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McCLEARY WASTEWATER TREATMENT PLANT
CLASS II INSPECTION

by

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ABSTRACT

A Class II inspection was conducted at the McCleary Wastewater Treatment Plant on August 26-27, 1986. The plant was operating very well and experienced no NPDES permit violations. Effluent quality was exceptional, and improvement due to plant upgrade in 1982 was dramatic. Several minor recommendations concerning lab technique and sampling were noted. An experiment to determine possible adverse effects of the dechlorination system is suggested.

INTRODUCTION

A Class II inspection was conducted at the McCleary Wastewater Treatment Plant on August 26 and 27, 1986, at the request of Darrel Anderson of Ecology's Southwest Regional Office (SWRO). Conducting the survey was Don Reif, WQIS, with assistance from Nancy Kmet, SWRO, and McCleary's head operator, Jim Wright.

This survey represents the first Class II inspection since the plant upgrade was completed in 1982. Objectives included:

1. Sample collection and analysis to estimate plant loadings and treatment efficiency.

2. Determine NPDES permit compliance.

3. Perform a laboratory review, including sample splits, for accuracy and adherence to accepted techniques.

4. Estimate treatment improvements since plant upgrade.

A receiving water study was conducted on Wildcat Creek at the same time, and is documented in a separate report (Kendra, 1987).

SITE LOCATION AND DESCRIPTION

The town of McCleary has operated a trickling filter/anaerobic digestion wastewater treatment plant since 1952. Figure 1 shows the plant location. The receiving stream, Wildcat Creek, has a history of water quality problems (Devitt, 1973). Wastewater effluent was found to cause violation of state water quality standards for dissolved oxygen, ammonia, fecal coliform bacteria, chlorine residual, and aesthetic values (Kendra, 1987). These adverse effects were enhanced by the very low dilution in Wildcat Creek. To protect water quality and aquatic life in Wildcat Creek, the facility was upgraded in 1982.

The upgrade to "advanced" secondary treatment added several new features to the McCleary plant (Figure 2). A trickling filter tower with plastic media (biotower) and final clarifier were added to enhance effluent quality and treatment stability. Also, a fine-mesh rotating screen at the headworks removes inorganic materials that could plug

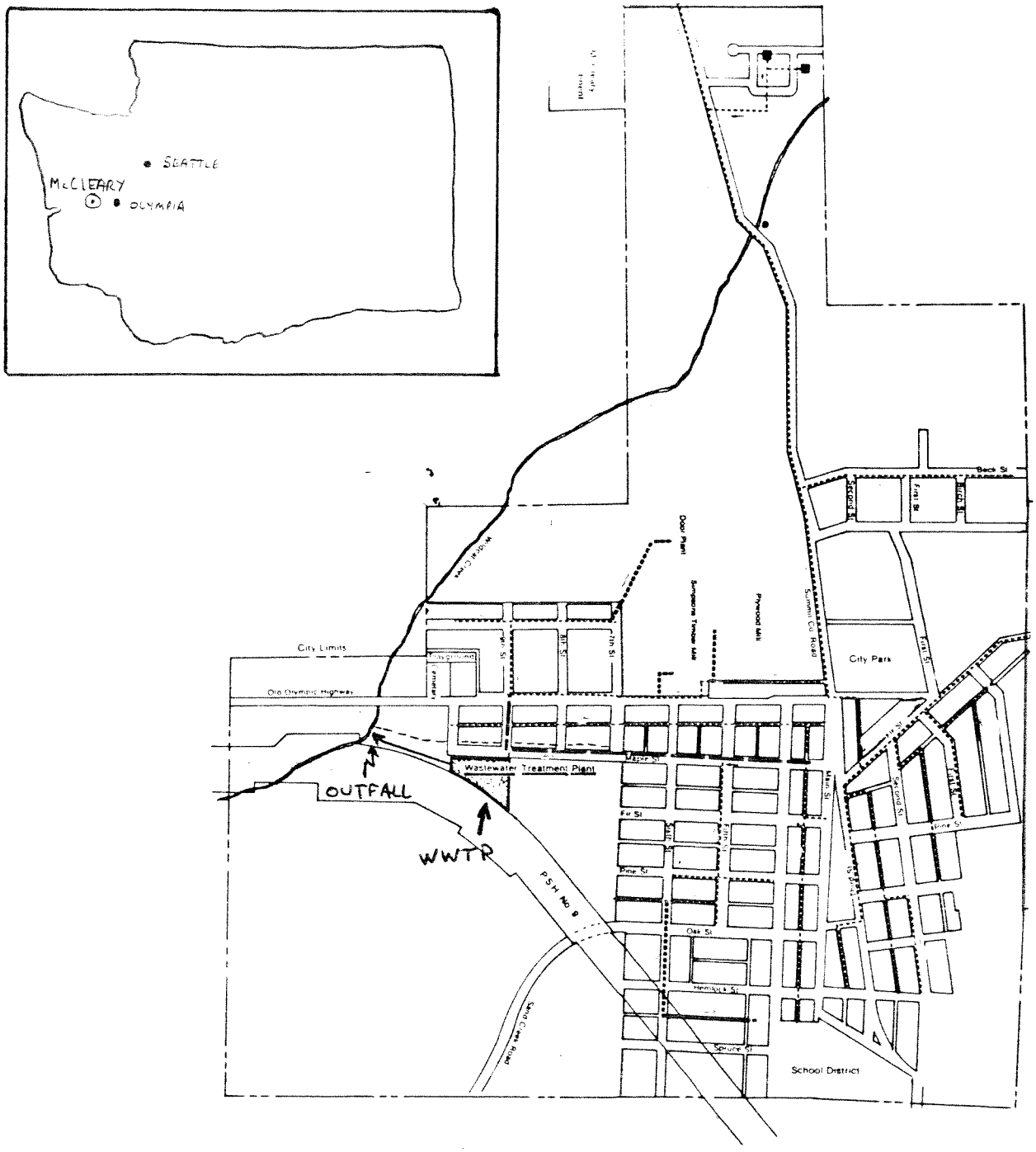

Figure 1.

Site location: McCleary Wastewater Treatment Plant, August 1986.

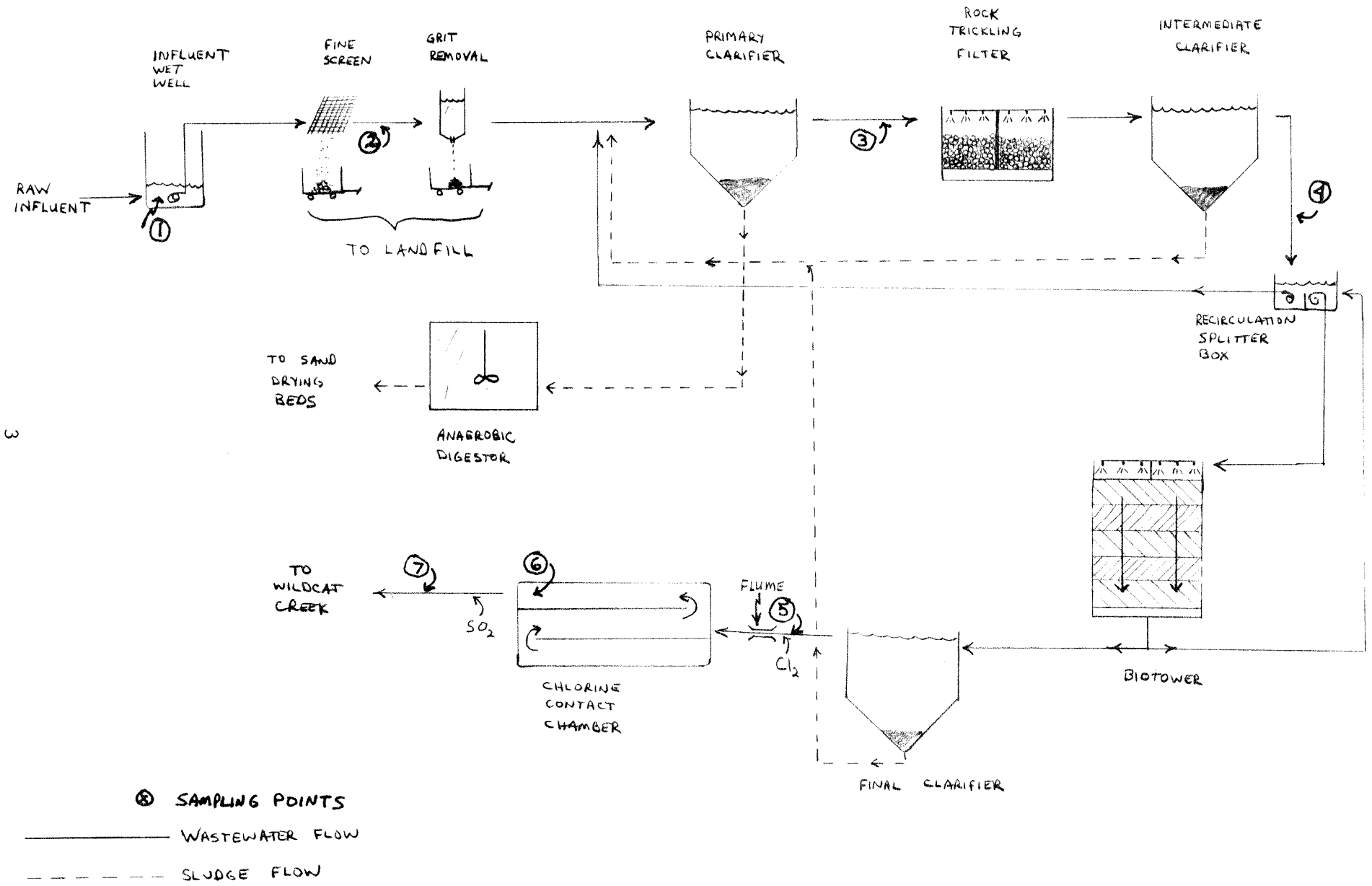

FIGURE 2. FLOW SCHEMATIC : McCLEARY WTP, AUGUST 1986.

the trickling filters. Finally, plant effluent is dechlorinated with sulfur dioxide.

METHODS

Table 1 lists the sampling schedule for the McCleary survey.

Twenty-four hour composite samples were collected at the raw influent wet well and final effluent, prior to chlorination. Approximately 200 mL were collected at 30-minute intervals. McCleary's operators collected composite samples at the same locations. Both sets of composites were split between Ecology's and McCleary's labs for analysis and comparison.

Grab samples were collected by Ecology at several intermediate stations throughout the plant (Figure 2). Besides raw influent, samples were collected from: primary influent, after the fine screen; primary effluent; intermediate clarifier effluent, after the rock trickling filter; secondary clarifier effluent, before chlorination; chlorinated effluent, after the chlorine contact chamber; and dechlorinated final effluent.

RESULTS AND DISCUSSION

Analytical results of the McCleary inspection are listed in Table 2.

Flow

Effluent flow is measured through a six-inch Parshall flume prior to the chlorine contact basin. The meter is calibrated every six months by a qualified technician.

Average plant flow rate is limited to 0.25 MGD by permit, although this figure is occasionally exceeded in wet weather. Typical dry weather flows range from 0.20 to 0.25 MGD. During rainy weather the flow can be as high as 0.45 MGD. The 24-hour flow during the inspection, from the plant's meter, was 0.20 MGD. This number is used in all calculations.

General Conditions

The McCleary wastewater plant was operating very well at the time of the inspection. Overall, the treatment process reduced pollutant levels as follows: BOD, 96 percent; COD, 86 percent; TSS, 88 percent; and ammonia-nitrogen, 99+ percent. This level of performance is outstanding for secondary treatment plants, and indicates a sound design as well as conscientious operation and maintenance.

At McCleary, anaerobically digested sludge is dewatered on sand drying beds. Farmers and local residents used the dried sludge for fertilizer

Table 1. Sampling schedule - McCleary Class II Inspection, August 1986.

Sample	Sampler	Laboratory	Date	Time	Field Analysis: Temp.	pH	Cond.	D.O.	Chl. Resid.	Laboratory Analysis: pH	Turb.	Cond.	Alk.	T. Hard	Sulfate	Solids (4)	TSS	$NO_2 + NO_3$	NH_3	Total P.	F.C.	BOD_5	$CBOD_5$	COD
Composite					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Influent (I-C)	Ecology	Ecology	8/26-27	0900-0900	X	X	X			X	X	X	X	X	X	X		X		X		X		X
		McCleary			X	X	X										X					X		
	McCleary	Ecology	8/26-27	0800-0800	X	X	X			X	X	X	X	X	X	X		X		X		X		X
		McCleary			X	X	X										X					X		
Effluent (5-C)	Ecology	Ecology	8/26-27	0930-0900						X	X		X	X	X	X		X		X		X	X	X
		McCleary															X					X		
	McCleary	Ecology	8/26-27	0800-0800						X	X		X	X	X	X		X		X		X		X
		McCleary															X					X		
Grabs																								
Influent			8/26	1045	X	X	X			X	X	X	X	X		X		X	X	X				X
			8/26	1535	X	X	X			X	X	X	X	X		X		X	X	X				X
			8/27	1050	X	X	X			X	X	X	X	X		X		X		X				X
Primary Influent			8/26	1030	X	X	X			X	X	X	X			X		X	X	X				X
			8/26	1530	X	X	X			X	X	X	X			X		X	X	X				X
Primary Effluent			8/26	1030	X	X	X			X	X	X	X			X		X	X	X				X
			8/26	1530	X	X	X			X	X	X	X			X		X	X	X				X
Intermediate Effluent			8/26	1015	X	X	X			X	X	X	X			X		X	X	X				X
			8/26	1520	X	X	X			X	X	X	X			X		X	X	X				X
Secondary Clarifier Effluent			8/26	0950	X	X	X			X	X	X	X	X		X		X	X	X				X
			8/26	1510	X	X	X			X	X	X	X	X		X		X	X	X				X
			8/27	1025	X	X	X			X	X		X	X		X		X		X				X
Chlorinated Effluent			8/26	1430					X												X			
			8/27	1030					X												X			
Final Eff. (after de-chlorination)			8/26	0945	X	X	X	X	X	X	X	X	X			X		X	X	X				X
			8/26	1500	X	X	X			X	X	X	X			X		X	X	X				X
			8/27	1035					X												X			

Table 2. Analytical Results - McCleary Class II Inspection, August 26-27, 1986

Sample	Sampler	Laboratory	Date	Time	Field Analysis* Temperature (°C)	pH (S.U.)	Cond. (umhos/cm)	Dissolved Oxygen	Cl_2 Residual (t)	Laboratory Analysis* pH (S.U.)	Turbidity (NTU)	Cond. (umhos/cm)	Alkalinity	Hardness	Sulfate	Total Solids	TNVS	TSS	TNVSS	$NO_3 + NO_2$-N	NH_3-N	Total Phosphorus	BOD_5	$CBOD_5$	COD	Fecal Coliforms (#/100 mL)
Composites					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Influent	Ecol	Ecol	8/26-27		11.5	8.6	520			8.6	31	438	200	58	18	370	210	80	10	.13		5.8	180		380	
(I-C)	Ecol	McCl	8/26-27															123					165			
	McCl	Ecol	8/26-27		17.5	7.5	540			7.4	28	510	190	64	20	380	210	76	10	.03		4.3	190		320	
	McCl	McCl	8/26-27															134					120			
Effluent	Ecol	Ecol	8/26-27							7.5	4		66	72	28	340	210	9	<1	14		5.5	10	6	52	
(5-C)	Ecol	McCl	8/26-27															11					7.2			
	McCl	Ecol	8/26-27							7.7	9		66	68	27	330	190	10	1	13		5.4	10		59	
	McCl	McCl	8/26-27															14					11			
Ecology Grabs																										
Influent			8/26	1045	20.5	9.2	500			7.7	40	658	210	86		460	250	110	18	2.4	20	3.3			320	
			8/26	1535	19.4	--	440			7.1	23	456	150	74		300	150	240	13	4.0	10	3.3			280	
			8/27	1050	20.3	9.4	470			8.6	26	575	200	80		500	280	120	13	3.0		5.6			380	
Primary			8/26	1030	19.9	8.7	560			8.1	45	650	220			420	220	76	<1	2.9	16	3.3			400	
Influent			8/26	1530	19.2	--	420			7.3	22	454	150			310	160	67	<1	3.0	9.6	8.5			270	
Primary			8/26	1030	19.6	8.1	520			7.6	17	538	180			320	190	38	<1	1.2	15	3.3			180	
Effluent			8/26	1530	20.9	--	480			7.5	20	532	180			350	220	34	<1	.21	16	3.3			210	
Intermediate			8/26	1015	19.5	7.6	480			7.4	6	478	140			220	190	10	<1	2.4	13	4.6			86	
Effluent			8/26	1520	21.3	7.3	530			7.5	7	520	160			310	200	27	<1	3.0	10	4.6			77	
Secondary			8/26	0950	19.4	7.7	440			7.6	5	425	70	78		170	95	11	<1	12	.15	4.6			47	
Clarifier			8/26	1510	21.4	6.7	440			7.4	4	428	57	74		350	230	9	<1	15	.13	4.7			39	
Effluent			8/27	1025	20.4	7.9	420			7.7	5		70	70		330	220	20	2	12		5.3			48	
Chlorinated			8/26	1430					0.5																	4
Effluent			8/27	1030					0.4																	<1
Dechlorinated			8/26	0945	18.9	7.6	430	8.2	<0.1	7.6	5	424	68			410	300	11	<1	12	.20	4.3			43	
Final			8/26	1500	21.2	7.5	460			7.6	4	425	60			470	240	10	<1	14	.16	4.5			43	
Effluent			8/27	1035					<0.1																	16

*Units for all parameters are mg/L unless otherwise noted.

prior to 1980. Since then, the sludge has been stockpiled on site. A suitable use or disposal site needs to be found.

Dechlorination

The dechlorination system was effective during the inspection. No chlorine residual (<0.1 mg/L) was detected in the final effluent. The sulfur dioxide reactions are as follows (WPCF, 1977):

1. with water:
   $SO_2 + H_2O = H_2SO_3$
2. with free chlorine residual:
   $H_2SO_3 + HOCL = H_2SO_4 + HCL$
3. with combined chlorine residual:
   $H_2SO_3 + NH_2CL + H_2O = NH_4HSO_4 + HCL$
4. with oxygen:
   $H_2SO_3 + 0.5O_2 = H_2SO_4$

Equation 1 shows the general reaction when sulfur dioxide mixes in water to form sulfurous acid. The sulfurous acid may then react with free and/or combined chlorine (equations 2 and 3). If excess SO_2 is added, dissolved oxygen will be bound (equation 4).

Dechlorination with sulfur dioxide can therefore have two undesirable side-effects. Effluent pH can be depressed because acid is formed by all of the reactions. Also, effluent dissolved oxygen concentrations may drop if excess SO_2 is added.

Because of the potential for lowered pH and D.O. in the final effluent due to SO_2, a two-day experiment is suggested. Dissolved oxygen, pH, and chlorine residual in the final effluent should be measured at two-hour intervals for 24 hours. This should be done during both high- and low flows, and the results recorded. As flows diminish at night, problems may occur that are not noticeable during the day. If adverse conditions are noted, changes in the manual settings may suffice. Otherwise, it may be necessary to replace the manual control of these systems with flow-paced automatic controls.

Permit Compliance

The inspection data are compared to NPDES permitted conditions in Table 3. All parameters were within permit limits for both monthly and weekly averages during the inspection.

Table 3. Comparison of inspection data to permit parameters - McCleary Class II Inspection, August 1986.

Parameter	Effluent Limitations: Monthly Average	Weekly Average	Inspection Results
BOD_5, mg/L : lb/day	15 : 31	23 : 47	5 : 8.3
SS, mg/L : lb/day	15 : 31	23 : 47	9 : 15
F.C. (#/100 mL)	200	400	16
NH_3-N, mg/L	< 2	--	0.18
D.O., mg/L	> 8	--	8.2
Total Chlorine, mg/L	N.D.	--	<0.1
pH	6.0 - 9.0	--	7.6
Flow, MGD	0.250	--	0.20

N.D. = not detectable

Carbonaceous Biochemical Oxygen Demand

A comparison of BOD_5 to nitrification-inhibited, or carbonaceous BOD_5 ($CBOD_5$), from Table 2 suggests that ammonia may be exerting an oxygen demand on McCleary's BOD results. This nitrogeneous oxygen demand may be from residual effluent ammonia or from ammonium chloride in the dilution water. To document this influence, a series of both BOD_5 and $CBOD_5$ tests should be run in summer and winter. From these results a change from BOD_5 to $CBOD_5$ may be in order.

Laboratory Review

Laboratory techniques and procedures were generally very good. Two recommendations are made. Nutrient and buffer solutions for BOD dilution water should be added just prior to test set-up, rather than several days before. Also, a larger filter apparatus, such as 47mm diameter, may improve ease and reliability of solids determinations. A smaller sample volume must be used with the 24mm diameter Gooch crucible currently used.

Table 4 lists results of split sample comparison between labs. The effluent results compared quite well. Fecal coliform counts varied somewhat, but may have been due to different analytical procedures. The Ecology lab used membrane filtration, while the most-probable-number method was utilized by Grays Harbor County Health Department, for McCleary's sample.

Table 4. Comparison of sample splits - McCleary Class II Inspection, August 1986.

Sample	Sampler	Laboratory	BOD_5 (mg/L)	TSS (mg/L)	Fecal Coliform (#/100 mL)	Dissolved Oxygen (mg/L)
Influent Composite	Ecology	Ecology	180	80		
		McCleary	165	123		
	McCleary	Ecology	190	76		
		McCleary	120	134		
Effluent Composite	Ecology	Ecology	5	9		
		McCleary	7.2	11		
	McCleary	Ecology	10	10		
		McCleary	11	14		
Effluent Grab	Ecology	Ecology			4	8.2
	McCleary	McCleary			49	7.7

McCleary's analysis indicated higher TSS values for both influent samples. Each lab found similar TSS values between composite samples, but McCleary's results were much higher for both samples.

Compositor bottles and sampling lines are currently flushed weekly with water. It is recommended that a chlorine bleach solution be used weekly on influent lines and monthly on effluent lines, or sooner if needed.

Final effluent D.O.s should be measured on-site with the plant's portable D.O. meter. Current practice is to transport a grab sample into the lab and then test the D.O. concentration. On-site measurements may be more accurate.

1973 versus 1986 Inspection Results

Ecology inspection results from 1973 (Devitt, 1973) are compared in Table 5 to the current survey. The comparison is limited by the few data available from the 1973 inspection. Effluent quality was significantly improved for the parameters listed.

Table 5. Comparison of 1986 Class II inspection with limited 1973 inspection - McCleary Wastewater treatment plant.

Effluent Parameter	1973	1986
pH (standard units)	7.6	7.5; 7.6
Conductivity (umhos/cm)	550	425
BOD_5 (mg/L)	31	10
COD^5 (mg/L)	111	59; 52
Total suspended solids (mg/L)	27	9
Fecal coliforms (#/100 mL)	20	16
Percent Removal		
BOD_5	66 percent	94 percent
COD	59 percent	86 percent

SUMMARY AND RECOMMENDATIONS

The McCleary Wastewater Treatment Plant was operating very well at the time of the inspection. Effluent quality was very good, and no NPDES permit parameters were violated. A comparison of 1986 to 1973 inspection data showed many significant increases in effluent quality.

A laboratory review and sample split comparison indicated generally very good laboratory technique. Recommendations concerning lab procedures are as follows:

1. Nutrient and buffer solutions for BOD dilution water should be added just prior to test set-up.

2. A larger filter apparatus may improve ease and reliability of solids determinations.

3. A chlorine bleach solution may be used to clean compositor bottles and sampling lines.

4. Final effluent D.O.s should be measured on-site with the plant's portable D.O. meter.

Because of low dilution ratio, careful control of the chlorination and dechlorination systems is very important. An experiment was suggested in the "dechlorination" section to aid in understanding these systems at McCleary. Based on the results, changes to the manual control systems may be necessary.

A solution should be found to the sludge disposal problem. A beneficial use (fertilizer, soil conditioner, etc.) is preferable to landfill.

A series of $CBOD_5$ tests, perhaps one per month, should be compared to BOD_5 results. Based on the findings, a permit change allowing $CBOD_5$ may be considered.

REFERENCES

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