

WASHINGTON STATE DEPARTMENT OF ECOLOGY
ENVIRONMENTAL INVESTIGATIONS AND LABORATORY SERVICES

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TO: Greg Bean
FROM: Pat Hallinan
SUBJECT: Weyerhaeuser, Everett Class II Inspection

INTRODUCTION

Ecology conducted a Class II inspection at the Weyerhaeuser pulp mill at Everett on April 18-20, 1988. Carlos Ruiz and Don Reif from the Ecology Compliance Monitoring Section conducted the inspection.

The mill uses the Kraft process to produce bleached pulp. Wastewater generated at the site is treated by a lagoon system consisting of a settling basin and an aerated lagoon (Figure 1). Treated effluent discharges at outfall 001 on outgoing tides into Steamboat Slough. Water used by the mill is filtered from the Snohomish River. The filters are periodically back-washed back into the Snohomish (outfall 004). The permit limit for total suspended solids (TSS) at outfall 001 includes the TSS contribution from the filter backwash.

Objectives of this inspection included:

1. Verify effluent compliance with NPDES permit limits.
2. Evaluate effluent toxicity using Rainbow trout (Oncorhynchus mykiss), Microtox, Bay Mussel (Mytilus edulis), Mysid Shrimp (Mysidopsis bahia), and Sea Urchin (Strongylocentrotus purpuratus) bioassays, and the Ames test.
3. Characterize both untreated (influent) and treated mill wastewater for toxic pollutants.
4. Evaluate bottom sediment toxicity surrounding the wastewater discharge using the amphipod, Rhepoxynius abronius.
5. Characterize bottom sediments surrounding the wastewater discharge for toxic pollutants.
6. Assess the permittee's self-monitoring by reviewing lab and sampling procedures. Samples were split with the mill to determine the accuracy of laboratory data.

PROCEDURES

Ecology collected both untreated (influent) and treated (effluent) mill wastewater composite and grab samples. The influent composite sample was collected by an ISCO automatic sampler, which collected about 220 mLs of sample every 30 minutes for 24 hours. The effluent composite sample was also collected by an ISCO automatic sampler, which sampled during the outgoing tidal discharges. Grab samples were also collected for field and laboratory analyses at the end of the settling basin, at sites along the aerated lagoon, at the outlet of a retention pond which flows into the lagoon treatment system, and at the filter backwash. Settled solids from the settling basin are periodically dredged to the above mentioned retention pond. Table 1 lists sampling times and parameters analyzed.

The wastewater samplers were fitted with teflon tubing and glass sampling bottles. This equipment was cleaned before use by washing with non-phosphate detergent and then rinsing three times with de-ionized water, dilute nitric acid, methylene chloride, and acetone. Collection equipment was air dried then wrapped in aluminum foil until used.

Three sites were sampled for bottom sediments in the vicinity of the Weyerhaeuser discharge (see Figure 1): at the mouth of the discharge ("at outfall"), at the downstream edge of the NPDES permitted dilution zone ("below outfall"), and at an upstream site ("field control") located about 1/2 mile upstream of the outfall.

Sediment samples were collected with a 0.1 meter square van Veen sampler following recommended Puget Sound protocols (Tetra Tech, 1986). Samples consisted of three to four individual grabs in which the top 2 cm of sediment from each grab was removed, then composited. Composites were thoroughly mixed, then divided for separate analysis, except for sediment analyzed for volatile organics (VOA's). These samples were taken directly from the van Veen. Stainless steel utensils were used in the collection of the sediment samples and were cleaned by the same procedures as the wastewater composite samplers. Table 1 also includes sediment sampling times and parameters analyzed. Appendix 1 lists all sediment and wastewater chemical, and bioassay test methods used, and the corresponding laboratory conducting the analyses.

RESULTS AND DISCUSSION

Comparison of Effluent Parameters to NPDES Permit Limits

Conventional pollutant data collected during the inspection is summarized in Table 2. At outfall 001, BOD, TSS, pH, and temperature were all well within permit limits (Table 3). However, the effluent failed the 96-hour Rainbow trout bioassay. At a 65 percent effluent concentration, a 57 percent survival rate was observed. The permit calls for at least an 80 percent survival rate. At outfall 004, pH was also within permit limits.

Other Effluent Bioassay Results

In the acute Mysid shrimp and Microtox (a luminescent bacteria) bioassays, toxicity was also observed (Table 4). In the Mysid test, a 50 percent mortality occurred at a 100 percent effluent concentration. In the Microtox test, EC₅₀s (effluent concentrations resulting in a 50 percent reduction in bacterial luminescence) of 72.8 and 58.9 percent were observed at exposure times of 10 and 15 minutes, respectively. This represents a moderate level of toxicity (EPA, 1980).

Significant chronic effects were observed in both the Bay mussel embryo development and Sea urchin sperm fertilization bioassays (Table 4). In the Bay mussel test, an EC₅₀ (effluent concentration resulting in 50 percent of the embryos developing abnormal shells) was 0.5 percent. This response is in the range seen for Pacific oyster bioassays (a similar test) performed at Ecology biomonitoring inspections at two bleached sulfite mills (Hallinan, 1989; Reif, 1989). The Sea urchin bioassay yielded an EC₅₀ of 2.4 percent. Both the Bay mussel (or Pacific oyster) and Sea urchin bioassays should be considered for use as the chronic bioassay requirement in the next re-issuance of the NPDES permit. The effluent showed no mutagenic effects in the Ames test.

Effluent Chemistry

Complete results for influent, effluent, filter backwash, and retention pond effluent analyses for volatile organics, semi-volatile organics, pesticides/PCBs, metals, and resin acids/guaiacols are included in Appendix 1 of this report. Metals and organic compounds detected in these samples are listed in Table 5.

Three compounds were detected in the effluent in the volatile and semi-volatile analyses: chloroform at 21 ppb (parts per billion; ug/L), 2,4-dichlorophenol at 4 ppb, and 2,4,6-trichlorophenol at 11 ppb. Chloroform and 2,4-dichlorophenol concentrations were well below acute water quality criteria (Table 6). In the resin acid/guaiacol scan, 4,5,6 trichloroguaiacol and tetrachloroguaiacol were detected at 30 and 32 ppb, respectively. However, these concentrations were below acute thresholds: In 96-hour rainbow trout bioassays, LC₅₀s (lethal concentration to 50 percent of the test organisms) for tetrachloroguaiacol and trichloroguaiacol have been determined at 320 and 750 ppb, respectively (EPA, 1979).

Numerous organic compounds were detected in the influent sample in the volatile, semi-volatile, and resin acids scans. Chloroform was found in the largest amount (5300 ppb). Other organics identified included 2-butanone at 210 ppb, phenol at 19 ppb, and 2,4,6-trichlorophenol at 9 ppb. Five resin acids were detected (see Table 5) at concentrations ranging from 18 to 73 ppb. Of the compounds in the influent sample, only chloroform and 2,4,6-trichlorophenol were also found in the effluent sample. Organics identified in the land retention pond effluent, that were not found in either the influent or effluent samples, included toluene at 7 ppb and 4-methylphenol at 66 ppb. Chloroform was the only organic detected (at 130 ppb) in the filter backwash sample.

Metals in the influent and effluent samples were generally comparable (Table 5). An exception was for selenium which was found at 22 ppb in the influent and not detected at 1 ppb in the effluent. Zinc, nickel, and copper in the land retention pond effluent were significantly higher than in either the influent or effluent samples.

Metals detected in the effluent and filter backwash are compared to Washington State Water Quality Criteria (EPA, 1986) in Table 7. In the effluent, no metal was above freshwater or saltwater acute criteria. However, lead exceeded both freshwater and saltwater chronic criteria while nickel exceeded the saltwater chronic limit. It should be noted that the effluent and filter backwash was analyzed for total metals which may overestimate actual toxic threshold concentrations.

Metals detected in the filter backwash were particularly high. Copper exceeded both freshwater and saltwater acute criteria by about 30 times. Zinc was about five times higher than freshwater criteria and about two times greater than saltwater criteria. Chromium, mercury, and nickel all exceeded fresh and saltwater chronic limits. The source of these metals may be from the Snohomish River. Ecology ambient monitoring data for the Snohomish River commonly finds mercury, chromium, copper, lead, zinc, and cadmium at detectable concentrations (Ecology, unpublished data). No ambient monitoring data exist for the other metals found in the filter backwash.

An estimation of the metals content of the filter backwash on a dry weight basis is presented in Table 8. This estimation was calculated assuming a 1000 mg/L suspended solids concentration is equal to 0.1 percent solids. Metal concentrations were below sediment quality standards. Also shown on Table 8 is a comparison of the filter backwash metals to criteria for open-water disposal of dredged materials. Two criteria values are listed on Table 8: one developed for freshwater by the state of Wisconsin (Wisconsin Department of Natural Resources, 1985) and the other developed for Puget Sound by PSDDA (Puget Sound Dredged Disposal Analysis, 1989). The filter backwash metals were below the PSDDA screening levels. However, arsenic exceeded the freshwater disposal criteria by over 50 percent. Mercury was also at the freshwater limit. A re-sampling to verify the metal results for the filter backwash is recommended. This sampling should include analyses for total and total recoverable metals, hardness, and percent solids. Water supply treatment chemicals and additives used by the mill should also be checked for any metal content.

Sediment Bioassays

Results for the amphipod bioassay for the three sediment samples collected are listed in Table 9. The outfall sample showed a slight decrease in survival compared to the field control, below outfall, and laboratory control samples. However at a 95 percent confidence limit, no significant difference in survival between the samples occurred. The number of survivors able to rebury after the 10-day exposure time was near or at 100 percent for all samples tested.

Sediments at the outfall contained significantly higher percent fines (silt + clay; <4um - 62um) than the field control and below outfall sediments: 45 percent compared to 2.2 and 1.6 percent, respectively. Sediment texture at the field control and below outfall stations were similar, consisting primarily of sand. Decrease in survival for the Rhepoxynius bioassay has been shown to occur for samples with a high percent fines (DeWitt et al., 1988). Therefore, the decrease in survival seen in the amphipod bioassay for the outfall sediments may have been due to the higher percent fines of the sample. These higher percent fines may indicate that deposition from the effluent is occurring at the outfall sediment sampling station.

Sediment Chemistry

Levels of chemical contamination at the three sediment stations were generally very low (Table 10). For the field control station, toluene was the only organic detected (at an estimated concentration of 2 ppb dry weight). Outfall sediments were more contaminated; however, all organics detected were far below proposed sediment quality standards (Table 10). Additional compounds detected at the outfall included alpha-chlordane, an insecticide, at 80 ppb dry weight; dehydroabiatic acid, a resin acid, at 530 ppb dry weight; and fluoranthene and pyrene, both polyaromatic hydrocarbons, at 85 and 62 ppb dry weight, respectively. Alpha-chlordane was the only compound detected at the below-outfall station (at 80 ppb dry weight). Complete sediment results for volatiles, semi-volatiles, pesticides/PCBs, and resin acids/guaiacols are given in Appendix 1.

Arsenic, copper, lead, mercury, nickel, and zinc were elevated in the outfall sediments compared to the below outfall and field control sediments (Table 11). However, all metals at the three stations were below proposed sediment quality standards.

COMPARISON OF LABORATORY RESULTS

Laboratory results for BOD, TSS, and pH between the Ecology and mill labs compared very well (Table 12). However, results for the trout bioassay differed significantly. Weyerhaeuser completed the bioassay at three effluent concentrations; 100, 65, and 32 percent with resulting mortalities of 100, 100, and 0 percent, respectively. Ecology's result at the 65 percent effluent concentration was 43 percent mortality.

LABORATORY REVIEW

Laboratory procedures at the mill were generally good. A laboratory review sheet is included in Appendix 2 of this report. Circled items indicate where work is needed to bring procedures in conformance with standard techniques. The final effluent continuous pH recording was not accurate compared to Ecology field measurements. At the time of the inspection, the continuous pH probe was periodically replaced but never calibrated. The pH probe should be frequently calibrated using the same procedures as the calibration of the mill laboratory pH meters.

CONCLUSIONS AND RECOMMENDATIONS

1. The effluent met permit limits for BOD, TSS, pH, and temperature. However, the effluent failed the Rainbow trout bioassay.
2. Acute toxic effects for the effluent were also observed in the Mysid shrimp and Microtox bioassays. Significant chronic toxicity was noted for the Bay mussel embryo development and Sea urchin sperm fertilization bioassays. Both the Bay mussel (or Pacific oyster) and Sea urchin bioassays should be considered for use as the chronic bioassay requirement in the next re-issuance of the NPDES permit. The effluent showed no mutagenic effects in the Ames test.
3. Effluent priority pollutant and resin acid analyses failed to identify a specific cause of the toxicity. All organics and metals detected in the effluent were below acute water quality criteria. Metals in the filter backwash were particularly high. A re-sampling of the backwash is recommended to verify the results from this inspection. This sampling should include analyses for total and total recoverable metals, percent solids, and hardness.
4. Sediment samples collected at the outfall and at the edge of the NPDES permitted dilution zone showed no significantly different amphipod mortality compared to field and laboratory control sediments.
5. Sediments in the vicinity of the Weyerhaeuser discharge generally showed low levels of contamination. All organics and metals detected were below proposed AET sediment quality standards.
6. Laboratory procedures at the mill were generally good. Rainbow trout bioassay results from Weyerhaeuser and Ecology labs did not compare well. Other minor recommendations are included in the laboratory review section of this report.

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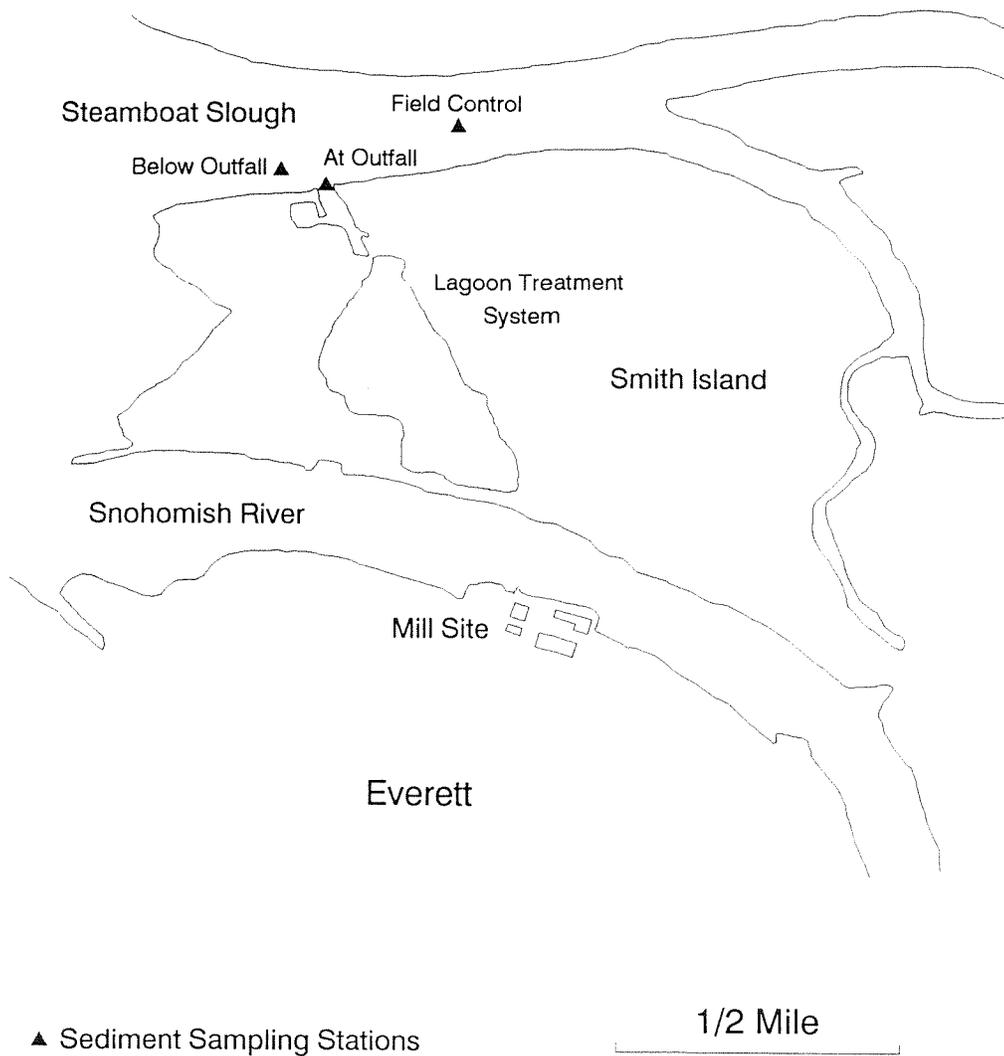


Figure 1 - Site and Sampling Locations - WEYCO, 4/88.

TABLES

Table 2 - Ecology Analytical Results - WEYCO, 4/88.

Station: Type: Date: Time:	Influent				Effluent				Lagoon #1		Lagoon #2		Lagoon #3		Filter #1	Filter #2	Filter Wash	Retention Pond Influent	Storm Sewer	Sediments		
	Grab		Composite		Grab		Composite		Grab		Grab		Grab		Grab	Grab	Grab	Grab	Grab	Field Control	@ Outfall	Below Outfall
	4/19	4/19	4/20	4/19-20	4/19	4/19	4/20	4/19-20	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/19	4/20	4/20	4/18	4/18	4/18
Parameters	0835	1615	1000	0935-0935	1910	1510	1125	0910-0910	1010	1605	1035	1530	1055	1550	1130	1135	1653	1545	1045	1720	1800	1840
GENERAL CHEMISTRY																						
Turbidity (NTU)	20	22	18	22	<1	<1	<1	<1	9.7	9.5	7.3	7.2	6.9	7.1	4	4	480	23	<1			
pH (S.U.)	10.1	9.8	11.4	8.5	7.2	6.8	7.2	7.1							6.6	6.5	6.5	7.4	7.2			
Conductivity (umhos/cm)	2440	2400	2810	2310	2520	2510	2560	2490	2600	2350	2660	2660	2560	2570	34	33	35	3070	36			
Alkalinity (mg/L as CaCO ₃)	310	250	380	180	120	120	120	120	330	220	230	230	140	140	280	6	6	1300	11			
Hardness (mg/L as CaCO ₃)				78				170									23	1100				
Cyanide (mg/L)				0.001				<0.005										<0.005		0.95	0.21	0.17
Solids (mg/L)																						
IS				1900				1800														
TNVS				1300				1500														
TSS	180	190	140	160	15	16	16	14	150	160	28	32	32	34	7	7	2100	70				
TNVSS	29	26	28	20	<1	<1	<1	<1	19	24	2	4	4	<1	5	5	1600	20				
TVSS	151	164	112	140	14	15	15	13	131	136	26	28	28	33	2	2	500	50				
BOD ₅ (mg/L)				240				21										<310				
COD ² (mg/L)	960	660	760	780	490	460	470	460	890	760	650	640	570	560			480	670	<4			
Nutrients (mg/L)																						
NH ₃ -N	2.40	1.30	2.20	4.30	0.25	0.31	0.40	0.28	5.20	3.50	0.11	0.07	0.07	0.07				0.10	0.02			
NO ₂ +NO ₃ -N	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS				IS	IS			
T-Phosphate	0.58	0.48	0.55	0.55	0.40	0.34	0.34	0.39	0.61	0.50	0.54	0.56	0.51	0.49				0.22	0.81			
O-Phosphate								0.06														
Fecal Coliform (#/100mL)																						
% Kleb																						
Phenols (ug/L)				850				19									2	44		<0.005	0.075	<0.007
FIELD ANALYSES																						
Temperature (°C)	31.2	34.1	32.4	7.9	19.2	23.5	19.9	4.0	33.2	33.8	25.2	25.4	22.0	23.4	9.1	9.3	9.4	15.6	36.2			
pH (S.U.)	10.14	9.39	11.42	8.93	7.25	6.96	7.02	7.17	9.73	9.31	7.67	7.40	7.19	7.02	7.00	7.17	7.16	7.30	7.18			
Conductivity (umhos/cm)	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	>1000	37	40	54	>1000	>1000			

IS - No analytical result due to an interfering substance
 CON - Confluent growth
 NAR - No analytical results

Table 3. Comparison of NPDES Permit Limits to Inspection Data - WEYCO, 4/88.

Parameter	NPDES Permit Limits		Inspection Data			
	Daily Average*	Daily Maximum	Ecology Composite (001)	WEYCO Composite (001)	Grab Samples (001)	Grab Samples (004)
BOD ₅ (mg/L) (lbs/D)	6,000	12,600	23 2,896	22 2,771	21 2,645	
TSS** (mg/L) (lbs/D)	13,400	24,900	12 1,511	8 1,007	13 1,637	5
Temperature (°C)		28.9			19.6	
pH (S.U.)		5.0 - 9.0			7.1	6.1
Flow (MGD)			15.1	15.1		
Rainbow trout bioassay	80% Survival in 65% Effluent		57%	0%		

* - Defined as average over one month's time.

** - Permit limit for outfalls 001 and 004 combined. Outfall 004 loading is determined by measuring Snohomish River influent TSS and flow.

Table 4 - Effluent Bioassay Results - WEYCO, 4/88.

Ames Test: Negative mutagenic response

Concentration	% Unfertilized Eggs		% Unfertilized Eggs Adjusted for Salinity Effects*
	Salinity		
	Control	Effluent	
100%	100	100	
33%	75	100	100
11%	17	100	100
3.7%	13	80.3	77
1.2%	13.7	24.3	12
Control		5.7	

EC₅₀ (95% Confidence limits) = 2.4% effluent

Effluent	EC ₅₀		
	5 min.	15 min.	30 min.
	100%	72.8%	58.9%

Mussel Larvae Bioassay:

Effluent	Mean Net Mortality**	Weighted Mean Net Abnormality***
32%	100	-
18%	0	100.0
10%	0	99.6
1.0%	1	66.9
0.1%	0	14.0
Control	0	0

EC₅₀ (95% Confidence limits) = 0.5% effluent

Rainbow trout (65 percent effluent concentration):

	# of live test organisms		% Mortality
	Initial	Final	
65% Effluent	30	17	43.3
Control	30	30	0

Mysid Shrimp:

Effluent	Percent Survival
100%	50
30%	100
10%	100
3.0%	100
1.0%	90
Control	100

* - Transformed with Abbott's correction (Dimmel and Stober, 1987).

** - Mean Net Mortality (%) = $\frac{(\% \text{ Mean Total Mortality} - \% \text{ Mean Control Mortality}) * 100}{100 - \% \text{ Mean Control Mortality}}$

*** - Weighted mean net abnormality was calculated using the above formula, replacing abnormality for mortality.

Table 5 - Metals and Organic Compounds Detected in Water Samples - WEYCO, 4/88.

	Influent (ug/L)	Effluent (ug/L)	Retention	
			Pond Influent (ug/L)	Filter Wash (ug/L)
Volatile Organics:				
Acetone	730 B	5 U	13 B	5 U
Chloroform	5300	21	1	130
2-Butanone	210	3 U	7	3 U
Toluene	50 U	1 U	7	1 U
Semi-Volatile Organics:				
Phenol	19	4 U	6	2 U
4-Methylphenol	4 U	4 U	66	2 U
2,4-Dichlorophenol	8 U	4	8 U	4 U
2,4,6-Trichlorophenol	9	11	8 U	4 U
Resin Acids/Guaiacols:				
Sandaracopimeric Acid	18	10 U	10 U	
Isopimeric Acid	65	10 U	11	
Palustric Acid	20	10 U	10 U	
Abietic Acid	73	10 U	10 U	
Dehydroabietic Acid	55	10 U	100	
4,5,6-Trichloroguaiacol	10 U	30	10 U	
Tetrachloroguaiacol	10 U	32	10 U	
Metals (total):				
Arsenic	2	1 U	3	46
Cadmium	5 U	5 U	7	5 U
Chromium	144	147	56	73
Copper	1.7	3.1	6.2	134
Lead	33	18	5	5 U
Mercury	0.05 U	0.05 U	0.05 U	0.2
Nickel	45	44	82	176
Selenium	22	1 U	1 U	1 U
Silver	0.2 U	0.7	0.2 U	0.2 U
Zinc	49	69	112	155

Qualifiers:

U - Not detected at detection limit shown.

B - Also detected in method blank.

Table 6 - Organic Compounds Compared to Water Quality Criteria - WEYCO, 4/88.

	Influent (ug/L)	Retention		Effluent (ug/L)	Water Quality Criteria (EPA, 1986)			
		Pond Influent (ug/L)	Filter Wash (ug/L)		Freshwater		Saltwater	
					Acute (ug/L)	Chronic (ug/L)	Acute (ug/L)	Chronic (ug/L)
Volatile Organics:								
Acetone	730 B	13 B	5 U	5 U	-	-	-	-
Chloroform	5300	1	130	21	28,900	1,240	-	-
2-Butanone	210	7	3 U	3 U	-	-	-	-
Toluene	50 U	7	1 U	1 U	17,500	-	6,300	5,000
Semi-Volatile Organics:								
Phenol	19	6	2 U	4 U	10,200	2,560	5,800	-
4-Methylphenol	4 U	66	2 U	4 U	-	-	-	-
2,4-Dichlorophenol	8 U	8 U	4 U	4	2,020	365	-	-
2,4,6-Trichlorophenol	9	8 U	4 U	11	-	970	-	-

Qualifiers:

U - Not detected at detection limit shown.

B - Also detected in method blank.

Table 7 - Effluent and Filter Backwash Metals Compared to Water Quality Criteria - WEYCO, 4/88.

Metal (Total)	Effluent (ug/L)	Water Quality Criteria (EPA, 1986)*			
		Freshwater		Saltwater	
		Acute (ug/L)	Chronic (ug/L)	Acute (ug/L)	Chronic (ug/L)
Arsenic	2	-	-	-	-
Chromium	144	2,682	320	10,300	-
Copper	1.7	29	19	2.9	2.9
Lead	33	160	<input type="checkbox"/> 6	140	<input type="checkbox"/> 5.6
Nickel	45	2,437	271	75	<input type="checkbox"/> 8.3
Selenium	22	260	35	-	-
Zinc	49	183	166	95	86
Hardness	170	-	-	-	-

Metal (Total)	Filter Backwash (ug/L)	Water Quality Criteria (EPA, 1986)*			
		Freshwater		Saltwater	
		Acute (ug/L)	Chronic (ug/L)	Acute (ug/L)	Chronic (ug/L)
Arsenic	46	-	-	-	-
Chromium	73	521	<input type="checkbox"/> 62	10,300	-
Copper	134	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2.9	<input type="checkbox"/> 2.9
Mercury	0.2	2.4	<input type="checkbox"/> 0.025	2.1	<input type="checkbox"/> 0.025
Nickel	176	433	<input type="checkbox"/> 48	<input type="checkbox"/> 75	<input type="checkbox"/> 8.3
Zinc	155	<input type="checkbox"/> 34	<input type="checkbox"/> 31	<input type="checkbox"/> 95	<input type="checkbox"/> 86
Hardness	23	-	-	-	-

* Criteria based on total recoverable method.

= Exceeded criteria.

Table 8 - Filter Backwash Metals Compared to AETs and Dredged Disposal Criteria - WEYCO, 4/88.

Metal (Total)	Filter Backwash (mg/kg dry)	Sediment Quality Standard (mg/kg dry)	Open Water Dredge Disposal Criteria	
			Draft PSDDA Screening Level (mg/kg dry)	Interim Wisconsin Criteria (freshwater) (mg/kg dry)
Arsenic	21.9	57	70	10
Chromium	34.8	260	-	100
Copper	63.8	390	81	100
Mercury	0.10	0.41	0.21	0.10
Nickel	83.8	-	-	100
Zinc	73.8	410	160	100

Table 9 - Sediment Parameters and Bioassay Results - WEYCO, 4/88.

Station	Grain Size Analysis			% TOC	% Dry Weight	Rhepoxynius bioassay	
	% Fines*	% Sand	% Gravel			% Survival	% Reburial
Field Control	2.2	97.8	<2.0	0.3	79.7	19.2 +/- 0.4	98.9
At Outfall	45.0	55.0	<2.0	1.8	58.5	17.0 +/- 0.8	100.0
Below Outfall	1.6	98.5	<2.0	0.3	82.6	19.8 +/- 3.4	98.0
Laboratory Control	-	-	-	-	-	19.8 +/- 0.4	100.0

* - Silt + Clay (<4um-62um)

Table 10 - Organic Compounds Detected in Sediment Samples Compared to Sediment Quality Standards - WEYCO, 4/88.

Compound	Sediments (ug/kg dry wt.)			Sediment Quality Standard
	Field Control	@ Outfall	Below Outfall	(mg/kg organic carbon)
% Fines*	2.2	45.0	1.6	
% Sand	97.8	55.0	98.5	
% Gravel	<2.0	<2.0	<2.0	
% Total Organic Carbon	0.3	1.8	0.3	
% Dry Weight	79.7	58.5	82.6	
Volatile Organics:				
Acetone	10.0 U	35.0	10.0 U	-
Toluene	2.0 M	2.0 U	2.0 U	-
Semi-Volatile Organics:				
Fluoranthene	42 U	85 (4.7)**	40 U	160
Pyrene	42 U	63 (3.5)**	40 U	1000
Pesticides:				
alpha-Chlordane	80 U	80	80	
Resin acids/Guaiacols:				
Dehydroabiatic Acid	250 U	530	240 U	

* - Silt + Clay (<4um-62um)

** - Value in parenthesis is concentration in mg/kg organic carbon

Qualifiers:

U - Not detected at detection limit shown.

B - Also detected in method blank.

M - Compound detected and confirmed by analyst with low spectral match parameters.

Table 11 - Sediment Priority Pollutant Metals Compared to Sediment Quality Standards - WEYCO, 4/88.

	Sediments (mg/kg dry wt.)			Sediment Quality Standard (mg/kg dry wt.)
	Field Control	@ Outfall	Below Outfall	
%Fines*	2.2	45.0	1.6	
% Sand	97.8	55.0	98.5	
% Gravel	<2.0	<2.0	<2.0	
% TOC	0.3	1.8	0.3	
% Dry Weight	79.7	58.5	82.6	
Arsenic	4.5	10.4	3.0	57
Beryllium	0.1 U	0.3	0.1 U	-
Chromium	159	32.4	13.3	260
Copper	14.2	37.5	11.2	390
Lead	1.5	4.0	0.5 U	450
Mercury	0.02	0.038	0.01	0.41
Nickel	21.3	36.5	17.3	-
Selenium	0.5	2.0	0.8	-
Silver	0.22	0.12	0.08	6.1
Thallium	0.3	0.4	0.4	-
Zinc	42.9	72.8	33.6	410

* Silt + Clay (<4um-62um)

Table 12 - Comparison of Laboratory Results - WEYCO, 4/88.

Parameter	Laboratory:	Effluent (001)				Storm Sewer (002)		Filter Wash (004)	
		Ecology	WEYCO	Ecology	WEYCO	Ecology	WEYCO	Ecology	WEYCO
Station:		Composite				Grab		Grab	
Type:		Composite				Grab		Grab	
Date:		4/19-20		4/19-20		4/20	4/20	4/20	4/20
Time:		0725-1030,2245-0155		0725-1030,2245-0155		1045	1045	am	am
Sampler:		Ecology		WEYCO		Ecology	WEYCO	Ecology	WEYCO
Laboratory:		Ecology	WEYCO	Ecology	WEYCO	Ecology	WEYCO	Ecology	WEYCO
BOD (mg/L)		21	28	23	28				
TSS (mg/L)		14	17	19	24	<1	2	5	7
pH (S.U.)		7.1	7.0	7.2	7.1	6.4	6.8	6.1	6.7
Rainbow Trout Bioassay (% survival in 65% effluent)		57			0				

APPENDIX 1

Chemical Analytical Methods - WEYCO, 4/88.

Analyses	Method Used	Laboratory
TOC (solids)	APHA, 1985: #505	Laucks Testing Labs; Seattle, WA
% Solids	APHA, 1985: #209F	Laucks Testing Labs; Seattle, WA
Grain Size	Tetra Tech, 1986	Laucks Testing Labs; Seattle, WA
Cyanide (water)	EPA, 1983: #335.2-1	Ecology; Manchester, WA
Total Phenolics	EPA, 1983: #420.2	Ecology; Manchester, WA
Volatiles (water)	EPA, 1984: #624	Laucks Testing Labs; Seattle, WA
Volatiles (solids)	EPA, 1986: #8240	Laucks Testing Labs; Seattle, WA
Semivolatiles (water)	EPA, 1984: #625	Laucks Testing Labs; Seattle, WA
Semivolatiles (solids)	EPA, 1986: #8270	Laucks Testing Labs; Seattle, WA
Pest/PCB (water)	EPA, 1984: #608	Laucks Testing Labs; Seattle, WA
Pest/PCB (solids)	EPA, 1986: #8080	Laucks Testing Labs; Seattle, WA
Metals (water)	EPA, 1983: #200 series	Ecology; Manchester, WA
Metals (solids)	EPA, 1983: #200 series	Ecology; Manchester, WA
Resin acids (water + solids)	NCASI, 1986	Ecology; Manchester, WA
Ammonia	EPA, 1983: #350.1	Ecology; Manchester, WA
Total Phosphorus	EPA, 1983: #353.2	Ecology; Manchester, WA
Nitrate/Nitrite	EPA, 1983: #365.1	Ecology; Manchester, WA

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EPA, 1983. Methods for Chemical Analysis of Water and Wastes, 600/4/79-020, revised March 1983.

EPA, 1984. 40 CFR Part 136, October 26, 1984.

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National Council for Air and Stream Improvement, 1986. Procedures for the Analysis for Resin and Fatty Acids in Pulp Mill Effluents. Tech. Bull. 501. New York, N.Y.

Tetra Tech, 1986, Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, Prepared for Puget Sound Estuary Program.

Effluent and sediment bioassay methods - WEYCO, 4/88.

Test Organism	Test Sample	Ref. Method	Test Laboratory	Test Duration	Test Concentration	Type of Test	Endpoint Measured
Amphipod (<u>Rhepoxynius abronius</u>)	Sediment	1	E.V.S. Consultants Seattle, WA	10 days	N/A	Acute and Chronic	Survival and avoidance, % reburial after 10 days
Bay Mussel (<u>Mytilus edulis</u>)	Effluent	2	E.V.S. Consultants Seattle, WA	48 hrs	0.1,1,2.2,4.6, 10,18%	Chronic	Development of abnormal larvae
Mysid Shrimp (<u>Mysidopsis bahia</u>)	Effluent	3	E.V.S. Consultants Seattle, WA	96 hrs	1,3,10,30,100%	Acute	Survival
Microtox (<u>Photobacterium phosphoreum</u>)	Effluent	4	Ecology	5,10, 15 mins	11.4,22.7, 45.5,90.9%	Acute/ Chronic	Reduction in bacterial luminescence
Rainbow Trout (<u>Oncorhynchus mykiss</u>)	Effluent	5	Ecology	96 hrs	65%	Acute	Survival
Purple Sea Urchin (<u>Strongylocentrotus purpuratus</u>)	Effluent	6	Ecology	20 mins	1.2,3.7,11,33, 100%	Chronic	%Fertilization
Ames Test	Effluent	7	SRI International Menlo Park, CA	48 hrs	50,100,200, 300,400,500 uL per plate	Mutagenic Activity	Genetic damage to <u>Salmonella typhimurium</u> bacteria strains TA1535, TA1537, TA1538, TA98 & TA100 with and without metabolic activation.

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- 2 - ASTM Method E 724-80, "Standard Practice for conducting Static Acute Tests with Larvae of Four Species of Bivalve Molluscs.
- 3 - EPA/600/4-85/013, "Methods for Measuring the Acute Toxicity of Effluents of Freshwater and Marine Organisms."
- 4 - Beckman Microtox System Operating Manual. Microbics Corporation, Carlsbad, CA.
- 5 - Department of Ecology procedure "Static Acute Fish Toxicity Test," July 1981 revision. DOE 80-12.
- 6 - Dinnel, P.A., J.M. Link, and Q.J. Stober, 1987. "Improved Methodology for a Sea Urchin Sperm Cell Bioassay for Marine Waters." Arch. Environ. Contam Toxicol., 16, 23-32, 1987.
- 7 - Maron, D.M. and B.N. Ames, 1983. "Revised Methods for the Salmonella Mutagenicity Test," Mutat. Res., 113, 173-215, 1983.

Results of Volatile Priority Pollutant Scan - WEYCO, 4/88.

Compound	Influent (ug/L)	Effluent (ug/L)	Retention			Sediments (ug/kg dry wt.)		
			Pond Influent (ug/L)	Filter Wash (ug/L)	Field Blank (ug/L)	Field Control	@ Outfall	Below Outfall
Chloromethane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Bromomethane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Vinyl Chloride	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Chloroethane	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
Methylene Chloride	50 U	1 U	1 B	1 U	370	2.0 U	2.0 U	2.0
Acetone	730 B	5 U	13 B	5 U	540	10.0 U	35.0	10.0 U
Carbon Disulfide	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
1,1-Dichloroethene	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
1,1-Dichloroethane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
1,2-Dichloroethene (total)	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Chloroform	5300	21	1	130	1 U	2.0 U	2.0 U	2.0 U
1,2-Dichloroethane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
2-Butanone	210	3 U	7	3 U	3 U	6.0 U	6.0 U	6.0 U
1,1,1-Trichloroethane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Carbon Tetrachloride	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Vinyl Acetate	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Bromodichloromethane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Cis-1,3-Dichloropropene	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
Trichloroethene	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Dibromochloromethane	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
1,1,2-Trichloroethane	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Benzene	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Trans-1,3-Dichloropropene	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
Bromoform	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
4-Methyl-2-Pentanone	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
2-Hexanone	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
Tetrachloroethene	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
1,1,2,2-Tetrachloroethane	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
Toluene	50 U	1 U	7	1 U	1 M	2.0 M	2.0 U	2.0 U
Chlorobenzene	150 U	3 U	3 U	3 U	3 U	6.0 U	6.0 U	6.0 U
Ethylbenzene	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Styrene	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U
Total Xylenes	50 U	1 U	1 U	1 U	1 U	2.0 U	2.0 U	2.0 U

Qualifiers:

U - Not detected at the detection limit shown.

J - Estimated result, value is less than the method detection limit.

B - Also detected in method blank.

M - Estimated value, analyte found and confirmed with low spectral match parameters.

Results of Priority Pollutant Metals - WEYCO, 4/88.

	Influent (ug/L)	Effluent (ug/L)	Retention		Sediments (mg/kg dry wt.)		
			Pond Influent (ug/L)	Filter Wash (ug/L)	Field Control	@ Outfall	Below Outfall
Antimony	-	-	-	-	0.1 U	0.1 U	0.1 U
Arsenic	2	1 U	3	46	4.5	10.4	3.0
Beryllium	1 U	1 U	1 U	1 U	0.1 U	0.3	0.1 U
Cadmium	5 U	5 U	7	5 U	0.5 U	0.5 U	0.5 U
Chromium	144	147	56	73	159	32.4	13.3
Copper	1.7	3.1	6.2	134	14.2	37.5	11.2
Lead	33	18	5	5 U	1.5	4.0	0.5 U
Mercury	0.05 U	0.05 U	0.05 U	0.2	0.02	0.038	0.01
Nickel	45	44	82	176	21.3	36.5	17.3
Selenium	22	1 U	1 U	1 U	0.5	2.0	0.8
Silver	0.2 U	0.7	0.2 U	0.2 U	0.22	0.12	0.08
Thallium	1 U	1 U	1 U	1 U	0.3	0.4	0.4
Zinc	49	69	112	155	42.9	72.8	33.6

APPENDIX 2

Results of Pesticide/PCB Priority Pollutant Scan - WEYCO, 4/88.

Compound	Influent (ug/L)	Effluent (ug/L)	Retention		Sediments (ug/kg dry wt.)		
			Pond Influent (ug/L)	Filter Wash (ug/L)	Field Control	@ Outfall	Below Outfall
Apha-BHC	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Beta-BHC	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Delta-BHC	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Gamma-BHC (Lindane)	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Heptachlor	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Aldrin	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Heptachlor Epoxide	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Endosulfan I	0.05 U	0.05 U	0.05 U	0.05 U	8 U	8 U	8 U
Dieldrin	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
4,4'-DDE	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
Endrin	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
Endosulfan II	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
4,4'-DDD	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
Endosulfan Sulfate	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
4,4'-DDT	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
Methoxychlor	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80 U	80 U
Endrin Ketone	0.10 U	0.10 U	0.10 U	0.10 U	16 U	16 U	16 U
alpha-Chlordane	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80	80
gamma-Chlordane	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80 U	80 U
Toxaphene	1.00 U	1.00 U	1.00 U	1.00 U	160 U	160 U	160 U
Aroclor-1016	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80 U	80 U
Aroclor-1221	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80 U	80 U
Aroclor-1232	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80 U	80 U
Aroclor-1242	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80 U	80 U
Aroclor-1248	0.50 U	0.50 U	0.50 U	0.50 U	80 U	80 U	80 U
Aroclor-1254	1.00 U	1.00 U	1.00 U	1.00 U	160 U	160 U	160 U
Aroclor-1260	1.00 U	1.00 U	1.00 U	1.00 U	160 U	160 U	160 U

Qualifier:

U - Not detected at detection limit shown.

Results of Semi-Volatile Priority Pollutant Scan - WEYCO, 4/88.

Compound	Influent (ug/L)	Effluent (ug/L)	Retention			Sediments (ug/kg dry wt.)		
			Pond Influent (ug/L)	Filter Wash (ug/L)	Field Blank (ug/L)	Field Control	@ Outfall	Below Outfall
Phenol	19	4 U	6	2 U	2 U	42 U	57 U	40 U
Aniline	10 U	10 U	20 U	10 U	10 U	210 U	280 U	200 U
bis(2-Chloroethyl)Ether	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
2-Chlorophenol	4 U	4 U	4 U	2 U	2 U	42 U	57 U	40 U
1,3-Dichlorobenzene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
1,4-Dichlorobenzene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Benzyl Alcohol	13 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
1,2-Dichlorobenzene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
2-Methylphenol	4 U	4 U	4 U	2 U	2 U	42 U	57 U	40 U
bis (2-chloroisopropyl)ether	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
4-Methylphenol	4 U	4 U	66	2 U	2 U	42 U	57 U	40 U
N-Nitroso-Di-n-Propylamine	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Hexachloroethane	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Nitrobenzene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Isophorone	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
2-Nitrophenol	8 U	8 U	8 U	4 U	4 U	84 U	110 U	81 U
2,4-Dimethylphenol	4 U	4 U	4 U	2 U	2 U	42 U	57 U	40 U
Benzoic Acid	100 U	100 U	100 U	50 U	50 U	1000 U	1400 U	1000 U
bis(2-Chloroethoxy)Methane	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
2,4-Dichlorophenol	8 U	4	8 U	4 U	4 U	84 U	110 U	81 U
1,2,4-Trichlorobenzene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Naphthalene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
4-Chloroaniline	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Hexachlorobutadiene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
4-Chloro-3-Methylphenol	8 U	8 U	8 U	4 U	4 U	84 U	110 U	81 U
2-Methylnaphthalene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Hexachlorocyclopentadiene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
2,4,6-Trichlorophenol	9	11	8 U	4 U	4 U	84 U	110 U	81 U
2,4,5-Trichlorophenol	8 U	8 U	8 U	4 U	4 U	84 U	110 U	81 U
2-Chloronaphthalene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
2-Nitroaniline	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Dimethyl Phthalate	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Acenaphthylene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
3-Nitroaniline	10 U	10 U	20 U	10 U	10 U	210 U	280 U	200 U
Acenaphthene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
2,4-Dinitrophenol	40 U	40 U	40 U	20 U	20 U	420 U	570 U	400 U
4-Nitrophenol	40 U	40 U	40 U	20 U	20 U	420 U	570 U	400 U
Dibenzofuran	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
2,4-Dinitrotoluene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
2,6-Dinitrotoluene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Diethylphthalate	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
4-Chlorophenyl-phenylether	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Fluorene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
4-Nitroaniline	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
4,6-Dinitro-2-Methylphenol	40 U	40 U	40 U	20 U	20 U	420 U	570 U	400 U
N-Nitrosodiphenylamine	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
1,2-Diphenylhydrazine	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
4-Bromophenyl-phenylether	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Hexachlorobenzene	2 U	2 U	4 U	2 U	2 U	84 U	110 U	81 U
Pentachlorophenol	40 U	40 U	40 U	20 U	20 U	420 U	570 U	400 U
Phenanthrene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Anthracene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Di-n-Butylphthalate	2 U	2 U	8 U	4 U	4 U	42 U	57 U	40 U
Fluoranthene	2 U	2 U	4 U	2 U	2 U	42 U	85 U	40 U
Pyrene	2 U	2 U	4 U	2 U	2 U	42 U	63 U	40 U
Benzidine	50 U	50 U	100 U	50 U	50 U	1000 U	1400 U	1000 U
Butylbenzylphthalate	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
3,3'-Dichlorobenzidine	20 U	20 U	40 U	20 U	20 U	420 U	570 U	400 U
Benzo(a)Anthracene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
bis(2-Ethylhexyl)Phthalate	7 B	5 B	8 B	3 B	2 B	42 B	110 B	40 B
Chrysene	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Di-n-Octyl Phthalate	2 U	2 U	4 U	2 U	2 U	42 U	57 U	40 U
Benzo(b)Fluoranthene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Benzo(k)Fluoranthene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Benzo(a)Pyrene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Indeno(1,2,3-cd)Pyrene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Dibenz(a,h)Anthracene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U
Benzo(ghi)Perylene	4 U	4 U	8 U	4 U	4 U	84 U	110 U	81 U

Qualifiers:

U - Not detected at the detection limit shown.

J - Estimated result, value is less than the method detection limit.

B - Also detected in method blank.

M - Estimated value, analyte found and confirmed with low spectral match parameters.

Results of Resin Acids/Guaiacols Scan - WEYCO, 4/88.

Compound	Influent (ug/L)	Effluent (ug/L)	Retention Pond Influent (ug/L)	Sediments (ug/kg dry wt.)		
				Field Control	@ Outfall	Below Outfall
Sandaracopimeric Acid	18	10 U	10 U	250 U	350 U	240 U
Isopimeric Acid	65	10 U	11	250 U	350 U	240 U
Palustric Acid	20	10 U	10 U	250 U	350 U	240 U
Abietic Acid	73	10 U	10 U	250 U	350 U	240 U
Neoabietic Acid	10 U	10 U	10 U	250 U	350 U	240 U
Dehydrobietic Acid	55	10 U	100	250 U	530	240 U
14-Chlorodehydroabietic Acid	10 U	10 U	10 U	250 U	350 U	240 U
12-Chlorodehydroabietic Acid	10 U	10 U	10 U	250 U	350 U	240 U
Dichlorodehydroabietic Acid	10 U	10 U	10 U	250 U	350 U	240 U
4,5,6-Trichloroguaiacol	10 U	30	10 U	250 U	350 U	240 U
Tetrachloroguaiacol	10 U	32	10 U	250 U	350 U	240 U
4,5-Dichloroguaiacol	10 U	10 U	10 U	250 U	350 U	240 U

Qualifier:

U - Not detected at detection limit shown.

Laboratory Procedure Review Sheet

Discharger: WEYCO, Everett

Date: April 19, 1988

Discharger representative:

Ecology reviewer: Carlos Ruiz, Don Reif

Instructions

Questionnaire for use reviewing laboratory procedures. Circled numbers indicate work is needed in that area to bring procedures into compliance with approved techniques. References are sited to help give guidance for making improvements. References sited include:

Ecology = Department of Ecology Laboratory User's Manual, December 8, 1986.

SM = APHA-AWWA-WPCF, Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

SSM = WPCF, Simplified Laboratory Procedures for Wastewater Examination, 3rd ed., 1985.

Sample Collection Review

1. Are grab, hand composite, or automatic composite samples collected for influent and effluent BOD and TSS analysis?
2. If automatic compositor, what type of compositor is used? ISCO
The compositor should have pre and post purge cycles unless it is a flow through type. Check if you are unfamiliar with the type being used.
3. Are composite samples collected based on time or flow?
4. What is the usual day(s) of sample collection? tidal cycle
5. What time does sample collection usually begin? tide 10 → 4 ft tide
6. How long does sample collection last? 3 hrs 2 cycles
7. How often are subsamples that make up the composite collected? not usually
8. What volume is each subsample?
9. What is the final volume of sample collected? 3-5 gallons
10. Is the composite cooled during collection? yes

11. To what temperature? *≈ 4 °C*
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).
12. How is the sample cooled?
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.
13. How often is the temperature measured?
The temperature should be checked at least monthly to assure adequate cooling.
NO but temperature is digital (certified?)
14. Are the sampling locations representative? *yes*
15. Are any return lines located upstream of the influent sampling location? *NO*
This should be avoided whenever possible.
16. How is the sample mixed prior to withdrawal of a subsample for analysis? *shake*
The sample should be thoroughly mixed.
17. How is the subsample stored prior to analysis? *used after 2 hrs*
The sample should be refrigerated (4 degrees C) until about 1 hour before analysis, at which time it is allowed to warm to room temperature.
18. What is the cleaning frequency of the collection jugs? *once a month*
The jugs should be thoroughly rinsed after each sample is complete and occasionally be washed with a non-phosphate detergent. *no potable water for daily wash*
19. How often are the sampler lines cleaned?
Rinsing lines with a chlorine solution every three months or more often where necessary is suggested. *replace when wash the bottles (note)*

pH Test Review

1. How is the pH measured? *pH meter*
A meter should be used. Use of paper or a colorimetric test is inadequate and those procedures are not listed in Standard Methods (SM p429).
2. How often is the meter calibrated? *daily*
The meter should be calibrated every day it is used.
3. What buffers are used for calibration? *4 and 7 sometimes 10*
Two buffers bracketing the pH of the sample being tested should be used.

If the meter can only be calibrated with one buffer, the buffer closest in pH to the sample should be used. A second buffer, which brackets the pH of the sample should be used as a check. If the meter cannot accurately determine the pH of the second buffer, the meter should be repaired.

BOD Test Review

1. What reference is used for the BOD test?
Standard Methods or the Ecology handout should be used.
2. How often are BODs run? *daily*
The minimum frequency is specified in the permit.
3. How long after sample collection is the test begun? *1 hr or room temperature*
The test should begin within 24 hours of composite sample completion (Ecology Lab Users Manual p42). Starting the test as soon after samples are complete is desirable.
4. Is distilled or deionized water used for preparing dilution water?
5. Is the distilled water made with a copper free still?
Copper stills can leave a copper residual in the water which can be toxic to the test (SSM p36).
6. Are any nitrification inhibitors used in the test? *NO* What?
2-chloro-6(trichloro methyl) pyridine or Hach Nitrification Inhibitor 2533 may be used only if carbonaceous BODs are being determined (SM p 527, #4g: SSM p 37).
6. Are the 4 nutrient buffers of powder pillows used to make dilution water? *NO*
If the nutrients are used, how much buffer per liter of dilution water are added? *1 ml/L*
1 mL per liter should be added (SM p527, #5a: SSM p37).
7. How often is the dilution water prepared? *daily*
Dilution water should be made for each set of BODs run.
8. Is the dilution water aged prior to use? *daily*
Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
Dilution water without inhibitor should not be aged.
9. Have any of the samples been frozen? *NO*
If yes, are they seeded?
Samples that have been frozen should be seeded (SSM p38).
10. Is the pH of all samples between 6.5 and 7.5? *yes (no)*
If no, is the sample pH adjusted?
The sample pH should be adjusted to between 6.5 and 7.5 with 1N NaOH or 1N H₂SO₄ if 6.5 > pH > 7.5 if caustic alkalinity or acidity is present (SM p529, #5e1: SSM p37). *use "HCl"*
High pH from lagoons is usually not caustic. Place the sample in the dark to warm up, then check the pH to see if adjustment is necessary.

If the sample pH is adjusted, is the sample seeded? *yes*
The sample should be seeded to assure adequate microbial activity if the pH is adjusted (SM p528, #5d).

11. Have any of the samples been chlorinated or ozonated? *no*
 If chlorinated are they checked for chlorine residual and dechlorinated as necessary?
 How are they dechlorinated?
 Samples should be dechlorinated with sodium sulfate (SM p529, #5e2: SSM p38), but dechlorination with sodium thiosulfate is common practice. Sodium thiosulfate dechlorination is probably acceptable if the chlorine residual is < 1-2 mg/L.
 If chlorinated or ozonated, is the sample seeded?
 The sample should be seeded if it was disinfected (SM p528, #5d&5e2: SSM p38).
12. Do any samples have a toxic effect on the BOD test? *no*
 Specific modifications are probably necessary (SM p528, #5d: SSM p37).
13. How are DO concentrations measured? *probe*
 If with a meter, how is the meter calibrated?
Air calibration is adequate. Use of a barometer to determine saturation is desirable, although not mandatory. Checks using the Winkler method of samples found to have a low DO are desirable to assure that the meter is accurate over the range of measurements being made.
 How frequently is the meter calibrated? *daily*
 The meter should be calibrated before use.
14. Is a dilution water blank run? *yes*
 A dilution waater blank should always be run for quality assurance (SM p527, #5b: SSM p40, #3).
 What is the usual initial DO of the blank? *9.1*
 The DO should be near saturation; 7.8 mg/L @ 4000 ft, 9.0 mg/L @ sea level (SM p528, #5b). The distilled or deionized water used to make the dilution water may be aged in the dark at ~20 degrees C for a week with a cotton plug in the opening prior to use if low DO or excess blank depletion is a problem .
 What is the usual 5 day blank depletion? *0.2 or less*
 The depletion should be 0.2 mg/L or less. If the depletion is greater, the cause should be found (SM p527-8, #5b: SSM p41, #6).
15. How many dilutions are made for each sample? *two ± duplicates*
 At least two dilutions are recommended. The dilutions should be far enough apart to provide a good extended range (SM p530, #5f: SSM p41).
16. Are dilutions made by the liter method or in the bottle?
 Either method is acceptable (SM p530, #5f).
17. How many bottles are made at each dilution? *1*
 How many bottles are incubated at each dilution? *1 + duplicates*
 When determining the DO using a meter only one bottle is necessary. The DO is measured, then the bottle is sealed and incubated (SM p530, #5f2).
 When determining the DO using the Winkler method two bottles are necessary. The initial DO is found of one bottle and the other bottle is sealed and incubated (Ibid.).

18. Is the initial DO of each dilution measured? *yes*
 What is the typical initial DO? *near saturation p. 8 → 7.0*
 The initial DO of each dilution should be measured. It should approximate saturation (see #14).
19. What is considered the minimum acceptable DO depletion after 5 days? *2.0*
 What is the minimum DO that should be remaining after 5 days? *1.0*
 The depletion should be at least 2.0 mg/L and at least 1.0 mg/L should be left after 5 days (SM p531, #6: SSM p41).
20. Are any samples seeded? *yes*
 Which? *Influent*
 What is the seed source? *effluent*
 Primary effluent or settled raw wastewater is the preferred seed. Secondary treated sources can be used for inhibited tests (SM p528, #5d: SSM p41).
- How much seed is added to each sample? *6 ml / 1000 ml*
 Adequate seed should be used to cause a BOD uptake of 0.6 to 1.0 mg/L due to seed in the sample (SM p529, #5d).
- How is the BOD of the seed determined? *Knowing the BOD of Effluent*
 Dilutions should be set up to allow the BOD of the seed to be determined just as the BOD of a sample is determined. This is called the seed control (SM p529, #5d: SSM p41).
21. What is the incubator temperature? *20*
 The incubator should be kept at 20 +/- 1 degree C (SM p531, #5i: SSM p40, #3).
- How is incubator temperature monitored? *thermometer on water bath*
 A thermometer in a water bath should be kept in the incubator on the same shelf as the BODs are incubated.
- How frequently is the temperature checked? *daily*
 The temperature should be checked daily during the test. A temperature log on the incubator door is recommended. *log on record*
- How often must the incubator temperature be adjusted? *no*
 Adjustment should be infrequent. If frequent adjustments (every 2 weeks or more often) are required the incubator should be repaired.
- Is the incubator dark during the test period? *yes*
 Assure the switch that turns off the interior light is functioning.
22. Are water seals maintained on the bottles during incubation? *yes*
 Water seals should be maintained to prevent leakage of air during the incubation period (SM p531, #5i: SSM p40, #4).

23. Is the method of calculation correct?

Check to assure that no correction is made for any DO depletion in the blank and that the seed correction is made using seed control data.

Standard Method calculations are (SM p531, #6):

for unseeded samples;

$$\text{BOD (mg/L)} = \frac{D1 - D2}{P}$$

for seeded samples;

$$\text{BOD (mg/L)} = \frac{(D1 - D2) - (B1 - B2)f}{P}$$

Where: D1 = DO of the diluted sample before incubation (mg/L)
 D2 = DO of diluted sample after incubation period (mg/L)
 P = decimal volumetric fraction of sample used
 B1 = DO of seed control before incubation (mg/L)
 B2 = DO of seed control after incubation (mg/L)

$$f = \frac{\text{amount of seed in bottle D1 (mL)}}{\text{amount of seed in bottle B1 (mL)}}$$

D1 - D2 x Diluted sample

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? *Technical Support (stand used)*
2. What type of filter paper is used?
Std. Mthds. approved papers are: Whatman 934AH (Reeve Angel), Gelman A/E, and Millipore AP-40 (SM p95, footnote: SSM p23)
3. What is the drying oven temperature?
The temperature should be 103-105 degrees C (SM p96, #3a: SSM p23).
4. Are any volatile suspended solids tests run? *no*
If yes--What is the muffle furnace temperature?
The temperature should be 550+/- 50 degrees C (SM p98, #3: SSM p23).
5. What type of filtering apparatus is used?
Gooch crucibles or a membrane filter apparatus should be used (SM p95, #2b: SSM p23).
6. How are the filters pre-washed prior to use?
The filters should be rinsed 3 times with distilled water (SM p23, #2: SSM p23, #2).

Are the rough or smooth sides of the filters up? *rough side up*
The rough side should be up (SM p96, #3a: SSM p23, #1)

How long are the filters dried? *1 - 2 1/2 hrs*
The filters should be dried for at least one hour in the oven. An additional 20 minutes of drying in the furnace is required if volatile solids are to be tested (Ibid).
- How are the filters stored prior to use? *oven 1 hr to cool in dessicator*
The filters should be stored in a dessicator (Ibid).
7. How is the effectiveness of the dessicant checked? *color*
All or a portion of the dessicant should have an indicator to assure effectiveness.

Test Procedure

8. In what is the test volume of sample measured?
The sample should be measured with a wide tipped pipette or a graduated cylinder.
9. Is the filter seated with distilled water? *yes*
The filter should be seated with distilled water prior to the test to avoid leakage along the filter sides (SM p97, #3c).

10. Is the entire measured volume always filtered? *yes*
 The entire volume should always be filtered to allow the measuring vessel to be properly rinsed (SM p97, #3c: SSM p24, #4).

11. What are the average and minimum volumes filtered? *150; 100*

	Minimum	Average
Influent		
Effluent	<i>100</i>	<i>150</i>

12. How long does it take to filter the samples?
 Time

Influent	
Effluent	<i>3-5 minutes</i>

13. How long is filtering attempted before deciding that a filter is clogged? *5-6 minutes*

Prolonged filtering can cause high results due to dissolved solids being caught in the filter (SM p96, #1b). We usually advise a five minute filtering maximum.

14. What do you do when a filter becomes clogged? *discard*
 The filter should be discarded and a smaller volume of sample should be used with a new filter.

15. How are the filter funnel and measuring device rinsed onto the filter following sample addition? *3x*

Rinse 3x's with approximately 10 mLs of distilled water each time (? ?).

16. How long is the sample dried? *1-2 hrs*
 The sample should be dried at least one hour for the TSS test and 20 minutes for the volatile test (SM p97, #3c; p98, #3: SSM p24, #4). Excessive drying times (such as overnight) should be avoided.

17. Is the filter thoroughly cooled in a dessicator prior to weighing?
 The filter must be cooled to avoid drafts due to thermal differences when weighing (SM p97, #3c: SSM p97 #3c). *1-2 hrs*

18. How frequently is the drying cycle repeated to assure constant filter weight has been reached (weight loss <0.5 mg or 4%, whichever is less: SM p97, #3c)? *don't have done it in the past; does not change*
 We recommend that this be done at least once every 2 months.

19. Do calculations appear reasonable? *yes*
 Standard Methods calculation (SM p97, #3c).

$$\text{mg/L TSS} = \frac{(A - B) \times 1000}{\text{sample volume (mL)}}$$

where: A= weight of filter + dried residue (mg)
 B= weight of filter (mg)

*reported in 8.
 16/den = 8.3x (m6b) (m5/e 55)*