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LOWER COLUMBIA RIVER TRANSECT STUDY

CLEAN WATER

FEDERAL WATER QUALITY ADMINISTRATION
NORTHWEST REGION
PORTLAND, OREGON

A Working Paper presents results of investigations which are to some extent limited or incomplete. Therefore, conclusions or recommendations--expressed or implied--are tentative.

LOWER COLUMBIA RIVER
TRANSECT STUDY

Station No. 403010
October 29, and 30, 1969
April 21, and 22, 1970

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Working Paper
No. 79

Technical Assistance and Investigations
Office of Technical Programs
Federal Water Quality Administration
Northwest Region
501 Pittock Block
Portland, Oregon

October, 1970

BRADWOOD TRANSECT STUDY

INTRODUCTION

General

The Federal Water Quality Administration (FWQA), Pollution Surveillance Branch, maintains a system of water quality sampling stations on interstate waters in the Northwest Region. Throughout the year water samples are collected at these stations and analyzed, and the data are used to evaluate water quality. Knowledge of the conditions peculiar to each station is valuable to the evaluation of the data obtained.

This study documents conditions at Station No. 403010 located on the Columbia River at river mile (RM) 38.9 near Bradwood, Oregon (Figure 1). In September 1969, an automatic water quality monitor was installed at this station. An initial survey was conducted on October 29 and 30, 1969, to verify the location of the monitor. A second survey was undertaken during April 21 and 22, 1970.

Objectives

The objectives of the studies were to answer the following questions:

1. Is the Columbia River at the monitor site completely mixed so that the point measurement of the monitor's probe is representative of the entire river cross section?

2. What are the diurnal and tidal changes occurring in water quality at the monitor location?

3. What are the influencing factors on water quality at this location?

Authority

Authorization for this study was from the Federal Water Pollution Control Act (33 U.S.C. et seq.) as amended. The study was performed by the Technical Assistance and Investigations Branch at the request of the Pollution Surveillance Branch.

Sampling Program

The October, 1969, and April, 1970, transect surveys encompassed the Columbia River from river range marker "17" (RM 27.0) upstream to range marker "57" (RM 43.0). The sampling stations for the two surveys are shown on Figure 1. The sampling program for each survey is shown in Table 1.

During the October, 1969, survey, the dissolved oxygen (DO) concentration at Station 12 was lower, suggesting a potential DO depression. Station No. 7 was established for the April 1970 survey to define the potential dissolved oxygen depression. To evaluate the entire water quality condition in the monitor vicinity, Station 9, at the mouth of the Cathlamet Channel, was also added to the April sampling program.

GENERAL LOCATION MAP Fig 1

LEGEND :
- o River Range Markers
- ⊡ Station Locations

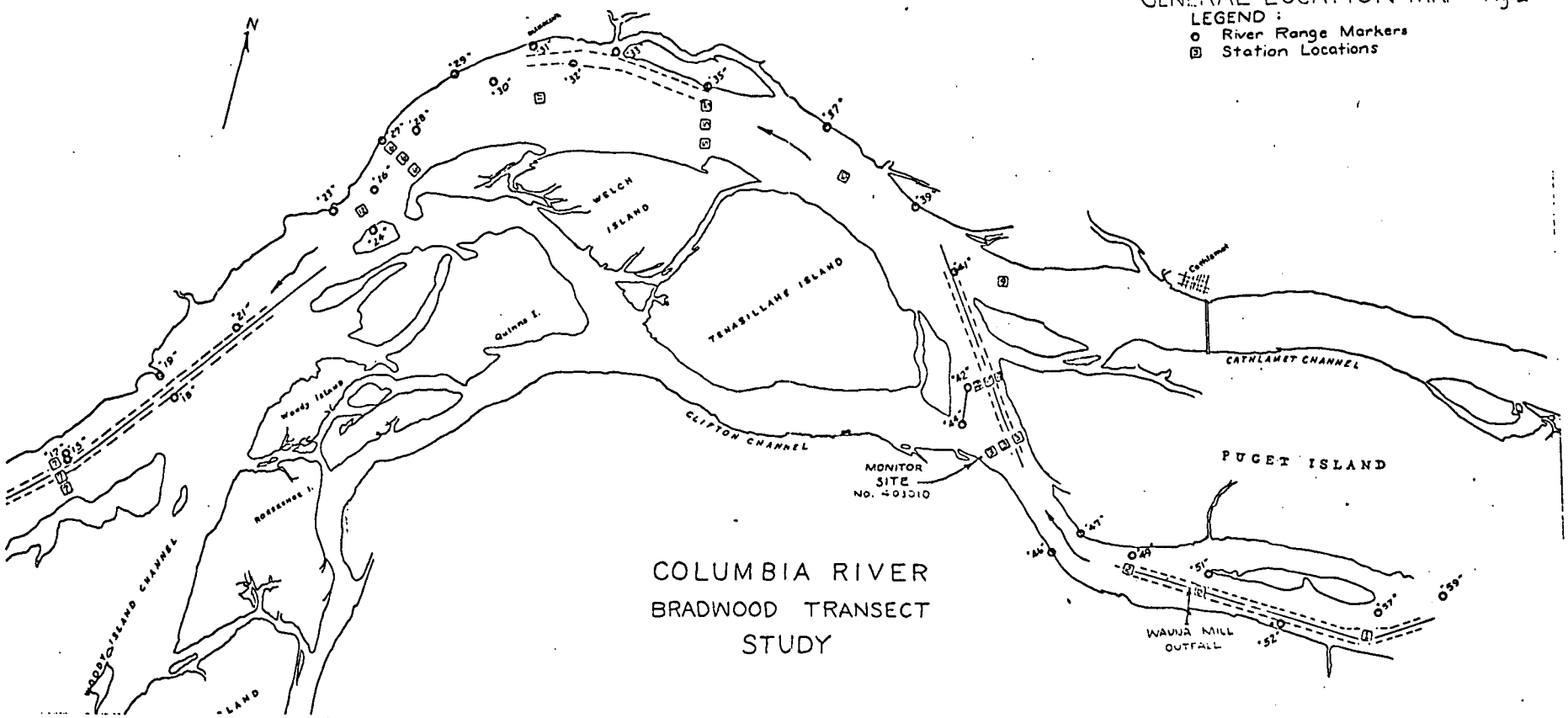


TABLE 1
October 1969-April 1970 SAMPLING PROGRAM

Sample Station	October 29-30, 1969 Survey		April 21-22, 1970 Survey	
	Cross Section	Grab Sample (Single Sample pt.)	Cross Section	Grab Sample (Single Sample pt.)
1		X		X
2		X		X
3		X	X	
4	X			X
5	X		X	
6	X		X	
7			X	
8		X		
9				X
10		X		
11		X		
12		X		

River samples were to be collected periodically over a 24-hour period during both surveys, but mechanical failures and extremely dangerous night working conditions curtailed some of the collection runs during both surveys. Figure 2 shows actual sampling times in relation to the tidal cycle. Samples were taken at or near the high and low tides, covering the most critical sampling periods. Sampling periods are shown as cross-hatched areas on the figure.

Stations 3 through 7 each contain three sample points spaced laterally across the river. Whenever possible, samples were taken at three depths (2 feet, middle, and bottom) at each sample point (a total of 9 samples per station). Sampling in this manner allowed detection of changes in concentrations of water quality parameters,

both vertically and horizontally.

Coliform samples were taken at all depths during the October survey, but only from the surface sampling points during the April survey.

The following water quality parameters were sampled and analyzed: pH, specific conductivity, dissolved oxygen, total alkalinity, total coliform, fecal coliform, and temperature.

SUMMARY

Findings

1. Complete mixing did not occur at any station sampled, but the variations encountered were minor.
2. Monitor location depends upon site access in the lower Columbia River.
3. Water quality changes resulting from diurnal and tidal fluctuations are more pronounced during low flows than high flows.
4. Total coliform counts were greater during the April, 1970, survey than during the October, 1969, survey.
5. During the October, 1969, survey, total coliform counts were greater (21,000 TC/100 ml avg.) downstream from the Wauna Mill outfall than upstream (2,000 TC/100 ml avg.). Average total coliform counts of about 19,000 TC/100 ml were recorded both upstream and downstream from the Wauna Mill outfall during the April, 1970, survey.
6. During the October, 1969, survey, average dissolved oxygen concentrations were 9.3 parts per million (ppm) and the average saturated values were 10.5 ppm. The average dissolved oxygen concentrations during the April survey were about equal to the saturated values of 11.5 ppm.
7. During low flows there appeared to be a dissolved oxygen sag (low DO of 7.0 ppm) at the lower end of the study reach.

SUMMARY

Conclusions

1. Complete mixing in the lower reach of the Columbia River is inhibited by tidal changes and unpredictable current patterns.
2. The monitor location is adequate to measure river water quality. At present, access is the main reason for this location. River mixing at this point is not complete, but it is adequate.
3. Because of the high volume of flow in the Columbia River during runoff, changes in water quality parameter concentrations due to tidal and diurnal fluctuations are minimal; however, during low flow periods, water quality changes are more responsive to these fluctuations.
4. The principal waste source in this reach of the Columbia River is the Crown Zellerbach pulp and paper mill located at Wauna, Oregon. Additional mills are located approximately 23 miles upstream at Longview, Washington. Water quality in the study area appears to be adversely affected by the Wauna Mill during low flows and by the accumulation of upstream sources during the higher runoff periods.

Recommendations

1. The water quality monitor, Station No. 403010, at Bradwood, Oregon, should be maintained at its present site.

2. A 24-hour survey at sampling station 3 should be conducted during both low and high flow to accurately define the mixed river condition at the monitor site.
3. A survey should be conducted in this area, concentrating on the relationship of pulp and paper mill waste effluent to bacteriological contamination.

SAMPLING AND ANALYTICAL METHODS

Sampling Methods

Water samples were collected at the locations shown on Figure 1. The locations could not be sampled on a periodic basis during either survey because of inclement weather and mechanical difficulties. However, samples were obtained during high and low tides for each survey. Samples were taken at three lateral points within the river cross section at Stations 4, 5, and 6 during the first survey and 3, 5, 6, and 7 during the second survey. All other stations were sampled in the middle of the stream (grab samples). Samples were obtained by using Van Dorn[1/] samplers. For sampling various depths, a string of one to three bottles was used to sample top, middle and bottom levels of the river, as appropriate. Each sampler provided enough water to fill containers for chemical (dissolved oxygen, pH, alkalinity, conductivity) and bacteriological (total and fecal coliform) analysis. All analytical work was done in the lab on the survey boat H. W. STREETER which was anchored near the monitor site. The dissolved oxygen samples were chemically stabilized at the time of collection and were tritrated later in the floating laboratory.

1/ The mention of brand names is for identification only and constitutes no endorsement by the U. S. Department of the Interior, Federal Water Quality Administration.

Analytical Procedures

The following laboratory methods were used for analysis:

1. pH was determined with a Beckman Zeromatic Model pH meter.
2. Specific conductivity analyses were performed with an Industrial Instruments Model RC-16-B2 conductivity bridge.
3. Dissolved oxygen samples were titrated for quantity, using the Modified Winkler with Full-Bottle Technique as found in FWPCA Methods For Chemical Analysis (1)
4. Alkalinity was determined by titration with a Hach Model DL-ER portable laboratory during the October 1969, survey and the Potentiometric Titration Method in Standard Methods (2) during the April, 1970, survey.
5. Fecal coliform determinations were conducted using the membrane filter method according to the procedure described by Geldreich (3). In studies by Geldreich (4) this method was confirmed as comparable to the Most Probable Number method for fecal coliform described in Standard Methods (2).
6. Total coliform densities were measured by the membrane filter method technique in Standard Methods (2).
7. All the bacteriological samples analyzed were incubated and counted in the field.

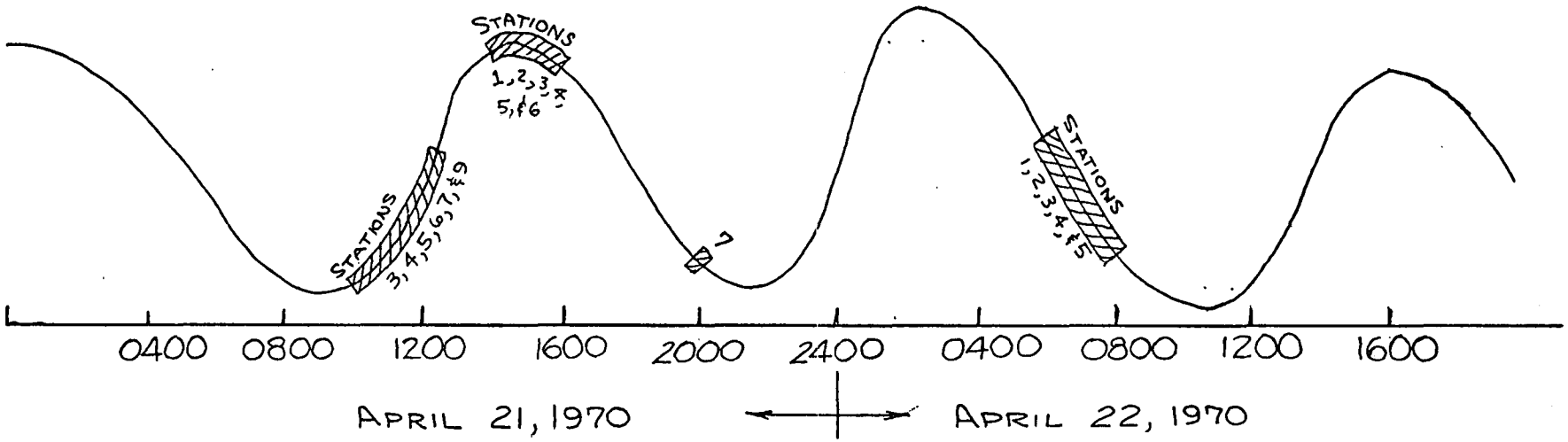
DISCUSSION

Water quality data for October 19, 1969, and April 21, 1970, are shown on Tables 2 and 3, respectively. The average Columbia River flow at Longview, Washington, during the October survey was 140,000 cubic feet per second (cfs). The average river flow was 180,000 cfs during the April survey.

Location of the water quality monitor in the Lower Columbia River depends upon site access and a completely mixed river cross section. Complete mixing of the river in this area is uncommon due to unpredictable current patterns caused by tidal fluctuations occurring throughout the channel networks. These currents tend to affect the distribution of water quality concentrations in the water column.

Table 4 shows the average range of values for Station 5 caused by the diurnal and tidal changes. Station 5 is representative of the range of values at all stations sampled. The monitor site at Bradwood (Station 3) has relatively easy access from the Oregon shore and is fairly well-mixed, although the sample results show that Station 5 has a higher degree of mixing throughout its cross section. The absence of land access eliminates locating the monitor near Station 5. Relocating the monitor upstream from the present site would be limited by the Crown Zellerbach Pulp Mill outfall. The present monitor site at Station 3 appears to be in the best location in this vicinity of the Columbia River.

SURVEY PERIODS



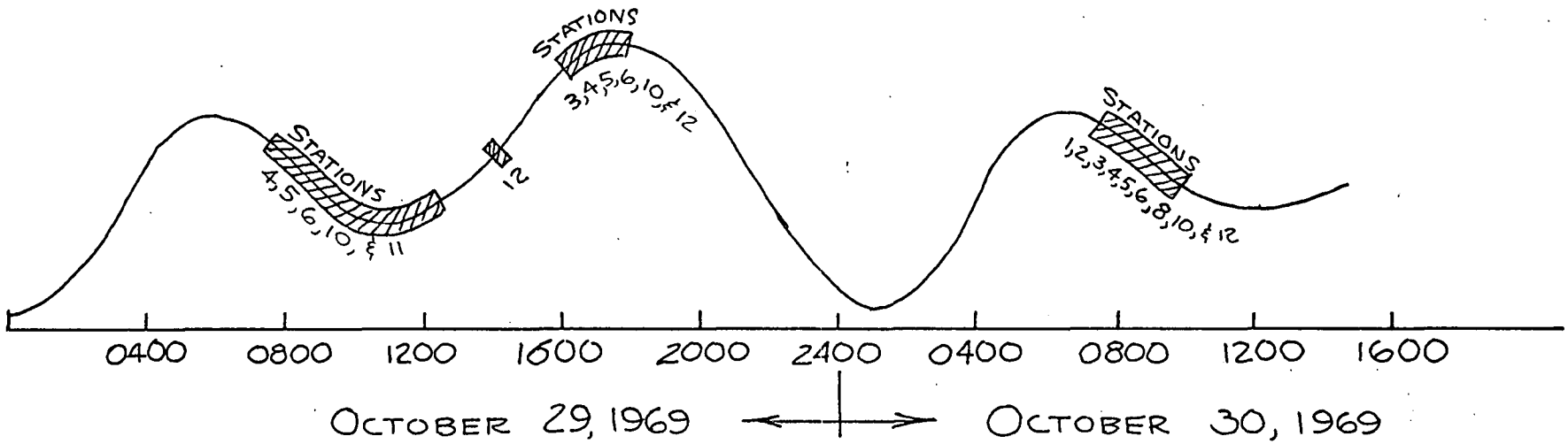


FIGURE 2

TABLE 2
OCTOBER 1969 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

	Date	Time	Station	Depth (ft.)	Temp. °C	D.O. (mg/l)	pH	Total Alkalinity (mg/l $CaCo_3$)	Cond. (umho/cm)	T.Coli. /100ml	F.Coli. /100ml
	10-29-69	0737	6wt	5	13.0	8.51	6.6	62	195	1220	-
			6wb	60	13.0	8.60	7.3	64	175	1110	2
		0755	6mt	5	13.0	8.90	6.6	60	190	960	-
			6mm	25	13.0	8.95	6.9	54	195	540	1
			6mb	40	13.0	8.85	7.0	60	195	780	-
		0808	6ot	5	13.0	8.95	6.9	60	195	1840	1
			6ob	10	13.0	8.80	7.0	64	192	1020	-
EBBING TIDE		0827	5ot	5	13.0	9.10	7.0	62	190	1920	-
			5ob	10	13.0	8.90	7.3	60	190	1530	-
		0845	5mt	5	13.0	9.05	7.1	64	190	1150	-
			5mm	20	13.0	9.00	7.2	64	190	-	-
			5mb	40	13.0	9.10	7.1	56	190	740	1
		0855	5wt	5	13.0	9.00	7.1	66	190	1100	2
			5wb	20	13 0	9.10	6.9	62	187	540	-
		0915	4ot	5	13.0	9.45	7.4	65	195	1480	-
			4ob	20	13.0	9.30	7.4	68	195	700	-
		0923	4mt	5	13.0	9.50	7.1	60	190	910	1
			4mm	20	13.0	9.45	7.3	64	195	950	-
			4mb	30	13.0	9.30	7.4	68	195	1480	-
		0930	4wt	5	13.0	9.40	7.1	62	190	890	1
			4wb	15	13.0	9.30	7.3	60	195	1420	-
		1110	6wt	5	13.5	9.15	7.1	68	190	1370	-
			6wb	50	13.5	9.00	7.5	64	185	1050	-
LOW TIDE		1120	6mt	5	13.5	9.25	7.5	64	185	1100	-
			6mm	30	13.5	9.35	7.6	60	187	1950	-
			6mb	40	13.5	9.30	7.5	64	185	1380	1

TABLE 2
OCTOBER 1969 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

	Date	Time	Station	Depth (ft.)	Temp. °C	D.O. (mg/l)	pH	Total Alkalinity (mg/l CaCo3)	Cond. (umho/cm)	T.Coli. /100ml	F.Coli. /100ml
	10-29-69	1125	6ot	5	13.5	9.15	7.5	62	185	1260	-
			6ob	20	13.5	9.25	7.7	66	185	1300	1
		1143	5wt	5	13.5	9.70	7.6	60	185	1550	-
LOW TIDE			5wb	60	13.5	9.15	7.5	60	180	1590	-
		1150	5mt	5	13.5	9.45	7.5	60	185	1650	-
			5mm	20	13.5	9.25	7.6	60	190	1300	-
			5mb	30	13.5	9.25	7.7	64	185	1830	1
		1150	5ot	5	13.5	9.50	7.7	62	185	2110	-
			5ob	10	13.5	9.45	7.5	64	185	2150	-
		1210	4wt	5	13.5	9.60	7.8	68	190	1280	-
			4wb	25	13.5	9.50	7.8	68	190	990	-
FLOODING TIDE		1215	4mt	5	13.5	9.75	7.7	62	190	1370	-
			4mm	25	13.5	9.60	7.9	64	185	2120	-
			4mb	40	13.5	9.45	8.1	68	185	1340	-
		1223	4ot	5	13.5	9.65	7.7	62	185	1520	-
			4ob	35	13.5	9.60	7.9	64	190	1620	-
		1609	5wt	5	13.5	9.10	8.9	70	180	1470	-
			5wb	60	13.0	9.15	8.3	68	180	2220	-
		1614	5mt	5	13.5	9.60	8.2	70	175	2480	1
			5mm	20	13.5	9.50	8.2	66	170	1430	1
HIGH SLACK TIDE			5mb	30	13.5	9.20	8.3	70	175	1560	-
		1620	5ot	5	13.5	9.20	8.3	70	170	2440	-
			5ob	10	13.5	9.00	7.8	70	155	1770	2
		1637	4ot	5	13.5	9.35	7.5	64	150	2220	-
			4ob	30	13.5	9.25	7.6	68	150	1650	1

TABLE 2
OCTOBER 1969 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

Date	Time	Station	Depth (ft.)	Temp. °C	D.O. (mg/l)	pH	Total Alkalinity (mg/l $CaCo_3$)	Cond. (umho/cm)	T.Coli. /100ml	F.Coli. /100ml
10-29-69	1642	4mt	5	13.5	9.35	7.6	70	155	2240	2
HIGH SLACK TIDE		4mm	25	13.5	9.50	7.4	70	155	2120	1
		4mb	35	13.5	9.40	7.8	70	155	1800	-
	1650	4wt	5	13.5	9.50	8.1	66	155	2170	-
		4wb	35	13.5	9.25	7.7	68	155	2080	-
	1745	6wt	5	13.0	8.60	-	70	160	860	1
		6wb	70	13.0	8.75	7.6	70	157	860	-
EBBING TIDE	1755	6mt	5	13.0	8.95	7.7	72	155	720	-
		6mm	25	13.0	8.95	7.6	70	156	720	-
		6mb	35	13.0	8.95	7.5	68	155	870	1
	1800	6ot	5	13.0	9.00	7.5	68	159	760	1
		6ob	15	13.0	9.00	7.9	70	158	600	1

TABLE 2
OCTOBER 1969 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

Date	Time	Station	Depth (ft.)	Temp. °C	D.O. (mg/l)	pH	Total Alkalinity (mg/l $CaCo_3$)	Cond. (umho/cm)	T.Coli. /100ml	F.Coli. /100ml
10-30-69	0742	6wt	5	13.0	9.40	7.6	70	178	4000	3
		6wb	70	13.0	9.35	7.7	70	175	3000	3
	0750	6mt	5	13.0	9.50	7.8	72	180	3100	3
		6mm	30	13.0	9.45	7.7	68	178	2900	3
		6mb	50	13.0	9.40	7.9	66	180	2900	3
	0800	6ot	5	13.0	9.30	7.7	68	178	4400	3
		6ob	15	13.0	9.40	7.9	68	175	2800	3
	0815	5wt	5	13.0	9.65	8.0	70	172	4000	3
		5wb	25	13.0	9.55	7.6	66	174	5500	3
	0825	5mt	5	13.0	9.80	7.8	70	178	4100	3
		5mm	30	13.0	9.85	7.6	68	175	3700	3
		5mb	50	13.0	9.80	7.6	68	172	3700	3
	0830	5ot	5	13.0	9.60	7.8	64	172	2000	3
		5ob	10	13.0	-	-	-	-	-	-
	0845	4ot	5	13.0	9.40	7.9	70	180	3800	3
		4ob	20	13.0	9.25	8.1	68	124	4200	3
	0853	4mt	5	13.0	9.80	7.5	68	176	4300	3
		4mm	25	13.0	9.70	7.7	70	176	4700	3
		4mb	35	13.0	9.55	7.8	70	178	3900	3
	0900	4wt	5	13.0	9.65	7.7	68	172	5200	3
		4wb	20	13.0	9.55	7.8	66	176	5300	3

EBBING TIDE

TABLE 2
OCTOBER 1969 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

Date	Time	Station	Depth (ft.)	D.O. (°C)	pH	Alkalinity (mg/l $CaCo_3$)	Cond. (umho/cm)	T.Coli. /100ml	F.Coli. /100ml
10-30-69	1000	1wt ½mile above C-2 Wauna outfall north side	2	9.65	8.2	68	180	1700	-
		1ot ½mile above C-2 Wauna outfall south side	2	9.80	7.7	72	180	2000	-
		8mt At outfall (approx.)	2	9.70	8.0	70	180	14000	-
		2wt ½mile below outfall (north)	2	9.80	7.8	68	182	19000	-
		2ot ½mile below outfall (south)	2	9.75	7.9	68	178	21000	-
	--GRAB SAMPLES--								
10-29-69	0810	11mt ½ between Sta. #5 and Sta. #6	2	8.85					
	1130	½ between Sta. #5 and Sta. #6	2	9.15					
10-30-69	0815	10mt	2	9.55					
10-29-69	0930	Above marker bouy 37	2	9.25					
	1210	Above marker bouy 37	2	9.40					
	1650	Above marker bouy 37	2	9.25					
10-30-69	0900	Above marker bouy 37	2	9.70					
10-29-69	1408	12mt Marker 26	2	8.75					
	1755	Marker 26	2	7.00					
10-30-69	0742	Marker 26	2	9.45					
10-29-69	1745	3ot Off Bradwood Pier	2	9.10					

TABLE 3
APRIL 1970 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

Date	Time	Station	Depth ft.	Temp. °C	D.O. mg/l	pH	Total Alkalinity mg/l $CaCO_3$	Cond.	T.Coli. /100ml	F.Coli. /100ml
4-21-70	0930	7ot	2	10.0	11.4	6.9	56	-	30000	-
		7om	15	10.0	11.4	-	-	-	-	-
		7ob	35	10.0	11.6	7.0	59	-	-	-
Low Tide	0940	7mt	2	10.1	11.4	7.2	58	-	14000	-
		7mm	25	10.1	11.6	7.0	58	-	-	-
		7mb	50	10.0	11.6	6.9	56	-	-	-
	1010	7wt	2	10.2	11.6	7.0	55	-	14000	-
		7wb	20	10.1	11.6	6.9	56	-	-	-
	1045	6ot	2	10.2	11.5	7.4	58	-	16000	-
		6om	25	10.2	11.5	7.2	60	-	-	-
		6ob	50	10.2	11.6	7.2	58	-	-	-
	1050	6mt	2	10.1	11.5	7.2	60	-	24000	-
		6mm	35	10.1	11.5	7.1	57	-	-	-
		6mb	70	10.1	11.6	7.5	56	-	-	-
Flooding Tide	1055	6wt	2	10.1	11.2	6.8	57	-	11000	-
		6wm	40	10.1	11.4	6.7	56	-	-	-
		6wb	90	10.1	11.5	6.9	54	-	-	-
	1135	5wt	2	10.2	11.4	7.2	58	-	14000	-
		5wm	30	10.2	11.5	7.0	56	-	-	-
		5wb	60	10.2	11.6	7.1	57	-	-	-
	1142	5mt	2	10.2	11.4	7.0	58	-	36000	-
		5mm	25	10.2	11.5	7.1	60	-	-	-
		5mb	50	10.2	11.6	7.2	60	-	-	-
	1152	5ot	2	10.2	11.4	7.3	60	-	18000	-
		5ob	15	10.2	11.4	-	-	-	-	-

TABLE 3
APRIL 1970 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

Date	Time	Station	Depth ft.	Temp. °C	D.O. mg/l	pH	Total Alkalinity mg/l $CaCo_3$	Cond.	T.Coli. /100ml	F.Coli. /100ml
4-21-70	1212	4mt	2	10.2	11.5	7.3	60	-	19000	-
		4mm	25	10.1	11.5	7.2	57	-	-	-
		4mb	50	10.1	11.6	7.2	57	-	-	-
	1222	3wt	2	10.2	11.9	7.5	57	-	21000	-
		3wm	15	10.2	11.6	7.2	60	-	-	-
		3wb	30	10.2	11.6	7.2	57	-	-	-
	1229	3mt	2	10.1	11.4	7.5	56	-	26000	-
		3mm	25	10.1	11.5	7.3	64	-	-	-
		3mb	50	10.1	11.6	7.3	55	-	-	-
	1235	3ot	2	10.2	11.6	7.4	57	-	21000	-
		3om	20	10.2	11.6	7.4	58	-	-	-
		3ob	40	10.2	11.6	7.3	58	-	-	-
	1402	1mt	2	10.2	11.6	6.9	50	-	19000	-
		1mm	30	10.2	11.7	7.1	53	-	-	-
		1mb	60	10.2	11.7	7.0	54	-	-	-
	1417	2mt	2	10.2	11.4	7.0	51	-	15000	-
		2mm	25	10.2	11.6	7.1	52	-	-	-
		2mb	50	10.2	11.7	7.2	52	-	-	-
	1435	3wt	2	10.2	11.7	6.4	52	-	-	-
		3wm	20	10.2	11.6	6.5	54	-	-	-
		3wb	40	10.2	11.6	6.6	52	-	-	-
	1442	3mt	2	10.2	11.6	6.8	54	-	7000	-
		3mm	30	10.2	11.6	6.8	57	-	-	-
		3mb	60	10.2	11.7	7.0	54	-	-	-
	1451	3ot	2	10.2	11.7	7.3	53	-	2000	-
		3om	25	10.2	11.6	7.2	52	-	-	-
		3ob	50	10.2	11.6	7.3	52	-	-	-

Flooding Tiding

High Slack Tide

TABLE 3
APRIL 1970 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

Date	Time	Station	Depth ft.	Temp. °C	D.O. mg/l	pH	Total Alkalinity mg/l $CaCo_3$	Cond.	T.Coli. /100ml	F.Coli. /100ml
4-21-70	1505	4mt	2	10.2	11.6	6.4	52	-	20000	-
		4mm	25	10.2	11.6	6.5	55	-	-	-
		4mb	55	10.2	11.6	6.5	55	-	-	-
	1518	5wt	2	10.2	11.6	6.7	52	-	36000	-
		5wm	30	10.2	11.5	6.8	56	-	-	-
		5wb	60	10.2	11.5	-	-	-	-	-
Ebbing Tide	1524	5mt	2	10.2	11.6	6.4	52	-	9000	-
		5mm	25	10.2	11.5	6.5	57	-	-	-
		5mb	50	10.2	11.5	6.7	52	-	-	-
	1535	5ot	2	10.2	11.6	6.7	56	-	21000	-
	1602	6mt	2	10.2	11.8	6.6	53	-	4000	-
		6mm	50	10.2	11.7	-	-	-	-	-
		6mb	90	10.2	11.7	6.7	53	-	-	-
	2000	7mt	2	10.1	11.6	7.2	51	-	-	-
		7mm	25	10.2	11.6	7.1	50	-	-	-
		7mb	50	10.2	11.6	7.0	51	-	-	-
Low Tide	2120	-	-	-	-	-	-	-	-	-
4-22-70	0620	1mt	2	10.0	11.4	7.1	49	-	19000	-
		1mm	25	9.5	-	7.0	52	-	-	-
		1mb	50	9.5	11.3	7.0	51	-	-	-
Ebbing Tide	0640	2mt	2	9.5	11.4	7.1	52	-	19000	-
		2mm	20	9.5	-	7.1	51	-	-	-
		2mb	40	9.5	11.4	7.0	52	-	-	-

TABLE 3
APRIL 1970 COLUMBIA RIVER
SURVEY DATA
RM 27.0 to 43.0

Date	Time	Station	Depth ft.	Temp. °C	D.O. mg/l	pH	Total Alkalinity mg/l CaCo3	Cond.	T.Coli. /100ml	F.Coli. /100ml
4-22-70	0705	3wt	2	9.5	11.3	7.2	51	-	24000	-
		3wm	15	9.5	-	7.0	55	-	-	-
		3wb	30	9.5	11.3	-	51	-	-	-
	0711	3mt	2	9.5	11.5	7.1	56	-	10000	-
		3mm	25	9.5	-	7.2	50	-	-	-
		3mb	50	9.5	11.6	7.0	50	-	-	-
	0716	3ot	2	9.5	11.6	7.2	55	-	15000	-
		3om	20	9.5	-	7.1	54	-	-	-
		3ob	40	9.5	11.7	-	50	-	-	-
	0724	4mt	2	9.5	11.7	7.0	49	-	9000	-
		4mm	20	9.5	-	7.2	54	-	-	-
		4mb	40	9.5	11.6	7.2	51	-	-	-
	0740	5wt	2	9.5	11.4	7.0	52	-	10000	-
		5wm	25	9.5	-	7.1	49	-	-	-
		5wb	50	9.5	11.5	7.1	52	-	-	-
	0747	5mt	2	9.5	11.5	6.8	46	-	21000	-
		5mm	20	9.5	-	-	-	-	-	-
		5mb	40	9.5	11.5	7.0	51	-	-	-
	0759	5ot	2	9.5	11.5	7.0	54	-	-	-
Ebbing Tide										
Low Tide	1016									
	GRAB SAMPLES									
4-21-70	1205	(9)	2	10.2	11.5	7.5	58	-	18000	-

The effects of diurnal and tidal changes were greater during the October, 1969, survey because of the lower river flow.

TABLE 4
AVERAGE SURVEY DATA RANGE
STATION NO. 5

Survey Date	D.O.	Temp.	pH	Alk.	Cond.	T. Coli.
Oct. 69	9.1-9.7	13.0-13.5	7.1-8.3	61-69	172-189	1160-3800
Apr. 70	11.5-11.6	9.5-10.2	6.6-7.1	51-59	----	19,000-23,000

The principal waste source in this reach of the Columbia River is Crown Zellerbach's pulp and paper mill at Wauna. The kraft mill provides primary treatment, diffusing the effluent into the Columbia River near river range marker 51 (Station 8). Four additional mills are located approximately 23 miles upstream (RM 66.0) at Longview, Washington.

During the October survey, the total coliform count upstream from the Wauna mill outfall was 2000 TC/100 ml. This count increased to 21,000 TC/100 ml immediately downstream from the Wauna mill outfall, then gradually decreased farther downstream (Table 2). In contrast, high coliform counts of about 19,000 TC/100 ml existed both upstream (Station 1) and downstream (Station 2) from the outfall during the April survey. The high upstream coliform counts probably came from waste discharges at Longview. Extended bacterial survival due to low water temperature and a reduced time to travel

due to high river flows could result in bacteria from Longview still being viable as they reached the study area. This condition did not occur in the October, 1969, survey since the water temperature was higher (13.5°C) and river velocity was lower.

The high rate of microorganism metabolism which occurred during the October, 1969, survey resulted in a dissolved oxygen (DO) demand in this study reach. The lowest DO concentrations of 7.0 ppm occurred about high tide at Station 12 near the lower end of the reach. The DO saturation value throughout the study area was about 10.5 ppm at 13.5°C and the average DO concentration in the upper part of the study area was approximately 9.3 ppm. It appears that the DO depression was a result of the Crown Zellerbach mill discharge.

There was no DO reduction during the April, 1970, survey, probably because of lower oxygen demand and a high rate of atmospheric reaeration resulting from the turbulence associated with the high river flow.

Average values of the remaining water quality parameters for these two periods are approximately equal to the historical values of samples taken upstream at the Clatskanie sampling point.

REFERENCES

(1) Federal Water Pollution Control Administration. FWPCA Methods For Chemical Analysis of Water and Wastes. November 1969.

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(3) Geldreich, Edwin E., et al. Fecal coliform organisms medium for membrane filter technique. Journal American Water Works Assoc. 57:2, 208-214, 1965.

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