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BREMERTON WASTEWATER TREATMENT PLANT
CLASS II INSPECTION

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ABSTRACT

A Class II inspection was conducted at the Bremerton Wastewater Treatment Plant on January 25-27, 1988. The plant had very good effluent quality and did not violate any NPDES permit parameters. Several bioassays indicated a slight amount of effluent toxicity. Laboratory split samples correlated very well; several recommendations were made to conform to Standard Methods. Installation of an access point for a portable influent compositor and recalibration of the effluent flowmeter was also recommended. Sediment and effluent bioassays, and related chemical analyses, are discussed.

INTRODUCTION

A Class II inspection was held at the Bremerton Wastewater Treatment Plant (WTP) on January 25-27, 1988. The inspection was requested by David Wright of Ecology's Northwest Regional Office. Conducting the inspection were Don Reif and Carlos E. Ruiz from Ecology's Compliance Inspections Section. Assisting from Bremerton was Robert M. Bruett, Plant Manager, with Senior Operations Chief Richard A. Fitzwater, and Jackie Horton from the lab.

The objectives were to:

1. Collect plant samples and measure flows to determine plant loading and efficiencies.

2. Perform a laboratory evaluation, including sample splits, for accuracy and adherence to accepted analytical protocol.

3. Determine compliance with NPDES permit parameters.

4. Perform a series of effluent bioassays and sediment bioassays from near the outfall.

LOCATION AND DESCRIPTION

Bremerton is located west of Seattle in south-central Kitsap County. The WTP is near the junction of Highways 3 and 16 in southwestern Bremerton (Figure 1). Conversion of the 10 MGD facility from primary to secondary treatment was completed in the summer of 1984. The upgraded plant receives residential and light commercial domestic sewage from the city of Bremerton and Kitsap County Sewer District No. 1. The facility also accepts leachate from the Kitsap County landfill. The Puget Sound Naval Shipyard sends domestic and most of its industrial waste, some of which is pretreated, to the WTP. Several combined sewers remain in the collection system, so a large portion of local storm flows are treated at the plant.

A treatment schematic is shown in Figure 2. Treatment consists of mechanical bar screens; pre-aeration; primary clarification; primary sludge degritting; grit washing; and secondary treatment with biofilter, followed by activated sludge and secondary

Figure 1. Location of Bremerton Wastewater Treatment Plant and sediment sample locations.

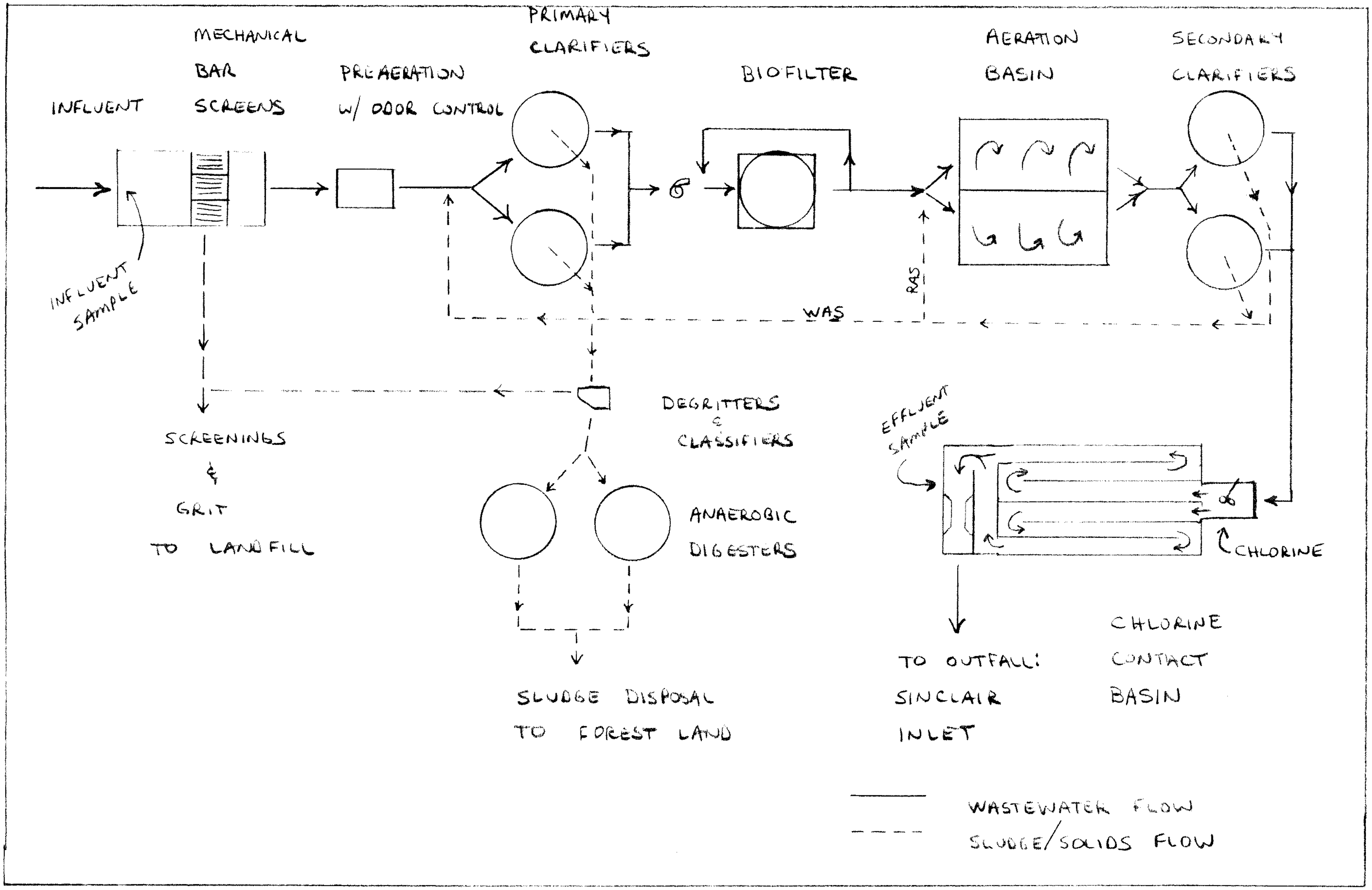

Figure 2. Flow schematic with sampling locations, Bremerton Wastewater Treatment Plant.

clarification. Chlorinated effluent is discharged to Sinclair Inlet about 500 feet offshore at a depth of 42 feet (MHHW).

Normally, secondary sludge is thickened by dissolved air flotation, but is currently co-settled with the primary sludge. After degritting, both sludges are gravity thickened and anaerobically digested. Anaerobic sludge is dewatered on a belt filter press and disposed of by private contractor for a silviculture operation. The city is in the process of obtaining its own silviculture disposal site.

METHODS

Twenty-four-hour composited samples were collected at the effluent Parshall flume. Approximately 230 mL of sample was collected at 30-minute intervals. General chemistry and priority pollutant parameters were run on these samples. Influent from Bremerton's compositor was used for general chemistry analyses. An Ecology influent composite sample was not collected; a suitable access point was unavailable. Sampling locations are indicated on the plant schematic (Figure 2). Three sets of influent and effluent grab samples were also collected during the inspection. The complete sampling schedule is listed in Table 1.

Most analyses were run at Ecology's Environmental Laboratory at Manchester. Priority pollutant scans (effluent, sludge, and sediments) were run by Analytical Resources, Inc., Seattle. Sediment percent solids and TOC were analyzed by Laucks Testing Laboratories, Inc. in Seattle. Parametrix, Inc. of Seattle ran sediment grain size.

Effluent bioassays (three-grab composites) were run on juvenile rainbow trout, Microtox, and *Ceriodaphnia dubia*. The trout (Static Acute Fish Toxicity Test: DOE 80-12) and Microtox (Microtox System Operating Manual by Beckman) bioassays were conducted at Manchester. E.V.S. Consultants of Vancouver, B.C. ran the *Ceriodaphnia* (EPA, 1985) and sediment bioassays with *Rhepoxinius abronius* (Tetra Tech, 1986a).

Two sediment samples were collected from each side of the outfall diffuser: No. 1 on the east side, No. 2 on the west side, each about 20 feet laterally from the diffuser's midsection. The sediment field control sample was collected from the opposite side of Sinclair Inlet (Figure 1). Sediments were collected using a 0.1 m2 Van Veen sampler, and conformed to procedures outlined in "Puget Sound Protocols" (Tetra Tech, 1986a).

RESULTS

Flow

Plant flow data are listed in Table 2. From the plant's flow meter totalizer, a flow of 7.41 MGD was recorded for both the plant's records (0800-0800) and Ecology's compositing period (0825-0825). However, a check of instantaneous flowrates did not correspond well with the indicated flowrate for a three-foot Parshall flume. As shown in Table 2, the flowmeter recorded greater flow values than predicted by the measured

Table 1. Ecology Sampling Results: Bremerton Class II Inspection, January 25-27, 1988.

				Field Analysis					Laboratory Analysis																										
																																Bioassays			
Sample Type	Station	Date	Time	Temperature (°C)	pH	Conductivity	Cl_2 Res.	Flow	pH	Turbidity	Conductivity	Alkalinity	Hardness	NH_3	NO_3	NO_2	T-Phosphorus	Nuts (4)	Solids (4)	TSS/TVSS	COD	BOD_5	Fecal Coliform	Cyanide	% Solids	ABN, Pest/PCB	VOA	Phenols	PP Metals	TOC	Grain Size	Rhep. Abronius	Trout	MicroTox	Ceriodaphnia
Grab																																			
	Inf.	26	AM	X	X	X			X	X	X	X		X	X		X			X	X														
		26	PM	X	X	X			X	X	X	X		X	X		X			X	X														
		27	AM	X	X	X			X	X	X	X		X	X		X			X	X														
	Eff.	26	AM	X	X	X		X	X	X	X	X		X	X		X			X	X		X												
		26	PM	X	X	X			X	X	X	X		X	X		X			X	X		X												
		27	AM	X	X	X	X	X	X	X	X	X		X	X		X			X	X		X												
	Sludge	26-27																						X	X	X	X		X						
	Sediment																																		
	Out.#1	25	PM																					X	X	X	X		X	X	X	X			
	Out.#2	25	PM																					X	X	X	X		X	X	X	X			
	Control	25	PM																					X	X	X	X		X	X	X	X			
Comp																																			
	Eco. Inf.	26-27		X	X	X			X	X	X	X	X					X	X		X	X		X		X	X		X						
	Brem. Inf.	26-27		X	X	X			X	X	X	X						X	X		X	X													
	Eco. Eff.	26-27		X	X	X	X		X	X	X	X	X					X	X		X	X		X		X	X		X				X	X	X
	Brem. Eff.	26-27		X	X	X			X	X	X	X	X					X	X		X	X													

Table 2. Plant Flow Data: Bremerton Class II Inspection, January 26-27, 1988.

		Ecology Instantaneous Measurement		Plant Meter (mgd)		
Date	Time	Height (ft.)[a]	Flow (mgd)[b]	Instantaneous	Totalizer	(%)[c]
1/26- 1/27	0839 0842				7.41	
1/26	1548	0.78	5.25	6.2		+15
1/27	1015	0.86	6.13	7.9		+22
1/27	1158	0.90	6.57	9.0		+27
1/26- 1/27	0800 0800				7.41	

[a] Staff gauge height, 3 ft. effluent Parshall flume.
[b] Flow conversion from staff gauge height - from Leupold & Stevens, Inc., 1978.
[c] Percent difference, instantaneous flow meter readout vs. staff gauge height.

staff gauge height. Also, the apparent discrepancy increased as the flowrate through the flume increased. Therefore, Bremerton's flow rates may be less than is currently being reported. The flow metering system should be recalibrated by a qualified technician.

General Conditions

Ecology's analytical results for general chemistry are listed in Table 3. Most notable is the high effluent quality indicated by very low suspended solids and BOD values. This range of effluent values (TSS from 2-8 mg/L and BOD of 10-14 mg/L) is excellent for secondary plants.

Conductivity values were about nine times higher than normal (4000 vs. 500 umhos/cm). Possible reasons for the elevated conductivities are sewer system inflow/infiltration and/or the naval shipyard influent. The influent may have been as much as twelve percent saltwater (30,000 ÷ [4000-500] umhos/cm).

High salinity can degrade effluent quality, especially if the salt concentration varies significantly over time. The plant may want to track conductivity versus effluent quality to determine any correlation.

Plant loading was well within design parameters during the inspection (Table 4). However, TSS loading was very close to 85 percent of the designed criterion. When this criterion is met or exceeded, a "plan for maintaining adequate capacity" must be submitted to Ecology. As mentioned in the flow section above, Bremerton's flows may be less than is currently being recorded. If so, influent loadings are less as well, and may not be close to the 85 percent criterion.

NPDES Permit Compliance

No violations of NPDES permit parameters occurred during the inspection, as shown in Table 5. All effluent loading parameters were well under permitted limits. Fecal coliform counts were low.

Laboratory Review

Split sample results are listed in Table 6. Interlaboratory values correlated very well, as did the effluent samples.

Review of laboratory procedures at the Bremerton WTP revealed one BOD procedure misunderstanding. The BOD of the seed material (seed control) must be known to properly determine that portion of the sample's D.O. uptake that is due to the seed (AWWA, p. 529). Determination of the seed BOD should be done with every seeded BOD sample.

Table 3. Ecology analytical results- Bremerton Class II inspection: January 26-27, 1988.

Station	Date	Time	Sampler	Field Analyses: Temperature	Field Analyses: pH (S.U.)	Field Analyses: Cond. (umhos/cm)	Chlorine Residual (mg/L): Free	Chlorine Residual (mg/L): Total	Laboratory Analyses: pH (S.U.)	Turbidity (NTU)	Cond. (umhos/cm)	Alkalinity (mg/L as $CaCO_3$)	Total Hardness (mg/L as $CaCO_3$)	Nutrients (mg/L): NH_3-N	NO_2-N	NO_3-N	NO_2+NO_3-N	O-PO_4-P	Total-P	Solids (mg/L): TS	TNVS	TSS	TNVSS	COD (mg/L)	BOD (mg/L)	Fecal Coliform (#/100mL)
Influent	1/26	9:45		10.2	7.32	>1000			7.4	63	3490	130		14			0.22		4.5			410	110	660		
		15:35		11.0	7.08	>1000			7.4	35	4080	240		25			0.20		8.1			330	50	620		
	1/27	12:52		12.4	7.57				7.4	44	4140	150		19			0.30		6.4			400	35	570		
Effluent	1/26	10:05		10.8	7.26	>1000			7.4	6	4940	160		21			0.08		5.0			8	<1	73		3
		15:45		12.5	7.30	>1000			7.5	5	4270	150		20			0.09		5.0			2	<1	92		33
	1/27	12:30		12.2	7.33		0.0	0.6	7.5	5	3670	160		24			0.05		4.6			2	1	87		2
Influent		Comp. (8:25-8:25)	Bremerton						7.3	52	3220	160	320	24	0.07		0.17	4.9	6.2	2100	1400	310	40	590	230	
Effluent		Comp. (8:25-8:25)	Ecology						7.6	5	4430	170	430	24	0.07		0.06	4.2	4.5	2400	2000	6	<1	83	10	
			Bremerton						7.5	5	4440	130	430	26	0.06		4.50	4.2	4.5	2400	2000	5	<1	84	14	

Table 4. Comparison of Design Criteria to Inspection Results: Bremerton Class II Inspection, January 26-27, 1988.

	Design Criteria*	85% of Design Criteria	Inspection Results
Maximum Month Average Flow, mgd	10.1	8.59	7.41
Maximum Month BOD_5 Loading, lbs/day	18,100	15,385	14,200
Maximum Month TSS Loading, lbs/day	22,600	19,210	19,200

* from Bremerton's current NPDES permit, p. 5.

Table 5. Comparison of Inspection Results to NPDES Permit Effluent Limits: Bremerton Class II Inspection, January 26-27, 1988

	Effluent Limitations		Ecology
Parameter	Monthly Average	Weekly Average	Inspection Results
BOD_5: mg/L	30	45	10
lbs/day	2527	3790	618
SS: mg/L	30	45	6
lbs/day	2527	3790	371
Fecal Coliform: #/100 ml	200	400	2,3,33
pH	6.0 - 9.0		7.3 - 7.5

Table 6. Comparison of Laboratory Results: Bremerton Class II Inspection, January 25-27, 1988.

Station	Date	Time	Sampler	Lab	Chlorine Residual (mg/L) Free	Chlorine Residual (mg/L) Total	Fecal Coliform (#/100mL)	BOD5 (mg/L)	TSS (mg/L)
Influent	1/26-27	Comp. (8:25-8:25)	Bremerton	Ecology				230	310
				Bremerton				240	317
Effluent	1/27	12:30	Ecology	Ecology	0.0	0.6	2		
				Bremerton			<10		
	1/26-27	Comp. (8:25-8:25)	Ecology	Ecology				10	6
				Bremerton				6	9
			Bremerton	Ecology				14	5
				Bremerton				16	9

A significant difference was seen between the Bremerton and Ecology effluent composite sample for nitrate-plus-nitrite nitrogen, in Table 3 (4.5 mg/L versus 0.06 mg/L). Bremerton's alkalinity was slightly lower as well. Also, Table 6 shows both labs found a higher apparent BOD_5 in Bremerton's effluent sample than in Ecology's sample.

This could indicate partial nitrification of Bremerton's sample. If so, the nitrification may have occurred during the collection/compositing process due to fixed microbial growth in the compositor sample lines or containers. A monthly cleaning of compositor lines with a dilute chlorine solution should prevent this situation.

A couple of minor suggestions are also made. Bremerton's BOD dilution water blank sometimes exceeds 0.2 mg/L D.O. depletion. If this is a problem, the cause should be found. Also, the temperature of the composite samples should be checked at least monthly to assure that the sample is being consistently cooled to approximately $4^{o}C$ (AWWA, 1985). Last, the fecal coliform workbench area should be disinfected before and after all microbiological lab work (AWWA, 1985).

Sludge Metals

Sludge metals concentrations are compared against historical data in Table 7. Cadmium, chromium, copper, and nickel were higher than the average for activated sludge plants across the state. Ecology's nickel concentration was the highest of 30 samples to date. Bremerton's analysis was lower, but previous DMR metals data have indicated levels as high as Ecology's; e.g., March 1987 (76.5 mg/kg).

Effluent Metals

Influent and effluent priority pollutant metals concentrations are compared against EPA water quality criteria in Table 8. A reduction between influent and effluent concentrations occurred in every case. Presumably, the remainder entered the sludge. Effluent copper levels exceeded the saltwater acute and chronic criteria. This concentration may have affected effluent bioassay results. However, water quality criteria in Sinclair Inlet may not have been violated due to the large dilution available in Bremerton's allowed mixing zone. Influent silver was high, but not checked in the effluent. Silver should be run in future metals testing.

Bioassay Results

Bioassay results are listed in Table 9. High toxicity was not observed in any of the tests. *Ceriodaphnia* showed acute toxicity at 100 percent effluent, but not at any lower concentrations. Microtox also indicated a small amount of acute toxicity. No acute toxicity was indicated by the trout bioassay. In addition, chronic toxicity was indicated by decreased *Ceriodaphnia* reproduction at 100 percent effluent only. These results compared well with a series of bioassays conducted in March of 1987 by the EPA

Table 7. Sludge metals results: Bremerton Class II inspection, January 25-27, 1988.

Metal	Ecology Results (mg/kg dry weight)	Bremerton Results (mg/kg dry weight)	Data from previous inspections*: Geometric Range (mg/kg dry weight)	Data from previous inspections*: Mean (mg/kg dry weight)	Data from previous inspections*: Number of samples
Cadmium	8.6	5	<0.1 - 25	7.6	34
Chromium	80.5	108	15 - 300	61.8	34
Copper	930	866	75 - 1700	398	34
Lead	206	151	34 - 600	207	34
Nickel	72	37	<0.1 - 62	25.5	29
Zinc	1170	1161	165 - 3370	1200	34
% Solids	2.67	2.8			

* Summary of data collected on digested sludge from activated sludge plants from previous inspections (Hallinan, 1988).

Table 8. Effluent metals compared with EPA water quality criteria: Bremerton Class II Inspection, January 25-27, 1988.

Criteria:	FW Acute	FW Chronic	SW Acute	SW Chronic	Influent	Effluent
Antimony	9000	1600			10 U*	—
Arsenic+3	360	190	69	36	1 U	—
Beryllium	130	5.3			1 U	—
Cadmium	20	4	43	9.3	5 U	5 U
Chromium+3	5734	684	10300		78	25 U
Copper	70	41	3	3	195	22
Lead	523	20	140	6	50 U	50 U
Mercury	2.4	0.012	2.1	0.025	1.06	0.1 U
Nickel	4872	542	75	8	98	25 U
Selenium	260	35	410	54	1 U	—
Silver	50	0.12	2		50.2	—
Thallium	1400	40	2130		1 U	—
Zinc	403	365	95	86	265	82
Hardness+	430					

* Undetected at detection limits shown.

\+ Most freshwater metals criteria are hardness-dependent. Effluent hardness was used where appropriate to calculate criteria.

Table 9. Summary of Bioassay Results: Bremerton Class II Inspection, January 26-27, 1988.

Bioassay	Results		
Effluent			
Ceriodaphnia	NOEC (% v/v) - 50% Effluent LOEC - 100% Effluent		
Microtox	EC_{50} - 70.1% Effluent @ 5 minutes		
Rainbow Trout	0% Mortality @ 100% Effluent		
Sediment	Mean Values = STD Deviation		
	Survival[1]	Avoidance[2]	% Reburial[3]
Lab Control	19.2 ± 0.8	0.8 ± 0.6	93.8
Field Control	18.8 ± 1.8	0.02 ± 0.1	97.9
Outfall:			
East side	18.0 ± 1.9	0.02 ± 0.6	100.0
West side	19.2 ± 0.8	0.1 ± 0.3	97.9

[1] Mean based on twenty amphipods per replicate: five replicates per sample.
[2] Number of amphipods on jar surface per day, out of twenty.
[3] Number of amphipods able to rebury in clean sediment at end of test period.

(Cummins, 1987). *Hyallela*, an amphipod, *Ceriodaphnia*, and the alga *Selenastrum* were tested. Some acute toxicity was observed from *Hyallela* at higher effluent concentrations, but none from *Ceriodaphnia*. Chronic effects occurred at 100 percent effluent for both *Ceriodaphnia* and *Selenastrum*.

The slight toxicity may have come from several sources, either singly or in combination. Among these are ammonia, chlorine/chloramines, and copper.

Based on these results, no specific testing for toxicity is recommended at this time. Suggestions for future bioassay testing include (a) dry-weather sampling to compare with the two wet-weather results, and (b) use of marine chronic tests, such as echinoderm.

No significant toxicity, as compared to the controls, was indicated by the amphipod sediment bioassays. Tables 10, 11, and 12 compare sediment chemistry with one type of criteria. Based on this, two phthalates and chromium, nickel, mercury, and zinc were high. Nickel and chromium were high in the control site as well.

Priority Pollutant Scans

Results of priority pollutant scans for effluent, sludge, and receiving water sediments were quite unremarkable. Some PCBs and a few base/neutral acid compounds were detected in the outfall sediment samples, mostly phthalates and polynuclear aromatics. As seen in Table 10, phthalates exceeded the sediment criteria as listed. The sediment analysis was hindered by high detection limits on BNA and pesticide/PCB compounds. In future testing, low detection limits for these tests should be requested.

CONCLUSIONS AND RECOMMENDATIONS

The city of Bremerton's wastewater treatment plant is a modern, well-operated facility. The plant was producing a very high-quality effluent during the inspection and did not violate any NPDES permit parameters. The plant's influent has an unusually high conductivity which could adversely affect plant performance, particularly if the conductivity is variable. The plant may want to monitor conductivity to assess any impacts on effluent quality.

Bremerton's compositor lines should be flushed out monthly with a chlorine solution to avoid biomass buildup that could affect lab results.

Split sample values correlated very well between Ecology's and the WTP's laboratories. The correct procedure for determining seed BODs and hence the seed correction factor has been implemented by Bremerton's lab analyst. A few other recommendations are listed in lab review section.

The effluent flowmeter did not correlate well with instantaneous readings from the staff gauge. Meter calibration should be checked by a qualified technician.

Influent TSS loading approached the 85 percent-of-design criterion. However, Bremerton's flowmeter must be recalibrated before this can be confirmed.

Effluent bioassays indicated a small amount of toxicity, and correlated well with previous bioassays. For comparison, future bioassays should (a) be run during dry weather, and (b) include marine species such as the echinoderm test.

An access point needs to be constructed so that an influent compositor may be set up beside Bremerton's.

Table 10. Criteria vs. sediment BNA results: Bremerton Class II Inspection - January 25-27, 1988.

BNA Compound	Criteria* (ug/kg dw)	Sediments: Outfalls East	Sediments: Outfalls West	Sediments: Control
Fluoranthene	1700	320 J	<940	<870
Pyrene	2600	370 J	<940	<870
Butylbenxylphthalate	63	**740 M**	<940	<870
Benzo(a)Anthracene	1300	200 M	<940	<870
bis(2-Ethylhexyl)Phthalate	1900	**4000**	**5000**	540 J
Chrysene	1400	200 M	<940	<870
Di-n-Octyl Phthalate	>420	160 J	370 M	<870
Benzofluoranthenes	3200	860 M	<940	<870

* Lowest apparent effects threshold, from Tetra Tech, 1986b.

< Indicates compound was analyzed for, but not detected at the given detection limit

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

M Indicates an estimated value of analyte found and confirmed by analyst, but with low spectral match parameters

Table 11. Criteria versus pesticide and PCB results: Bremerton Class II inspection, January 25-27, 1988.

Pest/PCB Compound	Criteria* (ug/kg dw)	Sediments: East	Sediments: West	Sediments: Control
4,4'-DDE	9	<20	<20	<50
4,4'-DDD	2	<20	<20	<50
4,4'-DDT	3.9	<20	<20	<50
Total PCB's	130	115	110	<400

* Lowest apparent effects threshold (AET) - from Tetra Tech, 1986b.

Table 12. Sediment metals vs. criteria comparison (mg/kg dw: Bremerton Class II inspection, January 25-27, 1988.

Metal	Criteria*	Outfall East	Outfall West	Field Control
Antimony	3.2	<1	<1	<1
Arsenic	85	9.8	10.6	13.6
Cadmium	5.8	1.1	1.3	<0.5
Chromium+3	27	**136**	**78.8**	**61**
Copper	310	218	208	140
Lead	300	137	121	89
Mercury	0.41	**0.427**	0.392	0.374
Nickel	28	**61.2**	**46.9**	**43**
Silver	5.2	1.6	2.7	2.3
Zinc	260	**273**	225	160

* Lowest apparent effects threshold (AET)- from Tetra Tech, 1986b.

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APPENDICES

Appendix Ia. Results of BNA Priority Pollutant Scan, Bremerton Class II Inspection, January 25-27, 1988.

BNA Compound	Effluent (ug/L)	Sludge (ug/kg wet wt)	Sediments East Outfall (ug/kg dry wt)	Sediments West Outfall (ug/kg dry wt)	Sediments Field Control (ug/kg dry wt)
Phenol	0.4 U	900 U	420 U	940 U	870 U
bis(2-Chloroethyl)Ether	0.4 U	900 U	420 U	940 U	870 U
2-Chlorophenol	0.5 U	900 U	420 U	940 U	870 U
1,3-Dichlorobenzene	0.2 U	900 U	420 U	940 U	870 U
1,4-Dichlorobenzene	0.4 U	900 U	420 U	940 U	870 U
Benzyl Alcohol	0.5 U	4500 U	2100 U	4700 U	4400 U
1,2-Dichlorobenzene	0.1 U	900 U	420 U	940 U	870 U
2-Methylphenol	0.6 U	900 U	420 U	940 U	870 U
bis(2-chloroisopropyl)ether	1.3 U	900 U	420 U	940 U	870 U
4-Methylphenol	0.3 U	900 U	420 U	940 U	870 U
N-Nitroso-Di-n-Propylamine	0.8 U	900 U	420 U	940 U	870 U
Hexachloroethane	0.8 U	1800 U	840 U	1900 U	1700 U
Nitrobenzene	0.5 U	900 U	420 U	940 U	870 U
Isophorone	1.2 U	900 U	420 U	940 U	870 U
2-Nitrophenol	1.6 U	4500 U	2100 U	4700 U	4400 U
2,4-Dimethylphenol	1.4 U	1800 U	840 U	1900 U	1700 U
Benzoic Acid	1.7 U	9000 U	4200 U	9400 U	8700 U
bis(2-Chloroethoxy)Methane	1.2 U	900 U	420 U	940 U	870 U
2,4-Dichlorophenol	1.7 U	2700 U	1300 U	2800 U	2600 U
1,2,4-Trichlorobenzene	0.9 U	900 U	420 U	940 U	870 U
Naphthalene	1.6 U	900 U	420 U	940 U	870 U
4-Chloroaniline	0.9 U	2700 U	1300 U	2800 U	2600 U
Hexachlorobutadiene	0.9 U	1800 U	840 U	1900 U	1700 U
4-Chloro-3-Methylphenol	0.9 U	1800 U	840 U	1900 U	1700 U
2-Methylnaphthalene	0.9 U	900 U	420 U	940 U	870 U
Hexachlorocyclopentadiene	0.8 U	4500 U	2100 U	4700 U	4400 U
2,4,6-Trichlorophenol	0.3 U	4500 U	2100 U	4700 U	4400 U
2,4,5-Trichlorophenol	0.4 U	4500 U	2100 U	4700 U	4400 U
2-Chloronaphthalene	0.1 U	900 U	420 U	940 U	870 U
2-Nitroaniline	1.6 U	4500 U	2100 U	4700 U	4400 U
Dimethyl Phthalate	0.5 U	900 U	420 U	940 U	870 U
Acenaphthylene	0.1 U	900 U	420 U	940 U	870 U
3-Nitroaniline	0.9 U	4500 U	2100 U	4700 U	4400 U
Acenaphthene	0.6 U	900 U	420 U	940 U	870 U
2,4-Dinitrophenol	3.2 U	9000 U	4200 U	9400 U	8700 U
4-Nitrophenol	1.0 U	4500 U	2100 U	4700 U	4400 U
Dibenzofuran	0.8 U	900 U	420 U	940 U	870 U
2,4-Dinitrotoluene	0.5 U	4500 U	2100 U	4700 U	4400 U
2,6-Dinitrotoluene	1.3 U	4500 U	2100 U	4700 U	4400 U
Diethylphthalate	0.4 U	900 U	420 U	940 U	870 U
4-Chlorophenyl-phenylether	0.7 U	900 U	420 U	940 U	870 U
Fluorene	0.6 U	900 U	420 U	940 U	870 U
4-Nitroaniline	1.8 U	4500 U	2100 U	4700 U	4400 U
4,6-Dinitro-2-Methylphenol	3.3 U	9000 U	4200 U	9400 U	8700 U
N-Nitrosodiphenylamine	1.6 U	900 U	420 U	940 U	870 U
4-Bromophenyl-phenylether	0.6 U	900 U	420 U	940 U	870 U

Appendix Ia. (continued)

BNA Compound	Effluent (ug/L)	Sludge (ug/kg wet wt)	Sediments: East Outfall (ug/kg dry wt)	Sediments: West Outfall (ug/kg dry wt)	Sediments: Field Control (ug/kg dry wt)
Hexachlorobenzene	0.9 U	900 U	420 U	940 U	870 U
Pentachlorophenol	0.6 U	4500 U	2100 U	4700 U	4400 U
Phenanthrene	0.8 U	900 U	420 U	940 U	870 U
Anthracene	0.5 U	900 U	420 U	940 U	870 U
Di-n-Butylphthalate	0.8 U	900 U	420 U	940 U	870 U
Fluoranthene	1.8 U	900 U	320 J	940 U	870 U
Pyrene	1.6 U	900 U	370 J	940 U	870 U
Butylbenxylphthalate	2.0 U	900 U	740 M	940 U	870 U
3,3'-Dichlorobenzidine	0.8 U	4500 U	2100 U	4700 U	4400 U
Benzo(a)Anthracene	1.3 U	900 U	200 M	940 U	870 U
bis(2-Ethylhexyl)Phthalate	2.2	4400	4000	5000	540 J
Chrysene	0.3 U	900 U	200 M	940 U	870 U
Di-n-Octyl Phthalate	1.6 U	900 U	160 J	370 M	870 U
Benzo(b)Fluoranthene	0.5 U	900 U	430 M	940 U	870 U
Benzo(k)Fluoranthene	2.1 U	900 U	430 M	940 U	870 U
Benzo(a)Pyrene	0.2 U	900 U	420 U	940 U	870 U
Indeno(1,2,3-cd)Pyrene	0.9 U	900 U	420 U	940 U	870 U
Dibenz(a,h)Anthracene	1.0 U	900 U	420 U	940 U	870 U
Benzo(ghi)Perylene	0.9 U	900 U	420 U	940 U	870 U

U Indicates compound was analyzed for, but not detected at the given detection limit.

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

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

M Indicates an estimated value of analyte found and confirmed by analyst, but with low spectral match parameters

Appendix 1b. Results of VOA priority pollutant scan: Bremerton Class II Inspection, January 25-27, 1988.

VOA Compound	Effluent (ug/l)	Sediments East Outfall (ug/kg)	West Outfall (ug/kg)	Field Control (ug/kg)
Chloromethane	10 U	25 U	31 U	25 U
Bromomethane	10 U	25 U	31 U	25 U
Vinyl Chloride	10 U	25 U	31 U	25 U
Chloroethane	10 U	25 U	31 U	25 U
Methylene Chloride	5 B	26 B	37 B	49 B
Acetone	11 B	25 U	31 U	25 U
Carbon Disulfide	5 U	13 U	15 U	12 U
1,1-Dichloroethene	5 U	13 U	15 U	12 U
1,1-Dichloroethane	5 U	13 U	15 U	12 U
Trans-1,2-Dichloroethene	5 U	13 U	15 U	12 U
Cis-1,2-Dichloroethene	5 U	25 U	31 U	25 U
Chloroform	3 J	13 U	15 U	12 U
1,2-Dichloroethane	10 U	13 U	15 U	12 U
2-Butanone	5 U	25 U	31 U	25 U
1,1,1-Trichloroethane	5 U	12 U	15 U	12 U
Carbon Tetrachloride	10 U	12 U	15 U	12 U
Vinyl Acetate	5 U	25 U	31 U	25 U
Bromodichloromethane	5 U	13 U	15 U	12 U
1,2-Dichloropropane	5 U	13 U	15 U	12 U
Trans-1,3-Dichloropropene	5 U	13 U	15 U	12 U
Trichloroethene	5 U	13 U	15 U	12 U
Dibromochloromethane	5 U	13 U	15 U	12 U
1,1,2-Trichloroethane	5 U	13 U	15 U	12 U
Benzene	5 U	13 U	2 M	1 M
cis-1,3-Dichloropropene	10 U	13 U	15 U	12 U
2-Chloroethylvinylether	5 U	25 U	31 U	25 U
Bromoform	10 U	13 U	15 U	12 U
4-Methyl-2-Pentanone	10 U	25 U	31 U	25 U
2-Hexanone	5 U	25 U	31 U	25 U
Tetrachloroethene	5 U	13 U	15 U	12 U
1,1,2,2-Tetrachloroethane	5 U	25 U	31 U	25 U
Toluene	5 U	13 U	3 J	2 U
Chlorobenzene	5 U	13 U	15 U	12 U
Ethylbenzene	5 U	13 U	2 J	2 J
Styrene	5 U	13 U	15 U	12 U
Total Xylenes	5 U	13 U	8 J	5 J

U Indicates compound was analyzed for, but not detected at the given detection limit.

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

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

M Indicates an estimated value of analyte found and confirmed by analyst, but with low spectral match parameters.

Appendix Ic. Results of Pest/PCB and Metal Priority Pollutant Scan: Bremerton Class II Inspection, January 25-27, 1988.

			Sediments		
Pest/PCB Compound	Effluent (ug/L)	Sludge (ug/kg)	East Outfall (ug/kg)	West Outfall (ug/kg)	Field Control (ug/kg)
Alpha-BHC	0.2 U	25 U	10 U	10 U	25 U
Beta-BHC	0.2 U	25 U	10 U	10 U	25 U
Delta-BHC	0.2 U	25 U	10 U	10 U	25 U
Gamma-BHC (Lindane)	0.2 U	25 U	10 U	10 U	25 U
Heptachlor	0.2 U	25 U	10 U	10 U	25 U
Aldrin	0.2 U	25 U	10 U	10 U	25 U
Heptachlor Epoxide	0.2 U	25 U	10 U	10 U	25 U
Endosulfan I	0.2 U	25 U	10 U	10 U	25 U
Dieldrin	0.4 U	50 U	20 U	20 U	50 U
4,4'-DDE	0.4 U	50 U	20 U	20 U	50 U
Endrin	0.4 U	50 U	20 U	20 U	50 U
Endosulfan II	0.4 U	50 U	20 U	20 U	50 U
4,4'-DDD	0.4 U	50 U	20 U	20 U	50 U
Endosulfan Sulfate	0.4 U	50 U	20 U	20 U	50 U
4,4'-DDT	0.4 U	50 U	20 U	20 U	50 U
Methoxychlor	0.4 U	50 U	20 U	20 U	50 U
Endrin Ketone	0.4 U	50 U	20 U	20 U	50 U
Chlordane	0.8 U	100 U	40 U	40 U	100 U
Toxaphene	40.0 U	5000 U	2000 U	2000 U	5000 U
Aroclor-1016	4.0 U	50 U	150 U	150 U	400 U
Aroclor-1242	4.0 U	50 U	150 U	150 U	400 U
Aroclor-1248	4.0 U	50 U	150 U	150 U	400 U
Aroclor-1254	4.0 U	50 U	115 J	110 J	400 U
Aroclor-1260	4.0 U	50 U	150 U	150 U	400 U

			Sediments		
Metal	Effluent (ug/L)	Sludge (mg/kg)	East Outfall (mg/kg)	West Outfall (mg/kg)	Field Control (mg/kg)
Arsenic	1 U	0.9	9.8	10.6	13.6
Thallium	1 U	0.007	0.3	0.3	0.3
Silver	50.2	5.2	1.6	2.7	2.3
Antimony	10 U	0.4	1 U	1 U	1 U
Selenium	1 U	0.8	0.9	0.5	0.6
Mercury	1.06	0.029	0.427	0.392	0.374
Beryllium	1 U	0.4	0.6	0.6	0.6
Cadmium	5 U	8.6	1.1	1.3	0.5 U
Chromium	78	80.5	136	78.8	61
Copper	195	930	218	208	140
Lead	8	216	137	121	89
Nickel	98	72	61.2	46.9	43
Zinc	265	1170	273	225	160
Cyanide		1.0	0.43	0.23 U	0.27

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J Indicates an estimated value when result is less than specified detection limit.
M Indicates an estimated value of analyte found and confirmed by analyst, but with low spectral match parameters.

Appendix II. Organic analytical methods for Bremerton Class II Inspection - January 25-27, 1988.

Analysis	Method	Method Number	Reference	Laboratory
BNA	GC/MS	625	EPA	ARI, Seattle
VOA	GC/MS	624	EPA	ARI, Seattle
Pest/PCB	GC/ECO	608	EPA	ARI, Seattle

Appendix III. Sediment TOC and Grain Size Analyses: Bremerton Class II Inspection - January 25-27, 1988.

Station	Solids	Gravel (>2mm)	Sand (2mm-62um)	Silt (62um-4um)	Clay (4um)	TOC
Diffuser, East	29.6	3.6	18.8	56.4	17.4	5.6
Diffuser, West	26.0	0.37	9.7	64.0	22.6	4.2
Field Control	29.9	0.00	8.8	67.9	19.0	3.6

All units are percent. TOC is percent dry weight.