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ITT RAYONIER CLASS II INSPECTION

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ABSTRACT

Ecology conducted a Class II inspection at the ITT Rayonier pulp mill at Hoquiam on May 23-25, 1988. The mill was meeting all effluent permit limits during the inspection although effluent quality was very poor. High effluent toxicity was observed in the Pacific oyster bioassay (EC_{50} of 0.2% effluent). No specific cause of the toxicity was determined. Silver and copper exceeded EPA's water quality criteria. Other contaminants did not exceed criteria. Several factors combined to render near-field sediment analyses inconclusive. Recommendations were made in the areas of laboratory procedures, plant operation, and future sampling.

INTRODUCTION

A Class II inspection was conducted at ITT Rayonier in Hoquiam on May 23-25, 1988. Timing of the inspection coincided with a multi-agency study into low survival of Chehalis River coho salmon. The inspection was performed by Don Reif of Ecology's Environmental Investigations and Laboratory Services Program, Compliance Monitoring Section. Assistance was provided by Jerry Schaaf and Dennis Davies from ITT.

The inspection objectives were to:

- Collect effluent samples to check NPDES permit compliance.
- Characterize the wastewater to identify pollutants of concern.
- Perform a series of effluent and sediment bioassays to assess toxicity, and to collect data for continued development of Ecology's biomonitoring program.
- Perform a laboratory evaluation, including sample splits, for accuracy and adherence to accepted analytical protocols.
- Provide data to meet objectives of the Grays Harbor salmon study.

This report is one of two Class II inspection reports associated with the salmon study. The other was conducted at the Weyerhaeuser, Cosmopolis pulp mill (Hallinan, 1989). Results of the other aspects of this study will be published by the Department of Ecology (Johnson, in preparation) and the Department of Fisheries.

LOCATION AND DESCRIPTION

ITT Rayonier, Inc., Grays Harbor Division, is located in Hoquiam at Grays Harbor on the central Washington coast (Figure 1). The plant produces about 400 tons per day of paper grade bleached pulp. The majority of the pulp is processed at Grays Harbor Paper Company, adjoining the pulp mill.

ITT's on-site wastewater treatment plant treats an average of 20 MGD of process wastewaters generated by the pulp plant, Grays Harbor Paper Company, and the nearby ITT Rayonier vanillin plant. A schematic of the treatment system is shown in Figure 2. Pump stations at various mill locations collect the influent streams, consisting of spent sulfite liquor and occasionally hot caustic and/or vanillin black liquor. The influent undergoes primary treatment, with polymer addition to enhance the removal of wood fibers and other particulates. The primary effluent is treated in a complete-mix activated sludge lagoon. Nutrients, as phosphoric acid and ammonium phosphate, are added to allow proper biological growth. The activated sludge is then settled in three secondary clarifiers.

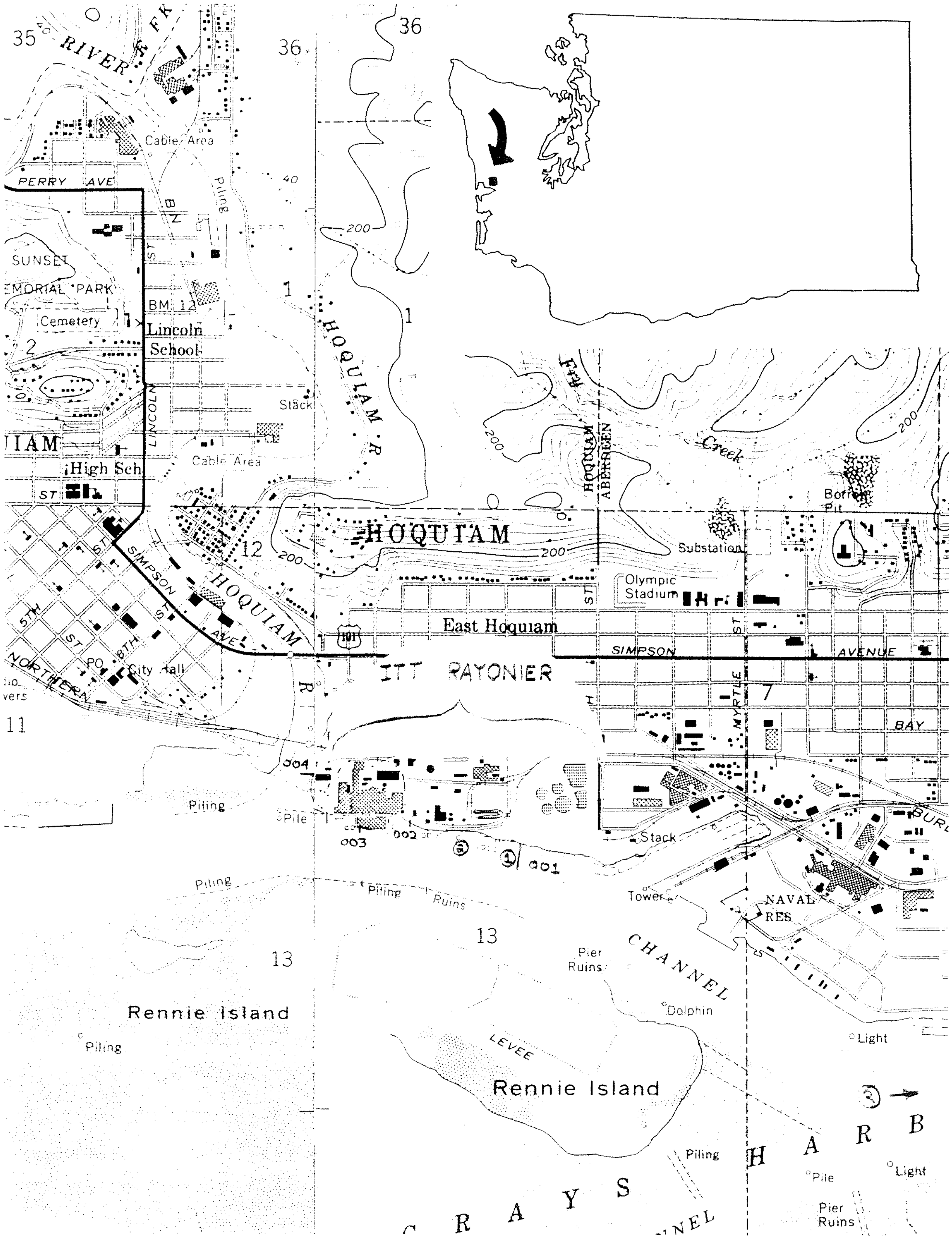

Figure 1. Mill location with treatment system, outfalls, and sediment sampling sites:
ITT Rayonier, Hoquiam Class II Inspection; May 23-25, 1988.

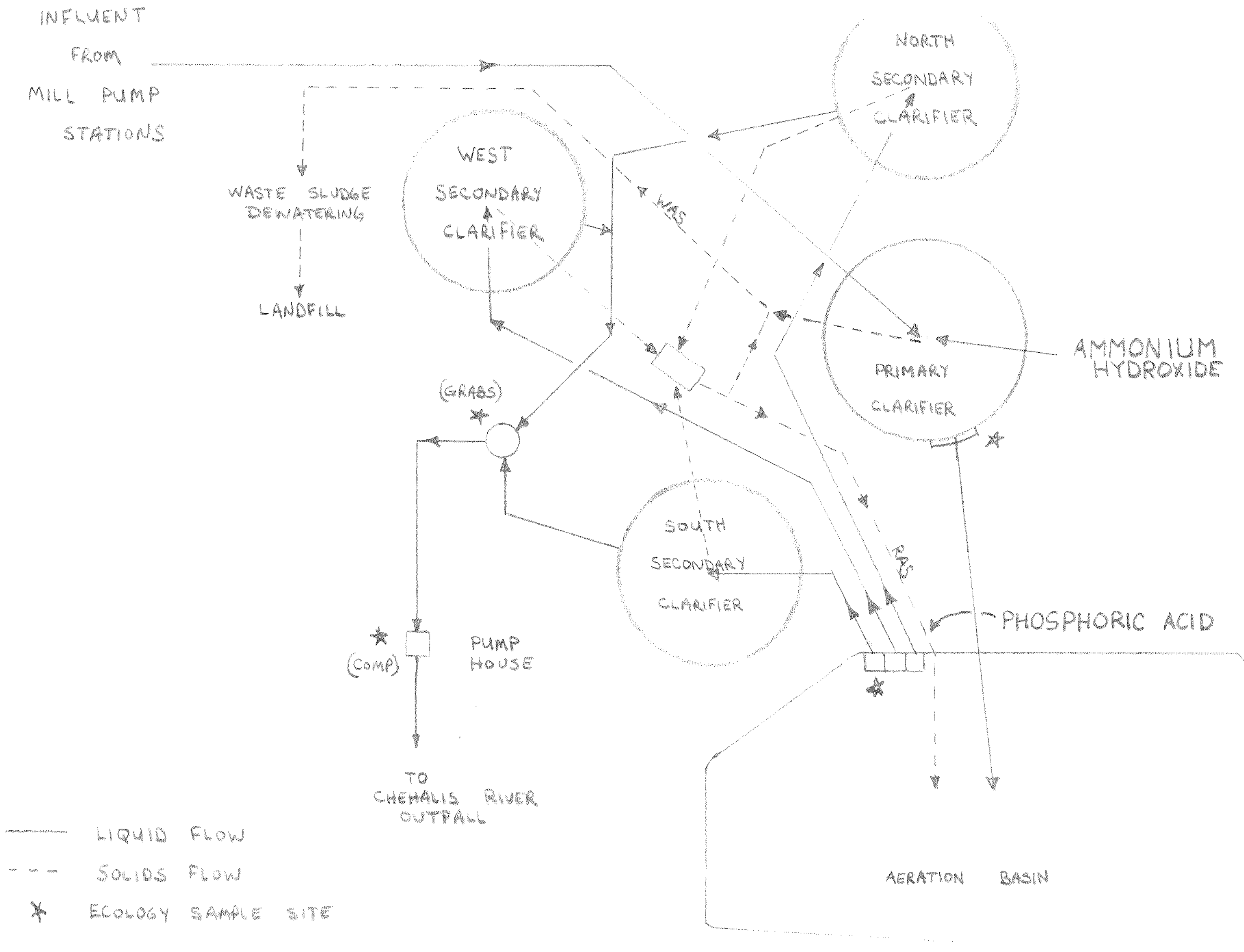

Figure 2. Process wastewater treatment system with sampling locations: ITT Rayonier, Hoquiam Class II Inspection; May 23-25, 1988.

Final effluent is discharged to the north channel of the Chehalis River in Grays Harbor estuary (outfall 001). Three other outfalls discharge nearby, carrying cooling water from chemical recovery and the powerhouse (002), old filter plant backwash and overflow water and paper mill cooling water (003), and new filter plant overflow and backwash water (004).

Waste activated sludge (excess activated sludge) has in the past been reintroduced to the final effluent before discharge, in amounts less than the daily permitted maximums for BOD and TSS. This practice did not occur during the inspection due to poorer-than-normal effluent quality (D. Davies, ITT, personal communication). Since a ruling by the Pollution Control Hearings Board (case #85-218, January 6, 1989), this method of sludge disposal is prohibited.

METHODS

The sampling schedule, including field analyses, is listed in Table 1. Sampling locations are shown in Figures 1 (sediment) and 2. Sample analysis was performed by Ecology's Manchester Laboratory and several contract labs. Analytical methods with references are summarized in Table 2.

A twenty-four hour effluent composite sample was collected at ITT's final effluent sampler building. Approximately 220 mL of sample were collected at 30-minute intervals. Effluent bioassay samples consisted of two-grab composites due to the large volume necessary. Grab samples were also taken of primary clarifier effluent, aeration basin effluent, and final effluent, as well as the other permitted discharges (Table 1). A sample of thickened sludge was collected from the sludge handling building.

Two sediment samples were collected off the outfall diffuser. However, the exact outfall line location was not positively identified due to a lack of available reference information. Therefore, the exact sampling locations with regard to the outfall is uncertain. The first was taken about 20 feet downstream of the outfall diffuser, and the second 300 feet downstream of #1. Cow Point, above Rennie Island, was used as a reference sample location.

Sediment toxicity was assessed with the marine amphipod *Rhepoxinius abronius*. Rainbow trout, *Daphnia pulex*, mysid shrimp, and oyster larvae bioassay tests were used to evaluate toxicity of the final effluent.

RESULTS

Flow

Flow through ITT's outfall #001 is measured with an inline venturi-type flow meter located before the outfall control house. Verification of meter accuracy was not possible. The outfall line is inaccessible except for the outfall control house, where flow control valves do not allow the use of an ultrasonic flow measuring device. Ecology's ability to verify flow rate is necessary to prove permit compliance. ITT should provide a safe and easily accessible flow sampling location.

Table 1. Ecology Sampling Schedule - ITT Rayonier, Hoquiam Class II Inspection: May 23-25, 1988

			Field Analysis			Laboratory Analysis																																Bioassays					
											Nutrients			Solids																											
Station	Date	Time	Temp.	pH	Cond.	pH	Turb.	Cond.	Alk.	Hard.	NH_3-N	NO_3-N	Total P	TS	TNVS	TSS	TNVSS	COD	BOD	TOC	% solids	Fecal Coli.	% Klebs.	Sulfite	Cyanide	Ep TOX	VOA	Phenol	BNA	Pest/PCB	TOX	PP metals	Resin acids	Dioxin	Grain size	Trout	Daph. pulex	Mysid shrimp	Oyster larvae	Ames test	Rhep. abr.
1-Clar.Eff.	5/24	am	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																							
	5/24	pm	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																							
AB Effluent	5/24	am	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																							
	5/24	pm	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																							
Effluent (001)	5/24	am	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																							
	5/24	pm	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X				X	X																		
	5/25	am	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X				X	X																		
Eff-Ecology	5/24-25		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X		X	X	X	X	X	X	X			X	X	X	X	X	
Eff-ITT	5/24	pm	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X																						
002-cooling	5/24	pm	X	X	X	X	X	X	X		X	X	X			X	X	X																							
003-filter	5/24	pm	X	X	X	X	X	X	X		X	X	X			X		X																							
004-filter	5/24	pm	X	X	X	X	X	X	X		X	X	X			X		X																							
Sludge	5/24	am																			X				X	X			X	X		X	X	X							
Sediment #1	5/23	pm																			X				X		X	X	X	X		X	X	X	X						X
Sediment #2	5/23	pm																			X				X		X	X	X	X		X	X		X						X
Sed.Control	5/23	pm																			X				X		X	X	X	X		X	X		X						X

Table 2. Analytical Methods- ITT Rayonier, Hoquiam Class II Inspection: May 23-25, 1988

Analysis	Method	Laboratory
TOC (solids)	APHA, 1985: #505	Laucks Testing Labs; Seattle, WA
Grain Size	Tetra Tech, 1986	Laucks Testing Labs; Seattle, WA
% Solids	APHA, 1985: #209F	Laucks Testing Labs; Seattle, WA
TOX (water)	EPA. 1986: #9020	Sound Analytical Services, Inc.; Tacoma, WA
TOC (water)	EPA, 1983: #415	Ecology; Manchester, WA
VOA (water)	EPA, 1984: #624	Ecology; Manchester, WA
VOA (solids)	EPA, 1986: #8240	Ecology; Manchester, WA
BNA (water)	EPA, 1984: #625	Ecology; Manchester, WA
BNA (solids)	EPA, 1986: #8270	Ecology; Manchester, WA
Pest/PCB (water)	EPA, 1984: #608	Ecology; Manchester, WA
Pest/PCB (solids)	EPA, 1986: #8080	Ecology; Manchester, WA
Resin Acids (water & solids)	NCASI, 1986	Ecology; Manchester, WA
Metals (water)	EPA, 1983: #200 series	Ecology; Manchester, WA
Metals (solids)	EPA, 1983: #200 series	Ecology; Manchester, WA
Total phenolics	EPA, 1983: #420.2	Ecology; Manchester, WA
Cyanide (water)	EPA, 1983: #335.2-1	Ecology; Manchester, WA
Dioxin (solids)	EPA, 1986: #8280	Enseco Incorporated; West Sacramento, CA
Trout 96-hour	Ecology, 1981	Ecology; Manchester, WA
Daphnia pulex	EPA, 1985	Ecology; Manchester, WA
Mysid shrimp	EPA, 1985	E.V.S. Consultants; Seattle, WA
Oyster larvae	ASTM, 1986	E.V.S. Consultants; Seattle, WA
Ames test	Maron & Ames, 1983	SRI International; Menlo Park, CA
Rhepoxinius	Tetra Tech, 1986	E.V.S. Consultants; Seattle, WA

For the inspection period, a flow of 21.55 MGD was recorded by ITT's meter and is used in subsequent loading calculations.

General Conditions

An examination of general chemistry results in Table 3 reveals some noteworthy points. First, effluent total suspended solids (TSS) seem excessive for an activated sludge plant (120-320 mg/L). Supporting this statement further is the fact that final effluent TSS was higher than in the primary clarifier effluent. Also, total solids removal was very slight. COD removal was modest in the secondary system. A check of secondary clarifier surface overflow rate, weir overflow rate, and solids loading rate indicated all were well within design parameters for domestic activated sludge systems. Therefore, the poor effluent quality would not seem to be related to the system's design (see permit compliance section). During several visits to the treatment system, several draft tubes (the clarifiers' sludge removal system) appeared to be clogged and nonfunctional, which could contribute to high solids carryover into the effluent. High effluent solids may be related to the WTP's operation and maintenance rather than design limitations or wastewater characteristics.

Also visible from Table 3 is nutrient levels in the WTP. The locations of ammonia and phosphorus addition can be seen. Final effluent concentrations were low for both nutrients, which should be good for protection of the receiving water environment. It appears, however, that nitrification occurred in ITT's composite sample. Table 3 shows that most of the ammonia in ITT's effluent composite sample had been converted to nitrate and/or nitrite. Decreased alkalinity, another indicator of nitrification, also occurred. Nitrification was not seen in grab samples or Ecology's composite sample. Therefore, the nitrification probably occurred due to a buildup of nitrifying bacteria in the sampling lines and/or sample container. This could affect the BOD test. Regular monthly cleaning of ITT's composite sampler lines and containers with a dilute chlorine solution is recommended.

Permit Compliance

Table 4 compares results of Ecology's composite sample to NPDES permit limits for ITT's main outfall, #001. BOD and pH were well within permitted limits. The trout bioassay passed with no mortality at 65 percent effluent. Total suspended solids exceeded the daily average limit but were less than the daily maximum allowed. Also, one of two fecal coliform analyses exceeded the monthly average criteria. Fecal coliforms can be associated with TSS and turbidity. The higher coliform count was found at the higher turbidity and TSS concentration. Associated with these solids are conventional, organic, and potentially toxic substances as noted in the effluent and sludge analyses. For these reasons, ITT is urged to operate all three clarifiers at all times and to flush out and adjust the flow through the secondary clarifier draft tubes daily, as part of their normal operating procedure.

Priority Pollutant Scan/Organic Analyses

Summaries of priority pollutants and other target chemicals that were detected are in Table 5 (organics) and Table 6 (metals). Complete results of analyses are listed in the appendices. These tables are referred to in the following discussions.

Table 3. Ecology Analytical Results for General Chemistry Parameters - ITT Rayonier, Hoquiam Class II Inspection: May 23-25, 1988

			Field Analysis			Laboratory Analysis																	
											Nutrients (mg/L)			Solids (mg/L)									
Station	Date	Time	Temp. (C.)	pH (s.u.)	Cond. (umhos/cm)	pH (S.U.)	Turb. (NTU)	Cond. (umhos/cm)	Alkal. (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	NH3-N	NO3+NO2-N	Total-P	TS	TNVS	TSS	TNVSS	COD (mg/L)	BOD (mg/L)	TOC (mg/L)	Fecal Coliform (#/100mL)	% Klebs.	Sulfite (mg/L)
1-Clar.Eff.	5/24	1000	23.5	5.54	650	5.3	12	1290	64		23	0.14 IS	0.79 H	1500	770	45	37	1000					
	5/24	1515	24.2	5.59	>1000	5.4	11	1520	85		29	0.12 IS	0.89 H	1800	950	120	82	1100					
AB Effluent	5/24	1010	23.6	6.69	820	6.4	275	1390	96		4.2	0.05 IS	14.0 H	2500	1100	1800	230	3000					
	5/24	1525	24.0	6.46	>1000	6.3	275	1360	78		4.7	0.05 IS	3.1 H	3300	1000	2000	640	3000					
Effluent	5/24	1021	23.3	6.84	1000	6.6	12	1430	87		3.4	0.04 IS	2.3 H	1700	940	320	110	850					
(001)	5/24	1535	23.4	6.60	>1000	6.5	25	1390	75		3.7	0.03 IS	0.39 H	1600	930	170	110	840			21000	(1)	
	5/25	1140	24.0	6.42	>1000	6.5	3	1370	71		4.3	0.04 IS	0.29 H	1400	760	120	41	830			6700	(1)	
Eff-Ecology	5/24-25 (0100-0030 hr)		3.1	6.81	>1000	6.7	14	1380	81	280	3.8	0.03 IS	0.27 H	1600	870	170	67	950	47	300			0.32
Eff-ITT	5/24-25 (0100-0030 hr)		11.3	6.49	>1000	6.7	3	1370	38		0.34	2.7 IS	0.36 H	1500	780	120	81	840	60				
002-cooling	5/24	1235	19.5	6.27	4810	6.5	2	4370	25		0.05	0.15 IS	0.08 H			26		260					
003-filter	5/24	1305	15.3	7.20	5820	6.8	<1	5720	25		<0.01	0.12 IS	0.01 H			8		<4					
004-filter	5/24	1320	13.5	7.20	5730	6.9	17	5610	19		0.01	0.13 IS	0.09 H			46		9					

1 - enumeration not possible due to large number of background organisms.
H - sample holding time prior to analysis was exceeded.
IS - 'interfering substance'- results should be evaluated with caution.

Table 4. Comparison of Inspection Results to NPDES Permit Limits - ITT Rayonier Class II Inspection: May 25-35, 1988

Parameter	Daily Average	Daily Maximum	Inspection Results
BOD_5, lbs/day*	14,700	28,200	8,450
TSS, lbs/day*	21,900	40,800	30,550
Fecal Coliform, #/100 mL	20,000/month avg.		21,000, 6700
pH	5.0-9.0		6.84, 6.60, 6.42
Trout bioassay	80% survival at 65% effluent		100% survival at 65% effluent

* - loadings based on flow of 21.55 MGD from ITT's flowmeter.

Table 5. Parameters Detected in VOA, BNA, Herbicide, Resin Acid, and Dioxin Analyses - ITT Rayonier Class II Inspection: May 23-25, 1988

	Effluent	Sediments (ug/kg dry wt.)			Waste Activated Sludge
VOA Compounds	(ug/L)	at ITT	below ITT	Cow Point	(ug/kg dry wt.)
Methylene Chloride				77 B	
Chloroform	320				
Bromodichloromethane	0.3 J				
Phenols, Total	4				0.018
Organic halides, Total (ug/L)	69				
Cyanide	0.005 U	0.05 U	0.06 U	0.04 U	0.08 U
BNA Compounds					
Phenol		120 BU		16 BJ	11,000
Bis(2-Chloroethyl)Ether	2.0				
4-Methylphenol	0.3 J		170	51 J	35,000
Isophorone					1400
2,4-Dichlorophenol	0.3 J				
Naphthalene		120 UB	28 BJ	34 BJ	4800
2-Methylnaphthalene				9 J	
2,4,6-Trichlorophenol	5.0				
Acenaphthylene				7 J	
Dibenzofuran		17 J	21 J		
Diethyl Phthalate		120 BU	130 BU	100 BU	
Fluorene		18 J		10 J	
Phenanthrene		110 J	120 J	51 J	1450
Di-n-butylphthalate		27 J	26 J	29 J	
Fluoranthene		120 J	110 J	57 J	930
Pyrene		140	160	76 J	890
Retene			540	110	
Butylbenzylphthalate	0.5 BU	120 BU	130 BU	100 BU	
bis(2-ethylhexyl)phthalate	0.5	170 B	610 B	97 BJ	
Di-n-Octyl Phthalate		120 BU	510 B	15 BJ	
Herbicides					
Diuron					3000
Atrazine					200 M
Butylate					500
Resin Acids/Guaiacols/Catechols					
Guaiacol (2-methoxyphenol)	0.4 U	19 J	130 U	100 U	68,000
4,5,6-trichloroguaiacol	8	9 J	130 U	100 U	5,000
Tetrachlorocatechol	6	NA	NA	NA	NA
Oleic acid	0.4 BU	1600 J	3500 J	1500	110,000
Linoleic acid	0.4 U	740	1200 J	630 J	500 U
Sandaracopimaric acid	0.4 U	120 U	130 U	100 U	6,600
Isopimaric acid	0.4 U	120 J	130 U	100 U	17,000
Dehydroabietic acid	2 B	330 JB	340 JB	250 BJ	47,000
Abietic acid	0.4 U	120 U	130 U	100 U	16,000
Dichlorodehydroabietic acid	6	72 J	130 U	100 U	27,000
Furans/Dioxins (pg/g)					
TCDF's (total)		2.4		2.8	3.5
2,3,7,8-TCDF		2.4		2.8	3.5
OCDF		12 U		21 U	18
HpCDD's (total)		32		42	8.5 U
1,2,3,4,6,7,8-HpCDD		15		18	8.5 U
OCDD		92		140	59

U - indicates compound was analyzed for but not detected at the given detection limit.
J - indicates an estimated value when result is less than specified detection limit.
B - analyte was found in the blank as well as the sample, indicating possible/probable blank contamination.
NA- analyte was not analyzed for.

Table 6. Effluent Metals Results and Comparison to EPA Water Quality Criteria - ITT Rayonier Class II Inspection: May 23-25, 1988

Metal(ug/L)	Effluent	FW Acute	FW Chronic	SW Acute	SW Chronic
Antimony	<1	9000	1600	-	-
Arsenic	<3	-	-	-	-
Beryllium	2	130	5.3	-	-
Cadmium	<5	12.5	2.6	43	9.3
Chromium	553	4040	480	10300	-
Copper	21B*	47	29	2.9	2.9
Lead	<50	303	12	140	5.6
Mercury	<0.034	2.4	0.012	2.1	0.025
Nickel	21	4034	209	75	8.3
Selenium	21B	260	35	410	54
Silver	10.5B	24	0.12	2.3	-
Thallium	<1	1400	40	2130	-
Zinc	27	755	47	95	86
Hardness	280				

B - parameter detected in field transfer blank.
* - parameter detected in laboratory blank.

Effluent Chemistry

Only a handful of organic compounds at relatively low concentrations was detected in ITT's effluent (Table 5). These included several phenols, a phthalate, several fatty acids, a guaiacol and a catechol. The highest concentration was chloroform at 320 ug/L, which is one-fourth (1240 ug/L) of EPA's quality criteria for chronic protection of freshwater organisms (EPA 1986a). No chlorinated pesticides, PCB's, organophosphorus pesticides, or herbicides were detected.

Concentrations of several metals exceeded EPA receiving water quality criteria for protection of aquatic life. These were chromium, copper, nickel, and silver. However, the effluent was analyzed for total metals which may overestimate concentrations bioavailable to aquatic life. EPA recommends criteria values be compared to total recoverable metals. With this possible overestimation and the amount of available dilution for the effluent, silver and copper are the only metals that might have a receiving water impact.

Effluent Bioassays

No acute toxicity was indicated by effluent bioassays (Table 7). However, a particularly high amount of chronic toxicity was found in the oyster larvae test (EC_{50} of 0.2% effluent). The cause of this toxicity is not clear, although the oyster larvae test is known to be quite sensitive to pulp mill effluents (Hallinan 1989). Metals may have been a factor, since several exceeded EPA water quality criteria, especially silver and copper (Table 6). However, both the semivolatile and resin acid scans tentatively identified many organic compounds in the effluent (Appendix 10). No chlorinated compounds were identified. Information on the remainder was difficult to find and inconclusive.

Sediment Chemistry

Volatile organics, pesticides, and PCB's were not detected in the sediment samples (Appendices 1 and 4). However, several semi-volatiles (BNA's), including phthalates, polynuclear aromatic hydrocarbons (PNA's), 4-methylphenol, phenols, resin acids, fatty acids, and guaiacols were detected at low concentrations (Table 5). Metals (Table 8) were below AET values except for chromium and nickel, which exceeded the most restrictive of the proposed AET levels. Several dioxin and furan isomers were found at low concentrations (see Johnson, 1989, for more details). Concentrations of these organic compounds and metals were not appreciably higher than at the upstream control. However, two factors make comparisons difficult. First, Cow Point has been determined to be a poor control station, since it is probably within the zone of tidal influence from Gray's Harbors' pulp mills (Hallinan, 1989). Also, the samples collected may not be representative of ITT's diffusers' near-field sediments due to location uncertainties mentioned earlier.

Sediment Bioassays

Sediment toxicity was not exhibited by *Rhepoxinius* (Table 7). No significant differences in response were noted between the three field samples and the lab control, although mortality

Table 7. Bioassay Data Summary - ITT-Rayonier, Hoquiam Class II Inspection: May 23-25, 1988.

Bioassay	Results		
Effluent			
Acute tests:			
Rainbow Trout	0% mortality @ 65% effluent.		
Daphnia pulex	0% mortality @ 100% effluent.		
Mysid Shrimp	LC_{50} > 100%(1).		
Chronic test:			
Oyster larvae	EC_{50} of 0.2% effluent, based on larvae abnormality(2).		
Sediment	**Survival(3)**	**Avoidance(4)**	**% Reburial(5)**
at ITT	18.8 +/- 1.3	0.3 +/- 0.5	98.9
below ITT	17.2 +/- 1.1	0.2 +/- 0.4	98.9
Field Control	18.6 +/- 1.1	0.1 +/- 0.3	98.9
Lab Control	18.8 +/- 1.6	0.7 +/- 1.1	100

1 - LC_{50} = concentration lethal to 50% of the organisms(Ecology 1988).

2 - EC_{50} = concentration causing the tested effect to 50% of the organisms (Ecology 1988).

3 - Mean, based on twenty amphipods per replicate: five replicates per sample.

4 - Number of amphipods on jar surface per day, out of twenty.

5 - Number of amphipods able to rebury in clean sediment at end of test period.

Table 8. Sediment Metals Compared to Candidate Puget Sound Sediment Chemical Standards (AET's)* - ITT Class II Inspection: May 23-25, 1988

Parameter					Sediment		
Metals (mg/kg dw)	LAET-UTOX(1)	New LAET(2)	ACR NOEC(3)	PSDDA SL(4)	at ITT	below ITT	Cow Point
Arsenic	57	57	57	70	4.5	4.1	3.9
Cadmium	5.1	5.1	0.96	0.96	0.5 U	0.5 U	0.5 U
Chromium	260	260	27	NA	30.7	35.0	30.0
Copper	390	390	130	81	52.0	56.1	44.0
Lead	450	450	66	66	5.0	5.4	0.5 U
Mercury	0.59	0.41	0.21	0.21	0.015	0.010	0.011
Nickel	>140	>140	14	28	55.4	57.7	56.0 U
Silver	>0.56	>0.56	0.61	1.2	0.02 U	0.02 U	0.05
Zinc	410	410	160	160	77.1	80.8	71.0

(1) 1988 Lowest Apparent Effects Threshold Value excluding the Microtox value

(2) 1988 Lowest Apparent Effects Threshold Value

(3) Acute to Chronic Ratio No Observable Effects Concentration as reported in Contaminated Sediments Criteria Report, August 1988, PTI Environmental Services, i.e. Highest Apparent Effects Threshold Value, whichever is lower

(4) Puget Sound Dredged Disposal Analysis Screening Level (SL), ie, the 1986 Highest Apparent Effects Threshold value divided by 10. The SL is defined as no lower than mean reference area values and no higher than the 1986 lowest apparent effects threshold value

* - candidate AET's were compiled by Brett Betts of Ecology's Sediment Management Unit.

was somewhat higher in sample #2. Avoidance and reburial also were similar and unremarkable.

Sludge Chemistry

Sludge contaminant concentrations tended to be much higher than in the outfall sediments. Compounds detected in the sludge are summarized in Table 5. Several BNA's were found, including phenol, 4-methylphenol, and several PNA's. Phthalates, found in the sediments, were noticeably absent in the sludge. The sludge also contained concentrated resin acids and guaiacols as compared to the sediments. Most of the same dioxin/furan isomers found in the sludge were also present in the sediments.

Three herbicides - Diuron, Atrazine, and Butylate - were also detected. These compounds can provide general and/or specific vegetation control, depending on application rates (Meister, 1988). They are probably used for weed control around the plant and find their way to the treatment plant via the plant's stormwater collection system. The concentrations detected in the sludge (3, 0.2, and 0.5 parts per million for Diuron, Atrazine, and Butylate, respectively) are well below acute oral LD_{50} concentrations for rats (3400, 1780, and 3500 parts per million, respectively). Other possible effects or concerns for sludge disposal, etc., are not known. These herbicides were not detected in the effluent composite sample or sediments.

Sludge metals are compared to criteria in Table 9. First, priority pollutant metals are compared to freshwater sediment criteria from the state of Wisconsin. From this analysis, ITT's sludge exceeded the criteria for cadmium and chromium. The data are also compared to the results of previous inspections of municipal sludges. ITT's sludge is well within 'normal' metals concentrations except for chromium, which was much higher than average, equaling the highest level observed in 34 samples. Chromium was also high compared to Weyerhaeuser, Cosmopolis results (296 vs. 6.9 mg/kg dry wt.). Finally, results of the metals extraction procedure toxicity test (EP TOX) are compared to Ecology's criteria for designation as a dangerous waste. No metals exceeded these criteria.

Laboratory Review/Split Samples Comparison

A review of ITT's lab procedures revealed that a confusing mixture of references is used. These include Standard Methods (APHA, 1975), Ecology's BOD procedure (Ecology, 1977), and ITT's custom modifications of both (Davies, 1981). All three of these references are outdated, which contribute to several departures from commonly accepted protocols. Most notable was ITT's procedure for the seed BOD determination. Results of seeded dilution water blanks (a QA/QC check) are mistakenly substituted for the actual BOD of the seed, which is not determined. This subject was addressed in an earlier memo (Reif, 1988). To assure correct analytical analyses and to maintain equity within Ecology's regulated industrial dischargers, it is recommended that ITT follow the latest edition of Standard Methods (1985) for all NPDES test protocols.

Comparison of lab results from split samples are listed in Table 10. Comparisons were acceptable for BOD and pH. TSS values did not compare well on four of seven samples. On

Table 9. Sludge Priority Pollutant and EP Toxicity Metals Results and Comparison to Criteria - ITT Rayonier Class II Inspection: May 23-25, 1988

	mg/kg dry wt.			mg/L	
Metal	Pr.Poll.	Criteria(1)	Previous Insp.Avg.(2)	EP TOX	Criteria(3)
Antimony	<0.1	-	-	-	-
Arsenic	<0.1	10	-	<0.05	5.0
Barium	-	-	-	0.115	100.0
Cadmium	2.2	1.0	7.6	<0.005	1.0
Chromium	**296**	100	61.8	0.027	5.0
Copper	34.2	100	398	-	-
Lead	11.5	50	207	<0.05	5.0
Mercury	0.022	0.10	-	-	0.2
Nickel	14.5	100	25.5	-	-
Selenium	-	-	-	<0.5	1.0
Silver	0.93	-	-	<0.004	5.0
Zinc	79.6	100	1200	-	-

(1) - interim criteria for open-water disposal of dredged materials - Wisconsin Department of Natural Resources, 1985.

(2) - geometric mean of metals results from previous inspections of municipal activated sludge (Hallinan, 1988).

(3) - dangerous waste maximum concentration: from Ecology, 1982.

Table 10. Comparison of Laboratory Results - ITT Rayonier Class II Inspection: May 23-25, 1988

Sample	Date	Time	Sampler	Laboratory	pH	BOD_5 (mg/L)	TSS (mg/L)	std deviation (mg/L)*	Fecal Coliform (#/100mL)
Grabs:									
Pri.Clar. Effluent:	5/24	1000	Ecology	Ecology	5.54	-	45	+/- 14	
			ITT	ITT	5.4	-	34	+/- 10	
AB Efflu.:	5/24	1010	Ecology	Ecology	6.69	-	1800	+/- 14	
			ITT	ITT	6.5	-	2160	+/- 16	
Secondary Effluent:	5/24	1021	Ecology	Ecology	6.84	-	320	+/- 32	
			ITT	ITT	6.6	-	116	+/- 12	
	5/24	1535	Ecology	Ecology	-	-	-		21000
			ITT	ITT	-	-	-		1200
Composites:									
Effluent:	5/24-25		Ecology	Ecology	6.81	47	170	+/- 17	
			Ecology	ITT	6.8	53	130	+/- 13	
	5/24-25		ITT	Ecology	6.49	60	120	+/- 12	
			ITT	ITT	6.6	41	90	+/- 9	
Outfall 002			Ecology	Ecology	6.3		26		
			ITT	ITT	6.6		-		
Outfall 003			Ecology	Ecology	7.2		8	+/- 2	
			ITT	ITT	7.3		2.8	+/- 0.8	
Outfall 004			Ecology	Ecology	7.2		46	+/- 14	
			ITT	ITT	7.2		40	+/- 12	

* - from Standard Methods (APHA, 1985)

all splits except the aeration basin sample, ITT's figure was less than Ecology's. Also, the fecal coliform split did not compare well (21,000 vs 1200), as had the fecal split from the previous inspection (too numerous to count vs. 1200- Kjosness, 1987). Therefore, further splits of fecal coliform and TSS samples with ITT are recommended.

CONCLUSIONS AND RECOMMENDATIONS

- Although the mill was not in technical violation of its NPDES discharge permit during the inspection, the effluent daily average limit for suspended solids was exceeded, as was the monthly average fecal coliform limit on one of two samples. Effluent quality was poorer than should be expected. The poor quality effluent did not seem related to design restrictions. ITT is urged to operate all final clarifiers simultaneously and to flush out and adjust clarifier return sludge drawoff tubes daily. In addition, an access point to allow independent verification of flow rate for the main outfall is needed.

- Effluent pollutants found were chloroform at 320 ug/L and several other organics at very low concentrations. No contaminants exceeded established criteria. Silver and copper exceeded EPA's water quality criteria for chronic protection of aquatic life by nearly an order of magnitude.

- The Pacific oyster bioassay indicated a high level of chronic effluent toxicity. Future chronic toxicity testing should include the Pacific oyster larvae bioassay. Few adverse acute effects were noted. No effluent mutagenic activity was found in the Ames test.

- Sediment samples showed no significant acute toxicity. Organic and metal contaminants were not significantly elevated with respect to the upstream control sediment, including dioxin. Detailed location information is needed on ITT's outfall to allow proper sediment collection in the future.

- Waste activated sludge was found to contain many organic compounds, including phenols, PNA's, resin acids and guaiacols, dioxin and furan isomers, and three herbicides. Some metals exceeded various criteria, especially chromium.

- Sample splits for permit parameters did not compare well for suspended solids and fecal coliforms. Further splits of fecal coliform and TSS samples are recommended. Monthly cleaning or replacement of compositor sampling lines should eliminate sample nitrification.

- The seed BOD procedure is not used correctly. Use of the latest edition of Standard Methods is recommended for lab protocols to avoid confusion, assure highest analytical accuracy, and maintain equity between industrial dischargers.

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Appendix 1. Volatile Organic Acid Analyses- ITT Rayonier, Hoquiam Class II Inspection: May 23-25, 1988

Parameter	Effluent (ug/L)	Sediment (ug/kg dry wt.) at ITT	below ITT	Cow Point
Carbon Tetrachloride	5 U	10 U	12 U	8 U
Acetone	2 U	29 U	26 U	4 U
Chloroform	320	10 U	12 U	8 U
Benzene	0.2 U	10 U	12 U	8 U
1,1,1-Trichloroethane	5 U	10 U	12 U	8 U
Bromomethane	10 U	20 U	23 U	16 U
Chloromethane	10 U	20 U	23 U	16 U
Dibromomethane	5 U	10 U	12 U	8 U
Chloroethane	10 U	20 U	23 U	16 U
Vinyl Chloride	10 U	20 U	23 U	16 U
Methylene Chloride	4 U	5 U	8 U	77 B
Carbon Disulfide	5 U	10 U	12 U	8 U
Bromoform	5 U	10 U	12 U	8 U
Bromodichloromethane	0.3 J	10 U	12 U	8 U
1,1-Dichloroethane	5 U	10 U	12 U	8 U
1,1-Dichloroethene	5 U	10 U	12 U	8 U
Trichlorofluoromethane	5 U	10 U	12 U	8 U
Methane, Dichlorodifluoro-	10 U	20 U	23 U	16 U
1,2-Dichloropropane	5 U	10 U	12 U	8 U
2-Butanone	0.9 U	9 U	7 U	0.7 U
1,1,2-Trichloroethane	5 U	10 U	12 U	8 U
Trichloroethene	5 U	10 U	12 U	8 U
1,1,2,2-Tetrachloroethene	5 U	10 U	12 U	8 U
1,2,3-Trichlorobenzene	5 U	10 U	12 U	8 U
Hexachlorobutadiene	5 U	10 U	12 U	8 U
Naphthalene	5 U	10 U	12 U	8 U
Total Xylenes	5 U	10 U	12 U	8 U
2-Chlorotoluene	5 U	10 U	12 U	8 U
1,2-Dichlorobenzene	5 U	10 U	12 U	8 U
1,2,4-Trimethylbenzene	5 U	10 U	12 U	8 U
DBCP	5 U	10 U	12 U	8 U
1,2,3-Trichloropropane	5 U	10 U	12 U	8 U
Tert-Butylbenzene	5 U	10 U	12 U	8 U
Isopropylbenzene	5 U	10 U	12 U	8 U
p-Isopropyltoluene	5 U	10 U	12 U	8 U
Ethylbenzene	5 U	10 U	12 U	8 U
Styrene	5 U	10 U	12 U	8 U
Benzene, Propyl-	5 U	10 U	12 U	8 U
Butylbenzene	5 U	10 U	12 U	8 U
4-Chlorotoluene	5 U	10 U	12 U	8 U
1,4-Dichlorobenzene	5 U	10 U	12 U	8 U
1,2-Dibromoethane(EDB)	10 U	20 U	23 U	16 U
1,2-Dichloroethane	5 U	10 U	12 U	8 U
Vinyl Acetate	10 U	20 U	23 U	16 U
4-Methyl-2-Pentanone	10 U	20 U	23 U	16 U
1,3,5-Trimethylbenzene	5 U	10 U	12 U	8 U
Bromobenzene	5 U	10 U	12 U	8 U
Toluene	5 U	.7 U	1 U	8 U
Chlorobenzene	5 U	10 U	12 U	8 U
1,2,4-Trichlorobenzene	5 U	10 U	12 U	8 U
Dibromochloromethane	5 U	10 U	12 U	8 U
Tetrachloroethene	5 U	10 U	12 U	8 U
Sec-Butylbenzene	5 U	10 U	12 U	8 U
1,3-Dichloropropane	5 U	10 U	12 U	8 U
Cis-1,2-Dichloroethene	5 U	10 U	12 U	8 U
trans-1,2-Dichloroethene	5 U	10 U	12 U	8 U
1,3-Dichlorobenzene	5 U	10 U	12 U	8 U
1,1-Dichloropropene	5 U	10 U	12 U	8 U
2,2-Dichloropropane	5 U	10 U	12 U	8 U
2-Hexanone	10 U	20 U	23 U	16 U
Ethane, 1,1,1,2-Tetra.	5 U	10 U	12 U	8 U
cis-1,3-Dichloropropene	5 U	10 U	12 U	8 U
trans-1,3-Dichloropropene	5 U	10 U	12 U	8 U

U indicates compound was analyzed for but not detected at the given detection limit

B indicates the analyte was found in the blank as well as the sample. Indicates possible/probable blank contamination

Appendix 2. Results of Effluent BNA Analysis:
ITT Rayonier Class II Inspection - May 23-35, 1988

BNA Compound	Effluent (ug/L)
Phenol	0.5 U
bis(2-Chloroethyl)Ether	2.0
2-Chlorophenol	0.5 U
1,3-Dichlorobenzene	0.5 U
1,4-Dichlorobenzene	0.5 U
Benzyl Alcohol	0.5 U
1,2-Dichlorobenzene	0.5 U
2-Methylphenol	0.5 U
bis(2-chloroisopropyl)ether	0.5 U
4-Methylphenol	0.3 J
N-Nitroso-Di-n-Propylamine	0.5 U
Hexachloroethane	0.5 U
Nitrobenzene	0.5 U
Isophorone	0.5 U
2-Nitrophenol	0.5 U
2,4-Dimethylphenol	0.5 U
Benzoic Acid	2.0 U
bis(2-Chloroethoxy)Methane	0.5 U
2,4-Dichlorophenol	0.3 J
1,2,4-Trichlorobenzene	0.5 U
Naphthalene	0.5 U
4-Chloroaniline	0.5 U
Hexachlorobutadiene	0.5 U
4-Chloro-3-Methylphenol	0.5 U
2-Methylnaphthalene	0.5 U
Naphthalene, 1-Methyl-	0.5 U
Hexachlorocyclopentadiene	0.9 U
2,4,6-Trichlorophenol	5.0
2,4,5-Trichlorophenol	2.0 U
2-Chloronaphthalene	0.5 U
2-Nitroaniline	2.0 U
Dimethyl Phthalate	0.5 U
Acenaphthylene	0.5 U
3-Nitroaniline	2.0 U
Acenaphthene	0.5 U
2,4-Dinitrophenol	2.0 U
4-Nitrophenol	2.0 U
Dibenzofuran	0.5 U
2,4-Dinitrotoluene	0.5 U
2,6-Dinitrotoluene	0.5 U
Diethylphthalate	0.5 U
4-Chlorophenyl-phenylether	0.5 U
Fluorene	0.5 U
4-Nitroaniline	2.0 U
4,6-Dinitro-2-Methylphenol	2.0 U
N-Nitrosodiphenylamine	0.5 U
4-Bromophenyl-phenylether	0.5 U
Hexachlorobenzene	0.5 U
Pentachlorophenol	2.0 U
Phenanthrene	0.5 U
Anthracene	0.5 U
Carbazole	0.5 U
Di-n-Butylphthalate	0.5 U
Fluoranthene	0.5 U
Pyrene	0.5 U
Retene	0.5 U
Butylbenzylphthalate	0.5 BU
3,3'-Dichlorobenzidine	0.5 U
Benzo(a)Anthracene	0.5 U
bis(2-Ethylhexyl)Phthalate	0.5
Chrysene	0.5 U
Di-n-Octyl Phthalate	0.5 U
Benzo(b)Fluoranthene	0.5 U
Benzo(k)Fluoranthene	0.5 U
Benzo(a)Pyrene	0.5 U
Indeno(1,2,3-cd)Pyrene	0.5 U
Dibenz(a,h)Anthracene	0.5 U
Benzo(ghi)Perylene	0.5 U

U indicates compound was analyzed for but not detected at the given detection limit

J indicates an estimated value when result is less than specified detection limit

B indicates the analyte was found in the blank as well as the sample. Indicates possible/probable blank contamination

Appendix 3. Results of Sediment and Sludge BNA Analyses: ITT Rayonier Class II Inspection - May 23-25, 1988 (ug/kg)

		Sediments		
BNA Compound	Waste Sludge	at ITT	below ITT	Cow Point (control)
Benzo(a)Pyrene	500 U	120 U	130 U	100 U
2,4-Dinitrophenol	2400 U	600 U	650 U	480 U
Dibenz(a,h)Anthracene	500 U	120 U	130 U	100 U
Benzo(a)Anthracene	500 U	120 U	130 U	16 J
4-Chloro-3-Methylphenol	500 U	120 U	130 U	100 U
Benzoic Acid	2400 U	600 U	650 U	480 U
Hexachloroethane	500 U	120 U	130 U	100 U
Hexachlorocyclopentadiene	1000 U	250 U	270 U	200 U
Isophorone	1400 U	120 U	130 U	100 U
Acenaphthene	500 U	120 U	130 U	100 U
Diethylphthalate	500 U	120 BU	130 BU	100 BU
Di-n-Butylphthalate	500 U	27 BJ	26 BJ	29 BJ
Phenanthrene	1450 U	110 J	120 J	51 J
Butylbenzylphthalate	500 U	120 BU	130 BU	100 BU
N-Nitrosodiphenylamine	500 U	120 U	130 U	100 U
Fluorene	500 U	18 J	130 U	10 J
Carbazole	500 U	120 U	130 U	100 U
Hexachlorobutadiene	500 U	120 U	130 U	100 U
Pentachlorophenol	2400 U	600 U	650 U	480 U
2,4,6-Trichlorophenol	500 U	120 U	130 U	100 U
2-Nitroaniline	2400 U	600 U	650 U	480 U
2-Nitrophenol	500 U	120 U	130 U	100 U
Naphthalene, 1-Methyl-	500 U	120 U	130 U	100 U
Naphthalene	4800 U	120 UB	28 BJ	34 BJ
2-Methylnaphthalene	500 U	120 U	130 U	9 J
2-Chloronaphthalene	500 U	120 U	130 U	100 U
3,3'-Dichlorobenzidine	500 U	120 U	130 U	100 U
2-Methylphenol	500 U	120 U	130 U	100 U
1,2-Dichlorobenzene	500 U	120 U	130 U	100 U
o-Chlorophenol	500 U	120 U	130 U	100 U
2,4,5-Trichlorophenol	2400 U	600 U	650 U	480 U
Nitrobenzene	500 U	120 U	130 U	100 U
3-Nitroaniline	2400 U	600 U	650 U	480 U
4-Nitroaniline	2400 U	600 U	650 U	480 U
4-Nitrophenol	2400 U	600 U	650 U	480 U
Benzyl Alcohol	500 U	120 U	130 U	100 U
4-Bromophenyl-phenylether	500 U	120 U	130 U	100 U
2,4-Dimethylphenol	500 U	120 U	130 U	100 U
4-Methylphenol	35000 U	120 U	170	51 J
1,4-Dichlorobenzene	500 U	120 U	130 U	100 U
4-Chloroaniline	500 U	120 U	130 U	100 U
Phenol	11000 U	120 BU	130 U	16 BJ
bis(2-Chloroethyl)Ether	500 U	120 U	130 U	100 U
bis(2-Chloroethoxy)Methane	500 U	120 U	130 U	100 U
bis(2-Ethylhexyl)Phthalate	500 U	170 B	610 B	97 BJ
Di-n-Octyl Phthalate	500 U	120 BU	510 B	15 BJ
Hexachlorobenzene	500 U	120 U	130 U	100 U
Anthracene	500 U	120 U	130 U	100 U
1,2,4-Trichlorobenzene	500 U	120 U	130 U	100 U
2,4-Dichlorophenol	500 U	120 U	130 U	100 U
2,4-Dinitrotoluene	500 U	120 U	130 U	100 U
Pyrene	890 U	140	160	76 J
Dimethyl Phthalate	500 U	120 U	130 U	100 U
Dibenzofuran	500 U	17 J	21 J	100 U
Benzo(ghi)Perylene	500 U	120 U	130 U	100 U
Indeno(1,2,3-cd)Pyrene	500 U	120 U	130 U	100 U
Benzo(b)Fluoranthene	500 U	120 U	130 U	100 U
Fluoranthene	930 U	120 J	110 J	57 J
Benzo(k)Fluoranthene	500 U	120 U	130 U	100 U
Acenaphthylene	500 U	120 U	130 U	7 J
Chrysene	500 U	120 U	130 U	100 U
Retene	500 U	370 U	540	110
4,6-Dinitro-2-Methylphenol	2400 U	600 U	650 U	480 U
1,3-Dichlorobenzene	500 U	120 U	130 U	100 U
2,6-Dinitrotoluene	500 U	120 U	130 U	100 U
N-Nitroso-Di-n-Propylamine	500 U	120 U	130 U	100 U
4-Chlorophenyl-phenylether	500 U	120 U	130 U	100 U
bis(2-chloroisopropyl)ether	500 U	120 U	130 U	100 U

U indicates compound was analyzed for but not detected at the given detection limit

J indicates an estimated value when result is less than specified detection limit

B indicates the analyte was found in the blank as well as the sample. Indicates possible/probable blank contamination

Appendix 5. Resin Acids, Guaiacols, and Catechols in Sediment: ITT Rayonier Class II Inspection: May 23-25, 1988

			Sediments (ug/kg dry wt.)		
Parameter	Effluent (ug/L)	Sludge (ug/kg dry wt.)	at ITT	below ITT	Cow Point (control)
Guaiacol (2-methoxyphenol)	0.4 U	68,000	19 J	130 U	100 U
4-Chloroguaiacol	0.4 U	500 U	120 U	130 U	100 U
4,5-Dichloroguaicol	0.4 U	500 U	120 U	130 U	100 U
4,5,6-trichloroguaiacol	8	5,000	9 J	130 U	100 U
Tetrachloroguaicol	6	500 U	120 U	130 U	100 U
4-Allylguaiacol	0.4 U	500 U	120 U	130 U	100 U
4-Propenylguaiacol	R	R	R	R	R
a-Terpeneol	R	R	R	R	R
Trichlorosyringol	0.4 U	500 U	120 U	130 U	100 U
4-chlorocatechol	0.4 U	30,000 UJ	7,500 UJ	8,100 UJ	6,000 UJ
4,5-dichlorocatechol	0.4 U	30,000 UJ	7,500 UJ	8,100 UJ	6,000 UJ
3,4,5-trichlorocatechol	0.4 U	10,000 UJ	2,500 UJ	2,700 UJ	2,000 UJ
Tetrachlorocatechol	6	NA	NA	NA	NA
Oleic acid	0.4 BU	110,000	1,600 J	3,500 J	1,500
Linoleic acid	0.4 U	500 U	740	1,200 J	630 J
Linolenic acid	R	R	R	R	NA
Sandaracopimaric acid	0.4 U	6,600	120 U	130 U	100 U
Isopimaric acid	0.4 U	17,000	120 J	130 U	100 U
Palustric acid	R	R	R	R	R
Levopimaric acid	R	R	R	R	R
Dehydroabietic acid	2 B	47,000	330 JB	340 JB	250 JB
Abietic acid	0.4 U	16,000	120 U	130 U	100 U
Neoabietic acid	R	R	R	R	R
9,10-Dichlorosteric acid	0.4 U	500 U	120 U	130 U	100 U
Dichlorodehydroabietic acid	6	27,000	72 J	130 U	100 U

U - indicates compound was analyzed for but not detected at the given detection limit.

J - indicates an estimated value when result is less than specified detection limit.

B - analyte was found in the blank as well as the sample, indicating possible/probable blank contamination.

R - indicates analysis was attempted but was unsuccessful. Analyte may or may not be present.

NA- analyte was not analyzed for.

Appendix 6. Metals Results: ITT Rayonier Class II Inspection - May 23-25, 1988

Metal	Effluent (ug/L)	Sludge (mg/kg dry wt)	Sediment (mg/kg dw) at ITT	Sediment (mg/kg dw) below ITT	Sediment (mg/kg dw) Cow Point
Antimony	<1	<0.1	0.1 U	0.1 U	0.1 U
Arsenic	<3	<0.1	4.5	4.1	3.9
Beryllium	2	-	1.0	1.1	1.0
Cadmium	<5	2.2	0.5 U	0.5 U	0.5 U
Chromium	553	296	30.7	35.0	30.0
Copper	21 B*	34.2	52.0	56.1	44.0
Lead	<50	11.5	5.0	5.4	0.5 U
Mercury	<0.034	0.0048	0.015	0.010	0.011
Nickel	21	14.5	55.4	57.7	56.0 U
Selenium	21 B	-	0.7	0.4 U	0.8
Silver	10.5 B	0.93	0.02 U	0.02 U	0.05
Thallium	<1	-	0.1 U	0.1 U	0.1 U
Zinc	27	79.6	77.1	80.8	71.0
Tin	-	-	104.0	109.0	96.0

B - parameter detected in field transfer blank.
* - parameter detected in laboratory blank.
U - parameter undetected at the detection limit indicated.

Appendix 7. Dioxins/Furans Analyses: ITT-Rayonier, Hoquiam Class II Inspection: May 23-25, 1988

Parameter (pg/g)*	Sediment @ ITT	Sediment Cow Point	Sludge
Furans			
TCDF's (total)	2.4	2.8	3.5
2,3,7,8-TCDF	2.4	2.8	3.5
PeCDF's (total)	4.1 U	9.4 U	6.1 U
1,2,3,7,8-PeCDF	4.1 U	9.4 U	6.1 U
2,3,4,7,8-PeCDF	4.1 U	9.4 U	6.1 U
HxCDF's (total)	4.5 U	5.7 U	6.1 U
1,2,3,4,7,8-HxCDF	4.5 U	5.7 U	6.1 U
1,2,3,6,7,8-HxCDF	4.5 U	5.7 U	6.1 U
2,3,4,6,7,8-HxCDF	4.5 U	5.7 U	6.1 U
1,2,3,7,8,9-HxCDF	4.5 U	5.7 U	6.1 U
HpCDF's (total)	5.0 U	7.7 U	6.1 U
1,2,3,4,6,7,8-HpCDF	5.0 U	7.7 U	6.1 U
1,2,3,4,7,8,9-HpCDF	5.0 U	7.7 U	6.1 U
OCDF	12 U	21 U	18
Dioxins			
TCDD's (total)	0.79 U	0.85 U	0.66 U
2,3,7,8-TCDD	0.79 U	0.85 U	0.66 U
PeCDD's (total)	8.1 U	8.6 U	11 U
1,2,3,7,8-PeCDD	8.1 U	8.6 U	11 U
HxCDD's (total)	10 U	11 U	9.4 U
1,2,3,4,7,8-HxCDD	10 U	11 U	9.4 U
1,2,3,6,7,8-HxCDD	10 U	11 U	9.4 U
1,2,3,7,8,9-HxCDD	10 U	11 U	9.4 U
HpCDD's (total)	32	42	8.5 U
1,2,3,4,6,7,8-HpCDD	15	18	8.5 U
OCDD	92	140	59

U - parameter undetected at specified detection limits.

* - picograms per gram, or parts per trillion.

Appendix 8. Sediment Sample Data: ITT Rayonier Class II Inspection - May 23-25, 1988

			Grain Size Analysis, %			
Sample	% Solids	TOC % dry	Gravel > 2 mm	Sand 2mm-62um	Silt 62um-4um	Clay < 4 um
at ITT	41.7	2.2	<2	17.6	64.5	17.9
below ITT	35.8	2.9	<2	13.4	67.2	19.4
Cow Point	53.5	1.3	<2	49.8	37.4	12.8
sludge	22.0	33	-	-	-	-

Appendix 9. Design Loading Calculations: ITT Rayonier, Hoquiam
Class II Inspection - May 23-25, 1988

Parameter:	Design Criteria(*): Avg. Flow	Peak Flow
Surface Overflow Rate:	400-600	1200 gal/day/ft2

21,550,000 gal/day / [(75ftx75ftx3.14)x3clarifiers] = 406 gal/day/ft2

Weir Overflow Rate:	15,000	30,000 gal/day/li.ft.

21,550,000 gal/day /(150ftx3.14x3) = 15,244 gal/day/li.ft.

Solids Loading Rate:	25	40 lb/day/ft2

[(21.55 + 7.0)MG/day x 8.34 x 2000mg/l] / 53,014ft2 = 9.0 lb/day/ft2

* criteria from `Criteria For Sewage Works Design', State of Washington Department of Ecology, DOE 78-5, February 1978, revised October 1985.

Appendix 10. Tentatively identified compounds in effluent, sludge, and sediment: ITT Rayonier, Hoquiam Class II inspection - May 23-25, 1988. (ug/kg dry wt.)

Compound	Effluent (ug/L)	Sludge	Sediments: at Cow Point (Control)	Outfall	Below Outfall
Lab ID :	# 228120	# 228109	# 228132	# 228137	# 228138
Chlorinated Organics:					
2-Propanol, 1,1,1-Trichloro			39 J		
2-Propanol, 1,1,1-trichloro-2-methyl-			130 J		
1,1,2,2-Tetrachloroethane			310 J		
Other Organics:					
Ethanone, 1-(2-furanyl)-	0.75 J	2300 J			
Ethanone, 1-(1-cyclohexen-1		16000 J			
Benzene, 1-methyl-3-(1-meth		1800 J			
Tetracosanoic acid, methyl ester			12000 J	10000 J	23000 J
2-Hexanone, 5-methyl-	14 J		3000 J	730 J	1400 J
Heptadecane			650 J		
Heptadecane, 2,6-dimethyl-	6.1 J				
Hexadecanoic acid	12 J		2300 J		
Pentacosane			1800 J		
2-cyclohehexen-1-one			160 J		
Benzaldehyde (acn)(dot)			100 J		
1H-pyrrole-2,5-dione, 3-ethyl-4-methyl-			190 J		
Tetradecanoic acid			700 J	1100 J	2500 J
Tetradecanoic acid, 12-methyl-, (S)-			570 J	1300 J	5200 J
Pentadecanoic acid			1100 J		
1H-naphtho[2,1-B]pyran, 4A,5,6,6A,7,8,9,10,10A-deca			300 J		
Heptadecenoic acid			790 J		
9-Octadecenoic acid (Z)-, methyl ester			1600 J		
Pentatriacontane			1300 J	2700 J	
Hexatriacontane			860 J		
10-Octadecenoic acid, methyl ester			3600 J	6600 J	
Eicosanoic acid, methyl ester			3300 J	2200 J	
Hexanedioic acid, mono(2-ethylhexyl)ester					51000 J
Hexacosanoic acid, methyl ester			5600 J	4600 J	15000 J
2-Heptanol acetate				140 J	
Octanoic acid, methyl ester			87 J	77 J	
Tetradecanoic acid, methyl ester		6100 J	1100 J	1100 J	
Tetradecanoic acid, 12-methyl-, methyl ester		18000 J	1900 J	1700 J	
Pentadecanoic acid, methyl ester			590 J	480 J	
9-Hexadecenoic acid, methyl ester, (Z)-			4100 J	1700 J	12000 J
Pentadecanoic acid, 14-methyl-, methyl ester				4200 J	
3-Hexen-2-one, 5-methyl-		11000 J	200 J		250 J
9-Hexadecenoic acid	17 J			890 J	12000 J
9-Octadecenoic acid, 12-(acetyloxy)-, methyl ester, [R]			6200 J		
11-Hexadecenoic acid, methyl ester				3800 J	
Hexadecanoic acid, 15-methyl-, methyl ester				220 J	790 J
1-Phenanthrenecaroxylic acid, 1,2,3,4,4A,9,10,10A-octa			530 J		
Docosanoic acid, methyl ester				8600 J	
Tricosanoic acid, methyl ester			1800 J	2000 J	
3-Penten-2-one, 4-methyl-					2300 J
Hexanoic acid, methyl ester			74 J		
1,3-Dithiolane			110 J		
Heptanoic acid, methyl ester			69 J		130 J
9-Octadecenoic acid, 12-(acetyloxy)-, methyl ester, [R]			6200 J		13000 J
Tetradecanoic acid, 5,9,13-trimethyl-, methyl ester					
Heptadecanoic acid, 16-methyl-, methyl ester			3300 J	3600 J	
1-Phenanthrenecarboxylic acid, 7-ethyltetradecahydro-1			560 J		840 J
2-Cyclohexen-1-one, 3,5-Dim		2400 J			
2-Cyclohexen-1-one, 3,5-dimethyl-, o-methyloxime			910 J		
1,3-dioxolane, 2,2,4-trimethyl-			94 J		
Hexanedioic acid, dioctyl ester			1300 J	910 J	
2-Propanol, 1-(2-Methoxy-1-	1.6 J				
4-Carene, (1S,3R,6R)-(-)-	1.6 J				
Bicyclo[3.1.1]Heptane, 6-Me	4.2 J				
2-Furanmethanol		13000 J			
2-Furancarboxaldehyde, 5-Me		5000 J			

Appendix 10. Continued

Compound	Lab ID :	Effluent (ug/L) # 228120	Sludge # 228109	Sediments at Cow Point (Control) # 228132	Sediments Outfall # 228137	Sediments Below Outfall # 228138
Hexanoic acid (DOT)			3100 J			
3-Buten-2-one, 4-(2-furanyl			26000 J			
Isophorone			7400 J			
Decane, 6-ethyl-2-methyl-			4000 J			
Benzeneacetic acid, 4-hydro			8900 J			
8-Octadecenoic acid, methyl					5700 J	
10-Nonadecenoic acid, methyl					510 J	
Octanoic acid, methyl ester					130 J	
Decanoic acid, methyl ester					46 J	110 J
Dodecanoic acid, methyl ester					110 J	240 J
Dodecanoic acid, 10-methyl						260 J
Octacosanoic acid, methyl ester					5400 J	
Pentacosanoic acid, methyl ester					1200 J	
Nonanoic acid, methyl ester					72 J	
Tridecanoic acid, methyl ester					77 J	
Heneicosanoic acid, methyl ester					380 J	
5,8,11,14-Eicosatetraenoic					410 J	