Publication No. 84-e43

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MEMORANDUM
May 1, 1984

To: Jon Neel, Southwest Regional Office

From: Bill Yake, Water Quality Investigations Section

Subject: Weyerhaeuser Wood Products (Longview) Class II Inspection and Associated Stormwater Sampling Surveys (March 29, April 19-20, and November 15, 1983)

INTRODUCTION

The Weyerhaeuser complex in Longview stores and processes wood products. There are four permitted discharges which are characterized by the most recent NPDES permit (WA-003918-7), as noted in Table 1. It should be noted that this NPDES permit has lapsed and that redrafting the permit is a high agency priority.

Table 1. Weyerhaeuser Wood Products Discharges Permitted Under NPDES Permit WA-003198-7.

Discharge Number	Discharge Name	Wastewater Type*	Receiving Water
001	85-foot clarifier effluent	"Wood products discharge waters"	Columbia River
002	East pond discharge	"East Pond Stormwater Runoff"	Longivew Diking Ditch #3
003	West oil/water separator discharge	"Uncontaminated Stormwater Runoff"	Longview Diking Ditch #3
004	East oil/water separator discharge	"Uncontaminated Stormwater Runoff"	Longview Diking Ditch #3

*As characterized in NPDES permit.

Memo to Jon Neel
Weyerhaeuser Wood Products (Longview) Class II Inspection and Associated Stormwater Sampling Surveys (March 29, April 19-20, and November 15, 1983)

Despite the NPDES permit characterization of discharges 002, 003, and 004 as "stormwater runoff" and 003 and 004 as "uncontaminated stormwater runoff", Weyerhaeuser's consolidated permit application (10/10/83) notes several process water discharges (dust-control sprays, vehicle washwaters, etc.) which contribute to these discharges. Also, as the results of analyses reported here show, the stormwater discharged to Diking District Ditch #3 is not uncontaminated.

Most of the process wastewaters are routed to the 85-foot clarifier and discharged to the Columbia River. Process wastewaters discharged from 001 include hydraulic log debarker, presto-log equipment cooling, powerhouse scrubber and boiler blow-down, and a number of other smaller-volume discharges.

In addition to wastewaters noted above, there is also a system for recycling scrubber water for the hogged-fuel/coal-fired boiler. This scrubber water is routed to a 45-foot diameter clarifier. Sludges are removed and supernatent is returned to the scrubber. Under some circumstances, this scrubber water has been discharged.

The primary purpose of sampling at this facility was to more fully characterize the wastewaters being discharged to the Longview ditches. Previous work by Singleton and Bailey (1983) had indicated that the Weyerhaeuser discharges to the ditches contributed to water quality problems associated with the following parameters: turbidity, suspended solids, COD, phenolics, fecal coliforms, oil and grease, copper, zinc, and cadmium.

In addition, sampling was conducted to characterize 001 effluent, scrubber water, scrubber (45-foot clarifier) supernatant, and scrubber sludge with regard to conventional, base/neutral extractable, and acid extractable priority pollutants.

The NPDES permit (WA-003928-7) for this facility lapsed on March 31, 1980. Redrafting and reissuing the permit are priority tasks for the Southwest Regional Office (SWRO), and the information obtained during these surveys is to be used in modifying the permit.

The Weyerhaeuser facility (see site map, Figure 1) was visited and samples were obtained on three occasions. These surveys are summarized below:

1. Reconnaissance Survey (3/29/83) - This survey was conducted by Mike Morhous (WDOE, SWRO) and Bill Yake (WDOE, WQIS) during a day of heavy rain (1.30 inches in 24 hours at Longview). Although it was originally conceived as primarily a visual and field measurement survey, the heavy rains provided a chance to sample the more heavily contaminated discharges (002 and 004) for a range of conventional and priority pollutants during a period of high flow.

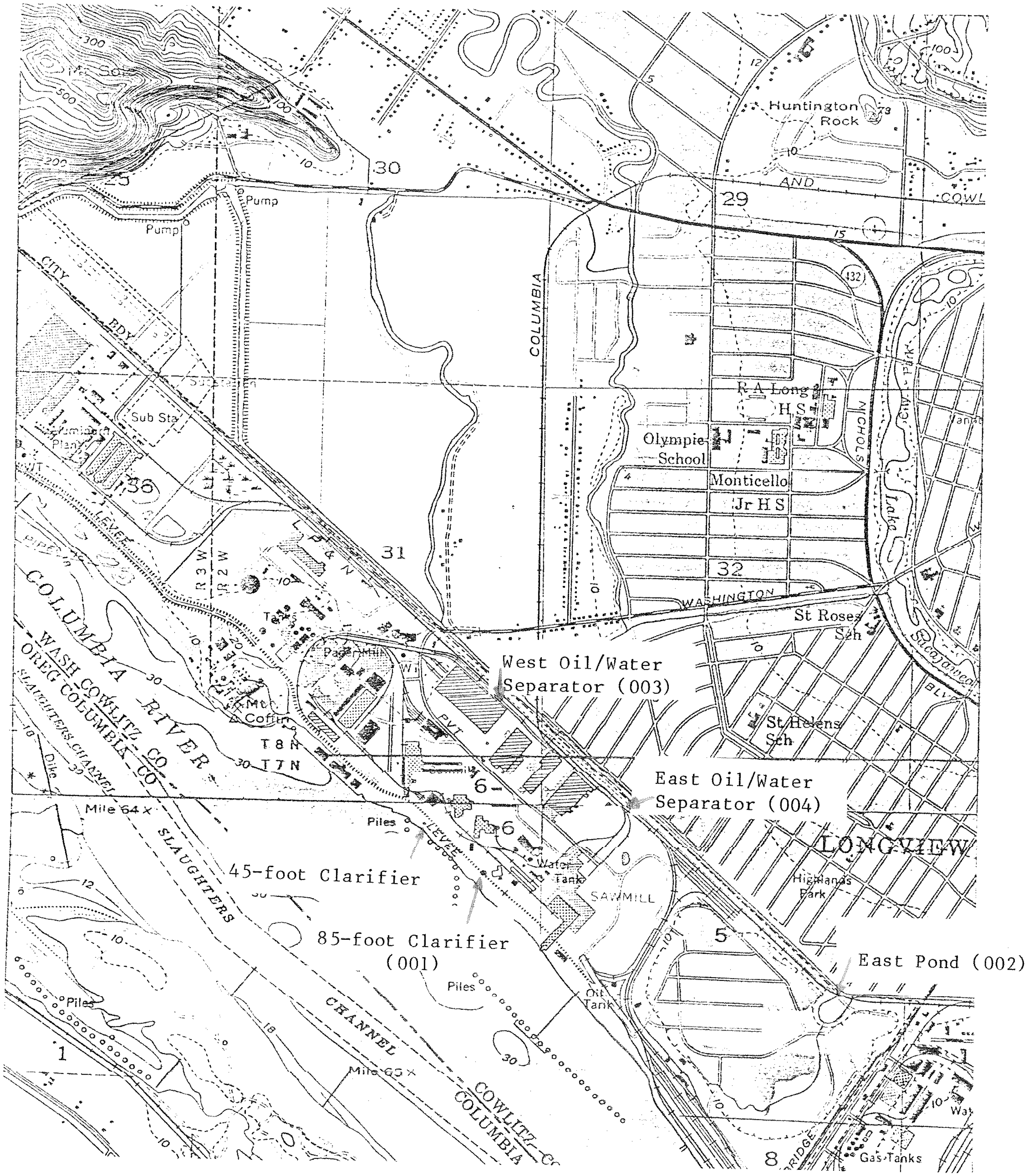

Figure 1. Study area; Weyerhaeuser Wood Products, Longview, WA.

2. Process Waters Survey (4/19-20/83) - This sampling survey was conducted primarily by Bill Yake and Dale Clark (WDOE, WQIS). Also present from WDOE were Brett Betts and Eric Egbers (WDOE, SWRO) and George Houck (WDOE Industrial Section). Weyerhaeuser was represented by Ken Johnson. Effluent from the 85-foot clarifier (001) was sampled using a flow-paced compositor. Grab samples of scrubber water (45-foot clarifier influent), scrubber (45-foot clarifier) supernatant, and scrubber sludge were collected as well. Samples were analyzed for conventional as well as base/neutral and acid extractable priority pollutants.

3. Stormwater Runoff Survey (11/15/83) - The source portion of this survey was conducted by Bill Yake and Marc Heffner (WDOE,WQIS). Grab composite samples of effluent from 002, 003, and 004 were obtained for conventional as well as base/neutral and acid extractable priority pollutant analyses. A separate receiving water survey was conducted by Gary Bailey and Lynn Singleton in the Diking District ditches at the same time. Results of this survey will be reported in a separate memorandum.

Sampling Survey Design

As noted above, three separate surveys were conducted at this facility. Some of the important details of these surveys are discussed here in the text; details regarding sampling locations, times, and methods are summarized in Table 2.

Each survey included field measurements (temperature, pH, conductivity, dissolved oxygen, and settleable solids) and collection of samples for laboratory analyses. Table 3 summarizes the laboratories at which each of these analyses were performed.

Table 3. Laboratory analyses.

Laboratory	Location	Analyses
WDOE	Tumwater	Fecal coliform, BOD, COD, solids, nutrients pH, conductivity, tannin/lignin, color, turbidity, oil and grease, recoverable phenolics, PBI
EPA	Manchester	Metals, organic priority pollutants (base/neutral and acid extractables only)

Table 2. Sample information: time, location, analyses, etc.

A. Reconnaissance Survey - 3/29/83

Grab Sample Information

Sample Location	Date - Time	Laboratory Analyses
West oil/water separator dischg. - between separator weirs, south of road	3/29/83 - 1100	Oil and grease
East oil/water separator dischg. - outfall of culvert, north of road	3/29/83 - 1130	Oil & grease, COD, BOD, solids (4), spec. cond., pH, turb., color, phenolics, base/neutral and acid extractable priority pollutants
East pond dischg. - outfall of culvert, north of road	3/29/83 - 1310	Oil & grease, COD, BOD, solids (4), spec. cond., pH, turb., color, base/neutral and acid extractable priority pollutants, metals (7)

Field Data

Sample Location	Date - Time	Field Analysis
West oil/water separator dischg. - between separator weirs, south of road	3/29/83 - 1100	Spec. cond., pH, temp.
East oil/water separator dischg. - outfall of culvert, north of road	3/29/83 - 1130	Spec. cond., pH, temp., flow
East pond dischg. - outfall of culvert, north of road	3/29/83 - 1310	Spec. cond., pH, temp., flow

B. Process Waters Survey - 4/19/83

24-hour Composite Sample Information

Sample Name/Aliquot	Date & Time Installed	Location
85-foot clarifier effluent - Flow-proportional composite	4/19/83 - 1100	At contracted effluent weir, immediately prior to discharge

Table 2. Continued.

Grab Sample Information

Sample Location	Date - Time	Laboratory Analyses
85-foot clarifier effluent	4/19/83 - 1115	Oil and grease, phenolics, fecal coliform
85-foot clarifier effluent	4/29/83 - 1030	Oil & grease, phenolics, fecal coliform
45-foot clarifier influent	4/19/83 - 1400	pH, turb., cond., COD, BOD, nutrients (5), solids (4), color, phenolics, base/neutrals and acid extractables
45-foot clarifier supernatant	4/19/83 - 1355	pH, turb., cond., COD, BOD, nutrients (5), solids (4), PBI, color, phenolics, tannins/lignin, base/neutrals, acid extractables
45-foot clarifier sludge	4/19/83 - 1345	Percent PNAs, base/neutrals, acid extractables

Field Data

Sample Location	Date - Time	Field Analysis
85-foot clarifier effluent	4/19/83 - 1115	Temp., dissolved oxygen, cond., pH
	- 1128	pH
	- 1420	Temp., dissolved oxygen, cond., pH
	4/20/83 - 1030	Temp., dissolved oxygen, cond., pH
	- comp. sample	Temp., cond., pH

C. Stormwater Runoff Survey - 11/15/83

Grab Composite Sample Information

Sample Name/Location	Date & Time	Laboratory Analyses
East pond effluent - from culvert, north side of road	11/15/83 - 1104, 1345, 1500	pH, cond., turb., COD, BOD, nutrients (5), solids (4), color, phenolics, base/neutrals, acid extractables
East oil/water separator - equal aliquots from east and west weirs	11/15/83 - 1135 (1145), 1400 (1405), 1510 (1515)	As above.
West oil/water separator - equal aliquots from east and west weirs	11/15/83 - 1215 (1220), 1440 (1445), 1525 (1530)	As above.

Table 2. Continued.

Grab Sample Information

Sample Location	Date - Time	Laboratory Analyses
East pond effluent - from culvert, north side of road	11/15/83 - 1104	Fecal coliform, oil and grease
	- 1345	Fecal coliform, oil and grease
East oil/water separator - equal samples from east & west weirs	11/15/83 - 1135 (1145)	Fecal coliform, oil and grease
	- 1400 (1405)	Fecal coliform
	- 1510 (1515)	Oil and grease
West oil/water separator - equal samples from east & west weirs	11/15/83 - 1215 (1220)	Fecal coliform, oil and grease
	- 1440 (1445)	Fecal coliform
	- 1525 (1530)	Oil and grease

Field Data

Sample Location	Date - Time	Field Analyses
East pond effluent - from culvert, north side of road	11/15/83 - 1104	Flow, temp., pH, cond., D.O., settleable solids
	- 1345	Flow, temp., pH, cond., D.O., settleable solids
	- 1500	Temp.
East oil/water separator - analysis of flow from both east & west weirs	11/15/83 - 1145	Flow, temp., pH, cond., D.O., settleable solids
	- 1405	Flow, temp., pH, cond., D.O., settleable solids
	- 1510	Temp.
West oil/water separator - analysis of flow from both east & west weirs	11/15/83 - 1215	Flow, temp., pH, cond., D.O., settleable solids
	- 1440	Flow, temp., pH, cond., D.O.
	- 1525	Temp.

All samples collected by WDOE personnel were either analyzed immediately in the field or preserved on ice prior to laboratory analysis. Organic priority pollutant samples were collected in specially cleaned one-gallon glass jars with teflon lid liners. The 24-hour composite sample from the 85-foot clarifier effluent was collected using a specially cleaned and constructed automatic composite sampler. This composite sampler is built so that only glass and teflon surfaces contact the sample during the collection process.

Usually during surveys of this kind, composite samples are split with the industry to provide a comparison of results. Weyerhaeuser personnel were offered an aliquot of the 85-foot clarifier effluent for analysis by their laboratory, but they declined. Weyerhaeuser's 24-hour composite sample collected beginning at 0800 hours on April 19 was split for analysis. Unfortunately, Weyerhaeuser chose to only run their standard suspended solids analysis on this sample, so very few data are available for inter-laboratory comparisons. It should be noted that the sample collected by the Weyerhaeuser composite sampler is time- (not flow-) composited and is not refrigerated. This diminishes the value of the data obtained from this sample (see: Findings).

In addition to water quality analyses, flows were also obtained in the field. Three different techniques were used:

1. During the March reconnaissance survey, flows were determined at the east pond and east oil/water separator using a magnetic flow meter with top-setting rod to obtain a velocity profile across the discharge pipe or ditch.

2. During the April process wastewater survey, flow from the 85-foot clarifier was determined using a Manning dipper flowmeter located behind a contracted rectangular weir at the discharge from the clarifier.

3. During the November stormwater survey, flow at the east pond (002) was determined as in 1, above; however, flows from the east and west oil/water separators (004 and 003, respectively) were determined by measuring head height behind the pair of weirs which contribute flow to each of these discharges. These were essentially broad-crested, contracted weirs modified by Weyerhaeuser personnel who blocked off flow from much of the original separator weirs, thus channeled most of the flow over a shorter length, raised the water height behind the weirs, and provided for reasonably accurate head measurements which were subsequently converted to flows.

During the April survey, the accuracy of Weyerhaeuser's flow-monitoring system for the 85-foot clarifier effluent was assessed. Table 4 summarizes the results of comparisons between the totalizers on WDOE's Manning dipper and Weyerhaeuser's in-place flow-measuring device. Instantaneous measurements of head height behind the contracted rectangular weir at the clarifier discharge were converted to flow rates, and compared favorably with the totalized Manning dipper flows. The in-place Weyerhaeuser meter read 35 to 70 percent high. Ken Johnson of Weyerhaeuser was notified of this error during the inspection; however, the meter had not been calibrated nearly a year later when Mr. Johnson was contacted in March of 1984.

Table 4. Accuracy check on effluent flow meter.

Beginning Date - time	Ending Date - Time	Total Flow (millions of gallons) WDOE Manning Dipper	Weyerhaeuser Flow Meter	Error
4/19 - 1143	4/19 - 1415	.296	.404	+36.5%
4/19 - 1143	4/20 - 1130	1.165	1.942	+66.7%

FINDINGS

The results of the reconnaissance survey are given in Table 5 (5a - conventionals; 5b - metals; 5c - organics). Process wastewater survey results are summarized in Table 6 (6a - conventionals; 6b - metals; 6c - priority pollutant organics; 6d - other organics). Table 7 summarizes the results of the stormwater runoff survey (7a - conventionals; 7b - metals; 7c - priority pollutant organics; 7d - other organics).

These results are discussed in two sections; the first dealing with April sampling of the 85-foot and 45-foot clarifiers, and the second dealing with the stormwater sampling from the discharges to the Longview ditches.

Process Wastewater Survey (4/19-20/83)

As noted above, all WDOE analytical results for this survey are reported in Tables 6a-d. Table 8 compares results for the sampling period with NPDES permit limits on the 85-foot clarifier effluent (001).

Table 5. Analytical results from reconnaissance survey (3/29/83).

Table 5a. Conventional results (units in mg/L unless otherwise noted).

Parameter	West Oil/Water Separator (003)	East Oil/Water Separator (004)	East Pond (002)
Flow (MGD)		11.4*	10.4*
COD		510	460
BOD		74	130
Temperature (°C)	10.2*	11.8*	9.6*
pH (S.U.)	6.8*	7.2* 7.7	6.2* 6.4
Spec. Cond. (umhos/cm)	50*	85* 101	132* 125
Total Solids		780	960
TNVS		420	600
TSS		640	710
TNVSS		350	470
Turbidity (NTU)		600	1100
Color (P.U.)		180	520
Recoverable Phenolics		0.15	
Oil & Grease	14	15	3

*Field data.

Table 5b. Metals (ug/L).

Parameter	West Oil/Water Separator (003)	East Oil/Water Separator (004)	East Pond (002)
As			2.9
Cd			5
Cr			9
Cu			82
Pb			50
Ni			2
Zn			134

Table 5c. Organics (ug/L); base/neutral and acid extractions only.

Parameter	West Oil/Water Separator (003)	East Oil/Water Separator (004)	East Pond (002)
Base/Neutral Priority Pollutants			
Acenaphthylene		4.1	--
Naphthalene		11	<0.5
Phenanthrene		37	3.8
Pyrene		11	--
Fluoranthene		10	--
Acid Extractable Priority Pollutants			
Pentachlorophenol		3.1	--
Phenol		5.8	5.6
Other Organic Compounds			
3,6,6-trimethyl bicyclo[3.1.1] hept-2-ene		(160)	(140)
benzenepropanoic acid		--	(540)

( ) = Estimate
\- = None detected.
< = Detected but less than level of quantification.

Table 6. Analytical results from process wastewater survey (4/19-20/83).

Table 6a. Conventionals.

Parameter	85-foot Clarifier Effluent			45-foot Clarifier Influent (Grab)	45-foot Clarifier Supernatant (Grab)
	WEYCO Composite Sample	WDOE Composite Sample	WDOE Grab Sample		
Flow (MGD)	1.14†	1.18			
COD (mg/L)	120	130		490	250
BOD (mg/L)	19	40		34	27
Temperature (°C)			19.2* 19.3* 18.5*		
pH (S.U.)	6.5	6.6	6.9* 6.6* 7.2* 7.2*	7.8	7.9
Specific Conductivity (umhos/cm)	293	441	252* 298* 790*	5350	4430
Total Solids (mg/L)	340	440		5800	4400
TNVS (mg/L)	230	300		4900	3800
TSS (mg/L)	100	120		200	28
TNVSS (mg/L)	64	80		120	8
Turbidity (NTU)	59	96		80	16
Color (P.U.)	240	260		150	130
Recoverable Phenolics (mg/L)		.089	.087 <.005	.19	.062
Oil and Grease (mg/L)			<1 <1		
NH_3-N (mg/L)	.04	.07		51	32
NO_2-N (mg/L)	.01	.02		75	62
NO_3-N (mg/L)	<.01	.15		27	25
O-PO_4-P (mg/L)	.10	.14		.50	.10
T-PO_4-P (mg/L)	.43	.56		4.4	.35
PBI (mg/L)	14	18			14
Fecal Coliform (#/100 mL)			900,000 Est. 1,300,000 Est.		
Dissolved Oxygen (mg/L)			3.0* 5.0* 3.8*		
Tannins & Lignin (mg/L as Tannin)					5.1

* = Field measurement
† = Corrected flow based on comparison of flows measured during WDOE sampling period.
Est. = Estimated count.
< = None detected at given detection limit.

Table 6b. Metals (ug/L).

Metal	85-foot Clarifier Effluent WDOE Composite Sample	45-foot Clarifier Influent (Grab)	45-foot Clarifier Supernatant (Grab)
Arsenic	<1	14.2	7.8
Cadmium	1	<1	1
Chromium	8	14	18
Copper	37	156	92
Lead	40	50	70
Mercury	<.06	<.06	<.06
Nickel	5.7	27.7	12.6
Zinc	32	174	22

Table 6c. Priority pollutant organics (ug/L, ug/Kg d.w.); base/neutral and acid extractables only.

Organic Compound	85-foot Clarifier Effluent WDOE Composite Sample (ug/L)	45-foot Clarifier Influent Grab (ug/L)	45-foot Clarifier Supernatant Grab (ug/L)	45-foot Clarifier Sludge (ug/Kg d.w.)
Base/Neutrals				
bis(2-ethylhexyl) phthalate	*	*	*	--
acenaphthene	--	0.17	--	--
naphthalene	1.4	25	2.7	130,000
acenaphthylene	2	--	--	106,000
anthracene	.03	--	--	--
phenanthrene	4	62	4.3	380,000
fluorene	.13	2.1	0.15	11,000
pyrene	2.2	27	1.4	210,000
chrysene	--	3.2	--	--
fluoranthene	1.4	24	1.3	21,600
benzo(a)pyrene	--	4.6	--	--
benzo(b)fluoranthene/ benzo(k)fluoranthene	--	2.3	--	--
benzo(g,h,i)perylene	--	7.3	--	--
ideno(1,2,3-cd)pyrene	--	2.3	--	--
Acid Extractables				
phenol	--	--	--	65,000
2-nitrophenol	--	100	--	--
pentachlorophenol	210	--	--	--

* = Present, but also present in blank.
-- = None detected.

Table 6d. Other organic compounds (ug/L, ug/Kg d.w.).

Organic Compound	85-foot Clarifier Effluent WDOE Composite Sample (ug/L)	45-foot Clarifier Influent (Grab) (ug/L)	45-foot Clarifier Supernatant (Grab) (ug/L)	45-foot Clarifier Sludge (Grab) (ug/Kg)
trichloroethene*	--	23 Est	37 Est.	--
3,7-dimethyl-,(E) 1,3,6-octatriene	230 Est.	--	--	--
3-chlorocyclohexene	--	--	54 Est.	--
4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol	190 Est.	--	--	--
(1S,3S,6R)-(-)-4-carene	11 Est.	--	--	--
benzoic acid	--	400 Est.	--	--
2,5-dimethyl-benzenebutanoic acid	--	6.1 Est.	--	--
2,3,4,6-tetrachlorophenol	140 Est.	--	--	--
bi-2-cyclohexen-1-yl	--	--	91 Est.	--
biphenylene	--	--	--	101,000 Est.
bis-1,1,1-(1,2-ethynediyl) benzene (aka - diphenylacetylene)	--	8 Est.	--	--
1-ethylidene-1H-indene	--	12 Est.	--	--
1,4-dihydro-1,4-methanonaphthalene	--	5.5 Est.	--	--
1-phenyl-naphthalene	--	3.3 Est.	--	--
retene (aka - 7-isopropyl-1-methyl phenanthrene)	--	<0.28	--	--
benzo(g,h,i)fluoranthene	--	4.8 Est.	--	--
1-(phenylmethylene)-1H-indene	--	1.2 Est.	--	--
9H-fluorene-9-one	--	12 Est.	--	--
1,2-acenaphthylenedione	--	1 Est.	--	--
9,10-anthracenedione	--	3.6 Est.	--	--
dibenzofuran	--	14 Est.	--	--
1,3-benzodioxole-8-carboxaldehyde	--	8.6 Est.	--	--
benzo(c)cinnoline	--	35 Est.	--	--
4-methylene-1-(1-methylethyl)-bicyclo (3.1.0)hex-2-ene	5.6 Est.	--	--	--
3,7,7-trimethyl-bicyclo(4.1.0)hpet-2-ene	5.1 est.	--	--	--
1,3,3-trimethyl-bicyclo (2.2.1)heptan-2-ol	60 Est.	--	--	--
2,2-dimethyl-3-methylene-bicyclo(2.2.1)heptone	7 Est.	--	--	--

* = Priority pollutant.
Est. = Estimated concentration.
-- = None detected.
< = Detected but less than level of quantification.

Table 7. Analytical results from stormwater runoff survey (11/15/83).

Table 7a. Conventionals.

Parameter	West Oil/Water Separator			East Oil/Water Separator			East Pond	
	Grab West Side	Grab East Side	Grab Composite	Grab West Side	Grab East Side	Grab Composite	Grab	Grab Composite
Flow (MGD)			.25			.26		1.2
COD (mg/L)			35			300		420
BOD (mg/L)			6			70		68
Temperature (°C)	11.9* 12.3* 12.4*	12.3* 12.4* 12.2*		18.0* 22.1* 22.7*	11.7* 11.8* 11.9*		9.6* 9.9* 9.9*	
pH (S.U.)	6.6* 6.4*	6.4* 6.3*	6.8	7.6* 7.7*	6.3* 6.4*	7.0	6.1* 6.0*	6.3
Specific Conductivity (umhos/cm)	209* 230*	237* 230*	211	>1000* 940*	236* 237*	614	120* 121*	117
Dissolved Oxygen (mg/L)	3.3* 2.8*	6.6* 6.5*		I I	1.6* 1.4*		1.9* 2.3*	
Total Solids (mg/L)			170			620		700
TNVS (mg/L)			120			390		400
TSS (mg/L)			15			110		440
TNVSS (mg/L)			10			52		260
Turbidity (NTU)			28			180		820
Color (P.U.)			110			710		1200
Recoverable Phenolics (mg/L)			.015			.033		.082
Oil & Grease (mg/L)	3 2			3 3			2 4	
NH_3-N (mg/L)			0.12			6.9		<.25
NO_2-N (mg/L)			<.01			8.4		<.05
NO_3-N (mg/LO			0.54			1.0		<.05
O-PO_4-P (mg/L)			I			I		I
$^{-}$-PO_4-P (mg/L)			<0.01			0.05		0.25
Fecal Coliform (#/100 mL)	400 1600			1100 1800			1100 800	

* = Field measurement.
I = Interference.
< = None detected at giver detection limit.

Table 7b. Metals (ug/L).

Metal	West Oil/Water Separator	East Oil/Water Separator	East Pond
Arsenic	<1	1	5
Cadmium	<0.1	<0.1	0.3
Chromium	5	8	22
Copper	25	58	78
Lead	23	34	51
Mercury	<.055	0.11	<.055
Nickel	7	9	30
Zinc	87	274	228

Table 7c. Priority pollutant organics (ug/L); base/neutral and acid extractions only.

Organic Compound	West Oil/Water Separator (ug/L)	East Oil/Water Separator (ug/L)	East Pond (ug/L)
Base/Neutrals			
bis(2-ethylhexyl) phthalate	1.5	21	4.7
butylbenzyl phthalate	<.06	--	--
di-n-butyl phthalate	.05	--	--
acenaphthene	.03	<0.1	--
naphthalene	.04	1.1	0.17
acenaphthylene	.03	0.9	<.08
anthracene	--	0.13	--
phenanthrene	.07	1.4	0.39
fluorene	.07	0.23	0.12
pyrene	.05	1.3	0.17
chrysene	--	0.44	--
benzo(a)anthracene	--	0.4	--
fluroanthene	.06	1.3	--
benzo(a)pyrene	--	1.0	--
benzo(b)fluoranthene/benzo(k)fluoranthene	--	1.7	--
benzo(g,h,i)perylene	--	3.6	--
ideno(1,2,3-CD)pyrene	.05	1.3	.05
Acid Extractables			
phenol	--	11	2
pentachlorophenol	--	20	<0.8

-- = None detected.
< = Detected but concentration less than limit of quantification.

Table 7d. Other organic compounds.

Organic Compound	West Oil/Water Separator (ug/L)	East Oil/Water Separator (ug/L)	East Pond (ug/L)
hexadecanoic acid	3 Est.	--	--
4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol	--	--	51 Est.
a,a,4-trimethyl-3-cyclohexene-1-methanol	--	210 Est.	77 Est.
1-methyl-4-(1-methylethyl)-1,4-cyclohexadiene	--	--	4 Est.
1,3-dimethylbenzene	4 Est.	64 Est.	--
1,2,4,5-tetramethylbenzene	0.4 Est.	--	--
1-methyl-3-(1-methylethyl)benzene	--	32 Est.	9 Est.
benzenepropanoic acid	--	7 Est.	14 Est.
benzenebutanoic acid	--	--	73 Est.
2,5-dimethylbenzenebutanoic acid	--	120 Est.	--
pentachlorobenzoic acid	--	2 Est.	--
2-methyl phenol	--	34 Est.	--
2,3,4,5-tetrachlorophenol	0.7 Est.	64 Est.	--
1,5-dimethyl naphthalene	0.9 Est.	--	--
2-methyl-5-(1-methylethyl)bicyclo[3.1.0]-hex-2-ene	--	--	5 Est.
1,7,7-trimethylbicyclo[2.2.1]heptan-2-one	--	61 Est.	--

-- = None detected.
Est. = Estimated concentration.

Table 8. Comparison of results with permit limits - 85-foot clarifier discharge 001 (4/19-20/83).

	Weyerhaeuser Sample		WDOE Samples	Permit Limits	
	Weyerhaeuser Analysis	WDOE Analysis	WDOE Analysis	30-day Average	Daily Maximum
Flow (MGD)	1.903	1.14*	1.18	--	7.0
BOD_5					
(mg/L)		19	40		
(lbs/day)		181	394	3000	4500
T. Susp. Solids					
(mg/L)	82	100	120		
(lbs/day)	1300	951	1180	3500	7000
Oil & Grease					
(mg/L)			<1	--	10
pH (S.U.)			6.6-7.2	6 to 9	

*Corrected flow based on comparison of flows measured during WDOE sampling period.

As indicated in Table 8, Weyerhaeuser's 001 discharge was meeting its effluent permit limits during the sample period. The main problems noted with parameters covered by permit limits had to do with the accuracy of Weyerhaeuser's flow and pH meters. As noted previously, Weyerhaeuser's flow meter appeared to be seriously out of calibration and had not been recalibrated nearly a year later.

Figure 2 is a copy of the script chart from the Manning dipper flow meter installed at the effluent weir during the sampling period. It is apparent from this chart that, at least during this sampling period, most of the flow occurred during the day shift (0700 hours to 1500 hours). Because the quality as well as the quantity of wastewater can change substantially under conditions like these, a flow-weighted composite sample is typically more accurate than a time-paced composite sample. Table 6a shows that the WDOE (flow-weighted) composite sample gave higher results for BOD and suspended solids than Weyerhaeuser's (time-paced) composite sample. Table 6a also shows similar discrepancies for nearly all parameters, with nutrients and conductivity showing the greatest deviation.

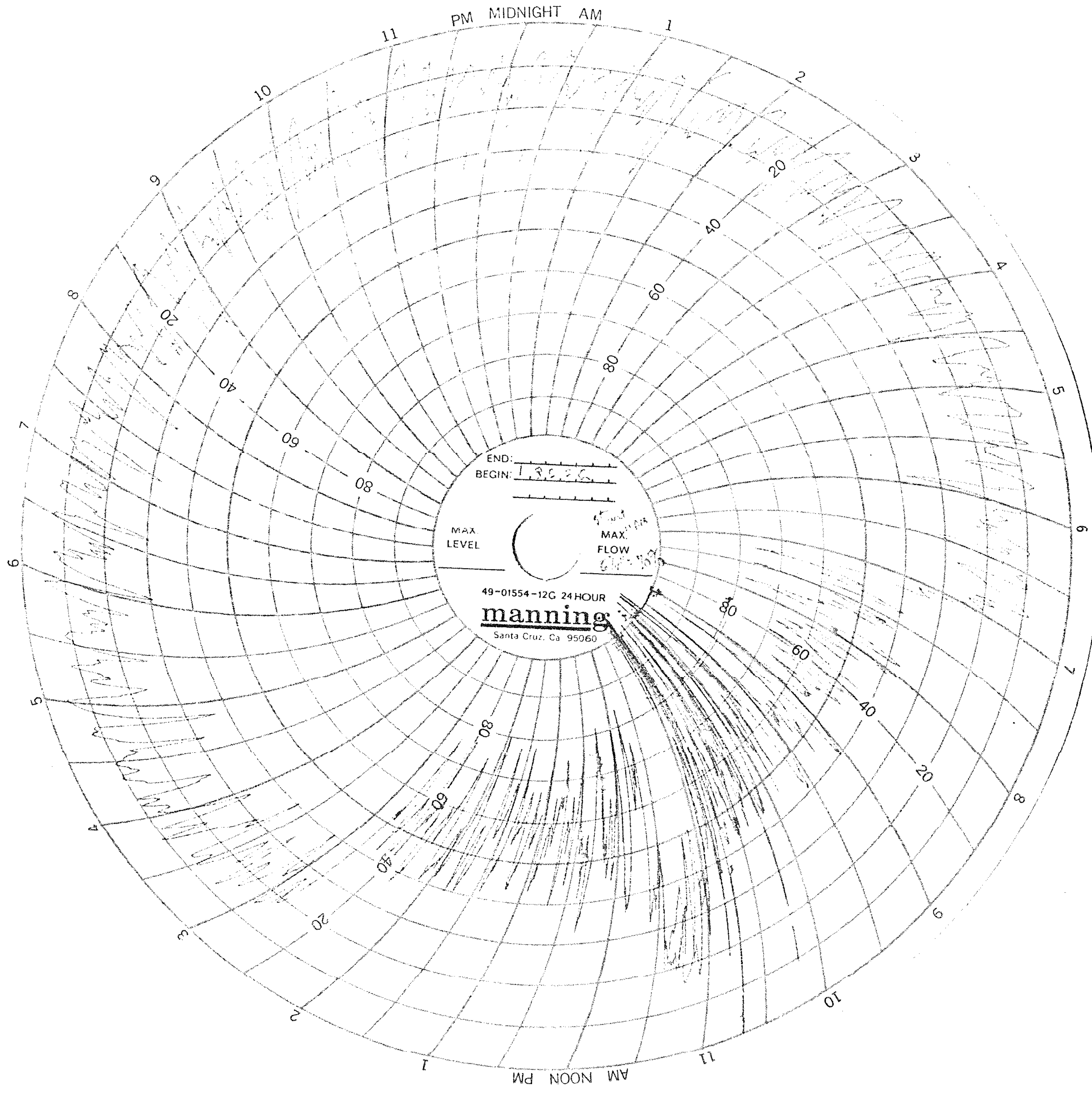

Figure 2. 24-hour script chart from Manning dipper flow meter (4/19/83, 1100 to 4/20/83, 1100).

An additional difference is that the Weyerhaeuser composite sample is not refrigerated to prevent BOD degradation. The refrigeration issue at this discharge location has been a matter of contention between WDOE and Weyerhaeuser for a number of years. Weyerhaeuser's request to be excluded from rules requiring sample refrigeration was forwarded to EPA Region X in August 1982. To our knowledge, EPA has not responded. Because of this we can only conclude that Weyerhaeuser is not in compliance with this permit requirement.

Based on the data generated during this inspection, it is not possible to ascribe the precise reason(s) for discrepancies between the WDOE and Weyerhaeuser composite samples. Nonetheless, conformance with good sampling practices (flow-weighted and refrigerated composite sample) would certainly improve the validity of and confidence in Weyerhaeuser's self-monitoring data.

Another discrepancy noted during the inspection was the measurement of effluent pH. Table 9 compares the pH values recorded by Weyerhaeuser's in-place pH probe with on-site measurements made with a calibrated, portable pH meter.

Table 9. Accuracy check on Weyerhaeuser effluent pH meter.

Date - Time	WDOE pH	Weyerhaeuser pH	Error
4/19 - 1115	6.9	7.8	+0.9
4/19 - 1128	6.6	7.75	+1.15
4/19 - 1420	7.2	7.8	+0.6

Table 9 shows the Weyerhaeuser system reading high by 0.6 to 1.15 units. When asked about meter calibration, Ken Johnson indicated that there was no set calibration schedule, but that the meter was checked once a week with a portable pH meter. We noted that this was probably inadequate. Subsequently, Mr. Johnson has indicated that the meter is now being calibrated weekly.

A review of the 85-foot clarifier effluent data points to several additional areas of potential concern:

1. Fecal coliform counts were very high (estimated counts of 900,000 and 1,300,000 per 100 mL). The bacterial load from this source alone could be expected to raise counts in the Columbia River by 10 organisms/100 mLs after complete mixing under conditions of

average river flow (200,000 cfs). At low flow (75,000 cfs), counts would be raised by about 25 organisms/100 mLs after complete mixing. This compares to the Washington State standard of a geometric mean of no greater than 100 organisms/100 mLs in Class A waters. With this load, the counts near the discharge (prior to complete mixing with the Columbia) would probably be in excess of the standard.

2. Several polynuclear aromatics (PNAs) were detected in this discharge. Concentrations for individual PNAs were in the 0.1 to 5 ug/L range, with the total PNA concentration being about 10 ug/L. This yields a daily load of about 0.1 lb/day. Although both the concentrations and loads appear quite low, they are in the same range as those for sources which have been associated with potential sediment contamination in other areas of the state (specifically Commencement Bay).

3. The pentachlorophenol concentration (210 ug/L) in the 85-foot clarifier effluent is also cause for concern. Analysis done by Weyerhaeuser for their consolidated permit application also detected pentachlorophenol in this discharge at 34 ug/L. These values compare to EPA receiving water criteria of 55 and 3.2 ug/L for protection of freshwater aquatic life against acute and chronic toxicity (respectively). To meet the chronic criterion, the effluent sampled during this inspection would have to be diluted about 65:1 with uncontaminated receiving waters. It should be noted that a closely related toxic compound (2,3,4,6-tetrachlorophenol) was also detected in the effluent at about 140 ug/L (Table 6d). There is, therefore, a potential problem in the vicinity of the outfall. The source of pentachlorophenol should be isolated and, if at all possible, eliminated.

Hogged-fuel boiler scrubber waters associated with the 45-foot clarifier were also sampled during this inspection. As noted earlier, water from the scrubbers is routed to the 45-foot clarifier where most of the solids are removed prior to recycling the supernatant back to the wet scrubbers. Grab samples of scrubber discharge (clarifier influent), clarifier supernatant, and sludge were collected for analyses. Results are reported in Tables 6a-d.

A primary reason for collection of these samles was that scrubber water has been, and continues to be, intermittently discharged to the environment. Generally, these waste releases are associated with repairs or equipment failure and, as such, requires that WDOE be notified of the bypass. Ironically, it appears that such an unscheduled bypass occurred during the 11/15/83 stormwater survey, evidentally while the scrubbers were being cleaned. Scrubber waters were discharged to the east oil/water separator discharge. WDOE was not notified of this bypass until Ken Johnson was contacted several days later by Brett Betts (WDOE, SWRO) after separator discharge laboratory tests showed high nitrite levels in the east oil/water separator sample.

Tables 6a-d summarize the scrubber water and sludge data. Constituents which appear to warrant concern if they are being discharged to the environment include:

1. Nutrients (especially nitrate, nitrite, ammonia) - The inorganic nitrogen forms were quite high (25 to 75 mg/L) in both scrubber water samples. Of particular concern are ammonia at 51 and 32 mg NH_3-N/L and nitrite at 75 and 62 mg/L. Both forms can be toxic to aquatic organisms. EPA (1976) notes NO_2-N concentrations below 5 mg/L should protect most warmwater fish and concentrations below 0.06 mg/L should protect salmonids. Dilution ratios of about 15:1 and 1250:1 would be required to dilute scrubber waters to these concentrations. Criteria for protection of aquatic organisms against ammonia are more complex as they are based on un-ionized ammonia concentrations. However, dilution of the waste to ratios of approximately 10:1 and 50:1 would be required to meet proposed acute and chronic ammonia criteria (Federal Register, 1984).

2. Metals - Certain metals, including copper, lead, and zinc, are somewhat elevated. Weyerhaeuser's consolidated permit reports higher concentrations for these metals than those detected during this survey.

3. Polynuclear aromatics (PNAs) - A wide range of PNAs and related compounds was detected in both scrubber waters and sludge. These PNAs are characteristic of those created during relatively low temperature combustion. These compounds typically have low solubilities and are primarily associated with suspended solids. Comparison of suspended solids and PNA concentrations in the clarifier influent and supernatant displays this relationship and points to the value of allowing the scrubber discharge to clarify prior to discharge. It is our understanding that Weyerhaeuser intends to run all future scrubber bypasses through the 85-foot clarifier prior to discharge. Any means of minimizing suspended solids discharge and associated PNA loads in this wastewater would represent an improvement over direct discharge.

Stormwater Surveys (3/17/83, 11/15/83)

The results for the reconnaissance and stormwater runoff surveys are summarized in Tables 5a-c and 7a-d, respectively. In addition, Weyerhaeuser personnel sampled the three outfalls to the Longview Diking District Ditch #3 on 5/17/83. Results from Weyerhaeuser's sampling effort are reported in their consolidated permit application. The WDOE stormwater runoff survey (11/15/83) and the Weyerhaeuser survey (5/17/83) were conducted in a similar manner (i.e., flow measurements and grab composite samples at each of the three discharges). The reconnaissance survey, however, was not as comprehensive. An additional difference was that rainfall and thus stormwater runoff during the reconnaissance survey (3/29/83) was much higher than during the other two surveys.

Even with three sets of results from the stormwater discharges, it is difficult to fully characterize the quantity and quality of wastewater. The quantity (and to a lesser degree, the quality) of these discharges varies dramatically with time--largely as a function of rainfall. Even though precise characterization of these discharges is difficult, they are clearly contaminated (particularly the east pond and east oil/water separator discharges).

To interpret the data from these surveys it is necessary to make some general assumptions. For instance, estimation of average annual discharges and loads to the Longview ditches requires extrapolation from known data. With additional data it would be possible to refine these estimates and obtain a more precise knowledge of the fluctuation in instantaneous, daily, and seasonal discharges.

Flows from the stormwater discharges have been measured three times. Total flows (from all three discharges) are summarized in Table 10. Also included in Table 10 are projected or predicted flows. These flows were calculated as follows. Total flow was divided into two components--process water flows and stormwater flows. Process water flows were calculated using the data contained in Weyerhaeuser's consolidated permit application ("Longview Wood Products Process Water Discharges to Diking District #3"). Stormwater flows ("rainfall projected flows") were based on the following assumptions: (a) all precipitation falling on that portion of Weyerhaeuser property north of the Columbia River dike flows to ditch #3, and (b) the area of this drainage is approximately 19 x 10^6 ft^2.

Rainfall measured at the City of Longview sewage treatment plant on the day of the survey was used to project stormwater flows. These rainfall data represent a 24-hour total beginning at 0700 on the day noted.

Table 10. Flow data for stormwater surveys.

Study	Survey Team	Date	Rainfall (inches)	RPF[1] (MGD)	Process Water Flow (MGD)	Total Projected Flow (MGD)	Measured Flow (MGD)
Reconnaissance Survey	WDOE	3/29/83	1.30	15.3	0.55	15.9	21.8[4]
Consolidated Permit Survey	WEYCO	5/17/83	T[2]	.05[3]	0.59	0.64[3]	1.27
Stormwater Survey	WDOE	11/15/83	.28	3.30	0.50	3.8	1.71

[1]Rainfall projected flow (see text).

[2]T = trace.

[3]Based on rainfall of 0.005 inch.

[4]Flow based on sum of 002 and 004 only; flow of west oil/water separator not measured.

One major potential reason for the discrepancy between measured and projected flows is the uneven intensity of rainfall. The only rainfall data available are 24-hour averages, while flows from the study area respond to variations in rainfall intensity of a much shorter time scale. For instance, projected flow is less than measured flow during the 3/17/83 survey even though the measured flow does not include the west oil/water separator. These flows were measured during heavy rainfall. When the rain ceased several hours later, flow from the discharges decreased visibly. On the other hand, measured flow was quite a bit lower than projected flow during the 11/15/83 survey. During this sampling period, rainfall was heavier during the evening after the sampling and flow measurement was concluded.

Despite the potential sources of error, the method described above appears to provide a reasonable estimation of flows and was used to estimate the mean annual discharge from Weyerhaeuser to ditch #3. Based on a mean annual rainfall of 45.7 inches and the process flow information in the consolidated permit, annual average discharges are: process waters - 0.68 MGD; stormwaters - 1.48 MGD; total discharge - 2.16 MGD.

Estimating loadings of specific pollutants (i.e., BOD and suspended solids) introduces an additional uncertainty. Concentrations of these contaminants may vary as a function of rainfall intensity and discharge flow.

Table 11. Flow, BOD, and suspended solids concentrations for stormwater discharges.

Survey Date	Discharge Number 003	Discharge Number 004	Discharge Number 002
		Flow (MGD)	
3/27*		11.4	10.4
4/17†	.13	.33	.81
11/15*	.25	.26	1.20
		BOD (mg/L)	
3/27*		74	130
4/17†	37	52	52
11/15*	6	70	68
		TSS (mg/L)	
3/27*		640	710
4/17†	<5	71	112
11/15*	15	110	440

* = WDOE study.
† = Weyerhaeuser study.

Based on the data in Table 11, it appears that suspended solids concentrations in these discharges are a function of flow; that is, rainfall intensity. TSS concentrations during the heavy rainfall event (3/27) are much higher than those measured during the other two surveys. BOD concentrations, on the other hand, appear to be less sensitive to flow variations. In addition, it appears that the east pond (002) and the east oil/water separator (004) are the major sources of these conventional pollutants, whereas the west oil/water separator (003) is a less significant source of BOD and TSS loads.

Table 12 is similar to Table 11, but presents BOD and TSS loads rather than concentrations. In addition, total measured loads for each survey are tabulated, and the final column gives a normalized load (lbs/MG).

Table 12. Flow, BOD, and suspended solids loads for stormwater discharges.

Survey Date	Discharge Number 003	004	002	Total Load	Normalized Load (lbs/MG)
	Flow (MGD)				
3/27*		11.4	10.4	21.4**	
4/17†	.13	.33	.81	1.27	
11/15*	.25	.26	1.20	1.71	
	BOD (lbs/day)				
3/27*		7,040	11,300	18,300**	860**
4/17†	38	140	350	530	420
11/15*	12	150	680	840	490
	TSS (lbs/day)				
3/27*		60,800	61,600	122,000**	5,700**
4/17†	<5	190	760	950	740
11/15*	31	240	4,400	4,700	2,700

* = WDOE study.
** = Based on results from 004 and 002 only; 003 not sampled.
† = Weyerhaeuser study.

From Table 12, again we see that suspended solids loading (even when normalized) varies substantially from study to study, apparently as a function of rainfall intensity. Given an estimated mean annual flow of about 2.2 MGD from these discharges, a value of about 3000 pounds of suspended solids per million gallons discharged may be reasonable. This would yield an average suspended solids discharge of about 6500 pounds TSS/day.

Normalized BOD loads are much more consistent, especially when one considers that the west oil/water separator was not sampled in the 3/27 survey. Had it been, the normalized BOD load for that date would have been substantially lower. There does, however, appear to be some increase in normalized BOD load as a function of flow. Given this, a normalized load of approximately 500 pounds of BOD per million gallons appears reasonable. At 2.2 MGD this would yield an annual mean of about 1100 pounds BOD/day.

It should also be noted that dissolved oxygen concentrations in the discharges were quite low (<2.5 mg/L in east pond oil/water separator discharges). This, associated with BOD, NH_3, and NO_2 loads in these sources all will contribute to depressed dissolved oxygen concentrations in the receiving water.

Other conventional parameters of concern include oils and grease, color, turbidity, ammonia, and nitrite. Weyerhaeuser's permit requires "no visible sheen" for oils and grease on discharges 002, 003, and 004. Concentrations of 3 to 15 mg/L were noted during the 3/29 survey, while lower concentrations (2 to 4 mg/L) were detected during the 11/15 survey. All oil and grease samples were obtained upstream from oil sorbent booms deployed at the culvert mouths in the Diking District ditch. Obtaining a representative sample downstream from the boom was not possible, but a visible sheen was noted below the booms on discharges 003 and 004 during the 3/29 survey.

Color and turbidity were particularly high in the 002 (east pond) and 004 (east oil/water separator) discharges. Color was higher when flows were lower (11/15), whereas turbidity (like suspended solids) was higher when discharge flows were higher (3/29).

High ammonia (6.9 mg NH_3-N/L) and nitrite (8.4 mg NO_2-N/L) concentrations were noted in the east oil/water separator discharge during the 11/15 survey. Analysis of an unpreserved nutrient sample taken from the west side contribution to this discharge was high in ammonia, nitrite, and nitrate which indicates the source of these compounds was to the west side of the east oil/water separator. This is the side which would have received the discharge from the hogged-fuel boiler scrubber cleaning bypass. This bypass (mentioned previously in the discussion of the 45-foot clarifier sampling) occurred during the 11/15 survey and was not reported to WDOE as required until subsequent inquiries were directed to Weyerhaeuser several days later. As can be noted in Table 6a, the scrubber water is very high in ammonia, nitrite, and nitrate and is the probable source of these pollutants in the west oil/water separator discharge. As noted previously, both ammonia and nitrite can be toxic to fish. The impact of these pollutants on the Diking District ditch will be discussed in the receiving water report.

Metals results are reported in Tables 5a and 7a. Elevated concentrations of zinc, copper, and lead were noted, particularly in the east pond and east oil/water separator discharges. Although the concentrations of these metals were only moderately elevated, they could have a deleterious impact on a limited-volume receiving water like ditch #3. This will be discussed in more detail in the receiving water study.

Priority pollutants in the acid extractable and base/neutral fractions of these discharges consisted primarily of two groups of compounds: (1) phenol and pentachlorophenol, and (2) polynuclear aromatic (PNA) compounds.

Phenol was reported in concentrations of 2 to 11 ug/L in the east pond and east oil/water separator discharges. Pentachlorophenol was detected in very low concentrations (<0.8 ug/L) in the east pond discharge and at higher concentrations (3.1 to 20 ug/L) in the east oil/water separator discharge. Phenol discharges probably do not represent a problem, as the concentrations detected are well below applicable federal receiving water criteria. The criteria documents (Federal Register, 1980) note, however, that "the available data for pentachlorophenol indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 55 and 3.2 ug/L, respectively, and would occur at lower concentrations among species that are more sensitive than those tested."

Another chlorinated phenol (2,3,4,6-tetrachlorophenol) closely related to pentachlorophenol was detected in both the east oil/water separator (estimated at 64 ug/L) and the west oil/water separator (estimated at 0.7 ug/L). The sources of chlorinated phenols should be identified and eliminated if at all possible.

The second class of priority pollutant organics detected in these discharges are the PNAs, ranging from 2-ring (naphthalene) compounds to 6-ring (ideno [1,2,3-cd] pyrene) compounds. In general, the lower molecular weight (2- and 3-ring) compounds are associated with contamination by petroleum products, while the higher weight (4- to 6-ring) compounds are associated with incomplete combustion. The higher weight PNAs are sometimes referred to as combustion PNAs (CPNAs). Another characteristic of PNAs is that, in general, they have a strong affinity for particulate matter and are typically associated with the suspended solids in a water sample. In the receiving environment, therefore, they most often contribute to contamination of sediments and are often below detection limits in water samples free of suspended solids.

Concentrations of PNAs were highest in the east oil/water separator discharge, followed by the east pond discharge and the west oil/water separator. PNAs in the east oil/water separator discharge were dominated by the higher weight (combustion) PNAs, while lower weight (petroleum source) PNAs were comparatively dominant in the other two discharges.

PNA concentrations in the discharges were below federal receiving water criteria, but are high enough (particularly the east oil/water separator) to raise concerns regarding contamination of sediments.

Table 13 presents PNA data for both wastewater and sediment samples from discharges 002, 003, and 004. The 11/15/83 sediment data are from receiving water work conducted by Singleton and Bailey presently pending publication. The data from the water samples collected from the discharges are presented in a somewhat unusual way. PNA concentrations are normalized to suspended solids concentrations in these samples. These data are therefore reported as mg of a PNA per kg of suspended solids (ppm dry weight). Thus the sediment and water sample data are presented on the same basis. This seems reasonable because (as noted earlier) PNAs are primarily associated with the particulate matter in water samples, and it is this suspended matter which will subsequently settle to become the sediments.

The sources and sediments generally agree in the suite of individual PNAs identified and in concentration. This indicates that removal of suspended solids prior to discharge would probably eliminate most of the PNA loading. It is also probable that, like suspended solids discharge, instantaneous PNA loading is a function of flow and thus rainfall intensity.

Conclusions and Recommendations

1. During this survey, Weyerhaeuser was generally meeting all current permit limitations. However, effluent sampling procedures at the 85-foot clarifier discharge could be improved by (a) routinely calibrating the effluent flow meter and totalizer, (b) assuring the accuracy of the effluent pH meter, (c) compositing samples on a flow-proportional basis, and (d) icing or refrigerating samples obtained for BOD analysis until such time as their appeal from this requirement is resolved.

2. The 85-foot clarifier effluent contained concentrations of chlorinated phenols and fecal coliform bacteria high enough to create potential receiving water problems. These are issues to address in the current round of permitting.

3. The hogged-fuel boiler scrubber waters contained concentations of ammonia, nitrite, and PNAs high enough to cause concern when they are discharged to the environment. Clarifying this wastewater (that is, removing suspended solids) prior to discharge would minimize PNA loads.

4. Discharges to Longview Diking District Ditch #3 are contaminated. On an annual basis these discharges are estimated to average about 2.2 MGD, 1100 pounds BOD/day, and 6500 pounds suspended solids/day. These represent estimates based on information currently available and are subject to revision when more extensive, improved data are available. Flows and loads from these discharges are variable, mainly in response to rainfall intensity. Suspended solids loads are particularly variable.

5. In terms of flow, BOD loading, and suspended solids loading, the east pond is the largest source, followed by the east oil/water separator. The west oil/water separator is a distant third. In terms of organic priority pollutants (pentachlorophenol and the PNAs), the east oil/water separator is the major source, followed by the east pond. Again, the west oil/water separator is the smallest source.

6. Other characteristics of the stormwater discharges include high color and turbidity. Ammonia and nitrite concentrations were elevated in the east oil/water separator discharge, but this may have been associated with a bypass from the hogged-fuel boiler scrubber water. In addition, metals (zinc, copper, and lead) were somewhat elevated in the stormwater discharges.

BY:cp

References

Federal Register, 1984. "Water Quality Criteria; Request for Comments." 2/7/84, V. 49 No. 26. p. 4551

Singleton, L. and G. Bailey, 1983. Longview Diking District Study. Memorandum to Jon Neel, 12/1/83. 24 pp.

U.S. EPA, 1976. Quality Criteria for Water. EPA-440/9-76-023. 501 pp.

Table 13. PNA data for water and sediment samples normalized (see text) to suspended solids (mg/Kg dry weight).

Parameter	Sample Location Date Sample Type	West Oil/Water Separator (003)		East Oil/Water Separator (004)			East Pond (002)			
		11/15/83 Water	11/15/83 Sediment[1]	3/27/83 Water	11/15/83 Water	11/15/83 Sediment[1]	3/27/83 Water	11/15/83 Water	1/25/83 Seciment[2]	11/15/83 Sediment[1]
Suspended solids (mg/L)		15		640	110		710	440		
acenaphthene		2.0	--	--	<0.9	0.99	--	--	0.18	0.64
naphthalene		2.7	4.0	17	10	53	0.7	0.4	1.3	0.79
acenpahthylene		2.0	1.7	6.4	8.2	31	--	<0.2	0.40	--
anthracene		--	1.0	--	1.2	11	--	--	--	--
phenanthrene		4.7	8.7	58	13	73	5.4	0.9	3.0	1.9
fluorene		4.7	0.8	--	2.1	5.4	--	0.3	--	0.61
pyrene		3.3	6.3	17	12	69	--	--	1.4	0.65
chrysene		--	1.4	--	4.0	7.2	--	--	--	--
benzo(a)anthracene		--	--	--	3.6	4.4	--	--	--	--
fluoroanthene		4.0	11	16	12	69	--	--	1.3	0.65
benzo(a)pyrene		--	--	--	9.1	2.1	--	--	--	--
benzo(b)fluoroanthere/benzo(k)fluoroanthene		--	--	--	16	6.2	--	--	--	--
benzo(g,h,i)perylene		--	--	--	33	--	--	--	--	--
ideno(1,2,3-cd)pyrere		--	--	--	12	--	--	0.1	--	--

[1]Data from receiving water survey by Singleton & Bailey, pending publication.
[2]Data from Singletor & Bailey, 1983.
-- = None detected.