit was used in this evaluation for those mill samples from the 104-mill study in which contaminant concentrations were below the analytical level of detection. The number of mills for which exposure and risk estimates were based on 1/2 the detection limits are identified in each of the figures presented in this results section as well as in Appendix C of this report.

In some instances, more than one sample result from the 104-mill study was available for a given mill. However, all exposure and risk calculations are based on effluent concentration levels for individual samples (i.e., sample concentrations for mills with multiple samples were not combined when calculating results). The discussions of exposure and risk presented in this chapter are based on the samples from each mill with the highest effluent contaminant concentrations.

3.1 EXPOSURE ASSESSMENT

3.1.1 In-Stream Contaminant Concentrations

Appendix D presents the estimated in-stream 2378-TCDD and 2378-TCDF concentrations (in pg/l) for each of the samples from the 104 mill sites based on harmonic mean flow. Appendix E presents estimated in-stream contaminant concentrations using the simple dilution method with hydrologically-based 7Q10 flow. Concentrations are presented in pg/l for comparison to EPA's preliminary chronic exposure levels for protection of aquatic life. For aquatic life impacts, contaminant concentrations for discharges to open water were calculated by simple dilution using zone of initial dilution or ZID factors. Since these are not free flowing streams, low flow conditions do not apply.

For each of the samples, estimated in-stream 2378-TCDD and 2378-TCDF concentrations based on harmonic mean flow were highest when calculated using the simple dilution exposure assessment method. In-stream 2378-TCDD concentrations estimated using the simple dilution method ranged from a high of $3.2 \times 10^{+2}$ pg/l to a low of 4.1×10^{-5} pg/l. In-stream 2378-TCDF concentrations ranged from a high of $8.0 \times 10^{+2}$ pg/l to a low of 1.0×10^{-4} pg/l. Using the EXAMS II water column method, estimated 2378-TCDD concentrations ranged from a high of $8.3 \times 10^{+1}$ pg/l to a low of 3.4×10^{-5} pg/l. Estimated 2378-TCDF concentrations ranged from $7.1 \times 10^{+2}$ pg/l to 1.1×10^{-3} pg/l.

In-stream 2378-TCDD concentration estimates based on simple dilution and 7Q10 flow ranged from a high of $3.2 \times 10^{+2}$ pg/l to a low of 1.37×10^{-4} pg/l. Estimated 2378-TCDF concentrations ranged from $1.5 \times 10^{+3}$ pg/l to 3.42×10^{-4} pg/l.

Figures 3.1 and 3.2 illustrate the estimated distribution of mills for which discharges result in 2378-TCDD and 2378-TCDF concentrations falling within specific concentration ranges (based on harmonic mean flow) using the simple dilution method (Figure 3.1) and EXAMS II water column method (Figure 3.2). Figure 3.3 illustrates the estimated distribution of mills for which discharges result in contaminant concentrations falling within specific concentration ranges using the simple dilution method based on 7Q10 flow. All figures are based on the samples with the highest effluent contaminant concentration for each mill.

3.1.2 Fish Tissue Contaminant Concentrations

Appendix F presents the mill-specific estimated fish tissue concentrations of 2378-TCDD and 2378-TCDF using the two exposure assessment methods. The actual fish tissue concentrations of 2378-TCDD and 2378-TCDF measured during the National Bioaccumulation Study (NBS) are presented in Appendix Q. It should be noted that the National Bioaccumulation Study was conducted during 1985 through 1987, and the condition of some receiving streams and thus the concentration of contaminants in fish tissues may have changed since the time the NBS was conducted.

The highest fish tissue concentrations due to in-stream exposure to the contaminants were estimated by the simple dilution method. The 2378-TCDD fish tissue concentrations estimated using the 5,000 BCF ranged from a high of $1.6 \times 10^{+3}$ ng/kg to a low of 2.05×10^{-4} ng/kg. Using the 50,000 BCF, 2378-TCDD fish tissue concentrations ranged from a high of $1.6 \times 10^{+4}$ ng/kg to a low of 2.05×10^{-3} ng/kg. Use of the simple dilution method estimated 2378-TCDF concentrations in fish tissue (using the single BCF of 1,950) ranging from $1.56 \times 10^{+3}$ ng/kg to 2.0×10^{-4} ng/kg.

The EXAMS II water column method resulted in fish tissue concentrations of 2378-TCDD ranging from a high of $4.15 \times 10^{+2}$ ng/kg to a low of 1.71×10^{-4} ng/kg using the 5,000 BCF and from $4.15 \times 10^{+3}$ ng/kg to 1.17×10^{-3} ng/kg using the 50,000 BCF. The 2378-TCDF fish tissue concentrations estimated by the EXAMS II water column method ranged from $1.39 \times 10^{+3}$ ng/kg to 1.49×10^{-3} ng/kg.

Actual 2378-TCDD concentrations measured during the National Bioaccumulation Study ranged from a high of $7.17 \times 10^{+1}$ ng/kg to a low of 2.05×10^{-1} ng/kg. 2378-TCDF measured values ranged from $2.07 \times 10^{+2}$ ng/kg to 1.3×10^{-1} ng/kg. It should be noted that both whole body and filet samples were analyzed in the NBS. One half the whole body contaminant concentrations were used to estimate filet concentrations as

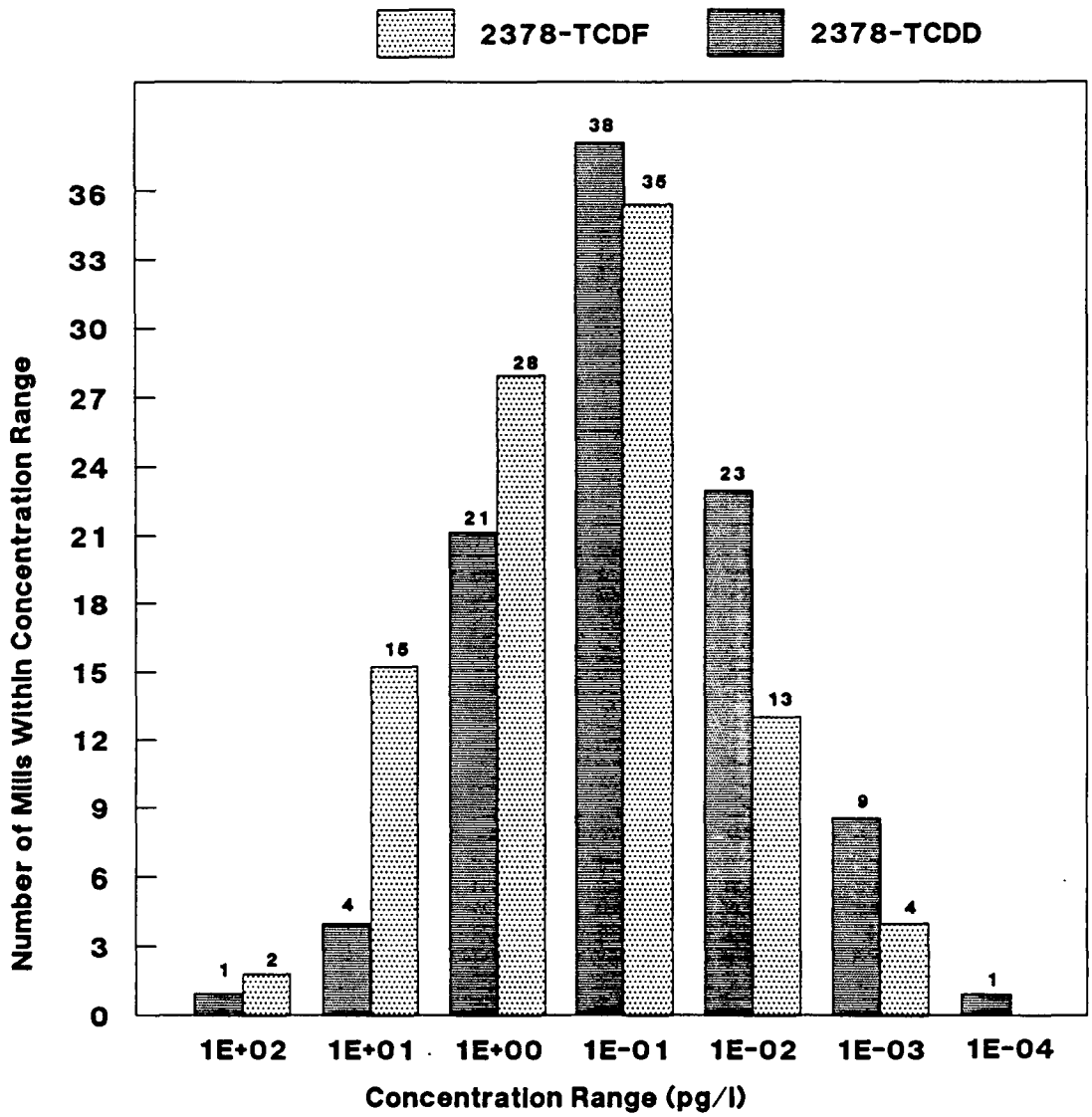

Figure 3.1. Distribution of the number of mills for which discharges would result in a given range of water column contaminant concentrations as estimated by the simple dilution method.

Notes:

Total number of mills evaluated = 97.
Estimates based on Harmonic Mean Flow of receiving waters.

Number of mills within concentration ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore water column concentration estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+0	1E-1	1E-2	1E-3
TCDD	1	9	7	4
TCDF		3	3	1

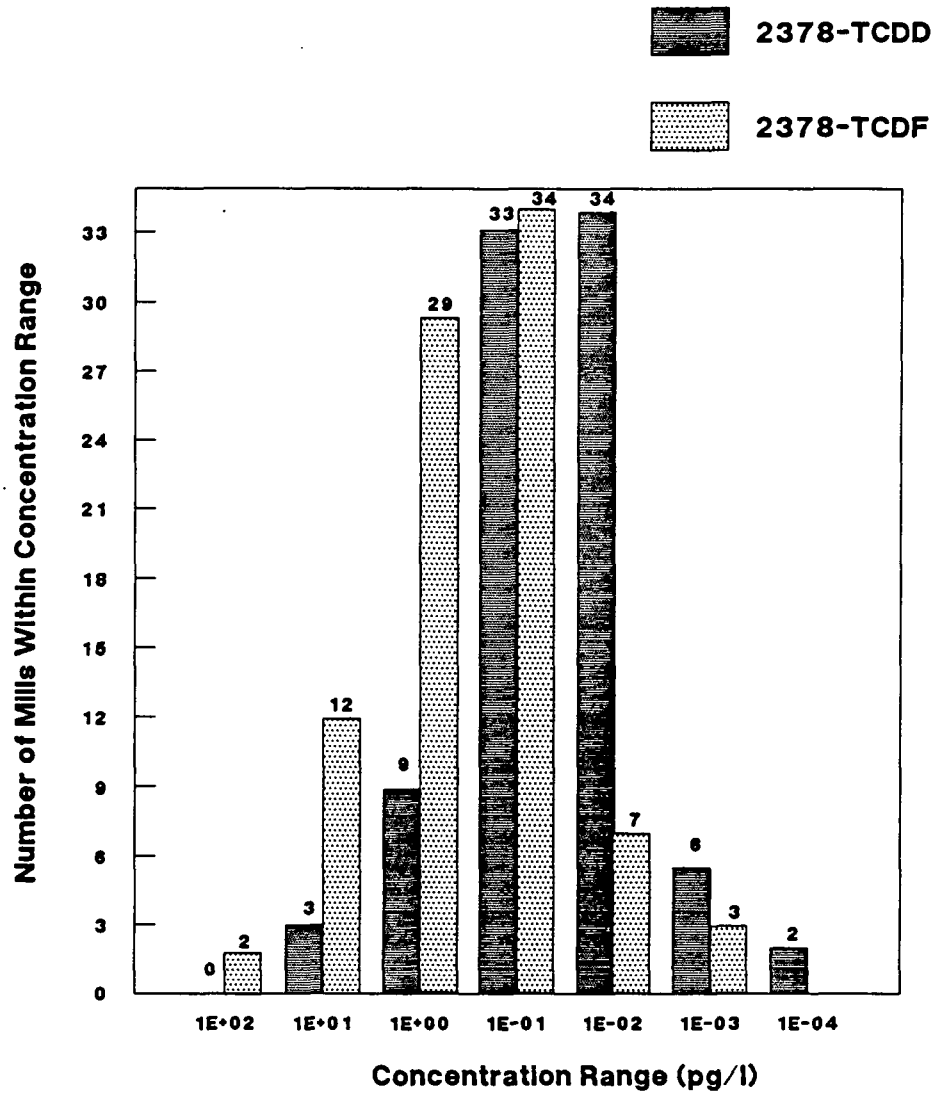

Figure 3.2. Distribution of the number of mills for which discharges would result in a given range of water column contaminant concentrations as estimated by the EXAMS II water column method.

Notes:

Total number of mills evaluated = 87.

Estimates based on Harmonic Mean Flow of receiving waters.

Number of mills within concentration ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore water column concentration estimates are based on effluent concentrations of 1/2 the detection limit.

	1E+0	1E-1	1E-2	1E-3	1E-4
TCDD	1	7	6	4	2
TCDF	1	2	4	1	

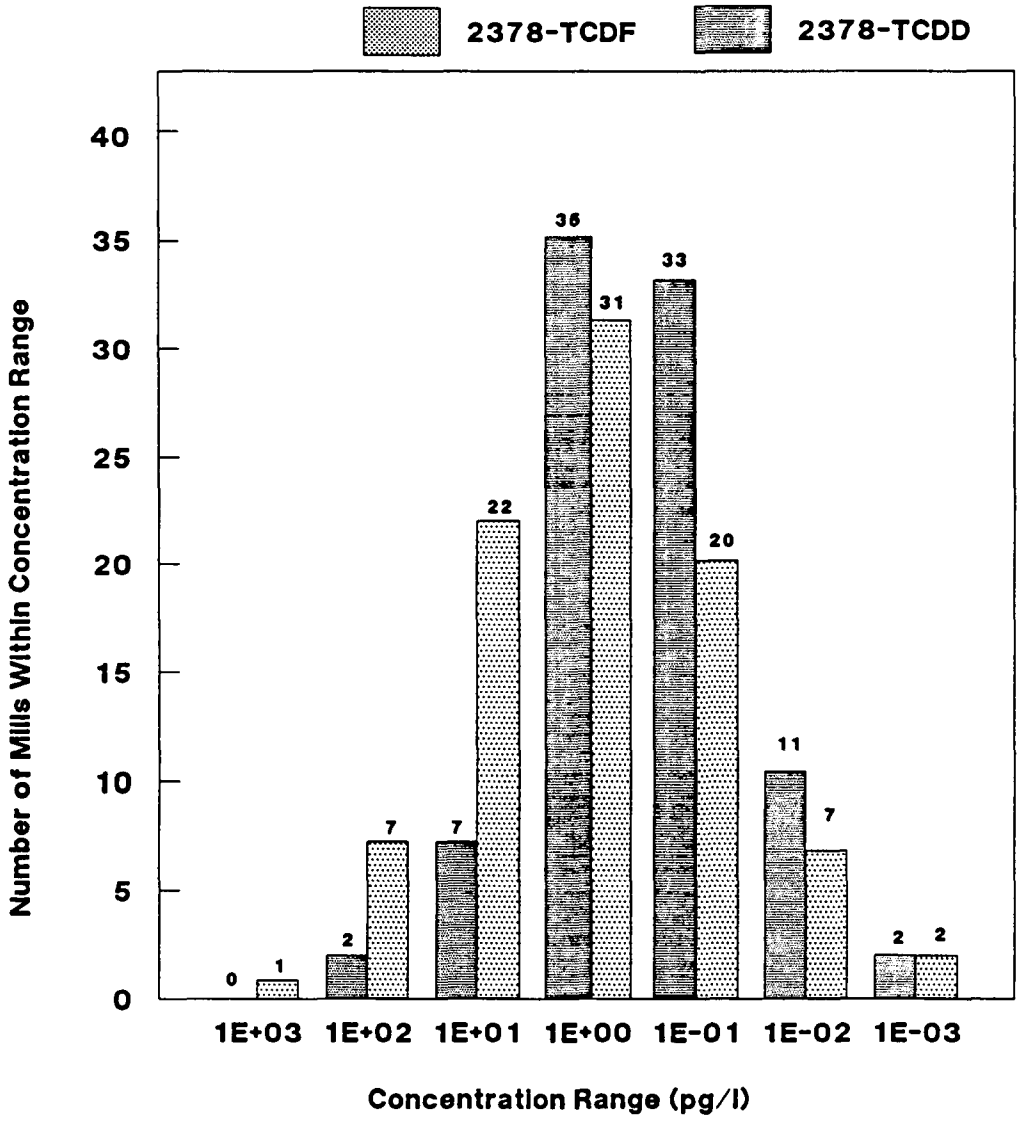

Figure 3.3. Distribution of the number of mills for which discharges would result in a given range of water column contaminant concentrations as estimated by the simple dilution method using 7Q10 low flow conditions.

Notes:
Total number of mills evaluated = 90.
Estimates based on 7Q10 flow values for receiving waters.

Number of mills within concentration ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore water column concentration estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+0	1E-1	1E-2	1E-3
TCDD		5	9	5	1
TCDF	1	2	2	2	1

presented in Appendix Q. Also, both pelagic and benthic species were evaluated in the NBS. Contaminant concentrations in benthic species tend to be higher than in pelagic species, although pelagic species are more often sought and consumed by recreational and subsistence fishermen.

3.1.3 Drinking Water Contamination

This study assumes that the concentrations of the contaminants expected to be found in drinking water are the same as those predicted in-stream. These predicted concentrations are presented in Appendix D. The distribution of the number of mills for which discharges resulted in in-stream concentrations of the contaminants within specific concentration ranges are illustrated in Figure 3.1 (for the simple dilution method) and Figure 3.2 (for the EXAMS II water column method).

3.1.4 Aquatic Life Impacts

Aquatic life impacts are estimated based on a comparison of predicted in-stream concentrations of 2378-TCDD and 2378-TCDF, using the simple dilution method with 7Q10 flow conditions (see Figure 3.3 and Appendix E), to EPA's preliminary chronic exposure levels for the protection of aquatic life (0.038 pg/l for 2378-TCDD and 0.41 pg/l for 2378-TCDF)(U.S. EPA, 1989b). The estimates presented in Figure 3.3 are based on the samples with the highest effluent contaminant concentration for each mill evaluated. Water column concentrations of 2378-TCDD immediately downstream of 80 out of 90 mills (89%) are estimated to exceed chronic exposure levels of 0.038 pg/l. Seventy-four mills (82%) exceed the 0.41 pg/l level for 2378-TCDF.

3.2 RISK ASSESSMENT

3.2.1 Bioavailable Dose From Ingestion Of Fish Tissue And Drinking Water

The bioavailable dose to humans from consumption of contaminated fish tissue was calculated based on 95% bioavailability and three fish tissue consumption rates: 6.5 g/day in combination with fish tissue concentrations based on fish filet bioconcentration factors of 5,000 for 2378-TCDD and 1,950 for 2378-TCDF; and 30 and 140 g/day in combination with fish tissue concentrations based on fish filet bioconcentration factors of 50,000 for 2378-TCDD and 1,950 for 2378-TCDF. The bioavailable dose from drinking water was calculated based on a drinking water ingestion rate of 2 L/day and a 100% oral dose bioavailability. The mill-specific estimated bioavailable doses of 2378-TCDD and 2378-TCDF from consumption of contaminated fish tissue based on the simple dilution and EXAMS II methods are presented in Appendix G. Mill-specific estimated bioavailable doses from ingestion of contaminated drinking water are presented in Appendix H. These values were used to predict the hypothetically exposed individual's upper bound cancer risk associated with discharges from each mill.

3.2.2 Estimated Cancer Risk From Ingestion Of Contaminated Fish Tissue And Drinking Water

Appendix I presents predicted mill-specific upper bound lifetime risks of cancer to the hypothetically exposed individual from consumption of contaminated fish tissue based on the simple dilution and EXAMS II methods. Appendix J presents the mill-specific upper bound risks of cancer from ingestion of contaminated drinking water. The cancer risks associated with contaminated fish consumption are presented for 6.5 g/day, 30g/day, and 140g/day consumption rates. The percent 2378-TCDD contributing to TEQ is also estimated for contaminated fish tissue consumption in Appendix I and for contaminated drinking water ingestion in Appendix J.

Contaminated Fish Tissue

Figures 3.4 through 3.7 present the estimated distribution of the number of mills for which discharges would result in a given range of estimated lifetime cancer risks for the hypothetically exposed individual due to the consumption of contaminated fish tissue based on the simple dilution exposure assessment method and the EXAMS II water column exposure assessment method. Estimates are based on the samples with the highest effluent contaminant concentration for each mill evaluated.

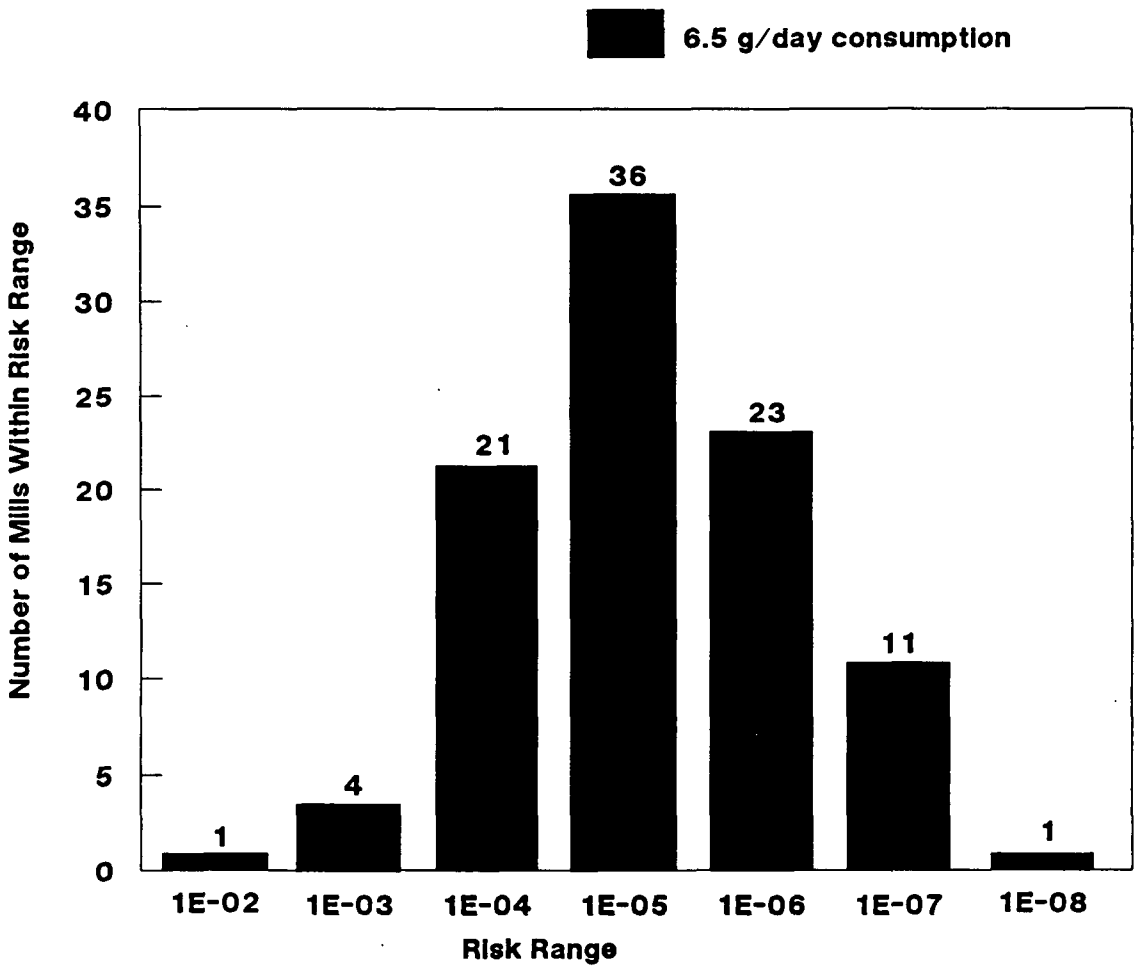

Figure 3.4. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the simple dilution method (6.5 g/day consumption rate and BCF of 5,000 for 2378-TCDD*).

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-4	1E-5	1E-6	1E-7
TCDD	2	7	4	3
TCDF		1		1
TCDD & TCDF		2	2	1

*** Recent laboratory evidence indicates that a BCF higher than 5,000 for 2378-TCDD (e.g., 50,000) more accurately reflects uptake of 2378-TCDD by fish. Use of a BCF of 50,000 for 2378-TCDD would increase risk by an order of magnitude.**

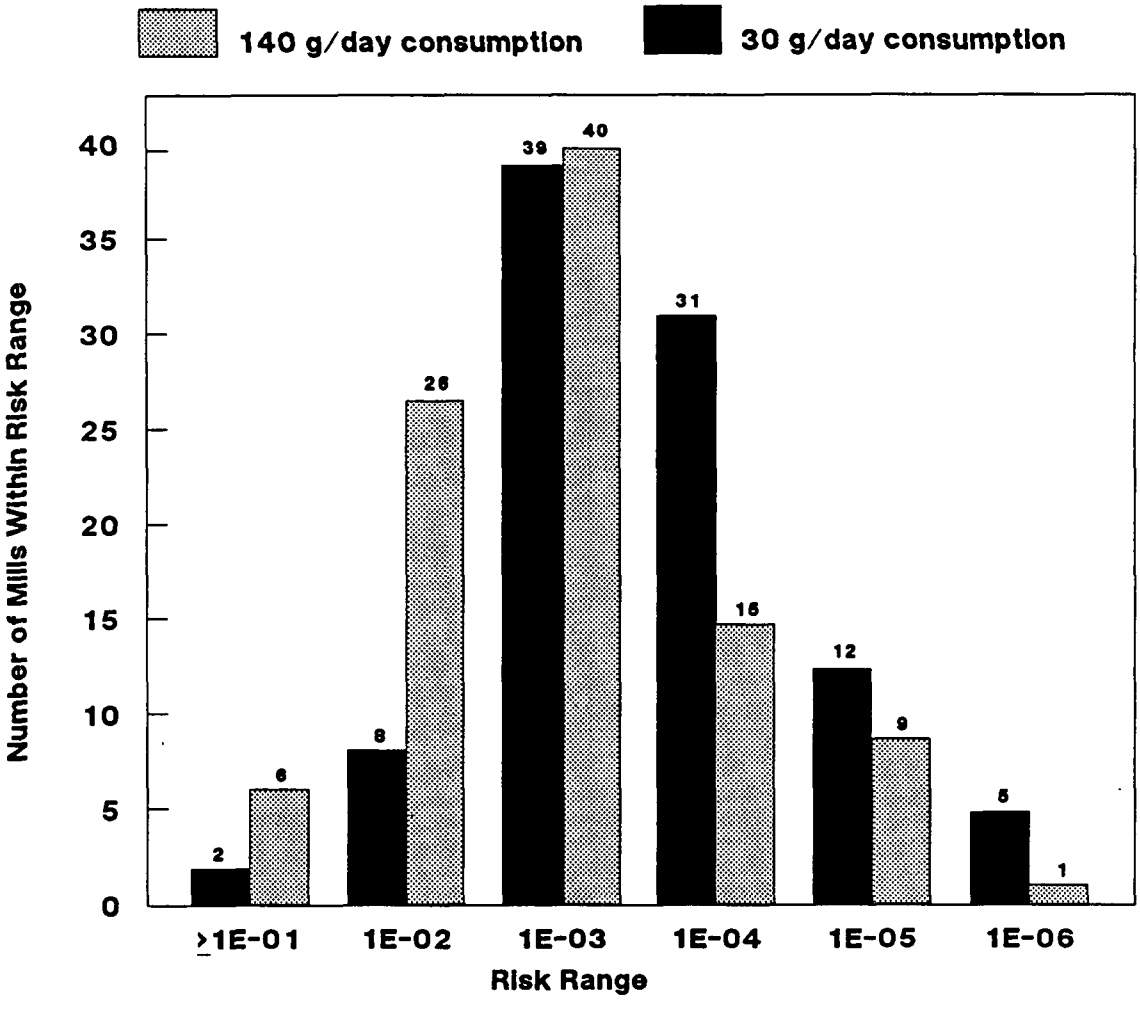

Figure 3.5. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the simple dilution method (30 and 140 g/day consumption rates and BCF of 50,000 for 2378-TCDD).

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-2	1E-3	1E-4	1E-5	1E-6
30g/day					
TCDD		7	4	3	2
TCDF		1		1	
TCDD & TCDF		1	3		1
140g/day					
TCDD	4	4	5	3	
TCDF		1	1		
TCDD & TCDF		3	1	1	

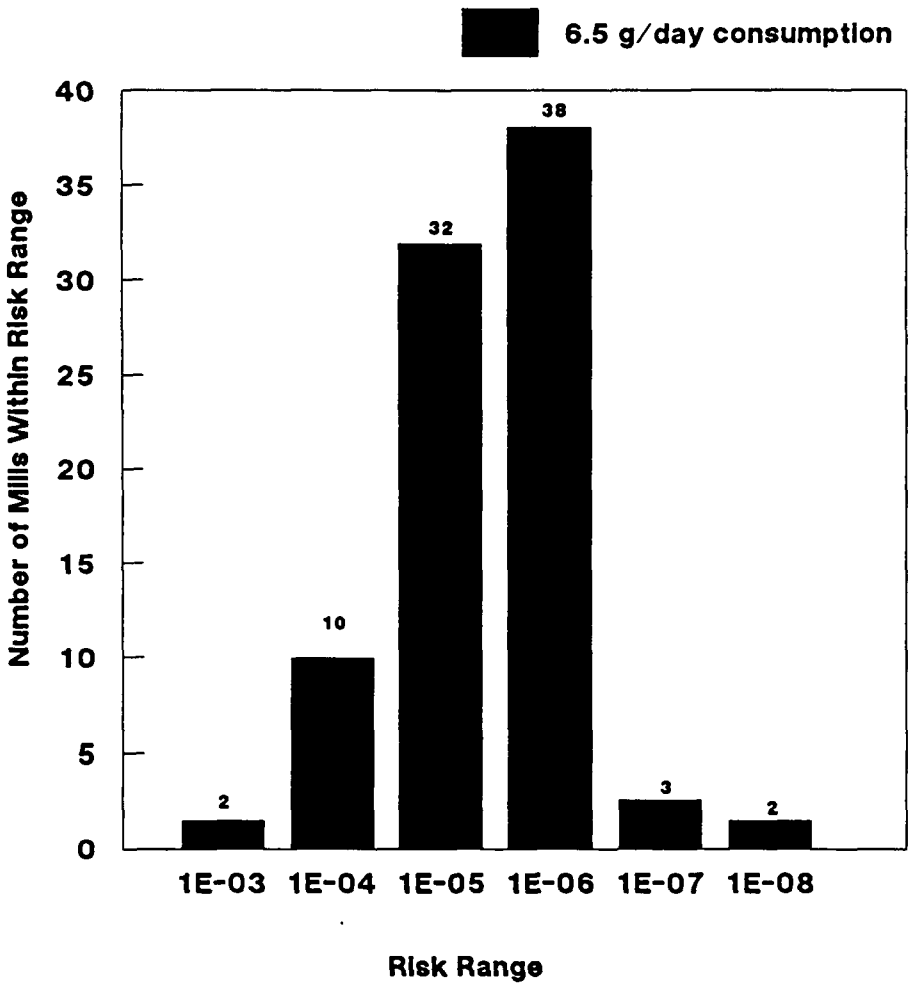

Figure 3.6. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the EXAMS II method (6.5 g/day consumption rate and BCF of 5,000 for 2378-TCDD*).

Notes:

Total number of mills evaluated = 87.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-4	1E-5	1E-6	1E-7	1E-8
TCDD	1	6	5	2	1
TCDF		1		1	
TCDD & TCDF		1	3		1

*** Recent laboratory evidence indicates that a BCF higher than 5,000 for 2378-TCDD (e.g., 50,000) more accurately reflects uptake of 2378-TCDD by fish. Use of a BCF of 50,000 for 2378-TCDD would increase risk by an order of magnitude.**

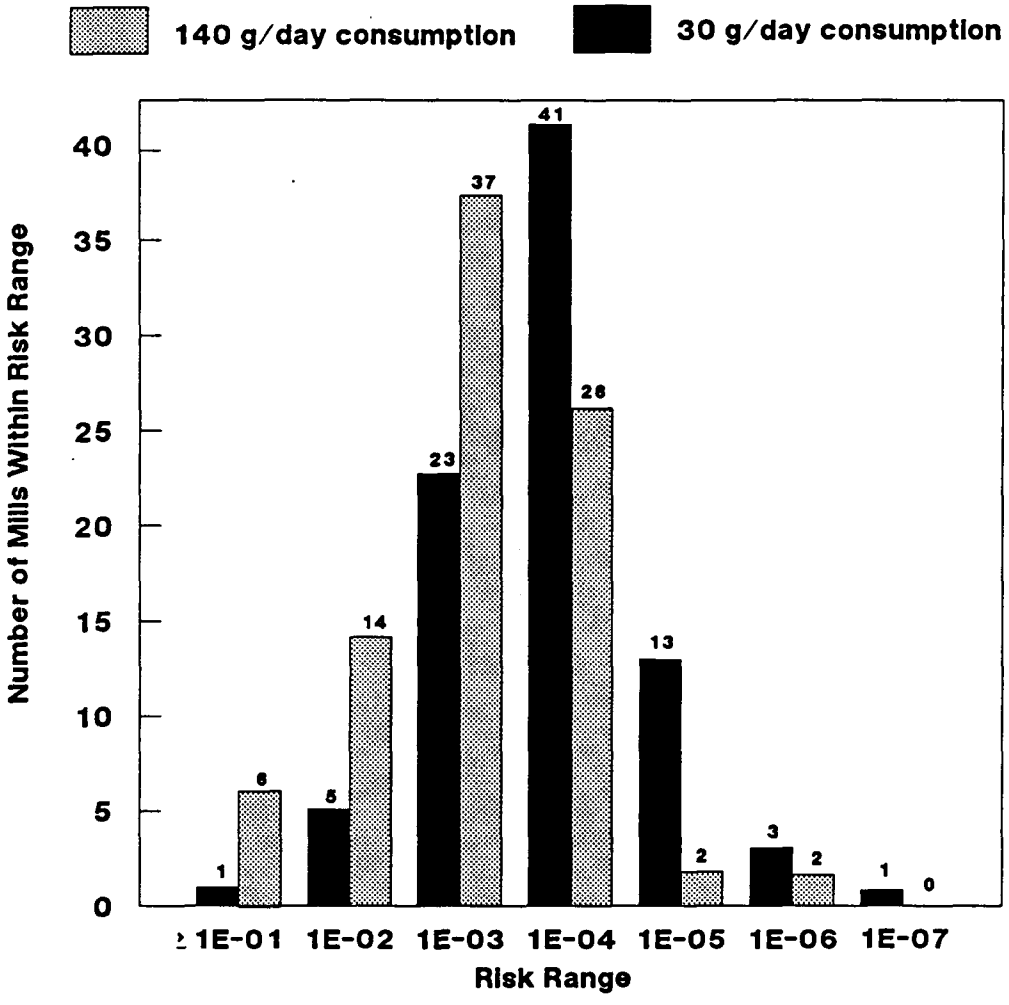

Figure 3.7. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the EXAMS II method (30 and 140 g/day consumption rates and BCF of 50,000 for 2378-TCDD).

Notes:
Total number of mills evaluated = 87.
Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-2	1E-3	1E-4	1E-5	1E-6	1E-7
30g/day						
TCDD		4	6	2	2	
TCDF			1		1	
TCDD & TCDF			2	2		1
140g/day						
TCDD	1	7	4	1	1	
TCDF		1		1		
TCDD & TCDF		1	3		1	

The results of calculations using the 6.5 g/day fish tissue consumption rate in combination with the 2378-TCDD BCF of 5,000 are based on EPA water quality criteria assumptions. The results of these calculations are presented separately from the results of calculations using the 30 and 140 g/day consumption rates in combination with the 2378-TCDD BCF of 50,000, which are considered more extreme scenarios.

Simple Dilution Exposure Assessment Method

Using the simple dilution exposure assessment estimates, the 6.5 g/day fish tissue consumption rate, and fish filet contaminant concentrations based on a BCF of 5,000 for 2378-TCDD, the upper bound mill-specific cancer rates for the hypothetically exposed individual ranged from the 10^{-2} to 10^{-8} risk levels (Figure 3.4). Risk levels associated with discharges from 80 of the 97 mills evaluated (82%) fell within the 10^{-4} to 10^{-6} risk levels, with 36 mills within the 10^{-5} risk level.

Mill-specific cancer rate estimates using the 30 g/day fish tissue consumption rate and fish tissue contaminant concentrations based on a BCF of 50,000 for 2378-TCDD range from the $\geq 10^{-1}$ to 10^{-6} risk levels (Figure 3.5). Seventy of the 97 mills (72%) were associated with risk levels between 10^{-3} to 10^{-4}, and 39 of these 70 fell within the 10^{-3} range. Using the 140 g/day fish tissue consumption rate and fish tissue contaminant concentrations based on the 50,000 BCF, risk levels ranged from $\geq 10^{-1}$ to 10^{-6} (Figure 3.5). Sixty-six out of the 97 mills (68%) were associated with risk levels between 10^{-2} to 10^{-3} with 40 within the 10^{-3} range.

EXAMS II Exposure Assessment Method

Mill-specific upper bound cancer rate estimates for the hypothetically exposed individual using the EXAMS II water column exposure assessment method, 6.5 g/day fish tissue consumption rates, and fish tissue contaminant concentrations based on a BCF of 5,000 for 2378-TCDD ranged from the 10^{-3} to 10^{-8} risk levels (Figure 3.6). Seventy of the 87 mills evaluated (80%) were associated with risk levels between 10^{-5} (32 mills) to 10^{-6} (38 mills).

Using the 30 g/day consumption rate and fish tissue contaminant concentrations based on the 50,000 BCF for 2378-TCDD, mill-specific cancer rates ranged from the $\geq 10^{-1}$ to 10^{-7} risk levels (Figure 3.7). Sixty-four of the 87 mills (74%) were associated with risk levels within the 10^{-3} to 10^{-4} range, and 41 of these fell within the 10^{-4} range. Cancer rate estimates using the 140 g/day fish tissue consumption rate and 50,000 BCF, ranged from the $\geq 10^{-1}$ to 10^{-6} risk levels (Figure 3.7). Sixty-three of the 87 mills (72%) were associated with risk levels between the 10^{-3} and 10^{-4} range, and 37 of these fell within the 10^{-3} range.

Contaminated Drinking Water

Figures 3.8 and 3.9 present the distribution of the number of mills for which discharges were estimated to result in a given range of upper bound lifetime cancer risks to the hypothetically exposed individual due to the ingestion of contaminated drinking water. Only those facilities discharging to fresh water lakes, rivers, and streams were included in this analysis. No discharges to marine or estuarine waters were included, since these water bodies would not be used as drinking water sources.

Use of the simple dilution method estimated that the cancer risks associated with the 69 mills evaluated ranged from the 10^{-4} to 10^{-9} risk levels (Figure 3.8). The greatest percentage of these mills (44, or 64%) were associated with risk levels within the 10^{-6} (23 mills) to 10^{-7} (21 mills) range. Use of the EXAMS II water column method estimated that the risk levels associated with the 64 mills evaluated ranged from the 10^{-5} to 10^{-9} levels (Figure 3.9). Fifty of these mills (78%) were associated with risk levels between the 10^{-6} (18 mills) to 10^{-7} (32 mills) range.

3.2.3 Non-Cancer Health Effects From Ingestion Of Contaminated Fish Tissue

Appendix K presents the estimated mill-specific human doses from the consumption of a single 115 gram (1/4 pound) portion of contaminated fish tissue (using at fish filet BCF of 50,000 for 2378-TCDD and 1,950 for 278-TCDF) based on the simple dilution and EXAMS II water column exposure assessment methods. Results

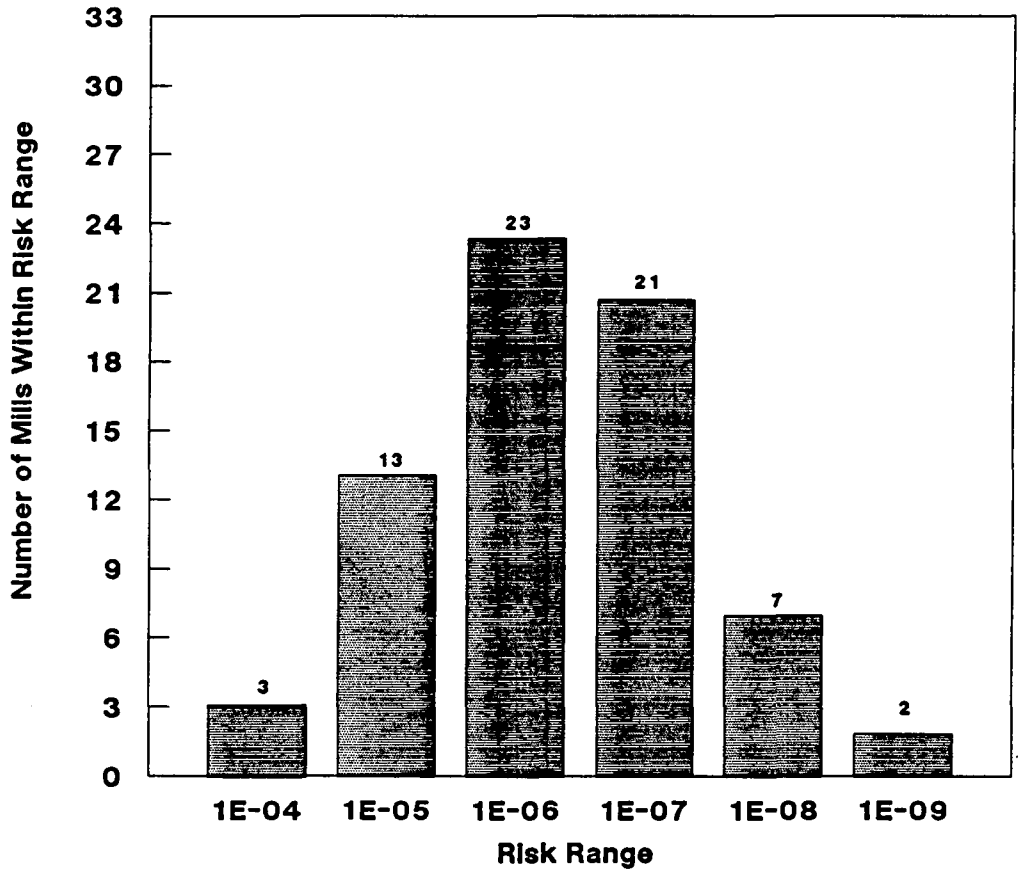

Figure 3.8 Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the ingestion of contaminated drinking water as estimated by the simple dilution method.

Notes:

Total number of mills evaluated = 69.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Based on a 2 L/day ingestion rate.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-5	1E-6	1E-7	1E-8	1E-9
TCDD	1	3	3	3	
TCDF		1		1	
TCDD & TCDF		1	2		1

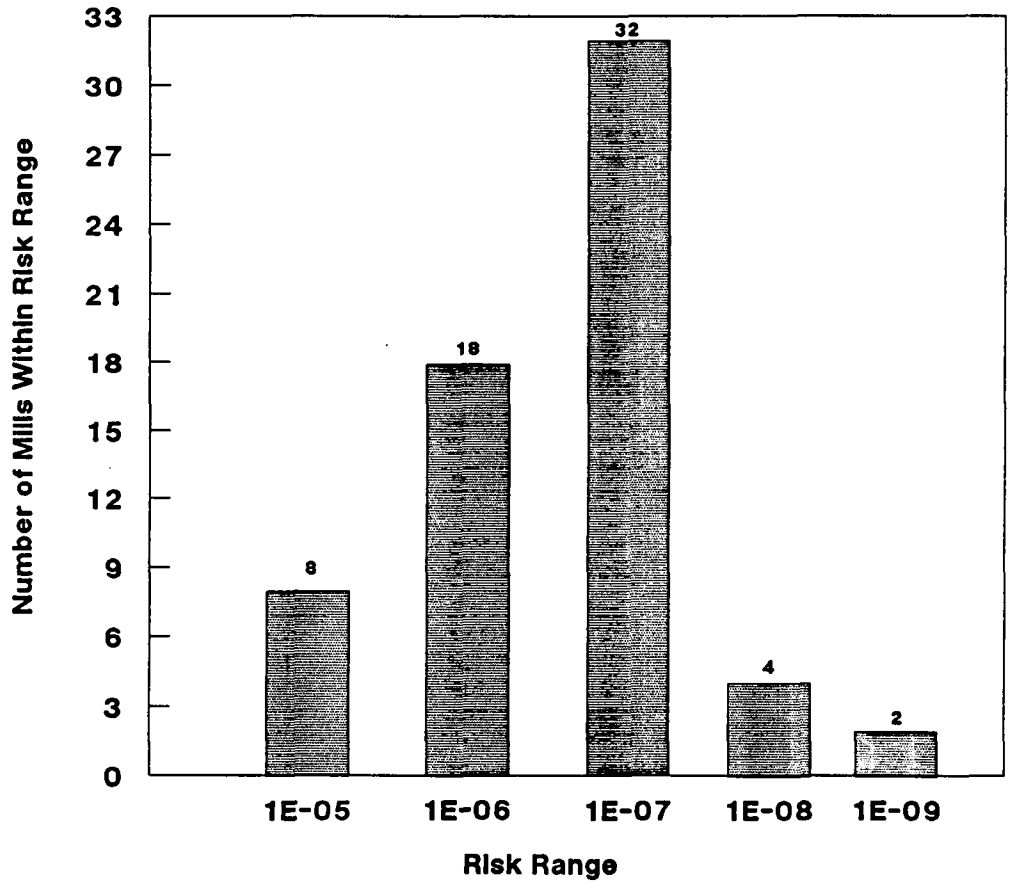

Figure 3.9. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the ingestion of contaminated drinking water as estimated by the EXAMS II method.

Notes:
Total number of mills evaluated = 64.
Combined 2378 -TCDD/-TCDF risk predicted using TEQ.
Based on a 2 L/day ingestion rate.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-5	1E-6	1E-7	1E-8	1E-9
TCDD	1	2	4	2	1
TCDF			1	1	
TCDD & TCDF			3	1	1

are reported in pg/kg/day for comparison to EPA's one-day Health Advisory for protection against liver effects (100 pg/kg/day).

Based on the simple dilution method results (Figure 3.10), the dose associated with discharges from 25 out of the 97 mills evaluated (27%) would equal or exceed the one-day HA dose for protection from liver effects (100 pg/kg/day). Use of the EXAMS II method (Figure 3.11) estimates that the dose associated with discharges from 9 mills out of 87 (10%) would equal or exceed the 100 pg/kg/day dose level.

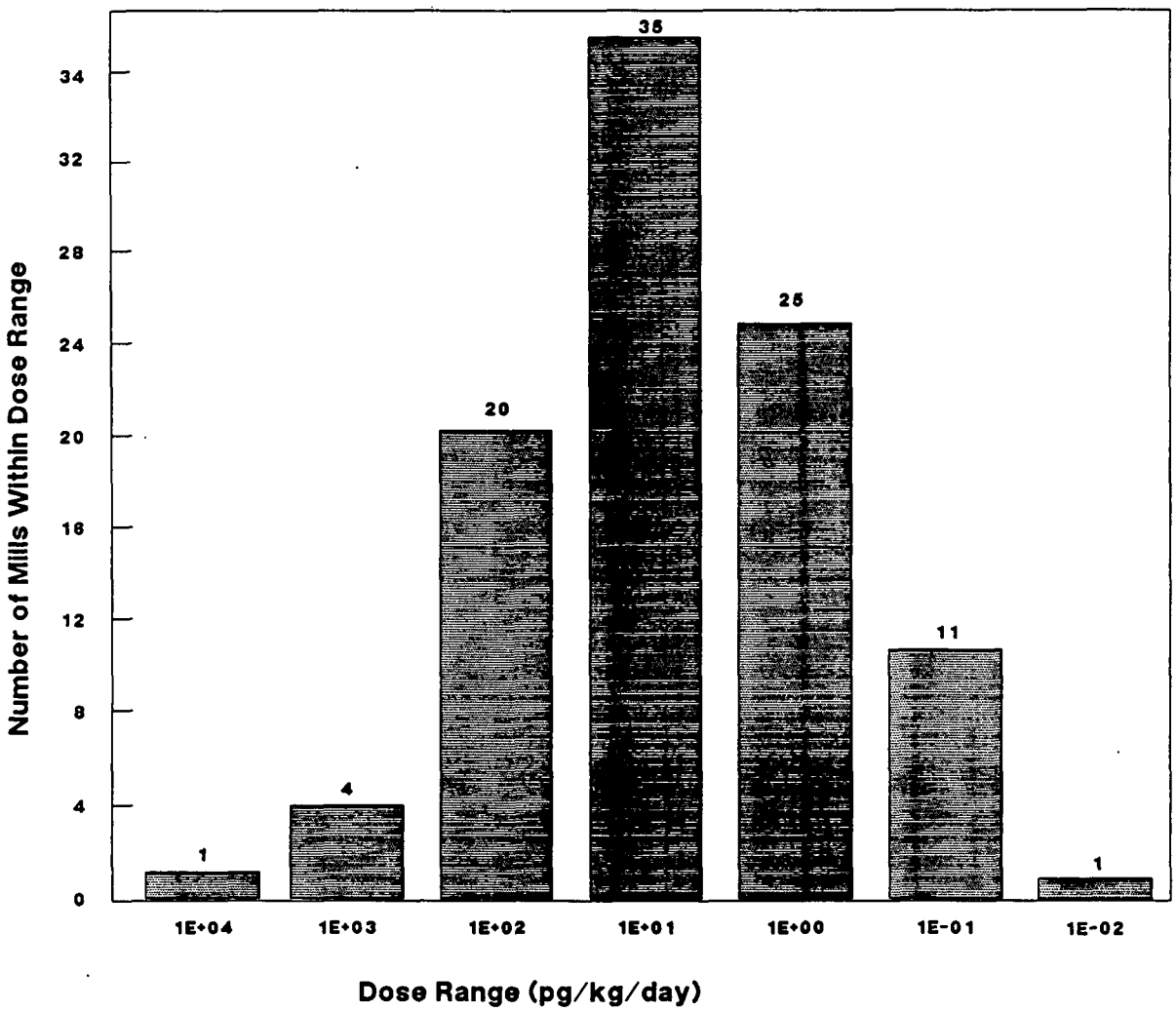

Figure 3.10. Distribution of the number of mills for which discharges would result in a given range of human doses from a one-time exposure to contaminated fish tissue as estimated by the simple dilution method.

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF dose predicted using TEQ.

Based on the consumption of a single 115 g portion of contaminated fish tissue and using a fish filet BCF of 50,000 for 2378-TCDD.

Number of mills within dose ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore dose estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+1	1E+0	1E-1
TCDD	1	7	4	3
TCDF		1		1
TCDD & TCDF		2	3	1

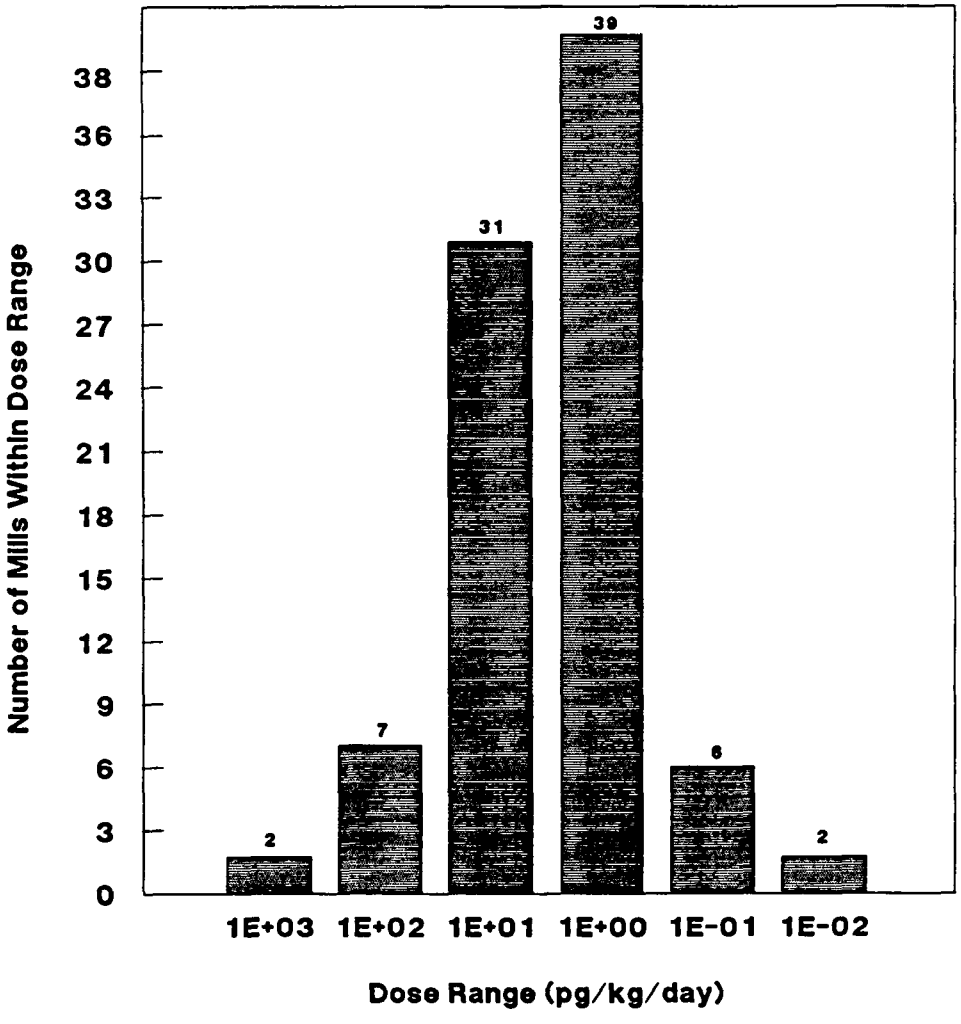

Figure 3.11. Distribution of the number of mills for which discharges would result in a given range of human doses from a one-time exposure to contaminated fish tissue as estimated by EXAMS II method.

Notes:

Total number of mills evaluated = 87.

Combined 2378 -TCDD/-TCDF dose predicted using TEQ.

Based on the consumption of a single 115 g portion of contaminated fish tissue and using a fish filet BCF of 50,000 for 2378-TCDD

Number of mills within dose ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore dose estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+1	1E+0	1E-1	1E-2
TCDD	1	5	5	2	1
TCDF		1		1	
TCDD & TCDF		1	3	1	1

4. DISCUSSION OF RESULTS

4.1 ASSUMPTIONS, LIMITATIONS, AND UNCERTAINITIES

This chapter presents the assumptions that were made during the planning and conduct of this study and discusses significant results and the limitations and uncertainties associated with those results. The following is a list of assumptions used in this investigation:

1) Mill-specific, five-day composite effluent contaminant concentrations collected during the 104-mill study were multiplied by mean plant flow rates to determine contaminant load. This resulting load to the receiving water was assumed to be continuous. The representativeness of the effluent sample as reflecting long-term mill operations is unknown; since then, the mills may have made plant process or operation changes to reduce dioxin and furan formation. This assumption may overestimate human health and aquatic life risks.

2) The highest estimated in-stream concentrations in the immediate vicinity of the discharges (assuming steady-state, fully mixed conditions) were considered for fish exposure. Fish are likely to move in and out of the area of maximum concentration, but these estimates assumed that fish remain exposed to the highest concentration. Consequently, this assumption is likely to overestimate fish exposure and overestimate human health and aquatic life risks.

3) Receiving water stream flow rates for estimating human health risks were calculated using the harmonic mean of historic flow measurements from nearby stream gaging stations. 7Q10 receiving water flow rates were used for estimating aquatic life impacts. These flows may not be the same as those used by specific States to assess risks. Therefore, these assumptions may over- or underestimate risks compared to State assumptions.

4) Three bioconcentration factor (BCF) values were used for estimating 2378-TCDD and 2378-TCDF concentrations in edible fish tissue (filet): two for 2378-TCDD and one for 2378-TCDF. The resulting fish tissue concentrations were used to estimate human exposure to the contaminants through consumption of fish tissue. For 2378-TCDD, a BCF of 5,000 was used in combination with a human consumption rate of fish tissue of 6.5 g/day, and a BCF of 50,000 was used in combination with consumption rates of 30 g/day and 140 g/day. The 6.5 g/day fish tissue consumption rate in combination with the BCF of 5,000 reflects the assumptions in EPA's ambient water quality criterion for 2378-TCDD and 2378-TCDF and is considered a reasonable estimate for an average consumer of locally caught fish. The 30 and 140 g/day consumption rates in combination with the BCF of 50,000 are used as sensitivity comparisons and represent more extreme exposure scenarios for recreational and subsistence fishermen. A single BCF for 2378-TCDF of 1,950 was used in combination with each of the three consumption rates. BCFs are species-specific and highly variable. This study did not take species variability or degree of bioconcentration into account. Also, actual fish consumption rates vary by locale. State assumptions for BCF, consumption rates, and also cancer potency may vary from those used in this assessment. Therefore, this assesmsent may overestimate or underestiamte risks compared to State assessments.

5) A drinking water ingestion rate of 2L/day was used to estimate human exposures through ingestion of contaminated drinking water. It was assumed that the water consumed was taken from the point of highest in-stream pollutant concentration after the effluent was fully mixed in the receiving stream, and no treatment of the water was undertaken to remove contaminants prior to ingestion. This assumption likely overestimates human health risk from drinking water.

6) Fish tissue contaminant bioavailability for humans was assumed to be 95% of oral dose. Contaminants in water were assumed to be 100% bioavailable to both fish and humans. This reflects the most current information EPA has on bioavailability, but the assumptions may overestimate the risk to humans.

7) Fish were assumed to be exposed to contaminants only in the water column. No food chain or sediment associated exposures were considered, other than for the simple dilution method in which the total in-stream contaminant level (both dissolved and adsorbed to suspended solids) were bioavailable.

8) The estimates of risk apply only to a hypothetically exposed individual in the immediate vicinity of the mills, and not to the entire population of fish consumers.

In evaluating the results of this study, it should be pointed out that BCFs are highly species specific. The BCF for a contaminant in a given fish species is dependent on fish tissue lipid content, mode of contaminant uptake, and other factors. Thus using a single BCF does not take into account interspecies differences in the rate and degree of contaminant bioconcentration. For example, the study conducted by Cook et. al. (Unpublished) indicates that a higher BCF than that used in this study (i.e., 200,000) may be applicable for 2378-TCDD for some species of fish. Also, the 50,000 BCF for 2378-TCDD used in conjunction with fish consumption rates of 30 and 140 g/day for recreational and subsistence fishermen is based on the assumption that only the filet portion of the fish is consumed. However, some subpopulations of subsistence fishermen and certain ethnic groups eat whole fish in which the concentration of contaminants is likely to be higher than in the filet alone. Therefore, the use of a BCF of 50,000 may underestimate risks to these subpopulations.

The predictions from the present study also do not take into consideration the mobility of fish in the receiving waters. Both resident and migrating species will move in and out of the discharge area. This study assumes that the fish remain exposed to the predicted contaminant concentration up to the time they are caught, thus resulting in a conservative estimate of aquatic life impacts and human health risk. In addition, no assessment of local fish patterns or actual commercial or recreational fishing practices were conducted as part of this evaluation. Therefore, it is not known whether or not commercially or recreationally valuable species occur or are taken in the vicinity of the discharges that were included in this evaluation.

No attempt was made to estimate fish exposure to contaminants associated with suspended particulates, bed sediments, or the food chain (except when considering the results of the simple dilution method in which total contaminant concentrations, both dissolved and adsorbed to suspended particulates, are evaluated). This was due to the lack of sufficient and appropriate scientific data and understanding of the bioaccumulation of these contaminants by fish through these routes of exposure. Although there is no doubt that food and sediment provide exposure routes to fish downstream where the amount of 2378-TCDD and 2378-TCDF available (i.e., dissolved) for uptake across gills becomes much less, the assumption that fish remain in the area immediately downstream from the point of discharge is probably sufficiently conservative to compensate for any lack of food chain or sediment associated exposure components. In addition, as a check and a sensitivity comparison, the results of the simple dilution calculation are considered to provide an upper bound on fish tissue contaminant levels since 100% of the in-stream contaminants were assumed to be bioavailable.

The assumed fish tissue consumption rates also have an impact on study results. Actual fish tissue consumption rates vary over time, between individuals, and in different parts of the country. Therefore, in some cases this evaluation scenario may have underestimated risks, in other cases it may have overestimated risks. For example, the fish tissue consumption rate of 6.5 g/day is considered by EPA to be an average level of fish and shellfish consumption in the United states. The 6.5 g/day rate applies to a national average consumption rate of fish and shellfish; however, this rate may not be representative of fish consumption rates for recreational or subsistence fishermen. Therefore, risks estimated based on this consumption rate may, in some cases, significantly underestimate risk.

Although EPA recommends the use of 7Q10 as a design flow for stressed aquatic systems, use of 7Q10 receiving water flow rates does not necessarily result in the extreme worst-case scenario for aquatic life

impacts. 7Q10 is defined as the lowest consecutive seven-day average flow over a ten-year period. However, it is possible that even brief exposures (i.e., less than seven days) to high concentrations of 2378-TCDD and 2378-TCDF can result in toxic effects to aquatic organisms, and such effects may occur after an appreciable delay following only brief exposures.

It should also be noted that, if multiple discharges to the same waterbody are present, the actual risk associated with a waterbody may be substantially greater than estimated in this study. For example, there are several chlorine-bleaching pulp and paper mills that discharge to the Columbia River basin. Calculations in this report assume that each mill discharges to a receiving stream with no background level of contamination. Therefore, in the case of multiple discharges to a receiving stream, estimating risks from one mill alone can result in a significant underestimate of risk.

For each of the mills analyzed, the simple dilution exposure assessment method resulted in higher contaminant concentrations and greater aquatic life impacts and human health risks than did the EXAMS II water column method. This is because the simple dilution method assumes that all contaminants in the water column, both dissolved and adsorbed to suspended solids, are bioavailable. The EXAMS II water column method, on the other hand, considers only those contaminants in the dissolved phase. In those cases where the receiving water TSS was relatively low, the simple dilution and EXAMS II water column results are comparable. However, when suspended solids concentrations were high, the EXAMS II method estimated risks significantly lower than those predicted by the simple dilution method. Therefore, in those water bodies with relatively high suspended solids content, the EXAMS II method likely underestimated human health risks from consumption of contaminated fish tissue, since fish exposure to sediment-absorbed contaminants was not considered.

Study results indicate that the fish tissue exposure route poses a greater human cancer risk to the hypothetically exposed individual than does the drinking water exposure route. However, the upper bound cancer risk estimated from consumption of contaminated fish tissue based on the 6.5 g/day consumption rate and 5,000 BCF are relatively close to the cancer risk estimates based on ingestion of contaminated drinking water. It should be pointed out that fish tissue consumption may not pose a greater risk to the entire population than ingestion of contaminated drinking water. Determining which exposure route poses the greatest risk to the entire population would require knowledge of the number of persons eating contaminated fish tissue versus the number of persons who use contaminated surface water as a drinking water source. Such a population assessment was not conducted for this study.

A comparison of the cancer versus non-cancer risks associated with 2378-TCDD and 2378-TCDF discharges from pulp and paper mill effluents indicates that more mills would result in potential cancer risks than would result in non-cancer risks. However, the non-cancer risk may actually be the more sensitive end point. The cancer risk was estimated for the lifetime of a continuously exposed individual. The non-cancer risk, on the other hand, was predicted based on the consumption of a single portion of contaminated fish tissue. More of the population would likely be exposed to a single dose of contaminated fish tissue than to a lifetime of consuming contaminated fish tissue or drinking water taken from the vicinity of certain mills. In addition the single dose used to predict the noncancer effects was a relatively modest serving of 115 g (about 1/4 lb.) which is less than an enthusiastic person might eat at one sitting.

Included in Appendix Q are actual measured fish tissue contamination data from the National Bioaccumulation Study (NBS). It should be pointed out that the fish tissue contaminant concentrations measured in the NBS may not be representative of actual ambient conditions at a given mill. The NBS samples that were used for this evaluation were taken from sites close to pulp and paper mills using chlorine for bleaching. However, the sites may have been several miles from the mill, and not immediately downstream. In some cases the samples were taken several miles upstream of the mills. In addition, the NBS sample analyses were performed on composites composed of several fish of different sizes (within a given range) from which aliquots were prepared and analyzed. This sample analysis procedure would tend to "average" contaminant concentration values. In addition, finfish will migrate in and out of an area and therefore the fish sampled from the NBS were not likely to be exposed to a constant level of contamination throughout their lifetime, as was assumed for the simple dilution and EXAMS II assessments. Some of the fish evaluated in the NBS were

bottom-feeding fish which are rarely consumed by humans. Therefore, careful precautions should be taken before attempting to compare fish tissue contaminant levels found in NBS and those estimated in this study and used to predict risks.

The prediction of human health risk presented in this study apply to hypothetically exposed individuals in the immediate vicinity of discharges only, using previously described assumptions. To more completely assess the potential risks posed by discharges from pulp and paper mills that use chlorine to bleach pulp, it would be necessary to predict the population exposed to 2378-TCDD and 2378-TCDF from these discharges. Predictions of the population exposed to 2378-TCDD and 2378-TCDF in the environment using site specific effluent and receiving stream characteristics (as were used in this study) were beyond the scope and resources of this study. One consequence of not conducting a population assessment is uncertainty concerning the extent of human exposure and total population risks associated with discharges of 2378-TCDD and 2378-TCDF.

4.2 CONCLUSIONS

Taking into account the above assumptions, simplifications, and limitations, the results of this study indicate that there is a potential for high levels of 2378-TCDD and 2378-TCDF contamination in the water column resulting from surface water effluent discharges from many of the chlorine-bleaching pulp and paper mills investigated. These predicted contaminant concentrations could represent significant implications for human health and aquatic life. Each of the exposure assessment approaches used in this analysis predict upper bound risks that should be carefully considered by risk managers while assessing potential impacts associated with the discharge of 2378-TCDD and 2378-TCDF in chlorine-bleaching pulp and paper mill effluents.

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APPENDIX A

APPENDIX A .
EVALUATION AND SELECTION OF ESTIMATION METHOD

A.1 REQUIREMENTS OF TECHNICAL APPROACH

Although it is desireable to obtain maximum accuracy in exposure/risk assessments, a practical balance must be found between the difficulty of the analysis and the accuracy of its predictive estimates. In order to develop estimates of contaminant exposures and risks associated with 2378-TCDD and 2378-TCDF discharges at the 104 pulp and paper mills under consideration, a technically sound, yet feasible, method of estimation was required. This section discusses factors which were critical to the methods development/selection process. Critical factors considered were: 1) analysis of in-stream chemical transformation processes, 2) applicability of calculation methods, 3) assessment of the availability of environmental data, and 4) appraisal of model sensitivity.

A.1.1 Analysis Of In-Stream Chemical Transformations

The physical and chemical properties of 2378-TCDD and 2378-TCDF that influence their fate in natural waters were investigated. These properties are summarized in Table A.1, and discussed below.

A.1.1.1 Physical/Chemical Properties of 2378-TCDD

At 20°C, pure 2378-TCDD is a white crystalline solid with a density of 1.827 g/ml. In water, 2378-TCDD solubility (S) is between 0.0193 μg/l (at 22°C) and 0.317 μg/l (at 25°C). The octanol-water partition coefficient is large (log K_{ow} = 6.15-7.28) as expected, due to low water solubility.

Because of the high K_{ow}, 2378-TCDD discharged to surface waters is expected to adsorb to suspended and bedded sediments and also to bioconcentrate in fish. For example, a typical river might contain 50 mg/l suspended solids (TSS) with 1 percent organic carbon (f_{oc}). In such a river, the partition coefficient, K_p, for 2378-TCDD is:

$$K_p = 0.63\, f_{oc}\, K_{ow}$$
$$= (0.63)(0.01)(10^7) = 63{,}000$$

where an octanol-water partition coefficient of 10^7 has been used for the calculations. The fraction of 2378-TCDD in the dissolved state can be calculated as follows:

$$\frac{C}{C_t} = \frac{1}{1 + K_p \times TSS \times 10^{-6}}$$

$$= \frac{1}{1 + (63{,}000)\,(50)\,10^{-6}}$$

$$= 0.24$$

Consequently, most of the 2378-TCDD discharged to the river will be adsorbed to suspended and benthic sediments.

A second process that could influence the fate of 2378-TCDD is volatilization. A reliable indicator of the importance of volatilization is Henry's Law Constant, which for 2378-TCDD is 2.1×10^{-6} atm · m^3 /mol at 25°C. This is a relatively small value, and indicates that 2378-TCDD volatilizes very slowly.

Table A.1
Chemical/Physical Property Values

For 2378-TCDD:

Parameter	Value
Molecular Weight (MWT)	3.22E+02
Vapor Pressure - Torr (VAPR)	7.40E-10
Henry's Law Constant (HENRY)	2.10E-06
Octanol-Water Partition Coefficient (KOW)	5.01E+06
Partition Coefficient - Org. Carbon (KOC)	1.80E+07
Solubility - mg/L (SOL)	1.93E-05
Partition Coefficient - Biomass (KPB)	5.20E+05

For 2378-TCDF:

Parameter	Value
Molecular Weight (MWT)	3.06E+02
Vapor Pressure - Torr (VAPR)	9.21E-07
Henry's Law Constant (HENRY)	1.80E-02
Octanol-Water Partition Coefficient (KOW)	6.60E+05
Partition Coefficient - Org. Carbon (KOC)	4.10E+05
Solubility - mg/L (SOL)	2.00E-05
Partition Coefficient - Biomass (KPB)	8.28E+04

Although little information is available for other fate processes (hydrolysis, photolysis, and biotransformation), available data indicate that other fate processes are not significant. Therefore, dilution and adsorption to sediments are likely to be the primary processes which control the fate of 2378-TCDD in surface waters. Processes such as resuspention of sediments due to bottom turbulence or desorption of contaminants from particles may result in contaminants reentering the water column. However, the rates at which these processes occur and their significance to the overall fate of these contaminants is not certain. These processes are probably highly site-specific and intermittent, depending upon the physical and chemical characteristics of the receiving water. In this investigation, we have assumed steady-state conditions at which there is no net loss or gain of sediment or dioxin between the water column and benthic sediments.

A.1.1.2 Physical/Chemical Properties of 2378-TCDF

At 25°C, 2378-TCDF is a also a white crystalline solid. The octanol-water partition, like 2378-TCDD, is large (log K_{ow} = 5.82). Because of the high K_{ow}, 2378-TCDF discharged to surface waters is expected to adsorb to suspended and bedded sediments and also to bioconcentrate in fish.

Due to the tendency of both 2378-TCDD and 2378-TCDF to adsorb to sediment, it is necessary to calculate the partitioning of 2378-TCDD and 2378-TCDF between the dissolved and solid phases in the receiving waters. This requires determination of suspended solids concentrations in the receiving streams.

A.1.2 Applicability of Calculation Methods

Assessing both human health and aquatic life risks requires the initial determination of an estimated in-stream contaminant concentration. Once these concentrations have been calculated for the appropriate receiving water flow conditions, in the case of aquatic life risk determinations, subsequent comparisons against the OTS Hazard Assessment (U.S. EPA, 1989b) chronic guidelines for water quality are made. For human risks associated with exposure from fish and drinking water ingestions, dose and risk are calculated from in-stream contamination concentrations by employing a series of standard bioconcentration factors, bioavailability factors, and ingestion rates. This multiple exposure/risk approach allows for an analysis of the sensitivity of risk levels.

Two calculation methods for estimating highest worst-case in-stream contaminant concentrations were considered, a simple dilution calculation and a method using EXAMS II. A brief discussion of each follows.

A.1.2.1 Calculating Simple Dilution

The following simple dilution equation provides an estimate of the concentration of a contaminant downstream from a point source release into a flowing water body, after dilution of the substance by the receiving water (EPA, 1988b):

$$C = \frac{C_e Q_e}{Q_t}$$

where,

- C = concentration of substance in stream (mass/volume),
- C_e = concentration of substance in effluent (mass/volume),
- Q_e = effluent flow rate (volume/time), and
- Q_t = combined effluent and stream flow rate (volume/time).*

* assumes wastewater was not originally drawn from the receiving stream

Although this calculation is easily executed and provides a quantitative estimate of in-stream contaminant concentration which is limited in precision only by the precision of the input parameters, this calculation provides only the <u>total</u> in-stream contaminant concentration attributable to the point source. It does not provide a distribution of the contaminant between the dissolved and adsorbed states or the downstream pollutant concentration gradient. This exposure estimation assumes all the 2378-TCDD and 2378-TCDF dissolved in the water column and adsorbed to suspended solids are bioavailable.

A.1.2.2 EXAMS II Modeling

The Exposure Assessment Modeling System (EXAMS II) is a state-of-the-art surface water contaminant modeling system which can compute:

1) "Exposure: the expected . . . environmental concentrations due to a user-specified pattern of chemical loadings,

2) Fate: the distribution of the chemical in the system and the relative dominance of each transport and transformation process, and

3) Persistence: the time required for effective purification of the system . . . once the chemical loadings terminate." (Burns and Cline, 1985)

This system is accessible through OTS's Graphical Exposure Modeling System (GEMS) and can take advantage of a resident set of environmental data called the Canonical Environment Data Base (CEDB).

Once input parameters describing the environment (temperature, compartment geometry, receiving water flow, solids, organic carbon fraction, etc.), the chemical contaminant characteristics (molecular weight, vapor pressure, Henry's Law constant, K_{ow}, K_{oc}, solubility, etc.), and the loadings are entered, the model produces a report detailing the three sets of computations described immediately above.

Although this model is powerful and fulfills the requirements imposed by the need for estimates of dissolved contaminant concentration, it requires significant effort to develop and enter environmental data into the system. This can be addressed in part by making the CEDB available through GEMS. In GEMS, the user can identify the stream segment for which environment data are desired by entering the unique reach number for a particular stream segment. GEMS will access the CEDB, attempt to locate the appropriate environment, and, if successful, will prepare an environment data file which can be automatically loaded into EXAMS II. When CEDB data are not available for a stream environment, environmental data can be obtained through other data sources, such as STORET. This data must be entered directly to EXAMS II, it can not be automatically loaded.

Because EXAMS II best meets the requirements of this assessment and because it "is recommended for use over most other models" for surface water fate analysis (EPA, 1988b), EXAMS II was selected for estimating in-stream contaminant concentrations.

A.1.3 Assessing the Availability of Environmental Data

As discussed briefly above, in order to properly operate EXAMS II for this assessment, basic physical/chemical properties of 2378-TCDD and 2378-TCDF, as well as mill-specific contaminant loadings and descriptive environmental data must be entered. To determine the simplifying assumptions appropriate for this exposure assessment, a multi-phase approach to assessing data availability was undertaken.

A.1.3.1 Determining CEDB Data Quality and Availability

Initially, an inventory of the CEDB was conducted to determine if environmental data for each of the 79 mills known to discharge into free-flowing streams were available and reliable. Of the 28 sites for which data sets were available, significant gaps in each data set were observed. The available environmental data (in addition to arithmetic mean flow values) consist primarily of physical compartment geometry data, seepage flow, suspended sediment concentrations , and bulk density of benthic sediments. In most cases, the majority of the other parameters used by the EXAMS II model were not available for these 28 sites.

Because CEDB data were incomplete for the purpose of this study and because of specific requirements for exposure analyses for harmonic mean flow conditions for human health exposure estimates, the CEDB was not considered further as a source of environmental data for the purposes of this assessment.

A.1.3.2 Determining Data Availability Through REACH, STORET, and GAGE

A thorough interrogation of STORET data bases (indexed by reach numbers from the Reach File) indicated the availability of flow (from GAGE stations), total suspended solids, pH, and water temperature data for most of the mill sites.

STORET is a water quality data base maintained by EPA's Office of Water. It provides access to water quality sampling data from monitoring stations around the country. The GAGE System is maintained by the U. S. Geological Survey and provides stream flow gage station numbers and their locations (by reach, river, state, and region). It can provide continuous flow data from each gage station and can calculate average and 7Q10 flow conditions. The GAGE System can also be accessed through STORET. The REACH File presents an index for all river and stream reach segments. Each reach segment is given a unique identification number which can be used to access other reach-specific water quality data through STORET.

Of the 104 mills under consideration, 98 had available reach identification numbers by which data of interest could be extracted. Of these, 79 discharge to free flowing streams, 19 discharge to other waters or reach types (e.g., lakes, coastline, wide river shoreline). Reach characteristics are displayed in Table A.2. This information is provided in more detail in Appendix L.

Table A.2. Reach Types for 104 Pulp and Paper Mill sites

Total number of mills:	104
Mills not identified by Reach No.	6*
Mills identified by Reach No.	98
Mills discharging to free- flowing streams:	79
Regular reaches (R)	63
Source reaches (S)	8
Terminal reaches (T)	6
Source & terminal reaches (X)	2
Mills discharging to non free- flowing streams:	19
Lakes (L)	4
Open water reach (M)	1
Coastline (C)	8
Great Lakes (G)	1
Wide river shoreline (W)	5

*NOTE: Two of these mills are in Alaska, which has not been indexed in the Reach File. Information about four of the mills was vague; Reach Nos., if any, were not available for this assessment.

For each of the 79 mills discharging to free-flowing streams, nearby stream gages and monitoring stations were identified via STORET. For each of these mills, the nearest streamgage with a relatively long recent record (generally greater than 15 years) for which there is information available in the STORET flow file, was selected and manually plotted on a reach map. In a few cases, two gages were selected if the gages bracketed the mill or if they represented two upstream branches. Out of the 79 mills, 57 are gaged based on this analysis and 22 are not gaged. Several of the ungaged streams are major rivers such as the Ohio River, Mississippi River, Susquehanna River for which there is adequate gaging information at other locations. For those pulp and paper mills not discharging to free flowing streams and some mills discharging to free flowing streams

for which gaging information is not avaialble, contaminant concentrations were based on dilution factors for these water bodies (provided by EPA Regional Offices).

For the 79 mills discharging to free-flowing streams, both an INDEX run and an INVENTory run were conducted on STORET. This identified monitoring stations (and gages and dischargers) on a flow path from the mills. Based on this information, a schematic (stick diagram) of the streams 5 miles downstream to 10 miles upstream of each mill was prepared. Dischargers and monitoring stations were identified on the schematic. (See Appendix M for an example of this information for one mill). For monitoring stations, the schematic indicates whether sample information was available for temperature (T), pH (P), and solids (S). Each mill was classified as follows:

0	=	no quality data available (8 mills)
1	=	only downstream data available (within 5 miles) (9 mills)
2	=	upstream data available for 1 or 2 of the parameters (11 mills)
3	=	upstream data available (within 10 miles) for S (51 mills)

Mill-specific information availability for mills discharging to free flowing streams is provided in more detail in Appendix N.

Based on the findings of the data survey described above, it was concluded that sufficient data were available to create EXAMS II environmental files for the 79 mills located on free-flowing streams or rivers.

Because EXAMS II requires stream flow data as input to calculate in-stream contaminant concentrations, and because flows for open water bodies are not available, it was necessary to back-calculate "surrogate" water body flows for direct dischargers to open water bodies based on known plant flows, and the dilution factors for the mills. The following calculation was used to determine surrogate water body flows for direct open water discharges:

$$F_o = (D * F_p) - F_p$$

where,

F_o	=	surrogate open water body flow
F_p	=	mill plant flow
D	=	dilution factor

The resulting estimated flow values were then used as input for the EXAMS II assessments. This procedure allowed the use of EXAMS II to estimate partitioning of the contaminant between dissolved and solid forms in open water discharge cases. This procedure was also used to estimate flow values for some free flowing streams for which no gaging information was available.

A.1.4 Appraising Model Sensitivity

In order to determine the environmental data parameter variations to which the EXAMS II model was sensitive -- under steady state conditions and given known 2378-TCDD and 2378-TCDF physical/chemical properties -- standard boilerplate environment and loading files were created. Environmental data parameters were varied individually over wide ranges. Resulting in-stream concentration variations were noted, if any.

As expected, due to 2378-TCDD and 2378-TCDF affinity for adsorption to solids, dramatic variations in effluent and receiving water suspended solids levels produced dramatic variations in resulting calculated in-stream and benthic solids contaminant concentrations. Because variations of these parameters affected calculated contaminant concentrations and because these data were readily available through STORET, it was determined that mill-specific values of suspended solids for each of the 79 mills discharging to free-flowing streams would be obtained and supplied to the EXAMS II model. For discharges to open water bodies, a default suspended sediment value of 10 mg/l was used and supplied to the EXAMS II model.

In-stream contaminant concentrations (at steady-state) were not, however, significantly affected by variations in stream temperature and compartment size. Default values for stream temperature and compart-

ment geometry were used for all sites. Remaining environmental parameters (e.g., meteorological conditions, and others) were not considered to be important to the estimation of in-stream contaminant concentrations. Concentrations for each mill were calculated using default values for these parameters.

Appendix C presents a list of environmental and effluent parameter values used for each site, including default values.

APPENDIX B

APPENDIX B
DATA SOURCES

B.1 EFFLUENT DATA

Effluent sampling results for each of the 104 pulp and paper mills were provided by the joint EPA/paper industry 104-mill study. Continuous loading values (mass/time) for each effluent sample were determined by multiplying the concentration of the contaminant (mass/vol) by the effluent flow rate (vol/time). Plant flow data were also supplied by the 104-mill study. For some mills, effluent flow data provided by the EPA Regions and the States were used which did not agree with the flow data provided by the 104-mill study.

Effluent sampling data and plant flow data are included in Appendix C. For those samples in which effluent contaminant concentrations were below the detection limit of the analytical instrument (indicated as "ND" in Appendix C), the value used in the exposure assessment is 1/2 the detection limit. For those samples for which contaminant concentrations in the effluent were not quantified by the analytical lab, the value reported is annotated with an "NQ." No loadings, concentrations, or risks were estimated based on "NQ" samples.

B.2 RECEIVING WATER STREAM FLOW DATA AND ADJUSTMENTS

B.2.1 Low Flows for Aquatic Life Effects

For the calculation of the chronic exposure levels for aquatic life, in-stream dissolved contaminant concentration were calculated using the hydrologically-based 7Q10 low flow for all mills on streams or rivers.

B.2.2. Harmonic Mean Flows For Human Health Effects

For each of the 79 mills discharging to free-flowing streams, in-stream contaminant concentrations were calculated using the harmonic mean flow for the receiving water. These concentrations were used to calculate human exposures to the contaminants. The harmonic mean flow is defined as the reciprocal of the mean value of the reciprocal of individual values.

Harmonic mean flow values were obtained/calculated in the following manner.

- Identify a stream gage representative of the flow in the receiving stream.
- Access the daily flow values for the period of record from the STORET/GAGE daily flow file.
- Adjust the daily flow values to reflect likely differences in flow, if any, between the gage site and the mill.
- Compute the harmonic mean using SAS.
- Examine the results and adjust the HMF value, if necessary.

A description of the specific methodology which was used follows. For each mill, a stream gage was selected from the STORET/GAGE daily flow file. The criteria used in selecting a gage were: locational relationship of the gage and the mill, and length of the record. Generally, the gage with a sufficiently long record (usually 15 years) that was located closest (coincidental drainage area) to the mill was selected. In most cases, the reach location (reach and milepoint) for gages were known from inspection of the IFD file. This is referred to as Method 1 in the output results (Appendix P). For other gages, the latitude/longitude values available in the STORET/GAGE daily flow file were used to determine the gage location on maps. This is referred to as Method 2. For a few mills, there were no gages located on a direct flow path to the mill. In these cases, a nearby gage (usually in the same hydrologic catalog unit) with similar size drainage area was identified and used. This is referred to as Method 3. Finally, for three mills, the available reach plot did not provide a clear description of the receiving stream. For these cases (Method 4), no estimates of the stream flows were made, since site-specific stream configurations were needed to understand the flow regime.

Since, in almost all cases, the gage is not located at the mill site, adjustments in the gage information were required. These adjustments were made based on drainage area ratios and discharges at the mill. Either of two separate gaging scenarios were identified (see Figure B.1): a) the gage was located upstream of the mill; or b) the gage was located downstream of the mill. In either case, a "drainage area factor" was calculated as follows:

DRAINAGE AREA FACTOR = drainage area at mill/drainage area at gage

Drainage area values were available from the STORET daily flow file for gages. Drainage areas for mills were estimated by scaling off areas from the reach maps. If the drainage area factor was greater than 1.05 or less than 0.95, then the individual daily flow values were multiplied by this factor prior to calculating the harmonic mean. If the factor was between 0.95 and 1.05, then it was assumed that the gage was sufficiently representative of the flow at the mill such that no adjustment was needed.

The second potential adjustment applied to those cases where the gage was located upstream of the mill and the discharge from the mill was of sufficient magnitude that it would affect the flow in the stream. If the mill discharge exceeded 5% of the average streamflow at the mill (based on the mean flow value available from the REACH File), then the mill discharge flow was added to the area-adjusted stream flow values prior to calculating the harmonic mean. For the few cases where a non-connected nearby gage was used (Method 3), the mill discharge was added to the area-adjusted flow values.

Following the calculation of the harmonic mean, the results were examined for unreasonably large differences between the harmonic mean and arithmetic mean. This would generally be caused by a significant number of very low stream flow values in the historical record. For those cases where there was a significant difference, the actual stream flow records were examined to determine whether the flows appeared to be reasonable or contain data errors. If there were obvious data errors (either zero flows inter-mixed in larger flows or very high flows), then these data points were eliminated prior to recalculating the harmonic mean. True high flows from episodic events, such as heavy rains and floods, were retained. Additionally, if the harmonic mean was significantly less than the arithmetic mean and the gage was upstream of the mill, then the "5% rule" was reapplied to determine whether the mill discharge should be added to the streamflow values prior to recalculating the harmonic mean.

The results of the harmonic mean calculations are presented in Appendix P for the 79 mills on free flowing streams plus four mills located on the Columbia River (which is identified in the Reach File as a wide river, but for which good stream flow information is available). For the three gages for which estimates were not made, detailed diagrams of the discharge location and stream configuration are needed. In each of these cases, the Reach File maps showed "loops" in the stream (i.e., the stream bifurcated near the mill) or other anomalous situations. It should be noted that some changes in the flow rates used in the assessment were made based on comments received from the EPA Regions.

B.3 TOTAL SUSPENDED SOLIDS DATA AND ADJUSTMENTS

Due to the significant tendency of 2378-TCDD and 2378-TCDF to adsorb to sediment, it is necessary to calculate the partitioning of 2378-TCDD and 2378-TCDF between the dissolved and solid phases in the receiving waters. This requires site-specific data for suspended solids concentrations in the receiving streams.

For each of the mills, an estimate of the total solids in the receiving stream (immediately upstream of the discharge point) was required. Ideally, this estimate should correspond to a flow value approximating the harmonic mean flow. Suspended solids concentrations are estimated based on historical values from a single monitoring station upstream of and in the vicinity of the mill. A two-step search was conducted: 1) stations within 10 miles upstream, on the same hydrologic stream level, and designated as "ON" the reach in STORET, and 2) if that did not detect a usable station, then a larger search (usually 25 miles but sometimes 50-100 miles for large rivers) with no restriction concerning the ON-OFF code. A station was selected based on closeness to mill, length of record and vintage of data. The station description was checked manually to ensure that the station was actually on the same mainstem as the mill. The results of this analysis are presented in Appendix O.

An adjustment ratio was used in developing the final estimated suspended solids content to ensure that the predicted total solids in the receiving stream corresponded to a flow value approximating harmonic mean flow. The ratio is the harmonic mean flow (at the selected stream gage) divided by the arithmetic mean flow, and the adjusted suspended solids is this ratio multiplied by the mean suspended solids. This calculation assumes that suspended solids are linearly related to flow and that as flow goes to zero so does suspended solids. Results are presented in Appendix O for 62 mills (out of the 79 discharging to free flowing streams and 4 discharging to the Columbia River). For the remaining mills, no monitoring stations were found. For some of the stations used in the analysis, very few observations were available. Some TSS values were also provided by the EPA Regions.

APPENDIX C

Table C.1
Raw Input Data

NPDES NUMBER	SAMPLEID	COMPANY	CITY	GRP ID[1]	HARMONIC MEAN FLOW (m^3/hr.)	7Q10 LOW FLOW (m^3/hr.)	TSS IN MILL EFFLUENT (mg/l)	ADJ TSS IN RECG WATERS (HARM MEAN Q) (mg/l)[2]	PLANT FLOW (mgd)	TCDD CONC. (ppq)	TCDD NON-DETECT[3]	TCDD LOAD (kg/hr)	TCDF CONC. (ppq)	TCDF NON-DETECT[3]	TCDF LOAD (kg/hr)
Region I															
ME0001872	M17EC	Georgia-Pacific Corp.	Woodland	1	184716	46505	248.9	1.7	23	6.8		2.5E-08	25		9.1E-08
ME0001937	RG1-86388	International Paper Co.	Jay	1	321317	159313	396.9	4.7	40	88		5.6E-07	420		2.6E-06
ME0002003	M11EC	Lincoln Pulp and Paper	Lincoln	1	578819	272426	102.5	1.7	10.47	32		5.3E-08	130		2.1E-07
ME0002020	M8EC	James River Corp.	Old Town	1	856709	336516	127.1	1.7	16	39		9.8E-08	130		3.3E-07
ME0002054	M82EC	Boise Cascade Corp.	Rumford	1	291652	145469	399.0	5.4	28.8	120		5.5E-07	570		2.6E-06
ME0002321	M30EC	Scott Paper Co.	Westbrook	1	52092	19420	144.5	4.7	19	6.3		1.9E-08	12		3.6E-08
ME0021521	M61EC	Scott Paper Co.	Hinckley	1	474839	165969	224.7	4.7	24.9	16		6.3E-08	63		2.5E-07
ME0021521	M61EC1	Scott Paper Co.	Hinckley	1	474839	165969	224.7	4.7	24.9	19		7.5E-08	100		3.9E-07
NH0000655	BM89EC	James River Corp.	Berlin	1	213871	90931	302.0	4.0	17.4	17		4.7E-08	61		1.7E-07
NH0000655	M89EC	James River Corp.	Berlin	1	213871	90931	302.0	4.0	17.4	59		1.6E-07	1200		3.3E-06
Region II															
NY0004413	M9EC	International Paper Co.	Ticonderoga	2A	39755	39755	128.6	10.0	14.8	18		4.2E-08	150		3.5E-07
NY0004413	M9EC1	International Paper Co.	Ticonderoga	2A	39755	39755	128.6	10.0	14.8	24		5.6E-08	160		3.7E-07
NY0005525	M41EC	Finch & Pruyn & Co., Inc.	Glen Falls	3D	264434	49248	166.7	4.0	14.9	7.9	ND	1.9E-08	2.9	ND	6.8E-09
Region III															
MD0021687	M62EC	Westvaco Corp.	Luke	4H	29665	4057	232.4	12.7	19.78	16		5.0E-08	49		1.5E-07
MD0021687	M62EC	Westvaco Corp.	Luke	4L	29665	4057	232.4	12.7	19.78	16		5.0E-08	49		1.5E-07
PA0002143	M57EAC	Penntech Papers, Inc.	Johnsonburg	3B	39363	8154	68.3	16.8	4.8	6.8	ND	5.1E-09	14		1.1E-08
PA0002143	M57EBC	Penntech Papers, Inc.	Johnsonburg	1	39363	8154	20.2	16.8	6.23	9.7		9.5E-09	65		6.4E-08
PA0008265	M13EDO	Appleton Papers, Inc.	Roaring Springs	3B	9888	1239	26.4	16.9	4.5	11	ND	7.8E-09	18		1.3E-08
PA0008869	M64EC20	P.H. Glatfelter Co.	Spring Grove	3B	6422	2039	54.7	27.0	12.6	8.4	ND	1.7E-08	26		5.2E-08
PA0008885	M42EC	Procter & Gamble Co.	Mehoopany	3B	358525	55293	94.4	6.4	2.4	9.7	ND	3.7E-09	2.8		1.1E-09
PA0026301	M103ECX	International Paper^fn	Erie	2CH	EZ	Z	353.9	10.0	14.2	24		5.4E-08	68		1.5E-07
PA0026301	M103ECX	International Paper^fn	Erie	2CL	EZ	Z	353.9	10.0	14.2	24		5.4E-08	68		1.5E-07
VA0003115	M74EC140	Chesapeake Corp.	West Point	1	41082	6432	470.6	13.2	14.9	16		3.8E-08	96		2.3E-07
VA0003646	BM28EC	Westvaco Corp.	Covington	3B	31091	9072	164.4	13.2	26.48	7.2	ND	3.0E-08	16		6.7E-08
VA0003646	M28EC	Westvaco Corp.	Covington	1	31091	9072	164.4	13.2	26.48	180		7.5E-07	520		2.2E-06
VA0003646	M28EC1	Westvaco Corp.	Covington	3B	31091	9072	164.4	13.2	26.48	18	ND	7.5E-08	173		7.2E-07
VA0003646	M28EC2	Westvaco Corp.	Covington	1	31091	9072	164.4	13.2	26.48	12		5.0E-08	132		5.5E-07
VA0004162	UCF1000	Union Camp Corp.	Franklin	1	35159	4373	439.2	0.3	125.2	68		1.3E-06	71		1.4E-06
Region IV															
AL0000396	M40EC	Champion International	Courtland	2A	4325625	4325625	120.4	10.0	59	77		7.2E-07	340		3.2E-06
AL0002682	M67EC	Container Corp. of America	Brewton	3C	100921	17330	73.8	5.9	35.7	6.5		3.7E-08	10	ND	5.6E-08
AL0002755	M65EC	Boise Cascade Corp.	Jackson	1	825107	160149	66.3	10.2	19.5	95		2.9E-07	540		1.7E-06
AL0002755	M65EC1	Boise Cascade Corp.	Jackson	1	825107	160149	66.3	10.2	19.5	120		3.7E-07	630		1.9E-06
AL0002780	M71EC	International Paper Co.	Mobile	1	1704447	714706	405.2	12.5	29.7	100		4.7E-07	850		4.0E-06
AL0002801	M26EC210	Scott Paper Co.	Mobile	1	1704447	714706	402.2	12.5	69	14		1.5E-07	19		2.1E-07
AL0002828	M101EC	Gulf States Paper Corp.	Demopolis	1	517043	91747	281.7	9.7	27	38		1.6E-07	110		4.7E-07
AL0003018	M88EC	International Paper Co.	Selma	1	1496080	532364	316.6	18.2	27	81		3.4E-07	310		1.3E-06
AL0003158	M36EC	Kimberly-Clark Corp.	Coosa Pines	1	640595	182606	257.4	18.2	43.8	35		2.4E-07	74		5.1E-07

Table C.1 (continued)

NPDES NUMBER	SAMPLEID	COMPANY	CITY	GRP ID[1]	HARMONIC MEAN FLOW (m^3/hr.)	7Q10 LOW FLOW (m^3/hr.)	TSS IN MILL EFFLUENT (mg/l)	ADJ TSS IN RECG WATERS (HARM MEAN Q) (mg/l)[2]	PLANT FLOW (mgd)	TCDD CONC. (ppq)	TCDD NON-DETECT[3]	TCDD LOAD (kg/hr)	TCDF CONC. (ppq)	TCDF NON-DETECT[3]	TCDF LOAD (kg/hr)
AL0003301	M96EC	James River Corp.	Butler	1	517043	91747	118.4	11.2	39	23		1.4E-07	72		4.4E-07
AL0025968	M21EC	Alabama River Pulp	Claiborne	1	1524522	514494	395.8	12.2	22.4	41		1.4E-07	250		8.8E-07
AL0025968	M21EC1	Alabama River Pulp	Claiborne	1	1524522	514494	395.8	12.2	22.4	40		1.4E-07	250		8.8E-07
AL0025968	M21EC2	Alabama River Pulp	Claiborne	1	1524522	514494	395.8	12.2	22.4	46		1.6E-07	210		7.4E-07
FL0000701	M90EC	ITT-Rayonier, Inc.	Fernandina Beach	2A	136266	136266	361.2	10.0	17.6	7		1.9E-08	35		9.7E-08
FL0000876	M91ECO	Buckeye Cellulose	Perry	1	336	102	337.9	1.9	55.23	27		2.4E-07	80		7.0E-07
FL0002526	CP1000	Champion International	Cantonment	3B	3058	255	86.6	4.9	21	11	ND	3.6E-08	38		1.3E-07
FL0002631	M102EAC	Stone Container Corp.	Panama City	2CH	166461	166461	479.6	10.0	21.5	8.4	ND	2.8E-08	7.9		2.7E-08
FL0002631	M102EAC	Stone Container Corp.	Panama City	2CL	166461	166461	479.6	10.0	21.5	8.4	ND	2.8E-08	7.9		2.7E-08
FL0002631	M102EBC	Stone Container Corp.	Panama City	2CH	166461	166461	479.6	10.0	21.5	6.9		2.3E-08	18		6.1E-08
FL0002631	M102EBC	Stone Container Corp.	Panama City	2CL	166461	166461	479.6	10.0	21.5	6.9		2.3E-08	18		6.1E-08
FL0002763	M24EC	Georgia-Pacific Corp.	Palatka	2A	4092	4092	61.4	1.7	37	16		9.3E-08	38		2.2E-07
FL0020206	M94EC1	St. Joe Paper Co.	Port St. Joe	4H	15291	7646	0.0	10.0	35	21		1.2E-07	60		3.3E-07
FL0020206	M94EC1	St. Joe Paper Co.	Port St. Joe	4L	15291	7646	0.0	10.0	35	21		1.2E-07	60		3.3E-07
GA0001953	M55EC	Gilman Paper Co.	St. Marys	2B	101125	101125	328.3	8.4	40	6.5	ND	4.1E-08	17		1.1E-07
GA0002801	M83EC	Federal Paper Board Co.	Augusta	1	655682	448539	311.8	8.4	30	16		7.6E-08	47		2.2E-07
GA0003620	M84EAC	ITT-Rayonier, Inc.	Jesup	1	711545	218051	409.6	8.4	59.7	24		2.3E-07	4.2		4.0E-08
GA0003620	M84EBC	ITT-Rayonier, Inc.	Jesup	1	711545	218051	409.6	8.4	59.7	23		2.2E-07	16		1.5E-07
GA0003654	M87EC	Brunswick Pulp and Paper	Brunswick	2A	172545	172545	559.1	10.0	52	30		2.5E-07	68		5.6E-07
GA0003654	M87EC1	Brunswick Pulp and Paper	Brunswick	2A	172545	172545	559.1	10.0	52	30		2.5E-07	50		4.1E-07
GA0049336	M22EC10	Buckeye Cellulose	Oglethorpe	3B	213056	68606	39.2	8.4	10	12	ND	1.9E-08	26		4.1E-08
KY0000086	M78EC	Westvaco Corp.	Wickliffe	1	32129740	10194060	66.8	128.6	22.4	35		1.2E-07	150		5.3E-07
KY0001716	M63EC	Willamette Industries	Hawesville	3D	5729164	1190666	189.9	50.4	12	11	ND	2.1E-08	8	ND	1.5E-08
MS0000213	M97EC	International Paper Co.	Natchez	1	40717114	13558100	486.8	221.9	38	38		2.3E-07	220		1.3E-06
MS0002674	M34EC	International Paper Co.	Moss Point	2CH	24460	24460	173.0	11.7	17.2	160		4.3E-07	920		2.5E-06
MS0002674	M34EC	International Paper Co.	Moss Point	2CL	24460	24460	173.0	11.7	17.2	160		4.3E-07	920		2.5E-06
MS0031704	BM35SEC30	Leaf River Forest Products	New Augusta	1	162086	62999	71.1	11.7	17.5	79		2.2E-07	100		2.8E-07
MS0031704	M35SEC30	Leaf River Forest Products	New Augusta	1	162086	62999	71.1	11.7	17.5	200		5.5E-07	410		1.1E-06
NC0000272	M47G100-500	Champion International	Canton	1	29767	6065	197.7	3.3	44	15		1.0E-07	7.2		5.0E-08
NC0000680	M86ECO	Weyerhaeuser Co.	Plymouth	2A	55461	55461	140.4	7.7	39	320		2.0E-06	4000		2.5E-05
NC0003191	M6EC	Weyerhaeuser Co.	New Bern	1	122329	24466	74.1	4.4	23.9	44		1.7E-07	180		6.8E-07
NC0003298	M16EC	Federal Paper Board Co.	Riegelwood	1	232119	64630	240.8	6.5	28	28		1.2E-07	61		2.7E-07
SC0000868	M70EC	International Paper Co.	Georgetown	2A	4424	4424	423.2	15.4	25	640		2.8E-06	1600		7.1E-06
SC0000868	M70EC1	International Paper Co.	Georgetown	2A	4424	4424	423.2	15.4	25	490		2.2E-06	1500		6.6E-06
SC0001015	M23EC	Bowater Corp.	Catawba	1	289409	90727	398.8	5.1	33.6	24		1.3E-07	42		2.2E-07
SC0038121	M93EC	Union Camp Corp.	Eastover	1	394510	99494	7.9	15.4	8.9	20		2.8E-08	53		7.4E-08
TN0001643	M73EC	Mead Corporation	Kingsport	1	152911	51378	191.8	5.6	9.7	6		9.2E-09	44		6.7E-08
TN0002356	M75EC	Bowater Corp.	Calhoun	3D	224269	62286	193.2	5.2	35	6.8	ND	3.8E-08	5.5	ND	3.0E-08
Region V															
MI0000027	ML802	Mead Corporation	Escanaba	3B	58004	17493	132.8	4.4	35	17	ND	9.4E-08	50.8		2.8E-07
MI0027391	M92EC	Scott Paper Co.	Muskegon	4H	153624	71797	3468.6	5.1	15.2	8.4	ND	2.0E-08	42		1.0E-07
MI0027391	M92EC	Scott Paper Co.	Muskegon	4L	153624	71797	3468.6	5.1	15.2	8.4	ND	2.0E-08	42		1.0E-07

Table C.1 (continued)

NPDES NUMBER	SAMPLEID	COMPANY	CITY	GRP ID[1]	HARMONIC MEAN FLOW (m^3/hr.)	7Q10 LOW FLOW (m^3/hr.)	TSS IN MILL EFFLUENT (mg/l)	ADJ TSS IN RECG WATERS (HARM MEAN Q) (mg/l)[2]	PLANT FLOW (mgd)	TCDD CONC. (ppq)	TCDD NON-DETECT[3]	TCDD LOAD (kg/hr)	TCDF CONC. (ppq)	TCDF NON-DETECT[3]	TCDF LOAD (kg/hr)
MI0042170	Q14E	Champion International	Quinnesec	1	192464	49186	108.8	3.3	12.8	9		1.8E-08	66		1.3E-07
MN-------	M38ECO	Potlatch Corp.	Cloquet	4H	131227	L	194.6	3.6	13.29	24		5.0E-08	46		9.6E-08
MN-------	M38ECO	Potlatch Corp.	Cloquet	4L	131227	L	194.6	3.6	13.29	24		5.0E-08	46		9.6E-08
MN0001643	DE020922	Boise Cascade Corp.	International Falls	1	1180268	5790	110.9	3.6	21.8	120		4.1E-07	2200		7.6E-06
OH0004481	DE026013	Mead Corp.	Chillicothe	3B	15138	2936	334.6	2.7	28.8	3	ND	1.4E-08	11		5.0E-08
WI0000663	M46EBC	Badger Paper Mills, Inc.	Peshtigo	1	63713	6871	5.0	4.2	1.51	4.5		1.1E-09	110		2.6E-08
WI0000663	M46EBCX	Badger Paper Mills, Inc.	Peshtigo	3B	63713	6871	5.0	4.2	1.51	5.3	ND	1.3E-09	130		3.1E-08
WI0001261	M72EAC	James River Corp.	Green Bay	1	301642	32774	302.6	13.7	9.96	11		1.7E-08	61		9.6E-08
WI0003212	M25EC	Pentair, Inc.	Park Falls	3B	32519	27942	48.7	3.5	4.7	5.4	ND	4.0E-09	4.8		3.6E-09
WI0003379	M54EC	Wausau Paper Mills Co. 1	Brokaw	3B	223760	94458	50.7	3.6	8.43	4.2	ND	5.6E-09	14		1.9E-08
WI0003379	M54ECX	Wausau Paper Mills Co. 2	Brokaw	3D	223760	94458	50.7	3.6	8.43	4.9	ND	6.5E-09	2.1	ND	2.8E-09
WI0003620	M77EC	Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	1	317545	123175	212.7	6.3	30.32	40		1.9E-07	320		1.5E-06
WI0020991	M72EBC	James River Corp.	Green Bay	4H	301642	32774	302.6	13.7	2.71	8.5	ND	3.6E-09	29		1.2E-08
WI0020991	M72EBC	James River Corp.	Green Bay	4L	301642	32774	302.6	13.7	2.71	8.5	ND	3.6E-09	29		1.2E-08
WI0026042	M29EC	Weyerhaeuser Co.	Rothchild	1	254240	109005	37.4	4.9	6.26	12		1.2E-08	24		2.4E-08
WI0030651	M46EAC	Badger Paper Mills, Inc.	Peshtigo	4H	63713	6871	5.0	4.2	3.7	9.8		5.7E-09	280		1.6E-07
WI0030651	M46EAC	Badger Paper Mills, Inc.	Peshtigo	4L	63713	6871	5.0	4.2	3.7	9.8		5.7E-09	280		1.6E-07
WI0030651	M46EACX	Badger Paper Mills, Inc.	Peshtigo	4H	63713	6871	5.0	4.2	3.7	6.4	ND	3.7E-09	170		9.9E-08
WI0030651	M46EACX	Badger Paper Mills, Inc.	Peshtigo	4L	63713	6871	5.0	4.2	3.7	6.4	ND	3.7E-09	170		9.9E-08
WI0037991	21	Consolidated Papers, Inc.	Wisconsin Rapids	3D	317545	118006	337.9	6.7	19.6	49	ND	1.5E-07	34	ND	1.1E-07
Region VI															
AR0001210	M68EC	Georgia-Pacific Corp.	Crosset	1	241497	10999	364.4	13.0	45	96		6.8E-07	370		2.6E-06
AR0001970	M51EC	International Paper Co.	Pine Bluff	1	996979	141422	308.1	6.5	27.55	110		4.8E-07	1100		4.8E-06
AR0002968	M20EC	Nekoosa Papers, Inc.	Ashdown	1	402156	54497	152.0	42.0	38.5	41		2.5E-07	94		5.7E-07
AR0035823	M18EC	Potlatch Corp.	McGhee	4H	37523825	11237198	69.1	130.4	12.2	40		7.7E-08	100		1.9E-07
AR0035823	M18EC	Potlatch Corp.	McGhee	4L	37523825	11237198	69.1	130.4	12.2	40		7.7E-08	100		1.9E-07
LA0003468	M52EC	James River Corp.	St. Francesville	1	35530784	10289660	211.2	107.3	28.3	82		3.7E-07	320		1.4E-06
LA0005258	M1EC	Georgia-Pacific Corp.	Zachary	3A	Q	Q	334.7	130.7	26	190		7.8E-07	0	NQ	0.0E+00
LA0005258	M1ECX	Georgia-Pacific Corp.	Zachary	1	35530784	10294421	334.7	130.7	26	160		6.6E-07	3000		1.2E-05
LA0007561	M85EC	International Paper Co.	Bastrop	5	F	163	300.7	10.0	25.4	330		1.3E-06	1600		6.4E-06
LA0007927	M58EC	Boise Cascade Corp.	Deridder	1	12233	2416	215.7	10.0	23.21	9.2		3.4E-08	44		1.6E-07
TX0000167	M99EC	International Paper Co.	Texarkana	1	24874	22804	494.9	0.7	38.36	13		7.9E-08	43		2.6E-07
TX0000167	M99EC1	International Paper Co.	Texarkana	1	24874	22804	494.9	0.7	38.36	18		1.1E-07	44		2.7E-07
TX0001643	DF024512	Champion International	Lufkin	3D	19980	153	78.4	1.5	19	7	ND	2.1E-08	7	ND	2.1E-08
TX0003891	M3EC	Temple-Eastex, Inc.	Evadale	1	150464	29339	175.9	7.4	55	88		7.6E-07	100		8.7E-07
TX0006041	M2EC	Simpson Paper Co.	Pasadena	3E	N	N	2736.9	10.0	21.11	0	NQ	0	1400		4.7E-06
TX0006041	M2EC	Simpson Paper Co.	Pasadena	3E	N	N	2736.9	10.0	21.11	0	NQ	0	1400		4.7E-06
TX0006041	M2EC	Simpson Paper Co.	Pasadena	3E	N	N	164.4	10.0	21.11	0	NQ	0	1400		4.7E-06
TX0053023	M15EC	Champion International	Houston	2B	5729	5729	115.9	3.8	15.54	5.5	ND	1.3E-08	86		2.1E-07
Region VIII															
MT0000035	M27EC	Stone Container Corp.	Missoula	3C	282885	54222	61.4	18.0	6.41	3.1		3.1E-09	7.6	ND	7.7E-09

Table C.1 (continued)

NPDES NUMBER	SAMPLEID	COMPANY	CITY	GRP ID[1]	HARMONIC MEAN FLOW (m^3/hr.)	7Q10 LOW FLOW (m^3/hr.)	TSS IN MILL EFFLUENT (mg/l)	ADJ TSS IN RECG WATERS (HARM MEAN Q) (mg/l)[2]	PLANT FLOW (mgd)	TCDD CONC. (ppq)	TCDD NON-DETECT[3]	TCDD LOAD (kg/hr)	TCDF CONC. (ppq)	TCDF NON-DETECT[3]	TCDF LOAD (kg/hr)
Region IX															
AZ-------	M100EC	Stone Container Corp.	Snowflake	2D	EZ	ZL	6815.5	10.0	13.31	5.5		1.2E-08	39		8.2E-08
CA0004065	M98EC	Simpson Paper Co.	Anderson	1	678313	261080	58.1	6.7	31	250		1.2E-06	8400		4.1E-05
CA0004847	M106EC	Gaylord Container Corp.	Antioch	5	F	L	52.0	10.0	11	49		8.5E-08	800		1.4E-06
CA0005282	M43ECO	Simpson Paper Co.	Fairhaven	2A	149317	149317	366.6	10.0	21	100		3.3E-07	660		2.2E-06
CA0005894	M70EC10	Louisiana Pacific Corp.	Samoa	2A	172342	172342	358.7	10.0	16.04	67		1.7E-07	320		8.1E-07
Region X															
AK0000531	M5EC-1	Alaska Pulp Corp.	Sitka	2B	22753	22753	595.7	10.0	24	7.7	ND	2.9E-08	32		1.2E-07
AK0000922	M31EAC	Ketchikan Pulp & Paper 1	Ketchikan	2B	149317	149317	83.8	10.0	31.5	6.7	ND	3.3E-08	5.3	ND	2.6E-08
AK0000922	M31EBC	Ketchikan Pulp & Paper 2	Ketchikan	2A	49772	49772	83.8	10.0	31.5	15		7.5E-08	7.2		3.6E-08
ID0001163	M56EC	Potlatch Corp.	Lewiston	1	3639279	1233491	588.7	18.5	34.4	71		3.9E-07	360		2.0E-06
ID0001163	M56EC1	Potlatch Corp.	Lewiston	1	3639279	1233491	588.7	18.5	34.4	79		4.3E-07	320		1.7E-06
OR0000795	8637-4645	James River Corp.	Clatskanie (Wauna)	1	19164833	L	246.6	21.5	40.8	15		9.7E-08	120		7.7E-07
OR0001074	M19EC	Pope & Talbot, Inc.	Halsey	1	774749	259184	116.1	7.0	11.58	30		5.5E-08	82		1.5E-07
OR0020834	M76ECO	Boise Cascade Corp.	St. Helens	4H	18349308	L	333.4	21.5	35.09	22		1.2E-07	100		5.5E-07
OR0020834	M76ECO	Boise Cascade Corp.	St. Helens	4L	18349308	L	333.4	21.5	35.09	22		1.2E-07	100		5.5E-07
WA0000078	M53EC	Longview Fibre Co.	Longview	3B	19164833	L	454.7	21.5	62.5	4.6	ND	4.5E-08	57		5.6E-07
WA0000124	M45EC1-L	Weyerhaeuser Co.	Longview	1	19164833	L	536.8	21.5	53	8.5		7.1E-08	21		1.8E-07
WA0000124	M45EC-L	Weyerhaeuser Co.	Longview	1	19164833	L	536.8	21.5	53	10		8.4E-08	37		3.1E-07
WA0000256	M32EC	James River Corp.	Camas	3E	ND	N	614.0	16.0	58	0	NQ	0	160		1.5E-06
WA0000621	M80EAC	Scott Paper Co. 1	Everett	2D	EZD	Z	251.1	10.0	29.9	7.5	ND	3.5E-08	29		1.4E-07
WA0000621	M80EBC	Scott Paper Co. 2	Everett	2D	EZD	Z	251.1	10.0	29.9	8.3	ND	3.9E-08	2.6	ND	1.2E-08
WA0000795	M12EC	ITT-Rayonier, Inc.	Port Angeles	2A	563140	L	692.3	10.0	36	22		1.2E-07	36		2.0E-07
WA0000809	M4EC	Weyerhaeuser Co.	Cosmopolis	2A	13905	L	416.2	10.0	22	9.7		3.4E-08	400		1.4E-06
WA0000850	M81EC	Simpson Paper Co.	Tacoma	2E	ND	N	192.1	97.6	28.8	0	NQ	0	27		1.2E-07
WA0000850	M81EC1	Simpson Paper Co.	Tacoma	2E	ND	N	192.1	97.6	28.8	0	NQ	0	22		1.0E-07
WA0000850	M81ECX	Simpson Paper Co.	Tacoma	2E	ND	N	192.1	97.6	28.8	0	NQ	0	26		1.2E-07
WA0000850	M81ECXX	Simpson Paper Co.	Tacoma	2E	ND	N	192.1	97.6	28.8	0	NQ	0	26		1.2E-07
WA0001091	M60EC1	Georgia-Pacific Corp.	Bellingham	2B	578783	418	563.8	10.0	37	5.3	ND	3.1E-08	840		4.9E-06
WA0003000	M79EC	Weyerhaeuser Co.	Everett	2A	66047	2039	78.5	10.0	22	33		1.1E-07	260		9.0E-07
WA0003077	M33EC	ITT-Rayonier, Inc.	Hoquiam	2A	60043	2039	333.7	10.0	20	23		7.3E-08	8.6		2.7E-08
WA0003697	M66EC	Boise Cascade Corp.	Wallula	1	14577506	L	393.3	10.0	20	360		1.1E-06	7500		2.4E-05

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[1] Legends of analysis group ID codes and error codes are on the next page.
[2] The default value is 10 mg/l for dischargers to open waters.
[3] ND = Nondetection, the concentration shown is the detection limit. NQ = Nonquantifiable.

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

Table C.2
Default Parameters Entered in EXAMS II

Ecosystem Location Parameters

par. name	parameter description	parameter value
ECONAM	Environment name (1-50 char)	BOILERPLATE
LAT	Geographic latitude (deg. & tenths)	40
LONG	Geographic longitude (deg. & tenths)	100
ELEV	Ground station elev. (m above s.l.)	200

Global Parameters

par. name	parameter description	parameter value
OXRAD	Oxidant radical concent. (moles/L)	0
RAIN	Rainfall (mm/month)	100
CLOUD	Cloudiness (tenths)	3
OZONE	Ozone content of atmosphere (cm NTP)	0.2
RHUM	Relative humidity (%)	50
ATURB	Atmospheric turbidity (km)	2
AIRTY	Air mass type (R,U,M or T)	R

Physical Geometry for Compartment #1, TYPE="L"

par.name	parameter description	parameter value
LENG	Length (m)	5000
WIDTH	Width (m)	9.6
DEPTH	Average vertical depth (m)	0.66

Physical Geometry for Compartment #2, TYPE="B"

par. name	parameter description	parameter value
LENG	Length (m)	5000
WIDTH	width (m)	9.6
DEPTH	Average vertical depth (m)	0.05

Dispersive Transport between Compartments "1" and "2"

par. name	parameter description	parameter value
DSP	Dispersion coefficient (m2/hr)	0.00001

Dispersive Transport between Compartments "1" and "0"

par. name	parameter description	parameter value
DSP	Dispersion coefficient (m2/hr)	200000

Hydrologic Parameters for Compartment #1, TYPE="L"

par. name	parameter description	parameter value
NPSFL	Non-point source flow (m3/hr)	0
NPSED	Non-point source sediment (kg/hr)	0
EVAP	Evaporation (mm/month)	100

Hydrologic Parameters for Compartment #2, TYPE="B"

par. name	parameter description	parameter value
SEEPS	Seepage flow (m3/hr)	0

Miscellaneous Environ. Parameters for Compartment #1, TYPE="L"

par. name	parameter description	parameter value
FROC	Fraction organic carbon on seds. (-) 0.01	
CEC	Cation exchange cap. (meq/100g dry)	0
AEC	Anion exchange cap. (meq/100g dry)	0

Sediment Properties for Compartment #2, TYPE="B"

par. name	parameter description	parameter value
BULKD	Bulk density of benthic sed. (g/cm3)	1.8
PCTWA	Percent water in benthic sed. (%)	137
FROC	Fraction organic carbon on seds. (-)	0.01
CEC	Cation exchange cap. (meq/100g dry)	0
AEC	Anion exchange cap. (meq/100g dry)	0

Table C.2 (Cont.)
Default Parameters Entered in EXAMS II

Sediment Properties for Compartment #1, TYPE = "L"

par. name	parameter description	parameter value
TCEL	Temperature of compt. (deg. C)	15
PH	pH of compartment (-)	7
POH	pOH of compartment (-)	7
REDAG	Reducing agents conc. (moles/L)	0
DOC	Dissolved organic carbon (mg/L)	1
DFAC	Distribution factor (-)	1.19
DISO2	Dissolved oxygen conc. (mg/L)	8
KO2	Oxygen exchange const. (cm/hr)	3
WIND	Wind speed (m/sec)	0.5
CHL	Chlorophylls + pheophytins (mg/L)	0.0001
BACPL	Bacterioplankton pop. den. (cfu/ml)	10000
PLMAS	Planktonic biomass (mg(dry wt)/L)	0.0016667

Miscellaneous Environ. Parameters for Compartment #2, TYPE = "B"

par. name	parameter description	parameter value
TCEL	Temperature of compt. (deg. C)	15
PH	pH of compartment (-)	7
POH	pOH of compartment (-)	7
REDAG	Reducing agents conc. (moles/L)	0
DOC	Dissolved organic carbon (mg/L)	1
BNBAC	Benthic bacteria pop. (cfu/100g dry)	0
BNMAS	Biomass of small benthos (g(dry)/m2)	20

Table C.3
Chemical/Physical Property Values

For 2378-TCDD:

Parameter	Value
Molecular Weight (MWT)	3.22E+02
Vapor Pressure - Torr (VAPR)	7.40E-10
Henry's Law Constant (HENRY)	2.10E-06
Octanol-Water Partition Coefficient (KOW)	5.01E+06
Partition Coefficient - Org. Carbon (KOC)	1.80E+07
Solubility - mg/L (SOL)	1.93E-05
Partition Coefficient - Biomass (KPB)	5.20E+05

For 2378-TCDF:

Parameter	Value
Molecular Weight (MWT)	3.06E+02
Vapor Pressure - Torr (VAPR)	9.21E-07
Henry's Law Constant (HENRY)	1.80E-02
Octanol-Water Partition Coefficient (KOW)	6.60E+05
Partition Coefficient - Org. Carbon (KOC)	4.10E+05
Solubility - mg/L (SOL)	2.00E-05
Partition Coefficient - Biomass (KPB)	8.28E+04

APPENDIX D

Appendix D.
In-stream Contaminant Concentrations in pg/l

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILTUTION TCDD CONC.	SIMPLE DILTUTION TCDF CONC.	EXAMS WATER COLUMN TCDD CONC.	EXAMS WATER COLUMN TCDF CONC.
Region I										
Georgia-Pacific Corp.	Woodland	M17EC	ME0001872	1			1.31E-01	4.81E-01	1.00E-01	4.75E-01
International Paper Co.	Jay	RG1-86388	ME0001937	1			1.69E+00	8.09E+00	9.21E-01	7.91E+00
Lincoln Pulp and Paper	Lincoln	M11EC	ME0002003	1			9.10E-02	3.70E-01	6.95E-02	3.65E-01
James River Corp.	Old Town	M8EC	ME0002020	1			1.15E-01	3.82E-01	8.77E-02	3.78E-01
Boise Cascade Corp.	Rumford	M82EC	ME0002054	1			1.84E+00	8.74E+00	9.33E-01	8.54E+00
Scott Paper Co.	Westbrook	M30EC	ME0002321	1			3.43E-01	6.53E-01	1.80E-01	6.19E-01
Scott Paper Co.	Hinckley	M61EC	ME0021521	1			1.31E-01	5.17E-01	7.08E-02	5.06E-01
Scott Paper Co.	Hinckley	M61EC1	ME0021521	1			1.56E-01	8.20E-01	8.41E-02	8.03E-01
James River Corp.	Berlin	BM89EC	NH0000655	1			2.15E-01	7.73E-01	1.25E-01	7.53E-01
James River Corp.	Berlin	M89EC	NH0000655	1			7.47E-01	1.52E+01	4.33E-01	1.48E+01
Region II										
International Paper Co.	Ticonderoga	M9EC	NY0004413	2A			1.00E+00	8.33E+00	3.39E-01	7.54E+00
International Paper Co.	Ticonderoga	M9EC1	NY0004413	2A			1.33E+00	8.89E+00	4.51E-01	8.04E+00
Finch & Pruyn & Co., Inc.	Glen Falls	M41EC	NY0005525	3D	ND	ND	3.48E-02	1.28E-02	2.00E-02	1.24E-02
Region III										
Westvaco Corp.	Luke	M62EC	MD0021687	4H			3.81E-01	1.17E+00	1.11E-01	1.05E+00
Westvaco Corp.	Luke	M62EC	MD0021687	4L			3.04E-02	9.32E-02	8.84E-03	8.41E-02
Penntech Papers, Inc.	Johnsonburg	M57EAC	PA0002143	3B	ND		6.42E-02	2.64E-01	2.90E-02	2.24E-01
Penntech Papers, Inc.	Johnsonburg	M57EBC	PA0002143	1			2.36E-01	1.58E+00	5.38E-02	1.35E+00
Appleton Papers, Inc.	Roaring Springs	M13EDO	PA0008265	3B	ND		3.68E-01	1.21E+00	6.68E-02	8.08E-01
P.H. Glatfelter Co.	Spring Grove	M64EC20	PA0008869	3B	ND		9.92E-01	6.14E+00	1.30E-01	4.12E+00
Procter & Gamble Co.[3]	Mehoopany	M42EC	PA0008885	3B	ND		5.11E-03	2.95E-03	2.35E-03	2.84E-03
International Paper[3]	Erie	M103ECX	PA0026301	2CH			EZ	EZ	EZ	EZ
International Paper[3]	Erie	M103ECX	PA0026301	2CL			EZ	EZ	EZ	EZ
Chesapeake Corp.	West Point	M74EC140	VA0003115	1			8.66E-01	5.19E+00	2.44E-01	4.65E+00
Westvaco Corp.	Covington	BM28EC	VA0003646	3B	ND		4.26E-01	1.89E+00	1.25E-01	1.76E+00
Westvaco Corp.	Covington	M28EC	VA0003646	1			2.13E+01	6.16E+01	6.24E+00	5.72E+01
Westvaco Corp.	Covington	M28EC1	VA0003646	3B	ND		1.07E+00	2.05E+01	3.12E-01	1.90E+01
Westvaco Corp.	Covington	M28EC2	VA0003646	1			1.42E+00	1.56E+01	4.16E-01	1.45E+01
Union Camp Corp.	Franklin	UCF1000	VA0004162	1			2.44E+01	2.55E+01	9.11E+00	2.55E+01
Region IV										
Champion International	Courtland	M40EC	AL0000396	2A			1.66E-01	7.31E-01	5.92E-02	7.03E-01
Container Corp. of America	Brewton	M67EC	AL0002682	3C		ND	3.43E-01	2.64E-01	1.69E-01	9.00E+00
Boise Cascade Corp.	Jackson	M65EC	AL0002755	1			3.53E-01	2.01E+00	1.24E-01	1.92E+00
Boise Cascade Corp.	Jackson	M65EC1	AL0002755	1			4.46E-01	2.34E+00	1.57E-01	2.24E+00
International Paper Co.	Mobile	M71EC	AL0002780	1			2.74E-01	2.33E+00	8.41E-02	2.22E+00
Scott Paper Co.	Mobile	M26EC210	AL0002801	1			8.88E-02	1.21E-01	2.74E-02	1.15E-01
Gulf States Paper Corp.	Demopolis	M101EC	AL0002828	1			3.10E-01	8.98E-01	8.93E-02	6.82E-01
International Paper Co.	Selma	M88EC	AL0003018	1			2.30E-01	8.80E-01	5.37E-02	8.18E-01
Kimberly-Clark Corp.	Coosa Pines	M36EC	AL0003158	1			3.73E-01	7.89E-01	8.76E-02	7.27E-01

Appendix D. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILTUTION TCDD CONC.	SIMPLE DILTUTION TCDF CONC.	EXAMS WATER COLUMN TCDD CONC.	EXAMS WATER COLUMN TCDF CONC.
James River Corp.	Butler	M96EC	AL0003301	1			2.70E-01	8.46E-01	8.92E-02	8.02E-01
Alabama River Pulp	Claiborne	M21EC	AL0025968	1			9.48E-02	5.78E-01	2.96E-02	5.50E-01
Alabama River Pulp	Claiborne	M21EC1	AL0025968	1			9.25E-02	5.78E-01	2.89E-02	5.50E-01
Alabama River Pulp	Claiborne	M21EC2	AL0025968	1			1.06E-01	4.85E-01	3.32E-02	4.62E-01
ITT-Rayonier, Inc.	Fernandina Beach	M90EC	FL0000701	2A			1.40E-01	7.00E-01	4.93E-02	6.62E-01
Buckeye Cellulose	Perry	M91EC0	FL0000876	1			2.59E+01	7.69E+01	1.04E+01	7.69E+01
Champion International	Cantonment	CP1000	FL0002526	3B	ND		2.86E+00	1.97E+01	1.26E+00	1.55E+01
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CH	ND		2.10E-02	3.95E-02	7.37E-03	3.72E-02
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CL	ND		1.68E-03	3.16E-03	5.90E-04	2.98E-03
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CH			3.45E-02	9.00E-02	1.21E-02	8.48E-02
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CL			1.38E-03	7.20E-03	9.69E-04	6.79E-03
Georgia-Pacific Corp.	Palatka	M24EC	FL0002763	2A			9.41E+00	2.24E+01	8.30E+00	2.45E+01
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4H			1.39E+00	1.00E+01	CD	CD
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4L			1.11E-01	3.18E-01	CD	CD
Gilman Paper Co.	St. Marys	M55EC	GA0001953	2B	ND		1.91E-01	1.00E+00	7.68E-02	9.70E-01
Federal Paper Board Co.	Augusta	M83EC	GA0002801	1			1.15E-01	3.37E-01	4.58E-02	3.25E-01
ITT-Rayonier, Inc.	Jesup	M84EAC	GA0003620	1			3.13E-01	5.48E-02	1.26E-01	5.34E-02
ITT-Rayonier, Inc.	Jesup	M84EBC	GA0003620	1			3.00E-01	2.09E-01	1.21E-01	2.03E-01
Brunswick Pulp and Paper	Brunswick	M87EC	GA0003654	2A			1.36E+00	3.09E+00	4.97E-01	3.02E+00
Brunswick Pulp and Paper	Brunswick	M87EC1	GA0003654	2A			1.36E+00	2.27E+00	2.22E+00	4.97E-01
Buckeye Cellulose	Oglethorpe	M22EC10	GA0049336	3B	ND		4.41E-02	1.91E-01	1.74E-02	1.82E-01
Westvaco Corp.	Wickliffe	M78EC	KY0000086	1			3.85E-03	1.65E-02	E	E
Willamette Industries	Hawesville	M63EC	KY0001716	3D	ND	ND	1.82E-03	1.32E-03	1.80E-04	1.09E-03
International Paper Co.	Natchez	M97EC	MS0000213	1			5.59E-03	3.24E-02	E	E
International Paper Co.	Moss Point	M34EC	MS0002674	2CH			4.00E+00	2.30E+01	1.20E+00	2.02E+01
International Paper Co.	Moss Point	M34EC	MS0002674	2CL			1.60E-01	1.84E+00	9.56E-02	1.61E+00
Leaf River Forest Products	New Augusta	BM35SEC30	MS0031704	1			1.32E+00	1.67E+00	4.21E-01	1.58E+00
Leaf River Forest Products	New Augusta	M35SEC30	MS0031704	1			3.35E+00	6.86E+00	1.07E+00	6.47E+00
Champion International	Canton	M47G100-500	NC0000272	1			2.83E+00	1.36E+00	1.07E+00	1.36E+00
Weyerhaeuser Co.	Plymouth	M86EC0	NC0000680	2A			3.20E+01	4.00E+02	1.37E+01	3.96E+02
Weyerhaeuser Co.	New Bern	M6EC	NC0003191	1			1.32E+00	5.38E+00	7.32E-01	5.24E+00
Federal Paper Board Co.	Riegelwood	M16EC	NC0003298	1			5.23E-01	1.14E+00	3.50E-01	1.62E+00
International Paper Co.	Georgetown	M70EC	SC0000868	2A			3.20E+02	8.00E+02	8.30E+01	7.14E+02
International Paper Co.	Georgetown	M70EC1	SC0000868	2A			2.45E+02	7.50E+02	6.35E+01	6.69E+02
Bowater Corp.	Catawba	M23EC	SC0001015	1			4.32E-01	7.55E-01	2.52E-01	7.41E-01
Union Camp Corp.	Eastover	M93EC	SC0038121	1			7.09E-02	1.88E-01	1.86E-02	1.75E-01
Mead Corporation	Kingsport	M73EC	TN0001643	1			5.94E-02	4.36E-01	2.89E-02	4.17E-01
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	8.17E-02	6.61E-02	4.23E-02	6.48E-02
Region V										
Mead Corporation	Escanaba	ML802	MI0000027	3B	ND		7.38E-01	4.41E+00	4.20E-01	4.38E+00
Scott Paper Co.	Muskegon	M92EC	MI0027391	4H	ND		1.61E-02	1.61E-01	8.31E-03	1.56E-01
Scott Paper Co.	Muskegon	M92EC	MI0027391	4L	ND		1.29E-03	1.29E-02	6.65E-04	1.24E-02

Appendix D. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILTUTION TCDD CONC.	SIMPLE DILTUTION TCDF CONC.	EXAMS WATER COLUMN TCDD CONC.	EXAMS WATER COLUMN TCDF CONC.
Champion International	Quinnesec	Q14E	MI0042170	1			9.34E-02	6.85E-01	5.79E-02	6.66E-01
Potlatch Corp.	Cloquet	M38EC0	MN-------	4H			9.43E-02	1.81E-01	5.62E-02	1.75E-01
Potlatch Corp.	Cloquet	M38EC0	MN-------	4L			7.55E-03	1.45E-02	4.50E-03	1.40E-02
Boise Cascade Corp.	International Falls	DE020922	MN0001643	1			3.49E-01	6.39E+00	2.11E-01	6.29E+00
Mead Corp.	Chillicothe	DE026013	OH0004481	3B	ND		3.46E-01	2.54E+00	2.33E-01	2.47E+00
Badger Paper Mills, Inc.	Peshtigo	M46EBC	WI0000663	1			1.68E-02	4.10E-01	8.90E-03	3.75E-01
Badger Paper Mills, Inc.	Peshtigo	M46EBCX	WI0000663	3B	ND		9.87E-03	4.84E-01	E	E
James River Corp.	Green Bay	M72EAC	WI0001261	1			5.70E-02	3.16E-01	1.63E-02	2.96E-01
Pentair, Inc.	Park Falls	M25EC	WI0003212	3B	ND		6.02E-02	1.07E-01	3.33E-02	9.37E-02
Wausau Paper Mills Co. 1	Brokaw	M54EC	WI0003379	3B	ND		1.24E-02	8.27E-02	7.46E-03	8.02E-02
Wausau Paper Mills Co. 2	Brokaw	M54ECX	WI0003379	3D	ND	ND	1.45E-02	6.20E-03	8.70E-03	6.02E-03
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	M77EC	WI0003620	1			5.93E-01	4.75E+00	2.78E-01	4.63E+00
James River Corp.	Green Bay	M72EBC	WI0020991	4H	ND		1.50E-03	1.03E-02	4.27E-04	9.57E-03
James River Corp.	Green Bay	M72EBC	WI0020991	4L	ND		1.20E-04	8.21E-04	3.42E-05	7.66E-04
Weyerhaeuser Co.	Rothchild	M29EC	WI0026042	1			4.64E-02	9.28E-02	2.43E-02	8.96E-02
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4H			2.22E-02	6.35E-01	1.19E-02	5.84E-01
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4L			1.78E-03	5.08E-02	9.51E-04	4.67E-02
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4H	ND		7.26E-03	3.86E-01	E	E
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4L	ND		5.81E-04	3.09E-02	E	E
Consolidated Papers, Inc.	Wisconsin Rapids	21	WI0037991	3D	ND	ND	2.36E-01	1.64E-01	1.07E-01	1.59E-01
Region VI										
Georgia-Pacific Corp.	Crosset	M68EC	AR0001210	1			2.74E+00	1.06E+01	8.29E-01	1.01E+01
International Paper Co.	Pine Bluff	M51EC	AR0001970	1			4.77E-01	4.77E+00	2.21E-01	4.65E+00
Nekoosa Papers, Inc.	Ashdown	M20EC	AR0002968	1			6.10E-01	1.40E+00	7.14E-02	1.20E+00
Potlatch Corp.	McGhee	M18EC	AR0035823	4H			5.13E-04	1.28E-03	E	E
Potlatch Corp.	McGhee	M18EC	AR0035823	4L			4.10E-05	1.03E-04	E	E
James River Corp.	St. Francesville	M52EC	LA0003468	1			1.03E-02	4.02E-02	E	E
Georgia-Pacific Corp.	Zachary	M1EC	LA0005258	3A		NQ	Q	Q	Q	Q
Georgia-Pacific Corp.	Zachary	M1ECX	LA0005258	1			1.85E-02	3.46E-01	E	E
International Paper Co.	Bastrop	M85EC	LA0007561	5			F	F	F	F
Boise Cascade Corp.	Deridder	M58EC	LA0007927	1			2.12E+00	1.01E+01	7.14E-01	9.03E+00
International Paper Co.	Texarkana	M99EC	TX0000167	1			2.54E+00	8.41E+00	5.38E-01	8.02E+00
International Paper Co.	Texarkana	M99EC1	TX0000167	1			3.52E+00	8.60E+00	1.31E+00	8.55E+00
Champion International	Lufkin	DF024512	TX0001643	3D	ND	ND	4.56E-01	4.56E-01	1.54E-01	4.05E-01
Temple-Eastex, Inc.	Evadale	M3EC	TX0003891	1			4.80E+00	5.45E+00	2.10E+00	5.42E+00
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N
Champion International	Houston	M15EC	TX0053023	2B	ND		8.25E-01	2.58E+01	3.88E-01	1.95E+01
Region VIII										
Stone Container Corp.	Missoula	M27EC	MT0000035	3C		ND	1.10E-02	1.35E-02	2.57E-03	1.24E-02

Appendix D. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET-ECT[2]	TCDF NON-DET-ECT[2]	SIMPLE DILTUTION TCDD CONC.	SIMPLE DILTUTION TCDF CONC.	EXAMS WATER COLUMN TCDD CONC.	EXAMS WATER COLUMN TCDF CONC.
Region IX										
Stone Container Corp.	Snowflake	M100EC	AZ-------	2D			EZ	EZ	EZ	EZ
Simpson Paper Co.	Anderson	M98EC	CA0004065	1			1.79E+00	6.01E+01	8.08E-01	5.85E+01
Gaylord Container Corp.	Antioch	M106EC	CA0004847	5			F	F	F	F
Simpson Paper Co.	Fairhaven	M43EC0	CA0005282	2A			2.17E+00	1.43E+01	7.69E-01	1.36E+01
Louisiana Pacific Corp.	Samoa	M70EC10	CA0005894	2A			9.71E-01	4.64E+00	3.42E-01	4.39E+00
Region X										
Alaska Pulp Corp.	Sitka	M5EC-1	AK0000531	2B	ND		5.50E-01	4.57E+00	1.89E-01	4.18E+00
Ketchikan Pulp & Paper 1	Ketchikan	M31EAC	AK0000922	2B	ND	ND	1.08E-01	8.55E-02	3.83E-02	8.13E-02
Ketchikan Pulp & Paper 2	Ketchikan	M31EBC	AK0000922	2A			1.36E+00	6.55E-01	4.90E-01	6.29E-01
Potlatch Corp.	Lewiston	M56EC	ID0001163	1			1.06E-01	5.36E-01	2.14E-02	4.37E-01
Potlatch Corp.	Lewiston	M56EC1	ID0001163	1			1.18E-01	4.76E-01	2.38E-02	3.89E-01
James River Corp.	Clatskanie (Wauna)	8637-4645	OR0000795	1			5.03E-03	4.03E-02	ED	ED
Pope & Talbot, Inc.	Halsey	M19EC	OR0001074	1			7.06E-02	1.93E-01	3.11E-02	1.87E-01
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4H			1.66E-03	7.54E-03	ED	ED
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4L			1.33E-04	6.03E-04	ED	ED
Longview Fibre Co.	Longview	M53EC	WA0000078	3B	ND		1.18E-03	2.93E-02	ED	ED
Weyerhaeuser Co.	Longview	M45EC1-L	WA0000124	1			3.71E-03	9.15E-03	ED	ED
Weyerhaeuser Co.	Longview	M45EC-L	WA0000124	1			4.36E-03	1.61E-02	ED	ED
James River Corp.	Camas	M32EC	WA0000256	3E	NQ		ND	ND	ND	ND
Scott Paper Co. 1	Everett	M80EAC	WA0000621	2D	ND		EZD	EZD	EZD	EZD
Scott Paper Co. 2	Everett	M80EBC	WA0000621	2D	ND	ND	EZD	EZD	EZD	EZD
ITT-Rayonier, Inc.	Port Angeles	M12EC	WA0000795	2A			2.20E-01	3.60E-01	7.87E-02	3.46E-01
Weyerhaeuser Co.	Cosmopolis	M4EC	WA0000809	2A			1.94E+00	8.00E+01	6.50E-01	7.10E+01
Simpson Paper Co.	Tacoma	M81EC	WA0000850	2E	NQ		ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81EC1	WA0000850	2E	NQ		ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECX	WA0000850	2E	NQ		ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECXX	WA0000850	2E	NQ		ND	ND	ND	ND
Georgia-Pacific Corp.	Bellingham	M60EC1	WA0001091	2B	ND		2.65E-02	8.40E+00	9.38E-03	8.00E+00
Weyerhaeuser Co.	Everett	M79EC	WA0003000	2A			1.65E+00	1.30E+01	6.15E-02	1.30E+00
ITT-Rayonier, Inc.	Hoquiam	M33EC	WA0003077	2A			1.15E+00	4.30E-01	4.01E-01	4.02E-01
Boise Cascade Corp.	Wallula	M66EC	WA0003697	1			7.79E-02	1.62E+00	2.25E-02	1.26E+00

[1] Legends of analysis group ID codes and error codes are on the next page.

[2] ND = Not detected in the effluent samples. In-stream concentration estimates are based on 1/2 the detection limit in the effluent sample.
NQ - Nonquantificable

[3] a.k.a. Hammermill Papers.

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX E

Appendix E.
In-stream Contaminant Concentrations for Low (7Q10) Flow Conditions Calculated by Simple Dilution Only

COMPANY	CITY	NPDES NUMBER	SAMPLEID	GRP ID	TCDD NON-DET-	TCDF NON-DET-	7Q10 FLOW (m^3/hr) ECT[2]	TCDD CONC. (pg/l) ECT[2]	TCDF CONC. (pg/l)	TEQ CONC. (pg/l)
Region I										
Georgia-Pacific Corp.	Woodland	ME0001872	M17EC	1			46505	4.92E-01	1.81E+00	6.73E-01
International Paper Co.	Jay	ME0001937	RG1-86388	1			159313	3.35E+00	1.60E+01	4.95E+00
Lincoln Pulp and Paper	Lincoln	ME0002003	M11EC	1			272426	1.93E-01	7.83E-01	2.71E-01
James River Corp.	Old Town	ME0002020	M8EC	1			336516	2.90E-01	9.68E-01	3.87E-01
Boise Cascade Corp.	Rumford	ME0002054	M82EC	1			145469	3.63E+00	1.73E+01	5.36E+00
Scott Paper Co.	Westbrook	ME0002321	M30EC	1			19420	8.42E-01	1.60E+00	1.00E+00
Scott Paper Co.	Hinckley	ME0021521	M61EC	1			165969	3.70E-01	1.46E+00	5.15E-01
Scott Paper Co.	Hinckley	ME0021521	M61EC1	1			165969	4.39E-01	2.31E+00	6.70E-01
James River Corp.	Berlin	NH0000655	BM89EC	1			90931	4.98E-01	1.79E+00	6.77E-01
James River Corp.	Berlin	NH0000655	M89EC	1			90931	1.73E+00	3.52E+01	5.24E+00
Region II										
International Paper Co.	Ticonderoga	NY0004413	M9EC	2A			39755	1.00E+00	8.33E+00	1.83E+00
International Paper Co.	Ticonderoga	NY0004413	M9EC1	2A			39755	1.33E+00	8.89E+00	2.22E+00
Finch & Pruyn & Co., Inc.	Glen Falls	NY0005525	M41EC	3D	ND	ND	49248	1.80E-01	6.60E-02	1.86E-01
Region III										
Westvaco Corp.	Luke	MD0021687	M62EC	4H			4057	1.74E+00	5.32E+00	2.27E+00
Westvaco Corp.	Luke	MD0021687	M62EC	4L			4057	1.39E-01	4.26E-01	1.82E-01
Penntech Papers, Inc.	Johnsonburg	PA0002143	M57EAC	3B	ND		8154	2.89E-01	1.19E+00	4.08E-01
Penntech Papers, Inc.	Johnsonburg	PA0002143	M57EBC	1			8154	1.04E+00	6.99E+00	1.74E+00
Appleton Papers, Inc.	Roaring Springs	PA0008265	M13EDO	3B	ND		1239	2.00E+00	6.55E+00	2.66E+00
P.H. Glatfelter Co.	Spring Grove	PA0008869	M64EC20	3B	ND		2039	2.07E+00	1.28E+01	3.35E+00
Procter & Gamble Co.[3]	Mehoopany	PA0008885	M42EC	3B	ND		55293	3.30E-02	1.90E-02	3.49E-02
International Paper[3]	Erie	PA0026301	M103ECX	2CH			Z	Z	Z	0.00E+00
International Paper[3]	Erie	PA0026301	M103ECX	2CL			Z	Z	Z	0.00E+00
Chesapeake Corp.	West Point	VA0003115	M74EC140	1			6432	4.28E+00	2.57E+01	6.85E+00
Westvaco Corp.	Covington	VA0003646	BM28EC	3B	ND		9072	1.13E+00	5.04E+00	1.64E+00
Westvaco Corp.	Covington	VA0003646	M28EC	1			9072	5.67E+01	1.64E+02	7.31E+01
Westvaco Corp.	Covington	VA0003646	M28EC1	3B	ND		9072	2.84E+00	5.45E+01	8.29E+00
Westvaco Corp.	Covington	VA0003646	M28EC2	1			9072	3.78E+00	4.16E+01	7.94E+00
Union Camp Corp.	Franklin	VA0004162	UCF1000	1			4373	5.56E+01	5.80E+01	6.14E+01
Champion International	Courtland	AL0000396	M40EC	2A			4325625	1.66E-01	7.31E-01	2.39E-01
Container Corp. of America	Brewton	AL0002682	M67EC	3C		ND	17330	1.59E+00	1.23E+00	1.72E+00
Region IV										
Boise Cascade Corp.	Jackson	AL0002755	M65EC	1			160149	1.79E+00	1.02E+01	2.81E+00
Boise Cascade Corp.	Jackson	AL0002755	M65EC1	1			160149	2.26E+00	1.19E+01	3.45E+00
International Paper Co.	Mobile	AL0002780	M71EC	1			714706	6.51E-01	5.53E+00	1.20E+00
Scott Paper Co.	Mobile	AL0002801	M26EC210	1			714706	2.10E-01	2.85E-01	2.38E-01
Gulf States Paper Corp.	Demopolis	AL0002828	M101EC	1			91747	1.69E+00	4.88E+00	2.17E+00
International Paper Co.	Selma	AL0003018	M88EC	1			532364	6.43E-01	2.46E+00	8.89E-01
Kimberly-Clark Corp.	Coosa Pines	AL0003158	M36EC	1			182606	1.28E+00	2.70E+00	1.55E+00

Appendix E. (continued)

COMPANY	CITY	NPDES NUMBER	SAMPLEID	GRP ID	TCDD NON-DET-	TCDF NON-DET-	7Q10 FLOW (m^3/hr) ECT[2]	TCDD CONC. (pg/l) ECT[2]	TCDF CONC. (pg/l)	TEQ CONC. (pg/l)
James River Corp.	Butler	AL0003301	M96EC	1			91747	1.44E+00	4.52E+00	1.90E+00
Alabama River Pulp	Claiborne	AL0025968	M21EC	1			514494	2.80E-01	1.70E+00	4.50E-01
Alabama River Pulp	Claiborne	AL0025968	M21EC1	1			514494	2.73E-01	1.70E+00	4.43E-01
Alabama River Pulp	Claiborne	AL0025968	M21EC2	1			514494	3.14E-01	1.43E+00	4.57E-01
ITT-Rayonier, Inc.	Fernandina Beach	FL0000701	M90EC	2A			136266	1.40E-01	7.00E-01	2.10E-01
Buckeye Cellulose	Perry	FL0000876	M91ECO	1			102	2.66E+01	7.89E+01	3.45E+01
Champion International	Cantonment	FL0002526	CP1000	3B	ND		255	5.10E+00	3.52E+01	8.62E+00
Stone Container Corp.	Panama City	FL0002631	M102EAC	2CH	ND		166461	2.10E-02	3.95E-02	2.50E-02
Stone Container Corp.	Panama City	FL0002631	M102EAC	2CL	ND		166461	1.68E-03	3.16E-03	2.00E-03
Stone Container Corp.	Panama City	FL0002631	M102EBC	2CH			166461	3.45E-02	9.00E-02	4.35E-02
Stone Container Corp.	Panama City	FL0002631	M102EBC	2CL			166461	1.38E-03	7.20E-03	2.10E-03
Georgia-Pacific Corp.	Palatka	FL0002763	M24EC	2A			4092	9.41E+00	2.24E+01	1.16E+01
St. Joe Paper Co.	Port St. Joe	FL0020206	M94EC1	4H			7646	2.20E+00	1.00E+01	3.20E+00
St. Joe Paper Co.	Port St. Joe	FL0020206	M94EC1	4L			7646	1.76E-01	5.03E-01	2.26E-01
Gilman Paper Co.	St. Marys	GA0001953	M55EC	2B	ND		101125	1.91E-01	1.00E+00	2.91E-01
Federal Paper Board Co.	Augusta	GA0002801	M83EC	1			448539	1.67E-01	4.91E-01	2.16E-01
ITT-Rayonier, Inc.	Jesup	GA0003620	M84EAC	1			218051	9.93E-01	1.74E-01	1.01E+00
ITT-Rayonier, Inc.	Jesup	GA0003620	M84EBC	1			218051	9.52E-01	6.62E-01	1.02E+00
Brunswick Pulp and Paper	Brunswick	GA0003654	M87EC	2A			172545	3.41E-01	7.73E-01	4.18E-01
Brunswick Pulp and Paper	Brunswick	GA0003654	M87EC1	2A			172545	1.36E-02	4.55E-02	1.82E-02
Buckeye Cellulose	Oglethorpe	GA0049336	M22EC10	3B	ND		68606	1.35E-01	5.84E-01	1.93E-01
Westvaco Corp.	Wickliffe	KY0000086	M78EC	1			10194060	1.21E-02	5.20E-02	1.73E-02
Willamette Industries	Hawesville	KY0001716	M63EC	3D	ND	ND	1190666	8.73E-03	6.35E-03	9.36E-03
International Paper Co.	Natchez	MS0000213	M97EC	1			13558100	1.68E-02	9.72E-02	2.65E-02
International Paper Co.	Moss Point	MS0002674	M34EC	2CH			24460	4.00E+00	2.30E+01	6.30E+00
International Paper Co.	Moss Point	MS0002674	M34EC	2CL			24460	1.60E-01	1.84E+00	3.44E-01
Leaf River Forest Products	New Augusta	MS0031704	BM35SEC30	1			62999	3.32E+00	4.20E+00	3.74E+00
Leaf River Forest Products	New Augusta	MS0031704	M35SEC30	1			62999	8.39E+00	1.72E+01	1.01E+01
Champion International	Canton	NC0000272	M47G100-5001				6065	8.00E+00	3.84E+00	8.38E+00
Weyerhaeuser Co.	Plymouth	NC0000680	M86ECO	2A			55461	3.20E+01	4.00E+02	7.20E+01
Weyerhaeuser Co.	New Bern	NC0003191	M6EC	1			24466	5.87E+00	2.40E+01	8.27E+00
Federal Paper Board Co.	Riegelwood	NC0003298	M16EC	1			64630	1.79E+00	3.90E+00	2.18E+00
International Paper Co.	Georgetown	SC0000868	M70EC	2A			4424	3.20E+02	8.00E+02	4.00E+02
International Paper Co.	Georgetown	SC0000868	M70EC1	2A			4424	2.45E+02	7.50E+02	3.20E+02
Bowater Corp.	Catawba	SC0001015	M23EC	1			90727	1.32E+00	2.32E+00	1.56E+00
Union Camp Corp.	Eastover	SC0038121	M93EC	1			99494	2.78E-01	7.37E-01	3.52E-01
Mead Corporation	Kingsport	TN0001643	M73EC	1			51378	1.73E-01	1.27E+00	3.01E-01
Bowater Corp.	Calhoun	TN0002356	M75EC	3D	ND	ND	62286	2.77E-01	2.24E-01	2.99E-01
Region V										
Mead Corporation	Escanaba	MI0000027	ML802	3B	ND		17493	2.04E+00	1.22E+01	3.26E+00
Scott Paper Co.	Muskegon	MI0027391	M92EC	4H	ND		71797	3.39E-02	3.39E-01	6.78E-02
Scott Paper Co.	Muskegon	MI0027391	M92EC	4L	ND		71797	2.71E-03	2.71E-02	5.43E-03

Appendix E. (continued)

COMPANY	CITY	NPDES NUMBER	SAMPLEID	GRP ID	TCDD NON-DET-	TCDF NON-DET-	7Q10 FLOW (m^3/hr) ECT[2]	TCDD CONC. (pg/l) ECT[2]	TCDF CONC. (pg/l)	TEQ CONC. (pg/l)
Champion International	Quinnesec	MI0042170	Q14E	1			49186	3.55E-01	2.60E+00	6.15E-01
Potlatch Corp.	Cloquet	MN-------	M38ECO	4H			L	L	L	0.00E+00
Potlatch Corp.	Cloquet	MN-------	M38ECO	4L			L	L	L	0.00E+00
Boise Cascade Corp.	International Falls	MN0001643	DE020922	1			5790	4.47E+01	8.19E+02	1.27E+02
Mead Corp.	Chillicothe	OH0004481	DE026013	3B	ND		2936	9.10E-01	6.67E+00	1.58E+00
Badger Paper Mills, Inc.	Peshtigo	WI0000663	M46EBC	1			6871	1.51E-01	3.68E+00	5.19E-01
Badger Paper Mills, Inc.	Peshtigo	WI0000663	M46EBCX	3B	ND		6871	8.88E-02	4.35E+00	5.24E-01
James River Corp.	Green Bay	WI0001261	M72EAC	1			32774	5.03E-01	2.79E+00	7.82E-01
Pentair, Inc.	Park Falls	WI0003212	M25EC	3B	ND		27942	6.98E-02	1.24E-01	8.22E-02
Wausau Paper Mills Co. 1	Brokaw	WI0003379	M54EC	3B	ND		94458	2.91E-02	1.94E-01	4.86E-02
Wausau Paper Mills Co. 2	Brokaw	WI0003379	M54ECX	3D	ND	ND	94458	3.40E-02	1.46E-02	3.55E-02
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	WI0003620	M77EC	1			123175	1.49E+00	1.20E+01	2.69E+00
James River Corp.	Green Bay	WI0020991	M72EBC	4H	ND		32774	1.37E-02	9.33E-02	2.30E-02
James River Corp.	Green Bay	WI0020991	M72EBC	4L	ND		32774	1.09E-03	7.47E-03	1.84E-03
Weyerhaeuser Co.	Rothchild	WI0026042	M29EC	1			109005	1.08E-01	2.15E-01	1.29E-01
Badger Paper Mills, Inc.	Peshtigo	WI0030651	M46EAC	4H			6871	1.92E-01	5.48E+00	7.40E-01
Badger Paper Mills, Inc.	Peshtigo	WI0030651	M46EAC	4L			6871	1.53E-02	4.38E-01	5.92E-02
Badger Paper Mills, Inc.	Peshtigo	WI0030651	M46EACX	4H	ND		6871	6.26E-02	3.33E+00	3.95E-01
Badger Paper Mills, Inc.	Peshtigo	WI0030651	M46EACX	4L	ND		6871	5.01E-03	2.66E-01	3.16E-02
Consolidated Papers, Inc.	Wisconsin Rapids	WI0037991	21	3D	ND	ND	118006	6.25E-01	4.34E-01	6.69E-01
Region VI										
Georgia-Pacific Corp.	Crosset	AR0001210	M68EC	1			10999	3.76E+01	1.45E+02	5.21E+01
International Paper Co.	Pine Bluff	AR0001970	M51EC	1			141422	3.28E+00	3.28E+01	6.56E+00
Nekoosa Papers, Inc.	Ashdown	AR0002968	M20EC	1			54497	4.11E+00	9.42E+00	5.05E+00
Potlatch Corp.	McGhee	AR0035823	M18EC	4H			11237198	1.71E-03	4.28E-03	2.14E-03
Potlatch Corp.	McGhee	AR0035823	M18EC	4L			11237198	1.37E-04	3.42E-04	1.71E-04
James River Corp.	St. Francesville	LA0003468	M52EC	1			10289660	3.56E-02	1.39E-01	4.94E-02
Georgia-Pacific Corp.	Zachary	LA0005258	M1EC	3A		NQ	Q	Q	Q	0.00E+00
Georgia-Pacific Corp.	Zachary	LA0005258	M1ECX	1			10294421	6.37E-02	1.19E+00	1.83E-01
International Paper Co.	Bastrop	LA0007561	M85EC	5			163	3.17E+02	1.53E+03	4.70E+02
Boise Cascade Corp.	Deridder	LA0007927	M58EC	1			2416	5.54E+00	2.65E+01	8.18E+00
International Paper Co.	Texarkana	TX0000167	M99EC	1			22804	2.72E+00	9.01E+00	3.63E+00
International Paper Co.	Texarkana	TX0000167	M99EC1	1			22804	3.77E+00	9.22E+00	4.69E+00
Champion International	Lufkin	TX0001643	DF024512	3D	ND	ND	153	3.32E+00	3.32E+00	3.66E+00
Temple-Eastex, Inc.	Evadale	TX0003891	M3EC	1			29339	2.01E+01	2.28E+01	2.24E+01
Simpson Paper Co.	Pasadena	TX0006041	M2EC	3E	NQ		N	N	N	0.00E+00
Simpson Paper Co.	Pasadena	TX0006041	M2EC	3E	NQ		N	N	N	0.00E+00
Simpson Paper Co.	Pasadena	TX0006041	M2EC	3E	NQ		N	N	N	0.00E+00
Champion International	Houston	TX0053023	M15EC	2B	ND		5729	8.33E-01	2.61E+01	3.44E+00
Region VIII										
Stone Container Corp.	Missoula	MT0000035	M27EC	3C		ND	54222	5.67E-02	6.95E-02	6.37E-02
Region IX										

Appendix E. (continued)

COMPANY	CITY	NPDES NUMBER	SAMPLEID	GRP ID	TCDD NON-DET-	TCDF NON-DET-	7Q10 FLOW (m^3/hr) ECT[2]	TCDD CONC. (pg/l) ECT[2]	TCDF CONC. (pg/l)	TEQ CONC. (pg/l)
Stone Container Corp.	Snowflake	AZ-------	M100EC	2D			ZL	ZL	ZL	0.00E+00
Simpson Paper Co.	Anderson	CA0004065	M98EC	1			261080	4.60E+00	1.54E+02	2.00E+01
Gaylord Container Corp.	Antioch	CA0004847	M106EC	5			L	L	L	0.00E+00
Simpson Paper Co.	Fairhaven	CA0005282	M43ECO	2A			149317	2.17E+00	1.43E+01	3.61E+00
Louisiana Pacific Corp.	Samoa	CA0005894	M70EC10	2A			172342	9.71E-01	4.64E+00	1.43E+00
Region X										
Alaska Pulp Corp.	Sitka	AK0000531	M5EC-1	2B	ND		22753	5.50E-01	4.57E+00	1.01E+00
Ketchikan Pulp & Paper 1	Ketchikan	AK0000922	M31EAC	2B	ND	ND	149317	1.08E-01	8.55E-02	1.17E-01
Ketchikan Pulp & Paper 2	Ketchikan	AK0000922	M31EBC	2A			49772	1.36E+00	6.55E-01	1.43E+00
Potlatch Corp.	Lewiston	ID0001163	M56EC	1			1233491	3.11E-01	1.58E+00	4.69E-01
Potlatch Corp.	Lewiston	ID0001163	M56EC1	1			1233491	3.46E-01	1.40E+00	4.86E-01
James River Corp.	Clatskanie (Wauna)	OR0000795	8637-4645	1			L	L	L	0.00E+00
Pope & Talbot, Inc.	Halsey	OR0001074	M19EC	1			259184	2.10E-01	5.74E-01	2.67E-01
Boise Cascade Corp.	St. Helens	OR0020834	M76ECO	4H			L	L	L	0.00E+00
Boise Cascade Corp.	St. Helens	OR0020834	M76ECO	4L			L	L	L	0.00E+00
Longview Fibre Co.	Longview	WA0000078	M53EC	3B	ND		L	L	L	0.00E+00
Weyerhaeuser Co.	Longview	WA0000124	M45EC1-L	1			L	L	L	0.00E+00
Weyerhaeuser Co.	Longview	WA0000124	M45EC-L	1			L	L	L	0.00E+00
James River Corp.	Camas	WA0000256	M32EC	3E	NQ		N	N	N	0.00E+00
Scott Paper Co. 1	Everett	WA0000621	M80EAC	2D	ND		Z	Z	Z	0.00E+00
Scott Paper Co. 2	Everett	WA0000621	M80EBC	2D	ND	ND	Z	Z	Z	0.00E+00
ITT-Rayonier, Inc.	Port Angeles	WA0000795	M12EC	2A			L	L	L	0.00E+00
Weyerhaeuser Co.	Cosmopolis	WA0000809	M4EC	2A			L	L	L	0.00E+00
Simpson Paper Co.	Tacoma	WA0000850	M81EC	2E	NQ		N	N	N	0.00E+00
Simpson Paper Co.	Tacoma	WA0000850	M81EC1	2E	NQ	0	N	N	N	0.00E+00
Simpson Paper Co.	Tacoma	WA0000850	M81ECX	2E	NQ	0	N	N	N	0.00E+00
Simpson Paper Co.	Tacoma	WA0000850	M81ECXX	2E	NQ	0	N	N	N	0.00E+00
Georgia-Pacific Corp.	Bellingham	WA0001091	M60EC1	2B	ND		578783	6.46E-01	2.05E+02	2.11E+01
Weyerhaeuser Co.	Everett	WA0003000	M79EC	2A			66047	1.65E+00	1.30E+01	2.95E+00
ITT-Rayonier, Inc.	Hoquiam	WA0003077	M33EC	2A			60043	1.15E+00	4.30E-01	1.19E+00
Boise Cascade Corp.	Wallula	WA0003697	M66EC	1			L	L	L	0.00E+00

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[1] Legends of analysis group ID codes and error codes are on the next page.

[2] ND = Not detected in the effluent samples. In-stream concentration estimates are based on 1/2 the detection limit in the effluent sample.
NQ = Nonquantifiable

[3] a.k.a. Hammermill Papers.

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX F

Appendix F.
Fish Filet Tissue Residue Levels (ng/kg)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILUTION: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950			SIMPLE DILUTION: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950			EXAMS WATER COLUMN: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950			EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950		
							TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.
Region I																		
Georgia-Pacific Corp.	Woodland	ME17EC	ME0001872	1			6.55E-01	9.39E-01	7.49E-01	6.55E+00	9.39E-01	6.64E+00	5.00E-01	9.26E-01	5.93E-01	5.00E+00	9.26E-01	5.09E+00
International Paper Co.	Jay	RG1-86388	ME0001937	1			8.47E+00	1.58E+01	1.00E+01	8.47E+01	1.58E+01	8.63E+01	4.60E+00	1.54E+01	6.14E+00	4.60E+01	1.54E+01	4.76E+01
Lincoln Pulp and Paper	Lincoln	M11EC	ME0002003	1			4.55E-01	7.21E-01	5.27E-01	4.55E+00	7.21E-01	4.62E+00	3.48E-01	7.12E-01	4.19E-01	3.48E+00	7.12E-01	3.55E+00
James River Corp.	Old Town	M8EC	ME0002020	1			5.73E-01	7.44E-01	6.47E-01	5.73E+00	7.44E-01	5.80E+00	4.38E-01	7.37E-01	5.12E-01	4.38E+00	7.37E-01	4.46E+00
Boise Cascade Corp.	Rumford	M82EC	ME0002054	1			9.20E+00	1.70E+01	1.09E+01	9.20E+01	1.70E+01	9.37E+01	4.66E+00	1.67E+01	6.33E+00	4.66E+01	1.67E+01	4.83E+01
Scott Paper Co.	Westbrook	M30EC	ME0002321	1			1.71E+00	1.27E+00	1.84E+00	1.71E+01	1.27E+00	1.73E+01	9.00E-01	1.21E+00	1.02E+00	9.00E+00	1.21E+00	9.12E+00
Scott Paper Co.	Hinckley	M61EC	ME0021521	1			6.56E-01	1.01E+00	7.57E-01	6.56E+00	1.01E+00	6.66E+00	3.54E-01	9.86E-01	4.53E-01	3.54E+00	9.86E-01	3.64E+00
Scott Paper Co.	Hinckley	M61EC1	ME0021521	1			7.79E-01	1.60E+00	9.39E-01	7.79E+00	1.60E+00	7.95E+00	4.21E-01	1.57E+00	5.77E-01	4.21E+00	1.57E+00	4.36E+00
James River Corp.	Berlin	BM89EC	NH0000655	1			1.08E+00	1.51E+00	1.23E+00	1.08E+01	1.51E+00	1.09E+01	6.23E-01	1.47E+00	7.70E-01	6.23E+00	1.47E+00	6.38E+00
James River Corp.	Berlin	M89EC	NH0000655	1			3.74E+00	2.96E+01	6.70E+00	3.74E+01	2.96E+01	4.03E+01	2.16E+00	2.89E+01	5.05E+00	2.16E+01	2.89E+01	2.45E+01
Region II																		
International Paper Co.	Ticonderoga	M9EC	NY0004413	2A			5.00E+00	1.62E+01	6.63E+00	5.00E+01	1.62E+01	5.16E+01	1.69E+00	1.47E+01	3.16E+00	1.69E+01	1.47E+01	1.84E+01
International Paper Co.	Ticonderoga	M9EC1	NY0004413	2A			6.67E+00	1.73E+01	8.40E+00	6.67E+01	1.73E+01	6.84E+01	2.26E+00	1.57E+01	3.83E+00	2.26E+01	1.57E+01	2.41E+01
Finch & Pruyn & Co., Inc.	Glen Falls	M41EC	NY0005525	3D	ND	ND	1.74E-01	2.49E-02	1.76E-01	1.74E+00	2.49E-02	1.74E+00	1.00E-01	2.43E-02	1.03E-01	1.00E+00	2.43E-02	1.00E+00
Region III																		
Westvaco Corp.	Luke	M62EC	MD0021687	4H			1.90E+00	2.27E+00	2.13E+00	1.90E+01	2.27E+00	1.93E+01	5.53E-01	2.05E+00	7.58E-01	5.53E+00	2.05E+00	5.73E+00
Westvaco Corp.	Luke	M62EC	MD0021687	4L			1.52E-01	1.82E-01	1.70E-01	1.52E+00	1.82E-01	1.54E+00	4.42E-02	1.64E-01	6.06E-02	4.42E-01	1.64E-01	4.59E-01
Penntech Papers, Inc.	Johnsonburg	M57EAC	PA0002143	3B	ND		3.21E-01	5.15E-01	3.72E-01	3.21E+00	5.15E-01	3.26E+00	1.45E-01	4.37E-01	1.89E-01	1.45E+00	4.37E-01	1.50E+00
Penntech Papers, Inc.	Johnsonburg	M57EBC	PA0002143	1			1.18E+00	3.09E+00	1.49E+00	1.18E+01	3.09E+00	1.21E+01	2.69E-01	2.63E+00	5.32E-01	2.69E+00	2.63E+00	2.95E+00
Appleton Papers, Inc.	Roaring Springs	M13EDO	PA0008265	3B	ND		1.84E+00	2.35E+00	2.08E+00	1.84E+01	2.35E+00	1.86E+01	3.34E-01	1.58E+00	4.92E-01	3.34E+00	1.58E+00	3.50E+00
P.H. Glatfelter Co.	Spring Grove	M64EC20	PA0008869	3B	ND		4.96E+00	1.20E+01	6.16E+00	4.96E+01	1.20E+01	5.08E+01	6.48E-01	8.03E+00	1.45E+00	6.48E+00	8.03E+00	7.28E+00
Procter & Gamble Co.	Mehoopany	M42EC	PA0008885	3B	ND		2.56E-02	5.76E-03	2.61E-02	2.56E-01	5.76E-03	2.56E-01	1.18E-02	5.54E-03	1.23E-02	1.18E-01	5.54E-03	1.18E-01
International Paper[3]	Erie	M103ECX	PA0026301	2CH			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
International Paper[3]	Erie	M103ECX	PA0026301	2CL			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
Chesapeake Corp.	West Point	M74EC140	VA0003115	1			4.33E+00	1.01E+01	5.34E+00	4.33E+01	1.01E+01	4.43E+01	1.22E+00	9.08E+00	2.13E+00	1.22E+01	9.08E+00	1.31E+01
Westvaco Corp.	Covington	BM28EC	VA0003646	3B	ND		2.13E+00	3.69E+00	2.50E+00	2.13E+01	3.69E+00	2.17E+01	6.23E-01	3.43E+00	9.67E-01	6.23E+00	3.43E+00	6.58E+00
Westvaco Corp.	Covington	M28EC	VA0003646	1			1.07E+02	1.20E+02	1.19E+02	1.07E+03	1.20E+02	1.08E+03	3.12E+01	1.12E+02	4.23E+01	3.12E+02	1.12E+02	3.23E+02
Westvaco Corp.	Covington	M28EC1	VA0003646	3B	ND		5.33E+00	3.99E+01	9.32E+00	5.33E+01	3.99E+01	5.73E+01	1.56E+00	3.71E+01	5.27E+00	1.56E+01	3.71E+01	1.93E+01
Westvaco Corp.	Covington	M28EC2	VA0003646	1			7.10E+00	3.05E+01	1.02E+01	7.10E+01	3.05E+01	7.41E+01	2.08E+00	2.83E+01	4.91E+00	2.08E+01	2.83E+01	2.36E+01
Union Camp Corp.	Franklin	UCF1000	VA0004162	1			1.22E+02	4.98E+01	1.27E+02	1.22E+03	4.98E+01	1.23E+03	4.56E+01	4.96E+01	5.05E+01	4.56E+02	4.96E+01	4.61E+02
Region IV																		
Champion International	Courtland	M40EC	AL0000396	2A			8.28E-01	1.43E+00	9.71E-01	8.28E+00	1.43E+00	8.42E+00	2.96E-01	1.37E+00	4.33E-01	2.96E+00	1.37E+00	3.09E+00
Container Corp. of America	Brewton	M67EC	AL0002682	3C		ND	1.72E+00	5.15E-01	1.77E+00	1.72E+01	5.15E-01	1.72E+01	8.43E-01	5.06E-01	8.94E-01	8.43E+00	5.06E-01	8.48E+00
Boise Cascade Corp.	Jackson	M65EC	AL0002755	1			1.76E+00	3.91E+00	2.15E+00	1.76E+01	3.91E+00	1.80E+01	6.22E-01	3.74E+00	9.96E-01	6.22E+00	3.74E+00	6.59E+00
Boise Cascade Corp.	Jackson	M65EC1	AL0002755	1			2.23E+00	4.56E+00	2.68E+00	2.23E+01	4.56E+00	2.27E+01	7.85E-01	4.37E+00	1.22E+00	7.85E+00	4.37E+00	8.29E+00
International Paper Co.	Mobile	M71EC	AL0002780	1			1.37E+00	4.54E+00	1.82E+00	1.37E+01	4.54E+00	1.42E+01	4.21E-01	4.32E+00	8.53E-01	4.21E+00	4.32E+00	4.64E+00
Scott Paper Co.	Mobile	M26EC210	AL0002801	1			4.44E-01	2.35E-01	4.68E-01	4.44E+00	2.35E-01	4.46E+00	1.37E-01	2.24E-01	1.59E-01	1.37E+00	2.24E-01	1.39E+00
Gulf States Paper Corp.	Demopolis	M101EC	AL0002828	1			1.55E+00	1.75E+00	1.73E+00	1.55E+01	1.75E+00	1.57E+01	4.46E-01	1.33E+00	5.79E-01	4.46E+00	1.33E+00	4.60E+00
International Paper Co.	Selma	M88EC	AL0003018	1			1.15E+00	1.72E+00	1.32E+00	1.15E+01	1.72E+00	1.17E+01	2.69E-01	1.60E+00	4.28E-01	2.69E+00	1.60E+00	2.85E+00
Kimberly-Clark Corp.	Coosa Pines	M36EC	AL0003158	1			1.87E+00	1.54E+00	2.02E+00	1.87E+01	1.54E+00	1.88E+01	4.38E-01	1.42E+00	5.80E-01	4.38E+00	1.42E+00	4.52E+00
James River Corp.	Butler	M96EC	AL0003301	1			1.35E+00	1.65E+00	1.52E+00	1.35E+01	1.65E+00	1.37E+01	4.46E-01	1.56E+00	6.02E-01	4.46E+00	1.56E+00	4.61E+00
Alabama River Pulp	Claiborne	M21EC	AL0025968	1			4.74E-01	1.13E+00	5.87E-01	4.74E+00	1.13E+00	4.85E+00	1.48E-01	1.07E+00	2.55E-01	1.48E+00	1.07E+00	1.59E+00
Alabama River Pulp	Claiborne	M21EC1	AL0025968	1			4.62E-01	1.13E+00	5.75E-01	4.62E+00	1.13E+00	4.74E+00	1.44E-01	1.07E+00	2.52E-01	1.44E+00	1.07E+00	1.55E+00
Alabama River Pulp	Claiborne	M21EC2	AL0025968	1			5.32E-01	9.47E-01	6.26E-01	5.32E+00	9.47E-01	5.41E+00	1.66E-01	9.01E-01	2.56E-01	1.66E+00	9.01E-01	1.75E+00
ITT-Rayonier, Inc.	Fernandina Beach	M90EC	FL0000701	2A			7.00E-01	1.37E+00	8.37E-01	7.00E+00	1.37E+00	7.14E+00	2.47E-01	1.24E+00	3.76E-01	2.47E+00	1.29E+00	2.60E+00
Buckeye Cellulose	Perry	M91EC0	FL0000876	1			1.30E+02	1.50E+02	1.45E+02	1.30E+03	1.50E+02	1.31E+03	5.18E+01	1.50E+02	6.68E+01	5.18E+02	1.50E+02	5.33E+02

Appendix F.

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILUTION: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950			SIMPLE DILUTION: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950			EXAMS WATER COLUMN: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950			EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950		
							TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.
Champion International	Cantonment	CP1000	FL0002526	3B	ND		1.43E+01	3.85E+01	1.81E+01	1.43E+02	3.85E+01	1.47E+02	6.30E+00	3.02E+01	9.32E+00	6.30E+01	3.02E+01	6.60E+01
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CH	ND		1.05E-01	7.70E-02	1.13E-01	1.05E+00	7.70E-02	1.06E+00	3.69E-02	7.26E-02	4.41E-02	3.69E-01	7.26E-02	3.76E-01
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CL	ND		8.40E-03	6.16E-03	9.02E-03	8.40E-02	6.16E-03	8.46E-02	2.95E-03	5.81E-03	3.53E-03	2.95E-02	5.81E-03	3.01E-02
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CH			1.73E-01	1.76E-01	1.90E-01	1.73E+00	1.76E-01	1.74E+00	6.06E-02	1.65E-01	7.71E-02	6.06E-01	1.65E-01	6.22E-01
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CL			6.90E-03	1.40E-02	8.30E-03	6.90E-02	1.40E-02	7.04E-02	4.84E-03	1.32E-02	6.17E-03	4.84E-02	1.32E-02	4.98E-02
Georgia-Pacific Corp.	Palatka	M24EC	FL0002763	2A			4.71E+01	4.36E+01	5.14E+01	4.71E+02	4.36E+01	4.75E+02	4.15E+01	4.77E+01	4.63E+01	4.15E+02	4.77E+01	4.20E+02
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4H			6.96E+00	1.95E+01	8.91E+00	6.96E+01	1.95E+01	7.15E+01	CD	CD	CD	CD	CD	CD
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4L			5.57E-01	6.20E-01	6.19E-01	5.57E+00	6.20E-01	5.63E+00	CD	CD	CD	CD	CD	CD
Gilman Paper Co.	St. Marys	M55EC	GA0001953	2B	ND		9.56E-01	1.95E+00	1.15E+00	9.56E+00	1.95E+00	9.75E+00	3.84E-01	1.89E+00	5.73E-01	3.84E+00	1.89E+00	4.03E+00
Federal Paper Board Co.	Augusta	M83EC	GA0002801	1			5.73E-01	6.57E-01	6.39E-01	5.73E+00	6.57E-01	5.80E+00	2.29E-01	6.35E-01	2.92E-01	2.29E+00	6.35E-01	2.35E+00
ITT-Rayonier, Inc.	Jesup	M84EAC	GA0003620	1			1.57E+00	1.07E-01	1.58E+00	1.57E+01	1.07E-01	1.57E+01	6.30E-01	1.04E-01	6.40E-01	6.29E+00	1.04E-01	6.31E+00
ITT-Rayonier, Inc.	Jesup	M84EBC	GA0003620	1			1.50E+00	4.07E-01	1.54E+00	1.50E+01	4.07E-01	1.51E+01	6.04E-01	3.96E-01	6.43E-01	6.04E+00	3.96E-01	6.07E+00
Brunswick Pulp and Paper	Brunswick	M87EC	GA0003654	2A			6.82E+00	6.03E+00	7.42E+00	6.82E+01	6.03E+00	6.88E+01	2.48E+00	5.89E+00	3.07E+00	2.48E+01	5.89E+00	2.54E+01
Brunswick Pulp and Paper	Brunswick	M87EC1	GA0003654	2A			6.82E+00	4.43E+00	7.26E+00	6.82E+01	4.43E+00	6.86E+01	2.48E+00	4.33E+00	2.92E+00	2.48E+01	4.33E+00	2.53E+01
Buckeye Cellulose	Oglethorpe	M22EC10	GA0049336	3B	ND		2.20E-01	3.73E-01	2.58E-01	2.20E+00	3.73E-01	2.24E+00	8.68E-02	3.55E-01	1.22E-01	8.68E-01	3.55E-01	9.03E-01
Westvaco Corp.	Wickliffe	M78EC	KY0000086	1			1.92E-02	3.22E-02	2.25E-02	1.92E-01	3.22E-02	1.96E-01	E	E	E	E	E	E
Willamette Industries	Hawesville	M63EC	KY0001716	3D	ND	ND	9.08E-03	2.58E-03	9.34E-03	9.08E-02	2.58E-03	9.11E-02	9.01E-04	2.13E-03	1.11E-03	9.01E-03	2.13E-03	9.22E-03
International Paper Co.	Natchez	M97EC	MS0000213	1			2.80E-02	6.31E-02	3.43E-02	2.80E-01	6.31E-02	2.86E-01	E	E	E	E	E	E
International Paper Co.	Moss Point	M34EC	MS0002674	2CH			2.00E+01	4.49E+01	2.45E+01	2.00E+02	4.49E+01	2.04E+02	5.98E+00	3.93E+01	9.90E+00	5.98E+01	3.93E+01	6.37E+01
International Paper Co.	Moss Point	M34EC	MS0002674	2CL			8.00E-01	3.59E+00	1.16E+00	8.00E+00	3.59E+00	8.36E+00	4.78E-01	3.14E+00	7.92E-01	4.78E+00	3.14E+00	5.09E+00
Leaf River Forest Products	New Augusta	BM35SEC30	MS0031704	1			6.61E+00	3.26E+00	6.94E+00	6.61E+01	3.26E+00	6.65E+01	2.11E+00	3.08E+00	2.41E+00	2.11E+01	3.08E+00	2.14E+01
Leaf River Forest Products	New Augusta	M35SEC30	MS0031704	1			1.67E+01	1.34E+01	1.81E+01	1.67E+02	1.34E+01	1.69E+02	5.33E+00	1.26E+01	6.59E+00	5.33E+01	1.26E+01	5.46E+01
Champion International	Canton	M47G100-500	NC0000272	1			1.42E+01	2.65E+00	1.44E+01	1.42E+02	2.65E+00	1.42E+02	5.37E+00	2.65E+00	5.64E+00	5.37E+01	2.65E+00	5.40E+01
Weyerhaeuser Co.	Plymouth	M86EC0	NC0000680	2A			1.60E+02	7.80E+02	2.38E+02	1.60E+03	7.80E+02	1.68E+03	6.86E+01	7.71E+02	1.46E+02	6.86E+02	7.71E+02	7.63E+02
Weyerhaeuser Co.	New Bern	M6EC	NC0003191	1			6.58E+00	1.05E+01	7.62E+00	6.58E+01	1.05E+01	6.68E+01	3.66E+00	1.02E+01	4.68E+00	3.66E+01	1.02E+01	3.76E+01
Federal Paper Board Co.	Riegelwood	M16EC	NC0003298	1			2.61E+00	2.22E+00	2.84E+00	2.61E+01	2.22E+00	2.64E+01	1.75E+00	3.16E+00	2.07E+00	1.75E+01	3.16E+00	1.78E+01
International Paper Co.	Georgetown	M70EC	SC0000868	2A			1.60E+03	1.56E+03	1.76E+03	1.60E+04	1.56E+03	1.62E+04	4.15E+02	1.39E+03	5.54E+02	4.15E+03	1.39E+03	4.29E+03
International Paper Co.	Georgetown	M70EC1	SC0000868	2A			1.23E+03	1.46E+03	1.37E+03	1.23E+04	1.46E+03	1.24E+04	3.18E+02	1.30E+03	4.48E+02	3.18E+03	1.30E+03	3.31E+03
Bowater Corp.	Catawba	M23EC	SC0001015	1			2.16E+00	1.47E+00	2.30E+00	2.16E+01	1.47E+00	2.17E+01	1.26E+00	1.44E+00	1.41E+00	1.26E+01	1.44E+00	1.28E+01
Union Camp Corp.	Eastover	M93EC	SC0038121	1			3.55E-01	3.66E-01	3.91E-01	3.55E+00	3.66E-01	3.58E+00	9.31E-02	3.41E-01	1.27E-01	9.31E-01	3.41E-01	9.65E-01
Mead Corporation	Kingsport	M73EC	TN0001643	1			2.97E-01	8.50E-01	3.82E-01	2.97E+00	8.50E-01	3.06E+00	1.45E-01	8.13E-01	2.26E-01	1.45E+00	8.13E-01	1.53E+00
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	4.08E-01	1.29E-01	4.21E-01	4.08E+00	1.29E-01	4.10E+00	2.11E-01	1.26E-01	2.24E-01	2.11E+00	1.26E-01	2.13E+00
Region V																		
Mead Corporation	Escanaba	ML802	MI0000027	3B	ND		3.69E+00	8.61E+00	4.55E+00	3.69E+01	8.61E+00	3.78E+01	2.10E+00	8.54E+00	2.95E+00	2.10E+01	8.54E+00	2.18E+01
Scott Paper Co.	Muskegon	M92EC	MI0027391	4H	ND		8.07E-02	3.15E-01	1.12E-01	8.07E-01	3.15E-01	8.38E-01	4.15E-02	3.03E-01	7.19E-02	4.15E-01	3.03E-01	4.46E-01
Scott Paper Co.	Muskegon	M92EC	MI0027391	4L	ND		6.45E-03	2.52E-02	8.97E-03	6.45E-02	2.52E-02	6.70E-02	3.32E-03	2.43E-02	5.75E-03	3.32E-02	2.43E-02	3.57E-02
Champion International	Quinnesec	Q14E	MI0042170	1			4.67E-01	1.34E+00	6.01E-01	4.67E+00	1.34E+00	4.80E+00	2.89E-01	1.30E+00	4.19E-01	2.89E+00	1.30E+00	3.02E+00
Potlatch Corp.	Cloquet	M38EC0	MN-------	4H			4.72E-01	3.53E-01	5.07E-01	4.72E+00	3.53E-01	4.75E+00	2.81E-01	3.40E-01	3.15E-01	2.81E+00	3.40E-01	2.85E+00
Potlatch Corp.	Cloquet	M38EC0	MN-------	4L			3.77E-02	2.82E-02	4.05E-02	3.77E-01	2.82E-02	3.80E-01	2.25E-02	2.72E-02	2.52E-02	2.25E-01	2.72E-02	2.28E-01
Boise Cascade Corp.	International Falls	DE020922	MN0001643	1			1.74E+00	1.25E+01	2.99E+00	1.74E+01	1.25E+01	1.87E+01	1.06E+00	1.23E+01	2.28E+00	1.06E+01	1.23E+01	1.18E+01
Mead Corp.	Chillicothe	DE026013	OH0004481	3B	ND		1.73E+00	4.95E+00	2.22E+00	1.73E+01	4.95E+00	1.78E+01	1.16E+00	4.81E+00	1.64E+00	1.16E+01	4.81E+00	1.21E+01
Badger Paper Mills, Inc.	Peshtigo	M46EBC	WI0000663	1			8.38E-02	7.99E-01	1.64E-01	8.38E-01	7.99E-01	9.18E-01	4.45E-02	7.32E-01	1.18E-01	4.45E-01	7.32E-01	5.18E-01
Badger Paper Mills, Inc.	Peshtigo	M46EBCX	WI0000663	3B	ND		4.93E-02	9.44E-01	1.44E-01	4.93E-01	9.44E-01	5.88E-01	E	E	E	E	E	E
James River Corp.	Green Bay	M72EAC	WI0001261	1			2.85E-01	6.16E-01	3.47E-01	2.85E+00	6.16E-01	2.91E+00	8.14E-02	5.77E-01	1.39E-01	8.14E-01	5.77E-01	8.72E-01
Pentair, Inc.	Park Falls	M25EC	WI0003212	3B	ND		3.01E-01	2.09E-01	3.22E-01	3.01E+00	2.09E-01	3.03E+00	1.66E-01	1.83E-01	1.85E-01	1.66E+00	1.83E-01	1.68E+00
Wausau Paper Mills Co. 1	Brokaw	M54EC	WI0003379	3B	ND		6.20E-02	1.61E-01	7.81E-02	6.20E-01	1.61E-01	6.36E-01	3.73E-02	1.56E-01	5.29E-02	3.73E-01	1.56E-01	3.88E-01
Wausau Paper Mills Co. 2	Brokaw	M54ECX	WI0003379	3D	ND	ND	7.24E-02	1.21E-02	7.36E-02	7.24E-01	1.21E-02	7.25E-01	4.35E-02	1.17E-02	4.47E-02	4.35E-01	1.17E-02	4.36E-01
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	M77EC	WI0003620	1			2.97E+00	9.26E+00	3.89E+00	2.97E+01	9.26E+00	3.06E+01	1.39E+00	9.02E+00	2.29E+00	1.39E+01	9.02E+00	1.48E+01
James River Corp.	Green Bay	M72EBC	WI0020991	4H	ND		7.52E-03	2.00E-02	9.52E-03	7.52E-02	2.00E-02	7.72E-02	2.14E-03	1.87E-02	4.00E-03	2.14E-02	1.87E-02	2.32E-02

Appendix F.
SIMPLE DILUTION — EXAMS WATER COLUMN

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET[2]	TCDF NON-DET[2]	TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TCDF FILET CONC.	TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TEQ FILET CONC.	TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TCDF FILET CONC.	TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TEQ FILET CONC.	EXAMS WATER COLUMN TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	EXAMS WATER COLUMN TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TCDF FILET CONC.	EXAMS WATER COLUMN TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TEQ FILET CONC.	EXAMS WATER COLUMN TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	EXAMS WATER COLUMN TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TCDF FILET CONC.	EXAMS WATER COLUMN TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TEQ FILET CONC.
James River Corp.	Green Bay	M72EBC	WI0020991	4L	ND		6.01E-04	1.60E-03	7.61E-04	6.01E-03	1.60E-03	6.17E-03	1.71E-04	1.49E-03	3.20E-04	1.71E-03	1.49E-03	1.86E-03
Weyerhaeuser Co.	Rothchild	M29EC	WI0026042	1			2.32E-01	1.81E-01	2.50E-01	2.32E+00	1.81E-01	2.34E+00	1.21E-01	1.75E-01	1.39E-01	1.21E+00	1.75E-01	1.23E+00
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4H			1.11E-01	1.24E+00	2.35E-01	1.11E+00	1.24E+00	1.24E+00	5.95E-02	1.14E+00	1.73E-01	5.95E-01	1.14E+00	7.08E-01
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4L			8.89E-03	9.91E-02	1.88E-02	8.89E-02	9.91E-02	9.88E-02	4.76E-03	9.10E-02	1.39E-02	4.76E-02	9.10E-02	5.67E-02
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4H	ND		3.63E-02	7.52E-01	1.12E-01	3.63E-01	7.52E-01	4.38E-01	E	E	E	E	E	E
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4L	ND		2.90E-03	6.02E-02	8.92E-03	2.90E-02	6.02E-02	3.51E-02	E	E	E	E	E	E
Consolidated Papers, Inc.	Wisconsin Rapids	21	WI0037991	3D	ND	ND	1.18E+00	3.20E-01	1.21E+00	1.18E+01	3.20E-01	1.18E+01	5.32E-01	3.09E-01	5.63E-01	5.33E+00	3.09E-01	5.36E+00
Region VI																		
Georgia-Pacific Corp.	Crosset	M68EC	AR0001210	1			1.37E+01	2.06E+01	1.58E+01	1.37E+02	2.06E+01	1.39E+02	4.14E+00	1.97E+01	6.12E+00	4.14E+01	1.97E+01	4.34E+01
International Paper Co.	Pine Bluff	M51EC	AR0001970	1			2.39E+00	9.31E+00	3.32E+00	2.39E+01	9.31E+00	2.48E+01	1.10E+00	9.06E+00	2.01E+00	1.10E+01	9.06E+00	1.19E+01
Nekoosa Papers, Inc.	Ashdown	M20EC	AR0002968	1			3.05E+00	2.73E+00	3.32E+00	3.05E+01	2.73E+00	3.08E+01	3.57E-01	2.33E+00	5.90E-01	3.57E+00	2.33E+00	3.80E+00
Potlatch Corp.	McGhee	M18EC	AR0035823	4H			2.56E-03	2.50E-03	2.81E-03	2.56E-02	2.50E-03	2.59E-02	E	E	E	E	E	E
Potlatch Corp.	McGhee	M18EC	AR0035823	4L			2.05E-04	2.00E-04	2.25E-04	2.05E-03	2.00E-04	2.07E-03	E	E	E	E	E	E
James River Corp.	St. Francesville	M52EC	LA0003468	1			5.15E-02	7.84E-02	5.93E-02	5.15E-01	7.84E-02	5.23E-01	E	E	E	E	E	E
Georgia-Pacific Corp.	Zachary	M1EC	LA0005258	3A		NQ	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Georgia-Pacific Corp.	Zachary	M1ECX	LA0005258	1			9.23E-02	6.75E-01	1.60E-01	9.23E-01	6.75E-01	9.91E-01	E	E	E	E	E	E
International Paper Co.	Bastrop	M85EC	LA0007561	5			F	F	F	F	F	F	F	F	F	F	F	F
Boise Cascade Corp.	Deridder	M58EC	LA0007927	1			1.06E+01	1.98E+01	1.26E+01	1.06E+02	1.98E+01	1.08E+02	3.57E+00	1.76E+01	5.33E+00	3.57E+01	1.76E+01	3.75E+01
International Paper Co.	Texarkana	M99EC	TX0000167	1			1.27E+01	1.64E+01	1.44E+01	1.27E+02	1.64E+01	1.29E+02	2.69E+00	1.56E+01	4.25E+00	2.69E+01	1.56E+01	2.85E+01
International Paper Co.	Texarkana	M99EC1	TX0000167	1			1.76E+01	1.68E+01	1.93E+01	1.76E+02	1.68E+01	1.78E+02	6.57E+00	1.67E+01	8.23E+00	6.57E+01	1.67E+01	6.73E+01
Champion International	Lufkin	DF024512	TX0001643	3D	ND	ND	2.28E+00	8.90E-01	2.37E+00	2.28E+01	8.90E-01	2.29E+01	7.68E-01	7.91E-01	8.47E-01	7.68E+00	7.91E-01	7.75E+00
Temple-Eastex, Inc.	Evadale	M3EC	TX0003891	1.			2.40E+01	1.06E+01	2.50E+01	2.40E+02	1.06E+01	2.41E+02	1.05E+01	1.06E+01	1.16E+01	1.05E+02	1.06E+01	1.06E+02
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N	N	N	N	N
Champion International	Houston	M15EC	TX0053023	2B	ND		4.13E+00	5.03E+01	9.16E+00	4.13E+01	5.03E+01	4.63E+01	1.94E+00	3.79E+01	5.73E+00	1.94E+01	3.79E+01	2.32E+01
Region VIII																		
Stone Container Corp.	Missoula	M27EC	MT0000035	3C		ND	5.52E-02	2.64E-02	5.78E-02	5.52E-01	2.64E-02	5.55E-01	1.28E-02	2.42E-02	1.53E-02	1.28E-01	2.42E-02	1.31E-01
Region IX																		
Stone Container Corp.	Snowflake	M100EC	AZ-------	2D			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
Simpson Paper Co.	Anderson	M98EC	CA0004065	1			8.94E+00	1.17E+02	2.07E+01	8.94E+01	1.17E+02	1.01E+02	4.04E+00	1.14E+02	1.54E+01	4.04E+01	1.14E+02	5.18E+01
Gaylord Container Corp.	Antioch	M106EC	CA0004847	5			F	F	F	F	F	F	F	F	F	F	F	F
Simpson Paper Co.	Fairhaven	M43ECO	CA0005282	2A			1.09E+01	2.80E+01	1.37E+01	1.09E+02	2.80E+01	1.11E+02	3.85E+00	2.66E+01	6.50E+00	3.85E+01	2.66E+01	4.11E+01
Louisiana Pacific Corp.	Samoa	M70EC10	CA0005894	2A			4.86E+00	9.04E+00	5.76E+00	4.86E+01	9.04E+00	4.95E+01	1.71E+00	8.56E+00	2.57E+00	1.71E+01	8.56E+00	1.80E+01
Region X																		
Alaska Pulp Corp.	Sitka	M5EC-1	AK0000531	2B	ND		2.75E+00	8.91E+00	3.64E+00	2.75E+01	8.91E+00	2.84E+01	9.45E-01	8.15E+00	1.76E+00	9.45E+00	8.15E+00	1.03E+01
Ketchikan Pulp & Paper 1	Ketchikan	M31EAC	AK0000922	2B	ND	ND	5.40E-01	1.67E-01	5.57E-01	5.40E+00	1.67E-01	5.42E+00	1.91E-01	1.59E-01	2.07E-01	1.91E+00	1.59E-01	1.93E+00
Ketchikan Pulp & Paper 2	Ketchikan	M31EBC	AK0000922	2A			6.82E+00	1.28E+00	6.95E+00	6.82E+01	1.28E+00	6.83E+01	2.45E+00	1.23E+00	2.57E+00	2.45E+01	1.23E+00	2.46E+01
Potlatch Corp.	Lewiston	M56EC	ID0001163	1			5.28E-01	1.04E+00	6.33E-01	5.28E+00	1.04E+00	5.39E+00	1.07E-01	8.53E-01	1.92E-01	1.07E+00	8.53E-01	1.16E+00
Potlatch Corp.	Lewiston	M56EC1	ID0001163	1			5.88E-01	9.29E-01	6.81E-01	5.88E+00	9.29E-01	5.97E+00	1.19E-01	7.58E-01	1.95E-01	1.19E+00	7.58E-01	1.27E+00
James River Corp.	Clatskanie (Wauna)	8637-4645	OR0000795	1			2.52E-02	7.85E-02	3.30E-02	2.52E-01	7.85E-02	2.60E-01	ED	ED	ED	ED	ED	ED
Pope & Talbot, Inc.	Halsey	M19EC	OR0001074	1			3.53E-01	3.76E-01	3.90E-01	3.53E+00	3.76E-01	3.57E+00	1.55E-01	3.64E-01	1.92E-01	1.55E+00	3.64E-01	1.59E+00
Boise Cascade Corp.	St. Helens	M76ECO	OR0020834	4H			8.29E-03	1.47E-02	9.76E-03	8.29E-02	1.47E-02	8.44E-02	ED	ED	ED	ED	ED	ED
Boise Cascade Corp.	St. Helens	M76ECO	OR0020834	4L			6.63E-04	1.18E-03	7.81E-04	6.63E-03	1.18E-03	6.75E-03	ED	ED	ED	ED	ED	ED
Longview Fibre Co.	Longview	M53EC	WA0000078	3B	ND		5.91E-03	5.71E-02	1.16E-02	5.91E-02	5.71E-02	6.48E-02	ED	ED	ED	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC1-L	WA0000124	1			1.85E-02	1.79E-02	2.03E-02	1.85E-01	1.79E-02	1.87E-01	ED	ED	ED	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC-L	WA0000124	1			2.18E-02	3.15E-02	2.49E-02	2.18E-01	3.15E-02	2.21E-01	ED	ED	ED	ED	ED	ED
James River Corp.	Camas	M32EC	WA0000256	3E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Scott Paper Co. 1	Everett	M80EAC	WA0000621	2D	ND		EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD

Appendix F.
SIMPLE DILUTION — EXAMS WATER COLUMN

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET EC1[2]	TCDF NON-DET EC1[2]	TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD BCF TO FILET=5,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.	TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 TCDD FILET CONC.	TCDF FILET CONC.	TEQ FILET CONC.
Scott Paper Co. 2	Everett	M80EBC	WA0000621	2D	ND	ND	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD
ITT-Rayonier, Inc.	Port Angeles	M12EC	WA0000795	2A			1.10E+00	7.02E-01	1.17E+00	1.10E+01	7.02E-01	1.11E+01	3.93E-01	6.75E-01	4.61E-01	3.93E+00	6.75E-01	4.00E+00
Weyerhaeuser Co.	Cosmopolis	M4EC	WA0000809	2A			9.70E+00	1.56E+02	2.53E+01	9.70E+01	1.56E+02	1.13E+02	3.25E+00	1.38E+02	1.71E+01	3.25E+01	1.38E+02	4.63E+01
Simpson Paper Co.	Tacoma	M81EC	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81EC1	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECXX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Georgia-Pacific Corp.	Bellingham	M60EC1	WA0001091	2B	ND		1.33E-01	1.64E+01	1.77E+00	1.33E+00	1.64E+01	2.96E+00	4.69E-02	1.56E+01	1.61E+00	4.69E-01	1.56E+01	2.03E+00
Weyerhaeuser Co.	Everett	M79EC	WA0003000	2A			8.25E+00	2.53E+01	1.08E+01	8.25E+01	2.53E+01	8.50E+01	3.08E-01	2.54E+00	5.62E-01	3.08E+00	2.54E+00	3.33E+00
ITT-Rayonier, Inc.	Hoquiam	M33EC	WA0003077	2A			5.75E+00	8.39E-01	5.83E+00	5.75E+01	8.39E-01	5.76E+01	2.01E+00	7.83E-01	2.08E+00	2.01E+01	7.83E-01	2.01E+01
Boise Cascade Corp.	Wallula	M66EC	WA0003697	1			3.89E-01	3.16E+00	7.06E-01	3.89E+00	3.16E+00	4.21E+00	1.13E-01	2.46E+00	3.59E-01	1.13E+00	2.46E+00	1.37E+00

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[1] Legends of analysis group ID codes and error codes are on the next page.

[2] ND = Not detected in the effluent samples. Filet concentration estimates are based on 1/2 the detection limit in the effluent sample.
NQ = Nonquantifiable

[3] a.k.a. Hammermill Papers.

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX G

Appendix G.
Average daily lifetime 95% Bioavailable Dose in mg/kg/day of 2378-TCDD and 2378-TCDF as TEQ from Fish Ingestion

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET=ECT[2]	TCDF NON-DET=ECT[2]	DOSE TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day
Region I												
Georgia-Pacific Corp.	Woodland	M17EC	ME0001872	1			6.6E-11	2.7E-09	1.2E-08	5.2E-11	2.1E-09	9.7E-09
International Paper Co.	Jay	RG1-86388	ME0001937	1			8.9E-10	3.5E-08	1.6E-07	5.4E-10	1.9E-08	9.0E-08
Lincoln Pulp and Paper	Lincoln	M11EC	ME0002003	1			4.7E-11	1.9E-09	8.6E-09	3.7E-11	1.4E-09	6.7E-09
James River Corp.	Old Town	M8EC	ME0002020	1			5.7E-11	2.4E-09	1.1E-08	4.5E-11	1.8E-09	8.5E-09
Boise Cascade Corp.	Rumford	M82EC	ME0002054	1			9.6E-10	3.8E-08	1.7E-07	5.6E-10	2.0E-08	9.2E-08
Scott Paper Co.	Westbrook	M30EC	ME0002321	1			1.6E-10	7.0E-09	3.3E-08	9.0E-11	3.7E-09	1.7E-08
Scott Paper Co.	Hinckley	M61EC	ME0021521	1			6.7E-11	2.7E-09	1.2E-08	4.0E-11	1.5E-09	6.9E-09
Scott Paper Co.	Hinckley	M61EC1	ME0021521	1			8.3E-11	3.2E-09	1.5E-08	5.1E-11	1.8E-09	8.3E-09
James River Corp.	Berlin	BM89EC	NH0000655	1			1.1E-10	4.4E-09	2.0E-08	6.8E-11	2.6E-09	1.2E-08
James River Corp.	Berlin	M89EC	NH0000655	1			5.9E-10	1.6E-08	7.1E-08	4.5E-10	1.0E-08	4.7E-08
Region II												
International Paper Co.	Ticonderoga	M9EC	NY0004413	2A			5.8E-10	2.1E-08	9.5E-08	2.8E-10	7.5E-09	3.5E-08
International Paper Co.	Ticonderoga	M9EC1	NY0004413	2A			7.4E-10	2.8E-08	1.3E-07	3.4E-10	9.8E-09	4.6E-08
Finch & Pruyn & Co., Inc.	Glen Falls	M41EC	NY0005525	3D	ND	ND	1.6E-11	7.1E-10	3.3E-09	9.1E-12	4.1E-10	1.9E-09
Region III												
Westvaco Corp.	Luke	M62EC	MD0021687	4H			1.9E-10	7.8E-09	3.6E-08	6.7E-11	2.3E-09	1.1E-08
Westvaco Corp.	Luke	M62EC	MD0021687	4L			1.5E-11	6.3E-10	2.9E-09	5.3E-12	1.9E-10	8.7E-10
Penntech Papers, Inc.	Johnsonburg	M57EAC	PA0002143	3B	ND		3.3E-11	1.3E-09	6.1E-09	1.7E-11	6.1E-10	2.8E-09
Penntech Papers, Inc.	Johnsonburg	M57EBC	PA0002143	1			1.3E-10	4.9E-09	2.2E-08	4.7E-11	1.2E-09	5.6E-09
Appleton Papers, Inc.	Roaring Springs	M13EDO	PA0008265	3B	ND		1.8E-10	7.6E-09	3.5E-08	4.3E-11	1.4E-09	6.6E-09
P.H. Glatfelter Co.	Spring Grove	M64EC20	PA0008869	3B	ND		5.4E-10	2.1E-08	9.4E-08	1.3E-10	3.0E-09	1.4E-08
Procter & Gamble Co[3]	Mehoopany	M42EC	PA0008885	3B	ND		2.3E-12	1.0E-10	4.9E-10	1.1E-12	4.8E-11	2.2E-10
International Paper[3]	Erie	M103ECX	PA0026301	2CH			EZ	EZ	EZ	EZ	EZ	EZ
International Paper[3]	Erie	M103ECX	PA0026301	2CL			EZ	EZ	EZ	EZ	EZ	EZ
Chesapeake Corp.	West Point	M74EC140	VA0003115	1			4.7E-10	1.8E-08	8.2E-08	1.9E-10	5.3E-09	2.5E-08
Westvaco Corp.	Covington	BM28EC	VA0003646	3B	ND		2.2E-10	8.8E-09	4.0E-08	8.5E-11	2.7E-09	1.2E-08
Westvaco Corp.	Covington	M28EC	VA0003646	1			1.0E-08	4.4E-07	2.0E-06	3.7E-09	1.3E-07	6.1E-07
Westvaco Corp.	Covington	M28EC1	VA0003646	3B	ND		8.2E-10	2.3E-08	1.0E-07	4.7E-10	7.9E-09	3.7E-08
Westvaco Corp.	Covington	M28EC2	VA0003646	1			9.0E-10	3.0E-08	1.3E-07	4.3E-10	9.6E-09	4.5E-08
Union Camp Corp.	Franklin	UCF1000	VA0004162	1			1.1E-08	5.0E-07	2.3E-06	4.5E-09	1.9E-07	8.8E-07
Region IV												
Champion International	Courtland	M40EC	AL0000396	2A			8.6E-11	3.4E-09	1.6E-08	3.8E-11	1.3E-09	5.9E-09
Container Corp. of America	Brewton	M67EC	AL0002682	3C		ND	1.6E-10	7.0E-09	3.3E-08	7.9E-11	3.5E-09	1.6E-08
Boise Cascade Corp.	Jackson	M65EC	AL0002755	1			1.9E-10	7.3E-09	3.4E-08	8.8E-11	2.7E-09	1.3E-08
Boise Cascade Corp.	Jackson	M65EC1	AL0002755	1			2.4E-10	9.3E-09	4.2E-08	1.1E-10	3.4E-09	1.6E-08
International Paper Co.	Mobile	M71EC	AL0002780	1			1.6E-10	5.8E-09	2.6E-08	7.5E-11	1.9E-09	8.8E-09

Appendix G. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET ECT[2]	TCDF NON-DET ECT[2]	DOSE TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day
Scott Paper Co.	Mobile	M26EC210	AL0002801	1			4.1E-11	1.8E-09	8.4E-09	1.4E-11	5.7E-10	2.6E-09
Gulf States Paper Corp.	Demopolis	M101EC	AL0002828	1			1.5E-10	6.4E-09	2.9E-08	5.1E-11	1.9E-09	8.7E-09
International Paper Co.	Selma	M88EC	AL0003018	1			1.2E-10	4.7E-09	2.2E-08	3.8E-11	1.2E-09	5.4E-09
Kimberly-Clark Corp.	Coosa Pines	M36EC	AL0003158	1			1.8E-10	7.7E-09	3.5E-08	5.1E-11	1.8E-09	8.6E-09
James River Corp.	Butler	M96EC	AL0003301	1			1.3E-10	5.6E-09	2.6E-08	5.3E-11	1.9E-09	8.8E-09
Alabama River Pulp	Claiborne	M21EC	AL0025968	1			5.2E-11	2.0E-09	9.0E-09	2.3E-11	6.5E-10	3.0E-09
Alabama River Pulp	Claiborne	M21EC1	AL0025968	1			5.1E-11	1.9E-09	8.8E-09	2.2E-11	6.3E-10	2.9E-09
Alabama River Pulp	Claiborne	M21EC2	AL0025968	1			5.5E-11	2.2E-09	1.0E-08	2.3E-11	7.1E-10	3.3E-09
ITT-Rayonier, Inc.	Fernandina Beach	M90EC	FL0000701	2A			7.4E-11	2.8E-09	1.4E-08	3.3E-11	1.1E-09	4.9E-09
Buckeye Cellulose	Perry	M91ECO	FL0000876	1			1.3E-08	5.3E-07	2.5E-06	5.9E-09	2.2E-07	1.0E-06
Champion International	Cantonment	CP1000	FL0002526	3B	ND		1.6E-09	6.0E-08	2.7E-07	8.2E-10	2.7E-08	1.3E-07
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CH	ND		9.9E-12	4.3E-10	2.0E-09	3.9E-12	1.5E-10	7.1E-10
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CL	ND		8.0E-13	3.4E-11	1.6E-10	3.1E-13	1.2E-11	5.7E-11
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CH			1.7E-11	7.1E-10	3.3E-09	6.8E-12	2.5E-10	1.2E-09
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CL			7.3E-13	2.9E-11	1.3E-10	5.4E-13	2.0E-11	9.5E-11
Georgia-Pacific Corp.	Palatka	M24EC	FL0002763	2A			4.5E-09	1.9E-07	8.9E-07	4.1E-09	1.7E-07	8.0E-07
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4H			7.9E-10	2.9E-08	1.3E-07	CD	CD	CD
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4L			5.5E-11	2.3E-09	1.1E-08	CD	CD	CD
Gilman Paper Co.	St. Marys	M55EC	GA0001953	2B	ND		1.0E-10	4.0E-09	1.8E-08	5.1E-11	1.6E-09	7.7E-09
Federal Paper Board Co.	Augusta	M83EC	GA0002801	1			5.6E-11	2.4E-09	1.1E-08	2.6E-11	9.6E-10	4.5E-09
ITT-Rayonier, Inc.	Jesup	M84EAC	GA0003620	1			1.4E-10	6.4E-09	3.0E-08	5.6E-11	2.6E-09	1.2E-08
ITT-Rayonier, Inc.	Jesup	M84EBC	GA0003620	1			1.4E-10	6.1E-09	2.9E-08	5.7E-11	2.5E-09	1.2E-08
Brunswick Pulp and Paper	Brunswick	M87EC	GA0003654	2A			6.5E-10	2.8E-08	1.3E-07	2.7E-10	1.0E-08	4.8E-08
Brunswick Pulp and Paper	Brunswick	M87EC1	GA0003654	2A			6.4E-10	2.8E-08	1.3E-07	2.6E-10	1.0E-08	4.8E-08
Buckeye Cellulose	Oglethorpe	M22EC10	GA0049336	3B	ND		2.3E-11	9.1E-10	4.2E-09	1.1E-11	3.7E-10	1.7E-09
Westvaco Corp.	Wickliffe	M78EC	KY0000086	1			2.0E-12	8.0E-11	3.7E-10	E	E	E
Willamette Industries	Hawesville	M63EC	KY0001716	3D	ND	ND	8.2E-13	3.7E-11	1.7E-10	9.8E-14	3.8E-12	1.8E-11
International Paper Co.	Natchez	M97EC	MS0000213	1			3.0E-12	1.2E-10	5.3E-10	E	E	E
International Paper Co.	Moss Point	M34EC	MS0002674	2CH			2.2E-09	8.3E-08	3.8E-07	8.7E-10	2.6E-08	1.2E-07
International Paper Co.	Moss Point	M34EC	MS0002674	2CL			1.0E-10	3.4E-09	1.5E-08	7.0E-11	2.1E-09	9.7E-09
Leaf River Forest Products	New Augusta	BM35SEC30	MS0031704	1			6.1E-10	2.7E-08	1.3E-07	2.1E-10	8.7E-09	4.1E-08
Leaf River Forest Products	New Augusta	M35SEC30	MS0031704	1			1.6E-09	6.9E-08	3.2E-07	5.8E-10	2.2E-08	1.0E-07
Champion International	Canton	M47G100-500	NC0000272	1			1.3E-09	5.8E-08	2.7E-07	5.0E-10	2.2E-08	1.0E-07
Weyerhaeuser Co.	Plymouth	M86ECO	NC0000680	2A			2.1E-08	6.8E-07	3.0E-06	1.3E-08	3.1E-07	1.4E-06
Weyerhaeuser Co.	New Bern	M6EC	NC0003191	1			6.7E-10	2.7E-08	1.2E-07	4.1E-10	1.5E-08	7.1E-08
Federal Paper Board Co.	Riegelwood	M16EC	NC0003298	1			2.5E-10	1.1E-08	5.0E-08	1.8E-10	7.3E-09	3.4E-08

Appendix G. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET.[2] ECT	TCDF NON-DET.[2] ECT	DOSE SIMPLE DILUTION TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day
International Paper Co.	Georgetown	M70EC	SC0000868	2A			1.5E-07	6.6E-06	3.0E-05	4.9E-08	1.7E-06	8.1E-06
International Paper Co.	Georgetown	M70EC1	SC0000868	2A			1.2E-07	5.0E-06	2.3E-05	4.0E-08	1.3E-06	6.3E-06
Bowater Corp.	Catawba	M23EC	SC0001015	1			2.0E-10	8.8E-09	4.1E-08	1.2E-10	5.2E-09	2.4E-08
Union Camp Corp.	Eastover	M93EC	SC0038121	1			3.5E-11	1.5E-09	6.7E-09	1.1E-11	3.9E-10	1.8E-09
Mead Corporation	Kingsport	M73EC	TN0001643	1			3.4E-11	1.2E-09	5.6E-09	2.0E-11	6.2E-10	2.9E-09
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	3.7E-11	1.7E-09	7.8E-09	2.0E-11	8.7E-10	4.0E-09
Region V												
Mead Corporation	Escanaba	ML802	MI0000027	3B	ND		4.0E-10	1.5E-08	7.0E-08	2.6E-10	8.9E-09	4.2E-08
Scott Paper Co.	Muskegon	M92EC	MI0027391	4H	ND		9.9E-12	3.4E-10	1.5E-09	6.3E-12	1.8E-10	8.5E-10
Scott Paper Co.	Muskegon	M92EC	MI0027391	4L	ND		7.9E-13	2.7E-11	1.2E-10	5.1E-13	1.5E-11	6.8E-11
Champion International	Quinnesec	Q14E	MI0042170	1			5.3E-11	2.0E-09	8.9E-09	3.7E-11	1.2E-09	5.7E-09
Potlatch Corp.	Cloquet	M38ECO	MN-------	4H			4.5E-11	1.9E-09	9.0E-09	2.8E-11	1.2E-09	5.4E-09
Potlatch Corp.	Cloquet	M38ECO	MN-------	4L			3.6E-12	1.5E-10	7.2E-10	2.2E-12	9.3E-11	4.3E-10
Boise Cascade Corp.	International Falls	DE020922	MN0001643	1			2.6E-10	7.6E-09	3.3E-08	2.0E-10	4.8E-09	2.2E-08
Mead Corp.	Chillicothe	DE026013	OH0004481	3B	ND		2.0E-10	7.2E-09	3.3E-08	1.5E-10	4.9E-09	2.3E-08
Badger Paper Mills, Inc.	Peshtigo	M46EBC	WI0000663	1			1.4E-11	3.7E-10	1.6E-09	1.0E-11	2.1E-10	9.8E-10
Badger Paper Mills, Inc.	Peshtigo	M46EBCX	WI0000663	3B	ND		1.3E-11	2.4E-10	9.4E-10	E	E	E
James River Corp.	Green Bay	M72EAC	WI0001261	1			3.1E-11	1.2E-09	5.4E-09	1.2E-11	3.5E-10	1.7E-09
Pentair, Inc.	Park Falls	M25EC	WI0003212	3B	ND		2.8E-11	1.2E-09	5.7E-09	1.6E-11	6.8E-10	3.2E-09
Wausau Paper Mills Co. 1	Brokaw	M54EC	WI0003379	3B	ND		6.9E-12	2.6E-10	1.2E-09	4.7E-12	1.6E-10	7.4E-10
Wausau Paper Mills Co. 2	Brokaw	M54ECX	WI0003379	3D	ND	ND	6.5E-12	3.0E-10	1.4E-09	3.9E-12	1.8E-10	8.3E-10
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	M77EC	WI0003620	1			3.4E-10	1.2E-08	5.6E-08	2.0E-10	6.0E-09	2.8E-08
James River Corp.	Green Bay	M72EBC	WI0020991	4H	ND		8.4E-13	3.1E-11	1.4E-10	3.5E-13	9.5E-12	4.4E-11
James River Corp.	Green Bay	M72EBC	WI0020991	4L	ND		6.7E-14	2.5E-12	1.1E-11	2.8E-14	7.6E-13	3.5E-12
Weyerhaeuser Co.	Rothchild	M29EC	WI0026042	1			2.2E-11	9.5E-10	4.4E-09	1.2E-11	5.0E-10	2.3E-09
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4H			2.1E-11	5.0E-10	2.1E-09	1.5E-11	2.9E-10	1.3E-09
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4L			1.7E-12	4.0E-11	1.7E-10	1.2E-12	2.3E-11	1.1E-10
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4H	ND		9.8E-12	1.8E-10	6.9E-10	E	E	E
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4L	ND		7.9E-13	1.4E-11	5.5E-11	E	E	E
Consolidated Papers, Inc.	Wisconsin Rapids	21	WI0037991	3D	ND	ND	1.1E-10	4.8E-09	2.2E-08	5.0E-11	2.2E-09	1.0E-08
Region VI												
Georgia-Pacific Corp.	Crosset	M68EC	AR0001210	1			1.4E-09	5.7E-08	2.6E-07	5.4E-10	1.8E-08	8.2E-08
International Paper Co.	Pine Bluff	M51EC	AR0001970	1			2.9E-10	1.0E-08	4.5E-08	1.8E-10	4.9E-09	2.3E-08
Nekoosa Papers, Inc.	Ashdown	M20EC	AR0002968	1			2.9E-10	1.3E-08	5.8E-08	5.2E-11	1.5E-09	7.2E-09
Potlatch Corp.	McGhee	M18EC	AR0035823	4H			2.5E-13	1.1E-11	4.9E-11	E	E	E
Potlatch Corp.	McGhee	M18EC	AR0035823	4L			2.0E-14	8.4E-13	3.9E-12	E	E	E
James River Corp.	St. Francesville	M52EC	LA0003468	1			5.2E-12	2.1E-10	9.8E-10	E	E	E

Appendix G. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET-ECT[2]	TCDF NON-DET-ECT[2]	DOSE TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day
Georgia-Pacific Corp.	Zachary	M1EC	LA0005258	3A		NQ	Q	Q	Q	Q	Q	Q
Georgia-Pacific Corp.	Zachary	M1ECX	LA0005258	1			1.4E-11	4.0E-10	1.8E-09	E	E	E
International Paper Co.	Bastrop	M85EC	LA0007561	5			F	F	F	F	F	F
Boise Cascade Corp.	Deridder	M58EC	LA0007927	1			1.1E-09	4.4E-08	2.0E-07	4.7E-10	1.5E-08	7.1E-08
International Paper Co.	Texarkana	M99EC	TX0000167	1			1.3E-09	5.2E-08	2.4E-07	3.8E-10	1.2E-08	5.4E-08
International Paper Co.	Texarkana	M99EC1	TX0000167	1			1.7E-09	7.2E-08	3.3E-07	7.3E-10	2.7E-08	1.3E-07
Champion International	Lufkin	DF024512	TX0001643	3D	ND	ND	2.1E-10	9.3E-09	4.3E-08	7.5E-11	3.2E-09	1.5E-08
Temple-Eastex, Inc.	Evadale	M3EC	TX0003891	1			2.2E-09	9.8E-08	4.6E-07	1.0E-09	4.3E-08	2.0E-07
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC'	TX0006041	3E	NQ		N	N	N	N	N	N
Champion International	Houston	M15EC	TX0053023	2B	ND		8.1E-10	1.9E-08	7.8E-08	5.1E-10	9.4E-09	4.4E-08
Region VIII												
Stone Container Corp.	Missoula	M27EC	MT0000035	3C		ND	5.1E-12	2.3E-10	1.0E-09	1.3E-12	5.3E-11	2.5E-10
Reigon IX												
Stone Container Corp.	Snowflake	M100EC	AZ-------	2D			EZ	EZ	EZ	EZ	EZ	EZ
Simpson Paper Co.	Anderson	M98EC	CA0004065	1			1.8E-09	4.1E-08	1.7E-07	1.4E-09	2.1E-08	9.8E-08
Gaylord Container Corp.	Antioch	M106EC	CA0004847	5			F	F	F	F	F	F
Simpson Paper Co.	Fairhaven	M43EC0	CA0005282	2A			1.2E-09	4.5E-08	2.1E-07	5.7E-10	1.7E-08	7.8E-08
Louisiana Pacific Corp.	Samoa	M70EC10	CA0005894	2A			5.1E-10	2.0E-08	9.2E-08	2.3E-10	7.3E-09	3.4E-08
Region X												
Alaska Pulp Corp.	Sitka	M5EC-1	AK0000531	2B	ND		3.2E-10	1.2E-08	5.2E-08	1.6E-10	4.2E-09	2.0E-08
Ketchikan Pulp & Paper 1	Ketchikan	M31EAC	AK0000922	2B	ND	ND	4.9E-11	2.2E-09	1.0E-08	1.8E-11	7.9E-10	3.7E-09
Ketchikan Pulp & Paper 2	Ketchikan	M31EBC	AK0000922	2A			6.1E-10	2.8E-08	1.3E-07	2.3E-10	1.0E-08	4.7E-08
Potlatch Corp.	Lewiston	M56EC	ID0001163	1			5.6E-11	2.2E-09	1.0E-08	1.7E-11	4.7E-10	2.2E-09
Potlatch Corp.	Lewiston	M56EC1	ID0001163	1			6.0E-11	2.4E-09	1.1E-08	1.7E-11	5.2E-10	2.4E-09
James River Corp.	Clatskanie (Wauna)	8637-4645	OR0000795	1			2.9E-12	1.1E-10	4.8E-10	ED	ED	ED
Pope & Talbot, Inc.	Halsey	M19EC	OR0001074	1			3.4E-11	1.5E-09	6.7E-09	1.7E-11	6.5E-10	3.0E-09
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4H			8.6E-13	3.4E-11	1.6E-10	ED	ED	ED
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4L			6.9E-14	2.7E-12	1.3E-11	ED	ED	ED
Longview Fibre Co.	Longview	M53EC	WA0000078	3B	ND		1.0E-12	2.6E-11	1.1E-10	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC1-L	WA0000124	1			1.8E-12	7.6E-11	3.5E-10	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC-L	WA0000124	1			2.2E-12	9.0E-11	4.1E-10	ED	ED	ED
James River Corp.	Camas	M32EC	WA0000256	3E	NQ		ND	ND	ND	ND	ND	ND
Scott Paper Co. 1	Everett	M80EAC	WA0000621	2D	ND		EZD	EZD	EZD	EZD	EZD	EZD
Scott Paper Co. 2	Everett	M80EBC	WA0000621	2D	ND	ND	EZD	EZD	EZD	EZD	EZD	EZD
ITT-Rayonier, Inc.	Port Angeles	M12EC	WA0000795	2A			1.0E-10	4.5E-09	2.1E-08	4.1E-11	1.6E-09	7.6E-09

Appendix G. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET[2]	TCDF NON-DET[2]	DOSE TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	SIMPLE DILUTION TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF FILET= 5,000, TCDF, 1,950 @ 6.5 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 30 g/day	DOSE FROM EXAMS WATER COLUMN TCDD BCF=50,000, TCDD,BCF=1,950 @ 140 g/day
Weyerhaeuser Co.	Cosmopolis	M4EC	WA0000809	2A			2.2E-09	4.6E-08	1.8E-07	1.5E-09	1.9E-08	8.8E-08
Simpson Paper Co.	Tacoma	M81EC	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81EC1	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECXX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Georgia-Pacific Corp.	Bellingham	M60EC1	WA0001091	2B	ND		1.6E-10	1.2E-09	2.5E-09	1.4E-10	8.3E-10	3.9E-09
Weyerhaeuser Co.	Everett	M79EC	WA0003000	2A			9.5E-10	3.5E-08	1.6E-07	5.0E-11	1.4E-09	6.3E-09
ITT-Rayonier, Inc.	Hoquiam	M33EC	WA0003077	2A			5.1E-10	2.3E-08	1.1E-07	1.8E-10	8.2E-09	3.8E-08
Boise Cascade Corp.	Wallula	M66EC	WA0003697	1			6.2E-11	1.7E-09	7.4E-09	3.2E-11	5.6E-10	2.6E-09

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[1] Legends of analysis group ID codes and error codes are on the next page.

[2] ND = Not detected in the effluent samples. Dose estimates are based on 1/2 the detection limit in the effluent sample.
NQ = Nonquantifiable

[3] a.k.a. Hammermill Papers

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX H

Appendix H.
Mill Specific Dose (pg/kg/day) from Drinking Water at Ingestion of 2 Liters per Day

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILUTION DRINKING WATER DOSES			EXAMS WATER COLUMN DRINKING WATER DOSES		
							TCDD	TCDF	TEQ	TCDD	TCDF	TEQ
							SD	SD	SD	EXWC	EXWC	EXWC
Region I												
Georgia-Pacific Corp.	Woodland	M17EC	ME0001872	1			3.7E-12	1.4E-11	5.1E-12	2.9E-12	1.4E-11	4.2E-12
International Paper Co.	Jay	RG1-86388	ME0001937	1			4.8E-11	2.3E-10	7.2E-11	2.6E-11	2.3E-10	4.9E-11
Lincoln Pulp and Paper	Lincoln	M11EC	ME0002003	1			2.6E-12	1.1E-11	3.7E-12	2.0E-12	1.0E-11	3.0E-12
James River Corp.	Old Town	M8EC	ME0002020	1			3.3E-12	1.1E-11	4.4E-12	2.5E-12	1.1E-11	3.6E-12
Boise Cascade Corp.	Rumford	M82EC	ME0002054	1			5.3E-11	2.5E-10	7.8E-11	2.7E-11	2.4E-10	5.1E-11
Scott Paper Co.	Westbrook	M30EC	ME0002321	1			9.8E-12	1.9E-11	1.2E-11	5.1E-12	1.8E-11	6.9E-12
Scott Paper Co.	Hinckley	M61EC	ME0021521	1			3.7E-12	1.5E-11	5.2E-12	2.0E-12	1.4E-11	3.5E-12
Scott Paper Co.	Hinckley	M61EC1	ME0021521	1			4.5E-12	2.3E-11	6.8E-12	2.4E-12	2.3E-11	4.7E-12
James River Corp.	Berlin	BM89EC	NH0000655	1			6.2E-12	2.2E-11	8.4E-12	3.6E-12	2.2E-11	5.7E-12
James River Corp.	Berlin	M89EC	NH0000655	1			2.1E-11	4.3E-10	6.5E-11	1.2E-11	4.2E-10	5.5E-11
Region II												
International Paper Co.	Ticonderoga	M9EC	NY0004413	2A			2.9E-11	2.4E-10	5.2E-11	9.7E-12	2.2E-10	3.1E-11
International Paper Co.	Ticonderoga	M9EC1	NY0004413	2A			3.8E-11	2.5E-10	6.3E-11	1.3E-11	2.3E-10	3.6E-11
Finch & Pruyn & Co., Inc.	Glen Falls	M41EC	NY0005525	3D	ND	ND	9.9E-13	3.6E-13	1.0E-12	5.7E-13	3.6E-13	6.1E-13
Region III												
Westvaco Corp.	Luke	M62EC	MD0021687	4H			1.1E-11	3.3E-11	1.4E-11	3.2E-12	3.0E-11	6.2E-12
Westvaco Corp.	Luke	M62EC	MD0021687	4L			8.7E-13	2.7E-12	1.1E-12	2.5E-13	2.4E-12	4.9E-13
Penntech Papers, Inc.	Johnsonburg	M57EAC	PA0002143	3B	ND		1.8E-12	7.5E-12	2.6E-12	8.3E-13	6.4E-12	1.5E-12
Penntech Papers, Inc.	Johnsonburg	M57EBC	PA0002143	1			6.7E-12	4.5E-11	1.1E-11	1.5E-12	3.9E-11	5.4E-12
Appleton Papers, Inc.	Roaring Springs	M13EDO	PA0008265	3B	ND		1.1E-11	3.4E-11	1.4E-11	1.9E-12	2.3E-11	4.2E-12
P.H. Glatfelter Co.	Spring Grove	M64EC20	PA0008869	3B	ND		2.8E-11	1.8E-10	4.6E-11	3.7E-12	1.2E-10	1.5E-11
Procter & Gamble Co.	Mehoopany	M42EC	PA0008885	3B	ND		1.5E-13	8.4E-14	1.5E-13	6.7E-14	8.1E-14	7.5E-14
International Paper^3	Erie	M103ECX	PA0026301	2CH			EZ	EZ	EZ	EZ	EZ	EZ
International Paper^3	Erie	M103ECX	PA0026301	2CL			EZ	EZ	EZ	EZ	EZ	EZ
Chesapeake Corp.	West Point	M74EC140	VA0003115	1			D	D	D	D	D	D
Westvaco Corp.	Covington	BM28EC	VA0003646	3B	ND		1.2E-11	5.4E-11	1.8E-11	3.6E-12	5.0E-11	8.6E-12
Westvaco Corp.	Covington	M28EC	VA0003646	1			6.1E-10	1.8E-09	7.8E-10	1.8E-10	1.6E-09	3.4E-10
Westvaco Corp.	Covington	M28EC1	VA0003646	3B	ND		3.0E-11	5.9E-10	8.9E-11	8.9E-12	5.4E-10	6.3E-11
Westvaco Corp.	Covington	M28EC2	VA0003646	1			4.1E-11	4.5E-10	8.5E-11	1.2E-11	4.2E-10	5.3E-11
Union Camp Corp.	Franklin	UCF1000	VA0004162	1			7.0E-10	7.3E-10	7.7E-10	2.6E-10	7.3E-10	3.3E-10
Region IV												
Champion International	Courtland	M40EC	AL0000396	2A			4.7E-12	2.1E-11	6.8E-12	1.7E-12	2.0E-11	3.7E-12
Container Corp. of America	Brewton	M67EC	AL0002682	3C		ND	9.8E-12	7.5E-12	1.1E-11	4.8E-12	7.4E-12	5.6E-12
Boise Cascade Corp.	Jackson	M65EC	AL0002755	1			1.0E-11	5.7E-11	1.6E-11	3.6E-12	5.5E-11	9.0E-12
Boise Cascade Corp.	Jackson	M65EC1	AL0002755	1			1.3E-11	6.7E-11	1.9E-11	4.5E-12	6.4E-11	1.1E-11
International Paper Co.	Mobile	M71EC	AL0002780	1			D	D	D	D	D	D
Scott Paper Co.	Mobile	M26EC210	AL0002801	1			D	D	D	D	D	D
Gulf States Paper Corp.	Demopolis	M101EC	AL0002828	1			8.9E-12	2.6E-11	1.1E-11	2.6E-12	1.9E-11	4.5E-12

Appendix H. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILUTION DRINKING WATER DOSES TCDD	SIMPLE DILUTION DRINKING WATER DOSES TCDF	SIMPLE DILUTION DRINKING WATER DOSES TEQ	EXAMS WATER COLUMN DRINKING WATER DOSES TCDD	EXAMS WATER COLUMN DRINKING WATER DOSES TCDF	EXAMS WATER COLUMN DRINKING WATER DOSES TEQ
International Paper Co.	Selma	M88EC	AL0003018	1			6.6E-12	2.5E-11	9.1E-12	1.5E-12	2.3E-11	3.9E-12
Kimberly-Clark Corp.	Coosa Pines	M36EC	AL0003158	1			1.1E-11	2.3E-11	1.3E-11	2.5E-12	2.1E-11	4.6E-12
James River Corp.	Butler	M96EC	AL0003301	1			7.7E-12	2.4E-11	1.0E-11	2.5E-12	2.3E-11	4.8E-12
Alabama River Pulp	Claiborne	M21EC	AL0025968	1			2.7E-12	1.7E-11	4.4E-12	8.5E-13	1.6E-11	2.4E-12
Alabama River Pulp	Claiborne	M21EC1	AL0025968	1			2.6E-12	1.7E-11	4.3E-12	8.3E-13	1.6E-11	2.4E-12
Alabama River Pulp	Claiborne	M21EC2	AL0025968	1			3.0E-12	1.4E-11	4.4E-12	9.5E-13	1.3E-11	2.3E-12
ITT-Rayonier, Inc.	Fernandina Beach	M90EC	FL0000701	2A			D	D	D	D	D	D
Buckeye Cellulose	Perry	M91EC0	FL0000876	1			7.4E-10	2.2E-09	9.6E-10	3.0E-10	2.2E-09	5.2E-10
Champion International	Cantonment	CP1000	FL0002526	3B	ND		8.2E-11	5.6E-10	1.4E-10	3.6E-11	4.4E-10	8.0E-11
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CH	ND		D	D	D	D	D	D
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CL	ND		D	D	D	D	D	D
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CH			D	D	D	D	D	D
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CL			D	D	D	D	D	D
Georgia-Pacific Corp.	Palatka	M24EC	FL0002763	2A			2.7E-10	6.4E-10	3.3E-10	2.4E-10	7.0E-10	3.1E-10
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4H			CD	CD	CD	CD	CD	CD
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4L			CD	CD	CD	CD	CD	CD
Gilman Paper Co.	St. Marys	M55EC	GA0001953	2B	ND		D	D	D	D	D	D
Federal Paper Board Co.	Augusta	M83EC	GA0002801	1			3.3E-12	9.6E-12	4.2E-12	1.3E-12	9.3E-12	2.2E-12
ITT-Rayonier, Inc.	Jesup	M84EAC	GA0003620	1			9.0E-12	1.6E-12	9.1E-12	3.6E-12	1.5E-12	3.7E-12
ITT-Rayonier, Inc.	Jesup	M84EBC	GA0003620	1			8.6E-12	6.0E-12	9.2E-12	3.4E-12	5.8E-12	4.0E-12
Brunswick Pulp and Paper	Brunswick	M87EC	GA0003654	2A			D	D	D	D	D	D
Brunswick Pulp and Paper	Brunswick	M87EC1	GA0003654	2A			D	D	D	D	D	D
Buckeye Cellulose	Oglethorpe	M22EC10	GA0049336	3B	ND		1.3E-12	5.5E-12	1.8E-12	5.0E-13	5.2E-12	1.0E-12
Westvaco Corp.	Wickliffe	M78EC	KY0000086	1			1.1E-13	4.7E-13	1.6E-13	E	E	E
Willamette Industries	Hawesville	M63EC	KY0001716	3D	ND	ND	5.2E-14	3.8E-14	5.6E-14	5.1E-15	3.1E-14	8.3E-15
International Paper Co.	Natchez	M97EC	MS0000213	1			1.6E-13	9.3E-13	2.5E-13	E	E	E
International Paper Co.	Moss Point	M34EC	MS0002674	2CH			D	D	D	D	D	D
International Paper Co.	Moss Point	M34EC	MS0002674	2CL			D	D	D	D	D	D
Leaf River Forest Products	New Augusta	BM35SEC30	MS0031704	1			3.8E-11	4.8E-11	4.3E-11	1.2E-11	4.5E-11	1.7E-11
Leaf River Forest Products	New Augusta	M35SEC30	MS0031704	1			9.6E-11	2.0E-10	1.2E-10	3.0E-11	1.8E-10	4.9E-11
Champion International	Canton	M47G100-500	NC0000272	1			8.1E-11	3.9E-11	8.5E-11	3.1E-11	3.9E-11	3.5E-11
Weyerhaeuser Co.	Plymouth	M86EC0	NC0000680	2A			D	D	D	D	D	D
Weyerhaeuser Co.	New Bern	M6EC	NC0003191	1			D	D	D	D	D	D
Federal Paper Board Co.	Riegelwood	M16EC	NC0003298	1			1.5E-11	3.3E-11	1.8E-11	1.0E-11	4.6E-11	1.5E-11
International Paper Co.	Georgetown	M70EC	SC0000868	2A			D	D	D	D	D	D
International Paper Co.	Georgetown	M70EC1	SC0000868	2A			D	D	D	D	D	D
Bowater Corp.	Catawba	M23EC	SC0001015	1			1.2E-11	2.2E-11	1.4E-11	7.2E-12	2.1E-11	9.3E-12
Union Camp Corp.	Eastover	M93EC	SC0038121	1			2.0E-12	5.4E-12	2.6E-12	5.3E-13	5.0E-12	1.0E-12
Mead Corporation	Kingsport	M73EC	TN0001643	1			1.7E-12	1.2E-11	2.9E-12	8.3E-13	1.2E-11	2.0E-12
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	2.3E-12	1.9E-12	2.5E-12	1.2E-12	1.9E-12	1.4E-12
Region V												
Mead Corporation	Escanaba	ML802	MI0000027	3B	ND		2.1E-11	1.3E-10	3.4E-11	1.2E-11	1.3E-10	2.5E-11

Appendix H. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DET-ECT[2]	TCDF NON-DET-ECT[2]	SIMPLE DILUTION DRINKING WATER DOSES TCDD	SIMPLE DILUTION DRINKING WATER DOSES TCDF	SIMPLE DILUTION DRINKING WATER DOSES TEQ	EXAMS WATER COLUMN DRINKING WATER DOSES TCDD	EXAMS WATER COLUMN DRINKING WATER DOSES TCDF	EXAMS WATER COLUMN DRINKING WATER DOSES TEQ
Scott Paper Co.	Muskegon	M92EC	MI0027391	4H	ND		4.6E-13	4.6E-12	9.2E-13	2.4E-13	4.4E-12	6.8E-13
Scott Paper Co.	Muskegon	M92EC	MI0027391	4L	ND		3.7E-14	3.7E-13	7.4E-14	1.9E-14	3.6E-13	5.5E-14
Champion International	Quinnesec	Q14E	MI0042170	1			2.7E-12	2.0E-11	4.6E-12	1.7E-12	1.9E-11	3.6E-12
Potlatch Corp.	Cloquet	M38ECO	MN-------	4H			2.7E-12	5.2E-12	3.2E-12	1.6E-12	5.0E-12	2.1E-12
Potlatch Corp.	Cloquet	M38ECO	MN-------	4L			2.2E-13	4.1E-13	2.6E-13	1.3E-13	4.0E-13	1.7E-13
Boise Cascade Corp.	International Falls	DE020922	MN0001643	1			1.0E-11	1.8E-10	2.8E-11	6.0E-12	1.8E-10	2.4E-11
Mead Corp.	Chillicothe	DE026013	OH0004481	3B	ND		D	D	D	D	D	D
Badger Paper Mills, Inc.	Peshtigo	M46EBC	WI0000663	1			4.8E-13	1.2E-11	1.6E-12	2.5E-13	1.1E-11	1.3E-12
Badger Paper Mills, Inc.	Peshtigo	M46EBCX	WI0000663	3B	ND		2.8E-13	1.4E-11	1.7E-12	E	E	E
James River Corp.	Green Bay	M72EAC	WI0001261	1			1.6E-12	9.0E-12	2.5E-12	4.7E-13	8.5E-12	1.3E-12
Pentair, Inc.	Park Falls	M25EC	WI0003212	3B	ND		1.7E-12	3.1E-12	2.0E-12	9.5E-13	2.7E-12	1.2E-12
Wausau Paper Mills Co. 1	Brokaw	M54EC	WI0003379	3B	ND		3.5E-13	2.4E-12	5.9E-13	2.1E-13	2.3E-12	4.4E-13
Wausau Paper Mills Co. 2	Brokaw	M54ECX	WI0003379	3D	ND	ND	4.1E-13	1.8E-13	4.3E-13	2.5E-13	1.7E-13	2.7E-13
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	M77EC	WI0003620	1			1.7E-11	1.4E-10	3.1E-11	7.9E-12	1.3E-10	2.1E-11
James River Corp.	Green Bay	M72EBC	WI0020991	4H	ND		4.3E-14	2.9E-13	7.2E-14	1.2E-14	2.7E-13	4.0E-14
James River Corp.	Green Bay	M72EBC	WI0020991	4L	ND		3.4E-15	2.3E-14	5.8E-15	9.8E-16	2.2E-14	3.2E-15
Weyerhaeuser Co.	Rothchild	M29EC	WI0026042	1			1.3E-12	2.7E-12	1.6E-12	6.9E-13	2.6E-12	9.5E-13
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4H			6.4E-13	1.8E-11	2.5E-12	3.4E-13	1.7E-11	2.0E-12
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4L			5.1E-14	1.5E-12	2.0E-13	2.7E-14	1.3E-12	1.6E-13
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4H	ND		2.1E-13	1.1E-11	1.3E-12	E	E	E
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4L	ND		1.7E-14	8.8E-13	1.0E-13	E	E	E
Consolidated Papers, Inc.	Wisconsin Rapids	21	WI0037991	3D	ND	ND	6.7E-12	4.7E-12	7.2E-12	3.0E-12	4.5E-12	3.5E-12
Region VI												
Georgia-Pacific Corp.	Crosset	M68EC	AR0001210	1			7.8E-11	3.0E-10	1.1E-10	2.4E-11	2.9E-10	5.3E-11
International Paper Co.	Pine Bluff	M51EC	AR0001970	1			1.4E-11	1.4E-10	2.7E-11	6.3E-12	1.3E-10	2.0E-11
Nekoosa Papers, Inc.	Ashdown	M20EC	AR0002968	1			1.7E-11	4.0E-11	2.1E-11	2.0E-12	3.4E-11	5.5E-12
Potlatch Corp.	McGhee	M18EC	AR0035823	4H			1.5E-14	3.7E-14	1.8E-14	E	E	E
Potlatch Corp.	McGhee	M18EC	AR0035823	4L			1.2E-15	2.9E-15	1.5E-15	E	E	E
James River Corp.	St. Francesville	M52EC	LA0003468	1			2.9E-13	1.1E-12	4.1E-13	E	E	E
Georgia-Pacific Corp.	Zachary	M1EC	LA0005258	3A		NQ	Q	Q	Q	Q	Q	Q
Georgia-Pacific Corp.	Zachary	M1ECX	LA0005258	1			5.3E-13	9.9E-12	1.5E-12	E	E	E
International Paper Co.	Bastrop	M85EC	LA0007561	5			F	F	F	F	F	F
Boise Cascade Corp.	Deridder	M58EC	LA0007927	1			6.1E-11	2.9E-10	8.9E-11	2.0E-11	2.6E-10	4.6E-11
International Paper Co.	Texarkana	M99EC	TX0000167	1			7.3E-11	2.4E-10	9.7E-11	1.5E-11	2.3E-10	3.8E-11
International Paper Co.	Texarkana	M99EC1	TX0000167	1			1.0E-10	2.5E-10	1.3E-10	3.8E-11	2.4E-10	6.2E-11
Champion International	Lufkin	DF024512	TX0001643	3D	ND	ND	1.3E-11	1.3E-11	1.4E-11	4.4E-12	1.2E-11	5.5E-12
Temple-Eastex, Inc.	Evadale	M3EC	TX0003891	1			1.4E-10	1.6E-10	1.5E-10	6.0E-11	1.5E-10	7.6E-11
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N
Champion International	Houston	M15EC	TX0053023	2B	ND		D	D	D	D	D	D
Region VIII												
Stone Container Corp.	Missoula	M27EC	MT0000035	3C		ND	3.2E-13	3.9E-13	3.5E-13	7.3E-14	3.6E-13	1.1E-13

Appendix H. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[1]	TCDD NON-DETECT[2]	TCDF NON-DETECT[2]	SIMPLE DILUTION DRINKING WATER DOSES TCDD	SIMPLE DILUTION DRINKING WATER DOSES TCDF	SIMPLE DILUTION DRINKING WATER DOSES TEQ	EXAMS WATER COLUMN DRINKING WATER DOSES TCDD	EXAMS WATER COLUMN DRINKING WATER DOSES TCDF	EXAMS WATER COLUMN DRINKING WATER DOSES TEQ
Region IX												
Stone Container Corp.	Snowflake	M100EC	AZ-------	2D			EZ	EZ	EZ	EZ	EZ	EZ
Simpson Paper Co.	Anderson	M98EC	CA0004065	1			5.1E-11	1.7E-09	2.2E-10	2.3E-11	1.7E-09	1.9E-10
Gaylord Container Corp.	Antioch	M106EC	CA0004847	5			F	F	F	F	F	F
Simpson Paper Co.	Fairhaven	M43EC0	CA0005282	2A			D	D	D	D	D	D
Louisiana Pacific Corp.	Samoa	M70EC10	CA0005894	2A			D	D	D	D	D	D
Region X												
Alaska Pulp Corp.	Sitka	M5EC-1	AK0000531	2B	ND		D	D	D	D	D	D
Ketchikan Pulp & Paper 1	Ketchikan	M31EAC	AK0000922	2B	ND	ND	D	D	D	D	D	D
Ketchikan Pulp & Paper 2	Ketchikan	M31EBC	AK0000922	2A			D	D	D	D	D	D
Potlatch Corp.	Lewiston	M56EC	ID0001163	1			3.0E-12	1.5E-11	4.6E-12	6.1E-13	1.2E-11	1.9E-12
Potlatch Corp.	Lewiston	M56EC1	ID0001163	1			3.4E-12	1.4E-11	4.7E-12	6.8E-13	1.1E-11	1.8E-12
James River Corp.	Clatskanie (Wauna)	8637-4645	OR0000795	1			ED	ED	ED	ED	ED	ED
Pope & Talbot, Inc.	Halsey	M19EC	OR0001074	1			2.0E-12	5.5E-12	2.6E-12	8.9E-13	5.3E-12	1.4E-12
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4H			ED	ED	ED	ED	ED	ED
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4L			ED	ED	ED	ED	ED	ED
Longview Fibre Co.	Longview	M53EC	WA0000078	3B	ND		ED	ED	ED	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC1-L	WA0000124	1			ED	ED	ED	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC-L	WA0000124	1			ED	ED	ED	ED	ED	ED
James River Corp.	Camas	M32EC	WA0000256	3E	NQ		ND	ND	ND	ND	ND	ND
Scott Paper Co. 1	Everett	M80EAC	WA0000621	2D	ND		EZD	EZD	EZD	EZD	EZD	EZD
Scott Paper Co. 2	Everett	M80EBC	WA0000621	2D	ND	ND	EZD	EZD	EZD	EZD	EZD	EZD
ITT-Rayonier, Inc.	Port Angeles	M12EC	WA0000795	2A			D	D	D	D	D	D
Weyerhaeuser Co.	Cosmopolis	M4EC	WA0000809	2A			D	D	D	D	D	D
Simpson Paper Co.	Tacoma	M81EC	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81EC1	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECXX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND
Georgia-Pacific Corp.	Bellingham	M60EC1	WA0001091	2B	ND		D	D	D	D	D	D
Weyerhaeuser Co.	Everett	M79EC	WA0003000	2A			D	D	D	D	D	D
ITT-Rayonier, Inc.	Hoquiam	M33EC	WA0003077	2A			D	D	D	D	D	D
Boise Cascade Corp.	Wallula	M66EC	WA0003697	1			D	D	D	D	D	D

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[1] Legends of analysis group ID codes and error codes are on the next page.

[2] ND = Not detected in the effluent samples. Dose estimates are based on 1/2 the detection limit in the effluent sample.
NQ = Nonquantifiable

[3] a.k.a. Hammermill Papers

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX I

Appendix I.
Mill Specific Unit Risk[1] from Fish Ingestion

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[2]	TCDD NON-DET[3]	TCDF NON-DET[3]	SIMPLE DILUTION: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950			SIMPLE DILUTION: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950					EXAMS WATER COLUMN: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950			EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950				
							TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ	TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ
Region I																					
Georgia-Pacific Corp.	Woodland	M17EC	ME0001872	1			9E-06	1E-05	87	4E-04	4E-04	2E-03	2E-03	99	7E-06	8E-06	84	3E-04	3E-04	1E-03	2E-03	98
International Paper Co.	Jay	RG1-86388	ME0001937	1			1E-04	1E-04	84	5E-03	5E-03	3E-02	3E-02	98	6E-05	8E-05	75	3E-03	3E-03	1E-02	1E-02	97
Lincoln Pulp and Paper	Lincoln	M11EC	ME0002003	1			6E-06	7E-06	86	3E-04	3E-04	1E-03	1E-03	98	5E-06	6E-06	83	2E-04	2E-04	1E-03	1E-03	98
James River Corp.	Old Town	M8EC	ME0002020	1			8E-06	9E-06	88	4E-04	4E-04	2E-03	2E-03	99	6E-06	7E-06	86	3E-04	3E-04	1E-03	1E-03	98
Boise Cascade Corp.	Rumford	M82EC	ME0002054	1			1E-04	2E-04	84	6E-03	6E-03	3E-02	3E-02	98	6E-05	9E-05	74	3E-03	3E-03	1E-02	1E-02	97
Scott Paper Co.	Westbrook	M30EC	ME0002321	1			2E-05	3E-05	93	1E-03	1E-03	5E-03	5E-03	99	1E-05	1E-05	88	6E-04	6E-04	3E-03	3E-03	99
Scott Paper Co.	Hinckley	M61EC	ME0021521	1			9E-06	1E-05	87	4E-04	4E-04	2E-03	2E-03	98	5E-06	6E-06	78	2E-04	2E-04	1E-03	1E-03	97
Scott Paper Co.	Hinckley	M61EC1	ME0021521	1			1E-05	1E-05	83	5E-04	5E-04	2E-03	2E-03	98	6E-06	8E-06	73	3E-04	3E-04	1E-03	1E-03	96
James River Corp.	Berlin	BM89EC	NH0000655	1			1E-05	2E-05	88	7E-04	7E-04	3E-03	3E-03	99	9E-06	1E-05	81	4E-04	4E-04	2E-03	2E-03	98
James River Corp.	Berlin	M89EC	NH0000655	1			5E-05	9E-05	56	2E-03	3E-03	1E-02	1E-02	93	3E-05	7E-05	43	1E-03	2E-03	6E-03	7E-03	88
Region II																					
International Paper Co.	Ticonderoga	M9EC	NY0004413	2A			7E-05	9E-05	75	3E-03	3E-03	1E-02	2E-02	97	2E-05	4E-05	54	1E-03	1E-03	5E-03	5E-03	92
International Paper Co.	Ticonderoga	M9EC1	NY0004413	2A			9E-05	1E-04	79	4E-03	4E-03	2E-02	2E-02	97	3E-05	5E-05	59	1E-03	2E-03	7E-03	7E-03	94
Finch & Pruyn & Co., Inc.	Glen Falls	M41EC	NY0005525	3D	ND	ND	2E-06	2E-06	99	1E-04	1E-04	5E-04	5E-04	100	1E-06	1E-06	98	6E-05	6E-05	3E-04	3E-04	100
Region III																					
Westvaco Corp.	Luke	M62EC	MD0021687	4H			3E-05	3E-05	89	1E-03	1E-03	6E-03	6E-03	99	8E-06	1E-05	73	4E-04	4E-04	2E-03	2E-03	96
Westvaco Corp.	Luke	M62EC	MD0021687	4L			2E-06	2E-06	89	1E-04	1E-04	5E-04	5E-04	99	6E-07	8E-07	73	3E-05	3E-05	1E-04	1E-04	96
Penntech Papers, Inc.	Johnsonburg	M57EAC	PA0002143	3B	ND		4E-06	5E-06	86	2E-04	2E-04	1E-03	1E-03	98	2E-06	3E-06	77	9E-05	9E-05	4E-04	4E-04	97
Penntech Papers, Inc.	Johnsonburg	M57E8C	PA0002143	1			2E-05	2E-05	79	8E-04	8E-04	4E-03	4E-03	97	4E-06	7E-06	51	2E-04	2E-04	8E-04	9E-04	91
Appleton Papers, Inc.	Roaring Springs	M13EDO	PA0008265	3B	ND		3E-05	3E-05	89	1E-03	1E-03	5E-03	6E-03	99	5E-06	7E-06	68	2E-04	2E-04	1E-03	1E-03	95
P.H. Glatfelter Co.	Spring Grove	M64EC20	PA0008869	3B	ND		7E-05	8E-05	81	3E-03	3E-03	1E-02	2E-02	98	9E-06	2E-05	45	4E-04	5E-04	2E-03	2E-03	89
Procter & Gamble Co.[5]	Mehoopany	M42EC	PA0008885	3B	ND		4E-07	4E-07	98	2E-05	2E-05	8E-05	8E-05	100	2E-07	2E-07	95	7E-06	7E-06	3E-05	3E-05	100
International Paper[5]	Erie	M103ECX	PA0026301	2CH			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
International Paper[5]	Erie	M103ECX	PA0026301	2CL			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
Chesapeake Corp.	West Point	M74EC140	VA0003115	1			6E-05	7E-05	81	3E-03	3E-03	1E-02	1E-02	98	2E-05	3E-05	57	8E-04	8E-04	4E-03	4E-03	93
Westvaco Corp.	Covington	BM28EC	VA0003646	3B	ND		3E-05	3E-05	85	1E-03	1E-03	6E-03	6E-03	98	9E-06	1E-05	64	4E-04	4E-04	2E-03	2E-03	95
Westvaco Corp.	Covington	M28EC	VA0003646	1			1E-03	2E-03	90	7E-02	7E-02	3E-01	3E-01	99	4E-04	6E-04	74	2E-02	2E-02	9E-02	1E-01	97
Westvaco Corp.	Covington	M28EC1	VA0003646	3B	ND		7E-05	1E-04	57	3E-03	4E-03	2E-02	2E-02	93	2E-05	7E-05	30	1E-03	1E-03	5E-03	6E-03	81
Westvaco Corp.	Covington	M28EC2	VA0003646	1			1E-04	1E-04	70	5E-03	5E-03	2E-02	2E-02	96	3E-05	7E-05	42	1E-03	2E-03	6E-03	7E-03	88
Union Camp Corp.	Franklin	UCF1000	VA0004162	1			2E-03	2E-03	96	8E-02	8E-02	4E-01	4E-01	100	6E-04	7E-04	90	3E-02	3E-02	1E-01	1E-01	99
Region IV																					
Champion International	Courtland	M40EC	AL0000396	2A			1E-05	1E-05	85	5E-04	5E-04	2E-03	2E-03	98	4E-06	6E-06	68	2E-04	2E-04	9E-04	9E-04	96
Container Corp. of America	Brewton	M67EC	AL0002682	3C		ND	2E-05	2E-05	97	1E-03	1E-03	5E-03	5E-03	100	1E-05	1E-05	94	5E-04	5E-04	2E-03	3E-03	99
Boise Cascade Corp.	Jackson	M65EC	AL0002755	1			2E-05	3E-05	82	1E-03	1E-03	5E-03	5E-03	98	9E-06	1E-05	62	4E-04	4E-04	2E-03	2E-03	94
Boise Cascade Corp.	Jackson	M65EC1	AL0002755	1			3E-05	4E-05	83	1E-03	1E-03	7E-03	7E-03	98	1E-05	2E-05	64	5E-04	5E-04	2E-03	2E-03	95
International Paper Co.	Mobile	M71EC	AL0002780	1			2E-05	3E-05	75	9E-04	9E-04	4E-03	4E-03	97	6E-06	1E-05	49	3E-04	3E-04	1E-03	1E-03	91
Scott Paper Co.	Mobile	M26EC210	AL0002801	1			6E-06	6E-06	95	3E-04	3E-04	1E-03	1E-03	99	2E-06	2E-06	86	9E-05	9E-05	4E-04	4E-04	98
Gulf States Paper Corp.	Demopolis	M101EC	AL0002828	1			2E-05	2E-05	90	1E-03	1E-03	5E-03	5E-03	99	6E-06	8E-06	77	3E-04	3E-04	1E-03	1E-03	97
International Paper Co.	Selma	M88EC	AL0003018	1			2E-05	2E-05	87	7E-04	7E-04	3E-03	3E-03	99	4E-06	6E-06	63	2E-04	2E-04	8E-04	8E-04	94
Kimberly-Clark Corp.	Coosa Pines	M36EC	AL0003158	1			3E-05	3E-05	92	1E-03	1E-03	6E-03	6E-03	99	6E-06	8E-06	76	3E-04	3E-04	1E-03	1E-03	97
James River Corp.	Butler	M96EC	AL0003301	1			2E-05	2E-05	89	9E-04	9E-04	4E-03	4E-03	99	6E-06	8E-06	74	3E-04	3E-04	1E-03	1E-03	97
Alabama River Pulp	Claiborne	M21EC	AL0025968	1			7E-06	8E-06	81	3E-04	3E-04	1E-03	1E-03	98	2E-06	4E-06	58	9E-05	1E-04	4E-04	5E-04	93

Appendix I. (continued)

COMPANY	CITY	SAMPLE ID	NPDES NUMBER	GRP ID[2]	TCDD NON-DET=ECT[3]	TCDF NON-DET=ECT[3]	SIMPLE DILUTION: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950 — TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	SIMPLE DILUTION: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 — TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ	EXAMS WATER COLUMN: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950 — TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 — TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ
Alabama River Pulp	Claiborne	M21EC1	AL0025968	1			6E-06	8E-06	80	3E-04	3E-04	1E-03	1E-03	98	2E-06	3E-06	57	9E-05	1E-04	4E-04	5E-04	93
Alabama River Pulp	Claiborne	M21EC2	AL0025968	1			7E-06	9E-06	85	3E-04	3E-04	2E-03	2E-03	98	2E-06	4E-06	65	1E-04	1E-04	5E-04	5E-04	95
ITT-Rayonier, Inc.	Fernandina Beach	M90EC	FL0000701	2A			1E-05	1E-05	84	4E-04	5E-04	2E-03	2E-03	98	3E-06	5E-06	66	2E-04	2E-04	7E-04	8E-04	95
Buckeye Cellulose	Perry	M91EC0	FL0000876	1			2E-03	2E-03	90	8E-02	8E-02	4E-01	4E-01	99	7E-04	9E-04	78	3E-02	3E-02	2E-01	2E-01	97
Champion International	Cantonment	CP1000	FL0002526	3B	ND		2E-04	2E-04	79	9E-03	9E-03	4E-02	4E-02	97	9E-05	1E-04	68	4E-03	4E-03	2E-02	2E-02	95
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CH	ND		1E-06	2E-06	93	7E-05	7E-05	3E-04	3E-04	99	5E-07	6E-07	84	2E-05	2E-05	1E-04	1E-04	98
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CL	ND		1E-07	1E-07	93	5E-06	5E-06	2E-05	3E-05	99	4E-08	5E-08	84	2E-06	2E-06	9E-06	9E-06	98
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CH			2E-06	3E-06	91	1E-04	1E-04	5E-04	5E-04	99	8E-07	1E-06	79	4E-05	4E-05	2E-04	2E-04	97
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CL			9E-08	1E-07	83	4E-06	4E-06	2E-05	2E-05	98	7E-08	8E-08	79	3E-06	3E-06	1E-05	1E-05	97
Georgia-Pacific Corp.	Palatka	M24EC	FL0002763	2A			6E-04	7E-04	92	3E-02	3E-02	1E-01	1E-01	99	6E-04	6E-04	90	3E-02	3E-02	1E-01	1E-01	99
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4H			1E-04	1E-04	78	4E-03	5E-03	2E-02	2E-02	97	CD	CD	CD	CD	CD	CD	CD	CD
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4L			8E-06	9E-06	90	4E-04	4E-04	2E-03	2E-03	99	CD	CD	CD	CD	CD	CD	CD	CD
Gilman Paper Co.	St. Marys	M55EC	GA0001953	2B	ND		1E-05	2E-05	83	6E-04	6E-04	3E-03	3E-03	98	5E-06	8E-06	67	2E-04	3E-04	1E-03	1E-03	95
Federal Paper Board Co.	Augusta	M83EC	GA0002801	1			8E-06	9E-06	90	4E-04	4E-04	2E-03	2E-03	99	3E-06	4E-06	78	1E-04	1E-04	7E-04	7E-04	97
ITT-Rayonier, Inc.	Jesup	M84EAC	GA0003620	1			2E-05	2E-05	99	1E-03	1E-03	5E-03	5E-03	100	9E-06	9E-06	98	4E-04	4E-04	2E-03	2E-03	100
ITT-Rayonier, Inc.	Jesup	M84EBC	GA0003620	1			2E-05	2E-05	97	1E-03	1E-03	4E-03	4E-03	100	8E-06	9E-06	94	4E-04	4E-04	2E-03	2E-03	99
Brunswick Pulp and Paper	Brunswick	M87EC	GA0003654	2A			9E-05	1E-04	92	4E-03	4E-03	2E-02	2E-02	99	3E-05	4E-05	81	2E-03	2E-03	7E-03	8E-03	98
Brunswick Pulp and Paper	Brunswick	M87EC1	GA0003654	2A			9E-05	1E-04	94	4E-03	4E-03	2E-02	2E-02	99	3E-05	4E-05	85	2E-03	2E-03	7E-03	7E-03	98
Buckeye Cellulose	Oglethorpe	M22EC1D	GA0049336	3B	ND		3E-06	4E-06	86	1E-04	1E-04	7E-04	7E-04	98	1E-06	2E-06	71	6E-05	6E-05	3E-04	3E-04	96
Westvaco Corp.	Wickliffe	M78EC	KY0000086	1			3E-07	3E-07	86	1E-05	1E-05	6E-05	6E-05	98	E	E	E	E	E	E	E	E
Willamette Industries	Hawesville	M63EC	KY0001716	3D	ND	ND	1E-07	1E-07	97	6E-06	6E-06	3E-05	3E-05	100	1E-08	2E-08	81	6E-07	6E-07	3E-06	3E-06	98
International Paper Co.	Natchez	M97EC	MS0000213	1			4E-07	5E-07	82	2E-05	2E-05	8E-05	8E-05	98	E	E	E	E	E	E	E	E
International Paper Co.	Moss Point	M34EC	MS0002674	2CH			3E-04	3E-04	82	1E-02	1E-02	6E-02	6E-02	98	8E-05	1E-04	60	4E-03	4E-03	2E-02	2E-02	94
International Paper Co.	Moss Point	M34EC	MS0002674	2CL			1E-05	2E-05	69	5E-04	5E-04	2E-03	2E-03	96	7E-06	1E-05	60	3E-04	3E-04	1E-03	2E-03	94
Leaf River Forest Products	New Augusta	BM35SEC30	MS0031704	1			9E-05	1E-04	95	4E-03	4E-03	2E-02	2E-02	100	3E-05	3E-05	87	1E-03	1E-03	6E-03	6E-03	99
Leaf River Forest Products	New Augusta	M35SEC30	MS0031704	1			2E-04	2E-04	93	1E-02	1E-02	5E-02	5E-02	99	7E-05	9E-05	81	3E-03	3E-03	2E-02	2E-02	98
Champion International	Canton	M47G100-500	NC0000272	1			2E-04	2E-04	98	9E-03	9E-03	4E-02	4E-02	100	7E-05	8E-05	95	3E-03	3E-03	2E-02	2E-02	100
Weyerhaeuser Co.	Plymouth	M86EC0	NC0000680	2A			2E-03	3E-03	67	1E-01	1E-01	5E-01	5E-01	95	9E-04	2E-03	47	4E-02	5E-02	2E-01	2E-01	90
Weyerhaeuser Co.	New Bern	M6EC	NC0003191	1			9E-05	1E-04	86	4E-03	4E-03	2E-02	2E-02	98	5E-05	6E-05	78	2E-03	2E-03	1E-02	1E-02	97
Federal Paper Board Co.	Riegelwood	M16EC	NC0003298	1			4E-05	4E-05	92	2E-03	2E-03	8E-03	8E-03	99	2E-05	3E-05	85	1E-03	1E-03	5E-03	5E-03	98
International Paper Co.	Georgetown	M70EC	SC0000868	2A			2E-02	2E-02	91	1E+00	1E+00	5E+00	5E+00	99	6E-03	8E-03	75	3E-01	3E-01	1E+00	1E+00	97
International Paper Co.	Georgetown	M70EC1	SC0000868	2A			2E-02	2E-02	89	8E-01	8E-01	4E+00	4E+00	99	4E-03	6E-03	71	2E-01	2E-01	9E-01	1E+00	96
Bowater Corp.	Catawba	M23EC	SC0001015	1			3E-05	3E-05	94	1E-03	1E-03	6E-03	6E-03	99	2E-05	2E-05	90	8E-04	8E-04	4E-03	4E-03	99
Union Camp Corp.	Eastover	M93EC	SC0038121	1			5E-06	5E-06	91	2E-04	2E-04	1E-03	1E-03	99	1E-06	2E-06	73	6E-05	6E-05	3E-04	3E-04	96
Mead Corporation	Kingsport	M73EC	TN0001643	1			4E-06	5E-06	78	2E-04	2E-04	9E-04	9E-04	97	2E-06	3E-06	64	9E-05	1E-04	4E-04	5E-04	95
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	6E-06	6E-06	97	3E-04	3E-04	1E-03	1E-03	100	3E-06	3E-06	94	1E-04	1E-04	6E-04	6E-04	99
Region V																						
Mead Corporation	Escanaba	ML802	MI0000027	3B	ND		5E-05	6E-05	81	2E-03	2E-03	1E-02	1E-02	98	3E-05	4E-05	71	1E-03	1E-03	6E-03	6E-03	96
Scott Paper Co.	Muskegon	M92EC	MI0027391	4H	ND		1E-06	2E-06	72	5E-05	5E-05	2E-04	2E-04	96	6E-07	1E-06	58	3E-05	3E-05	1E-04	1E-04	93
Scott Paper Co.	Muskegon	M92EC	MI0027391	4L	ND		9E-08	1E-07	72	4E-06	4E-06	2E-05	2E-05	96	5E-08	8E-08	58	2E-06	2E-06	1E-05	1E-05	93
Champion International	Quinnesec	Q14E	MI0042170	1			6E-06	8E-06	78	3E-04	3E-04	1E-03	1E-03	97	4E-06	6E-06	69	2E-04	2E-04	9E-04	9E-04	96
Potlatch Corp.	Cloquet	M38EC0	MN-------	4H			6E-06	7E-06	93	3E-04	3E-04	1E-03	1E-03	99	4E-06	4E-06	89	2E-04	2E-04	8E-04	8E-04	99
Potlatch Corp.	Cloquet	M38EC0	MN-------	4L			5E-07	6E-07	93	2E-05	2E-05	1E-04	1E-04	99	3E-07	3E-07	89	1E-05	1E-05	7E-05	7E-05	99
Boise Cascade Corp.	International Falls	DE020922	MN0001643	1			2E-05	4E-05	58	1E-03	1E-03	5E-03	6E-03	93	1E-05	3E-05	46	7E-04	7E-04	3E-03	3E-03	90

Appendix I. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[2]	TCDD NON-DET[3]	TCDF NON-DET[3]	SIMPLE DILUTION: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950			SIMPLE DILUTION: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950					EXAMS WATER COLUMN: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950			EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950				
							TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ	TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ
Mead Corp.	Chillicothe	DE026013	OH0004481	3B	ND		2E-05	3E-05	78	1E-03	1E-03	5E-03	5E-03	97	2E-05	2E-05	71	7E-04	8E-04	3E-03	4E-03	96
Badger Paper Mills, Inc.	Peshtigo	M46EBC	WI0000663	1			1E-06	2E-06	51	5E-05	6E-05	2E-04	3E-04	91	6E-07	2E-06	38	3E-05	3E-05	1E-04	2E-04	86
Badger Paper Mills, Inc.	Peshtigo	M46EBCX	WI0000663	3B	ND		7E-07	2E-06	34	3E-05	4E-05	1E-04	2E-04	84	E	E	E	E	E	E	E	E
James River Corp.	Green Bay	M72EAC	WI0001261	1			4E-06	5E-06	82	2E-04	2E-04	8E-04	9E-04	98	1E-06	2E-06	59	5E-05	6E-05	2E-04	3E-04	93
Pentair, Inc.	Park Falls	M25EC	WI0003212	3B	ND		4E-06	4E-06	94	2E-04	2E-04	9E-04	9E-04	99	2E-06	3E-06	90	1E-04	1E-04	5E-04	5E-04	99
Wausau Paper Mills Co. 1	Brokaw	M54EC	WI0003379	3B	ND		9E-07	1E-06	79	4E-05	4E-05	2E-04	2E-04	97	5E-07	7E-07	70	2E-05	2E-05	1E-04	1E-04	96
Wausau Paper Mills Co. 2	Brokaw	M54ECX	WI0003379	3D	ND	ND	1E-06	1E-06	98	5E-05	5E-05	2E-04	2E-04	100	6E-07	6E-07	97	3E-05	3E-05	1E-04	1E-04	100
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	M77EC	WI0003620	1			4E-05	5E-05	76	2E-03	2E-03	9E-03	9E-03	97	2E-05	3E-05	61	9E-04	9E-04	4E-03	4E-03	94
James River Corp.	Green Bay	M72EBC	WI0020991	4H	ND		1E-07	1E-07	79	5E-06	5E-06	2E-05	2E-05	97	3E-08	6E-08	53	1E-06	1E-06	6E-06	7E-06	92
James River Corp.	Green Bay	M72EBC	WI0020991	4L	ND		8E-09	1E-08	79	4E-07	4E-07	2E-06	2E-06	97	2E-09	4E-09	53	1E-07	1E-07	5E-07	6E-07	92
Weyerhaeuser Co.	Rothchild	M29EC	WI0026042	1			3E-06	3E-06	93	1E-04	1E-04	7E-04	7E-04	99	2E-06	2E-06	87	8E-05	8E-05	4E-04	4E-04	99
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4H			2E-06	3E-06	47	7E-05	8E-05	3E-04	4E-04	90	8E-07	2E-06	34	4E-05	4E-05	2E-04	2E-04	84
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4L			1E-07	3E-07	47	6E-06	6E-06	3E-05	3E-05	90	7E-08	2E-07	34	3E-06	4E-06	1E-05	2E-05	84
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4H	ND		5E-07	2E-06	33	2E-05	3E-05	1E-04	1E-04	83	E	E	E	E	E	E	E	E
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4L	ND		4E-08	1E-07	33	2E-06	2E-06	9E-06	1E-05	83	E	E	E	E	E	E	E	E
Consolidated Papers, Inc.	Wisconsin Rapids	21	WI0037991	3D	ND	ND	2E-05	2E-05	97	8E-04	8E-04	4E-03	4E-03	100	7E-06	8E-06	95	3E-04	3E-04	2E-03	2E-03	99
Region VI																						
Georgia-Pacific Corp.	Crosset	M68EC	AR0001210	1			2E-04	2E-04	87	9E-03	9E-03	4E-02	4E-02	99	6E-05	8E-05	68	3E-03	3E-03	1E-02	1E-02	95
International Paper Co.	Pine Bluff	M51EC	AR0001970	1			3E-05	5E-05	72	2E-03	2E-03	7E-03	7E-03	96	2E-05	3E-05	55	7E-04	8E-04	3E-03	4E-03	92
Nekoosa Papers, Inc.	Ashdown	M20EC	AR0002968	1			4E-05	5E-05	92	2E-03	2E-03	9E-03	9E-03	99	5E-06	8E-06	60	2E-04	2E-04	1E-03	1E-03	94
Potlatch Corp.	McGhee	M18EC	AR0035823	4H			4E-08	4E-08	91	2E-06	2E-06	8E-06	8E-06	99	E	E	E	E	E	E	E	E
Potlatch Corp.	McGhee	M18EC	AR0035823	4L			3E-09	3E-09	91	1E-07	1E-07	6E-07	6E-07	99	E	E	E	E	E	E	E	E
James River Corp.	St. Francesville	M52EC	LA0003468	1			7E-07	8E-07	87	3E-05	3E-05	2E-04	2E-04	99	E	E	E	E	E	E	E	E
Georgia-Pacific Corp.	Zachary	M1EC	LA0005258	3A		NQ	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Georgia-Pacific Corp.	Zachary	M1ECX	LA0005258	1			1E-06	2E-06	58	6E-05	6E-05	3E-04	3E-04	93	E	E	E	E	E	E	E	E
International Paper Co.	Bastrop	M85EC	LA0007561	5			F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Boise Cascade Corp.	Deridder	M58EC	LA0007927	1			1E-04	2E-04	84	7E-03	7E-03	3E-02	3E-02	98	5E-05	7E-05	67	2E-03	2E-03	1E-02	1E-02	95
International Paper Co.	Texarkana	M99EC	TX0000167	1			2E-04	2E-04	89	8E-03	8E-03	4E-02	4E-02	99	4E-05	6E-05	63	2E-03	2E-03	8E-03	8E-03	95
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2E-04	3E-04	91	1E-02	1E-02	5E-02	5E-02	99	9E-05	1E-04	80	4E-03	4E-03	2E-02	2E-02	98
Champion International	Lufkin	DF024512	TX0001643	3D	ND	ND	3E-05	3E-05	96	1E-03	1E-03	7E-03	7E-03	100	1E-05	1E-05	91	5E-04	5E-04	2E-03	2E-03	99
Temple-Eastex, Inc.	Evadale	M3EC	TX0003891	1			3E-04	3E-04	96	2E-02	2E-02	7E-02	7E-02	100	1E-04	2E-04	91	7E-03	7E-03	3E-02	3E-02	99
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Champion International	Houston	M15EC	TX0053023	2B	ND		6E-05	1E-04	45	3E-03	3E-03	1E-02	1E-02	89	3E-05	8E-05	34	1E-03	1E-03	6E-03	7E-03	84
Region VIII																						
Stone Container Corp.	Missoula	M27EC	MT0000035	3C		ND	8E-07	8E-07	95	4E-05	4E-05	2E-04	2E-04	100	2E-07	2E-07	84	8E-06	8E-06	4E-05	4E-05	98
Region IX																						
Stone Container Corp.	Snowflake	M100EC	AZ-------	2D			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
Simpson Paper Co.	Anderson	M98EC	CA0004065	1			1E-04	3E-04	43	6E-03	6E-03	3E-02	3E-02	88	6E-05	2E-04	26	3E-03	3E-03	1E-02	2E-02	78
Gaylord Container Corp.	Antioch	M106EC	CA0004847	5			F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Simpson Paper Co.	Fairhaven	M43EC0	CA0005282	2A			1E-04	2E-04	80	7E-03	7E-03	3E-02	3E-02	97	5E-05	9E-05	59	2E-03	3E-03	1E-02	1E-02	94
Louisiana Pacific Corp.	Samoa	M70EC10	CA0005894	2A			7E-05	8E-05	84	3E-03	3E-03	1E-02	1E-02	98	2E-05	4E-05	67	1E-03	1E-03	5E-03	5E-03	95
Region X																						
Alaska Pulp Corp.	Sitka	M5EC-1	AK0000531	2B	ND		4E-05	5E-05	76	2E-03	2E-03	8E-03	8E-03	97	1E-05	2E-05	54	6E-04	7E-04	3E-03	3E-03	92

Appendix I. (continued)

COMPANY		CITY	SAMPLEID	NPDES NUMBER	GRP ID[2]	TCDD NON-DET[3] ECT	TCDF NON-DET[3] ECT	SIMPLE DILUTION: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950			SIMPLE DILUTION: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950					EXAMS WATER COLUMN: TCDD FILET BCF=5,000[4] TCDF FILET BCF=1,950			EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950				
								TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ	TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ
Ketchikan Pulp & Paper	1	Ketchikan	M31EAC	AK0000922	2B	ND	ND	7E-06	8E-06	97	3E-04	3E-04	2E-03	2E-03	100	3E-06	3E-06	92	1E-04	1E-04	6E-04	6E-04	99
Ketchikan Pulp & Paper	2	Ketchikan	M31EBC	AK0000922	2A			9E-05	1E-04	98	4E-03	4E-03	2E-02	2E-02	100	3E-05	4E-05	95	2E-03	2E-03	7E-03	7E-03	100
Potlatch Corp.		Lewiston	M56EC	ID0001163	1			7E-06	9E-06	83	3E-04	3E-04	2E-03	2E-03	98	1E-06	3E-06	56	7E-05	7E-05	3E-04	3E-04	93
Potlatch Corp.		Lewiston	M56EC1	ID0001163	1			8E-06	9E-06	86	4E-04	4E-04	2E-03	2E-03	98	2E-06	3E-06	61	8E-05	8E-05	4E-04	4E-04	94
James River Corp.		Clatskanie (Wauna)	8637-4645	OR0000795	1			3E-07	5E-07	76	2E-05	2E-05	7E-05	8E-05	97	ED	ED	ED	ED	ED	ED	ED	ED
Pope & Talbot, Inc.		Halsey	M19EC	OR0001074	1			5E-06	5E-06	90	2E-04	2E-04	1E-03	1E-03	99	2E-06	3E-06	81	1E-04	1E-04	5E-04	5E-04	98
Boise Cascade Corp.		St. Helens	M76EC0	OR0020834	4H			1E-07	1E-07	85	5E-06	5E-06	2E-05	3E-05	98	ED	ED	ED	ED	ED	ED	ED	ED
Boise Cascade Corp.		St. Helens	M76EC0	OR0020834	4L			9E-09	1E-08	85	4E-07	4E-07	2E-06	2E-06	98	ED	ED	ED	ED	ED	ED	ED	ED
Longview Fibre Co.		Longview	M53EC	WA0000078	3B	ND		8E-08	2E-07	51	4E-06	4E-06	2E-05	2E-05	91	ED	ED	ED	ED	ED	ED	ED	ED
Weyerhaeuser Co.		Longview	M45EC1-L	WA0000124	1			3E-07	3E-07	91	1E-05	1E-05	5E-05	6E-05	99	ED	ED	ED	ED	ED	ED	ED	ED
Weyerhaeuser Co.		Longview	M45EC-L	WA0000124	1			3E-07	3E-07	87	1E-05	1E-05	6E-05	7E-05	99	ED	ED	ED	ED	ED	ED	ED	ED
James River Corp.		Camas	M32EC	WA0000256	3E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Scott Paper Co.	1	Everett	M80EAC	WA0000621	2D	ND		EZD	EZD	EZD D	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD
Scott Paper Co.	2	Everett	M80EBC	WA0000621	2D	ND	ND	EZD	EZD	EZD D	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD
ITT-Rayonier, Inc.		Port Angeles	M12EC	WA0000795	2A			2E-05	2E-05	94	7E-04	7E-04	3E-03	3E-03	99	5E-06	6E-06	85	2E-04	3E-04	1E-03	1E-03	98
Weyerhaeuser Co.		Cosmopolis	M4EC	WA0000809	2A			1E-04	3E-04	38	6E-03	7E-03	3E-02	3E-02	86	4E-05	2E-04	19	2E-03	3E-03	1E-02	1E-02	70
Simpson Paper Co.		Tacoma	M81EC	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.		Tacoma	M81EC1	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.		Tacoma	M81ECX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.		Tacoma	M81ECXX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Georgia-Pacific Corp.		Bellingham	M60EC1	WA0001091	2B	ND		2E-06	2E-05	7	8E-05	2E-04	4E-04	9E-04	45	6E-07	2E-05	3	3E-05	1E-04	1E-04	6E-04	23
Weyerhaeuser Co.		Everett	M79EC	WA0003000	2A			1E-04	1E-04	76	5E-03	5E-03	2E-02	3E-02	97	4E-06	8E-06	55	2E-04	2E-04	9E-04	1E-03	92
ITT-Rayonier, Inc.		Hoquiam	M33EC	WA0003077	2A			8E-05	8E-05	99	4E-03	4E-03	2E-02	2E-02	100	3E-05	3E-05	96	1E-03	1E-03	6E-03	6E-03	100
Boise Cascade Corp.		Wallula	M66EC	WA0003697	1			5E-06	1E-05	55	2E-04	3E-04	1E-03	1E-03	92	2E-06	5E-06	31	7E-05	9E-05	3E-04	4E-04	82

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[1] U.S. EPA weight-of-the-evidence classification "B2" (US EPA, 1986a)

[2] Legends of analysis group ID codes and error codes are on the next page.

[3] ND = Not detected in the effluent sample. Risk estimates are based on 1/2 the detection limit in the effluent sample.
NQ = Nonquantifiable

[4] Recent laboratory evidence indicates that use of a BCF of 50,000 would more accurately reflect the uptake of 2378-TCDD by fish. Therefore, risk estimates based on a fish filet BCF of 5,000 may underestimate risks by an order of magnitude.

[5] a.k.a. Hammermill Papers.

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX J

Appendix J.

Mill Specific Unit Risk[1] from Drinking Water Ingestion @ 2 Liters per Day

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[2]	TCDD NON-DET-ECT[3]	TCDF NON-DET-ECT[3]	SIMPLE DILUTION TEQ DRINK. WATER RISK	SIMPLE DILUTION % TCDD RISK IN TEQ RISK	EXAMS WATER COLUMN TEQ DRINK. WATER RISK	EXAMS WATER COLUMN % TCDD RISK IN TEQ RISK
Region I										
Georgia-Pacific Corp.	Woodland	M17EC	ME0001872	1			8E-07	73	7E-07	68
International Paper Co.	Jay	RG1-86388	ME0001937	1			1E-05	68	8E-06	54
Lincoln Pulp and Paper	Lincoln	M11EC	ME0002003	1			6E-07	71	5E-07	66
James River Corp.	Old Town	M8EC	ME0002020	1			7E-07	75	6E-07	70
Boise Cascade Corp.	Rumford	M82EC	ME0002054	1			1E-05	68	8E-06	52
Scott Paper Co.	Westbrook	M30EC	ME0002321	1			2E-06	84	1E-06	74
Scott Paper Co.	Hinckley	M61EC	ME0021521	1			8E-07	72	5E-07	58
Scott Paper Co.	Hinckley	M61EC1	ME0021521	1			1E-06	66	7E-07	51
James River Corp.	Berlin	BM89EC	NH0000655	1			1E-06	74	9E-07	62
James River Corp.	Berlin	M89EC	NH0000655	1			1E-05	33	9E-06	23
Region II										
International Paper Co.	Ticonderoga	M9EC	NY0004413	2A			8E-06	55	5E-06	31
International Paper Co.	Ticonderoga	M9EC1	NY0004413	2A			1E-05	60	6E-06	36
Finch & Pruyn & Co., Inc.	Glen Falls	M41EC	NY0005525	3D	ND	ND	2E-07	96	9E-08	94
Region III										
Westvaco Corp.	Luke	M62EC	MD0021687	4H			2E-06	77	1E-06	51
Westvaco Corp.	Luke	M62EC	MD0021687	4L			2E-07	77	8E-08	51
Penntech Papers, Inc.	Johnsonburg	M57EAC	PA0002143	3B	ND		4E-07	71	2E-07	56
Penntech Papers, Inc.	Johnsonburg	M57EBC	PA0002143	1			2E-06	60	8E-07	28
Appleton Papers, Inc.	Roaring Springs	M13EDO	PA0008265	3B	ND		2E-06	75	7E-07	45
P.H. Glatfelter Co.	Spring Grove	M64EC20	PA0008869	3B	ND		7E-06	62	2E-06	24
Procter & Gamble Co.	Mehoopany	M42EC	PA0008885	3B	ND		2E-08	95	1E-08	89
International Paper[4]	Erie	M103ECX	PA0026301	2CH			EZ	EZ	EZ	EZ
International Paper[4]	Erie	M103ECX	PA0026301	2CL			EZ	EZ	EZ	EZ
Chesapeake Corp.	West Point	M74EC140	VA0003115	1			D	D	D	D
Westvaco Corp.	Covington	BM28EC	VA0003646	3B	ND		3E-06	69	1E-06	41
Westvaco Corp.	Covington	M28EC	VA0003646	1			1E-04	78	5E-05	52
Westvaco Corp.	Covington	M28EC1	VA0003646	3B	ND		1E-05	34	1E-05	14
Westvaco Corp.	Covington	M28EC2	VA0003646	1			1E-05	48	8E-06	22
Union Camp Corp.	Franklin	UCF1000	VA0004162	1			1E-04	91	5E-05	78
Region IV										
Champion International	Courtland	M40EC	AL0000396	2A			1E-06	69	6E-07	46
Container Corp. of America	Brewton	M67EC	AL0002682	3C		ND	2E-06	93	9E-07	87
Boise Cascade Corp.	Jackson	M65EC	AL0002755	1			2E-06	64	1E-06	39
Boise Cascade Corp.	Jackson	M65EC1	AL0002755	1			3E-06	66	2E-06	41
International Paper Co.	Mobile	M71EC	AL0002780	1			D	D	D	D
Scott Paper Co.	Mobile	M26EC210	AL0002801	1			D	D	D	D
Gulf States Paper Corp.	Demopolis	M101EC	AL0002828	1			2E-06	78	7E-07	57
International Paper Co.	Selma	M88EC	AL0003018	1			1E-06	72	6E-07	40
Kimberly-Clark Corp.	Coosa Pines	M36EC	AL0003158	1			2E-06	83	7E-07	55
James River Corp.	Butler	M96EC	AL0003301	1			2E-06	76	8E-07	53
Alabama River Pulp	Claiborne	M21EC	AL0025968	1			7E-07	62	4E-07	35
Alabama River Pulp	Claiborne	M21EC1	AL0025968	1			7E-07	62	4E-07	34
Alabama River Pulp	Claiborne	M21EC2	AL0025968	1			7E-07	69	4E-07	42
ITT-Rayonier, Inc.	Fernandina Beach	M90EC	FL0000701	2A			D	D	D	D
Buckeye Cellulose	Perry	M91ECO	FL0000876	1			1E-04	77	8E-05	57
Champion International	Cantonment	CP1000	FL0002526	3B	ND		2E-05	59	1E-05	45
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CH	ND		D	D	D	D
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CL	ND		D	D	D	D
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CH			D	D	D	D
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CL			D	D	D	D
Georgia-Pacific Corp.	Palatka	M24EC	FL0002763	2A			5E-05	81	5E-05	77
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4H			CD	CD	CD	CD
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4L			CD	CD	CD	CD
Gilman Paper Co.	St. Marys	M55EC	GA0001953	2B	ND		D	D	D	D
Federal Paper Board Co.	Augusta	M83EC	GA0002801	1			7E-07	77	3E-07	58
ITT-Rayonier, Inc.	Jesup	M84EAC	GA0003620	1			1E-06	98	6E-07	96
ITT-Rayonier, Inc.	Jesup	M84EBC	GA0003620	1			1E-06	93	6E-07	86

Appendix J. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[2]	TCDD NON-DET-ECT[3]	TCDF NON-DET-ECT[3]	SIMPLE DILUTION TEQ DRINK. WATER RISK	SIMPLE DILUTION % TCDD RISK IN TEQ RISK	EXAMS WATER COLUMN TEQ DRINK. WATER RISK	EXAMS WATER COLUMN % TCDD RISK IN TEQ RISK
Brunswick Pulp and Paper	Brunswick	M87EC	GA0003654	2A			D	D	D	D
Brunswick Pulp and Paper	Brunswick	M87EC1	GA0003654	2A			D	D	D	D
Buckeye Cellulose	Oglethorpe	M22EC10	GA0049336	3B	ND		3E-07	70	2E-07	49
Westvaco Corp.	Wickliffe	M78EC	KY0000086	1			2E-08	70	E	E
Willamette Industries	Hawesville	M63EC	KY0001716	3D	ND	ND	9E-09	93	1E-09	62
International Paper Co.	Natchez	M97EC	MS0000213	1			4E-08	63	E	E
International Paper Co.	Moss Point	M34EC	MS0002674	2CH			D	D	D	D
International Paper Co.	Moss Point	M34EC	MS0002674	2CL			D	D	D	D
Leaf River Forest Products	New Augusta	BM35SEC30	MS0031704	1			7E-06	89	3E-06	73
Leaf River Forest Products	New Augusta	M35SEC30	MS0031704	1			2E-05	83	8E-06	62
Champion International	Canton	M47G100-500	NC0000272	1			1E-05	95	5E-06	89
Weyerhaeuser Co.	Plymouth	M86EC0	NC0000680	2A			D	D	D	D
Weyerhaeuser Co.	New Bern	M6EC	NC0003191	1			D	D	D	D
Federal Paper Board Co.	Riegelwood	M16EC	NC0003298	1			3E-06	82	2E-06	68
International Paper Co.	Georgetown	M70EC	SC0000868	2A			D	D	D	D
International Paper Co.	Georgetown	M70EC1	SC0000868	2A			D	D	D	D
Bowater Corp.	Catawba	M23EC	SC0001015	1			2E-06	85	1E-06	77
Union Camp Corp.	Eastover	M93EC	SC0038121	1			4E-07	79	2E-07	52
Mead Corporation	Kingsport	M73EC	TN0001643	1			5E-07	58	3E-07	41
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	4E-07	93	2E-07	87
Region V										
Mead Corporation	Escanaba	ML802	MI0000027	3B	ND		5E-06	63	4E-06	49
Scott Paper Co.	Muskegon	M92EC	MI0027391	4H	ND		1E-07	50	1E-07	35
Scott Paper Co.	Muskegon	M92EC	MI0027391	4L	ND		1E-08	50	9E-09	35
Champion International	Quinnesec	Q14E	MI0042170	1			7E-07	58	6E-07	46
Potlatch Corp.	Cloquet	M38EC0	MN-------	4H			5E-07	84	3E-07	76
Potlatch Corp.	Cloquet	M38EC0	MN-------	4L			4E-08	84	3E-08	76
Boise Cascade Corp.	International Falls	DE020922	MN0001643	1			4E-06	35	4E-06	25
Mead Corp.	Chillicothe	DE026013	OH0004481	3B	ND		D	D	D	D
Badger Paper Mills, Inc.	Peshtigo	M46EBC	WI0000663	1			3E-07	29	2E-07	19
Badger Paper Mills, Inc.	Peshtigo	M46EBCX	WI0000663	3B	ND		3E-07	17	E	E
James River Corp.	Green Bay	M72EAC	WI0001261	1			4E-07	64	2E-07	35
Pentair, Inc.	Park Falls	M25EC	WI0003212	3B	ND		3E-07	85	2E-07	78
Wausau Paper Mills Co. 1	Brokaw	M54EC	WI0003379	3B	ND		9E-08	60	7E-08	48
Wausau Paper Mills Co. 2	Brokaw	M54ECX	WI0003379	3D	ND	ND	7E-08	96	4E-08	94
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	M77EC	WI0003620	1			5E-06	56	3E-06	38
James River Corp.	Green Bay	M72EBC	WI0020991	4H	ND		1E-08	59	6E-09	31
James River Corp.	Green Bay	M72EBC	WI0020991	4L	ND		9E-10	59	5E-10	31
Weyerhaeuser Co.	Rothchild	M29EC	WI0026042	1			2E-07	83	1E-07	73
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4H			4E-07	26	3E-07	17
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4L			3E-08	26	3E-08	17
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4H	ND		2E-07	16	E	E
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4L	ND		2E-08	16	E	E
Consolidated Papers, Inc.	Wisconsin Rapids	21	WI0037991	3D	ND	ND	1E-06	94	5E-07	87
Region VI										
Georgia-Pacific Corp.	Crosset	M68EC	AR0001210	1			2E-05	72	8E-06	45
International Paper Co.	Pine Bluff	M51EC	AR0001970	1			4E-06	50	3E-06	32
Nekoosa Papers, Inc.	Ashdown	M20EC	AR0002968	1			3E-06	81	9E-07	37
Potlatch Corp.	McGhee	M18EC	AR0035823	4H			3E-09	80	E	E
Potlatch Corp.	McGhee	M18EC	AR0035823	4L			2E-10	80	E	E
James River Corp.	St. Francesville	M52EC	LA0003468	1			6E-08	72	E	E
Georgia-Pacific Corp.	Zachary	M1EC	LA0005258	3A		NQ	Q	Q	Q	Q
Georgia-Pacific Corp.	Zachary	M1ECX	LA0005258	1			2E-07	35	E	E
International Paper Co.	Bastrop	M85EC	LA0007561	5			F	F	F	F
Boise Cascade Corp.	Deridder	M58EC	LA0007927	1			1E-05	68	7E-06	44
International Paper Co.	Texarkana	M99EC	TX0000167	1			2E-05	75	6E-06	40
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2E-05	80	1E-05	61
Champion International	Lufkin	DF024512	TX0001643	3D	ND	ND	2E-06	91	9E-07	79
Temple-Eastex, Inc.	Evadale	M3EC	TX0003891	1			2E-05	90	1E-05	80
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N

Appendix J. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[2]	TCDD NON-DET-ECT[3]	TCDF NON-DET-ECT[3]	SIMPLE DILUTION TEQ DRINK. WATER RISK	SIMPLE DILUTION % TCDD RISK IN TEQ RISK	EXAMS WATER COLUMN TEQ DRINK. WATER RISK	EXAMS WATER COLUMN % TCDD RISK IN TEQ RISK
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N
Champion International	Houston	M15EC	TX0053023	2B	ND		D	D	D	D
Region VIII										
Stone Container Corp.	Missoula	M27EC	MT0000035	3C		ND	6E-08	89	2E-08	67
Region IX										
Stone Container Corp.	Snowflake	M100EC	AZ-------	2D			EZ	EZ	EZ	EZ
Simpson Paper Co.	Anderson	M98EC	CA0004065	1			3E-05	23	3E-05	12
Gaylord Container Corp.	Antioch	M106EC	CA0004847	5			F	F	F	F
Simpson Paper Co.	Fairhaven	M43EC0	CA0005282	2A			D	D	D	D
Louisiana Pacific Corp.	Samoa	M70EC10	CA0005894	2A			D	D	D	D
Region X										
Alaska Pulp Corp.	Sitka	M5EC-1	AK0000531	2B	ND		D	D	D	D
Ketchikan Pulp & Paper 1	Ketchikan	M31EAC	AK0000922	2B	ND	ND	D	D	D	D
Ketchikan Pulp & Paper 2	Ketchikan	M31EBC	AK0000922	2A			D	D	D	D
Potlatch Corp.	Lewiston	M56EC	ID0001163	1			7E-07	66	3E-07	33
Potlatch Corp.	Lewiston	M56EC1	ID0001163	1			7E-07	71	3E-07	38
James River Corp.	Clatskanie (Wauna)	8637-4645	OR0000795	1			ED	ED	ED	ED
Pope & Talbot, Inc.	Halsey	M19EC	OR0001074	1			4E-07	79	2E-07	62
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4H			ED	ED	ED	ED
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4L			ED	ED	ED	ED
Longview Fibre Co.	Longview	M53EC	WA0000078	3B	ND		ED	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC1-L	WA0000124	1			ED	ED	ED	ED
Weyerhaeuser Co.	Longview	M45EC-L	WA0000124	1			ED	ED	ED	ED
James River Corp.	Camas	M32EC	WA0000256	3E	NQ		ND	ND	ND	ND
Scott Paper Co. 1	Everett	M80EAC	WA0000621	2D	ND		EZD	EZD	EZD	EZD
Scott Paper Co. 2	Everett	M80EBC	WA0000621	2D	ND	ND	EZD	EZD	EZD	EZD
ITT-Rayonier, Inc.	Port Angeles	M12EC	WA0000795	2A			D	D	D	D
Weyerhaeuser Co.	Cosmopolis	M4EC	WA0000809	2A			D	D	D	D
Simpson Paper Co.	Tacoma	M81EC	WA0000850	2E	NQ		ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81EC1	WA0000850	2E	NQ		ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECX	WA0000850	2E	NQ		ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECXX	WA0000850	2E	NQ		ND	ND	ND	ND
Georgia-Pacific Corp.	Bellingham	M60EC1	WA0001091	2B	ND		D	D	D	D
Weyerhaeuser Co.	Everett	M79EC	WA0003000	2A			D	D	D	D
ITT-Rayonier, Inc.	Hoquiam	M33EC	WA0003077	2A			D	D	D	D
Boise Cascade Corp.	Wallula	M66EC	WA0003697	1			D	D	D	D

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[1] U.S. EPA weight-of-the-evidence classification "B2" (US EPA, 1986a)

[2] Legends of analysis group ID codes and error codes are on the next page.

[3] ND = Not detected in the effluent samples. Risk estimates are based on 1/2 the detection limit in the effluent sample. NQ - Nonquantifiable

[4] a.k.a. Hammermill Papers

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX K

Appendix K.

Mill Specific Human Dose[1] from a Single 115 Gram (1/4 Pound) Fish Ingestion (in pg/kg/day) for Comparison with the TCDD Health Advisory[2] for Protection from Liver Effects

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[3]	TCDD NON-DET-ECT[4]	TCDF NON-DET-ECT[4]	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD DOSE	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ DOSE	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD DOSE	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ DOSE
Region I														
Georgia-Pacific Corp.	Woodland	M17EC	ME0001872	1			1.0E+00	1.2E+00	1.0E+01	1.0E+01	7.8E-01	9.2E-01	7.8E+00	7.9E+00
International Paper Co.	Jay	RG1-86388	ME0001937	1			1.3E+01	1.6E+01	1.3E+02	1.3E+02	7.2E+00	9.6E+00	7.2E+01	7.4E+01
Lincoln Pulp and Paper	Lincoln	M11EC	ME0002003	1			7.1E-01	8.2E-01	7.1E+00	7.2E+00	5.4E-01	6.5E-01	5.4E+00	5.5E+00
James River Corp.	Old Town	M8EC	ME0002020	1			8.9E-01	1.0E+00	8.9E+00	9.1E+00	6.8E-01	8.0E-01	6.8E+00	7.0E+00
Boise Cascade Corp.	Rumford	M82EC	ME0002054	1			1.4E+01	1.7E+01	1.4E+02	1.5E+02	7.3E+00	9.9E+00	7.3E+01	7.5E+01
Scott Paper Co.	Westbrook	M30EC	ME0002321	1			2.7E+00	2.9E+00	2.7E+01	2.7E+01	1.4E+00	1.6E+00	1.4E+01	1.4E+01
Scott Paper Co.	Hinckley	M61EC	ME0021521	1			1.0E+00	1.2E+00	1.0E+01	1.0E+01	5.5E-01	7.1E-01	5.5E+00	5.7E+00
Scott Paper Co.	Hinckley	M61EC1	ME0021521	1			1.2E+00	1.5E+00	1.2E+01	1.2E+01	6.6E-01	9.0E-01	6.6E+00	6.8E+00
James River Corp.	Berlin	BM89EC	NH0000655	1			1.7E+00	1.9E+00	1.7E+01	1.7E+01	9.7E-01	1.2E+00	9.7E+00	1.0E+01
James River Corp.	Berlin	M89EC	NH0000655	1			5.8E+00	1.0E+01	5.8E+01	6.3E+01	3.4E+00	7.9E+00	3.4E+01	3.8E+01
Region II														
International Paper Co.	Ticonderoga	M9EC	NY0004413	2A			7.8E+00	1.0E+01	7.8E+01	8.1E+01	2.6E+00	4.9E+00	2.6E+01	2.9E+01
International Paper Co.	Ticonderoga	M9EC1	NY0004413	2A			1.0E+01	1.3E+01	1.0E+02	1.1E+02	3.5E+00	6.0E+00	3.5E+01	3.8E+01
Finch & Pruyn & Co., Inc.	Glen Falls	M41EC	NY0005525	3D	ND	ND	2.7E-01	2.8E-01	2.7E+00	2.7E+00	1.6E-01	1.6E-01	1.6E+00	1.6E+00
Region III														
Westvaco Corp.	Luke	M62EC	MD0021687	4H			3.0E+00	3.3E+00	3.0E+01	3.0E+01	8.6E-01	1.2E+00	8.6E+00	9.0E+00
Westvaco Corp.	Luke	M62EC	MD0021687	4L			2.4E-01	2.7E-01	2.4E+00	2.4E+00	6.9E-02	9.5E-02	6.9E-01	7.2E-01
Penntech Papers, Inc.	Johnsonburg	M57EAC	PA0002143	3B	ND		5.0E-01	5.8E-01	5.0E+00	5.1E+00	2.3E-01	2.9E-01	2.3E+00	2.3E+00
Penntech Papers, Inc.	Johnsonburg	M57EBC	PA0002143	1			1.8E+00	2.3E+00	1.8E+01	1.9E+01	4.2E-01	8.3E-01	4.2E+00	4.6E+00
Appleton Papers, Inc.	Roaring Springs	M13EDO	PA0008265	3B	ND		2.9E+00	3.2E+00	2.9E+01	2.9E+01	5.2E-01	7.7E-01	5.2E+00	5.5E+00
P.H. Glatfelter Co.	Spring Grove	M64EC20	PA0008869	3B	ND		7.7E+00	9.6E+00	7.7E+01	7.9E+01	1.0E+00	2.3E+00	1.0E+01	1.1E+01
Procter & Gamble Co[5]	Mehoopany	M42EC	PA0008885	3B	ND		4.0E-02	4.1E-02	4.0E-01	4.0E-01	1.8E-02	1.9E-02	1.8E-01	1.8E-01
International Paper[5]	Erie	M103ECX	PA0026301	2CH			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
International Paper[5]	Erie	M103ECX	PA0026301	2CL			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
Chesapeake Corp.	West Point	M74EC140	VA0003115	1			6.8E+00	8.3E+00	6.8E+01	6.9E+01	1.9E+00	3.3E+00	1.9E+01	2.0E+01
Westvaco Corp.	Covington	BM28EC	VA0003646	3B	ND		3.3E+00	3.9E+00	3.3E+01	3.4E+01	9.7E-01	1.5E+00	9.7E+00	1.0E+01
Westvaco Corp.	Covington	M28EC	VA0003646	1			1.7E+02	1.9E+02	1.7E+03	1.7E+03	4.9E+01	6.6E+01	4.9E+02	5.0E+02
Westvaco Corp.	Covington	M28EC1	VA0003646	3B	ND		8.3E+00	1.5E+01	8.3E+01	8.9E+01	2.4E+00	8.2E+00	2.4E+01	3.0E+01
Westvaco Corp.	Covington	M28EC2	VA0003646	1			1.1E+01	1.6E+01	1.1E+02	1.2E+02	3.2E+00	7.7E+00	3.2E+01	3.7E+01
Union Camp Corp.	Franklin	UCF1000	VA0004162	1			1.9E+02	2.0E+02	1.9E+03	1.9E+03	7.1E+01	7.9E+01	7.1E+02	7.2E+02
Region IV														
Champion International	Courtland	M40EC	AL0000396	2A			1.3E+00	1.5E+00	1.3E+01	1.3E+01	4.6E-01	6.8E-01	4.6E+00	4.8E+00
Container Corp. of America	Brewton	M67EC	AL0002682	3C		ND	2.7E+00	2.8E+00	2.7E+01	2.7E+01	1.3E+00	1.4E+00	1.3E+01	1.3E+01
Boise Cascade Corp.	Jackson	M65EC	AL0002755	1			2.8E+00	3.4E+00	2.8E+01	2.8E+01	9.7E-01	1.6E+00	9.7E+00	1.0E+01
Boise Cascade Corp.	Jackson	M65EC1	AL0002755	1			3.5E+00	4.2E+00	3.5E+01	3.5E+01	1.2E+00	1.9E+00	1.2E+01	1.3E+01
International Paper Co.	Mobile	M71EC	AL0002780	1			2.1E+00	2.8E+00	2.1E+01	2.2E+01	6.6E-01	1.3E+00	6.6E+00	7.2E+00
Scott Paper Co.	Mobile	M26EC210	AL0002801	1			6.9E-01	7.3E-01	6.9E+00	7.0E+00	2.1E-01	2.5E-01	2.1E+00	2.2E+00

Appendix K. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[3]	TCDD NON-DET-ECT[4]	TCDF NON-DET-ECT[4]	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD DOSE	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ DOSE	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD DOSE	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ DOSE
Gulf States Paper Corp.	Demopolis	M101EC	AL0002828	1			2.4E+00	2.7E+00	2.4E+01	2.4E+01	7.0E-01	9.0E-01	7.0E+00	7.2E+00
International Paper Co.	Selma	M88EC	AL0003018	1			1.8E+00	2.1E+00	1.8E+01	1.8E+01	4.2E-01	6.7E-01	4.2E+00	4.4E+00
Kimberly-Clark Corp.	Coosa Pines	M36EC	AL0003158	1			2.9E+00	3.2E+00	2.9E+01	2.9E+01	6.8E-01	9.0E-01	6.8E+00	7.1E+00
James River Corp.	Butler	M96EC	AL0003301	1			2.1E+00	2.4E+00	2.1E+01	2.1E+01	7.0E-01	9.4E-01	7.0E+00	7.2E+00
Alabama River Pulp	Claiborne	M21EC	AL0025968	1			7.4E-01	9.2E-01	7.4E+00	7.6E+00	2.3E-01	4.0E-01	2.3E+00	2.5E+00
Alabama River Pulp	Claiborne	M21EC1	AL0025968	1			7.2E-01	9.0E-01	7.2E+00	7.4E+00	2.3E-01	3.9E-01	2.3E+00	2.4E+00
Alabama River Pulp	Claiborne	M21EC2	AL0025968	1			8.3E-01	9.8E-01	8.3E+00	8.4E+00	2.6E-01	4.0E-01	2.6E+00	2.7E+00
ITT-Rayonier, Inc.	Fernandina Beach	M90EC	FL0000701	2A			1.1E+00	1.3E+00	1.1E+01	1.1E+01	3.8E-01	5.9E-01	3.8E+00	4.1E+00
Buckeye Cellulose	Perry	M91EC0	FL0000876	1			2.0E+02	2.3E+02	2.0E+03	2.0E+03	8.1E+01	1.0E+02	8.1E+02	8.3E+02
Champion International	Cantonment	CP1000	FL0002526	3B	ND		2.2E+01	2.8E+01	2.2E+02	2.3E+02	9.8E+00	1.5E+01	9.8E+01	1.0E+02
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CH	ND		1.6E-01	1.8E-01	1.6E+00	1.7E+00	5.8E-02	6.9E-02	5.8E-01	5.9E-01
Stone Container Corp.	Panama City	M102EAC	FL0002631	2CL	ND		1.3E-02	1.4E-02	1.3E-01	1.3E-01	4.6E-03	5.5E-03	4.6E-02	4.7E-02
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CH			2.7E-01	3.0E-01	2.7E+00	2.7E+00	9.5E-02	1.2E-01	9.5E-01	9.7E-01
Stone Container Corp.	Panama City	M102EBC	FL0002631	2CL			1.1E-02	1.3E-02	1.1E-01	1.1E-01	7.6E-03	9.6E-03	7.6E-02	7.8E-02
Georgia-Pacific Corp.	Palatka	M24EC	FL0002763	2A			7.3E+01	8.0E+01	7.3E+02	7.4E+02	6.5E+01	7.2E+01	6.5E+02	6.5E+02
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4H			1.1E+01	1.4E+01	1.1E+02	1.1E+02	CD	CD	CD	CD
St. Joe Paper Co.	Port St. Joe	M94EC1	FL0020206	4L			8.7E-01	9.7E-01	8.7E+00	8.8E+00	CD	CD	CD	CD
Gilman Paper Co.	St. Marys	M55EC	GA0001953	2B	ND		1.5E+00	1.8E+00	1.5E+01	1.5E+01	6.0E-01	8.9E-01	6.0E+00	6.3E+00
Federal Paper Board Co.	Augusta	M83EC	GA0002801	1			8.9E-01	1.0E+00	8.9E+00	9.0E+00	3.6E-01	4.6E-01	3.6E+00	3.7E+00
ITT-Rayonier, Inc.	Jesup	M84EAC	GA0003620	1			2.4E+00	2.5E+00	2.4E+01	2.4E+01	9.8E-01	1.0E+00	9.8E+00	9.8E+00
ITT-Rayonier, Inc.	Jesup	M84EBC	GA0003620	1			2.3E+00	2.4E+00	2.3E+01	2.4E+01	9.4E-01	1.0E+00	9.4E+00	9.5E+00
Brunswick Pulp and Paper	Brunswick	M87EC	GA0003654	2A			1.1E+01	1.2E+01	1.1E+02	1.1E+02	3.9E+00	4.8E+00	3.9E+01	4.0E+01
Brunswick Pulp and Paper	Brunswick	M87EC1	GA0003654	2A			1.1E+01	1.1E+01	1.1E+02	1.1E+02	3.9E+00	4.6E+00	3.9E+01	3.9E+01
Buckeye Cellulose	Oglethorpe	M22EC10	GA0049336	3B	ND		3.4E-01	4.0E-01	3.4E+00	3.5E+00	1.4E-01	1.9E-01	1.4E+00	1.4E+00
Westvaco Corp.*	Wickliffe	M78EC	KY0000086	1			3.0E-02	3.5E-02	3.0E-01	3.1E-01	E	E	E	E
Willamette Industries	Hawesville	M63EC	KY0001716	3D	ND	ND	1.4E-02	1.5E-02	1.4E-01	1.4E-01	1.4E-03	1.7E-03	1.4E-02	1.4E-02
International Paper Co.*	Natchez	M97EC	MS0000213	1			4.4E-02	5.3E-02	4.4E-01	4.5E-01	E	E	E	E
International Paper Co.	Moss Point	M34EC	MS0002674	2CH			3.1E+01	3.8E+01	3.1E+02	3.2E+02	9.3E+00	1.5E+01	9.3E+01	9.9E+01
International Paper Co.	Moss Point	M34EC	MS0002674	2CL			1.2E+00	1.8E+00	1.2E+01	1.3E+01	7.5E-01	1.2E+00	7.5E+00	8.0E+00
Leaf River Forest Products	New Augusta	BM35SEC30	MS0031704	1			1.0E+01	1.1E+01	1.0E+02	1.0E+02	3.3E+00	3.8E+00	3.3E+01	3.3E+01
Leaf River Forest Products	New Augusta	M35SEC30	MS0031704	1			2.6E+01	2.8E+01	2.6E+02	2.6E+02	8.3E+00	1.0E+01	8.3E+01	8.5E+01
Champion International	Canton	M47G100-500	NC0000272	1			2.2E+01	2.3E+01	2.2E+02	2.2E+02	8.4E+00	8.8E+00	8.4E+01	8.4E+01
Weyerhauser Co.	Plymouth	M86EC0	NC0000680	2A			2.5E+02	3.7E+02	2.5E+03	2.6E+03	1.1E+02	2.3E+02	1.1E+03	1.2E+03
Weyerhauser Co.	New Bern	M6EC	NC0003191	1			1.0E+01	1.2E+01	1.0E+02	1.0E+02	5.7E+00	7.3E+00	5.7E+01	5.9E+01
Federal Paper Board Co.	Riegelwood	M16EC	NC0003298	1			4.1E+00	4.4E+00	4.1E+01	4.1E+01	2.7E+00	3.2E+00	2.7E+01	2.8E+01
International Paper Co.	Georgetown	M70EC	SC0000868	2A			2.5E+03	2.7E+03	2.5E+04	2.5E+04	6.5E+02	8.6E+02	6.5E+03	6.7E+03
International Paper Co.	Georgetown	M70EC1	SC0000868	2A			1.9E+03	2.1E+03	1.9E+04	1.9E+04	5.0E+02	7.0E+02	5.0E+03	5.2E+03
Bowater Corp.	Catawba	M23EC	SC0001015	1			3.4E+00	3.6E+00	3.4E+01	3.4E+01	2.0E+00	2.2E+00	2.0E+01	2.0E+01
Union Camp Corp.	Eastover	M93EC	SC0038121	1			5.5E-01	6.1E-01	5.5E+00	5.6E+00	1.5E-01	2.0E-01	1.5E+00	1.5E+00
Mead Corporation	Kingsport	M73EC	TN0001643	1			4.6E-01	6.0E-01	4.6E+00	4.8E+00	2.3E-01	3.5E-01	2.3E+00	2.4E+00
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	6.4E-01	6.6E-01	6.4E+00	6.4E+00	3.3E-01	3.5E-01	3.3E+00	3.3E+00

Appendix K. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[3]	TCDD NON-DET-ECT[4]	TCDF NON-DET-ECT[4]	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ
							DOSE	DOSE	DOSE	DOSE	DOSE	DOSE	DOSE	DOSE
Bowater Corp.	Calhoun	M75EC	TN0002356	3D	ND	ND	6.4E-01	6.6E-01	6.4E+00	6.4E+00	3.3E-01	3.5E-01	3.3E+00	3.3E+00
Region V														
Mead Corporation	Escanaba	ML802	MI0000027	3B	ND		5.8E+00	7.1E+00	5.8E+01	5.9E+01	3.3E+00	4.6E+00	3.3E+01	3.4E+01
Scott Paper Co.	Muskegon	M92EC	MI0027391	4H	ND		1.3E-01	1.7E-01	1.3E+00	1.3E+00	6.5E-02	1.1E-01	6.5E-01	7.0E-01
Scott Paper Co.	Muskegon	M92EC	MI0027391	4L	ND		1.0E-02	1.4E-02	1.0E-01	1.0E-01	5.2E-03	9.0E-03	5.2E-02	5.6E-02
Champion International	Quinnesec	Q14E	MI0042170	1			7.3E-01	9.4E-01	7.3E+00	7.5E+00	4.5E-01	6.5E-01	4.5E+00	4.7E+00
Potlatch Corp.	Cloquet	M38ECO	MN-------	4H			7.4E-01	7.9E-01	7.4E+00	7.4E+00	4.4E-01	4.9E-01	4.4E+00	4.4E+00
Potlatch Corp.	Cloquet	M38ECO	MN-------	4L			5.9E-02	6.3E-02	5.9E-01	5.9E-01	3.5E-02	3.9E-02	3.5E-01	3.6E-01
Boise Cascade Corp.	International Falls	DE0020922	MN0001643	1			2.7E+00	4.7E+00	2.7E+01	2.9E+01	1.6E+00	3.6E+00	1.6E+01	1.8E+01
Mead Corp.	Chillicothe	DE0026013	OH0004481	3B	ND		2.7E+00	3.5E+00	2.7E+01	2.8E+01	1.8E+00	2.6E+00	1.8E+01	1.9E+01
Badger Paper Mills, Inc.	Peshtigo	M46EBC	WI0000663	1			1.3E-01	2.6E-01	1.3E+00	1.4E+00	6.9E-02	1.8E-01	6.9E-01	8.1E-01
Badger Paper Mills, Inc.	Peshtigo	M46EBCX	WI0000663	3B	ND		7.7E-02	2.2E-01	7.7E-01	9.2E-01	E	E	E	E
James River Corp.	Green Bay	M72EAC	WI0001261	1			4.4E-01	5.4E-01	4.4E+00	4.5E+00	1.3E-01	2.2E-01	1.3E+00	1.4E+00
Pentair, Inc.	Park Falls	M25EC	WI0003212	3B	ND		4.7E-01	5.0E-01	4.7E+00	4.7E+00	2.6E-01	2.9E-01	2.6E+00	2.6E+00
Wausau Paper Mills Co. 1	Brokaw	M54EC	WI0003379	3B	ND		9.7E-02	1.2E-01	9.7E-01	9.9E-01	5.8E-02	8.3E-02	5.8E-01	6.1E-01
Wausau Paper Mills Co. 2	Brokaw	M54ECX	WI0003379	3D	ND	ND	1.1E-01	1.1E-01	1.1E+00	1.1E+00	6.8E-02	7.0E-02	6.8E-01	6.8E-01
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	M77EC	WI0003620	1			4.6E+00	6.1E+00	4.6E+01	4.8E+01	2.2E+00	3.6E+00	2.2E+01	2.3E+01
James River Corp.	Green Bay	M72EBC	WI0020991	4H	ND		1.2E-02	1.5E-02	1.2E-01	1.2E-01	3.3E-03	6.2E-03	3.3E-02	3.6E-02
James River Corp.	Green Bay	M72EBC	WI0020991	4L	ND		9.4E-04	1.2E-03	9.4E-03	9.6E-03	2.7E-04	5.0E-04	2.7E-03	2.9E-03
Weyerhauser Co.	Rothchild	M29EC	WI0026042	1			3.6E-01	3.9E-01	3.6E+00	3.7E+00	1.9E-01	2.2E-01	1.9E+00	1.9E+00
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4H			1.7E-01	3.7E-01	1.7E+00	1.9E+00	9.3E-02	2.7E-01	9.3E-01	1.1E+00
Badger Paper Mills, Inc.	Peshtigo	M46EAC	WI0030651	4L			1.4E-02	2.9E-02	1.4E-01	1.5E-01	7.4E-03	2.2E-02	7.4E-02	8.8E-02
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4H	ND		5.7E-02	1.7E-01	5.7E-01	6.8E-01	E	E	E	E
Badger Paper Mills, Inc.	Peshtigo	M46EACX	WI0030651	4L	ND		4.5E-03	1.4E-02	4.5E-02	5.5E-02	E	E	E	E
Consolidated Papers, Inc.	Wisconsin Rapids	21	WI0037991	3D	ND	ND	1.8E+00	1.9E+00	1.8E+01	1.8E+01	8.3E-01	8.8E-01	8.3E+00	8.4E+00
Region VI														
Georgia-Pacific Corp.	Crosset	M68EC	AR0001210	1			2.1E+01	2.5E+01	2.1E+02	2.2E+02	6.5E+00	9.5E+00	6.5E+01	6.8E+01
International Paper Co.	Pine Bluff	M51EC	AR0001970	1			3.7E+00	5.2E+00	3.7E+01	3.9E+01	1.7E+00	3.1E+00	1.7E+01	1.9E+01
Nekoosa Papers, Inc.	Ashdown	M20EC	AR0002968	1			4.8E+00	5.2E+00	4.8E+01	4.8E+01	5.6E-01	9.2E-01	5.6E+00	5.9E+00
Potlatch Corp.	McGhee	M18EC	AR0035823	4H			4.0E-03	4.4E-03	4.0E-02	4.0E-02	E	E	E	E
Potlatch Corp.*	McGhee	M18EC	AR0035823	4L			3.2E-04	3.5E-04	3.2E-03	3.2E-03	E	E	E	E
James River Corp.*	St. Francesville	M52EC	LA0003468	1			8.0E-02	9.3E-02	8.0E-01	8.2E-01	E	E	E	E
Georgia-Pacific Corp.	Zachary	M1EC	LA0005258	3A		NQ	Q	Q	Q	Q	Q	Q	Q	Q
Georgia-Pacific Corp.*	Zachary	M1ECX	LA0005258	1			1.4E-01	2.5E-01	1.4E+00	1.5E+00	E	E	E	E
International Paper Co.	Bastrop	M85EC	LA0007561	5			F	F	F	F	F	F	F	F
Boise Cascade Corp.	Deridder	M58EC	LA0007927	1			1.7E+01	2.0E+01	1.7E+02	1.7E+02	5.6E+00	8.3E+00	5.6E+01	5.8E+01
International Paper Co.	Texarkana	M99EC	TX0000167	1			2.0E+01	2.2E+01	2.0E+02	2.0E+02	4.2E+00	6.6E+00	4.2E+01	4.4E+01
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2.7E+01	3.0E+01	2.7E+02	2.8E+02	1.0E+01	1.3E+01	1.0E+02	1.1E+02
Champion International	Lufkin	DF024512	TX0001643	3D	ND	ND	3.6E+00	3.7E+00	3.6E+01	3.6E+01	1.2E+00	1.3E+00	1.2E+01	1.2E+01
Temple-Eastex, Inc.	Evadale	M3EC	TX0003891	1			3.7E+01	3.9E+01	3.7E+02	3.8E+02	1.6E+01	1.8E+01	1.6E+02	1.7E+02

Appendix K. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[3]	TCDD NON-DETECT[4]	TCDF NON-DETECT[4]	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD DOSE	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ DOSE	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD DOSE	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD DOSE	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ DOSE
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N
Simpson Paper Co.	Pasadena	M2EC	TX0006041	3E	NQ		N	N	N	N	N	N	N	N
Champion International	Houston	M15EC	TX0053023	2B	ND		6.4E+00	1.4E+01	6.4E+01	7.2E+01	3.0E+00	9.0E+00	3.0E+01	3.6E+01
Region VIII														
Stone Container Corp.	Missoula	M27EC	MT0000035	3C		ND	8.6E-02	9.0E-02	8.6E-01	8.7E-01	2.0E-02	2.4E-02	2.0E-01	2.0E-01
Region IX														
Stone Container Corp.	Snowflake	M100EC	AZ-------	2D			EZ	EZ	EZ	EZ	EZ	EZ	EZ	EZ
Simpson Paper Co.	Anderson	M98EC	CA0004065	1			1.4E+01	3.2E+01	1.4E+02	1.6E+02	6.3E+00	2.4E+01	6.3E+01	8.1E+01
Gaylord Container Corp.	Antioch	M106EC	CA0004847	5			F	F	F	F	F	F	F	F
Simpson Paper Co.	Fairhaven	M43EC0	CA0005282	2A			1.7E+01	2.1E+01	1.7E+02	1.7E+02	6.0E+00	1.0E+01	6.0E+01	6.4E+01
Louisiana Pacific Corp.	Samoa	M70EC10	CA0005894	2A			7.6E+00	9.0E+00	7.6E+01	7.7E+01	2.7E+00	4.0E+00	2.7E+01	2.8E+01
Region X														
Alaska Pulp Corp.	Sitka	M5EC-1	AK0000531	2B	ND		4.3E+00	5.7E+00	4.3E+01	4.4E+01	1.5E+00	2.7E+00	1.5E+01	1.6E+01
Ketchikan Pulp & Paper 1	Ketchikan	M31EAC	AK0000922	2B	ND	ND	8.4E-01	8.7E-01	8.4E+00	8.5E+00	3.0E-01	3.2E-01	3.0E+00	3.0E+00
Ketchikan Pulp & Paper 2	Ketchikan	M31EBC	AK0000922	2A			1.1E+01	1.1E+01	1.1E+02	1.1E+02	3.8E+00	4.0E+00	3.8E+01	3.8E+01
Potlatch Corp.	Lewiston	M56EC	ID0001163	1			8.2E-01	9.9E-01	8.2E+00	8.4E+00	1.7E-01	3.0E-01	1.7E+00	1.8E+00
Potlatch Corp.	Lewiston	M56EC1	ID0001163	1			9.2E-01	1.1E+00	9.2E+00	9.3E+00	1.9E-01	3.0E-01	1.9E+00	2.0E+00
James River Corp.	Clatskanie (Wauna)	8637-4645	OR0000795	1			3.9E-02	5.2E-02	3.9E-01	4.1E-01	ED	ED	ED	ED
Pope & Talbot, Inc.	Halsey	M19EC	OR0001074	1			5.5E-01	6.1E-01	5.5E+00	5.6E+00	2.4E-01	3.0E-01	2.4E+00	2.5E+00
Boise Cascade Corp.	St. Helens	M76EC0	OR0020834	4H			1.3E-02	1.5E-02	1.3E-01	1.3E-01	ED	ED	ED	ED
Boise Cascade Corp.*	St. Helens	M76EC0	OR0020834	4L			1.0E-03	1.2E-03	1.0E-02	1.1E-02	ED	ED	ED	ED
Longview Fibre Co.*	Longview	M53EC	WA0000078	3B	ND		9.2E-03	1.8E-02	9.2E-02	1.0E-01	ED	ED	ED	ED
Weyerhauser Co.*	Longview	M45EC1-L	WA0000124	1			2.9E-02	3.2E-02	2.9E-01	2.9E-01	ED	ED	ED	ED
Weyerhauser Co.*	Longview	M45EC-L	WA0000124	1			3.4E-02	3.9E-02	3.4E-01	3.5E-01	ED	ED	ED	ED
James River Corp.	Camas	M32EC	WA0000256	3E	NQ		ND	ND	ND	ND	ND	ND	ND	ND
Scott Paper Co. 1	Everett	M80EAC	WA0000621	2D	ND		EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD
Scott Paper Co. 2	Everett	M80EBC	WA0000621	2D	ND	ND	EZD	EZD	EZD	EZD	EZD	EZD	EZD	EZD
ITT-Rayonier, Inc.	Port Angeles	M12EC	WA0000795	2A			1.7E+00	1.8E+00	1.7E+01	1.7E+01	6.1E-01	7.2E-01	6.1E+00	6.2E+00
Weyerhauser Co.	Cosmopolis	M4EC	WA0000809	2A			1.5E+01	3.9E+01	1.5E+02	1.8E+02	5.1E+00	2.7E+01	5.1E+01	7.2E+01
Simpson Paper Co.	Tacoma	M81EC	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81EC1	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND
Simpson Paper Co.	Tacoma	M81ECXX	WA0000850	2E	NQ		ND	ND	ND	ND	ND	ND	ND	ND
Georgia-Pacific Corp.	Bellingham	M60EC1	WA0001091	2B	ND		2.1E-01	2.8E+00	2.1E+00	4.6E+00	7.3E-02	2.5E+00	7.3E-01	3.2E+00
Weyerhauser Co.	Everett	M79EC	WA0003000	2A			1.3E+01	1.7E+01	1.3E+02	1.3E+02	4.8E-01	8.8E-01	4.8E+00	5.2E+00
ITT-Rayonier, Inc.	Hoquiam	M33EC	WA0003077	2A			9.0E+00	9.1E+00	9.0E+01	9.0E+01	3.1E+00	3.3E+00	3.1E+01	3.1E+01
Boise Cascade Corp.	Wallula	M66EC	WA0003697	1			6.1E-01	1.1E+00	6.1E+00	6.6E+00	1.8E-01	5.6E-01	1.8E+00	2.1E+00

Appendix K. (continued)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID[3]	TCDD NON-DET-ECT[4]	TCDF NON-DET-ECT[4]	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD	SIMPLE DILUTION BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD	SIMPLE DILUTION BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TCDD	EXAMS WATER COLUMN BCF TO FILET TCDD=5,000 TCDF=1,950 TEQ	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TCDD	EXAMS WATER COLUMN BCF TO FILET TCDD=50,000 TCDF=1,950 TEQ
							DOSE	DOSE	DOSE	DOSE	DOSE	DOSE	DOSE	DOSE

[1] Dose is the bioavailable (95%) portion of exposure.

[2] Health Advisory Level = 100 pg/kg/day.

[3] Legends of analysis group ID codes and error codes are on the next page.

[4] ND - Not detected in the effluent samples. Dose estimates are based on 1/2 the detection limit in the effluent sample.
NQ = Nonquantifiable

[5] a.k.a. Hammermill Papers.

Legends for Analysis Group and Special Status Codes

Analysis Group

1 Calculations based on stream flow in cubic feet/sec. All effluent sample concentrations above detection limits.

2A Calculations based on the dilution ratio at the edge of the zone of initial dilution. All effluent sample concentrations were above detection limits.

2B Calculations based on the dilution ratio at the edge of the zone of initial dilution. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

2CH Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

2CL Calculations based on the dilution ratio at the edge of the zone of initial dilution. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample chemical concentrations above detection limits unless noted otherwise.

2D Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but such a ratio is not available. Effluent sample concentrations were above detection limits unless noted otherwise.

2E Calculations could be based on the dilution ratio at the edge of the zone of initial dilution, but chemical concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

3A Calculations could be based on stream flow in cubic feet/sec, but effluent sample concentrations were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

3B Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD concentrations in effluent samples were below detection limits.

3C Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3D Calculations based on stream flow in cubic feet/sec. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in effluent samples were below detection limits.

3E Calculations could be based on stream flow in cubic feet/sec, but concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

4H Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 75% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

4L Calculations based on stream flow in cubic feet/sec. Indirect discharge through a POTW assuming of 98% pollutant removal. Effluent sample concentrations were above detection limits unless noted otherwise.

5 Calculations could be based on stream flow in cubic feet/sec, but flow data was not available.

Special Status Codes

C Concentration of Total Suspended Solids in effluent samples was not available.

D Drinking water calculations were not done because the receiving water is either marine or estuarine or is not designated for drinking water use.

E The EXAMS II model failed to run for this data record.

F A stream flow rate was not available.

L A value for low stream flow (7Q10) was not available.

N Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF. These samples might be re-analyzed and data might become available.

P A plant effluent flow rate was not available.

Q Concentrations in effluent samples were not quantifiable for 2,3,7,8-TCDD and/or 2,3,7,8-TCDF.

S Concentration of Total Suspended Solids in receiving water was not available.

Z A dilution ratio was not available for the edge of the zone of initial dilution

APPENDIX L

Appendix L.
Receiving Waters at 104 Pulp & Paper Mills by Reach Type
as Determined by STORET/REACH

NAME	NPDES PERMIT NUMBER	REACH NAME
Reach Type: Regular Reach		
Alabama River Pulp	AL0025968	Alabama River
Boise Cascade Corp.	AL0002755	Tombigbee River
Boise Cascade Corp.	LA0007927	Bayou Anacoco[1]
Boise Cascade Corp.	ME0002054	Androscoggin River
Boise Cascade Corp.	MN0001643	Rainy River
Bowater Carolina Co.	SC0001015	Catawba River
Bowater Southern Paper Co	TN0002356	Hiwassee River
Buckeye Cellulose	GA0049336	Flint River
Champion Intn'l Corp.	FL0002526	Perdido River[2]
Champion Intn'l Corp.	MI0042170	Menominee River[3]
Champion Intn'l Corp.	NC0000272	Pigeon River
Champion Intn'l Corp.	TX0001643	Angelina River
Champion Intn'l Corp.	TX0053023	Houston Shipping Channel
Chesapeake Corp.	VA0003115	Pamunkey River
Consolidated Papers, Inc.	WI0037991	Wisconsin River
Container Corp of America	AL0002682	Conecuh River
Federal Paper Board Co.	NC0003298	Cape Fear River
Finch Pruyn & Co., Inc.	NY0005525	Hudson River
Georgia-Pacific Corp.	AR0001210	Ouachita River
Georgia-Pacific Corp.	LA0005258	Mississippi River
Georgia-Pacific Corp.	ME0001872	St. Croix River
Gulf States Paper Corp.	AL0002828	Tombigbee River
Hammermill Papers	AL0003018	Alabama River
ITT-Rayonier, Inc.	GA0003620	Altamaha River
International Paper Co.	AL0002780	Chickasaw Creek
International Paper Co.	AR0001970	Arkansas River
International Paper Co.	LA0007561	Bayou La Fourche
International Paper Co.	ME0001937	Androscoggin River
International Paper Co.	MS0000213	Mississippi River
International Paper Co.	MS0002674	Escatawpa River
International Paper Co.	TX0000167	Sulphur River[4]
James River Corp.	LA0003468	Mississippi River
James River Corp.	ME0002020	Penobscot River
James River Corp.	NH0000655	Androscoggin River
Kimberly-Clark Corp.	AL0003158	Coosa River
Leaf River Forest Product	MS0031704	Leaf River
Lincoln Pulp/Paper	ME0002003	Penobscot River[5]
Mead Corp.	OH0004481	Paint Creek
Mead Corp.	TN0001643	Holston River
Nekoosa Papers, Inc.	AR0002968	Red River
Nekoosa Papers, Inc.	WI0003620	Wisconsin River
Pentair, Inc.	WI0003212	NF Flambeau River
Pope & Talbot, Inc.	OR0001074	Willamette River

Appendix L. (Continued)

NAME	NPDES PERMIT NUMBER	REACH NAME
Potlatch Corp.	AR0035823	Mississippi River
Potlatch Corp.	ID0001163	Snake River
Procter & Gamble Co.	PA0008885	Susquehanna River
Scott Paper Co.	AL0002801	Chickasaw Creek
Scott Paper Co.	ME0002321	Presumscot River
Scott Paper Co.	ME0021521	Kennebec River
Scott Paper Co.	MI0027391	Muskegon River[6]
Simpson Paper Co.	CA0004065	Sacramento River
Stone Container Corp.	MT0000035	Clark Fork River
Union Camp Corp.	SC0038121	Wateree River
Union Camp Corp.	VA0004162	Blackwater River
Wausau Paper Mills Co.	WI0003379	Wisconsin River
Westvaco Corp.	KY0000086	Mississippi River
Westvaco Corp.	MD0021687	N. Branch Potomac River
Westvaco Corp.	VA0003646	Jackson River
Weyerhaeuser Co.	NC0000680	Roanoke River[7]
Weyerhaeuser Co.	NC0003191	Neuse River
Weyerhaeuser Co.	WI0026042	Wisconsin River
Willamette Industries	KY0001716	Ohio River

Total = 63

Reach Type: Source Reaches

Appleton Papers, Inc.	PA0008265	Juniata River[8]
Buckeye Cellulose	FL0000876	Fenholloway River
Federal Paper Board Co.	GA0002801	Spirit Creek
Georgia-Pacific Corp.	FL0002763	Rice Creek
Gilman Paper Co.	GA0001953	North River
James River Corp.	AL0003301	Tombigbee River
P.H. Glatfelter Co.	PA0008869	Codorus Creek
Penntech Papers, Inc.	PA0002143	Clarion River

Total = 8

Appendix L. (Continued)

NAME	NPDES PERMIT NUMBER	REACH NAME
Reach Type: Terminal Reaches		
Badger Paper Mills, Inc.	WI0000663	Peshtigo River
Badger Paper Mills, Inc.	WI0030651	Peshtigo River
James River Corp.	WI0020991	Fox River
James River Corp.	WI0001261	Fox River
Mead Corp.	MI0000027	Escanaba River
Simpson Paper Co.	WA0000850	Puyallup River[9]
Temple-Eastex, Inc.	TX0003891	Neches River
Weyerhaeuser Co.	WA0003000	Snohomish River
	Total = 6	
Reach Type: Source and Terminal Reaches		
Georgia-Pacific Corp.	WA0001091	Whatcom Waterway
International Paper Co.	SC0000868	Sampit River
	Total = 2	
	Free Flowing Streams Grand Total = 79	
Reach Type: Coastline		
ITT-Rayonier, Inc.	FL0000701	Atlantic Ocean
ITT-Rayonier, Inc.	WA0000795	Port Angeles Harbor
ITT-Rayonier, Inc.	WA0003077	N Ch Grays Harbor
Scott Paper Co.	WA0000621	Port Gardner Bay
Simpson Paper Co.	CA0005282	Pacific Ocean
St. Joe Paper Co.	FL0020206	St Joseph Sound
Stone Container Corp.	FL0002631	St. Andrew Bay
Weyerhaeuser Co.	WA0000809	Grays Harbor
	Total = 8	
Reach Type: Great Lakes		
Hammermill Papers	PA0026301	Lake Erie
	Total = 1	

Appendix L. (Continued)

NAME	NPDES PERMIT NUMBER	REACH NAME
Reach Type: Lakes		
Boise Cascade Corp.	WA0003697	Columbia River
Champion Intn'l Corp.	AL0000396	Wheeler Re
International Paper Co.	NY0004413	Lake Champlain
Nekoosa Papers, Inc.	WI0002810	Wisconsin River
	Total = 4	
Reach Type: Wide River Shoreline		
Brunswick Pulp/Paper	GA0003654	Turtle River
Boise Cascade Corp.	OR0000752	Multnomah Channel[10]
James River Corp.	OR0000795	Columbia River
James River Corp.	WA0000256	Columbia River
Longview Fibre Co.	WA0000078	Columbia River
Weyerhaeuser Co.	WA0000124	Columbia River
	Total = 5	
	Non-Free Flowing Stream Grand Total = 19	
Reach Type: Not Identified by Reach		
Alaska Pulp Corp.	AK0000531	Silver Bay
Gaylord Container	CA0004847	San Joaquin River
Ketchikan Pulp & Paper	AK0000922	Ward Cove
Louisiana Pacific Corp.	CA0005894	Humboldt Bay[11]
Potlatch Corp.		?St Louis River
Simpson Paper Co.	TX0006041	
Stone Container Corp.		
	Total = 7	

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[1] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Cypress Creek.

[2] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Elevenmile Creek.

[3] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is a tributary of this waterbody.

[4] The EPA regional contact and/or the Industrial Discharge Facility Database

NAME	NPDES PERMIT NUMBER	REACH NAME

indicate that a more correct receiving water name is Baker Slough.

[5] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Mattanawcock River.

[6] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Mosquito Creek.

[8] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Halter Creek.

[5] The NPDES permit no. for the POTW is OR0020834. The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Columbia River.

[9] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Commencement Bay.

[10] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Welch Creek.

[11] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that the receiving water is the Pacific Ocean.

APPENDIX M

Walter M. Grayman, Ph.D., P.E.

Consulting Engineer
730 Avon Fields Lane **Cincinnati, Ohio 45229** **(513) 281-6139**

MEMO

TO: Jim Pagenkopf
FROM: Walter Grayman
RE: Progress on Mill Inventory
DATE: June 2, 1989

I have finished the first phase on the inventory process; namely, investigating what type of information is available and putting together a package of info for a pilot mill. I'm using mill VA0003115 as my example. I've attached 6 exhibits showing different information and methods of displaying the information as follows:

EXHIBIT 1: A tree structure printoff for the hydrologic catalog unit in which the mill is contained. If the mill is at the extreme downstream end of the catalog unit (as is the case for this mill), it may be useful to also generate the tree for the next downstream catalog unt.

EXHIBIT 2: A STORET inventory of monitoring stations in the vicinity of the mill. I selected a search of all stations within 10 miles upstream of the mill or within 5 miles downstream of the mill. I also limited this search to stations reporting values for temperature, pH and/or solids. In this case there were 6 stations and a overall summation of all this data.

EXHIBIT 3: An example of the same type of inventory retrieval but considering all parameters. This results in many more stations and considerably more output.

EXHIBIT 4: A hand drawn tree of the reaches within 10 miles U/S and 5 miles D/S showing discharger, monitoring and gaging stations.

EXHIBIT 5: A summary of information available from the STORET daily flow file containing most information that is available from USGS. I selected the closest station to the discharger and in this case the only one on the mainstem of the Pamunkey River.

EXHIBIT 6: A reach plot on which I have put the location of the mill and the stream flow gage.

I should note that the process of acquiring and organizing this information is not a automated seamless process. For example, the STORET flow file is not keyed to the Reach File so I need to use another series of programs to identify appropriate gages and then access that information.

Through June 2, I have spent 22 hours and approximately $25 in expenses. I suspect that when I get into production I can probably average about 1 hour per mill. It would help to have a prioritization (e.g. mills not in GEMS first?). Any comments or questions are welcome. I'll proceed along refining this process for other mills. I received your letter of May 31 and I will not go beyond the 40 hour limit unless I hear from you.

EXHIBIT 1

STORET RETRIEVAL DATE 89/05/30 - REACH FILE LISTING - CATALOGING UNIT(S) 09030004,02080106,18040003
REACHRET VERSION OF JUL 06, 1987 REACH FILE VERSION OF SEPTEMBER 1982

TREE LEVEL 12	11	10	9	8	7	6	5	4	3	2	1	REACH NAME	REACH NUMBER	CHECK DIGIT	TYPE	LENGTH (MILES)	UPSTREAM LAT/LONG
												@@ DOWNSTREAM TERMINUS					37 34 29.9
											001	PAMUNKEY R	02080106001	3	R	30.60	76 57 34.9
										/		>> ENTERING FROM THE LEFT					37 40 31.7
										002		COHOKE CR	02080106002	7	S	10.00	77 00 19.7
												<< ENTERING FROM THE RIGHT					37 36 18.3
											003	PAMUNKEY R	02080106003	1	R	12.80	77 03 59.0
										/		>> ENTERING FROM THE LEFT					37 43 17.0
										004		JACKS CR	02080106004	5	S	12.30	77 06 22.6
												<< ENTERING FROM THE RIGHT					37 37 51.9
											005	PAMUNKEY R	02080106005	9	R	6.10	77 07 48.7
										/		<< ENTERING FROM THE RIGHT					37 38 20.3
										038		MATATEQUIN CR	02080106038	2	S	12.40	77 17 47.0
												>> ENTERING FROM THE LEFT					37 40 07.6
											006	PAMUNKEY R	02080106006	3	R	5.40	77 08 49.1
										/		>> ENTERING FROM THE LEFT					37 47 42.7
										007		WEBB CR	02080106007	7	S	13.60	77 15 25.9
												<< ENTERING FROM THE RIGHT					37 41 04.1
											008	PAMUNKEY R	02080106008	1	R	8.60	77 12 48.9
										/		<< ENTERING FROM THE RIGHT					37 42 53.6
										037		TOTOPONOMOY CR	02080106037	8	S	17.00	77 25 59.8
												>> ENTERING FROM THE LEFT					37 48 21.9
											009	PAMUNKEY R	02080106009	5	R	34.40	77 24 20.5
										/		<< ENTERING FROM THE RIGHT					37 48 35.9
										030		S ANNA R	02080106030	0	R	6.20	77 29 40.9
									/			>> ENTERING FROM THE LEFT					37 51 51.1
									031			NEWFOUND R	02080106031	4	S	18.10	77 45 09.7

STORET [redacted]RIEVAL DATE 89/05/30 - REACH FILE LISTING - CATALOGING [redacted]NIT(S) 09030004,02080106,18040003
REACHRET VERSION OF JUL 06, 1987 REACH FILE VERSION OF SEPTEMBER 1982

TREE LEVEL 12	11	10	9	8	7	6	5	4	3	2	1	REACH NAME	REACH NUMBER	CHECK DIGIT	TYPE	LENGTH (MILES)	UPSTREAM LAT/LONG
												<< ENTERING FROM THE RIGHT					37 45 28.0
										032		S ANNA R	02080106032	8	R	14.80	77 37 50.8
												>> ENTERING FROM THE LEFT					37 51 47.5
									033			TAYLORS CR	02080106033	2	S	15.80	77 49 53.3
												<< ENTERING FROM THE RIGHT					37 49 55.1
										034		S ANNA R	02080106034	6	R	25.60	77 50 42.7
												>> ENTERING FROM THE LEFT					37 56 30.4
									035			*A	02080106035	0	S	9.80	77 53 44.8
												<< ENTERING FROM THE RIGHT					38 09 37.4
										036		S ANNA R	02080106036	4	S	48.90	78 13 20.6
												>> ENTERING FROM THE LEFT					37 49 35.0
											010	N ANNA R	02080106010	6	R	3.80	77 25 37.9
												<< ENTERING FROM THE RIGHT					37 59 37.3
										029		LITTLE R	02080106029	9	S	37.10	77 52 43.3
												>> ENTERING FROM THE LEFT					38 00 43.9
											011	N ANNA R	02080106011	0	R	29.20	77 40 55.1
												>> ENTERING FROM THE LEFT					38 11 09.2
										012		NORTH EAST CR	02080106012	4	S	16.20	77 47 20.7
												<< ENTERING FROM THE RIGHT					38 00 52.5
											013	N ANNA R	02080106013	8	R	1.70	77 42 22.6
												== CONTINUING UPSTREAM					38 06 20.5
											014	N ANNA R	02080106014	2	A	10.30	77 50 18.5
												(OPEN WATER REACH THRU L ANNA)					
												+ ASSOCIATED SHORELINE (LAKE/RESERVOIR)					38 10 28.1
												L ANNA	02080106015	6	L	34.00	77 55 01.1
												(NOT DISPLAYED IN DIAGRAM)					
												+ ASSOCIATED SHORELINE (LAKE/RESERVOIR)					38 00 52.5
												L ANNA	02080106039	6	L	70.40	77 42 22.6
												(NOT DISPLAYED IN DIAGRAM)					

STORET RETRIEVAL DATE 89/05/30 - REACH FILE LISTING - CATALOGING UNIT(S) 09030004,02080106,18040003
REACHRET VERSION OF JUL 06, 1987 REACH FILE VERSION OF SEPTEMBER 1982

TREE LEVEL 12	11	10	9	8	7	6	5	4	3	2	1	REACH NAME	REACH NUMBER	CHECK DIGIT	TYPE	LENGTH (MILES)	UPSTREAM LAT/LONG
										/	!	>> ENTERING FROM THE LEFT					38 08 34.4
										019	!	PAMUNKEY CR	02080106019	2	A	3.90	77 52 51.2
										!	!	(OPEN WATER REACH THRU L ANNA)					
										!	!						
										!	!	+ ASSOCIATED SHORELINE (LAKE/RESERVOIR)					38 07 33.9
										!	!	L ANNA	02080106017	4	L	17.60	77 59 06.3
										!	!	(NOT DISPLAYED IN DIAGRAM)					
										*	!						
									/	!	!	>> ENTERING FROM THE LEFT					38 10 28.1
									020	!	!	TERRYS RUN	02080106020	3	A	1.90	77 55 01.1
									!	!	!	(OPEN WATER REACH THRU L ANNA)					
									*	!	!						
									!	!	!	== CONTINUING UPSTREAM					38 14 03.1
									021	!	!	TERRYS RUN	02080106021	7	S	9.20	77 50 38.3
									!	!	!						
									*	!	!						
										!	!	<< ENTERING FROM THE RIGHT					38 09 07.1
										022	!	PAMUNKEY CR	02080106022	1	A	3.20	77 56 17.5
										!	!	(OPEN WATER REACH THRU L ANNA)					
										*	!						
										!	!	== CONTINUING UPSTREAM					38 15 56.5
										023	!	PAMUNKEY CR	02080106023	5	S	15.80	78 04 49.7
										!	!						
										*	!						
											!	<< ENTERING FROM THE RIGHT					38 07 11.6
											024	N ANNA R	02080106024	9	A	6.10	77 56 12.1
											!	(OPEN WATER REACH THRU L ANNA)					
											!						
											!	+ ASSOCIATED SHORELINE (LAKE/RESERVOIR)					38 09 07.1
											!	L ANNA	02080106016	0	L	5.90	77 56 17.5
											!	(NOT DISPLAYED IN DIAGRAM)					
											*						
										/	!	<< ENTERING FROM THE RIGHT					38 06 33.8
										027	!	GOLD MINE	02080106027	1	A	1.30	77 57 24.1
										!	!	(OPEN WATER REACH THRU L ANNA)					
										!	!						
										!	!	+ ASSOCIATED SHORELINE (LAKE/RESERVOIR)					38 06 33.8
										!	!	L ANNA	02080106018	8	L	3.80	77 57 24.1
										!	!	(NOT DISPLAYED IN DIAGRAM)					
										*	!						
										!	!	== CONTINUING UPSTREAM					38 01 33.5
										028	!	GOLD MINE	02080106028	5	S	7.40	77 57 59.0
										!	!						
										*	!						
											!	>> ENTERING FROM THE LEFT					38 07 33.9
											025	N ANNA R	02080106025	3	A	1.90	77 59 06.3
											!	(OPEN WATER REACH THRU L ANNA)					
											*						
											!	== CONTINUING UPSTREAM					38 09 37.7
											026	N ANNA R	02080106026	7	S	14.60	78 10 27.8
											!						
											*						

STORET RETRIEVAL DATE 89/06/02 PGM=INVENT PAGE:
RET4.3

8-YRK031.39
37 30 24.0 076 47 18.0 4
C 57 (COUNTY OF KING AND QUEEN)
51095 VIRGINIA JAMES CITY
NORTH-ATLANTIC 020800
8-YORK
21VASWCB 841207 HQ 02080107010 0006.730 OFF
0000 FEET DEPTH

/TYPA/AMBNT/STREAM

PARAMETER				MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	BOTTOM		29	20.52900	49.90000	7.064000	28.6	5.1	85/07/03	87/11/17
				WATER		68	21.27200	48.67800	6.977000	29.2	4.9	85/07/03	87/11/17
00400	PH		SU	BOTTOM		24	7.239600	.2022900	.4497600	8.40	6.48	85/07/03	87/11/17
				WATER		28	7.195700	.1913300	.4374100	8.21	6.37	85/07/03	87/11/17

/TYPA/AMBNT/STREAM

8-YRK031.48 VA8-01-X0075 VA8-4X0075
37 30 44.0 076 47 35.0 1
YORK RIVER
51127 VIRGINIA NEW KENT
02-NORTH ATLANTIC
8-YORK
21VASWCB HQ 02080107010 0007.160 OFF
0000 FEET DEPTH

PARAMETER				MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	WATER		67	23.60000	38.68400	6.219600	31.1	7.2	68/07/03	79/03/13
00400	PH		SU	WATER		67	7.574200	.2827300	.5317300	8.80	6.50	68/07/03	79/03/13
00403	PH	LAB	SU	WATER		6	6.966000	.0945310	.3074600	7.3	6.5	69/06/03	75/10/14
00500	RESIDUE	TOTAL	MG/L	WATER		5	9133.800	5022200	2241.000	11080	5560	69/06/03	70/05/07
00505	RESIDUE	TOT VOL	MG/L	WATER		5	1559.400	1256900	1121.100	3277	322	69/06/03	70/05/07
00510	RESIDUE	TOT FIX	MG/L	WATER		5	6538.900	15153000	3892.600	9744	52	69/06/03	70/05/07
00530	RESIDUE	TOT NFLT	MG/L	WATER		5	113.8000	29939.00	173.0300	420	10	69/06/03	70/05/07
00535	RESIDUE	VOL NFLT	MG/L	WATER		5	12.20000	64.70000	8.043600	26	5	69/06/03	70/05/07
00540	RESIDUE	FIX NFLT	MG/L	WATER		5	26.00000	354.5000	18.82800	48	5	69/06/03	70/05/07

/TYPA/AMBNT/STREAM

8-PMK000.98 VA8-01-X0045 VA8-5X0045
37 32 02.0 076 48 30.0 1
PAMUNKEY RIVER
51127 VIRGINIA NEW KENT
02-NORTH ATLANTIC 021592
8-YORK
21VASWCB HQ 02080106001 0001.040 OFF
0000 FEET DEPTH

	PARAMETER			MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	WATER		126	21.93400	533.2200	23.09200	260.0	.0	68/07/02	84/08/06
00400	PH		SU	WATER		118	7.426300	.2817500	.5308000	9.00	6.20	68/07/02	84/08/06
00403	PH	LAB	SU	WATER		27	7.185000	.0697870	.2641700	7.7	6.6	69/06/03	84/08/06
00500	RESIDUE	TOTAL	MG/L	WATER		12	6860.800	8022600	2832.400	11370	2571	69/06/03	79/11/13
00505	RESIDUE	TOT VOL	MG/L	WATER		12	1303.200	640670.0	800.4200	2833	412	69/06/03	79/11/13
00510	RESIDUE	TOT FIX	MG/L	WATER		12	5559.200	5427500	2329.700	8984	2159	69/06/03	79/11/13
00530	RESIDUE	TOT NFLT	MG/L	WATER		65	281.9100	1188500	1090.200	7000	14	69/06/03	84/08/06
00535	RESIDUE	VOL NFLT	MG/L	WATER		65	73.60000	244690.0	494.6600	4000	3	69/06/03	84/08/06
00540	RESIDUE	FIX NFLT	MG/L	WATER		65	39.40000	647.5600	25.44700	137	0	69/06/03	84/08/06

01673650
37 32 16.0 076 48 28.0 2
PAMUNKEY RIVER AT WEST POINT, VA
51101 VIRGINIA KING WILLIAM
021592

/TYPA/AMBNT/STREAM

112WRD HQ 02080106001 0001.180 OFF
0000 FEET DEPTH

PARAMETER				MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	WATER		46	16.61500	70.19100	8.378000	28.5	3.5	70/01/30	74/02/19
00400	PH		SU	WATER		45	7.126600	.1070100	.3271300	7.80	6.20	70/01/30	74/02/19
00515	RESIDUE	DISS-105 C	MG/L	WATER		3	5923.300	5482700	2341.500	7700	3270	70/07/28	72/05/13
00530	RESIDUE	TOT NFLT	MG/L	WATER		8	50.37500	707.9900	26.60800	92	9	70/07/28	73/12/21

STORET RETRIEVAL DATE 89/06/02 PGM=INVENT PAGE:

8-PMK002.58 VA8-01-X0046 VA8-5X0046
37 33 08.2 076 49 23.4 1
PAMUNKEY RIVER
51101 VIRGINIA KING WILLIAM
02-NORTH ATLANTIC 021592
8-YORK
21VASWCB HQ 02080106001 0002.730 OFF
0000 FEET DEPTH

/TYPA/AMBNT/STREAM

PARAMETER				MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	WATER		39	24.53000	27.02700	5.198700	30.0	5.0	72/05/30	76/11/23
00400	PH		SU	WATER		39	7.265000	.1824600	.4271600	8.50	6.40	72/05/30	76/11/23
00530	RESIDUE	TOT NFLT	MG/L	WATER		11	44.00000	428.0000	20.68800	92	8	75/05/22	76/11/23
00535	RESIDUE	VOL NFLT	MG/L	WATER		11	9.272700	68.21800	8.259400	22	.0000009	75/05/22	76/11/23
00540	RESIDUE	FIX NFLT	MG/L	WATER		11	34.90900	493.0900	22.20600	92	6	75/05/22	76/11/23

8-PMK006.36 RET4.1
37 31 30.0 076 52 12.0 4
SOUTHERN END LEE MARSH (COUNTY OF NEW KENT)
51127 VIRGINIA NEW KENT
NORTH-ATLANTIC 020800
8-YORK
21VASWCB 841207 HQ 02080106001 0010.160 OFF
0000 FEET DEPTH

/TYPA/AMBNT/STREAM

PARAMETER				MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	BOTTOM		66	19.45800	62.84200	7.927300	29.6	.8	84/07/16	87/11/17
				WATER		152	19.34600	60.73500	7.793300	29.6	.9	84/07/16	87/11/17
00400	PH		SU	BOTTOM		54	7.026300	.2274400	.4769100	8.60	6.06	84/08/14	87/11/17
				WATER		66	6.979500	.2063900	.4543000	8.60	5.94	84/08/14	87/11/17
00403	PH	LAB	SU	BOTTOM		1	6.500000			6.5	6.5	84/07/16	84/07/16
				WATER		1	6.600000			6.6	6.6	84/07/16	84/07/16
00505	RESIDUE	TOT VOL	MG/L	WATER		33	13.30300	117.4100	10.83500	54	2	84/09/14	87/11/17
					K	1	5.000000			5	5	85/11/19	85/11/19
					TOT	34	13.05900	115.8800	10.76500	54	2	84/09/14	87/11/17
00530	RESIDUE	TOT NFLT	MG/L	WATER		33	59.71200	2075.900	45.56200	190	5	84/09/14	87/11/17
					K	2	4.000000	2.000000	1.414200	5	3	85/07/03	85/11/19
					TOT	35	56.52900	2126.000	46.10900	190	3	84/09/14	87/11/17
00540	RESIDUE	FIX NFLT	MG/L	WATER		33	47.63600	1215.700	34.86800	136	8	84/09/14	87/11/17
					K	1	5.000000			5	5	85/11/19	85/11/19
					TOT	34	46.38200	1232.400	35.10500	136	5	84/09/14	87/11/17

6 TOTAL STATIONS PROCESSED

	STA BEG	STA END	# OF OBS	# OF SAMPLE	STA END-PERIOD OF RECD IN YRS =0	<.5	<3	>=3
<1970	2	0	47	10	15	0	0	0
1970	1	0	103	27	0	0	0	0
1971	0	0	40	21	0	0	0	0
1972	1	0	79	41	0	0	0	0
1973	0	0	79	41	0	0	0	0
1974	0	1	56	28	0	0	0	1
1975	0	0	52	20	0	0	0	0
1976	0	1	62	21	0	0	0	1
1977	0	0	12	7	0	0	0	0
1978	0	0	24	12	0	0	0	0
1979	0	1	57	9	0	0	0	1
1980	0	0	55	11	0	0	0	0
1981	0	0	59	12	0	0	0	0
1982	0	0	59	11	0	0	0	0
1983	0	0	63	12	0	0	0	0
1984	1	1	99	41	0	0	0	1
1985	1	0	172	88	0	0	0	0
1986	0	0	186	93	0	0	0	0
1987	0	2	173	102	0	0	1	1
1988	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
TOTAL	6	6	1477	607	15	0	1	5

6 TOTAL STATIONS PROCESSED

PARAMETER				MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	BOTTOM		95	19.78500	58.56500	7.652700	29.6	.8	84/07/16	87/11/17
				WATER		498	20.99000	177.4200	13.32000	260.0	.0	68/07/02	87/11/17
00400	PH		SU	BOTTOM		78	7.091900	.2268100	.4762500	8.60	6.06	84/08/14	87/11/17
				WATER		363	7.300100	.2686300	.5182900	9.00	5.94	68/07/02	87/11/17
00403	PH	LAB	SU	BOTTOM		1	6.500000			6.5	6.5	84/07/16	84/07/16
				WATER		34	7.129200	.0851760	.2918500	7.7	6.5	69/06/03	84/08/06
00500	RESIDUE	TOTAL	MG/L	WATER		17	7529.400	7910700	2812.600	11370	2571	69/06/03	79/11/13
00505	RESIDUE	TOT VOL	MG/L	WATER		50	477.4800	678020.0	823.4200	3277	2	69/06/03	87/11/17
					K	1	5.000000			5	5	85/11/19	85/11/19
					TOT	51	468.2200	668830.0	817.8200	3277	2	69/06/03	87/11/17
00510	RESIDUE	TOT FIX	MG/L	WATER		17	5847.300	7731300	2780.500	9744	52	69/06/03	79/11/13
00515	RESIDUE	DISS-105 C	MG/L	WATER		3	5923.300	5482700	2341.500	7700	3270	70/07/28	72/05/13
00530	RESIDUE	TOT NFLT	MG/L	WATER		122	178.2800	642760.0	801.7200	7000	5	69/06/03	87/11/17
					K	2	4.000000	2.000000	1.414200	5	3	85/07/03	85/11/19
					TOT	124	175.4700	632790.0	795.4800	7000	3	69/06/03	87/11/17
00535	RESIDUE	VOL NFLT	MG/L	WATER		81	61.07400	196410.0	443.1800	4000	.0000009	69/06/03	84/08/06
00540	RESIDUE	FIX NFLT	MG/L	WATER		114	40.76300	795.0700	28.19700	137	0	69/06/03	87/11/17
					K	1	5.000000			5	5	85/11/19	85/11/19
					TOT	115	40.45200	799.2200	28.27100	137	0	69/06/03	87/11/17

EXHIBIT 3

8-PMK002.58 VA8-01-X0046 VA8-5X0046
37 33 08.2 076 49 23.4 1
PAMUNKEY RIVER
51101 VIRGINIA KING WILLIAM
02-NORTH ATLANTIC 021592
8-YORK
21VASWCB HQ 02080106001 0002.730 OFF
0000 FEET DEPTH

/TYPA/AMBNT/STREAM

	PARAMETER			MEDIUM	RMK	NUMBER	MEAN	VARIANCE	STAN DEV	MAXIMUM	MINIMUM	BEG DATE	END DATE
00002	HSAMPLOC	% FROM	RT BANK	WATER		39	50.00000	.0000000	.0000000	50.0	50.0	72/05/30	76/11/23
00005	VSAMPLOC	DEPTH	% OF TOT	WATER		39	50.00000	.0000000	.0000000	50	50	72/05/30	76/11/23
00010	WATER	TEMP	CENT	WATER		39	24.53000	27.02700	5.198700	30.0	5.0	72/05/30	76/11/23
00011	WATER	TEMP	FAHN	WATER	$	39	76.15400	87.54300	9.356400	86.0	41.0	72/05/30	76/11/23
00041	WEATHER	WMO CODE	4501	WATER		39	2.307700	.9028400	.9501800	3	1	72/05/30	76/11/23
00067	TIDE	STAGE	CODE	WATER		31	3.000000	1.266700	1.125500	4	1	72/05/30	76/11/23
00300	DO		MG/L	WATER		39	5.519900	1.532400	1.237900	9.5	2.6	72/05/30	76/11/23
00301	DO	SATUR	PERCENT	WATER	$	39	66.18400	130.6600	11.43100	90.4	32.1	72/05/30	76/11/23
00310	BOD	5 DAY	MG/L	WATER		17	1.846800	.8124000	.9013300	4.0	1.0	72/06/16	76/08/24
					K	3	1.000000	.0000000	.0000000	1.0	1.0	75/08/04	76/09/16
					TOT	20	1.719800	.7803700	.8833900	4.0	1.0	72/06/16	76/09/16
00400	PH		SU	WATER		39	7.265000	.1824600	.4271600	8.50	6.40	72/05/30	76/11/23
00530	RESIDUE	TOT NFLT	MG/L	WATER		11	44.00000	428.0000	20.68800	92	8	75/05/22	76/11/23
00535	RESIDUE	VOL NFLT	MG/L	WATER		11	9.272700	68.21800	8.259400	22	.0000009	75/05/22	76/11/23
00540	RESIDUE	FIX NFLT	MG/L	WATER		11	34.90900	493.0900	22.20600	92	6	75/05/22	76/11/23
00610	NH3+NH4-	N TOTAL	MG/L	WATER		1	.0999900			.100	.100	76/03/01	76/03/01
					K	24	.0999900	.0000000	.0000000	.100	.100	73/05/10	76/09/16
					TOT	25	.0999900	.0000000	.0000000	.100	.100	73/05/10	76/09/16
00612	UN-IONZD	NH3-N	MG/L	WATER	$	25	.0022985	.0000138	.0037245	.019	.00009	73/05/10	76/09/16
00615	NO2-N	TOTAL	MG/L	WATER		4	.0124970	.0000249	.0049955	.020	.010	73/05/10	76/09/16
					K	22	.0099990	.0000000	.0000000	.010	.010	73/06/24	76/11/23
					TOT	26	.0103830	.0000038	.0019595	.020	.010	73/05/10	76/11/23
00619	UN-IONZD	NH3-NH3	MG/L	WATER	$	25	.0027947	.0000205	.0045286	.023	.0001	73/05/10	76/09/16
00620	NO3-N	TOTAL	MG/L	WATER		17	.1570200	.0431980	.2078400	.890	.010	73/05/10	76/05/12
					K	4	.0499900	.0000000	.0000000	.050	.050	75/06/06	75/08/04
					TOT	21	.1366300	.0364130	.1908200	.890	.010	73/05/10	76/05/12
00625	TOT KJEL	N	MG/L	WATER		24	.3165800	.0136250	.1167300	.600	.100	73/05/10	76/09/16
00630	NO2&NO3	N-TOTAL	MG/L	WATER		4	.1074700	.0026207	.0511920	.18	.06	76/06/29	76/11/23
					K	1	.0499900			.05	.05	76/08/24	76/08/24
					TOT	5	.0959720	.0026262	.0512470	.18	.05	76/06/29	76/11/23
00680	T ORG C	C	MG/L	WATER		10	9.100000	4.766700	2.183300	11.0	5.0	75/07/09	76/11/23
00940	CHLORIDE	TOTAL	MG/L	WATER		33	2717.000	2656700	1630.000	6500	7	72/06/16	76/11/23
01002	ARSENIC	AS,TOT	UG/L	WATER	K	4	2.249700	3.581700	1.892500	5	1.0	72/05/30	76/09/16
01027	CADMIUM	CD,TOT	UG/L	WATER	K	7	7.427800	19.28200	4.391100	10	1.0	72/05/30	76/09/16
01034	CHROMIUM	CR,TOT	UG/L	WATER		1	9.999000			10	10	73/08/06	73/08/06
					K	10	9.999000	.0000000	.0000000	10	10	72/05/30	76/09/16
					TOT	11	9.999000	.0000000	.0000000	10	10	72/05/30	76/09/16
01042	COPPER	CU,TOT	UG/L	WATER		6	16.66100	66.59500	8.160600	30	10	72/08/28	76/09/16
					K	5	9.999000	.0000000	.0000000	10	10	72/05/30	75/05/22

JOB

SHEET NO. OF

CALCULATED BY DATE

CHECKED BY DATE

SCALE

MILL: VA0003115
Receiving Reach = 02080106001
Mile Point = 1.98

Skeleton map of monitoring stations, gages and dischargers in vicinity of mill

● = Monitoring Stations
O = Gaging stations
← = Discharger

MILES UPSTREAM OF PULP & PAPER MILL

MILES D/S OF MILL

8-PMK006.36 (MP = 10.16 OFF) TEMP, pH, TSS

REACH: 02080106001
PAMUNKEY RIVER
LENGTH = 30.6 MILES

8-PMK003.17 (MP = 7.22)

8-PMK002.58 (MP = 2.73) TEMP, pH, TSS

VA0003115 (MP = 1.98)
8-PMK001.18 (MP = 1.18)
01673650 (MP = 1.18) TEMP, pH, TSS
8-PMK000.98 (MP = 1.04) TEMP, pH, TSS

VA0003115 (MP = 1.03)
Pipes 1-4

8-YRK031.48 (MP = 7.16) TEMP, pH, TSS
8-YRK031.39 (MP = 6.73) TEMP, pH
BSS049208 (MP = 6.58)
BSS049207 (MP = 6.04)
BSS049206 (MP = 5.5)

REACH: 02080107010
YORK RIVER
LENGH = 7.6 MILE

Information from STORET Flow File

STATION NUMBER	CROSS SEC LOCATION	DEPTH	PARM CODE	STAT CODE	BEGIN YEAR	BEGIN MO	END YEAR	END MO	NO. DAYS	MISSING DAYS	YEARS	MAXIMUM	MINIMUN	MEAN
PAMUNKEY RIVER NEAR HANOVER, VA				AGENCY USGS	STATE 51		DISTRICT 51		COUNTY 085		SITE SW DR	AREA =		1081 SQ M
01673000			00010	00011	1945	10	1946	9	363	2	1	25.99	0.49	13.19
01673000			00010	00011	1968	4	1976	1	2787	75	9	28.00	0.00	15.11
01673000			00060	00003	1941	10	1969	9	10227	0	28	39300.00	13.00	912.41
01673000			00060	00003	1970	10	1988	10	6579	27	19	25000.00	22.00	1155.65
01673000			00095	00011	1968	4	1976	1	2795	67	9	142.00	36.00	72.00

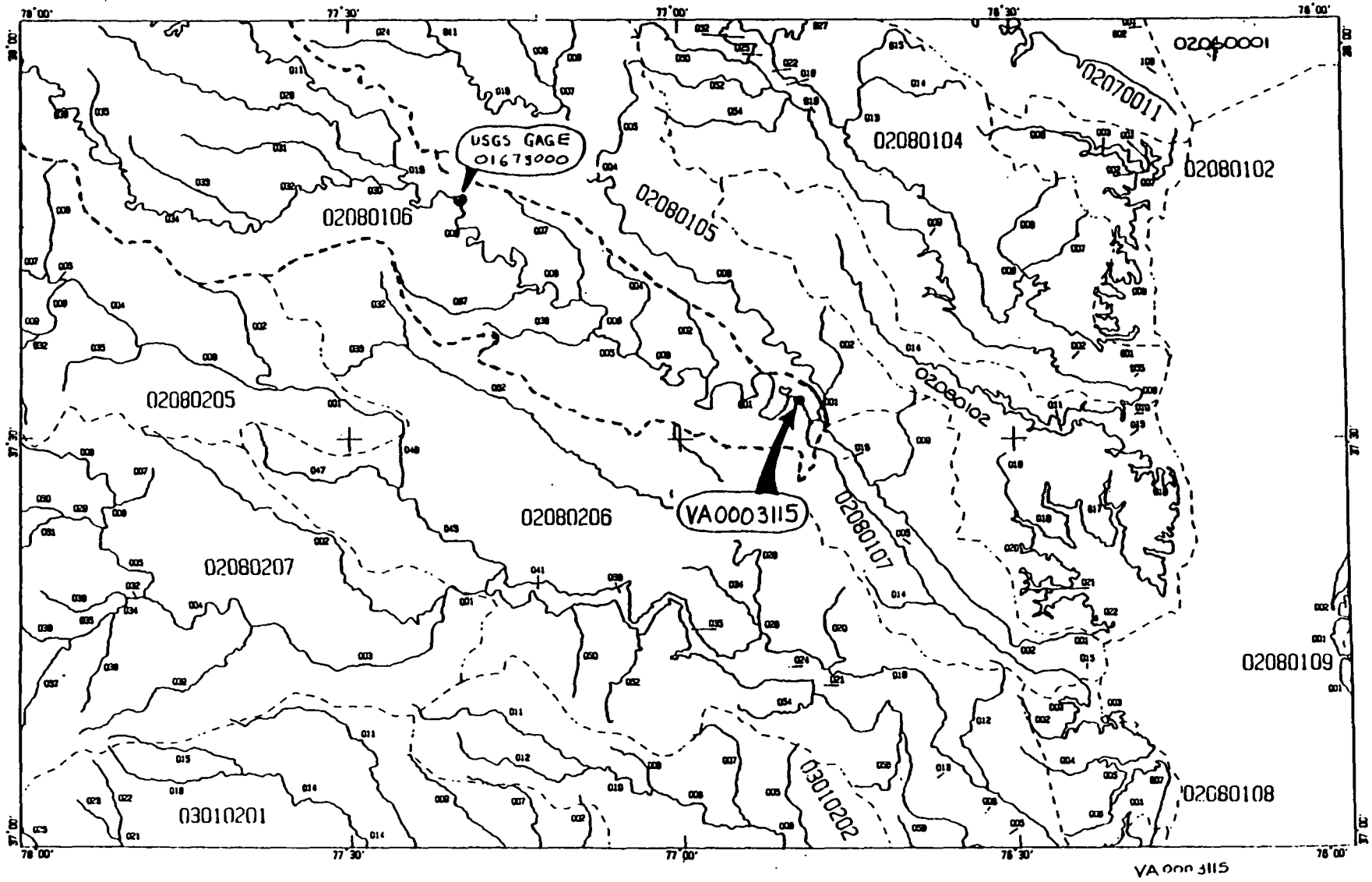
END OF DATA

Parameter Codes

10 = Water Temperature °C

60 = Streamflow (cfs)

95 = Conductivity



M-16

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REACH FILE

HYDROLOGIC SEGMENT PLOT

1981

EXHIBIT 6

RICHMOND

37/76:

APPENDIX N

Appendix N.
STORET/REACH Data Availability for 79 Free Flowing Streams

NAME	NPDES PERMIT NUMBER	REACH NAME
Data Type 0: No Quality Data Available		
Buckeye Cellulose	GA0049336	Flint River
Federal Paper Board Co.	GA0002801	Spirit Creek
International Paper Co.	LA0007561	Bayou La Fourche
International Paper Co.	TX0000167	Sulphur River[1]
Lincoln Pulp/Paper	ME0002003	Penobscot River[2]
Potlatch Corp.	AR0035823	Mississippi River
Scott Paper Co.	ME0021521	Kennebec River
Westvaco Corp.	KY0000086	Mississippi River
	Total = 8	
Data Type 1: Downstream Data Only (within 5 miles)		
Boise Cascade Corp.	ME0002054	Androscoggin River
Bowater Carolina Co.	SC0001015	Catawba River
Finch Pruyn & Co., Inc.	NY0005525	Hudson River
Georgia-Pacific Corp.	AR0001210	Ouachita River
Georgia-Pacific Corp.	ME0001872	St. Croix River
Gilman Paper Co.	GA0001953	North River
Union Camp Corp.	SC0038121	Wateree River
Westvaco Corp.	VA0003646	Jackson River
Willamette Industries	KY0001716	Ohio River
	Total = 9	
Data Type 2: Upstream Data for 1 or 2 Parameters		
Appleton Papers, Inc.	PA0008265	Juniata River[3]
Boise Cascade Corp.	LA0007927	Bayou Anacoco[4]
Georgia-Pacific Corp.	LA0005258	Mississippi River
Georgia-Pacific Corp.	WA0001091	Whatcom Waterway
International Paper Co.	MS0000213	Mississippi River
James River Corp.	AL0003301	Tombigbee River
James River Corp.	ME0002020	Penobscot River
Kimberly-Clark Corp.	AL0003158	Coosa River
Mead Corp.	OH0004481	Paint Creek
Scott Paper Co.	ME0002321	Presumscot River
Temple-Eastex, Inc.	TX0003891	Neches River
	Total = 11	

Appendix N. (Continued)

NAME	NPDES PERMIT NUMBER	REACH NAME
Data Type 3: Upstream Data for T, pH, and SS		
Alabama River Pulp	AL0025968	Alabama River
Badger Paper Mills, Inc.	WI0000663	Peshtigo River
Badger Paper Mills, Inc.	WI0030651	Peshtigo River
Boise Cascade Corp.	AL0002755	Tombigbee River
Boise Cascade Corp.	MN0001643	Rainy River
Boise Cascade Corp.	OR0000752	Multnomah Channel[5]
Bowater Southern Paper Co	TN0002356	Hiwassee River
Buckeye Cellulose	FL0000876	Fenholloway River
Champion Intn'l Corp.	FL0002526	Perdido River[6]
Champion Intn'l Corp.	MI0042170	Menominee River[6]
Champion Intn'l Corp.	NC0000272	Pigeon River
Champion Intn'l Corp.	TX0001643	Angelina River
Champion Intn'l Corp.	TX0053023	Houston Shipping Channel
Chesapeake Corp.	VA0003115	Pamunkey River
Consolidated Papers, Inc.	WI0037991	Wisconsin River
Container Corp of America	AL0002682	Conecuh River
Federal Paper Board Co.	NC0003298	Cape Fear River
Georgia-Pacific Corp.	FL0002763	Rice Creek
Gulf States Paper Corp.	AL0002828	Tombigbee River
Hammermill Papers	AL0003018	Alabama River
ITT-Rayonier, Inc.	GA0003620	Altamaha River
International Paper Co.	AL0002780	Chickasaw Creek
International Paper Co.	AR0001970	Arkansas River
International Paper Co.	ME0001937	Androscoggin River
International Paper Co.	MS0002674	Escatawpa River
International Paper Co.	SC0000868	Sampit River
James River Corp.	LA0003468	Mississippi River
James River Corp.	NH0000655	Androscoggin River
James River Corp.	WI0020991	Fox River
James River Corp.	WI0001261	Fox River
Leaf River Forest Product	MS0031704	Leaf River
Mead Corp.	MI0000027	Escanaba River
Mead Corp.	TN0001643	Holston River
Nekoosa Papers, Inc.	AR0002968	Red River
Nekoosa Papers, Inc.	WI0003620	Wisconsin River
P.H. Glatfelter Co.	PA0008869	Codorus Creek
Penntech Papers, Inc.	PA0002143	Clarion River
Pentair, Inc.	WI0003212	NF Flambeau River
Pope & Talbot, Inc.	OR0001074	Willamette River
Potlatch Corp.	ID0001163	Snake River
Procter & Gamble Co.	PA0008885	Susquehanna River
Scott Paper Co.	AL0002801	Chickasaw Creek
Scott Paper Co.	MI0027391	Muskegon River[8]
Simpson Paper Co.	CA0004065	Sacramento River

Appendix N. (Continued)

NAME	NPDES PERMIT NUMBER	REACH NAME
Simpson Paper Co.	WA0000850	Puyallup River[9]
Stone Container Corp.	MT0000035	Clark Fork River
Union Camp Corp.	VA0004162	Blackwater River
Wausau Paper Mills Co.	WI0003379	Wisconsin River
Westvaco Corp.	MD0021687	N. Branch Potomac River
Weyerhaeuser Co.	NC0000680	Roanoke River[10]
Weyerhaeuser Co.	NC0003191	Neuse River
Weyerhaeuser Co.	WA0003000	Snohomish River
Weyerhaeuser Co.	WI0026042	Wisconsin River

Total = 51

Grand Total = 79

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[1] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Baker Slough.

[2] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Mattanawcock River.

[3] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Halter Creek.

[4] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Cypress Creek.

[5] The NPDES permit no. for the POTW is OR0020834. The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Columbia River.

[6] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Elevenmile Creek.

[7] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is a tributary of this waterbody.

[8] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Mosquito Creek.

[9] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Commencement Bay.

[10] The EPA regional contact and/or the Industrial Discharge Facility Database indicate that a more correct receiving water name is Welch Creek.

APPENDIX O

Appendix O.
In-stream adjusted total suspended solids worksheet

NPDES	AGENCY	STATION	NO. OBS.	MIN	MEAN	MAX	SD	YEARS	RATIO	Adjusted TSS in (mG/L)	Foot-note
AK0000531			0	0	0	0	0		0	0	
AK0000922			0	0	0	0	0		0	0	
AL0000396			0	0	0	0	0		0	0	
AL0002682	11135050	17750	31	2	16	40	10	68-71	0	6	
AL0002755	112WRD	2470040	4	22	44	75	26	71-74	0	10	
AL0002780	21AWIC	CS2	184	2	23	136	18	74-89	1	13	
AL0002801	21AWIC	CS2	184	2	23	136	18	74-89	1	13	
AL0002828	11MOB4	3103	10	2	42	166	58	78-79	0	10	
AL0003018	11MOB4	2422765	115	5	32	180	51	77-78	1	18	
AL0003158			0	0	0	0	0		0	0	1
AL0003301	21AWIC	T1	74	3	48	300	57	74-80	0	11	
AL0025968	11MOB4	2428399	11	5	22	60	19	77-78	1	12	
AR0001210	112WRD	7362400	93	6	25	149	28	72-82	1	13	
AR0001970	1116APCC	50080	58	6	28	150	26	83-89	0	6	
AR0002968	1116APCC	50139	178	4	131	764	140	74-89	0	42	
AR0035823	1116APCC	50059	32	36	198	699	148	68-74	1	130	
AZ-------			0	0	0	0	0		0	0	
CA0004065	21CAL-1	A0282500	10	2	10	17	6	60-83	1	7	
CA0004847			0	0	0	0	0		0	0	
CA0005282			0	0	0	0	0		0	0	
CA0005894			0	0	0	0	0		0	0	
FL0000701			0	0	0	0	0		0	0	
FL0000876	21FLA	22050027	25	0	5	27	6	71-83	0	2	
FL0002526	21FLA	33010003	67	1	8	34	7	70-83	1	5	
FL0002631			0	0	0	0	0		0	0	
FL0002763	21FLA	20030424	4	0	7	12	5	78-80	0	2	
FL0020206			0	0	0	0	0		0	0	
GA0001953			0	0	0	0	0		0	0	2
GA0002801			0	0	0	0	0		1	0	2
GA0003620	21GAEPD	6014001	196	1	16	93	12	70-89	1	8	
GA0003654			0	0	0	0	0		0	0	
GA0049336			0	0	0	0	0		1	0	2
ID0001163	10EPAINT	153646	19	1	29	342	76	75-77	1	21	
KY0000086	112WRD	7024070	10	26	192	512	173	69-70	1	129	
KY0001716	31ORWUNT	OR3551M	182	5	112	1630	193	76-89	0	50	
LA0003468	21LA10RS	7705	130	0	147	406	93	66-78	1	107	
LA0005258	112WRD	7373420	93	2	179	611	113	79-88	1	131	
LA0007561			0	0	0	0	0		0	0	
LA0007927			0	0	0	0	0		0	0	
MD0021687	21MD	NBP0534	64	1	40	1244	157	68-81	0	13	
ME0001872	1111REG1	SCOK	12	1	2	5	1	70-72	1	2	
ME0001937	1111REG1	AR13	6	4	7	10	2	72-72	1	5	
ME0002003			0	0	0	0	0		1	0	3
ME0002020			0	0	0	0	0		1	0	3
ME0002054	1111REG1	AR08	6	4	8	10	2	72-72	1	5	
ME0002321			0	0	0	0	0		0	0	4
ME0021521			0	0	0	0	0		1	0	4
MI0000027	21MICH	210030	117	1	8	110	10	73-87	1	4	
MI0027391	21MICH	620001	19	1	7	15	4	73-75	1	5	
MI0042170	21WIS	383210	6	2	4	8	2	84-88	1	3	
MN-------			0	0	0	0	0		0	0	5
MN0001643	21MINN	LRRA-83	237	0	5	44	5	53-89	1	4	
MS0000213	1110NET	210054	100	19	304	928	215	59-64	1	222	
MS0002674			0	0	0	0	0		0	0	6
MS0031704	21MSWQ	2473260	24	7	32	101	27	75-77	0	12	
MT0000035	21MTHDWQ	4115CL01	55	1	35	832	115	84-87	1	18	
NC0000272	21NC01WQ	E5500000	110	1	6	58	8	71-85	1	3	
NC0000680	21NC01WQ	N9250000	62	1	13	36	6	82-89	1	8	
NC0003191	21NC01WQ	J7930000	172	2	11	38	6	70-89	0	4	
NC0003298	21NC01WQ	B8350000	80	1	16	138	20	80-89	0	7	
NH0000655	11113300	10-AND	20	1	5	18	4	74-76	1	4	
NY0004413			0	0	0	0	0		0	0	
NY0005525	21NYDEC1	11 0602	157	0	8	65	9	66-86	1	4	
OH0004481	21OHIO	V10P06	7	9	21	40	11	85-86	0	3	

Appendix O. (continued)

NPDES	AGENCY	STATION	NO. OBS.	MIN	MEAN	MAX	SD	YEARS	RATIO	Adjusted TSS in (mG/L)	Foot-note
OR0000795			0	0	0	0	0		1	0	7
OR0001074	21400000	402023	142	1	7	75	11	65-89	1	4	
OR0020834			0	0	0	0	0		0	0	7
PA0002143	21PA	WQN0823	43	5	35	204	43	62-72	0	17	
PA0008265			0	0	0	0	0		0	0	8
PA0008869	112WRD	1574520	42	10	59	180	45	62-76	0	27	
PA0008885	21PA	WQN0305	108	0	21	154	22	62-89	0	6	
PA0026301			0	0	0	0	0		0	0	
SC0000868			0	0	0	0	0		1	0	9
SC0001015	112WRD	2146000	142	0	10	86	13	27-79	0	5	
SC0038121	215C60WQ	CW-206	122	1	23	120	20	77-89	1	15	
TN0001643	21TNWQ	2610	251	0	10	61	8	60-85	1	6	
TN0002356	21TNWQ	1585	110	0	12	61	11	74-85	0	5	
TX0000167	21TXWQB	3010100	39	4	22	113	19	76-88	0	1	
TX0001643	21TXWQB	6110100	43	6	24	65	17	76-89	0	1	
TX0003891	21TXWQB	6020100	121	8	37	805	72	76-88	0	7	
TX0006041			0	0	0	0	0		0	0	
TX0053023	21TXWQB	10072350	104	2	47	366	56	76=89	0	4	
VA0003115	21VASWCB	8-PMK002.58	11	8	44	92	21	75-76	0	13	
VA0003646			0	0	0	0	0		0	0	10
VA0004162	21NC01WQ	D0001200	98	1	6	36	6	81-89	0	0	
WA0000078			0	0	0	0	0		1	0	7
WA0000124			0	0	0	0	0		1	0	7
WA0000256			0	0	0	0	0		1	0	
WA0000621			0	0	0	0	0		0	0	
WA0000795			0	0	0	0	0		0	0	
WA0000809			0	0	0	0	0		0	0	
WA0000850	21540000	10A070	126	2	134	2400	319	78-88	1	98	
WA0001091			0	0	0	0	0		0	0	
WA0003000			0	0	0	0	0		0	0	
WA0003077			0	0	0	0	0		0	0	
WA0003697			0	0	0	0	0		0	0	7
WI0000663	21WIS	383001	299	0	6	226	16	61-89	1	4	
WI0001261			0	0	0	0	0		0	0	
WI0003212	21WIS	23025	12	0	6	14	4	75-81	1	3	
WI0003379	21WIS	353068	136	0	5	28	4	58-89	1	4	
WI0020991	21WIS	53001	174	0	20	106	16	61-76	1	14	
WI0030651			0	0	0	0	0		0	0	
WI0037991	21WIS	723002	144	0	11	34	8	76-89	1	7	

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1 The stream solids concentration for AL0003018 was used.

2 The stream solids concentration for GA0003620 was used.

3 The stream solids concentration for ME0001872 was used.

4 The stream solids concentration for ME0001937 was used.

5 The stream solids concentration for MN0001643 was used.

6 The stream solids concentration for MS0031704 was used.

7 The stream solids data used was supplied by the EPA regional contact.

8 The stream solids concentration for PA0002163 was used.

9 The stream solids concentration for SC0003812 was used.

10 The stream solids concentration for VA0003115 was used.

APPENDIX P

Appendix P.
Harmonic mean and 7Q10 stream flow worksheet

NPDES	HMF in Ft3/sec	Q710 flow in Ft3/sec	Method	A	B	SC	GAGE	Foot-note
AK0000531	0	0		0	0	0	0	1
AK0000922	0	0		0	0	0	0	1
AL0000396	0	0		0	0	0	0	1
AL0002682	1385	290	1	1	0	1	2374000	1
AL0002755	6138	1032	1	1	0	1	2470000	1
AL0002780	249	52	1	1	46	1	2471001	1
AL0002801	324	52	1	1	107	1	2471001	1
AL0002828	5080	858	1	1	0	1	2467000	1
AL0003018	14676	5222	1	1	0	1	2423000	
AL0003158	6284	1791	1	1	0	1	2405000	
AL0003301	5639	946	1	1	0	1	2467000	1
AL0025968	18032	6018	1	1	0	1	2429500	1
AR0001210	2369	108	1	1	0	5	7364100	
AR0001970	9780	1387	1	1	0	5	7263450	
AR0002968	3945	535	1	1	0	5	7337000	
AR0035823	368095	110233	1	1	0	5	7265450	
AZ-------	0	0		0	0	0	0	
CA0004065	6654	2561	1	1	0	6	11370500	
CA0004847	0	0		0	0	0	0	1
CA0005282	0	0		0	0	0	0	1
CA0005894	0	0		0	0	0	0	1
FL0000701	0	0		0	0	0	0	1
FL0000876	174	8	1	1	86	12	2324500	1
FL0002526	531	232	1	1	0	12	2376500	1
FL0002631	0	0		0	0	0	0	1
FL0002763	80	10	1	1	57	12	2244473	1
FL0020206	0	0		0	0	0	0	1
GA0001953	69	0	3	0	62	12	2230000	1
GA0002801	196	14	3	1	46	45	2197300	1
GA0003620	6945	2290	1	1	0	13	2226000	1
GA0003654	0	0		0	0	0	0	1
GA0049336	2291	710	1	1	0	13	2349500	1
ID0001163	40672	12100	1	1	0	53	13343600	1
KY0000086	326071	65103	2	1	0	47	326071	1
KY0001716	57912	8454	2	1	0	21	3303280	1
LA0003468	348544	100938	2	1	0	28	7295100	
LA0005258	348544	100984	2	1	0	28	7295100	
LA0007561	0	2	4	0	0	0	0	
LA0007927	120	24	1	1	30	22	8028000	
MD0021687	291	40	1	2	0	24	1595800	
ME0001872	1812	456	1	1	0	23	1021000	
ME0001937	3152	1563	1	1	0	23	1054500	
ME0002003	5678	2672	1	1	0	23	1034500	
ME0002020	8404	3301	1	1	0	23	1034500	
ME0002054	2861	1427	1	1	0	23	1054500	
ME0002321	511	190	1	1	29	23	1064000	
ME0021521	4658	1628	2	1	0	23	1049265	

Appendix P. (continued)

NPDES	HMF in Ft3/sec	Q710 flow in Ft3/sec	Method	A	B	SC	GAGE	Footnote
MI0000027	569	172	1	1	54	26	4059000	
MI0027391	1507	704	1	1	0	26	4122000	
MI0042170	1888	482	1	1	0	55	4066000	
MN-------	0	0		0	0	0	0	1
MN0001643	11578	57	2	1	0	27	5133500	
MS0000213	348544	73	2	1	0	28	7295100	1
MS0002674	857	383	1	2	0	28	2479560	1
MS0031704	1527	464	2	1	0	28	2475000	1
MT0000035	2775	532	1	1	0	30	12353000	
NC0000272	292	60	1	1	68	37	3457000	
NC0000680	5303	443	1	1	0	37	2081000	1
NC0003191	1648	244	1	1	0	37	2089500	1
NC0003298	2294	536	1	1	0	37	2105769	1
NH0000655	2098	892	1	1	0	33	1054000	
NY0004413	0	0		0	0	0	0	
NY0005525	2594	483	1	2	0	36	1318500	
OH0004481	253	90	1	1	43	39	3234000	1
OR0000795	132932	0	2	1	0	41	14105700	1
OR0001074	8252	2542	1	1	0	41	14166000	1
OR0020834	0	20	4	0	0	0	0	1
PA0002143	237	28	1	1	0	42	3028500	1
PA0008265	97	64	1	1	0	42	1556000	1
PA0008869	63	15	1	1	20	42	1574500	1
PA0008885	3517	542	2	1	0	42	1531500	
PA0026301	0	0		0	0	0	0	1
SC0000868	281	10	3	1	39	37	2133500	1
SC0001015	2531	934	1	1	0	45	2146000	1
SC0038121	3691	580	1	1	0	45	2148315	1
TN0001643	1499	499	1	1	0	47	3487500	1
TN0002356	2179	968	1	1	0	47	3566000	1
TX0000167	244	224	2	1	43	48	7344210	
TX0001643	196	2	1	1	29	48	8037000	
TX0003891	1476	288	1	1	0	48	8041000	
TX0006041	0	0		0	0	0	0	
TX0053023	105	2	2	2	25	48	8074000	
VA0003115	403	63	1	1	0	51	1673000	
VA0003646	95	69	1	1	34	51	2013000	1
VA0004162	211	43	1	1	54	51	2049500	
WA0000078	132932	0	2	1	0	41	14105700	1
WA0000124	132932	0	2	1	0	41	14105700	1
WA0000256	132932	0	2	1	0	41	14105700	1
WA0000621	0	0		0	0	0	0	1
WA0000795	0	0		0	0	0	0	1
WA0000809	0	0		0	0	0	0	1
WA0000850	2428	815	1	1	0	53	1210500	1
WA0001091	88	4	2	1	62	53	12203500	1
WA0003000	0	8	4	0	0	0	0	1
WA0003077	0	0		0	0	0	0	1

Appendix P. (continued)

NPDES	HMF in Ft3/sec	Q710 flow in Ft3/sec	Method	A	B	SC	GAGE	Foot-note
WA0003697	0	0		0	0	0	0	1
WI0000663	625	67	1	1	0	55	4069500	
WI0001261	0	0		0	0	0	0	
WI0003212	319	274	2	1	0	55	5357500	
WI0003379	2195	927	2	1	0	55	5395000	
WI0020991	2959	322	1	1	0	55	4084500	
WI0030651	0	0		0	0	0	0	
WI0037991	3115	1158	2	1	0	55	5400760	

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[1] Stream flow or dilution data actually used was supplied by the U.S. EPA regional contact.

APPENDIX Q

Appendix Q.
Mill Specific Fish Filet Concentrations from the National Bioaccumulation Study

COMPANY	CITY	NPDES NUMBER	ANAL TYPE[2]	TCDD FILET CONC. (ng/Kg)	TCDD NON-DET.[3]	TCDF FILET CONC. (ng/Kg)	TEQ FILET CONC. (ng/Kg)	% TCDD IN TEQ
Region I								
Georgia-Pacific Corp.	Woodland	ME0001872	W	0.00E+00	ND	NO DATA	0.00E+00	ERR
International Paper Co.	Jay	ME0001937	W	2.05E+01		1.04E+02	3.09E+01	66
Lincoln Pulp and Paper	Lincoln	ME0002003	F	5.00E+00		NO DATA	5.00E+00	100
James River Corp.	Old Town	ME0002020	W	3.99E+00		2.03E+01	6.01E+00	66
Boise Cascade Corp.	Rumford	ME0002054	W	8.04E+00		5.34E+01	1.34E+01	60
Scott Paper Co.	Westbrook	ME0002321	W	2.60E+00		NO DATA	2.60E+00	100
Scott Paper Co.	Hinckley	ME0021521	W	3.20E+00		NO DATA	3.20E+00	100
James River Corp.	Berlin	NH0000655	W	3.91E+00		4.06E+01	7.97E+00	49
Region II								
International Paper Co.	Ticonderoga	NY0004413	W	4.80E-01		3.33E+00	8.13E-01	59
Finch & Pruyn & Co., Inc.	Glen Falls	NY0005525	W	9.45E-01		1.24E+01	2.18E+00	43
Region III								
Westvaco Corp.	Luke	MD0021687	W	2.91E+01		8.56E+01	3.77E+01	77
Penntech Papers, Inc.	Johnsonburg	PA0002143	F	3.55E+00		3.89E+00	3.94E+00	90
Appleton Papers, Inc.	Roaring Springs	PA0008265	W	8.55E-01		1.54E+01	2.39E+00	36
P.H. Glatfelter Co.	Spring Grove	PA0008869	W	2.95E-01		3.89E+00	6.84E-01	43
Procter & Gamble Co.	Mehoopany	PA0008885	F	6.50E-01		5.60E-01	7.06E-01	92
International Paper[4]	Erie	PA0026301	F	4.95E-01		2.40E-01	5.19E-01	95
Chesapeake Corp.	West Point	VA0003115	W	1.23E+00		1.66E+00	1.40E+00	88
Westvaco Corp.	Covington	VA0003646	W	2.70E+01		3.01E+01	3.01E+01	90
Union Camp Corp.	Franklin	VA0004162	W	9.20E-01		3.40E-01	9.54E-01	96
Region IV								
Champion International	Courtland	AL0000396	F	0.00E+00	ND	NO DATA	0.00E+00	ERR
Container Corp. of America	Brewton	AL0002682	W	2.75E-01		2.25E-01	2.98E-01	92
Boise Cascade Corp.	Jackson	AL0002755	F	4.30E+00		NO DATA	4.30E+00	100
International Paper Co.	Mobile	AL0002780	W	8.30E+00		NO DATA	8.30E+00	100
Scott Paper Co.	Mobile	AL0002801	W	4.42E+00		7.31E+00	5.15E+00	86
Gulf States Paper Corp.	Demopolis	AL0002828	F	2.20E+00		NO DATA	2.20E+00	100
International Paper Co.	Selma	AL0003018	F	2.20E+00		NO DATA	2.20E+00	100
Kimberly-Clark Corp.	Coosa Pines	AL0003158	W	1.50E+01		6.62E+00	1.57E+01	96
James River Corp.	Butler	AL0003301	F	3.00E+00		NO DATA	3.00E+00	100
Alabama River Pulp	Claiborne	AL0025968	F	1.61E+01		3.45E+01	1.95E+01	82
ITT-Rayonier, Inc.	Fernandina Beach	FL0000701	W	3.15E-01		1.48E+00	4.63E-01	68
Buckeye Cellulose	Perry	FL0000876	W	6.60E+00		2.04E+01	8.63E+00	76
Champion International	Cantonment	FL0002526	W	1.20E+01		3.92E+00	1.24E+01	97
Stone Container Corp.	Panama City	FL0002631	W	1.57E+00		8.10E-01	1.65E+00	95
Georgia-Pacific Corp.	Palatka	FL0002763	F	0.00E+00	ND	1.30E-01	1.30E-02	0
St. Joe Paper Co.	Port St. Joe	FL0020206	W	1.75E+00		3.55E-01	1.79E+00	98
Gilman Paper Co.	St. Marys	GA0001953	W	1.77E+00		2.44E+00	2.01E+00	88
Federal Paper Board Co.	Augusta	GA0002801	W	2.25E+00		1.10E+01	3.35E+00	67
ITT-Rayonier, Inc.	Jesup	GA0003620	W	2.31E+00		4.45E+00	2.75E+00	84
Brunswick Pulp and Paper	Brunswick	GA0003654	W	2.01E+01		4.61E+00	2.06E+01	98
Buckeye Cellulose	Oglethorpe	GA0049336	F	2.60E+00		2.10E+00	2.81E+00	93
Westvaco Corp.	Wickliffe	KY0000086	W	2.38E+00		3.40E+00	2.71E+00	87
Willamette Industries	Hawesville	KY0001716	W	2.21E+00		3.28E+00	2.54E+00	87
International Paper Co.	Natchez	MS0000213	W	1.54E+00		4.15E+00	1.96E+00	79
International Paper Co.	Moss Point	MS0002674	W	1.72E+01		9.03E+00	1.81E+01	95
Leaf River Forest Products	New Augusta	MS0031704	W	4.94E+01		5.09E+00	4.99E+01	99
Champion International	Canton	NC0000272	W	3.79E+01		7.20E+01	4.50E+01	84
Weyerhaeuser Co.	Plymouth	NC0000680	W	7.17E+01		1.04E+02	8.21E+01	87
Weyerhaeuser Co.	New Bern	NC0003191	W	2.46E+01		1.37E+02	3.83E+01	64
Federal Paper Board Co.	Riegelwood	NC0003298	W	1.12E+01		1.67E+00	1.13E+01	99
International Paper Co.	Georgetown	SC0000868	W	5.21E+01		1.31E+01	5.34E+01	98
Bowater Corp.	Catawba	SC0001015	W	7.66E+00		2.06E+00	7.86E+00	97
Union Camp Corp.	Eastover	SC0038121	W	4.55E+00		5.22E+00	5.07E+00	90
Mead Corporation	Kingsport	TN0001643	F	0.00E+00	ND	1.51E+00	1.51E-01	0
Bowater Corp.	Calhoun	TN0002356	W	1.99E+00		2.16E+00	2.20E+00	90
Region V								
Mead Corporation	Escanaba	MI0000027	W	5.81E+00		7.32E+00	6.54E+00	89
Scott Paper Co.	Muskegon	MI0027391	W	1.73E+00		4.27E+00	2.16E+00	80

Appendix Q. (continued)

COMPANY	CITY	NPDES NUMBER	ANAL. TYPE[2]	TCDD FILET CONC. (ng/Kg)	TCDD NON-DET.[3]	TCDF FILET CONC. (ng/Kg)	TEQ FILET CONC. (ng/Kg)	% TCDD IN TEQ
Champion International	Quinnesec	MI0042170	W	1.05E+01		8.46E+00	1.14E+01	93
Potlatch Corp.	Cloquet	MN-------	W	0.00E+00		NO DATA	0.00E+00	ERR
Boise Cascade Corp.	International Falls	MN0001643	W	1.63E+01		3.76E+01	2.01E+01	81
Mead Corp.	Chillicothe	OH0004481	W	7.38E+00		3.07E+00	7.68E+00	96
Badger Paper Mills, Inc.	Peshtigo	WI0000663	W	4.27E+00		1.75E+01	6.02E+00	71
James River Corp.	Green Bay	WI0001261	W	1.96E+00		4.40E+00	2.40E+00	82
Pentair, Inc.	Park Falls	WI0003212	F	5.00E-01		2.75E-01	5.28E-01	95
Wausau Paper Mills Co. #1	Brokaw	WI0003379	W	0.00E+00	ND	1.33E+00	1.33E-01	0
Nekoosa Papers, Inc.	Nekoosa & Pt. Edwards	WI0003620	W	3.36E+01		1.76E+01	3.54E+01	95
James River Corp.	Green Bay	WI0020991	W	1.96E+00		4.40E+00	2.40E+00	82
Weyerhaeuser Co.	Rothchild	WI0026042	W	2.28E+00		5.55E+00	2.84E+00	80
Badger Paper Mills, Inc.	Peshtigo	WI0030651	W	4.27E+00		1.75E+01	6.02E+00	71
Consolidated Papers, Inc.	Wisconsin Rapids	WI0037991	W	3.36E+01		1.76E+01	3.54E+01	95
Region VI								
Georgia-Pacific Corp.	Crosset	AR0001210	W	1.81E+00		3.48E+00	2.16E+00	84
International Paper Co.	Pine Bluff	AR0001970	W	1.69E+01		1.60E+01	1.85E+01	91
Nekoosa Papers, Inc.	Ashdown	AR0002968	W	2.09E+00		8.31E+00	2.92E+00	72
Potlatch Corp.	McGhee	AR0035823	W	2.37E+00		2.09E+00	2.58E+00	92
James River Corp.	St. Francesville	LA0003468	F	1.83E+00		1.80E-01	1.85E+00	99
Georgia-Pacific Corp.	Zachary	LA0005258	F	1.83E+00		1.80E-01	1.85E+00	99
International Paper Co.	Bastrop	LA0007561	W	5.89E+01		1.31E+02	7.20E+01	82
Boise Cascade Corp.	Deridder	LA0007927	W	6.85E+00		3.83E+00	7.23E+00	95
International Paper Co.	Texarkana	TX0000167	W	3.30E-01		7.35E-01	4.04E-01	82
Champion International	Lufkin	TX0001643	F	9.40E-01		8.00E-01	1.02E+00	92
Temple-Eastex, Inc.	Evadale	TX0003891	W	2.05E-01		2.75E-01	2.33E-01	88
Simpson Paper Co.	Pasadena	TX0006041	F	6.70E+00		1.41E+01	8.11E+00	83
Champion International	Houston	TX0053023	NO SAMPLE					
Region VIII								
Stone Container Corp.	Missoula	MT0000035	W	0.00E+00	ND	1.49E+00	1.49E-01	0
Region IX								
Stone Container Corp.	Snowflake	AZ-------	NO SAMPLE					
Simpson Paper Co.	Anderson	CA0004065	F	1.17E+01		1.07E+02	2.24E+01	52
Gaylord Container Corp.	Antioch	CA0004847	W	1.74E+00		1.79E+01	3.52E+00	49
Simpson Paper Co.	Fairhaven	CA0005282	NO SAMPLE					
Louisiana Pacific Corp.	Samoa	CA0005894	NO SAMPLE					
Region X								
Alaska Pulp Corp.	Sitka	AK0000531	F	0.00E+00	ND	2.60E-01	2.60E-02	0
Ketchikan Pulp & Paper #1	Ketchikan	AK0000922	W	0.00E+00	ND	3.13E-01	3.13E-02	0
Potlatch Corp.	Lewiston	ID0001163	F	7.40E-01		2.75E+00	1.02E+00	73
Boise Cascade Corp.	St. Helens	OR0000752	W	1.29E+00		5.69E+00	1.85E+00	69
James River Corp.	Clatskanie	OR0000795	F	1.73E+00		2.16E+01	3.89E+00	44
Pope & Talbot, Inc.	Halsey	OR0001074	F	4.58E+00		1.61E+01	6.19E+00	74
Weyerhaeuser Co.	Longview	WA0000124	W	2.62E+00		1.42E+01	4.04E+00	65
Longview Fibre Co.	Longview	WA0000078	W	2.62E+00		1.42E+01	4.03E+00	65
James River Corp.	Camas	WA0000256	F	1.14E+00		1.20E+01	2.34E+00	49
Scott Paper Co. #1	Everett	WA0000621	W	7.85E-01		5.79E+00	1.36E+00	58
ITT-Rayonier, Inc.	Port Angeles	WA0000795	W	0.00E+00	ND	7.20E-01	7.20E-02	0
Weyerhaeuser Co.	Cosmopolis	WA0000809	W	2.25E-01		4.54E+00	6.79E-01	33
Simpson Paper Co.	Tacoma	WA0000850	F	5.67E+00		2.07E+02	2.63E+01	22
Georgia-Pacific Corp.	Bellingham	WA0001091	W	0.00E+00	ND	4.90E-01	4.90E-02	0
Weyerhaeuser Co.	Everett	WA0003000	W	7.85E-01		5.79E+00	1.36E+00	58
ITT-Rayonier, Inc.	Hoquiam	WA0003077	F	0.00E+00	ND	1.90E+00	1.90E-01	0
Boise Cascade Corp.	Wallula	WA0003697	W	2.80E+01		1.60E+02	4.40E+01	64

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1 Based on 2378-TCDD concentration or the 2378-TCDF concentration alone when one was not available.

2 W=Sample was analyzed on a whole fish basis. F=Sample was analyzed on a filet only basis. When data based on a filet was not available, 1/2 the whole body value was presented as the filet concentration; 1/2 the whole body value also was presented as a filet if the given filet value was less than 1/2 whole body value.

3 ND represents nondetection of TCDD. All TCDF concentrations were above detection limits.

4 a.k.a. Hammermill papers.

APPENDIX R

Table R.1
COMPARISON OF ASSUMPTIONS USED FOR ADOPTED STATE DIOXIN HUMAN HEALTH CRITERIA (T = DERIVED BY TRANSLATOR PROCERURE)

State	Biocon-centration Factor	Fish Cons Rate g/day	Cancer Slope mg/kg/day	Risk Level	CRITERIA Wat + Fish	CRITERIA Fish Only	CRITERIA Water Only
AK	5,000	6.5	156,000	10-6	0.013 ppq	0.014 pp	
AL	5,000	6.5	17,500	10-5		1.2 ppq	
CA	5,000	23	156,000	10-6		0.0039 ppq	
CO	5,000		156,000	10-6			0.22 ppq
DE	5,000	37	156,000	10-6		0.0024 ppq	
Ga	5,000	6.5		10-5		7.2 ppq	
GU	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
HI	5,000	19.9	156,000	10-6		0.005 ppq	
IL (T)		20		10-6			
IN	5,000	6.5	156,000	10-5	0.1 ppq	0.1 ppq	
MD	5,000	6.5	17,500	10-5		1.2 ppq	
ME	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
MI (T)	51,000	6.5	156,000	10-5	0.014 ppq		
MO	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
MT	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
NC	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
NE	5,000	6.5	156,000	10-5	0.13 ppq	0.14 ppq	
NY						1 ppq	
OH	5,000	6.5	156,000	10-5	0.13 ppq	0.14 ppq	
OR	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
PA (T)	5,000	6.5	156,000	10-6	0.01 ppq		
SD	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
VA	5,000	6.5	17,500	10-5		1.2 ppq	
WI	5,000	20	156,000	10-5	0.03 ppq		

In addition to the parameters listed above, many States also use different approaches for calculating stream flow for use in the development of dioxin human health criteria. These approaches include use of the harmonic mean, average or mean annual flows.

Source: EPA, 1990

Table R.2
COMPARISON OF ASSUMPTIONS USED FOR PROPOSED STATE DIOXIN HUMAN HEALTH CRITERIA (T = DERIVED BY TRANSLATOR PROCEDURE)

State	Biocon-centration Factor	Fish Cons Rate g/day	Cancer Slope mg/kg/day	Risk Level	CRITERIA		
					Wat + Fish	Fish Only	Water Only
AS	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
CA	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
FL	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
KY	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
MN (T)	230,000	30	156,000	10-5	0.00061 ppq		
TN				10-6		1 ppq	
WY	5,000	6.5	156,000	10-6	0.013 ppq		

In addition to the parameters listed above, many States also use different approaches for calculating stream flow for use in the development of dioxin human health criteria. These approaches include use of the harmonic mean, average or mean annual flows.

Source: EPA, 1990

TABLE R.3
COMPARISON OF ASSUMPTIONS USED FOR EXPECTED STATE DIOXIN HUMAN HEALTH CRITERIA (T = DERIVED BY TRANSLATOR PROCEDURE)

State	Biocon-centration Factor	Fish Cons Rate g/day	Cancer Slope mg/kg/day	Risk Level	CRITERIA		
					Wat + Fish	Fish Only	Water Only
AR							
AZ	5,000	6.5	156,000	10-6	0.01 ppq		
CM	5,000	6.5	156,000	10-6	0.013 pp1	0.014 ppq	
CT	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
ID	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
KS	5,000	6.5	156,000	10-6	0.013 pp1	0.014 ppq	
MA	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
ND	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
NH	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
RI	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
TT	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
TX							
UT	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
VT	5,000	6.5	156,000	10-6	0.013 ppq	0.014 ppq	
WA							

In addition to the parameters listed above, many States also use different approaches for calculating stream flow for use in the development of dioxin human health criteria. These approaches include use of the harmonic mean, average or mean annual flows.

Source: EPA, 1990

EXECUTIVE SUMMARY

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA), acting under a consent decree with the Environmental Defense Fund and the National Wildlife Federation, assessed both human health and environmental risks from the contaminants 2,3,7,8-tetrachloro dibenzo-*p*-dioxin (2378-TCDD) and 2,3,7,8-tetrachloro dibenzofuran (2378-TCDF) that are discharged from 104 pulp and paper mills located in the United States using chlorine or its derivatives to bleach pulp. As a part of this program, the Office of Water Regulations and Standards (OWRS) was responsible for estimating the potential human health and aquatic life risks associated with exposures via surface water pathways based on mill-specific effluent sample results.

This report presents a generalized uniform approach for assessing impacts from the discharges of the 104 mills to support the decision by EPA to either regulate or not regulate discharges of 2378-TCDD and 2378-TCDF from pulp and paper mills that use chlorine to bleach pulp. It should be noted that in some respects, the approach for assessing risks presented in this report may differ from approaches used by the States. For example, States may use different cancer potency factors (either FDA's or their own), fish consumption rates, or bioconcentration factors. In some cases States do not use models to predict risks, but rather use actual fish tissues data. In other cases, States do not use the "toxicity equivalence" procedure as a means of predicting the combined risk from 2378-TCDD and 2378-TCDF as was used in this report. As a result of the differences in approaches taken by various States for assessing risks and the approach presented in this report, estimated risks may be over- or underestimated in comparison to the States' adopted or proposed water quality standards. A summary of State assumptions used to develop 2378-TCDD water quality standards is presented in Appendix R.

Effluent sampling results for each of the 104 pulp and paper mills were provided by the joint EPA/paper industry 104-mill study. The 104-mill data, however, are now over two years old, and since the time the 104-mill study was conducted, conditions at some mills may have changed due to mills taking actions to install or incorporate activities identified as necessary to reduce the formation of dioxins or furans, or more recent information may be available that would alter some of the exposure and risk estimates developed in the present study. However, because this study was designed to provide a snapshot of exposure and risk estimates at one point in time, for the most part, no attempt was made to include effluent data from sources other than the 104-mill study. The only exception to the use of 104-mill study effluent data was the use of plant flow data for several mills that were provided by the EPA Regions and which differed from the flow values identified in the 104-mill study.

The purpose of this analysis was to develop estimates of exposures and risks to human health and aquatic life associated with 2378-TCDD and 2378-TCDF discharges from chlorine-bleaching pulp and paper mills. This study was not designed to rank the exposure or human health and aquatic life risks associated with specific mills, but rather to estimate the risk potential posed by the entire chlorine-bleaching pulp and paper industry. This analysis focused on the highest estimated in-stream contaminant concentrations immediately downstream of each mill discharge point (assuming steady-state, fully mixed conditions) and the potential human health impacts resulting from the consumption of 2378-TCDD and 2378-TCDF contaminated fish and drinking water associated with these exposures. Because no comprehensive studies on 2378-TCDD and 2378-TCDF build-up in sediments and bioaccumulation up the food chain exist, only the water column was investigated as a potential route of exposure and uptake of 2378-TCDD and 2378-TCDF by fish. However, a sensitivity analysis is presented to look at bioconcentration in fish both before and after particulate 2378-TCDD and 2378-TCDF settle to the sediment. Carcinogenic and non-carcinogenic effects in humans were considered, as were potential adverse effects to aquatic life.

One result of this analysis is an understanding of the potential upper bound human cancer risk to a hypothetically exposed individual eating contaminated fish and drinking contaminated water near the mills. These results are presented as the estimated risk of cancer incidence during the exposed individual's lifetime. No attempt was made to characterize or estimate the human population potentially at risk. For these risk estimations, reasonable worst-case ambient and effluent characterizations were used, as well as best estimates of the physical and chemical properties of 2378-TCDD and 2378-TCDF. Because not all of the parameter values used in this assessment are "worst case," the hypothetically exposed individual is not considered the "most exposed individual."

Long-term animal studies of 2378-TCDD have provided clear evidence that the contaminant is an animal carcinogen (Kociba et at., 1978; NTP, 1982a; NTP, 1982b). Based on these animal studies as well as other considerations, EPA has concluded that 2378-TCDD should be regarded as a probable human carcinogen (U.S. EPA, 1985). EPA has assigned 2378-TCDD a qualitative weight-of-evidence designation of "B2" for its carcinogenic potential. This designation indicates that 2378-TCDD is an agent for which there is sufficient evidence of carcinogenicity based on animal studies but inadequate data regarding its carcinogenicity from human epidemiologic studies (U.S. EPA, 1986).

APPROACH

In this investigation, two approaches were used to estimate and compare exposures to 2378-TCDD and 2378-TCDF resulting from surface water effluent discharges from pulp and paper mills. The first approach consisted of a simple dilution calculation conducted to estimate the in-stream concentration of the contaminants after the effluent is mixed with the receiving water. This calculation assumes 100% of the in-stream contaminants (both dissolved and adsorbed to suspended solids) are bioavailable. In the second approach, the Exposure Assessment Modeling System (EXAMS II) was used to partition in-stream steady-state concentrations of the contaminants between dissolved and particulate forms. EXAMS II is able to account for the high affinity of 2378-TCDD and 2378-TCDF for solids and, therefore, the likelihood that a percentage of the contaminants will be associated with suspended and benthic solids. It is assumed that the particulate form of the contaminants will not be available for uptake across fish gills nor available to humans through ingestion of contaminated drinking water.

Both the simple dilution and EXAMS II approaches were used to estimate and compare the potential human health risks associated with ingestion of contaminated fish tissue and drinking water. Since the simple dilution approach assumes 100% of the in-stream contaminants to be bioavailable to fish, this approach effectively includes exposure through uptake across fish gills (dissolved form) as well as through ingestion of suspended solids (particulate form). The simple dilution approach is also considered to represent the upper bound for bioaccumulation since a bioconcentration factor based on dissolved contaminants was applied to the particulate contaminants as well. In the EXAMS II model analysis, however, only the dissolved contaminant concentration is assumed to be bioavailable to fish.

Although EXAMS II predicts contaminant concentrations associated with both suspended and benthic solids, no attempt was made to separately estimate fish exposure to contaminants associated with suspended particulates, bed sediments, or the food chain. These exposure routes were not directly addressed due to a lack of adequate information concerning the bioaccumulation of these contaminants through the food chain and the sediment-to-fish partition coefficient needed to predict uptake through contact with contaminated sediments. In addition, it is generally believed that 2378-TCDD and 2389-TCDF tend to adsorb to very fine suspended sediments which would be transported out of the immediate area of the discharge and therefore beyond the area under consideration. (These sediment-associated contaminants would, however, pose a potential risk to fish inhabiting those areas further downstream where the fine sediments are eventually deposited.) For these reasons, and because uptake of 2378-TCDD and 2378-TCDF through the water column has been more thoroughly investigated, exposure to dissolved contaminants in the water column was the basis for estimating fish tissue contamination using the EXAMS II approach.

Using exposure estimates from both approaches (simple dilution and EXAMS II water column), fish tissue contaminant residue levels were estimated by employing fish bioconcentration factors (BCFs) for 2378-TCDD

and 2378-TCDF. From fish tissue contaminant concentrations, average daily lifetime exposures (or chronic daily intake, CDI) for humans consuming 6.5, 30 and 140 g/day were calculated. These calculations took into consideration factors that adjust for lower contaminant concentrations in fish muscle (filet) and fatty/oily food bioavailability in humans of 95% of oral exposure. Receiving water concentrations were also used to estimate the average daily lifetime 2378-TCDD and 2378-TCDF exposure associated with drinking water ingestion, assuming a 2 L/day consumption rate.

Multiplying average daily lifetime doses by the EPA carcinogenic potency factor for 2378-TCDD yielded a conservative (upper bound) estimate of the expected rate of cancer incidence above background incidence rates due to 2378-TCDD exposure. Combined 2378-TCDD/-TCDF cancer risk was estimated using the "toxicity equivalence" (TEQ) procedure, in which the cancer potency of 2378-TCDF is assumed to be one tenth that of 2378-TCDD. It should be noted that, although in this report TEQ represents only the contributions of 2378-TCDD and 2378-TCDF to risk, there are likely to be additional risk contributions from other chlorinated dibenzo-p-dioxins and furans associated with discharges from chlorine-bleaching pulp and paper mills. However, 2378-TCDD and 2378-TCDF account for greater than 90% of the TEQ from chlorinated dioxins and furans found in the effluents of these mills.

Mill-specific contaminant concentration estimates were also used to calculate the exposure level associated with a single ingestion of a 0.25 lb. (115 g) contaminated fish portion. This dose was evaluated against a 2378-TCDD Health Advisory threshold value for protection against liver effects, estimated by EPA for this investigation following appropriate guidelines.

The mill-specific, simple dilution contaminant concentrations for 7Q10 low flow receiving water conditions (based on the lowest consecutive seven-day average flow during any ten-year period) were compared to EPA's preliminary chronic exposure levels for the protection of aquatic life to predict whether chronic toxicity to aquatic organisms from 2378-TCDD and 2378-TCDF would result under the assessment scenarios.

ASSUMPTIONS USED IN ANALYSIS

The following is a list of assumptions used in this investigation:

1) Mill-specific, five-day effluent composite contaminant concentrations collected during the 104-mill study were multiplied by mean plant flow rates to determine contaminant load. This resulting load to the receiving stream was assumed to be continuous. The representativeness of the sample effluent as reflecting long-term mill operations is unknown; since then, the mills may have made plant process or operation changes to reduce dioxin and furan formation. This assumption may overestimate human health and aquatic life risks.

2) The highest estimated steady-state in-stream concentrations in the immediate downstream vicinity of the discharges (assuming fully mixed conditions) were considered for fish exposure. Fish are likely to move in and out of the area of maximum concentration, but these estimates assumed that fish remain exposed to the highest concentration. Consequently, this assumption is likely to overestimate fish exposure and overestimate human health and aquatic life risks.

3) Receiving water stream flow rates for estimating human health risks were calculated using the harmonic mean of historic flow measurements from nearby stream gaging stations. 7Q10 receiving water flow rates were used for estimating aquatic life impacts. These flows may not be the same as those used by specific States to assess risks. Therefore, these assumptions may over- or underestimate risks compared to State assumptions.

4) Three bioconcentration factor (BCF) values were used for estimating 2378-TCDD and 2378-TCDF concentrations in edible fish tissue (the filet): two for 2378-TCDD and one for 2378-TCDF. The resulting fish tissue concentrations were used to estimate human exposure to the contaminants through consumption of fish tissue. For 2378-TCDD, a BCF of 5,000 was used in combination with a human consumption rate of fish tissue of 6.5 g/day, and a BCF of 50,000 was used in combination with consumption rates of 30 g/day and 140 g/day. The 6.5 g/day fish tissue consumption

rate in combination with the BCF of 5,000 reflects the assumptions in EPA's ambient water quality criterion for 2378-TCDD and 2378-TCDF and is considered a reasonable estimate for an average consumer of locally-caught fish. The 30 and 140 g/day consumption rates in combination with the BCF of 50,000 are used as sensitivity comparisons and represent more extreme exposure scenarios for recreational and subsistence fishermen or other high rate consumers of fish. A single BCF for 2378-TCDF of 1,950 was used in combination with each of the three consumption rates. BCFs are species-specific and highly variable. This study did not take species variability or degree of bioconcentration into account. Also, actual fish consumption rates vary by locale. State assumptions for BCF, consumption rates, and also cancer potency may vary from those used in this assessment. Therefore, this assessment may overestimate or underestimate risks compared to State assessments.

5) A drinking water ingestion rate of 2L/day was used to estimate human exposures through ingestion of contaminated drinking water. It was assumed that the water consumed was taken from the point of highest in-stream pollutant concentration after the effluent was fully mixed in the receiving stream, and no treatment of the water was undertaken to remove contaminants prior to ingestion. This assumption likely overestimates human health risks from drinking water.

6) Fish tissue bioavailability for humans was assumed to be 95% of oral dose. Contaminants in water were assumed to be 100% bioavailable to both fish and humans. This reflects the most current information EPA has on bioavailability, but the assumptions may overestimate the risk to humans.

7) Fish were assumed to be exposed to contaminants only in the water column. No food chain or sediment associated exposures were considered, other than for the simple dilution method in which the total in-stream contaminant level (both dissolved and adsorbed to suspended solids) were bioavailable.

8) The estimates of risk apply only to a hypothetically exposed individual in the immediate vicinity of the mills, and not to the entire population of fish consumers.

SUMMARY OF RESULTS

The results of the human health risk and aquatic life impact analyses for the 104 mills included in this investigation are summarized below. It should be noted that sufficient information was not available for all of the mills to allow complete evaluation and comparison of results for each of the 104 facilities. For example, for several of the mills discharging to open waters (i.e., lakes, open ocean), no information was available on receiving stream zone of initial dilution, which was necessary for calculating effluent dilution. For a few other mills, data were questioned as to their accuracy and new samples were being taken, but the results of the new sample evaluations were not available for inclusion in this study. In addition, for some facilities, there was sufficient information to predict risks based on the simple dilution method, but insufficient information to predict risk based on the EXAMS II method. Also, either harmonic mean flow or 7Q10 flow data were not available for several facilities.

Cancer Risk Associated with Consumption of Contaminated Fish Tissue

Figures A through D present the predicted distribution of the number of mills for which discharges would result in a given range of estimated upper bound lifetime cancer risks to the hypothetically exposed individual due to the consumption of contaminated fish tissue based on the simple dilution exposure assessment method and the EXAMS II water column exposure assessment method.

The results of calculations using the 6.5 g/day fish tissue consumption rate in combination with the BCF of 5,000 reflect the assumptions in EPA's ambient water quality criterion for dioxin and are considered reasonable exposures for average consumers of locally-caught fish. The results of these calculations are presented separately from the results of calculations using the 30 and 140 g/day consumption rates and BCF of 50,000, which are considered more extreme exposure scenarios (for example, for recreational and subsistence fishermen) to be used for sensitivity comparisons.

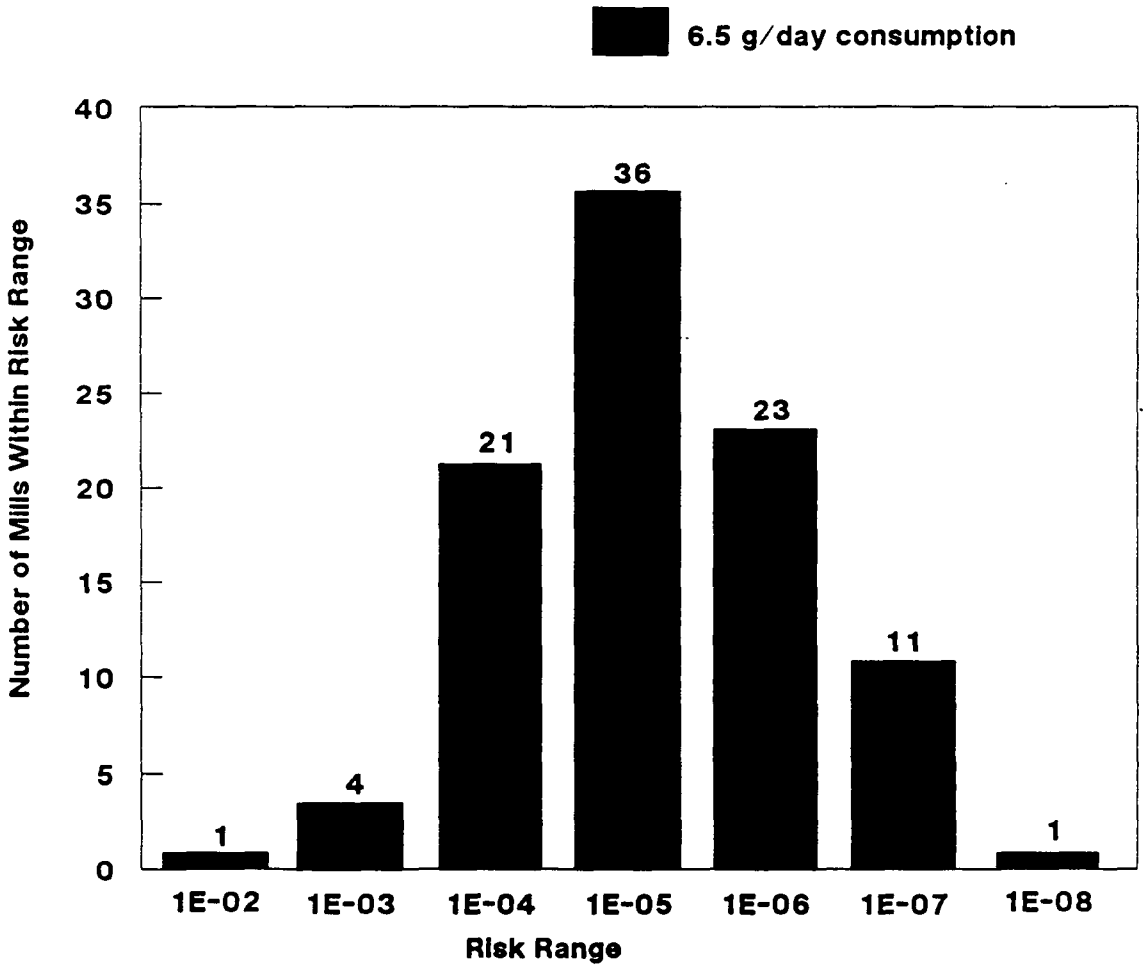

Figure A. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the simple dilution method (6.5 g/day consumption rate and BCF of 5,000 for 2378-TCDD*).

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-4	1E-5	1E-6	1E-7
TCDD	2	7	4	3
TCDF		1		1
TCDD & TCDF		2	2	1

*** Recent laboratory evidence indicates that a BCF higher than 5,000 for 2378-TCDD (e.g., 50,000) more accurately reflects uptake of 2378-TCDD by fish. Use of a BCF of 50,000 for 2378-TCDD would increase risk by an order of magnitude.**

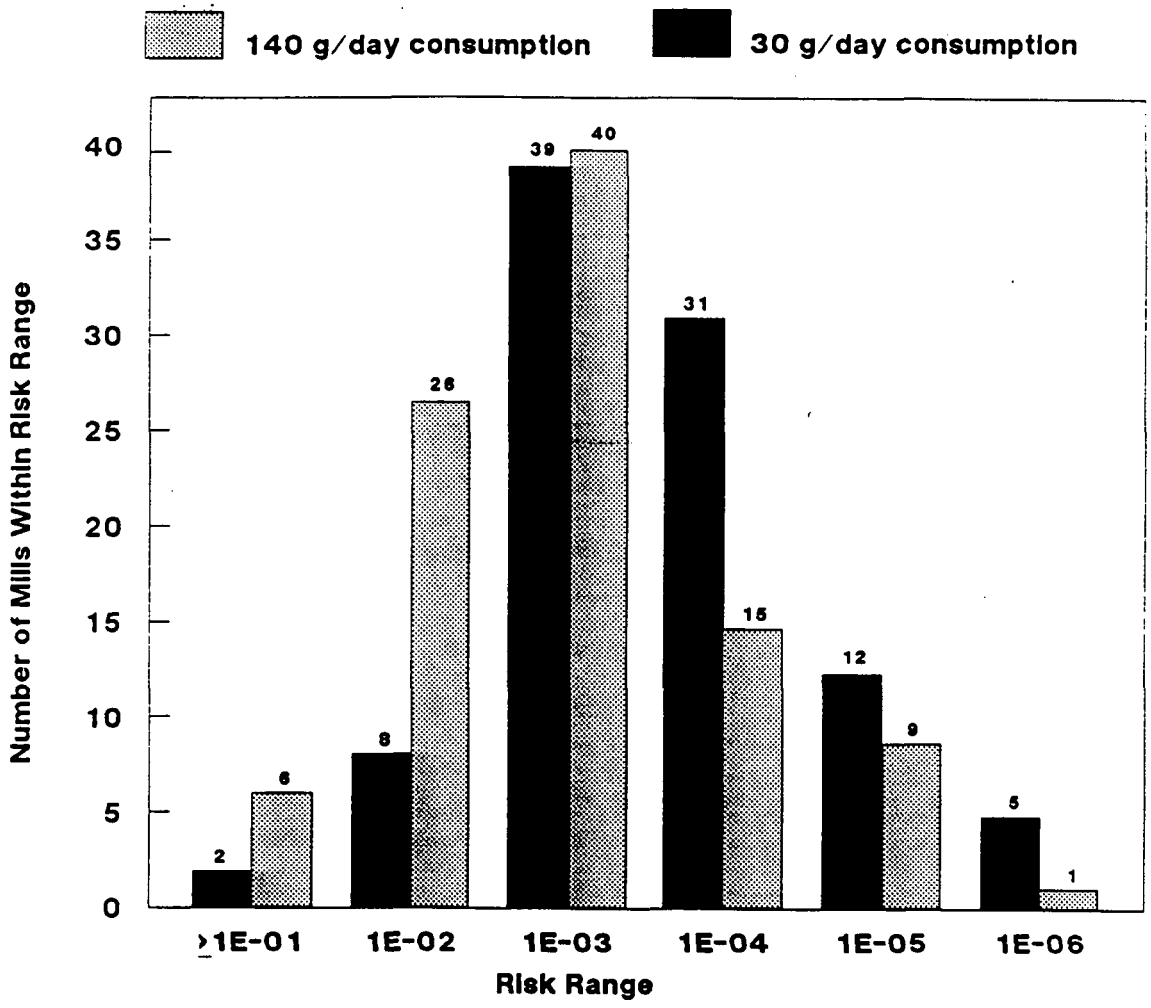

Figure B. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the simple dilution method (30 and 140 g/day consumption rates and BCF of 50,000 for 2378-TCDD).

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-2	1E-3	1E-4	1E-5	1E-6
30g/day					
TCDD		7	4	3	2
TCDF		1		1	
TCDD & TCDF		1	3		1
140g/day					
TCDD	4	4	5	3	
TCDF		1	1		
TCDD & TCDF		3	1	1	

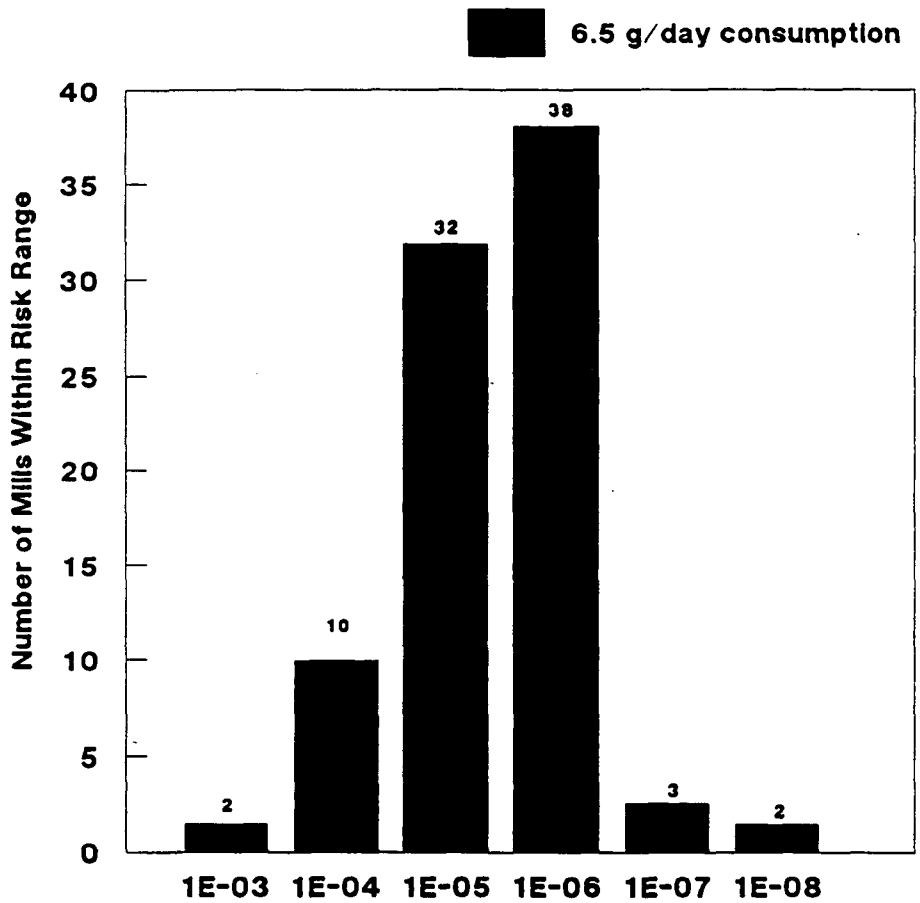

Figure C. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the EXAMS II method (6.5 g/day consumption rate and BCF of 5,000 for 2378-TCDD*).

Notes:

Total number of mills evaluated = 87.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-4	1E-5	1E-6	1E-7	1E-8
TCDD	1	8	5	2	1
TCDF		1		1	
TCDD & TCDF		1	3		1

*** Recent laboratory evidence indicates that a BCF higher than 5,000 for 2378-TCDD (e.g., 50,000) more accurately reflects uptake of 2378-TCDD by fish. Use of a BCF of 50,000 for 2378-TCDD would increase risk by an order of magnitude.**

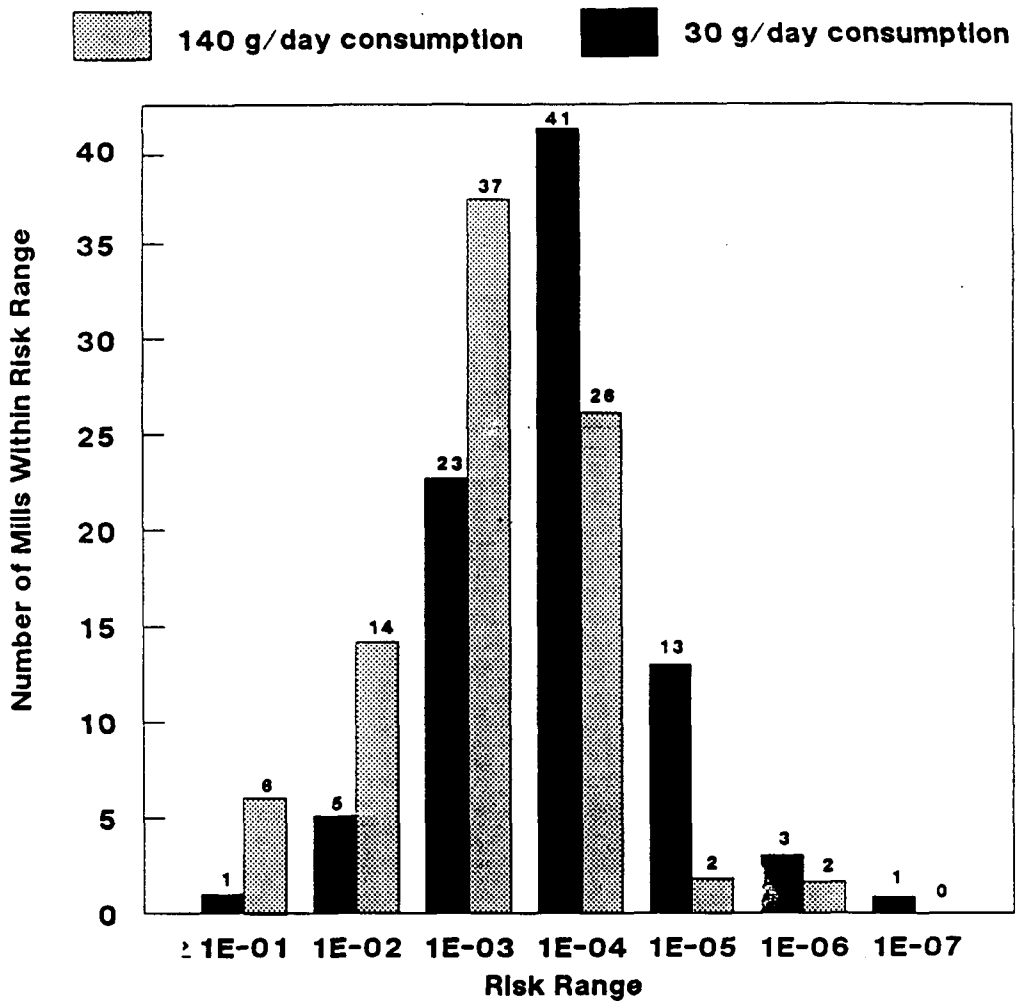

Figure D. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the consumption of contaminated fish tissue as estimated by the EXAMS II method (30 and 140 g/day consumption rates and BCF of 50,000 for 2378-TCDD).

Notes:

Total number of mills evaluated = 87.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-2	1E-3	1E-4	1E-5	1E-6	1E-7
30g/day						
TCDD		4	6	2	2	
TCDF			1		1	
TCDD & TCDF			2	2		1
140g/day						
TCDD	1	7	4	1	1	
TCDF		1		1		
TCDD & TCDF		1	3		1	

1. Simple Dilution Exposure Assessment Method

Using the simple dilution exposure assessment estimates, the 6.5 g/day fish tissue consumption rate, and fish filet contaminant concentrations based on a BCF of 5,000 for 2378-TCDD, the upper bound mill-specific cancer rates for the hypothetically exposed individual ranged from the 10^{-2} to 10^{-8} risk levels (Figure A). Risk levels associated with discharges from 80 of the 97 mills evaluated (82%) fell within the 10^{-4} to 10^{-6} risk levels, with 36 mills within the 10^{-5} risk level.

Mill-specific cancer rate estimates using the 30 g/day fish tissue consumption rate and fish filet contaminant concentrations based on a BCF of 50,000 ranged from the $\geq 10^{-1}$ to 10^{-6} risk levels (Figure B). Seventy of the 97 mills (72%) were associated with risk levels between 10^{-3} to 10^{-4}, and 39 of these 70 fell within the 10^{-3} range. Using the 140 g/day fish tissue consumption rate and fish filet contaminant concentrations based on the 50,000 BCF, risk levels ranged from $\geq 10^{-1}$ to 10^{-6} (Figure B). Sixty-six out of the 97 mills (68%) were associated with risk levels between 10^{-2} to 10^{-3}, with 40 within the 10^{-3} range.

2. EXAMS II Exposure Assessment Method

Mill-specific upper bound cancer rate estimates for the hypothetically exposed individual using the EXAMS II water column exposure assessment method, 6.5 g/day fish tissue consumption rates, and fish filet contaminant concentrations based on a BCF of 5,000 for 2378-TCDD ranged from the 10^{-3} to 10^{-8} risk levels (Figure C). Seventy of the 87 mills evaluated (80%) were associated with risk levels between 10^{-5} (32 mills) to 10^{-6} (38 mills).

Using the 30 g/day consumption rate and fish filet contaminant concentrations based on the 50,000 BCF, mill-specific cancer rates ranged from the 10^{-1} to 10^{-7} risk levels (Figure D). Sixty-four of the 87 mills (74%) were associated with risk levels within the 10^{-3} to 10^{-4} range, and 41 of these fell within the 10^{-4} range. Cancer rate estimates using the 140 g/day fish tissues consumption rate and 50,000 BCF ranged from the $\geq 10^{-1}$ to 10^{-6} risk levels (Figure D). Sixty-three of the 87 mills (72%) were associated with risk levels between the 10^{-3} and 10^{-4} range, and 37 of these fell within the 10^{-3} range.

Cancer Risks Associated with Ingestion of Contaminated Drinking Water

Figures E and F present the distribution of the number of mills for which discharges were estimated to result in a given range of upper bound lifetime cancer risks to the hypothetically exposed individual due to the ingestion of contaminated drinking water. Only those facilities discharging to fresh water lakes, rivers, and streams were included in this analysis. No discharges to marine or estuarine waters were included, since these water bodies would not be used as drinking water sources.

Use of the simple dilution method estimated that the cancer risks associated with the 69 mills evaluated ranged from the 10^{-4} to 10^{-9} risk levels (Figure E). The greatest percentage of these mills (44, or 64%) were associated with risk levels within the 10^{-6} (23 mills) to 10^{-7} (21 mills) range. Use of the EXAMS II water column method estimated that the risk levels associated with the 64 mills evaluated would range from the 10^{-5} to 10^{-9} levels (Figure F). Fifty of these mills (78%) were associated with risk levels between the 10^{-6} (18 mills) to 10^{-7} (32 mills) range.

Non-Cancer (Short-Term Exposure) Risks

Figures G through H present the distribution of the number of mills for which discharges would result in a given range of human dose due to the single portion consumption of 115 grams of contaminated fish tissue. The concentrations of fish tissue contaminants used for this assessment were based on a BCF of 50,000 for 2378-TCDD and 1,950 for 2378-TCDF in the edible portion of the fish (the filet). Results are reported in pg/kg/day for comparison to a one-day Health Advisory for protection against liver effects (100 pg/kg/day), estimated by EPA for this investigation.

Based on the simple dilution method results (Figure G), the dose associated with discharges from 25 out of 97 mills evaluated (27%) would equal or exceed the one-day HA dose for protection from liver effects (100

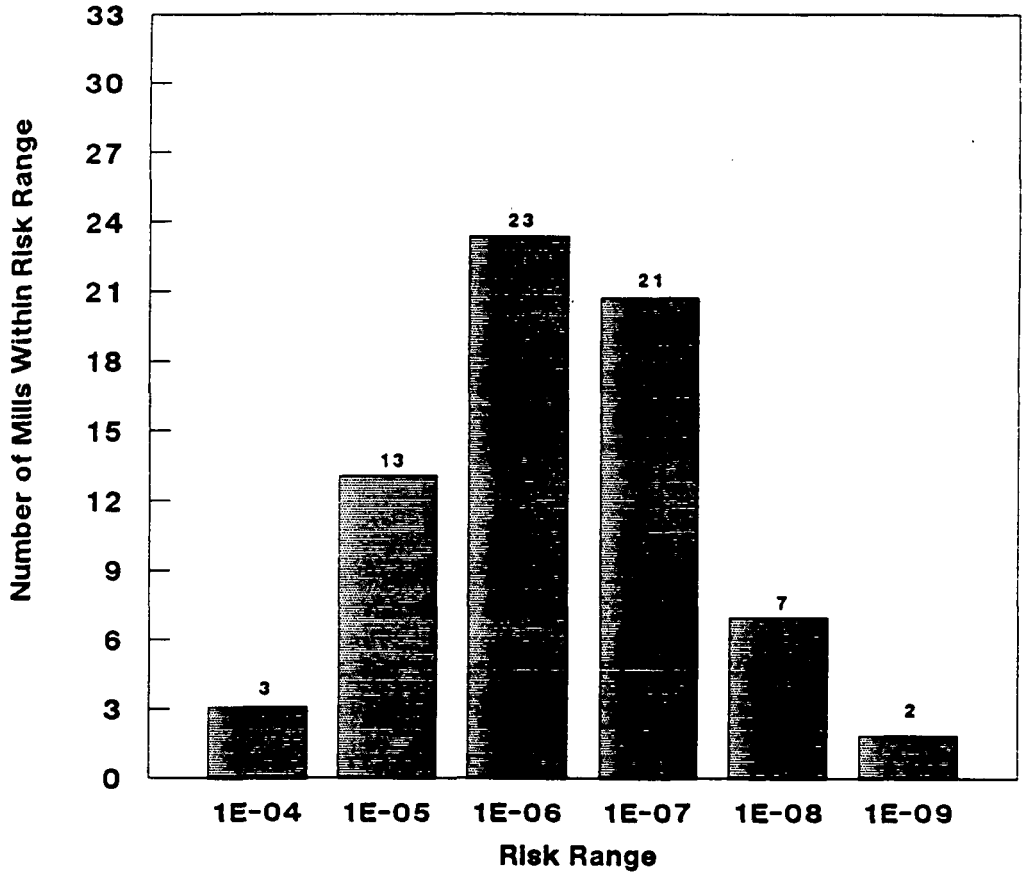

Figure E. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the ingestion of contaminated drinking water as estimated by the simple dilution method.

Notes:

Total number of mills evaluated = 69.

Combined 2378 -TCDD/-TCDF risk predicted using TEQ.

Based on a 2 L/day ingestion rate.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-5	1E-6	1E-7	1E-8	1E-9
TCDD	1	3	3	3	
TCDF		1		1	
TCDD & TCDF		1	2		1

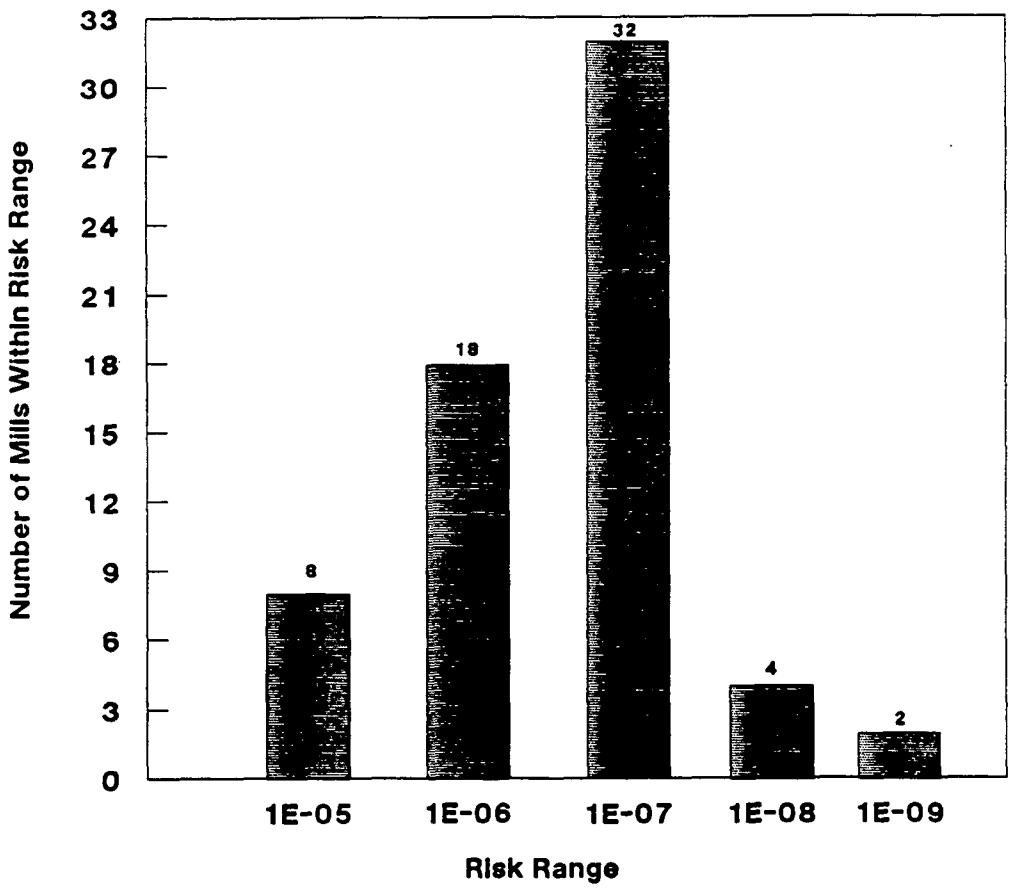

Figure F. Distribution of the number of mills for which discharges would result in a given range of lifetime cancer risk due to the ingestion of contaminated drinking water as estimated by the EXAMS II method.

Notes:
Total number of mills evaluated = 64.
Combined 2378 -TCDD/-TCDF risk predicted using TEQ.
Based on a 2 L/day ingestion rate.

Number of mills within risk ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore risk estimates are based on effluent concentrations of 1/2 the detection limit:

	1E-5	1E-6	1E-7	1E-8	1E-9
TCDD	1	2	4	2	1
TCDF			1	1	
TCDD & TCDF			3	1	1

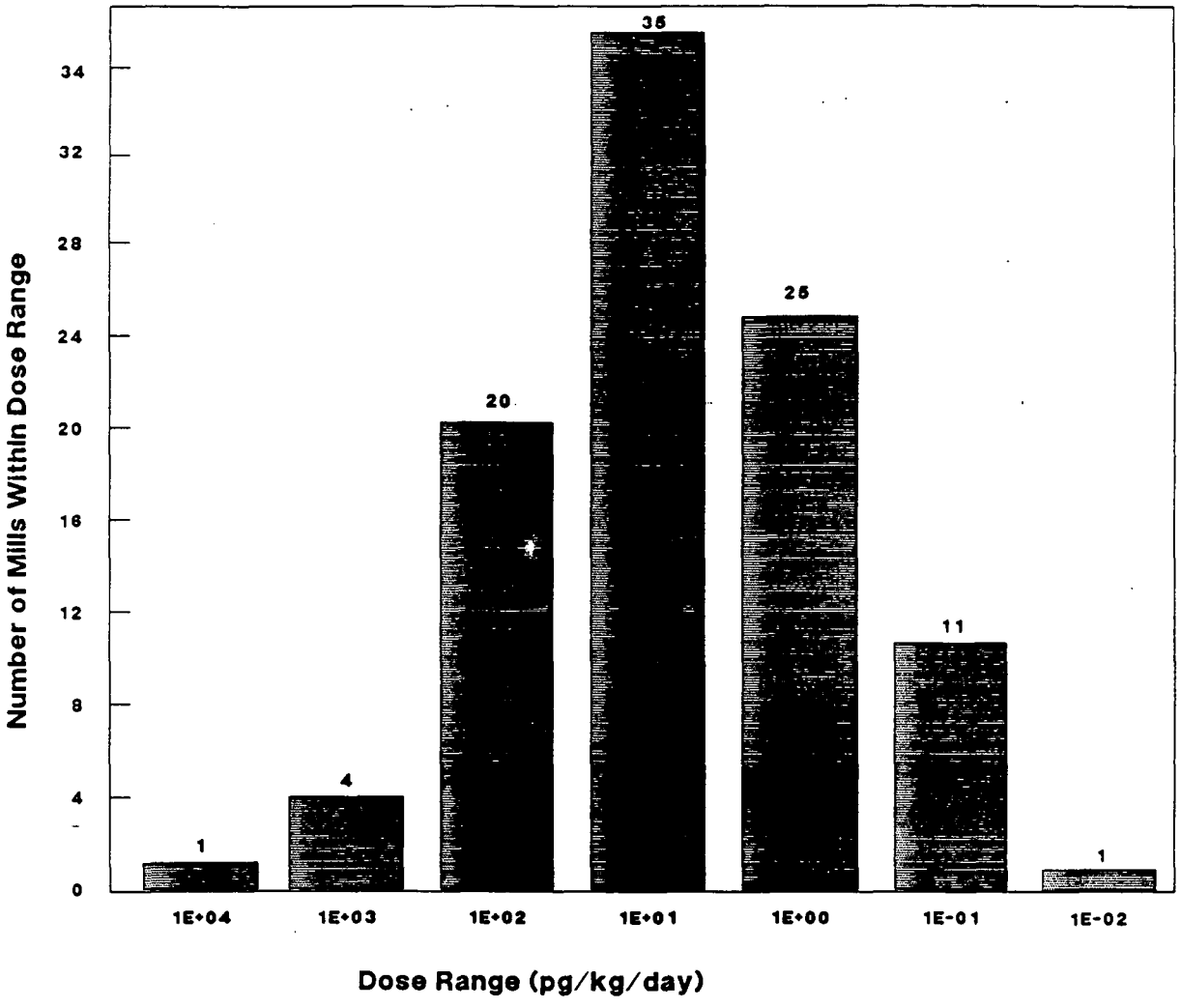

Figure G. Distribution of the number of mills for which discharges would result in a given range of human doses from a one-time exposure to contaminated fish tissue as estimated by the simple dilution method.

Notes:

Total number of mills evaluated = 97.

Combined 2378 -TCDD/-TCDF dose predicted using TEQ.

Based on the consumption of a single 115 g portion of contaminated fish tissue and using a fish filet BCF of 50,000 for 2378-TCDD.

Number of mills within dose ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore dose estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+1	1E+0	1E-1
TCDD	1	7	4	3
TCDF		1		1
TCDD & TCDF		2	3	1

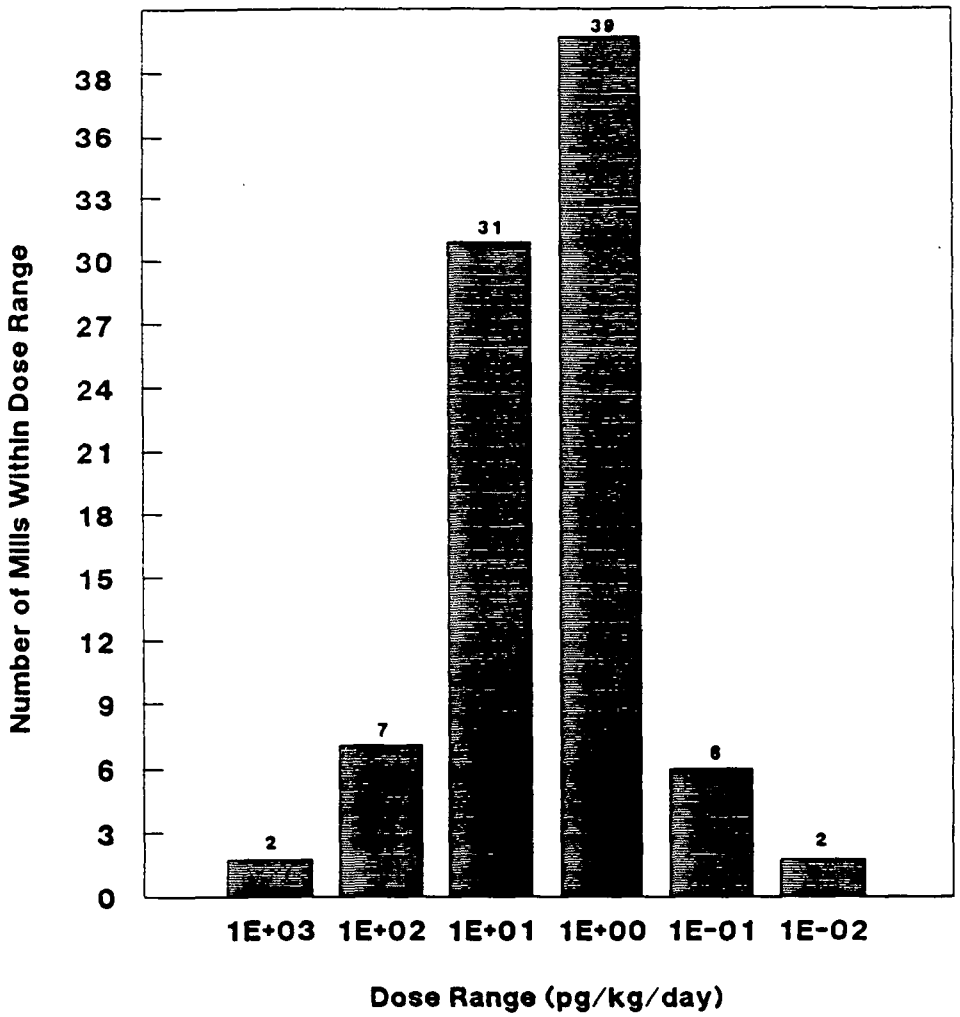

Figure H. Distribution of the number of mills for which discharges would result in a given range of human doses from a one-time exposure to contaminated fish tissue as estimated by EXAMS II method.

Notes:

Total number of mills evaluated = 87.

Combined 2378 -TCDD/-TCDF dose predicted using TEQ.

Based on the consumption of a single 115 g portion of contaminated fish tissue and using a fish filet BCF of 50,000 for 2378-TCDD

Number of mills within dose ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore dose estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+1	1E+0	1E-1	1E-2
TCDD	1	5	5	2	1
TCDF		1		1	
TCDD & TCDF		1	3	1	1

pg/kg/day). Use of the EXAMS II method (Figure H) estimates that the dose associated with discharges from 9 mills out of 87 (10%) would equal or exceed the 100 pg/kg/day dose level.

Aquatic Life Impacts

Aquatic life impacts were estimated based on a comparison of predicted in-stream concentrations of 2378-TCDD and 2378-TCDF (in pg/l) to EPA's preliminary chronic exposure levels for the protection of aquatic life (0.038 pg/l for 2378-TCDD and 0.41 pg/l for 2378-TCDF). The simple dilution method, using 7Q10 low flow conditions, predicted that water column concentrations of 2378-TCDD immediately downstream of 80 out of 90 mills (89%) would exceed the chronic exposure level of 0.038 pg/l (Figure I). Seventy-four mills (82%) would exceed the 0.41 pg/l level for 2378-TCDF.

DISCUSSION OF RESULTS

The results of this study indicate that, taking into consideration the effects of the assumptions and simplifications used in this analysis, there is a potential for high level contamination of the water column by 2378-TCDD and 2378-TCDF from the effluent discharges of many of the chlorine-bleaching pulp and paper mills investigated. For each of the mills analyzed, use of the simple dilution exposure assessment method resulted in higher estimated water column contaminant concentrations and greater estimated aquatic life impacts and human health risks than the EXAMS II water column method. This is because the simple dilution method assumes that all contaminants in the water column, both dissolved and adsorbed to suspended solids, are bioavailable. The EXAMS II water column method, on the other hand, only considers those contaminants in the dissolved phase. In those cases where the receiving water TSS (total suspended solids) was relatively low, the simple dilution and EXAMS II water column results are comparable. When suspended solids concentrations were high, however, the EXAMS II water column method estimated risks significantly lower than those predicted by the simple dilution method. Therefore, for those water bodies included in this study with relatively high suspended solids content, the EXAMS II water column method likely underestimated human health risk from consumption of contaminated fish tissues, since fish exposure to sediment-adsorbed contaminants was not considered.

The primary reason for ignoring the exposure routes through contaminated sediments using EXAMS II was the lack of acceptable and appropriate fish bioaccumulation factors for this exposure scenario as well as the tendency for the contaminants to associate with the very fine sediment fraction which is typically transported and deposited well downstream of the immediate discharge vicinity. As a check and a sensitivity comparison on this approach, however, the results of the simple dilution calculation are considered to provide an upper bound on fish tissue contaminant levels.

In addition to the absence of consideration of sediment and food chain exposure routes in the EXAMS II method, a number of other simplifications and assumptions have influenced the results of this study, including the selection and use of BCFs and fish tissue ingestion rates for the evaluation. BCFs are highly variable depending on the species, and this study did not take into account inter-species variability in the rate and degree of contaminant bioconcentration. Actual fish tissue consumption rates also vary over time, with individuals, and in different parts of the country. For example, risk estimates based on the 6.5 g/day consumption rate and fish filet BCF of 5,000 for 2378-TCDD were established on the basis of EPA's water quality criteria assumptions. The 6.5 g/day rate applies to a national average consumption rate of fish and shellfish; however, this rate may not be representative of fish consumption rates for recreational or subsistence fishermen. Also, the 50,000 BCF for 2378-TCDD used in conjunction with fish consumption rates of 30 and 140 g/day for recreational and subsistence fishermen was based on the assumption that only the filet portion of the fish is consumed. However, some subpopulations of subsistence fishermen and certain ethnic groups eat whole fish and crabs in which the concentration of contaminants is likely to be higher than in the filet alone. Therefore, the use of a 50,000 BCF for 2378-TCDD may underestimate risks to these subpopulations.

It should also be noted that, if multiple discharges to the same waterbody are present, the actual risk associated with a waterbody may be substantially greater than estimated in this study. For example, there are several chlorine-bleaching pulp and paper mills that discharge to the Columbia River basin. Calculations

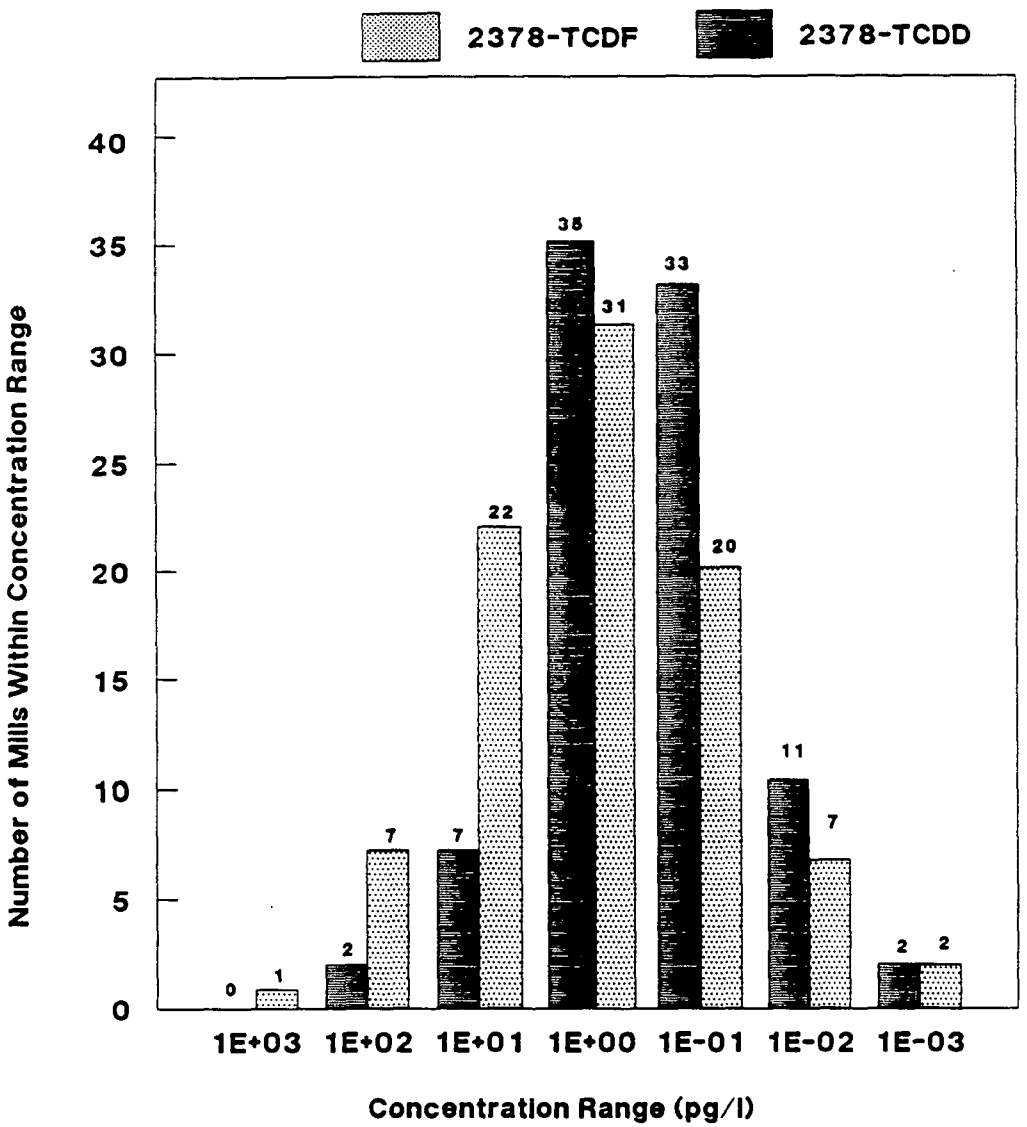

Figure I. Distribution of the number of mills for which discharges would result in a given range of water column contaminant concentrations as estimated by the simple dilution method using 7Q10 low flow conditions.

Notes:
Total number of mills evaluated = 90.
Estimates based on 7Q10 flow values for receiving waters.

Number of mills within concentration ranges for which 2378-TCDD and/or 2378-TCDF were not detected in the effluent and therefore water column concentration estimates are based on effluent concentrations of 1/2 the detection limit:

	1E+2	1E+0	1E-1	1E-2	1E-3
TCDD		5	9	5	1
TCDF	1	2	2	2	1

in this report assume that each mill discharges to a receiving stream with no background level of contamination. Therefore, in the case of multiple discharges to a receiving stream, estimating risks from one mill alone can result in a significant underestimate of risk.

Finally, no assessment of local fish patterns or actual commercial or recreational fishing practices were conducted as part of this evaluation. Therefore, it is not known whether or not commercially or recreationally valuable species occur or are taken in the vicinity of the discharges that were included in this evaluation.

A comparison of predicted cancer versus non-cancer human health risk was also conducted to determine which of the two end points is the most sensitive. Cancer health risks were estimated to occur for more mills than non-cancer risks. The results also indicate a potentially greater risk of cancer due to the consumption of contaminated fish tissue than through the ingestion of contaminated drinking water. It should be pointed out that this conclusion may only be true for the hypothetically exposed individual and may not be true for the entire exposed population. Determining which exposure route poses the greatest risk to the entire population would require knowledge of the number of persons eating contaminated fish tissue versus the number of persons who use contaminated surface water as a drinking water source. More of the population would likely be exposed to a single dose of contaminated fish tissue than to a lifetime of exposure to contaminated fish tissue or drinking water taken from the vicinity of certain mills. Such a population assessment was not conducted for this investigation.

Each of the exposure assessment approaches used in this analysis predict upper bound risks that should be carefully considered by risk managers while assessing potential impacts associated with the discharge of 2378-TCDD and 2378-TCDF in chlorine-bleaching pulp and paper mill effluents.

ERRATA SHEET

Changes in results for the International Paper Co. mill in Texarkana, TX (TX0000167) have been made based on comments received from EPA Region VI. These comments were received after the final document had been reproduced.

EPA region VI indicated that this mill does not discharge throughout the entire year, but rather discharges intermittently from October to May. Therefore, the receiving stream harmonic mean and 7Q10 flows used to calculate instream concentration (which were based on a year-round discharge) were incorrect. The revised Tables C-K which follow present the corrected results for the two samples taken from this mill using the revised harmonic mean and 7Q10 flows (for the months October - May) for the receiving stream. These changes, which are relatively minor, have not resulted in any changes to the main text of the document.

Errata Sheet for Table C.1
Raw Input Data

NPDES NUMBER	SAMPLEID	COMPANY	CITY	GRP ID	HARMONIC MEAN FLOW (m^3/hr.)	7Q10 LOW FLOW (m^3/hr.)	TSS IN MILL EFFLUENT (mg/l)	ADJ TSS* IN RECG WATERS (HARM MEAN Q) (mg/l)	PLANT FLOW (mgd)	TCDD CONC. (ppq)	TCDD NON-DETECT	TCDD LOAD (kg/hr)	TCDF CONC. (ppq)	TCDF NON-DETECT	TCDF LOAD (kg/hr)
TX0000167	M99EC	International Paper Co.	Texarkana	1	30603	4893	494.9	0.7	38.36	13		7.9E-08	43		2.6E-07
TX0000167	M99EC1	International Paper Co.	Texarkana	1	30603	4893	494.9	0.7	38.36	18		1.1E-07	44		2.7E-07

*The present EXAMS II runs were made using an in-stream TSS value of 9.6 mg/l, which is the combined in-stream and effluent TSS concentration. This value was used due to the calculation of harmonic mean flow for this mill using the sum of stream and plant flow. As described in Appendix B, Section B.2.2. of this report, if the mill discharge exceeded 5% of the average stream flow at the mill, then the mill discharge flow was added to the area-adjusted stream flow values prior to calculating the harmonic mean. During earlier assessments of this mill, EXAMS II failed to run using the low instream TSS concentration that resulted from adjustment for annual harmonic mean flow. For these runs, an in-stream TSS concentration based on average annual water flow was used (22 mg/l).

Errata Sheet for Appendix D.
In-stream Contaminant Concentrations in pg/l

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DETECT	TCDF NON-DETECT	SIMPLE DILTUTION TCDD CONC.	SIMPLE DILTUTION TCDF CONC.	EXAMS WATER COLUMN TCDD CONC.	EXAMS WATER COLUMN TCDF CONC.
International Paper Co.	Texarkana	M99EC	TX0000167	1			2.15E+00	7.10E+00	8.18E-01	7.05E+00
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2.97E+00	7.26E+00	1.13E+00	7.21E+00

Errata Sheet for Appendix E.
In-stream Contaminant Concentrations for Low (7Q10) Flow Conditions Calculated by Simple Dilution Only

COMPANY	CITY	NPDES NUMBER	SAMPLEID	GRP ID	TCDD NON-DETECT	TCDF NON-DETECT	7Q10 FLOW (m^3/hr)	TCDD CONC. (pg/l)	TCDF CONC. (pg/l)	TEQ CONC. (pg/l)
International Paper Co.	Texarkana	TX0000167	M99EC	1			4893	7.18E+00	2.37E+01	9.55E+00
International Paper Co.	Texarkana	TX0000167	M99EC1	1			4893	9.94E+00	2.43E+01	1.24E+01

Errata Sheet for Appendix F.
Fish Filet Tissue Residue Levels (ng/kg)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	SIMPLE DILUTION: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	SIMPLE DILUTION: TCDF FILET CONC.	SIMPLE DILUTION: TEQ FILET CONC.	SIMPLE DILUTION: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	SIMPLE DILUTION: TCDF FILET CONC.	SIMPLE DILUTION: TEQ FILET CONC.	EXAMS WATER COLUMN: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	EXAMS WATER COLUMN: TCDF FILET CONC.	EXAMS WATER COLUMN: TEQ FILET CONC.	EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	EXAMS WATER COLUMN: TCDF FILET CONC.	EXAMS WATER COLUMN: TEQ FILET CONC.
International Paper Co.	Texarkana	M99EC	TX0000167	1			1.07E+01	1.38E+01	1.21E+01	1.07E+02	1.38E+01	1.09E+02	4.09E+00	1.37E+01	5.46E+00	4.09E+01	1.37E+01	4.23E+01
International Paper Co.	Texarkana	M99EC1	TX0000167	1			1.49E+01	1.42E+01	1.63E+01	1.49E+02	1.42E+01	1.50E+02	5.67E+00	1.41E+01	7.08E+00	5.67E+01	1.41E+01	5.81E+01

Errata Sheet for Appendix G.
Average daily lifetime 95% Bioavailable Dose in mg/kg/day of 2378-TCDD and 2378-TCDF as TEQ from Fish Ingestion

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	DOSE: SIMPLE DILUTION — TCDD BCF FILET=5,000, TCDF, 1,950 @ 6.5 g/day	SIMPLE DILUTION @ 30 g/day	SIMPLE DILUTION @ 140 g/day	DOSE FROM EXAMS WATER COLUMN — TCDD BCF FILET=5,000, TCDF, 1,950 @ 6.5 g/day	EXAMS WATER COLUMN @ 30 g/day	EXAMS WATER COLUMN @ 140 g/day
							SIMPLE DILUTION: TCDD BCF=50,000, TCDD,BCF=1,950			EXAMS WATER COLUMN: TCDD BCF=50,000, TCDD,BCF=1,950		
International Paper Co.	Texarkana	M99EC	TX0000167	1			1.1E-09	4.4E-08	2.1E-07	4.8E-10	1.7E-08	8.0E-08
International Paper Co.	Texarkana	M99EC1	TX0000167	1			1.4E-09	6.1E-08	2.8E-07	6.2E-10	2.4E-08	1.1E-07

Errata Sheet for Appendix H.
Mill Specific Dose (pg/kg/day) from Drinking Water at Ingestion of 2 Liters per Day

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	SIMPLE DILUTION: DRINKING WATER DOSES — TCDD	SIMPLE DILUTION: TCDF	SIMPLE DILUTION: TEQ	EXAMS WATER COLUMN: DRINKING WATER DOSES — TCDD	EXAMS WATER COLUMN: TCDF	EXAMS WATER COLUMN: TEQ
International Paper Co.	Texarkana	M99EC	TX0000167	1			6.1E-11	2.0E-10	8.2E-11	2.3E-11	2.0E-10	4.4E-11
International Paper Co.	Texarkana	M99EC1	TX0000167	1			8.5E-11	2.1E-10	1.1E-10	3.2E-11	2.1E-10	5.3E-11

Errata Sheet for Appendix I.
Mill Specific Unit Risk[1] from Fish Ingestion

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	SIMPLE DILUTION: TCDD FILET BCF=5,000[2] TCDF FILET BCF=1,950 — TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	SIMPLE DILUTION: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 — TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ	EXAMS WATER COLUMN: TCDD FILET BCF=5,000[2] TCDF FILET BCF=1,950 — TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 — TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ
International Paper Co.	Texarkana	M99EC	TX0000167	1			1E-04	2E-04	89	7E-03	7E-03	3E-02	3E-02	99	6E-05	8E-05	75	3E-03	3E-03	1E-02	1E-02	97
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2E-04	2E-04	91	1E-02	9E-03	4E-02	4E-02	99	8E-05	1E-04	80	4E-03	4E-03	2E-02	2E-02	98

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[1] U.S. EPA weight-of-the-evidence classification "B2" (US EPA, 1986a)

[2] Recent laboratory evidence indicates that use of a BCF of 50,000 would more accurately reflect the uptake of 2378-TCDD by fish. Therefore, risk estimates based on a fish filet BCF of 5,000 may underestimate risks by an order of magnitude.

Errata Sheet for Appendix J.
Mill Specific Unit Risk[1] from Drinking Water Ingestion @ 2 Liters per Day

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	SIMPLE DILUTION: TEQ DRINK. WATER RISK	% TCDD RISK IN TEQ	EXAMS WATER COLUMN: TEQ DRINK. WATER RISK	% TCDD RISK IN TEQ
International Paper Co.	Texarkana	M99EC	TX0000167	1			1E-05	75	7E-06	54
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2E-05	80	8E-06	61

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[1] U.S. EPA weight-of-the-evidence classification "B2" (US EPA, 1986a)

Errata Sheet for Appendix K.
Mill Specific Human Dose[1] from a Single 115 Gram (1/4 Pound) Fish Ingestion (in pg/kg/day) for Comparison with the TCDD Health Advisory[2] for Protection from Liver Effects

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	SIMPLE DILUTION: BCF TO FILET TCDD=5,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE	BCF TO FILET TCDD=50,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE	EXAMS WATER COLUMN: BCF TO FILET TCDD=5,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE	BCF TO FILET TCDD=50,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE
International Paper Co.	Texarkana	M99EC	TX0000167	1			1.7E+01	1.9E+01	1.7E+02	1.7E+02	6.4E+00	8.5E+00	6.4E+01	6.6E+01
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2.3E+01	2.5E+01	2.3E+02	2.3E+02	8.8E+00	1.1E+01	8.8E+01	9.1E+01

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[1] Dose is the bioavailable (95%) portion of exposure.
[2] Health Advisory Level = 100 pg/kg/day.

INFORMATION PACKET FOR

RISK ASSESSMENT FOR 2378-TCDD AND 2378-TCDF

CONTAMINATED RECEIVING WATERS FROM

U.S. CHLORINE-BLEACHING PULP AND PAPER MILLS

Contents:

SUMMARY OF POTENTIAL RISKS POSED BY PULP AND PAPER MILL DISCHARGES TO SURFACE WATERS

EPA recently completed a multi-media risk assessment designed to estimate the potential human health and aquatic life impacts caused by dioxin contamination in surface water resulting from the manufacture of chlorine-bleached pulp and paper. This summary of the surface water portion of the risk assessment is designed to explain how the study was conducted, what it showed, and what EPA is doing in response to the findings.

What is Dioxin?

Dioxin is a general term for a group of 75 related chemical compounds. It is an unwanted by-product created by the manufacture of some chemical products, by certain combustion processes, and by treating wood pulp with chlorine bleaching to make white paper. Dioxin can accumulate in tissue of fish, other wildlife, and humans. Dioxin has been shown to cause cancer, liver damage, and other toxic effects, based on animal testing. EPA classifies dioxin as a "probable human carcinogen (B2)."

How Was the Study Done?

First EPA and the paper industry jointly collected and analyzed samples of effluent from each of 104 mills that use the chlorine bleaching process to determine the actual concentration of dioxin in the effluent from the mills. With this information, EPA then estimated the concentration of dioxin that might be found in fish caught downstream of the paper mills. To make these estimates, EPA used a number of assumptions by selecting among a range of scientifically plausible values for key factors of the risk assessment.

For example, EPA had to select a bioconcentration factor (BCF), which represents the number of times the concentration of a chemical in fish exceeds the concentration of that chemical in water. Since data exist to support a range of BCFs, EPA presents risk estimates using two different BCFs. EPA also had to estimate such factors as the fate and transport characteristics of dioxin in the water environment, the percentage of time that fish are exposed to dioxin, and the amount of fish that the average consumer, or recreational or subsistence level fisherman, typically consume.

Once EPA estimated the concentration of dioxin in the fish caught downstream of the mills, it then calculated the increase in lifetime

cancer and non-cancer risks to consumers of fish caught downstream from the 104 mills. Risks were estimated for individuals with average fish consumption rates, as well as for recreational and subsistence fishers. EPA also estimated the potential for human liver toxicity and aquatic life effects, as well as effects from consumption of drinking water.

What Did the Study Show?

Results of the study indicate that there are potentially high risks to humans associated with eating fish caught downstream of a number of the paper mills. It estimates that dioxin levels downstream from some mills in the study may lead to contamination of fish to a level where there is an increased risk of average consumers developing cancer which is greater than one in ten thousand. The estimated cancer risk is greater for recreational and subsistence level fisherman because their estimated consumption of fish is higher than that of average consumers. Estimates also indicate that dioxin levels downstream of five mills may lead to contamination of fish to a level at which damage to liver tissue may occur after eating a single one-quarter pound meal. Aquatic life impacts, such as aberrations in growth, weight, and hatching, are predicted to occur downstream of many of the mills. Finally, study results indicate that the fish tissue exposure route poses a greater human cancer risk than does drinking water to the exposed individual.

What Does It Mean?

Results of the study indicate that, over a lifetime of consumption, there are potentially high risks associated with eating fish caught downstream of some chlorine-bleaching pulp and paper mills. Currently, States have issued fish consumption advisories near 22 of these particular mills. In addition, some of the data used in the study are now two years old, and States may have more recent or comprehensive data that indicate that discharges from some of these mills are not currently causing the same level of contamination.

What are EPA and the States Doing in Response?

While there is much uncertainty associated with the science of dioxin and with risk estimates, EPA is suggesting that States consider establishing fish consumption advisories for waterbodies near identified mills as soon as possible, or implementing site-specific monitoring programs to better evaluate the actual risks at these sites. In addition to these actions, EPA and the States are issuing permits with limits to control dioxin, many of which also include requirements for these mills to make changes that will reduce the use of chlorine.

EPA is also developing new technology-based standards to reduce dioxin contamination from manufacture of bleached paper products. In addition, EPA is undertaking a pollution prevention initiative that involves other Federal Agencies, States, industry, environmentalists and the international regulatory community.

DIOXIN RISK ASSESSMENT ISSUES PAPER

The scientific basis for EPA's assessment of risks to human health from emissions of dioxin has been the source of much confusion and debate for some time now. Recently, however, a number of new developments have placed the science in a state of flux. The following is a brief discussion of EPA's current position on some of these issues, as well as an indication where EPA may be headed.

HUMAN HEALTH EFFECTS

The multi-media risk assessment used the same carcinogenic potency factor used in EPA's 1984 ambient water quality criteria document: 1.6×10^{5} $(mg/kg/day)^{-1}$. Recently this potency has been questioned as a result of a reevaluation of the toxicity study results (rereading of the Kociba slides) according to new pathological guidelines, which are more discriminatory than past practices with regard to identifying carcinogenic lesions. By reducing the overall numbers of tumors counted in the study, the rereading of the slides reduced the risk numbers generated from this data set by a factor of 3 to 4.

This result is consistent with EPA's earlier judgment that 2,3,7,8-TCDD (dioxin) human health risk estimates, based on the animal data, represent plausible upper bounds on risk; true risk is likely to be less. The change suggested by the re-reading of the Kociba slides is less than an order of magnitude and is within EPA's level of uncertainty; therefore it does not warrant a change in EPA's potency factor at this time. EPA will, however, keep a close eye on the ongoing research, and may reevaluate this position in the next 18 to 24 months. In the meantime, EPA does not plan to change the potency estimate in its water quality criteria document.

CANCER RISK

In trying to estimate concentrations of dioxin in fish caught downstream of the mills, EPA relied on 1988 effluent data in its computer models. These estimates were updated with more recent fish tissue monitoring data provided by the EPA Regions. It is important to note that these monitoring data are **not** included in the surface water risk assessment report, but were used to create Table 1.

Table 1 lists sites where fish sampled in 1986-88 for EPA's National Bioaccumulation Study, or fish sampled more recently by the EPA Regional Offices, have concentrations of dioxin that are estimated to pose an increased cancer risk as high as one in 10,000 to one in 100 for persons consuming these fish over a lifetime. The one in 10,000 risk was selected as a possible level of concern because it corresponds to a dioxin concentration that is just below the level of concern for non-cancer effects of liver and reproductive toxicity. Table 1 risk estimates are based on EPA's 1984 water quality criterion assumptions regarding the dioxin potency factor and a fish consumption rate of 6.5 grams per day (e.g., two quarter-pound meals per month).

Because of the limited monitoring data on fish below the 104 mills, the surface water risk assessment for the multi-media study depends on modeling predictions of dioxin concentrations that could be expected in the fish. Table 2 lists sites where a simple dilution model predicts that dioxin concentrations measured in effluent in 1988 are estimated to contaminate fish to levels that, with a lifetime of exposure, would increase cancer risk to a range of one in 10,000 to one in 100. These risk estimates are based on EPA's water quality criterion assumptions regarding the dioxin potency factor, a 6.5 grams per day fish consumption rate, and a bioconcentration factor of 5000 for edible fish tissue. The bioconcentration factor (BCF) represents the number of times the concentration of a chemical in fish exceeds the concentration of that chemical in water.

Recent studies have indicated that BCFs may be higher than the 5,000 BCF used in the EPA water quality criterion for dioxin. The most recent work on a dioxin BCF comes from EPA's Duluth laboratory, which estimates equilibrium BCFs for whole body levels that may range up to 150,000, depending on the species of fish. For edible fish tissue, these studies would suggest that a 50,000 BCF may be appropriate. The Duluth studies will be completed and submitted for peer-reviewed publication this fall. EPA may give further guidance to States on the BCF issue following this publication. Table 3, which is based on the new evidence regarding a potentially higher BCF, is included for your consideration. It lists sites with a predicted increased cancer risk as high as one in 10,000 to one in 100 based on EPA's water quality criterion assumptions regarding a dioxin potency factor and its fish consumption rate of 6.5 grams per day, but uses a 50,000 BCF for edible fish tissue.

NON-CANCER HEALTH EFFECTS

Significant non-cancer human health effects (in particular liver and reproductive effects) from fish consumption in areas just below the mills could

also be a cause for concern in certain circumstances. Based on animal laboratory studies, EPA has estimated that dioxin exposure should not exceed picogram per kilogram of body weight per day to fully protect against adverse non-cancer effects. Using EPA's criteria document assumptions at the dioxin levels associated with a one in 10,000 cancer risk, dioxin exposure is calculated to be below, but very close to, the lower end of this range, and represents approximately a doubling of accepted estimates of general population exposure from all sources. Children and pregnant women may be particularly at risk.

FISH CONSUMPTION RATES

In many cases, the States and EPA have no data on local fish consumption rates or dioxin contamination in sediments. The Office of Policy, Planning and Evaluation (OPPE) and the Office of Research and Development (ORD) are currently developing a methodology that States could use to identify exposed populations and estimate local consumption patterns. In the meantime, States should work on their own procedures for estimating consumption, since this is a critical factor in determining whether standards adopted to comply with Section 303(c)(2)(B) of the Clean Water Act are protective for any chemicals presenting human health risks to fish consumers. Next fiscal year, EPA may be able to provide some contract dollars to help States estimate local consumption rates or monitor sediment contamination below high risk mills. The Office of Water will be providing further guidance to you on this issue in the near future.

RELEVANCE OF FOOD AND DRUG ADMINISTRATION ADVISORY NUMBERS

Some States base the decision to issue a fish consumption advisory or ban on FDA's chemical action levels. FDA exposure assumptions, in accordance with its legislative mandate, reflect expected consumption by buyers of fish in interstate commerce. FDA generally assumes, for example, that contaminated fish would not constitute a high proportion of such a consumer's diet. Fish sold in interstate commerce comes from many waterbodies, reducing the likelihood that a consumer will be steadily exposed to fish taken from a waterbody with high dioxin levels. In contrast, EPA is concerned about (and the States may be obligated under local authorities to consider) the individual who frequently fishes at the site or who regularly eats fish from the area. Thus, the FDA advisory number of 25 parts per trillion for dioxin in fish would not be sufficiently protective where individuals are consuming more than a few meals per year. The EPA-FDA Standing Committee on Contaminants in Fish and Shellfish has encouraged the use of toxicology and risk assessment in establishing local sport fish advisories.

Table 1. Mills Below Which Consumption of Fish is Predicted to Result in Individual Cancer Risk Exceeding 10^{-4} **Based on Fish Tissue Monitoring Data**

The fish tissue monitoring data confirmed EPA's modeling calculations which predicted high risks for these mills. (See Table 2.)

Mill	Mill Location	Advisory In-Place
Boise Cascade	Rumford, ME	Yes
International Paper	Jay, ME	Yes
Westvaco Corp.	Covington, VA	Yes
International Paper	Moss Point, MS	Yes
Weyerhaeuser	Plymouth, NC	Yes
Champion International	Canton, NC	Yes(NC)/Yes(TN)
International Paper	Georgetown, SC	Yes
Boise Cascade	Deridder, LA	No
Temple-Eastex	Evadale, TX	No
Simpson Paper	Anderson, CA	Yes

EPA's modeling calculations did not predict high risks for these 14 mills, however the fish tissue sampling showed high concentrations of dioxin in fish downstream of these mills.

Westvaco Corp.	Luke, MD	Yes(MD)/Yes(WV)
P.H. Glatfelter	Spring Grove, PA	Yes
Kimberly-Clark	Coosa Pines, AL	No
Champion International	Cantonment, FL	No
Mead Corp.	Escanaba, MI	Yes
Boise Cascade	International Falls, MN	Yes
Nekoosa Papers	Port Ed/Nekoosa, WI	Yes
Consolidated Paper	Wisconsin Rapids, WI	Yes
International Paper	Pine Bluff, AR	Yes
Nekoosa Paper	Ashdown, AR	Yes
International Paper	Bastrop, LA	Yes
Champion International	Houston, TX	No
Simpson Paper	Pasadena, TX	No
Boise Cascade	Wallula, WA	No

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[1]Estimates based on 2,3,7,8-TCDD only, 6.5 grams/day fish consumption and EPA cancer slope factor of $1.6 \times 10^{-4}(pg/kg\text{-}day)^{-1}$.

[2]Fish tissue collected as part of EPA national bioaccumulation study or EPA regional follow-on sampling.

[3]This information is not part of EPA's surface water risk assessment.

Table 2. Mills Below Which Consumption of Fish is Predicted to Result in Individual Cancer Risk Exceeding 10^{-4} **Based on Effluent Modeling Assuming a 5,000 BCF**

Mill	Mill Location	Advisory In-Place
Boise Cascade	Rumford, ME	Yes
International Paper	Jay, ME	Yes
Westvaco Corp.*	Covington, VA	Yes
Union Camp*	Franklin, VA	No
Georgia-Pacific	Palatka, FL	No
St. Joe Paper	Port St. Joe, FL	No
International Paper	Moss Point, MS	Yes
Leaf River Forest	New Augusta, MS	Yes
Champion International	Canton, NC	Yes
Weyerhaeuser*	Plymouth, NC	Yes
International Paper*	Georgetown, SC	Yes
Buckeye Cellulose*	Perry, FL	No
Georgia-Pacific	Crosset, AR	No
Boise Cascade	Deridder, LA	No
International Paper	Texarkana, TX	No
Temple-Eastex	Evadale, TX	No
Simpson Paper	Anderson, CA	Yes
Simpson Paper	Fairhaven, CA	No
Weyerhaeuser	Everett, WA	No
Weyerhaeuser	Cosmopolis, WA	No

[1]Estimates based on 2,3,7,8-TCDD only, 6.5 grams/day fish consumption, 5,000 fish filet bioconcentration factor, and EPA cancer slope factor of 1.6×10^{-4} $(pg/kg\text{-}day)^{-1}$.

[2]Based on dioxin detected in effluent collected during 1988 EPA/Paper Industry dioxin effort.

*Mills below which consumption of fish predicted to cause liver damage.

Table 3. Mills Below Which Consumption of Fish is Predicted to Result in Individual Cancer Risk Exceeding 10^{-4} Based on Effluent Modeling assuming a 50,000 BCF.[1,2]

Mill	Mill Location	Advisory In-Place
Boise Cascade*	Rumford, ME	Yes
International Paper*	Jay, ME	Yes
Scott Paper	Westbrook, ME	Yes
Scott Paper	Hinckley, ME	Yes
James River Corp.	Berlin, NH	Yes
International Paper*	Ticonderoga, NY	Yes[3]
Westvaco Corp.	Luke, MD	Yes
Penntech Papers	Johnsonburg, PA	No
Chesapeake Corp.	West Point, VA	No
Westvaco Corp.*	Covington, VA	Yes
Union Camp*	Franklin, VA	No
Champion International	Courtland, AL	No
Container Corp.	Brewton, AL	No
Boise Cascade	Jackson, AL	No
International Paper	Mobile, AL	No
Gulf States Paper	Demopolis, AL	No
International Paper	Selma, AL	No
Kimberly-Clark	Coosa Pines, AL	No
James River Corp.	Butler, AL	No
Buckeye Cellulose*	Perry, FL	No
ITT-Rayonier	Fernandina Beach, FL	No
Georgia-Pacific*	Palatka, FL	No
St. Joe Paper*	Port St. Joe, FL	No
ITT-Rayonier	Jesup, GA	No
Brunswick Pulp and Paper*	Brunswick, GA	No
International Paper*	Moss Point, MS	Yes
Leaf River Forest*	New Augusta, MS	Yes
Champion International*	Canton, NC	Yes
Weyerhaeuser*	Plymouth, NC	Yes
Weyerhaeuser*	New Bern, NC	No
Federal Paperboard	Rieglewood, NC	No
Bowater Corp.	Catawba, SC	No
International Paper*	Georgetown, SC	Yes
Boise Cascade	International Falls, MN	Yes
Nekoosa Papers	Port Ed/Nekoosa, WI	Yes
Georgia-Pacific*	Crosset, AR	No
International Paper	Pine Bluff, AR	Yes
Nekoosa Papers	Ashdown, AR	Yes
Boise Cascade*	Deridder, LA	No
International Paper*	Texarkana, TX	No
Temple-Eastex*	Evadale, TX	No

Table 3 (cont'd)

Louisiana Pacific	Samoa, CA	No
Simpson Paper*	Anderson, CA	Yes
Simpson Paper*	Fairhaven, CA	No
Ketchikan Pulp & Paper*	Ketchikan, AK	No
ITT-Rayonier	Port Angeles, WA	No
ITT-Rayonier	Hoquiam, WA	No
Weyerhaeuser*	Everett, WA	No
Weyerhaeuser*	Cosmopolis, WA	No

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[1]Estimates based on 2,3,7,8-TCDD only,6.5 grams/day fish consumption, 50,000 fish filet bioconcentration factor, and EPA cancer slope factor of $1.6 \times 10^{-4}(pg/kg\text{-}day)^{-1}$.

[2]Based on dioxin detected in effluent collected during 1988 EPA/Paper Industry dioxin effort.

[3]Fish consumption advisory is in effect for these waters due to contaminants other than dioxin, and/or the potential for unidentified contamination.

*Mills below which consumption of fish predicted to cause liver damage.

INFORMATION ABOUT MATRIX OF 104 PULP AND PAPER MILLS, RISK ESTIMATES SECTION 304(l) STATUS, FISH ADVISORY STATUS, AND WATER QUALITY STANDARDS.

For each of the 104 chlorine-bleaching pulp and paper mills (one mill is represented twice because it has two discharge pipes) included in EPA's surface water risk assessment the attached matrix provides the following information:

- A cancer risk estimate for 2,3,7,8-TCDD (dioxin). This cancer risk estimate is based on modeling of effluent data from the EPA/Industry Cooperative 104 Mill Study using a bioconcentration factor (BCF) of 5,000 and average fish consumption rate of 6.5 grams per day. These assumptions are from EPA's 1984 Water Quality Criteria Document for 2,3,7,8-TCDD. This information can be found in Appendix I of the surface water risk assessment. It is the only information in this matrix that can be found in the surface water risk assessment. The risk assessment also includes several other risk estimates based on alternative sets of assumptions.

- Whether or not the mill is on the list of facilities required by Section 304(l)(1)(C) of the Clean Water Act due to discharges of dioxin, and the status of the Individual Control Strategy for each of those facilities. Section 304(l) requires that States identify those waters that do not meet State water quality standards for toxic pollutants entirely or substantially due to point source discharges and to identify the responsible point sources. The State must then write an individual control strategy (ICS) for each of those facilities, and EPA must approve or disapprove the ICS. An ICS is defined as either a draft or final National Pollutant Discharge Elimination System (NPDES) permit.

- Whether or not a fish consumption advisory is in-place downstream of the mill due to dioxin contamination of fish.

- The status of the adoption of the State water quality standard for dioxin. The matrix includes values for water and fish criteria or fish only criteria or both. Section 303(c)(2)(B) of the Clean Water Act requires States to adopt water quality criteria for all toxic pollutants of concern in the State.

The mills appear in order according to cancer risk, starting with the highest cancer risk.

MATRIX #1

TCDD RISK ESTIMATES, §304(1) STATUS, FISH ADVISORY STATUS, AND WATER QUALITY STANDARDS INFORMATION

9/19/90

COMPANY	CITY, ST	CANCER RISK (TCDD)(a)	SECTION 304(l) OF THE CWA: ON LIST	SECTION 304(l) OF THE CWA: ICS STATUS (b)	FISH ADVISORY IN-PLACE (c)	WATER QUALITY STANDARDS (d): WATER & FISH CRITERIA (ppq)	WATER QUALITY STANDARDS (d): FISH ONLY CRITERIA (ppq)	WATER QUALITY STANDARDS (d): STATUS	WATER QUALITY STANDARDS (d): EPA APPROVED
*International Paper Co.	Georgetown, SC	2×10^{-2}	X	APPROVED	X		1.2	PROPOSED	
*Union Camp Corp.	Franklin, VA	2×10^{-5}	X	PENDING			1.2	ADOPTED	
*Buckeye Cellulose	Perry, FL	2×10^{-5}				0.013	0.014	PROPOSED	
*Weyerhaeuser Co.	Plymouth, NC	2×10^{-5}	X	APPROVED	X	0.013	0.014	ADOPTED	X
*Westvaco Corp.	Covington, VA	1×10^{-5}			X		1.2	ADOPTED	
Georgia-Pacific Corp.	Palatka, FL	6×10^{-7}	X	APPROVED		0.013	0.014	PROPOSED	
International Paper Co.	Moss Point, MS	3×10^{-6} (e)	X	APPROVED					
Temple-Eastex, Inc.	Evadale, TX	3×10^{-6}	X	APPROVED		0.5	0.3	EXPECTED	
Champion International	Cantonment, FL	2×10^{-7} (f)	X	APPROVED		0.013	0.014	PROPOSED	
Champion International	Canton, NC	2×10^{-7}	X	APPROVED	X	0.013	0.014	ADOPTED	X
Georgia-Pacific Corp.	Crosset, AR	2×10^{-7}	X	APPROVED		1.36		PROPOSED	
International Paper Co.	Texarkana, TX	2×10^{-7}	X	APPROVED		0.5	0.3	EXPECTED	
International Paper Co.	Jay, ME	1×10^{-7}	X	PENDING	X	0.013	0.014	ADOPTED	
Boise Cascade Corp.	Rumford, ME	1×10^{-6}	X	PENDING	X	0.013	0.014	ADOPTED	
St. Joe Paper Co.	Port St. Joe, FL	1×10^{-6} (e)	X	APPROVED		0.013	0.014	PROPOSED	
Boise Cascade Corp.	Deridder, LA	1×10^{-6}	X	APPROVED					
Simpson Paper Co.	Anderson, CA	1×10^{-6}	X	PENDING	X		0.0039	ADOPTED	X
Simpson Paper Co.	Fairhaven, CA	1×10^{-6}	X	PENDING			0.0039	ADOPTED	X
Weyerhaeuser Co.	Cosmopolis, WA	1×10^{-6}	X	PENDING				EXPECTED	
Weyerhaeuser Co.	Everett, WA	1×10^{-6}	X	PENDING				EXPECTED	
Brunswick Pulp and Paper	Brunswick, GA	9×10^{-5}					7.2	ADOPTED	
Leaf River Forest Prod.	New Augusta, MS	9×10^{-5}	X	APPROVED	X				
Weyerhaeuser Co.	New Bern, NC	9×10^{-5}	X	APPROVED		0.013	0.014	ADOPTED	X
Ketchikan Pulp & Paper	Ketchikan, AK	9×10^{-5}				0.013	0.014	ADOPTED	X
ITT-Rayonier, Inc.	Hoquiam, WA	8×10^{-5}	X	PENDING				EXPECTED	
International Paper Co.	Ticonderoga, NY	7×10^{-5}	X	PENDING	X (h)		1.0	ADOPTED	X
P.H. Glatfelter Co.	Spring Grove, PA	7×10^{-5} (f)	X	PENDING	X	0.01 (T)		ADOPTED	X
Louisiana Pacific Corp.	Samoa, CA	7×10^{-5}	X	PENDING			0.0039	ADOPTED	X
Chesapeake Corp.	West Point, VA	6×10^{-5}					1.2	ADOPTED	
Champion International	Houston, TX	6×10^{-5} (f)	X	APPROVED		0.5	0.3	EXPECTED	
Mead Corporation	Escanaba, MI	5×10^{-5} (f)	X	APPROVED	X	0.014 (T)		ADOPTED	X
Federal Paper Board Co.	Riegelwood, NC	4×10^{-5}	X	APPROVED		0.013	0.014	ADOPTED	X
Nekoosa Papers, Inc.	Nekoosa/Pt. Ed., WI	4×10^{-5}	X	APPROVED	X	0.03		ADOPTED	X
Nekoosa Papers, Inc.	Ashdown, AR	4×10^{-5}	X	APPROVED	X	1.36		PROPOSED	
Alaska Pulp Corp.	Sitka, AK	4×10^{-5} (f)				0.013	0.014	ADOPTED	X

* = Mills below which consumption of fish is predicted to cause liver damage

(a = 2378-TCDD only; based on effluent data from 104 Mill Study and EPA's 1984 Water Quality Criteria Document for Dioxin which assumes a bioconcentration factor of 5000 and a consumption rate of slightly less than 2 quarter-pound meals per month)

(b = Section 304(l) of the Clean Water Act (Toxic Hot Spots Program) requires states to list those facilities contributing to violations of water quality standards for toxic pollutants and write an Individual Control Strategy (ICS) for each.)

(c = as of August 14, 1990. Please note that all mills do not require advisories.)

(d = as of August 21, 1990)

(e = mill discharges to a POTW)

(f = dioxin not detected in effluent; risk calculated using one-half of the detection limit)

(g = model input data on receiving water flow or effluent dioxin concentrations not quantifiable)

(h = fish consumption advisory is in effect for these waters due to contaminants other than dioxin, and/or the potential for unidentifed contaminantion.)

(T = derived by Translator Procedure)

MATRIX #1

9/19/90

COMPANY	CITY, ST	CANCER RISK (TCDD)(a)	SECTION 304(l) OF THE CWA: ON LIST	SECTION 304(l) OF THE CWA: ICS STATUS (b)	FISH ADVISORY IN-PLACE (c)	WATER QUALITY STANDARDS (d): WATER & FISH CRITERIA (ppq)	WATER QUALITY STANDARDS (d): FISH ONLY CRITERIA (ppq)	WATER QUALITY STANDARDS (d): STATUS	EPA APPROVED
Westvaco Corp.	Luke, MD	3×10^{-5} (e)			X		1.2	ADOPTED	X
Appleton Papers, Inc.	Roaring Springs, PA	3×10^{-5} (f)				0.01 (T)		ADOPTED	X
Kimberly-Clark Corp.	Coosa Pines, AL	3×10^{-5}	X	APPROVED			1.2	ADOPTED	
Bowater Corp.	Catawba, SC	3×10^{-5}	X	APPROVED			1.2	PROPOSED	
International Paper Co.	Pine Bluff, AR	3×10^{-5}	X	APPROVED	X	1.36		PROPOSED	
Champion International	Lufkin, TX	3×10^{-5} (f)	X	APPROVED		0.5	0.3	EXPECTED	
Scott Paper Co.	Westbrook, ME	2×10^{-5}	X	PENDING	X	0.013	0.014	ADOPTED	
Penntech Papers, Inc.	Johnsonburg, PA	2×10^{-5}	X	PENDING		0.01 (T)		ADOPTED	X
Container Corp. of Amer.	Brewton, AL	2×10^{-5}					1.2	ADOPTED	
Boise Cascade Corp.	Jackson, AL	2×10^{-5}					1.2	ADOPTED	
International Paper Co.	Mobile, AL	2×10^{-5}					1.2	ADOPTED	
Gulf States Paper Corp.	Demopolis, AL	2×10^{-5}					1.2	ADOPTED	
International Paper Co.	Selma, AL	2×10^{-5}					1.2	ADOPTED	
James River Corp.	Butler, AL	2×10^{-5}					1.2	ADOPTED	
ITT-Rayonier, Inc.	Jesup, GA	2×10^{-5}					7.2	ADOPTED	
Boise Cascade Corp.	Int'l Falls, MN	2×10^{-5}	X	APPROVED	X	0.00051 (T)		PROPOSED	
Mead Corp.	Chillicothe, OH	2×10^{-5} (f)	X	PENDING		0.13	0.14	ADOPTED	X
Consolidated Papers, Inc.	Wisc. Rapids, WI	2×10^{-5} (f)	X	APPROVED	X	0.03		ADOPTED	X
ITT-Rayonier, Inc.	Port Angeles, WA	2×10^{-5}						EXPECTED	
James River Corp.	Berlin, NH	1×10^{-5}	X	PENDING	X		1.0	ADOPTED	
Champion International	Courtland, AL	1×10^{-5}					1.2	ADOPTED	
ITT-Rayonier, Inc.	Fernandina Beach, FL	1×10^{-5}				0.013	0.014	PROPOSED	
Gilman Paper Co.	St. Marys, GA	1×10^{-5} (f)					7.2	ADOPTED	
Georgia-Pacific Corp.	Woodland, ME	9×10^{-6}	X	APPROVED		0.013	0.014	ADOPTED	
Scott Paper Co.	Hinckley, ME	9×10^{-6}	X	APPROVED	X	0.013	0.014	ADOPTED	
James River Corp.	Old Town, ME	8×10^{-6}	X	PENDING	X	0.013	0.014	ADOPTED	
Federal Paper Board Co.	Augusta, GA	8×10^{-6}					7.2	ADOPTED	
Alabama River Pulp	Claiborne, AL	7×10^{-6}					1.2	ADOPTED	
Potlatch Corp.	Lewiston, ID	7×10^{-6}	X	APPROVED		0.013	0.014	EXPECTED	
Lincoln Pulp and Paper	Lincoln, ME	6×10^{-6}	X	PENDING	X	0.013	0.014	ADOPTED	
Scott Paper Co.	Mobile, AL	6×10^{-6}					1.2	ADOPTED	
Bowater Corp.	Calhoun, TN	6×10^{-6} (f)	X	PENDING			1.0	PROPOSED	
Champion International	Quinnesec, MI	6×10^{-6}	X	APPROVED		0.014 (T)		ADOPTED	X
Potlatch Corp.	Cloquet, MN	6×10^{-6} (e)				0.00051 (T)		PROPOSED	
Union Camp Corp.	Eastover, SC	5×10^{-6}					1.2	PROPOSED	
Pope & Talbot, Inc.	Halsey, OR	5×10^{-6}	X	PENDING		0.013	0.014	ADOPTED	X
Boise Cascade Corp.	Wallula, WA	5×10^{-6}	X	PENDING				EXPECTED	
Mead Corporation	Kingsport, TN	4×10^{-6}	X	APPROVED			1.0	PROPOSED	

* = Mills below which consumption of fish is predicted to cause liver damage
(a = 2378-TCDD only; based on effluent data from 104 Mill Study and EPA's 1984 Water Quality Criteria Document for Dioxin which assumes a bioconcentration factor of 5000 and a consumption rate of slightly less than 2 quarter-pound meals per month)
(b = Section 304(l) of the Clean Water Act (Toxic Hot Spots Program) requires states to list those facilities contributing to violations of water quality standards for toxic pollutants and write an Individual Control Strategy (ICS) for each.)
(c = as of August 14, 1990. Please note that all mills do not require advisories.)
(d = as of August 21, 1990)
(e = mill discharges to a POTW)
(f = dioxin not detected in effluent; risk calculated using one-half of the detection limit)
(g = model input data on receiving water flow or effluent dioxin concentrations not quantifiable)
(h = fish consumption advisory is in effect for these waters due to contaminants other than dioxin, and/or the potential for unidentifed contamination.)
(T = derived by Translator Procedure)

COMPANY	CITY, ST	CANCER RISK (TCDD)(a)	SECTION 304(l) OF THE CWA: ON LIST	SECTION 304(l) OF THE CWA: ICS STATUS (b)	FISH ADVISORY IN-PLACE (c)	WATER QUALITY STANDARDS (d): WATER & FISH CRITERIA (ppq)	WATER QUALITY STANDARDS (d): FISH ONLY CRITERIA (ppq)	WATER QUALITY STANDARDS (d): STATUS	EPA APPROVED
James River Corp.	Green Bay, WI	4×10^{-6}				0.03		ADOPTED	X
Pentair, Inc.	Park Falls, WI	4×10^{-6} (f)				0.03		ADOPTED	X
Buckeye Cellulose	Oglethorpe, GA	3×10^{-6} (f)					7.2	ADOPTED	
Weyerhaeuser Co.	Rothchild, WI	3×10^{-6}				0.03		ADOPTED	X
Finch & Pruyn & Co., Inc.	Glen Falls, NY	2×10^{-6} (f)			X (h)		1.0	ADOPTED	X
Stone Container Corp.	Panama City, FL	2×10^{-6} (e)	X	APPROVED		0.013	0.014	PROPOSED	
Badger Paper Mills, Inc.	Peshtigo, WI	2×10^{-6} (e)				0.03		ADOPTED	X
Georgia-Pacific Corp.	Bellingham, WA	2×10^{-6} (f)	X	PENDING				EXPECTED	
Scott Paper Co.	Muskegon, MI	1×10^{-6} (e)(f)				0.014 (T)		ADOPTED	X
Badger Paper Mills, Inc.	Peshtigo, WI	1×10^{-6}				0.03		ADOPTED	X
Wausau Paper Mills Co.	Brokaw, WI	1×10^{-6} (f)				0.03		ADOPTED	X
Stone Container Corp.	Missoula, MT	8×10^{-7}				0.013	0.014	ADOPTED	X
James River Corp.	St. Francesv'l, LA	7×10^{-7}	X	APPROVED					
Procter & Gamble Co.	Mehoopany, PA	4×10^{-7} (f)				0.01 (T)		ADOPTED	X
International Paper Co.	Natchez, MS	4×10^{-7}							
Westvaco Corp.	Wickliffe, KY	3×10^{-7}				0.013	0.014	ADOPTED	
James River Corp.	Clatskanie, OR	3×10^{-7}	X	APPROVED		0.013	0.014	ADOPTED	X
Weyerhaeuser Co.	Longview, WA	3×10^{-7}	X	PENDING				EXPECTED	
Willamette Industries	Hawesville, KY	1×10^{-7} (f)				0.013	0.014	ADOPTED	
James River Corp.	Green Bay, WI	1×10^{-7} (e)(f)				0.03		ADOPTED	X
Boise Cascade Corp.	St. Helens, OR	1×10^{-7} (e)	X	APPROVED		0.013	0.014	ADOPTED	X
Longview Fibre Co.	Longview, WA	8×10^{-8} (f)	X	PENDING				EXPECTED	
Potlatch Corp.	McGhee, AR	4×10^{-8} (e)	X	APPROVED		1.36		PROPOSED	
International Paper Co.	Erie, PA	not avail. (e)(g)				0.01 (T)		ADOPTED	X
Georgia-Pacific Corp.	Zachary, LA	not avail. (g)	X	APPROVED					
International Paper Co.	Bastrop, LA	not avail. (g)	X	APPROVED	X				
Simpson Paper Co.	Pasadena, TX	not avail. (g)				0.5	0.3	EXPECTED	
Stone Container Corp.	Snowflake, AZ	not avail. (g)	X	PENDING		0.01		EXPECTED	
Gaylord Container Corp.	Antioch, CA	not avail. (g)	X	PENDING			0.0039	ADOPTED	X
James River Corp.	Camas, WA	not avail. (g)	X	PENDING				EXPECTED	
Scott Paper Co.	Everett, WA	not avail. (g)	X	PENDING				EXPECTED	
Simpson Paper Co.	Tacoma, WA	not avail. (g)	X	PENDING				EXPECTED	

* = Mills below which consumption of fish is predicted to cause liver damage
(a = 2378-TCDD only; based on effluent data from 104 Mill Study and EPA's 1984 Water Quality Criteria Document for Dioxin which assumes a bioconcentration factor of 5000 and a consumption rate of slightly less than 2 quarter-pound meals per month)
(b = Section 304(l) of the Clean Water Act (Toxic Hot Spots Program) requires states to list those facilities contributing to violations of water quality standards for toxic pollutants and write an Individual Control Strategy (ICS) for each.)
(c = as of August 14, 1990. Please note that all mills do not require advisories.)
(d = as of August 21, 1990)
(e = mill discharges to a POTW)
(f = dioxin not detected in effluent; risk calculated using one-half of the detection limit)
(g = model input data on receiving water flow or effluent dioxin concentrations not quantifiable)
(h = fish consumption advisory is in effect for these waters due to contaminants other than dioxin, and/or the potential for unidentifed contamination.)
(T = derived by Translator Procedure)

EPA Environmental News

EPA RELEASES RISK ESTIMATES FOR EATING DIOXIN-CONTAMINATED FISH

Sean McElheny (202) 382-4387

Monday, September 24, 1990

The U.S. Environmental Protection Agency today released estimates of lifetime cancer risks, at levels of concern, for consumers of dioxin-contaminated fish taken from waters downstream of 20 chlorine-bleaching pulp and paper mills that discharge dioxin.

These mill-by-mill risk estimates are part of a comprehensive Dioxin-in-Paper Integrated Risk Assessment. The Agency released a summary of this risk assessment on April 30, 1990, when it announced its plans to reduce the dioxin risks associated with the chlorine-bleaching pulp and paper industry. All of the key findings in the assessment were included in the summary, except for the mill-specific risk numbers announced today.

The study results are presented as the estimated risk of cancer incidence during the lifetime of the exposed individual. For these risk estimates, reasonable worst-case characterizations were used. Study results indicate that dioxin levels downstream from the 20 mills may be high enough to pose an increased cancer risk greater than one in 10,000 to average consumers of fish caught below the mills. The estimated cancer risk is potentially greater for avid sports fishermen and subsistence level fishermen because their consumption of fish is generally higher than that of average consumers. There are a total of 104 pulp and paper mills that discharge dioxin. (For more information on risks from all 104 mills, see attachments.)

"EPA suggests that states consider imposing fish consumption advisories or start site-specific monitoring programs at all streams that have a projected risk as high as one in ten thousand or greater," said Deputy EPA Administrator Henry Habicht. "These risks levels will come down as EPA and states impose more stringent permit limits and mills reduce dioxin discharges." (See attached list for mills for which fishing advisories already are in place.)

States should consider all data available to them in deciding whether fishing advisories or monitoring programs may be appropriate.

All risk estimates in the assessment are based on consumption of fish--such as catfish, suckers, squawfish and bass--that spend their entire lifetime in the vicinity of a mill and consequently accumulate greater concentrations of dioxin in their tissue. The risk estimates do not apply to migratory fish, such as salmon, that spend a short portion of their lives in these waters.

EPA and states are issuing, on an expedited basis, wastewater discharge permits that limit dioxin discharges from chlorine-bleaching pulp and paper mills. These National Pollutant Discharge Elimination System permits will ensure that mill discharges achieve the more stringent of either water-quality-based effluent limits, or technology-based limits (that is, based on the capability of existing technology). Many of these permits also include requirements for mills to make process changes and/or product substitutions to reduce the use of chlorine by certain dates.

Permits to limit dioxin discharges are being issued for about 66 mills on an expedited basis where water quality problems due to dioxin have been identified through EPA and state efforts to locate toxic hot spots. Most of these permits will be issued by February 1991. Permits for 18 of the 20 mills with projected risk of one-in-ten thousand or greater are included in this group. Under these permits, mills will be required to meet water-quality-based limits for dioxin no later than June 1993. Permits for the other two high-risk mills will be revised to include dioxin limits within the next year. Permits with dioxin controls for the remaining chlorine-bleaching pulp and paper mills will be issued over the next few years as existing permits for these mills expire.

EPA also is developing national industrial effluent limit guidelines and standards to reduce dioxin contamination and total chlorinated organics from the manufacture of bleached paper products. These standards, based on the best available, economically achievable technologies, are expected to focus on changes in the bleaching process so as to prevent the formation of dioxin. EPA plans to issue proposed standards in 1993 and final standards in 1995. These standards will be used in subsequent rounds of permit revisions for pulp and paper mills and are expected to reduce dioxin contamination in sludge and pulp as well as wastewater.

"The overall risk of dioxin to human health and aquatic

systems requires the precautionary actions we are taking, even though the scientific basis for estimating dioxin cancer risk and the mill-based specific risk numbers themselves may be changing," said Habicht.

EPA is proposing a dioxin pollution prevention initiative that will involve other federal agencies, states, industry, environmental groups and the international regulatory community. The purpose of the initiative is to accelerate pollution reduction through industrial process modifications and chlorine substitutes. Many of the 104 mills already have reduced dioxin discharges through such changes; some have achieved significant reductions. The initiative will include an exchange with Canada, West Germany, Sweden and other nations of technology transfer projects and public information efforts.

The full Dioxin-in-Paper Integrated Risk Assessment is available. That document is the result of a cooperative effort among EPA, the Food and Drug Administration and the Consumer Product Safety Commission to estimate the risks posed by dioxin associated with the chlorine-bleaching of pulp and paper. The risk assessment was the technical foundation for EPA's April 30 announcement.

The risk assessment is a scientific support document. It estimates dioxin risks from pulp and paper mill effluent, pulp and paper mill sludge, food contact papers and body contact papers. It also includes risks to wildlife and occupational risks.

The risk assessment is supported by 12 studies. The surface water risk assessment that contains the mill-specific risk calculations is one of these studies.

# # #

Mills Below Which Consumption of Fish is Predicted to Result in Individual Cancer Risk Exceeding 10^{-6} Based on Effluent Modeling Assuming a 5,000 BCF

Mill	Mill Location	Advisory In-Place
Boise Cascade	Rumford, ME	Yes
International Paper	Jay, ME	Yes
Westvaco Corp.	Covington, VA	Yes
Union Camp*	Franklin, VA	No
Georgia-Pacific	Palatka, FL	No
St. Joe Paper	Port St. Joe, FL	No
International Paper	Moss Point, MS	Yes
Leaf River Forest	New Augusta, MS	Yes
Champion International	Canton, NC	Yes
Weyerhaeuser*	Plymouth, NC	Yes
International Paper*	Georgetown, SC	Yes
Buckeye Cellulose*	Perry, FL	No
Georgia-Pacific	Crosset, AR	No
Boise Cascade	Deridder, LA	No
International Paper	Texarkana, TX	No
Temple-Eastex	Evadale, TX	No
Simpson Paper	Anderson, CA	Yes
Simpson Paper	Fairhaven, CA	No
Weyerhaeuser	Everett, WA	No
Weyerhaeuser	Cosmopolis, WA	No

[1]Estimates based on 2,3,7,8-TCDD only, 6.5 grams/day fish consumption, 5,000 fish filet bioconcentration factor, and EPA cancer slope factor of 1.6×10^{-6} $(pg/kg\text{-}day)^{-1}$.

[2]Based on dioxin detected in effluent collected during 1988 EPA/Paper Industry dioxin effort.

*Mills below which consumption of fish predicted to cause liver damage.

INFORMATION ABOUT MATRIX OF 104 PULP AND PAPER MILLS, RISK ESTIMATES, SECTION 304(l) STATUS, FISH ADVISORY STATUS, AND WATER QUALITY STANDARDS.

For each of the 104 chlorine-bleaching pulp and paper mills (one mill is represented twice because it has two discharge pipes) included in EPA's surface water risk assessment the attached matrix provides the following information:

- A cancer risk estimate for 2,3,7,8-TCDD (dioxin). This cancer risk estimate is based on modeling of effluent data from the EPA/Industry Cooperative 104 Mill Study using a bioconcentration factor (BCF) of 5,000 and average fish consumption rate of 6.5 grams per day. These assumptions are from EPA's 1984 Water Quality Criteria Document for 2,3,7,8-TCDD. This information can be found in Appendix I of the surface water risk assessment. It is the only information in this matrix that can be found in the surface water risk assessment. The risk assessment also includes several other risk estimates based on alternative sets of assumptions.

- Whether or not the mill is on the list of facilities required by Section 304(l)(1)(C) of the Clean Water Act due to discharges of dioxin, and the status of the Individual Control Strategy for each of those facilities. Section 304(l) requires that States identify those waters that do not meet State water quality standards for toxic pollutants entirely or substantially due to point source discharges and to identify the responsible point sources. The State must then write an individual control strategy (ICS) for each of those facilities, and EPA must approve or disapprove the ICS. An ICS is defined as either a draft or final National Pollutant Discharge Elimination System (NPDES) permit.

- Whether or not a fish consumption advisory is in-place downstream of the mill due to dioxin contamination of fish.

- The status of the adoption of the State water quality standard for dioxin. The matrix includes values for water and fish criteria or fish only criteria or both. Section 303(c)(2)(B) of the Clean Water Act requires States to adopt water quality criteria for all toxic pollutants of concern in the State.

The mills appear in order according to cancer risk, starting with the highest cancer risk.

COMPANY	CITY, ST	CANCER RISK (TCDD)(a)	SECTION 304(l) OF THE CWA: ON LIST	SECTION 304(l) OF THE CWA: ICS STATUS (b)	FISH ADVISORY IN-PLACE (c)	WATER QUALITY STANDARDS (d): WATER & FISH CRITERIA (ppq)	WATER QUALITY STANDARDS (d): FISH ONLY CRITERIA (ppq)	WATER QUALITY STANDARDS (d): STATUS	EPA APPROVED
James River Corp.	Green Bay, WI	4×10^{-4}				0.03		ADOPTED	X
Pentair, Inc.	Park Falls, WI	4×10^{-4} (f)				0.03		ADOPTED	X
Buckeye Cellulose	Oglethorpe, GA	3×10^{-4} (f)					7.2	ADOPTED	
Weyerhaeuser Co.	Rothchild, WI	3×10^{-4}				0.03		ADOPTED	X
Finch & Pruyn & Co., Inc.	Glen Falls, NY	2×10^{-4} (f)			X (h)		1.0	ADOPTED	X
Stone Container Corp.	Panama City, FL	2×10^{-4} (e)	X	APPROVED		0.013	0.014	PROPOSED	
Badger Paper Mills, Inc.	Peshtigo, WI	2×10^{-4} (e)				0.03		ADOPTED	X
Georgia-Pacific Corp.	Bellingham, WA	2×10^{-4} (f)	X	PENDING				EXPECTED	
Scott Paper Co.	Muskegon, MI	1×10^{-4} (e)(f)				0.014 (T)		ADOPTED	X
Badger Paper Mills, Inc.	Peshtigo, WI	1×10^{-4}				0.03		ADOPTED	X
Wausau Paper Mills Co.	Brokaw, WI	1×10^{-4} (f)				0.03		ADOPTED	X
Stone Container Corp.	Missoula, MT	8×10^{-7}				0.013	0.014	ADOPTED	X
James River Corp.	St. Francesv'l, LA	7×10^{-7}	X	APPROVED					
Procter & Gamble Co.	Mehoopany, PA	4×10^{-7} (f)				0.01 (T)		ADOPTED	X
International Paper Co.	Natchez, MS	4×10^{-7}							
Westvaco Corp.	Wickliffe, KY	3×10^{-7}				0.013	0.014	ADOPTED	
James River Corp.	Clatskanie, OR	3×10^{-7}	X	APPROVED		0.013	0.014	ADOPTED	X
Weyerhaeuser Co.	Longview, WA	3×10^{-7}	X	PENDING				EXPECTED	
Willamette Industries	Hawesville, KY	1×10^{-7} (f)				0.013	0.014	ADOPTED	
James River Corp.	Green Bay, WI	1×10^{-7} (e)(f)				0.03		ADOPTED	X
Boise Cascade Corp.	St. Helens, OR	1×10^{-7} (e)	X	APPROVED		0.013	0.014	ADOPTED	X
Longview Fibre Co.	Longview, WA	8×10^{-8} (f)	X	PENDING				EXPECTED	
Potlatch Corp.	McGhee, AR	4×10^{-8} (e)	X	APPROVED		1.36		PROPOSED	
International Paper Co.	Erie, PA	not avail. (e)(g)				0.01 (T)		ADOPTED	X
Georgia-Pacific Corp.	Zachary, LA	not avail. (g)	X	APPROVED					
International Paper Co.	Bastrop, LA	not avail. (g)	X	APPROVED	X				
Simpson Paper Co.	Pasadena, TX	not avail. (g)				0.5	0.3	EXPECTED	
Stone Container Corp.	Snowflake, AZ	not avail. (g)	X	PENDING		0.01		EXPECTED	
Gaylord Container Corp.	Antioch, CA	not avail. (g)	X	PENDING			0.0039	ADOPTED	X
James River Corp.	Camas, WA	not avail. (g)	X	PENDING				EXPECTED	
Scott Paper Co.	Everett, WA	not avail. (g)	X	PENDING				EXPECTED	
Simpson Paper Co.	Tacoma, WA	not avail. (g)	X	PENDING				EXPECTED	

* = Mills below which consumption of fish is predicted to cause liver damage

(a = 2378-TCDD only; based on effluent data from 104 Mill Study and EPA's 1984 Water Quality Criteria Document for Dioxin which assumes a bioconcentration factor of 5000 and a consumption rate of slightly less than 2 quarter-pound meals per month)

(b = Section 304(l) of the Clean Water Act (Toxic Hot Spots Program) requires states to list those facilities contributing to violations of water quality standards for toxic pollutants and write an Individual Control Strategy (ICS) for each.)

(c = as of August 14, 1990. Please note that all mills do not require advisories.)

(d = as of August 21, 1990)

(e = mill discharges to a POTW)

(f = dioxin not detected in effluent; risk calculated using one-half of the detection limit)

(g = model input data on receiving water flow or effluent dioxin concentrations not quantifiable)

(h = fish consumption advisory is in effect for these waters due to contaminants other than dioxin, and/or the potential for unidentified contamination.)

(T = d[redacted]ived by Translator Procedure)

QUALITY STANDARDS INFORMATION

COMPANY	CITY, ST	CANCER RISK (TCDD)(a)	SECTION 304(l) OF THE CWA: ON LIST	SECTION 304(l) OF THE CWA: ICS STATUS (b)	FISH ADVISORY IN-PLACE (c)	WATER QUALITY STANDARDS (d): WATER & FISH CRITERIA (ppq)	WATER QUALITY STANDARDS (d): FISH ONLY CRITERIA (ppq)	WATER QUALITY STANDARDS (d): STATUS	EPA APPROVI
*International Paper Co.	Georgetown, SC	2×10^{-2}	X	APPROVED	X		1.2	PROPOSED	
*Union Camp Corp.	Franklin, VA	2×10^{-3}	X	PENDING			1.2	ADOPTED	
*Buckeye Cellulose	Perry, FL	2×10^{-3}				0.013	0.014	PROPOSED	
*Weyerhaeuser Co.	Plymouth, NC	2×10^{-3}	X	APPROVED	X	0.013	0.014	ADOPTED	X
*Westvaco Corp.	Covington, VA	1×10^{-3}			X		1.2	ADOPTED	
Georgia-Pacific Corp.	Palatka, FL	6×10^{-4}	X	APPROVED		0.013	0.014	PROPOSED	
International Paper Co.	Moss Point, MS	3×10^{-4} (e)	X	APPROVED					
Temple-Eastex, Inc.	Evadale, TX	3×10^{-4}	X	APPROVED		0.5	0.3	EXPECTED	
Champion International	Cantonment, FL	2×10^{-4} (f)	X	APPROVED		0.013	0.014	PROPOSED	
Champion International	Canton, NC	2×10^{-4}	X	APPROVED	X	0.013	0.014	ADOPTED	X
Georgia-Pacific Corp.	Crosset, AR	2×10^{-4}	X	APPROVED		1.36		PROPOSED	
International Paper Co.	Texarkana, TX	2×10^{-4}	X	APPROVED		0.5	0.3	EXPECTED	
International Paper Co.	Jay, ME	1×10^{-4}	X	PENDING	X	0.013	0.014	ADOPTED	
Boise Cascade Corp.	Rumford, ME	1×10^{-4}	X	PENDING	X	0.013	0.014	ADOPTED	
St. Joe Paper Co.	Port St. Joe, FL	1×10^{-4} (e)	X	APPROVED		0.013	0.014	PROPOSED	
Boise Cascade Corp.	Deridder, LA	1×10^{-4}	X	APPROVED					
Simpson Paper Co.	Anderson, CA	1×10^{-4}	X	PENDING	X		0.0039	ADOPTED	X
Simpson Paper Co.	Fairhaven, CA	1×10^{-4}	X	PENDING			0.0039	ADOPTED	X
Weyerhaeuser Co.	Cosmopolis, WA	1×10^{-4}	X	PENDING				EXPECTED	
Weyerhaeuser Co.	Everett, WA	1×10^{-4}	X	PENDING				EXPECTED	
Brunswick Pulp and Paper	Brunswick, GA	9×10^{-5}					7.2	ADOPTED	
Leaf River Forest Prod.	New Augusta, MS	9×10^{-5}	X	APPROVED	X				
Weyerhaeuser Co.	New Bern, NC	9×10^{-5}	X	APPROVED		0.013	0.014	ADOPTED	X
Ketchikan Pulp & Paper	Ketchikan, AK	9×10^{-5}				0.013	0.014	ADOPTED	X
ITT-Rayonier, Inc.	Hoquiam, WA	8×10^{-5}	X	PENDING				EXPECTED	
International Paper Co.	Ticonderoga, NY	7×10^{-5}	X	PENDING	X (h)		1.0	ADOPTED	X
P.H. Glatfelter Co.	Spring Grove, PA	7×10^{-5} (f)	X	PENDING	X	0.01 (T)		ADOPTED	X
Louisiana Pacific Corp.	Samoa, CA	7×10^{-5}	X	PENDING			0.0039	ADOPTED	X
Chesapeake Corp.	West Point, VA	6×10^{-5}					1.2	ADOPTED	
Champion International	Houston, TX	6×10^{-5} (f)	X	APPROVED		0.5	0.3	EXPECTED	
Mead Corporation	Escanaba, MI	5×10^{-5} (f)	X	APPROVED	X	0.014 (T)		ADOPTED	X
Federal Paper Board Co.	Riegelwood, NC	4×10^{-5}	X	APPROVED		0.013	0.014	ADOPTED	X
Nekoosa Papers, Inc.	Nekoosa/Pt. Ed., WI	4×10^{-5}	X	APPROVED	X	0.03		ADOPTED	X
Nekoosa Papers, Inc.	Ashdown, AR	4×10^{-5}	X	APPROVED	X	1.36		PROPOSED	
Alaska Pulp Corp.	Sitka, AK	4×10^{-5} (f)				0.013	0.014	ADOPTED	X

* = Mills below which consumption of fish is predicted to cause liver damage

(a = 2378-TCDD only; based on effluent data from 104 Mill Study and EPA's 1984 Water Quality Criteria Document for Dioxin which assumes a bioconcentration factor of 5000 and a consumption rate of slightly less than 2 quarter-pound meals per month)

(b = Section 304(l) of the Clean Water Act (Toxic Hot Spots Program) requires states to list those facilities contributing to violations of water quality standards for toxic pollutants and write an Individual Control Strategy (ICS) for each.)

(c = as of August 14, 1990. Please note that all mills do not require advisories.)

(d = as of August 21, 1990)

(e = mill discharges to a POTW)

(f = dioxin not detected in effluent; risk calculated using one-half of the detection limit)

(g = model input data on receiving water flow or effluent dioxin concentrations not quantifiable)

(h = fish consumption advisory is in effect for these waters due to contaminants other than dioxin, and/or the potential for unidentifed contaminantion.)

(T = derived by Translator Procedure)

COMPANY	CITY, ST	CANCER RISK (TCDD)(a)	SECTION 304(l) OF THE CWA: ON LIST	SECTION 304(l) OF THE CWA: ICS STATUS (b)	FISH ADVISORY IN-PLACE (c)	WATER QUALITY STANDARDS (d): WATER & FISH CRITERIA (ppq)	WATER QUALITY STANDARDS (d): FISH ONLY CRITERIA (ppq)	WATER QUALITY STANDARDS (d): STATUS	EPA APPROVAL
Westvaco Corp.	Luke, MD	3×10^{-5} (e)			X		1.2	ADOPTED	X
Appleton Papers, Inc.	Roaring Springs, PA	3×10^{-5} (f)				0.01 (T)		ADOPTED	X
Kimberly-Clark Corp.	Coosa Pines, AL	3×10^{-5}	X	APPROVED			1.2	ADOPTED	
Bowater Corp.	Catawba, SC	3×10^{-5}	X	APPROVED			1.2	PROPOSED	
International Paper Co.	Pine Bluff, AR	3×10^{-5}	X	APPROVED	X	1.36		PROPOSED	
Champion International	Lufkin, TX	3×10^{-5} (f)	X	APPROVED		0.5	0.3	EXPECTED	
Scott Paper Co.	Westbrook, ME	2×10^{-5}	X	PENDING	X	0.013	0.014	ADOPTED	
Penntech Papers, Inc.	Johnsonburg, PA	2×10^{-5}	X	PENDING		0.01 (T)		ADOPTED	X
Container Corp. of Amer.	Brewton, AL	2×10^{-5}					1.2	ADOPTED	
Boise Cascade Corp.	Jackson, AL	2×10^{-5}					1.2	ADOPTED	
International Paper Co.	Mobile, AL	2×10^{-5}					1.2	ADOPTED	
Gulf States Paper Corp.	Demopolis, AL	2×10^{-5}					1.2	ADOPTED	
International Paper Co.	Selma, AL	2×10^{-5}					1.2	ADOPTED	
James River Corp.	Butler, AL	2×10^{-5}					1.2	ADOPTED	
ITT-Rayonier, Inc.	Jesup, GA	2×10^{-5}					7.2	ADOPTED	
Boise Cascade Corp.	Int'l Falls, MN	2×10^{-5}	X	APPROVED	X	0.00051 (T)		PROPOSED	
Mead Corp.	Chillicothe, OH	2×10^{-5} (f)	X	PENDING		0.13	0.14	ADOPTED	X
Consolidated Papers, Inc.	Misc. Rapids, MI	2×10^{-5} (f)	X	APPROVED	X	0.03		ADOPTED	X
ITT-Rayonier, Inc.	Port Angeles, WA	2×10^{-5}						EXPECTED	
James River Corp.	Berlin, NH	1×10^{-5}	X	PENDING	X		1.0	ADOPTED	
Champion International	Courtland, AL	1×10^{-5}					1.2	ADOPTED	
ITT-Rayonier, Inc.	Fernandina Beach, FL	1×10^{-5}				0.013	0.014	PROPOSED	
Gilman Paper Co.	St. Marys, GA	1×10^{-5} (f)					7.2	ADOPTED	
Georgia-Pacific Corp.	Woodland, ME	9×10^{-6}	X	APPROVED		0.013	0.014	ADOPTED	
Scott Paper Co.	Hinckley, ME	9×10^{-6}	X	APPROVED	X	0.013	0.014	ADOPTED	
James River Corp.	Old Town, ME	8×10^{-6}	X	PENDING	X	0.013	0.014	ADOPTED	
Federal Paper Board Co.	Augusta, GA	8×10^{-6}					7.2	ADOPTED	
Alabama River Pulp	Claiborne, AL	7×10^{-6}					1.2	ADOPTED	
Potlatch Corp.	Lewiston, ID	7×10^{-6}	X	APPROVED		0.013	0.014	EXPECTED	
Lincoln Pulp and Paper	Lincoln, ME	6×10^{-6}	X	PENDING	X	0.013	0.014	ADOPTED	
Scott Paper Co.	Mobile, AL	6×10^{-6}					1.2	ADOPTED	
Bowater Corp.	Calhoun, TN	6×10^{-6} (f)	X	PENDING			1.0	PROPOSED	
Champion International	Quinnesec, MI	6×10^{-6}	X	APPROVED		0.014 (T)		ADOPTED	X
Potlatch Corp.	Cloquet, MN	6×10^{-6} (e)				0.00051 (T)		PROPOSED	
Union Camp Corp.	Eastover, SC	5×10^{-6}					1.2	PROPOSED	
Pope & Talbot, Inc.	Halsey, OR	5×10^{-6}	X	PENDING		0.013	0.014	ADOPTED	X
Boise Cascade Corp.	Wallula, WA	5×10^{-6}	X	PENDING				EXPECTED	
Mead Corporation	Kingsport, TN	4×10^{-6}	X	APPROVED			1.0	PROPOSED	

* = Mills below which consumption of fish is predicted to cause liver damage

(a = 2378-TCDD only; based on effluent data from 104 Mill Study and EPA's 1984 Water Quality Criteria Document for Dioxin which assumes a bioconcentration factor of 5000 and a consumption rate of slightly less than 2 quarter-pound meals per month)

(b = Section 304(l) of the Clean Water Act (Toxic Hot Spots Program) requires states to list those facilities contributing to violations of water quality standards for toxic pollutants and write an Individual Control Strategy (ICS) for each.)

(c = as of August 14, 1990. Please note that all mills do not require advisories.)

(d = as of August 21, 1990)

(e = mill discharges to a POTW)

(f = dioxin not detected in effluent; risk calculated using one-half of the detection limit)

(g = model input data on receiving water flow or effluent dioxin concentrations not quantifiable)

(h = fish consumption advisory is in effect for these waters due to contaminants other than dioxin, and/or the potential for unidentified contamination.)

(T = derived by Translator Procedure)

ERRATA SHEET

Changes in results for the International Paper Co. mill in Texarkana, TX (TX000167) have been made based on comments received from EPA Region VI. These comments were received after the final document had been reproduced.

EPA region VI indicated that this mill does not discharge throughout the entire year, but rather discharges intermittently from October to May. Therefore, the receiving stream harmonic mean and 7Q10 flows used to calculate instream concentration (which were based on a year-round discharge) were incorrect. The revised Tables C-K which follow present the corrected results for the two samples taken from this mill using the revised harmonic mean and 7Q10 flows (for the months October - May) for the receiving stream. These changes, which are relatively minor, have not resulted in any changes to the main text of the document.

Errata Sheet for Table C.1
Raw Input Data

NPDES NUMBER	SAMPLEID	COMPANY	CITY	GRP ID	HARMONIC MEAN FLOW (m^3/hr.)	7Q10 LOW FLOW (m^3/hr.)	TSS IN MILL EFFLUENT (mg/l)	ADJ TSS* IN RECG WATERS (HARM MEAN Q) (mg/l)	PLANT FLOW (mgd)	TCDD CONC. (ppq)	TCDD NON-DETECT	TCDD LOAD (kg/hr)	TCDF CONC. (ppq)	TCDF NON-DETECT	TCDF LOAD (kg/hr)
TX0000167	M99EC	International Paper Co.	Texarkana	1	30603	4893	494.9	0.7	38.36	13		7.9E-08	43		2.6E-07
TX0000167	M99EC1	International Paper Co.	Texarkana	1	30603	4893	494.9	0.7	38.36	18		1.1E-07	44		2.7E-07

*The present EXAMS II runs were made using an in-stream TSS value of 9.6 mg/l, which is the combined in-stream and effluent TSS concentration. This value was used due to the calculation of harmonic mean flow for this mill using the sum of stream and plant flow. As described in Appendix B, Section B.2.2. of this report, if the mill discharge exceeded 5% of the average stream flow at the mill, then the mill discharge flow was added to the area-adjusted stream flow values prior to calculating the harmonic mean. During earlier assessments of this mill, EXAMS II failed to run using the low instream TSS concentration that resulted from adjustment for annual harmonic mean flow. For these runs, an in-stream TSS concentration based on average annual water flow was used (22 mg/l).

Errata Sheet for Appendix D.
In-stream Contaminant Concentrations in pg/l

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DETECT	TCDF NON-DETECT	SIMPLE DILTUTION TCDD CONC.	SIMPLE DILTUTION TCDF CONC.	EXAMS WATER COLUMN TCDD CONC.	EXAMS WATER COLUMN TCDF CONC.
International Paper Co.	Texarkana	M99EC	TX0000167	1			2.15E+00	7.10E+00	8.18E-01	7.05E+00
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2.97E+00	7.26E+00	1.13E+00	7.21E+00

Errata Sheet for Appendix E.
In-stream Contaminant Concentrations for Low (7Q10) Flow Conditions Calculated by Simple Dilution Only

COMPANY	CITY	NPDES NUMBER	SAMPLEID	GRP ID	TCDD NON-DETECT	TCDF NON-DETECT	7Q10 FLOW (m^3/hr)	TCDD CONC. (pg/l)	TCDF CONC. (pg/l)	TEQ CONC. (pg/l)
International Paper Co.	Texarkana	TX0000167	M99EC	1			4893	7.18E+00	2.37E+01	9.55E+00
International Paper Co.	Texarkana	TX0000167	M99EC1	1			4893	9.94E+00	2.43E+01	1.24E+01

Errata Sheet for Appendix F.
Fish Filet Tissue Residue Levels (ng/kg)

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	SIMPLE DILUTION: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	SIMPLE DILUTION: TCDF FILET CONC.	SIMPLE DILUTION: TEQ FILET CONC.	SIMPLE DILUTION: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	SIMPLE DILUTION: TCDF FILET CONC.	SIMPLE DILUTION: TEQ FILET CONC.	EXAMS WATER COLUMN: TCDD BCF TO FILET=5,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	EXAMS WATER COLUMN: TCDF FILET CONC.	EXAMS WATER COLUMN: TEQ FILET CONC.	EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 / TCDF BCF TO FILET=1,950 — TCDD FILET CONC.	EXAMS WATER COLUMN: TCDF FILET CONC.	EXAMS WATER COLUMN: TEQ FILET CONC.
International Paper Co.	Texarkana	M99EC	TX0000167	1			1.07E+01	1.38E+01	1.21E+01	1.07E+02	1.38E+01	1.09E+02	4.09E+00	1.37E+01	5.46E+00	4.09E+01	1.37E+01	4.23E+01
International Paper Co.	Texarkana	M99EC1	TX0000167	1			1.49E+01	1.42E+01	1.63E+01	1.49E+02	1.42E+01	1.50E+02	5.67E+00	1.41E+01	7.08E+00	5.67E+01	1.41E+01	5.81E+01

Errata Sheet for Appendix G.
Average daily lifetime 95% Bioavailable Dose in mg/kg/day of 2378-TCDD and 2378-TCDF as TEQ from Fish Ingestion

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	DOSE	SIMPLE DILUTION: TCDD BCF=50,000, TCDD BCF=1,950 — @ 6.5 g/day	SIMPLE DILUTION: @ 30 g/day	SIMPLE DILUTION: @ 140 g/day	DOSE FROM EXAMS WATER COLUMN: TCDD BCF=50,000, TCDD BCF=1,950 — @ 6.5 g/day	DOSE FROM EXAMS WATER COLUMN: @ 30 g/day	DOSE FROM EXAMS WATER COLUMN: @ 140 g/day
							TCDD BCF FILET= 5,000, TCDF, 1,950						
International Paper Co.	Texarkana	M99EC	TX0000167	1				1.1E-09	4.4E-08	2.1E-07	4.8E-10	1.7E-08	8.0E-08
International Paper Co.	Texarkana	M99EC1	TX0000167	1				1.4E-09	6.1E-08	2.8E-07	6.2E-10	2.4E-08	1.1E-07

Errata Sheet for Appendix H.
Mill Specific Dose (pg/kg/day) from Drinking Water at Ingestion of 2 Liters per Day

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DET-ECT	TCDF NON-DET-ECT	SIMPLE DILUTION: DRINKING WATER DOSES — TCDD	SIMPLE DILUTION: TCDF	SIMPLE DILUTION: TEQ	EXAMS WATER COLUMN: DRINKING WATER DOSES — TCDD	EXAMS WATER COLUMN: TCDF	EXAMS WATER COLUMN: TEQ
International Paper Co.	Texarkana	M99EC	TX0000167	1			6.1E-11	2.0E-10	8.2E-11	2.3E-11	2.0E-10	4.4E-11
International Paper Co.	Texarkana	M99EC1	TX0000167	1			8.5E-11	2.1E-10	1.1E-10	3.2E-11	2.1E-10	5.3E-11

Errata Sheet for Appendix I.
Mill Specific Unit Risk[1] from Fish Ingestion

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DETECT	TCDF NON-DETECT	SIMPLE DILUTION: TCDD FILET BCF=5,000[2] TCDF FILET BCF=1,950 — TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	SIMPLE DILUTION: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 — TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ	EXAMS WATER COLUMN: TCDD FILET BCF=5,000[2] TCDF FILET BCF=1,950 — TCDD RISK @ 6.5 g/day	TEQ RISK @ 6.5 g/day	% TCDD IN TEQ	EXAMS WATER COLUMN: TCDD BCF TO FILET=50,000 TCDF BCF TO FILET=1,950 — TCDD RISK @ 30 g/day	TEQ RISK @ 30 g/day	TCDD RISK @ 140 g/day	TEQ RISK @ 140 g/day	% TCDD IN TEQ
International Paper Co.	Texarkana	M99EC	TX0000167	1			1E-04	2E-04	89	7E-03	7E-03	3E-02	3E-02	99	6E-05	8E-05	75	3E-03	3E-03	1E-02	1E-02	97
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2E-04	2E-04	91	1E-02	9E-03	4E-02	4E-02	99	8E-05	1E-04	80	4E-03	4E-03	2E-02	2E-02	98

[1] U.S. EPA weight-of-the-evidence classification "B2" (US EPA, 1986a)

[2] Recent laboratory evidence indicates that use of a BCF of 50,000 would more accurately reflect the uptake of 2378-TCDD by fish. Therefore, risk estimates based on a fish filet BCF of 5,000 may underestimate risks by an order of magnitude.

Errata Sheet for Appendix J.
Mill Specific Unit Risk[1] from Drinking Water Ingestion @ 2 Liters per Day

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DETECT	TCDF NON-DETECT	SIMPLE DILUTION: TEQ DRINK. WATER RISK	SIMPLE DILUTION: % TCDD RISK IN TEQ RISK	EXAMS WATER COLUMN: TEQ DRINK. WATER RISK	EXAMS WATER COLUMN: % TCDD RISK IN TEQ RISK
International Paper Co.	Texarkana	M99EC	TX0000167	1			1E-05	75	7E-06	54
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2E-05	80	8E-06	61

[1] U.S. EPA weight-of-the-evidence classification "B2" (US EPA, 1986a)

Errata Sheet for Appendix K.
Mill Specific Human Dose[1] from a Single 115 Gram (1/4 Pound) Fish Ingestion (in pg/kg/day) for Comparison with the TCDD Health Advisory[2] for Protection from Liver Effects

COMPANY	CITY	SAMPLEID	NPDES NUMBER	GRP ID	TCDD NON-DETECT	TCDF NON-DETECT	SIMPLE DILUTION: BCF TO FILET TCDD=5,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE	SIMPLE DILUTION: BCF TO FILET TCDD=50,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE	EXAMS WATER COLUMN: BCF TO FILET TCDD=5,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE	EXAMS WATER COLUMN: BCF TO FILET TCDD=50,000 TCDF=1,950 — TCDD DOSE	TEQ DOSE
International Paper Co.	Texarkana	M99EC	TX0000167	1			1.7E+01	1.9E+01	1.7E+02	1.7E+02	6.4E+00	8.5E+00	6.4E+01	6.6E+01
International Paper Co.	Texarkana	M99EC1	TX0000167	1			2.3E+01	2.5E+01	2.3E+02	2.3E+02	8.8E+00	1.1E+01	8.8E+01	9.1E+01

[1] Dose is the bioavailable (95%) portion of exposure.
[2] Health Advisory Level = 100 pg/kg/day.