A Department of Ecology Report

Ocean Spray Cranberries Wastewater Treatment Plant Class II Inspection

Abstract

The Washington State Department of Ecology (Ecology) conducted a Class II inspection at the Ocean Spray Cranberries' wastewater treatment plant in Markham, Washington, on February 1-2, 1993. Effluent from outfall 001 met permit requirements for flow, pH, total residual chlorine, fecal coliform, total suspended solids (TSS), and 5-day biochemical oxygen demand (BOD_5). Effluent from outfall 002 met permit requirements except for pH. Split sample analyses revealed disparities in effluent BOD_5 measurements. In addition, the permittee's influent sampler collected a weaker sample than the Ecology sampler. The low fecal coliform counts and occasional high total residual chlorine levels in effluent suggested over-chlorination. The discharger's influent and effluent composite sample temperatures were higher than the recommended 4°C. Other minor recommendations are included in this report.

Introduction

The Washington State Department of Ecology (Ecology) conducted a Class II inspection at the Ocean Spray Cranberries' (OS) wastewater treatment plant (WWTP) in Markham, Washington, on February 1-2, 1993. Ocean Spray Cranberries is located on the Johns River near Grays Harbor (Figure 1). Tapas Das and Rebecca Inman of the Watershed Assessments Section of the Environmental Investigations and Laboratory Services (EILS) Program conducted the inspection. Raymond Gueffroy, WWTP operator, and Glen Piehl, environmental engineer, provided assistance during the inspection.

Ocean Spray owns and operates a fruit processing plant that produces fruit juices, cranberry sauce, and jelly. Employment is about 350 people during the busy season and 150 people during the off season. Primary sources of wastewater to the facility are:

- process, consisting of cranberry cleaning, juice preparation/refrigeration, boiler washdown, equipment washdown, and general cleanup;
- sanitary;
- storm runoff; and
- non-contact cooling water (continuously chlorinated as fresh water is added to the cooler).

Figure 2 is a schematic diagram of the WWTP at the time of inspection. It consists of a rotary screen, 60° V-notch weir, aerated lagoon, clarifier, chlorination, dechlorination with SO_2, sludge return, and sludge press. Influent flow to the WWTP is intermittent and the quality of wastewater varies depending on the fruit plant processes. Influent flows over the V-notch weir, into the wet well

by Tapas Das
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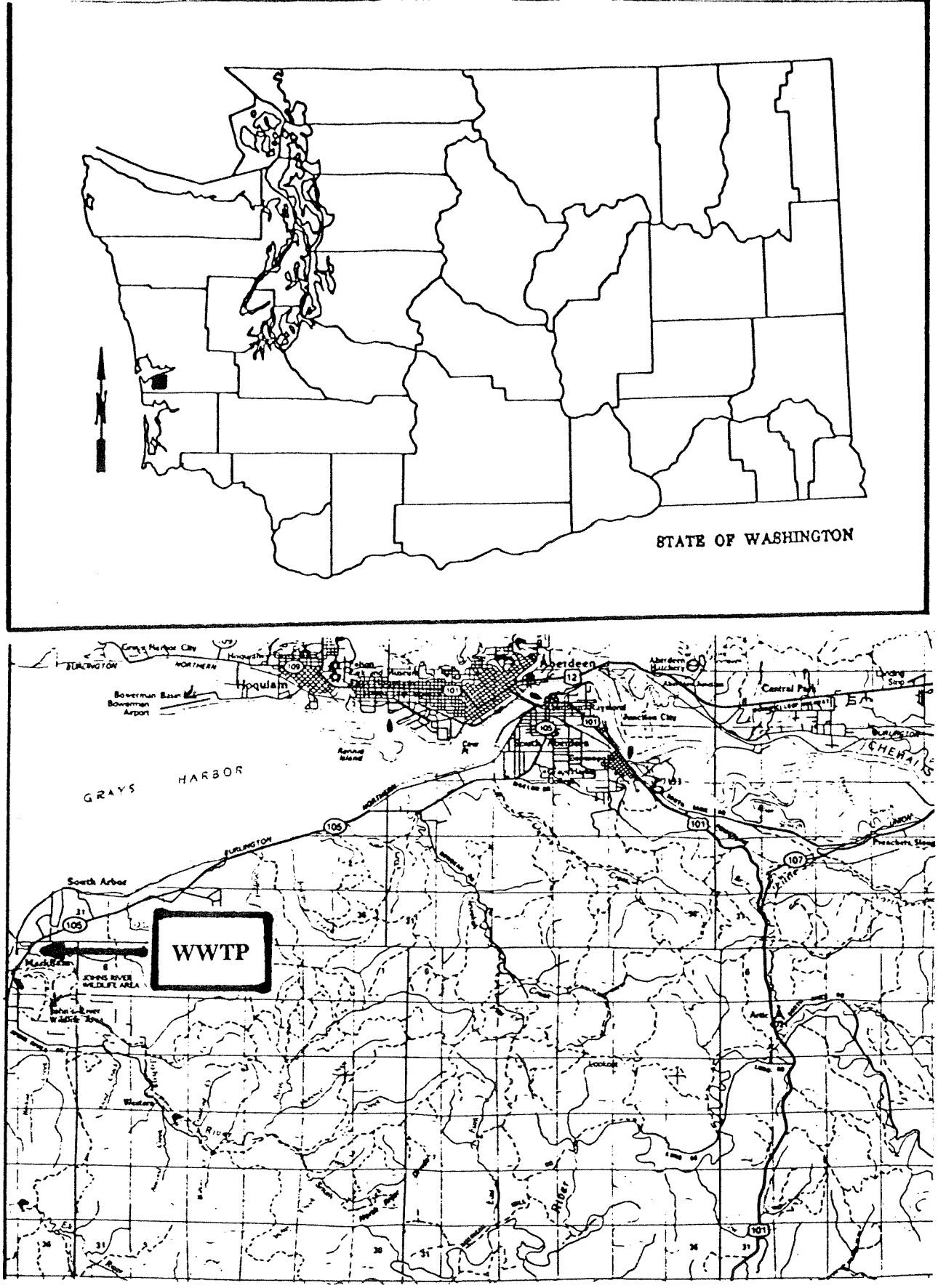

Figure 1. Location Map - Ocean Spray Cranberries Class II Inspection, 2/93

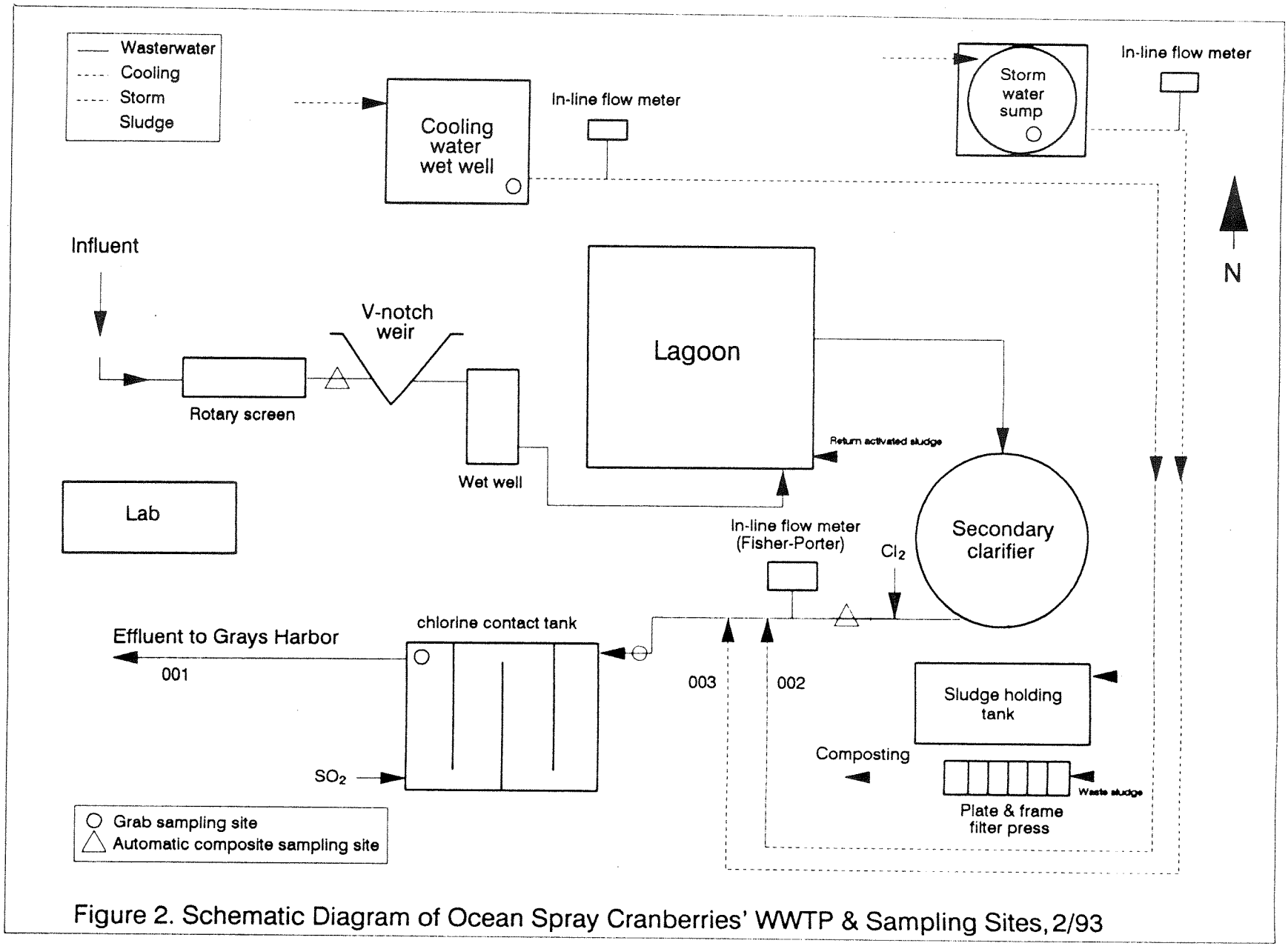

Figure 2. Schematic Diagram of Ocean Spray Cranberries' WWTP & Sampling Sites, 2/93

and then feeds by gravity to the lagoon. Sanitary wastewater goes to a septic tank first (not shown in Figure 2), where solids are separated. Effluent from the septic tank is chlorinated and then goes to the lagoon (Piehl, 1994).

The lagoon is divided into four compartments by hydraulic curtains in order to minimize short-circuiting. Influent is fed to the southeasterly compartment of the lagoon, which has two aerators. The other three compartments have one aerator each. The lagoon capacity is 2.5 million gallons. Effluent from the lagoon passes to a secondary clarifier. Return activated sludge from the sludge holding tank (adjacent to the clarifier) goes to the lagoon. The waste sludge goes to a sludge press where dewatering increases solids content from 4 percent to 18 percent. Dewatered sludge is disposed of to a composting site. There is no digester at the plant.

Cooling water and storm water are combined with chlorinated clarifier effluent and routed to the chlorine contact chamber. Sulfur dioxide is used for dechlorination. Cl_2 and SO_2 are continuously injected in the effluent stream at a constant rate. Dechlorinated wastewater is discharged through a 12" outfall pipe to a diffuser located about 1,000 feet offshore in Grays Harbor. Ocean Spray Cranberries is authorized to discharge under National Pollutant Discharge Elimination System (NPDES) Permit No. WA-000327-1, which will expire on October 31, 1995.

Objectives

- verify compliance with NPDES permit parameters
- characterize WWTP influent and effluent
- verify flow meter accuracy
- evaluate efficiency of the dechlorination system
- assess permittee's sampling and testing procedures using splits

Procedures

Composite sampling equipment was cleaned before use by washing with non-phosphate detergent and rinsing with tap water. Collection equipment was air-dried and then wrapped in aluminum foil until used.

Sampling sites are shown in Figure 2. Grab and 24-hour composite samples of effluent were collected. A composite sample of influent was also collected upstream of the weir. Ecology's ISCO® automatic sampler collected an aliquot (220 mL) every 30 minutes for 24 hours. Ecology's influent and effluent composite samplers were installed at approximately the same locations as the permittee's samplers. The permittee's samplers were also set for time proportional sampling, but took about 400 mL of sample every 1 hour. During each day of sampling, one set of grab samples was collected at post-chlorination, post-dechlorination, cooling water outfall 002, and storm water outfall 003 (Figure 2). A replicate grab sample was also collected at post-dechlorination (labelled - T) to evaluate sampling and analytical variability.

Data Quality Assurance

A summary of the analytical methods and laboratories conducting the analyses is given in Table 1. Data quality and quality of the reporting were assured through careful attention to representativeness of samples collected, as well as accuracy (precision and bias), completeness, and comparability of

Table 1. Analytical Methods and Laboratories - Ocean Spray Cranberries WWTP, 2/93

Parameter	Method	Lab Used
Turbidity	EPA, 1983: 180.1	Ecology; Manchester, WA
Conductivity	EPA, 1983: 120.1	Ecology; Manchester, WA
Alkalinity	EPA, 1983: 310.1	Ecology; Manchester, WA
SOLIDS4		
TS	EPA, 1983: 160.3	Ecology; Manchester, WA
TNVS	EPA, 1983: 160.4	Ecology; Manchester, WA
TSS	EPA, 1983: 160.2	Ecology; Manchester, WA
TNVSS	EPA, 1983: 160.4	Ecology; Manchester, WA
BOD5	EPA, 1983: 405.1	Ecology; Manchester, WA
TOC	EPA, 1983: 415.2	Ecology; Manchester, WA
NUTRIENTS		
NH3-N	EPA, 1983: 350.1	Ecology; Manchester, WA
NO2+NO3-N	EPA, 1983: 353.2	Ecology; Manchester, WA
T-phosphorus	EPA, 1983: 365.1	Ecology; Manchester, WA
Fecal coliform (MF)	APHA, 1989: 9222D	Ecology; Manchester, WA
Oil and grease	EPA, 1983: 413.1	Ecology; Manchester, WA

data such that the stated objectives of the inspection were met. Recommended holding times were met for all analyses performed. Two BOD_5 results (lab ID#: 068235 and -36) reported by Ecology's Manchester lab were flagged with the qualifier "greater than" (an incorrect dilution of the sample may have necessitated this qualifier) (Lacroix, 1994).

Influent and effluent composite samples were split for comparative analyses. Composite samples were split two ways (*i.e.*, both Ecology's and the permittee's samples were analyzed at both laboratories). Under proper circumstances, these two splits can produce revealing information about both sample representativeness and laboratory analytical techniques. Results from samples collected by two different compositors (Ecology and the permittee) but analyzed at the same lab (e.g., Ecology) help address the issue of sample representativeness. Results from samples collected by the same compositor (e.g., Ecology) but analyzed at two different labs (Ecology and the permittee) help address the issue of lab performance.

Results and Discussion

Measurements taken of the critical dimensions of the weir showed it was correctly installed. Flow from the secondary clarifier is monitored by an in-line device whose accuracy could not be verified. The plant's totalizer readings for a 24-hour time period (beginning at 0845 on February 1, 1993) indicated a flow of 0.37 MGD; this flow was used to calculate loadings for permit parameters for outfall 001. A Rockwell® turbine flow meter is installed in the cooling water line for monitoring flow. The accuracy of this device could not be verified either. The cooling water flow rate was about 0.126 MGD.

General chemistry results are presented in Table 2. The permittee's effluent composite results should be interpreted with caution since composite sample temperatures exceeded 4°C. BOD_5 and TOC data indicated that the plant was receiving the equivalent of a high-strength domestic influent (Metcalf and Eddy, 1991). Percent removal for BOD_5 was greater than 95%, while for TSS it was 85%. As can be expected for an industrial influent of this type, the ammonia-nitrogen concentration was low (0.35 mg/L). The ammonia concentration was even less in effluent (0.14 mg/L) suggesting some nitrification was taking place. This was substantiated by the nitrate-nitrite concentration in effluent (4.49 mg/L) being higher than influent (0.49 mg/L). Some phosphorus was removed (35%) by the plant. The Ecology replicate sample results agreed well, and did not indicate any problem in the areas of sample representativeness and lab analytical variability.

A comparison of effluent parameters to NPDES permit limits is presented in Table 3. Treated wastewater discharge to Grays Harbor (outfall 001) met daily maximum permit requirements for flow, pH, total residual chlorine, fecal coliform, BOD_5, and TSS. If TSS loading remained at this level, then the projected annual average loading (44,000 lbs) would exceed the permit limit. The flow of 0.37 MGD through outfall 001 approached the daily maximum limit of 0.41 MGD. The cooling water discharge to the chlorine contact chamber (outfall 002) met permit requirements for oil and grease, but pH on one occasion (8.6 S.U.) exceeded the permit limit. The cooling water had relatively high levels of BOD_5, indicating possible contamination with process wastewater.

Table 4 shows percent removal of free and total residual chlorine by the dechlorination process. Fecal coliform counts were below detection limits on three counts at post-chlorination and post-dechlorination, suggesting adequate chlorine dosage and contact time. In fact, the low fecal coliform counts and considerable levels of total residual chlorine in effluent suggest over-chlorination.

Table 2. General Chemistry Results - Ocean Spray Cranberries Class II Inspection, 2/93
(Permittee's Composite Results Should be Interpreted with Caution since Sample Temperatures Exceeded 4°C)

Station:	Eff-PC	Eff-PDC	Eff-T	Cooling	Inf-E	Inf-OS	Eff-E	Eff-OS	Eff-PC	Eff-PDC	Cooling
Type:	grab	grab	grab	grab	comp	comp	comp	comp	grab	grab	grab
Date:	2/1	2/1	2/1	2/1	2/1-2	2/1-2	2/1-2	2/1-2	2/2	2/2	2/2
Time:	1005	1015	1025	1100	0900-0900	0900-0900	0845-0845	0800-0800	1055	1100	1120
Parameter Lab ID#0682:	-30	-31	-32	-33	-35	-36	-37	-38	-39	-40	-41
Turbidity (NTU)		13	13	0.2	49		14	14		15	3.3
Conductivity (µmho/cm)		231	231	179	253		221	221		215	191
Alkalinity (mg/L)		44.4	44.6	70.6	64.1		53.4	53.6		46.6	74.8
TS (mg/L)					1130		182	181			
TNVS (mg/L)					286		110	108			
TSS (mg/L)		29	31	<1	246	132	39	40		40	1
TNVSS (mg/L)					160		16	17			
BOD5 (mg/L)		11	12	28	>567	>560	27	26		11	33
TOC (mg/L)		19.1	20.4		572		19.3	21.7		21.4	
NH3-N (mg/L)		0.13	0.13		0.35		0.14	0.12		0.07	
NO2+NO3-N (mg/L)		6.28	6.0		0.49		4.49	4.4		3.32	
Total Phosphorus (mg/L)		1.51	1.58		4.19		2.72	2.84		3.87	
Oil & Grease (mg/L)		<1	1.0	<1						<1	<1
F-Coliform MF (#/100 mL)	<1	<1	<1						3	<1	
FIELD OBSERVATIONS											
Flow (MGD)							0.37+				
Temperature (°C)	9.3	9.4	9.2	25.9	3.7*	15.2*	2.1*	6.2*	10.4	20.5	32.8
pH (SU)	7.2	7.5	7.1	8.4	--	--	--	--	7.0	7.1	8.6
Conductivity (µmho/cm)	197	200	225	177	240	240	220	210	210	195	195
Chlorine											
Free (mg/L)	0.40	0.10	0.20	0.45					0.10	0.02	0.25
Total (mg/L)	0.65	0.25	0.30	0.80					1.50	0.05	0.25

Eff - Effluent, Inf - Influent (beverage processed wastewater), E - Ecology sample, OS - Ocean Spray sample, T - Ecology replicate sample of 068231
PC - Postchlorination, PDC - Postdechlorination

\+ Flow (at outfall 001) was obtained from plant's totalizer for a 24-hour time period.

* Iced composite sample.

Table 3. Comparison of Inspection Results to NPDES Permit Limits - Ocean Spray Cranberries Class II Inspection, 2/93

OUTFALL 001 - COMBINED PROCESS AND SANITARY WASTEWATER DISCHARGE TO CHLORINE CONTACT CHAMBER

	NPDES Permit Limits			Inspection Data & Derived Loadings		
Effluent Parameter	Daily Maximum* (lbs/day)	Daily Average** (lbs/day)	Annual Average (lbs/year)	Ecology Composite (mg/L)	Grab Samples (mg/L)	Derived Loading (lbs/day)
BOD5	1,028	610	72,975	27	11;11	83
TSS	1,055	738	42,191	39	29;40	120
Total Residual Chlorine	1.0	0.5	---		0.25;0.05	0.77;0.15
pH (S.U.)	6.5 pH 8.5		---		7.5;7.1	
Flow (MGD)	0.41	0.255	N/A	0.37		
	Monthly Average**	Weekly Average**				
F-Coliform (#/100 mL)	200	400			<1;<1	

OUTFALL 002 - COOLING WATER DISCHARGE TO CHLORINE CONTACT CHAMBER

	NPDES Permit Limits		Inspection Data	
Effluent Parameter	Daily Maximum*	Daily Average**	Grab Sample	
Oil & Grease (mg/L)	15	10	<1;<1	
pH (S.U.)	6.5 pH 8.5		8.4;8.6	
Flow	NA	NA		0.126 MGD

* The daily maximum is a maximum allowable value for any one day.

** The monthly, weekly, or daily averages for all parameters, except fecal coliform, are based on the arithmetic mean of all values obtained during the specified period. The average for fecal coliform is the geometric mean of all values obtained during the specified period.

Table 4. Efficiency Evaluation of Disinfection & Dechlorination Processes - Ocean Spray Cranberries Class II Inspection, 2/93

	Inspection Data & Derived Result					
Station:	PC	PDC		PC	PDC	
Lab ID#0682:	-30	-31	Percent	-39	-40	Percent
Date:	2/1	2/1	Removal	2/2	2/2	Removal
Parameter						
Free Chlorine (mg/L)	0.40	0.10	75	0.10	0.02	80
Total Residual Chlorine (mg/L)	0.65	0.25	62	1.50	0.05	97
Fecal Coliform (#/100 mL)	<1	<1	--	3	<1	--

PC - Postchlorination.

PDC - Postdechlorination.

Percent removals of total residual chlorine by the sulfur dioxide dechlorination process were 62 and 97, respectively. These data indicate that the dechlorination process is somewhat efficient (Metcalf and Eddy, 1991). However, more field testing may prove useful to avoid excessive Cl_2/SO_2 dosages.

Table 5 compares results of analyses performed by Ocean Spray Cranberries and Ecology on splits of the same samples. Effluent TSS results showed very good agreement and did not indicate any obvious problem in sampling or lab technique. However, effluent BOD_5 results from the permittee's laboratory were about 46-48% lower than Ecology's lab data. These results suggest that the permittee's BOD_5 lab protocol should be examined. Influent TSS and BOD_5 results suggest that the permittee's sampler collected a weaker sample than the Ecology sampler. The permittee's samplers took 400 mL of sample every 60 minutes, whereas Ecology took 220 mL every 30 minutes; this may have contributed to the differences. In addition, the permittee's influent composite sample temperature of 15.2°C was much higher than the recommended 4°C (APHA, 1989); this too may explain the sampler discrepancies.

Conclusions and Recommendations

- At the time of inspection, the plant met outfall 001 effluent permit limitations for flow, BOD_5, TSS, pH, fecal coliform, and total residual chlorine. Flow from the plant approached the daily maximum limit. The cooling water discharge to the chlorine contact chamber (outfall 002) met permit requirements for oil and grease, but a pH of 8.6 S.U. was higher than the permit limit of 8.5. The cooling water had relatively high levels of BOD_5, indicating possible contamination with process wastewater.

- Low fecal coliform counts indicated that the chlorination process was efficient. Percent removal of total residual chlorine by sulfur dioxide indicated that the dechlorination process was somewhat effective. However, low fecal counts and considerable levels of total residual chlorine in effluent indicated over-chlorination. More field testing may prove useful to determine optimum Cl_2/SO_2 dosages.

- Both Ecology's and the permittee's effluent TSS results showed very good agreement and did not indicate any obvious problem in sampling or lab technique. However, the permittee's effluent BOD_5 results were nearly 50% lower than Ecology's results. The permittee's BOD_5 protocol should be examined. Influent TSS and BOD_5 results revealed a disparity in sample representativeness.

- The permittee's influent and effluent composite sample temperatures were higher than the recommended 4°C. The plant's sample coolers should be inspected and repaired as necessary to provide adequate sample cooling. Until this correction is made, the permittee's influent and effluent results should be used with caution.

Table 5. Comparison of Laboratory Results of Sample Splits - Ocean Spray Cranberries Class II Inspection, 2/93

Station ID:	Inf-E		Inf-OS		Eff-E		Eff-OS	
Lab ID#:	068235		068236		068237		068238	
Date:	2/1-2		2/1-2		2/1-2		2/1-2	
Sampler:	Ecology		Ocean Spray		Ecology		Ocean Spray	
Laboratory:	Ecology	OS	Ecology	OS	Ecology	OS	Ecology	OS
BOD5 (mg/L)	>567	995	>560	830	27	14	26	14
TSS (mg/L)	246	272	132	179	39	32	40	38

E - Ecology, OS - Ocean Spray Cranberries, Inf - Influent, Eff - Effluent

References

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Contacts

Norm Glenn Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
(206) 407-6683

Will Kendra Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
(206) 407-6698

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