Publication No. 84-e37

WA-25-5010
WA-CR-1010

JOHN SPELLMAN
Governor

1889

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
7272 Cleanwater Lane, LU-11 • Olympia, Washington 98504 • (206) 753-2353

MEMORANDUM

August 16, 1984

To: Jon Neel, District Engineer, Southwest Regional Office WDOE

From: Lynn Singleton, Water Quality Investigations Section

Subject: Weyerhaeuser - Longview Ditches Water Quality Survey

INTRODUCTION

This report is the second of two concerning the water quality of the Longview ditches, Consolidated Diking District No. 1. The first report, Singleton and Bailey (1983), discussed water quality conditions, sources, and flow direction in several of the ditches during a January 25 and 26, 1983 survey. This report predominantly addresses November 15, 1983 conditions in Ditch 3 during wet-weather conditions. The survey was conducted by Lynn Singleton and Gary Bailey of the Intensive Surveys Unit. A concomitant survey of the Weyerhaeuser discharges is presented in a separate memorandum (Yake, 1984).

METHODS

Surface water grab samples were collected on November 15, 1983 at six stations: 6, 5, 9, 8, Wa. St., and Douglas St. Sediment samples were collected at separate sites: 7S, 10S, and 12S, with an Eckman grab. Station locations are shown in Figure 1, and descriptions are presented in Table 1. Station designations follow the conventions established in Singleton and Bailey (1983) for all previously sampled locations. Selected data (Yake, 1984) have also been included and follow the previously noted conventions.

Temperature measurements and dissolved oxygen (Winkler method) samples were obtained in the field. Water samples were collected for all or some combination of the following analyses at each site:

pH
turbidity
specific conductivity
fecal coliform bacteria
ammonia-nitrogen
nitrate-nitrogen
nitrite-nitrogen
chemical oxygen demand
biochemical oxygen demand
total solids
total non-vol. solids
total suspended solids
total non-vol. susp. solids
total phosphorus
orthophosphate-phosphorus
color
tannin and lignin
recoverable phenolics
recoverable oil and grease
copper
zinc
nickel
chromium
cadmium
lead
antimony
mercury
arsenic
selenium
silver
beryllium
thallium
acid/base-neutral organic compounds

Sediment samples were collected and analyzed for acid/base-neutral organic compounds. Metals, organic water, and sediment analyses were performed by the U.S. EPA Region X laboratory at Manchester, WA, whereas the WDOE Olympia Environmental Laboratory performed all other analyses.

Discharge measurements were made by either wading or from a boat with a Marsh-McBirney flow meter and a top-setting rod.

RESULTS AND DISCUSSION

As noted previously (Singleton and Bailey, 1983), the direction of flow in the ditches is related to which pump stations are operational at a given time, the conditions of the ditches, and hydraulic load from a specific area. Due to the variability of the controlling factors, flow direction is not constant or predictable. Flow directions present during the November 15, 1983 survey (Figure 1) were different than had been observed previously. Therefore, the "Flow System" designation and discussion in Singleton and Bailey (1983) may not apply here; however, the format is the same.

Flow System I. - This system had not changed from the earlier work. Water in Ditch No. 3, east of the Oregon Way pump station, flowed in a westerly direction to the pump station and was discharged to the Columbia River. Direction in this system will always be the same unless the Oregon Way pump station stopped after a large pumpdown. Filling from other sources could then temporarily reverse the flow.

Three stations (6, 5, and 9) were sampled in this system.

Station 6 represents background conditions in the ditch. In general, groundwater, surface runoff, urban stormwater, and a permitted NPDES discharge (American Cyanamid) all contribute to the upstream ditch waters. Singleton and Bailey (1983) should be consulted if a more detailed discussion of upstream inputs is needed.

Station 6 water quality data are presented in Table 2. Conditions during the wet-weather survey where 0.28 inch of rain fell (Yake, 1984) were somewhat poorer than the conditions observed during the drier January 26, 1983 survey. Turbidity, COD, and total suspended solids were double, and the dissolved oxygen concentration (2.8 mg/L) was about one-half the previously observed levels. Nutrients, oil and greases, and specific conductance levels were similar.

Station 5, the pipe coming from the International Paper Company pond, was discharging a relatively small amount. Inspection of the IPCO pond outlet revealed the pond was not draining to Ditch No. 3.

This observation verified speculation by Singleton and Bailey (1983) that the pipe also received water from other sources. The sample results indicated the colored, turbid discharge was a few degrees warmer than background conditions, and had a high COD, all of which could be indicative of urban runoff.

Water quality at station 9, the farthest downstream sampled point in Flow System I, appeared to have changed somewhat from upstream conditions. Turbidity, color, solids, and COD were all lower than the upstream site. Ammonia and conductivity were slightly higher. The decline in turbidity, solids, and COD suggests some settling may have occurred between sites; however, dilution with less turbid and colored waters may have also been important. This would explain a decrease in the turbidity, solids, COD, and color as well as account for increases in the conductivity and ammonia.

A few priority pollutants (Table 3) were found in low concentrations at all stations in Flow System I. The detection limits for the priority pollutant analyses for water and sediment samples are given in Appendix I. It should be noted that detection limits for the water samples were the same for each station. Sediment detection limits were much higher in general and varied by station depending on the interferences present. All tentatively identified compounds found during this survey (stations 6, 5, 9, 7S, 10S, and 12S) are reported in Table 4. Any of these compounds also occurring at stations 7, 10, or 12 (Yake, 1984) are also reported. Yake (1984) should be consulted for a complete list of compounds tentatively identified during his work.

Flow System II. - Flow conditions present in this system were as explained previously in Singleton and Bailey (1983). The flow direction is easterly from about 26th Street to Oregon Way. Although not observed, flow direction would reverse when the Oregon Way pump station was not operating.

The area receives drainage from the residential lands to the north and the Weyerhaeuser Company to the south. The ditch walks performed for the previous work indicate the Weyerhaeuser pond is the only point source present; however, effluent from the Weyerhaeuser east oil-water separator, located just west of 26th Street, could potentially enter this system.

The instantaneous pond discharge was measured at 1.2 MGD during the survey (Yake, 1984). The downstream flow at station 8 was 17.3 MGD. This resulted in a dilution ratio of 13.5:1. Table 5 details loads for selected parameters.

Pond effluent, station 7, was similar to the previous sample in that it was highly colored, turbid, and had a large potential for oxygen consumption (Table 2). Notable differences in color were visually apparent above and below the entry of the discharge. Results for the fecal coliform bacteria, oil and grease, and nutrient concentrations were different from the previous work. Fecal coliform (890 org/100 mLs) were about three times higher and accounted for 91 percent of the downstream load (Table 5); whereas oil levels were considerably lower, 3 versus 130 mg/L. An oil sheen below the discharge was not present during this survey. The ammonia and total phosphorus concentrations had increased, but were still below a level of concern.

The effluent dissolved oxygen concentration (2.1 mg/L) cannot be compared to the January 25-26, 1983 data because the excessive color and turbidity interfered with the Winkler determination. As before, BOD and COD concentrations were the highest observed during the survey and represented 19 and 36 percent of the downstream load, respectively. Copper and lead concentrations in the effluent exceeded the maximum allowable, and zinc exceeded the average allowable receiving water concentrations (Table 2). The criteria violations assume a hardness of 80 mg/L $CaCO_3$ (Singleton and Bailey, 1983).

Priority pollutant analyses of the pond effluent (Table 3) indicated the presence of a few compounds. Only the thalate esters exceeded the chronic standard (Federal Register, 1980). Thalate esters are very ubiquitous and because the detected quantity was so low, very near the criterion, it was not noted in previous work. The sediment sample (7S) indicated much higher concentrations for the compounds detected. Criteria for allowable concentrations in sediment are not available; therefore, levels have been compared to water criteria. In general, fewer priority pollutant compounds were found and concentrations tended to be slightly lower than levels observed previously (Singleton and Bailey, 1983). Naphthalene was above the chronic toxicity criterion; however, the acute toxicity level would be exceeded if the naphthalene base compounds (Table 4) are considered also. Acenaphthalene also exceeded the chronic concentration.

Water quality at the downstream station (8) was poor. The highly colored, turbid ditch had a dissolved oxygen of 0.1 mg/L, a BOD_5 of 24 mg/L, and a COD of 81 mg/L. Station 8 had the highest solids concentration found in a ditch sample. Zinc and lead both exceeded the allowable average and copper exceeded the maximum allowed concentration. All of these were noted as important constituents in the pond discharge. Table 5 indicates 12 to 91 percent of the pollutant load at station 8 is attributable to the pond inputs.

The conductivity data may suggest other sources upstream from the pond are contributing to the ditch load. The walking survey of the ditch performed for the earlier work (Singleton and Bailey, 1983) indicated the next westerly point source is the Weyerhaeuser east oil-water separator. The proximity of the oil-water separator implies that Ditch No. 3 could flow in an easterly direction given the Oregon Way pump station is operating. This would help explain higher conductance at Station 8 if the conductivity of the east oil-water separator (614 umhos/cm) and the background conductance (251 umhos/cm) in this segment of Ditch No. 3, represented by the WA Street station are considered.

Flow System III. - Flow System III. is not clearly defined, and differs from the System III. of Singleton and Bailey (1983). The system present during this survey was bordered by 26th Street on the east and included all of Ditch 3 and any adjoining waters to the west (Figure 1). On the day of the survey, water moved westerly from 26th Street to a point near where Ditch No. 1 intersects Ditch No. 3. Waters to the west moved easterly and converged with the westerly waters at the Ditch No. 1 intersection. The combined waters then flowed north into Ditch No. 1, through the residential district, and ultimately through the main pump station to Coal Creek Slough. This flow pattern probably occurred because the Industrial Way pump station was not operating and the connection with the Reynolds pump station (via Ditch No. 14) was blocked for a road construction project.

Several point-source discharges exist in this system; however, the two NPDES-permitted Weyerhaeuser oil-water separators were the focus of this work. Singleton and Bailey (1983) provide a discussion of cyanide and metals contamination in this area of Ditch No. 3.

The Weyerhaeuser east and west separators, discharge numbers 004 and 003, respectively, are permitted to discharge "uncontaminated stormwater runoff." The Weyerhaeuser NPDES permit application indicates dust control runoff and and vehicle washwater either occasionally or routinely enter the 004 discharge in addition to stormwater. Yake (1984) indicated one bypass enters the drainage system, and Neel and Bailey (1984) found that steam-cleaning runoff did also. Data from these two discharges, 004 and 003, were presented by Yake (1984) and have also been presented and discussed here. Ditch waters were evaluated at two stations; Douglas Street and Washington Street. Flow System III. has been divided into two subsystems--III.a. where flow is westerly, and III.b. where flow is easterly.

Flow System III.a. - Flow from the east oil-water separator was measured at 0.26 MGD (Yake, 1984). This equates to a dilution ratio of 16.5:1 in Ditch No. 3.

The quality of the east oil-water separator (station 10) effluent was different in several aspects from the previous sample. Solids-related parameters were lower as were the oils and greases and phenolics. Fecal coliform concentrations (1400 org/100 mL) were about twice the previous sample. Nitrogen forms, conductance, and metals were also higher. The effluent was highly colored during this and the previous survey.

Increases in the nitrogen species and conductance were probably due to the discharge of hogged fuel boiler scrubber water (Yake, 1984). Increases in conductance are not noteworthy; however, the effluent loads (Table 6) of nitrite (concentrations of 8.4 mg/L-N) and ammonia (6.9 mg/L-N) are of concern. No criterion exists for nitrite-nitrogen, probably because it is rarely found in the aquatic environment; however, data indicate a concentration of 0.06 mg/L NO_2-N or less should be protective of salmonid fishes (U.S. EPA, 1976).

Conversion of nitrite to nitrate is a biological-mediated process which can occur relatively quickly in aerobic environments. Nitrite can be converted to ammonia, the more reduced form, in an anaerobic environment. This could occur in the ditches and would add to the in-stream ammonia and un-ionized ammonia levels.

Un-ionized ammonia toxicity in freshwater has been well documented, and the present criteria are for maximum allowable and average concentrations are based on pH and temperature. The appropriate criteria for conditions during the survey are 0.025 mg/L-N and 0.005 mg/L-N, respectively (Federal Register, 1984). The un-ionized ammonia concentration of the effluent was 0.019 mg/L.

The BOD and COD concentrations in the discharge were similar to levels observed in the previous study; whereas, the dissolved oxygen concentration (1.5 mg/L) was lower. In combination, the BOD and NOD loads and low oxygen concentration in the discharge represent a significant problem for the system.

The metals, copper and zinc, both exceeded the maximum allowable, and lead exceeded the allowable average concentration (Table 2).

Priority pollutant analyses were conducted on both effluent and Ditch No. 3 sediments (collected from the entry point of the east oil-water separator). Pentachlorophenol (Table 3) was the only compound found in the water which exceeded the established chronic toxicity criterion (Federal Register, 1980). Analyses of the sediments indicated fluoroanthene, naphthalene, and di-n-butyl phthalate all exceeded the acute freshwater criteria for water and phenol exceeded the chronic criterion (Federal Register, 1980).

In general, compounds found in the water were found in the sediment sample. Yake (1984) normalized water concentrations with suspended solids and found good correspondence between effluent and sediment concentrations. Yake (1984) should be consulted for further discussion. This is not surprising in light of the affinity most organic pollutants have for non-aqueous environments; i.e., sediments. See U.S.EPA (1982) for a literature review and discussion of organic affinities (partition coefficients).

The lack of sediment criteria for the priority pollutants makes evaluation of potential impacts very difficult. The concentrations of organic compounds (Tables 3 and 4) in and at the east oil-water separator discharge are noteworthy. More compounds in higher concentrations were present at the site than at any other site sampled in this survey.

The differences in the effluent quality between the January 26, 1983 and the November 15, 1983 samples may be due to the variable nature of the discharge (see Yake, 1984); however, the sampling locations were not exactly the same. Yake (1984) was able to sample the discharge directly prior to its entering Ditch No. 3, whereas the Singleton and Bailey (1983) sample was taken immediately outside the oil boom in the ditch. The ditch collection was necessary because a sample obtained through approximately 1 cm of floating oil scum would have severely biased the results. Data collected in January 1983 indicate that the ditch waters were diluting the east oil-water separator effluent with the exception of most nitrogen species and possibly cadmium. Therefore, the January sample probably underestimates effluent concentrations. The ditch waters were the diluent for most parameters during the November 15 survey also.

Water quality at the Douglas Street station (Table 2), downstream of the east oil-water separator, could be characterized as violating the Class A standards for dissolved oxygen and fecal coliform bacteria; having elevated nitrogen concentrations which violate the nitrite salmonid guideline; and violating the maximum allowable copper and the average allowable zinc and lead criteria. Every one of the problems is potentially exacerbated by the east oil-water separator discharge located upstream. Table 6 provides the loads at Douglas Street and indicates that from 10 to 95 percent of the loads are attributable to the east oil-water separator.

Flow System III.b. - Water movement at the Washington Street station was found to be slightly eastward. Dissolved oxygen levels were the highest observed (7.0 mg/L) anywhere in Ditch No. 3; however, they were below the Class A standards (8.0 mg/L). Bacteria also exceeded its standard, and copper and lead exceeded the applicable criteria (Table 2). Although cyanide was not analyzed, previous data from potential upstream sources to the west (Singleton and Bailey, 1983) indicate it was very likely present.

Station 12, the west oil-water separator, is downflow of Washington Street. It has the cleaner discharge of the two oil-water separators (Table 2) and does not appear to receive the same type of process-related wastewaters (Yake, 1984). In general, some metals exceeded the criteria, and the fecal coliform levels were in excess of the Class A standard. Table 7 shows the loads: from the west oil-water separator; at Washington Street upstream; the percentage of downstream load; and the predicted downstream concentrations. A poor effluent dilution ratio (2:1) caused the percent increase in the downstream load to be substantial. Load increases ranged from <12 to 130 percent with zinc, fecal coliform bacteria, and lead showing the greatest increased loads. The effluent further aggravates the instream criteria and standards violations.

The flow direction present in System III. during this survey is significant for several reasons:

1. A large number of industries discharge to Ditch No. 3.
2. Dilution in the ditch is at times very poor.
3. Water quality is at times very poor, with potentially elevated cyanides, metals, organics, and bacteria levels.
4. Children have ready access to the ditches in the residential area to the north.

Table 8 lists the available data and mean concentrations for selected parameters found in the Weyerhaeuser discharges to Ditch No. 3.

SUMMARY

- The pipe draining the IPCO pond also receives inputs from one or more sources.

- Flow direction in the ditches is unpredictable, and the residential areas to the north of Ditch No. 3 receive drainage from the major industrial sources along Ditch No. 3.

- Water quality conditions in Ditch No. 3 are poor in the area of the three Weyerhaeuser permitted discharges. Dissolved oxygen is low; zinc, copper, lead, fecal coliforms, solids, turbidity, and color all exceed acceptable levels in the ditches and are all significantly loaded by the discharges.

- Effluent quality from each of the Weyerhaeuser discharges is variable. The east oil-water separator and the pond discharges had the poorest quality of the three; however, loading from all is significant due to poor dilution ratios (16.5:1 to 2:1) and high concentrations. The dilution each may receive is also quite variable and depends on flow magnitude and direction in the ditch system. Process-related discharges to the east oil-water separator drainage had a marked effect on its effluent quality and the quality of the receiving water.

- Priority pollutant data indicate the east oil-water separator has the highest water and sediment concentrations of the three Weyerhaeuser discharges to Ditch No. 3. Process-related wastewaters may be one likely source of the contamination. The pond discharge had the second highest levels, and the west oil-water seaprator the third.

- The occurrence of large oil discharges is probably in part related to intermittent maintenance of the oil containment systems.

RECOMMENDATIONS

1. Treatment of the Weyerhaeuser wastewaters influent to Ditch No. 3 is needed and would improve existing conditions. As a minimum, process-related wastewaters should be removed from the stormwater drainage system.

2. Installation of a flapper gate on Ditch No. 1 at the entrance to Ditch No. 3 would prevent poorly diluted industrial wastewaters from occasionally flowing through residential areas to the north.

LRS:cp

LITERATURE CITED

Federal Register, 1980. Vol. 45, No. 231. pages 79318 - 79379.

Federal Register, 1984. Vol. 49, No. 2. page 4551.

Merck and Co., 1983. The Merck Index. 10th ed. 1463 pp.

Neel, J. and G. Bailey, 1984. Weyerhaeuser inspection report dated April 10, 1984.

Singleton, L. and G. Bailey, 1983. Longview Diking District Study. December 1, 1983. Memorandum to Jon Neel. WDOE. 24 pp.

U.S. EPA, 1976. Quality Criteria for Water. 256 pp.

U.S. EPA, 1982. Water Quality Assessment: A Screening Procedure for Toxic and Conventinal Pollutants - Part 1. EPA 600/6-82-004a. 570 pp.

Yake, B., 1983. Weyerhaeuser wood products (Longview) Class II inspection and associated stormwater sampling surveys (March 29, April 19-20, and November 15, 1983. Memorandum to Jon Neel. May 1, 1984. WDOE.

Figure 1. SAMPLING LOCATIONS ON LONGVIEW DITCHES'. MAP MODIFIED FROM CONSOLIDATED DIKING IMPROVEMENT DISTRICT NO. 1, 1982.

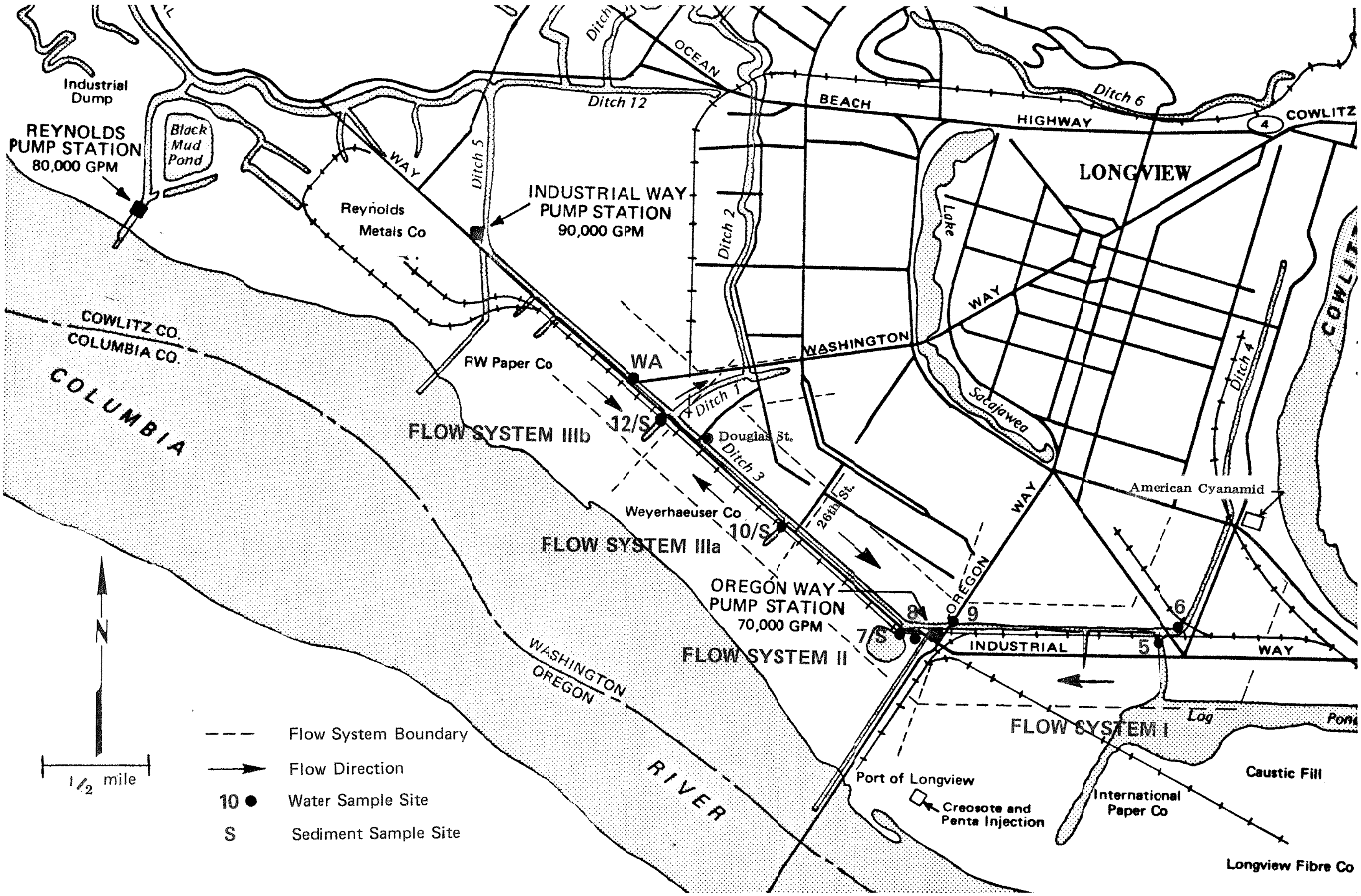

Table 1. Sampling sites for Longview ditches (November 15, 1983). Selected stations from Yake (1984) are also described. It should be noted that these flow systems were present at the time of sampling, but are subject to change.

Station	Location
	Flow System I.
6	Upflow side (east) of California Way before International Paper Company (IPCO) log pond discharge in Ditch No. 3.
5	IPCO log pond discharge pipe where it enters Ditch No. 3.
9	Ditch No. 3, at the east side of Oregon Way, upstream from the pump station.
	Flow System II.
7	Weyerhaeuser discharge 002, the pond..
7S	Sediment sample from Ditch No. 3 adjacent to the Weyerhaeuser pond discharge plume.
8	Ditch No. 3 between Weyerhaeuser pond discharge and Oregon Way pump station.
	Flow System III.a.
10	Weyerhaeuser discharge 004, east oil-water separator (near 26th Street).
10S	Ditch No. 3 sediment sample taken in the east oil-water separator plume.
Douglas Street	Ditch No. 3 at the west side of Douglas Street.
	Flow System III.b.
12	Weyerhaeuser discharge 003, west oil-water separator.
12S	Ditch No. 3 sediment sample taken in the west oil-water separator plume.
Washington St.	Ditch No. 3 on the east side of Washington Street.

Table 2. Conventional pollutants and metals results for water samples from Longview Ditch No. 3, November 15, 1983. Units are in mg/L unless otherwise noted.

	Flow System I.			Flow System II.		Flow System III.a.		Flow System III.b.	
Station	6	5	9	8	7*	10*	Doug. St.	12*	WA St.
Station Type**	D	P	D	D	P	P	D	P	D
Flow (MGD)	--	--	--	17.3	1.2	0.26	4.3	0.25	0.5
pH (S.U.)	6.5	6.8	6.5	6.5	6.3	7.0	6.7	6.8	6.7
Temperature (°C)	10.8	12.7	11.3	10.5	9.8^{c}	14.8^{d}	11.6	12.2^{d}	11.0
Dissolved Oxygen	$2.8^{\dagger}$	$2.7^{\dagger}$	$2.8^{\dagger}$	$0.1^{\dagger}$	$2.1^{\dagger,d}$	$1.5^{\dagger,d}$	$3.2^{\dagger}$	$4.8^{\dagger,d}$	$7.0^{\dagger}$
Turbidity (NTU)	160	260	110	260	820	180	48	28	36
Color (P.U.)	230	580	160	360	1200	710	180	110	170
Sp. cond. (umhos/cm)	143	258	167	279	117	614	260	211	251
COD	50	180	35	81	420	300	42	35	35
BOD_5	--	--	--	24	68	70	11	6	11
Fecal coliform (col/100 mL)	--	--	--	67^{f}	$890^{e,\dagger}$	$1400^{\dagger}$	510	$800^{e,\dagger}$	$490^{\dagger}$
NO_3-N	0.07	0.08	0.11	0.20	<0.05	1.0	0.35	0.54	1.8
NO_2-N	<0.01	0.02	<0.01	0.1	<0.05	8.4	0.55	<0.01	0.04
NH_3-N	0.20	0.08	0.38	0.59	0.25	6.9	0.70	0.12	0.30
T-PO_4-P	0.04	0.02	0.03	0.07	0.25	0.05	0.10	<0.01	0.06
O-PO_4-P	i	i	i	i	i	i	i	i	i
Total solids	230	390	200	360	700	620	210	170	200
Total non-vol. solids	160	240	150	260	400	390	150	120	150
Total susp. solids	90	120	69	160	440	110	29	15	19
Total non-vol. susp. solids	70	90	53	110	260	52	21	10	15
Tannin & lignin (as Tan.)	4	16	3	7	--	--	2	--	2
Phenolics	--	--	--	0.14	0.082	0.033	0.019	0.015	0.028
Oil & grease	<1	<1	--	<1	3.0^{d}	3.5^{d}	<1	2.5^{d}	1
Metals - Total Recoverable (ug/L)									
Copper				41^{m}	78^{m}	58^{m}	26^{m}	25^{m}	31^{m}
Zinc				113^{k}	228^{k}	274^{m}	62^{k}	87^{k}	33
Nickel				3	30	9	3	7	<1
Chromium				9	22	8	4	5	4
Cadmium				<0.1	0.3	<0.1	<0.1	<0.1	<0.1
Lead				30^{k}	51^{m}	34^{k}	20^{k}	23^{k}	22^{k}
Antimony				<1	<1	<1	<1	<1	<1
Mercury				1.32	<0.055	0.11	0.44	<0.055	0.11
Arsenic				<1	5^{m}	1^{k}	<1	<1	<1
Selenium				<1	1	1	<1	<1	<1
Silver				0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Beryllium				<0.5	0.6	<0.5	<0.5	<0.5	<0.5
Thallium				<1	<1	<1	<1	<1	<1

*Source: Yake, 1984.
**D = Ditch sample; P = Point-source sample.

d = mean
† = exceeds Class A standards
e = geometric mean
f = estimate
i = interferance
k = exceeds average allowable criterion (hardness = 80 mg/L)
m = exceeds maximum allowable criterion (hardness = 80 mg/L)

Table 3. Priority pollutant results from Longview Ditch No. 3 water and sediment samples, November 15, 1983.

	Flow System I			Flow System II.		Flow System III.a.		Flow System III.b.		Water Criteria**	
Station	6	5	9	7*	7S	10*	10S	12*	12S		
Station Type***	D,W	D,W	D,W	P,W	P,S	P,W	P,S	P,W	P,S	Acute	Chronic
Base/Neutral Compounds											
Acenaphthene	<0.06	<0.06	<0.06		640[d]	<0.1	990[d]	0.03		1,700	--
Naphthalene		0.06	0.03	0.17	790[e]	1.1	53,000[f]	0.04	4,000[f]	2,300	620
Acenaphthalene	<0.04		<0.04	<0.08		0.9	31,000	0.03	1,700	--	--
Anthracene						0.13	11,000		1,000	--	--
Fluorene				0.12	610	0.23	5,400	0.07	800	--	--
Phenanthrene	0.14	0.17	<0.06	0.39	1,900	1.4	73,000	0.07	8,700	--	--
Fluoranthene	0.19	0.14	0.06		650	1.3	69,000[f]	0.06	11,000[f]	3,980	--
Benzo(a)anthracene	0.07					0.4	4,400			--	--
Chrysene	<0.2	<0.2				0.44	7,200		1,400	--	--
Pyrene	0.22	0.14	0.07	0.17	650	1.3	69,000	0.05	6,300	--	--
Benzo(a)pyrene						1.0	2,100			--	--
Benzo(k)fluoranthene +						1.7	6,200			--	--
3,4-benzofluoranthene										--	--
Benzo(g,h,i)perylene						3.6				--	--
Ideno(1,2,3-cd)pyrene						4.9				--	--
1,2-dichlorobenzene	<0.06		<0.06							--	--
Isophorone		<0.06								117,000	--
Di-n-butyl phthalate							<2,000	0.05		940	3
Bis-2-ethylhexyl phthalate				4.7[f]		21[f]		1.5		940	3
Butylbenzyl phthalate								<0.06		940	3
Acid Compounds											
2-chlorophenol		<0.2									
2,4-dichlorophenol		<0.2									
4,6-dinitro-o-cresol		1.8									
Pentachlorophenol		0.4		<0.8		20					
Phenol		1.3		2		11	8,200[e]		3,400[e]	10,200	2,560

*Source: Yake, 1984.

**Federal Register, 1980.

***D = Ditch; P = Point source; W - Water, units in ug/L; S = sediment, units in ug/Kg d.w.

< = Detected, but below quantification levels.

d = Exceeds algal inhibition level.

e = Exceeds chronic toxicity criterion.

f = Exceeds acute toxicity criterion.

Table 4. Estimated tentatively identified compounds from Longview Ditch No. 3 water and sediment samples, November 15, 1983.

Flow System	I.			II.		III.a.		III.b.		
Station	6	5	9	7*	7S	10*	10S	12*	12S	
Station Type**	D,W	D,W	D,W	P,W	P,S	P,W	P,S	P,W	P,S	Compound Association***
Compound										
4-(1,1,3,3-tetramethylbutyl)phenol	1.8									detertent
Hexadecanoic acid	28	9	4.6						3	palm oil-wax
4-ethyl-phenol		4						3		phenols-toxic
Benzenepropanoic acid		65		14		7				--
3,4,5-trimethyl-2-cyclopenten-1-one		9.4								--
Tetradecanoic acid			1.6							animal fats
2,5-dimethylbenzenebutanoic acid			0.5			120				
3,7,7-trimethyl-bicyclo(4.1.0)hept-2-ene					3,700					turpentine
2,7,10-trimethyldodecane					22,000					
1,8-dimethyl-naphthalene					17,000				18,000	
3,6,6-trimethyl-bicyclo(3.1.1)hept-2-ene				140		160	9,500			turpentine
1-methyl-3-(1-methyl-ethyl)benzene				9		32	11,000		10,000	solvent
1-methyl-naphthalene							9,300			
1-1-biphenyl							20,000			heat transfer agent-toxic
Biphenylene							120,000			
1-naphthalene-carboxaldehyde							21,000			
dibenzofuran							34,000			
9H-fluoren-9-one							35,000			
9-methylene-9H-fluorene							300			
benzo(c)-cinnoline							70,000			
4H-cyclopenta-(DEP) phenanthrene							40,000			
1-phenyl-naphthalene							13,000			
benzo(g,h,i)-fluoranthene							26,000			
7H-benzo(DE)-anthracen-7-one							8,800			

*Source: Yake, 1984.

**D = ditch; P = point source; W = water sample, units in ug/L; S = sediment sample, units in ug/Kg d.w.

***Merck and Co., 1983.

Table 5. Selected loadings (lbs/day) from the Weyerhaeuser pond discharge (002) and the percentage of the downstream load it comprised at station 8, November 15, 1983.

Station	Loads 7 (pond) (Q = 1.2 MGD)	 8 (ditch) (Q = 17.3 MGD)	Percent of Downstream Load
Parameter			
BOD_5	651	3,443	19
COD	4,203	11,619	36
TSS	4,404	22,952	19
Fecal Coliform	4.0×10^{10} org/day	4.4×10^{10} org/day	91
Metals (total recoverable)			
Copper	0.78	5.88	13
Zinc	2.28	16.21	14
Arsenic	0.05	<0.14	<35
Lead	0.51	4.3	12

Table 6. Weyerhaeuser east oil-water separator loads; downstream ditch load, and percentage of the downstream load attributable to the 004 discharge (station 10) on November 15, 1983. Loads are in lbs/day except where noted.

Station	Loads		Percent of Downstream Load
	10 (east oil-water separator) (Q = 1.2 MGD)	Douglas Street ditch (Q = 17.3 MGD)	
Parameter			
NH_3-N	15.0	25.1	60
NO_2-N	18.2	19.7	92
NO_3-N	2.2	12.6	18
Fecal Coliform (org/day)	1.4×10^{10}	8.3×10^{10}	17
BOD_5	152	395	38
COD	651	1,506	43
TSS	238	1,040	23
Metals (total recoverable)			
Copper	0.13	0.93	13
Zinc	0.59	2.22	27
Lead	0.074	0.72	10
Mercury	9.5×10^{-4}	$<19.7 \times 10^{-4}$	<48

Table 7. Weyerhaeuser west oil-water separator loads (003); upstream ditch load; percentage of downstream load; and predicted downstream concentration on November 15, 1983. Loads are in pounds/day.

Station	Loads		Percent Increase in Downstream load	Predicted Downstream Concentration (mg/L)
	Washington Street (Q = 0.5 MGD)	12 (west oil-water separator) (Q = 0.25 MGD)		
BOD_5	46	13	27	9.4
COD	146	73	50	35
TSS	79	31	39	17.6
Fecal coliforms (org/day)	9.3×10^9	7.6×10^9	82	600 (org/100 mL)[c]
NH_3-N	1.25	0.25	20	0.24
NO_2-N	0.17	<0.02	<12	<0.03
NO_3-N	7.5	1.1	15	1.4
Metals (total recoverable)				
Copper	0.13	0.05	38	0.029[b]
Zinc	0.14	0.18	130	0.051[a]
Lead	0.092	0.048	52	0.022[a]

a = exceeds average allowable concentration hardness = 80 mg/L
b = exceeds minimum allowable concentration hardness = 80 mg/L
c = Class A standard violation

Table 8. Compiled data and means for Weyerhaeuser discharges influent to Ditch No. 3, Longview, Washington. Units in mg/L unless otherwise noted.

Parameter	Pond				East Oil-Water Separator				West Oil-Water Separator			
	1/26^a	3/29^b	11/15^b	Mean	1/26*^{a}	3/29^b	11/15^b	Mean	1/26^a	3/29^b	11/15^b	Mean
Color (P.U.)	--	520	1200	860	--	180	710	440	--	--	110	--
Turbidity (NTU)	1100	1100	820	1010	410	600	180	400	220	--	28	120
TSS	570	710	440	570	290	640	110	350	130	--	15	73
D.O.	**	--	2.1	--	3.1	--	1.5	2.3	6.7	--	4.8	5.8
COD	450	460	420	440	510	460	300	420	190	--	35	110
BOD_5	--	130	68	99	--	74	70	72	--	--	6	--
Fecal Coliform (col/100 mL)	320	--	890	530^c	690	--	1400	980^c	390	--	800	560^c
pH (S.U.)	6.3	6.2	6.3	--	6.4	7.2	7.0	--	6.7	6.8	6.8	--
Oils & Greases	130	3	3	45	6	15	3.5	8	--	14	2.5	8
Phenolics	0.185	--	0.082	0.13	0.069	0.15	0.033	0.084	0.034	--	0.015	0.025
Flow	See Yake (1984) for discussion											
As (ug/L)	--	2.9	5	17	--	--	1	--	--	--	<1	--
Cd (ug/L)	<2	5	0.3	<2.4	2	--	<0.1	<1	6	--	<0.1	<3
Cr (ug/L)	10	9	22	14	<10	--	8	<9	<10	--	5	<8
Cu (ug.L)	60	82	78	73	20	--	58	39	20	--	25	22
Pb (ug/L)	<20	50	51	<40	<20	--	34	<26	<20	--	23	<22
Ni (ug/L)	<20	2	30	<17	<20	--	9	<14	<20	--	7	<14
Zn (ug/L)	120	134	228	161	150	--	274	212	130	--	87	108
Hg (ug/L)	--	--	<0.055	--	--	--	0.11	--	--	--	<0.055	--

*Sample diluted by ditch water

**Interference

^{a}Source: Singleton and Bailey, 1983

^{b}Source: Yake, 1984

^{c}Geometric mean

APPENDIX I.

Appendix I Detection Limits and results for Longview Ditch samples
November, 15, 1983.

BASE/NEUTRAL COMPOUNDS

PROJECT: Longview Ditches COMPILED BY: ________ DATE: ________
LABORATORY: ________ REVIEWED BY: ________ DATE: ________

Station ~~SAMPLE #~~ :	6	5	9		7S	10S	12S	
UNITS :	ug/L	→			ug/kg	→		
LOQ :								
1. acenaphthene	0.06m	0.06m	0.06m		640	990	80u	
2. benzidine	0.3u	→			10,000u	50,000u	4,000u	
3. 1,2,4-trichlorobenzene	0.2u	→			400u	2,000u	160u	
4. hexachlorobenzene	0.2u	→			400u	2,000u	160u	
5. hexachloroethane	0.2u	→			400u	2,000u	160u	
6. bis(2-chloroethyl) ether	0.06u	→			200u	1,000u	80u	
7. 2-chloronapthalene	0.06u	→			200u	1,000u	80u	
8. 1,2-dichlorobenzene	0.06m	0.06	0.06m		200u	1,000u	80u	
9. 1,3-dichlorobenzene	0.06u	→			200u	1,000u	80u	
10. 1,4-dichlorobenzene	0.06u	→			200u	1,000u	80u	
11. 3,3'-dichlorobenzidine	0.3u	→			1,000u	5,000u	400u	
12. 2,4-dinitrotoluene	0.3u	→			1,000u	5,000u	400u	
13. 2,6-dinitrotoluene	0.3u	→			1,000u	5,000u	400u	
14. 1,2-diphenylhydrazine (as azobenzene)	0.04u	→			120u	600u	50u	
15. fluroanthene	0.19	0.14	0.06		650	69,000	11,000	
16. 4-chlorophenyl phenyl ether	0.2u	→			400u	2,000u	160u	

u = detection limit
m = detected but not quantified
○ = Quantified at or above the detection limit
ND = Not determined

BASE/NEUTRAL COMPOUNDS (continued)

PROJECT: ______________ COMPILED BY: ______________ DATE: __________

LABORATORY: ______________ REVIEWED BY: ______________ DATE: __________

Station ~~SAMPLE~~ # :	6	5	9		7S	10S	12S	
UNITS :								
LOQ :								
17. 4-bromophenyl phenyl ether	0.3u	→			800u	4,000u	300u	
18. bis(2-chloroisopropyl) ether	0.06u	→			200u	1,000u	80u	
19. bis(2-chloroethoxy) methane	0.06u	→			200u	1,000u	80u	
20. hexachlorobutadiene	0.2u	→			600u	5,000u	200u	
21. hexachlorocyclopentadiene	0.6u	→			2,000u	10,000u	800u	
22. isophorone	0.06u	0.06m	0.06u		100u	800u	60u	
23. napthalene	0.03u	0.06	0.03		790	53,000	1,000	
24. nitrobenzene	0.4u	→			1,200u	6,000u	500u	
~~25. N-nitrosodimethylamine~~	—	—	—		—	—	—	
26. N-nitrosodiphenylamine	0.06u	→			200u	1,000u	80u	
27. N-nitrosodi-n-propylamine	0.6u	→			2,000u	10,000u	800u	
28. bis(2-ethyl hexyl) phthalate	0.06u	→			200u	1,000u	80u	
29. butyl benzyl phthalate	0.2u	→			400u	2,000u	160u	
30. di-n-butyl phthalate	0.04u	→			100u	2,000m	40u	
31. di-n-octyl phthalate	0.06u	→			160u	800u	60u	
32. diethyl phthalate	0.06u	→			160u	800u	60u	
33. dimethyl phthalate	0.06u	→			160u	800u	60u	
34. benzo(a)anthracene	0.07	0.06u	→		200u	4,400	80u	
35. benzo(a)pyrene	0.2u	→			400u	2,100	160u	
36. 3,4-benzofluroanthene	0.2u	→			400u	6,200	160u	
37. benzo(k)fluoranthene	0.2u	→			400u		160u	
38. chrysene	0.2m	0.2m	0.2u		400u	7,200	1400	

BASE/NEUTRAL COMPOUNDS (continued)

PROJECT: ____________ COMPILED BY: ____________ DATE: ____________

LABORATORY: ____________ REVIEWED BY: ____________ DATE: ____________

Station ~~SAMPLE~~ # :	6	5	9		7S	10S	12S	
UNITS :								
LOQ :								
39. acenaphthylene	0.04m	0.04u	0.04m		120u	31,000	1,700	
40. anthracene	0.06u	→			100u	11,000	1000	
41. benzo(ghi)perylene	0.4u	→			1,200u	6,000u	500u	
42. fluorene	0.06u	→			610	9,400	800	
43. phenanthrene	0.14	0.17	0.06m		1,900	73,000	8,700	
44. dibenzo(a,h)anthracene	0.3	→			800u	4,000u	300u	
45. ideno(1,2,3-cd)pyrene	0.4	→			1200u	6,000u	500u	
46. pyrene	0.22	0.14	0.07		650	69,000	6,300	
47. TCDD	ND	ND	ND		ND	ND	ND	

ACID COMPOUNDS

PROJECT: ____________ COMPILED BY: ____________ DATE: ____________

LABORATORY: ____________ REVIEWED BY: ____________ DATE: ____________

SAMPLE # :	6	5	9		75	105	125	
UNITS :								
LOQ :								
1. 2,4,6-trichlorophenol	0.3u	———	→		800u	3200u	300u	
2. p-chloro-m-cresol	0.2	———	→		400u	2000u	160u	
3. 2-chlorophenol	0.2	0.2m	0.2u		400u	2,000u	160u	
4. 2,4-dichlorophenol	0.2u	0.2m	0.2u		400u	2,000u	160u	
5. 2,4-dimethyl phenol	0.3u	———	→		1,000u	4,000u	400u	
6. 2-nitrophenol	0.2u	———	→		400u	2,000u	160u	
7. 4-nitrophenol	2u	———	→		4,000u	2,000u	1600u	
8. 2,4-dinitrophenol	0.5u	———	→		1,700u	8,500u	600u	
9. 4,6-dinitro-o-cresol	0.3u	1.8	0.3u		800u	4,000u	300u	
10. pentachlorophenol	0.4u	0.4	0.4u		1,200u	6,000u	500u	
11. phenol	0.2u	1.3	0.2u		400u	8,200	3,400	