92-e28

CITY OF MARYSVILLE
CLASS II INSPECTION
JULY 16 - 17, 1990

by
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Environmental Investigations and Laboratory Services Program
Watershed Assessments Section
Olympia, Washington 98504-7710

Water Body No. WA 07-1020
(Segment No. 03-07-10)

ABSTRACT

Ecology conducted a Class II Inspection at the city of Marysville wastewater treatment plant on July 16-17, 1990. Timing of the inspection was prompted by a Notice of Violation issued to the City in February, 1990 for repeated violations of permit conditions. The resultant Consent Order contained revised effluent limits which were to be met by July 15, 1990. The plant was probably violating these limits for BOD_5.

Short-circuiting, limited use of available aerators, and a single inlet in the system were contributing to reduced performance. Very little nitrification was occurring. Effluent ammonia concentrations exceeded freshwater criteria for chronic toxicity. Effluent back-up during high tide likely promotes elevated concentrations of chlorine. Copper and lead exceeded criteria for protection of freshwater and marine life. Arsenic and Aroclor-1254 were present in lagoon sludge in significant concentrations. High chronic toxicity was indicated by the echinoderm bioassay; mild toxicity by several other bioassays.

All three flow measuring devices had deficiencies, and the accuracy of their flow data is open to question. There were a number of problems with their composite samplers, creating the opportunity for collection of unrepresentative samples. A laboratory evaluation found a well run lab with no significant problems. However, the lone plant operator/lab technician appeared to be fully committed with present duties.

INTRODUCTION

Ecology conducted a Class II Inspection at the city of Marysville on July 16-17, 1990. Norm Glenn, Keith Seiders, and Ken Pensula conducted the inspection. Dave Wright, from Ecology's Northwest Regional Office, was also present on both days. Dale Thayer, the city's wastewater treatment plant (WWTP) operator, provided assistance. Figure 1 is an area map showing the location of the Marysville WWTP.

The WWTP consists of two ponds in series for which Ecology issued NPDES Permit No. WA-002249-7 in 1983. The Everett-Marysville urban area has experienced extraordinary growth pressures in recent years, and the DMRs indicate that permit conditions are being violated with increasing regularity. Mass emission limits for BOD and TSS, as well as concentration limits for BOD, are being exceeded. The city has also exceeded its design flow and design BOD loading.

On February 13, 1990, Ecology issued a Notice of Violation No. DE 89-N259 to the city for effluent limit violations. The Order stipulated that the city must have installed aeration capacity by June 15, and that the following effluent limits would take effect on July 15, 1990:

Parameter	**Discharge Limitations Monthly Average**
Biochemical oxygen demand (BOD_5)	30 mg/L (700 lbs/d) or 85% removal minimum, whichever is most stringent
Total Suspended Solids (TSS)	75 mg/L (1750 lbs/d), whichever is most stringent
Fecal coliform bacteria	200 CFU/100 ml
pH	between 6.0 - 9.0

Aerators were installed and operational on or close to the June 15 deadline imposed by the Order. The city believed that the microorganism population would reach a new equilibrium level by the time the effluent limits took effect.

The Order stipulated that the city was to complete a study of the outfall location and an examination of alternative outfall locations by October 1, 1990. They were also required to submit a draft engineering report for the improvement of the WWTP by November 1, 1990.

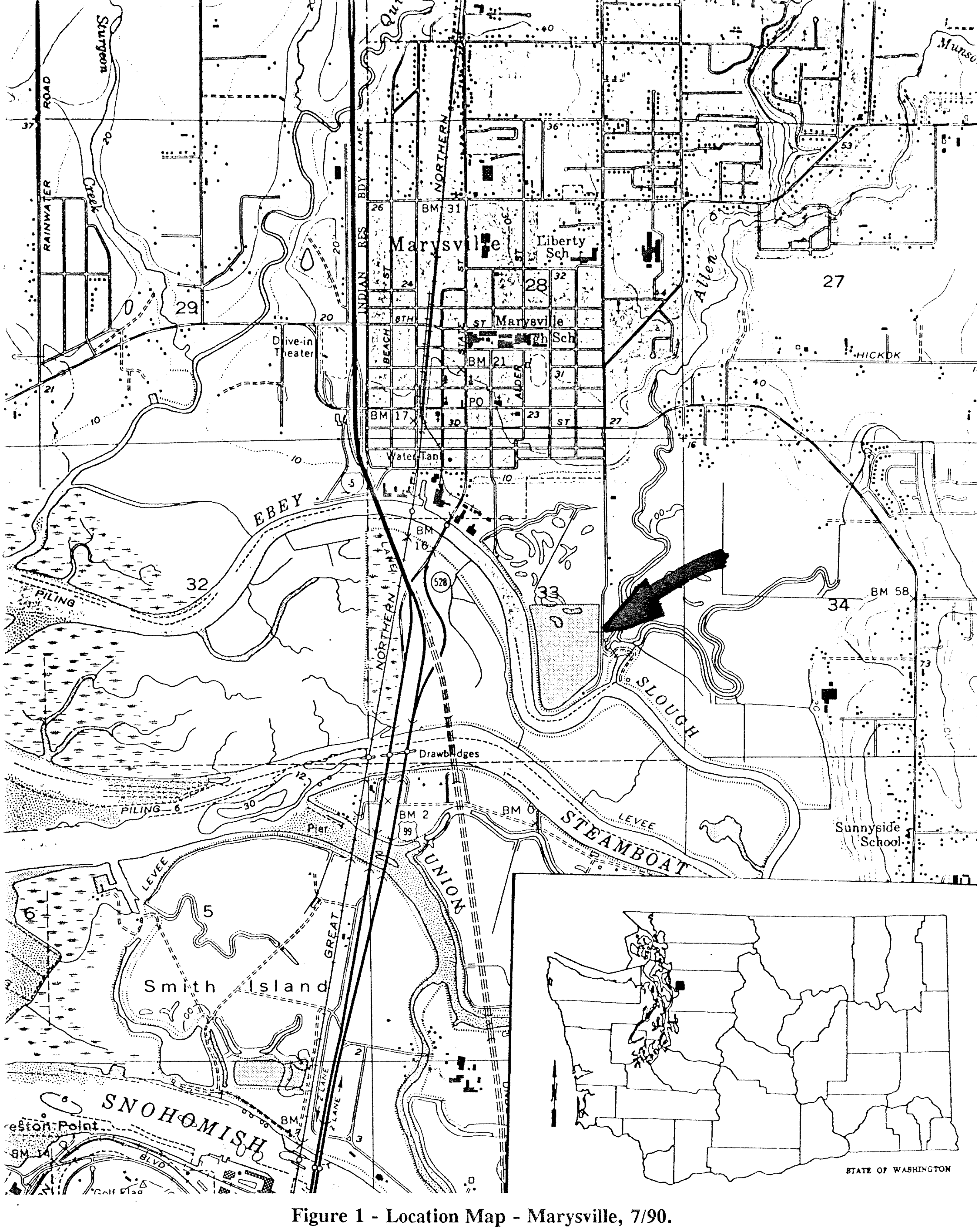

Figure 1 - Location Map - Marysville, 7/90.

Objectives of this survey included the following:

1. Verify compliance with the effluent limits in the Order;

2. Analyze performance of the WWTP by determining loading and efficiency, and whether capacity is still being exceeded;

3. Identify toxic pollutants in influent, effluent, and sludge;

4. Characterize toxicity in the effluent by using bioassays; and

5. Assess the permittee's self-monitoring by reviewing laboratory, sampling, and flow measuring procedures; and by conducting sample splits.

SITE DESCRIPTION

Marysville WWTP consists of two lagoons separated by a berm (Figure 2). As designed, each lagoon was to be separated into two cells by a hydraulic curtain, and flow was supposed to move through the system as shown by the shaded line in Figure 2. However, the curtain that created cells 1 & 2 was swept aside by a storm event several years prior to the inspection (Kissinger, 1990). The lagoons occupy 72 acres and average about five feet in depth.

Ten Oxygon 25 HP aerators were installed in cells 1 & 2 one month prior to the inspection. The aerator shafts are directed into the water at an angle, and act as propellers to direct the wastewater path toward and through cell 2. It is unclear how effective the propellers have been, particularly in the absence of the hydraulic curtain and the presence of prevailing southwesterly winds. Three aerators have been operating in cell 3 for some time prior to the Order. None of the aerators is on a timer - they operate at the discretion of the operator.

There are two influent lines, an eastside and a westside line. Wastes collected from the eastern portion of the city arrive by gravity flow at a pump station/wet well in the northeast corner of the lagoon system. The wastes then travel through a second manhole, a flume and a sampling station before entering the lagoon system (Figure 2). The flume is a 27-inch Palmer-Bowlus located in the 48 inch trunk line. It's visible just downstream from the second manhole, which is several blocks upstream from the sampling station. A bar screen/comminutor is located in the vicinity of the sampling station.

The westside flow measuring device is a 6-inch, concrete Parshall flume. It is the exit point from this line's bar screen/grit chamber and is easily accessible. Westside wastewater then travels via force main to the northeast corner of the lagoon system where it enters cell 1 in the vicinity of the eastside wastewater.

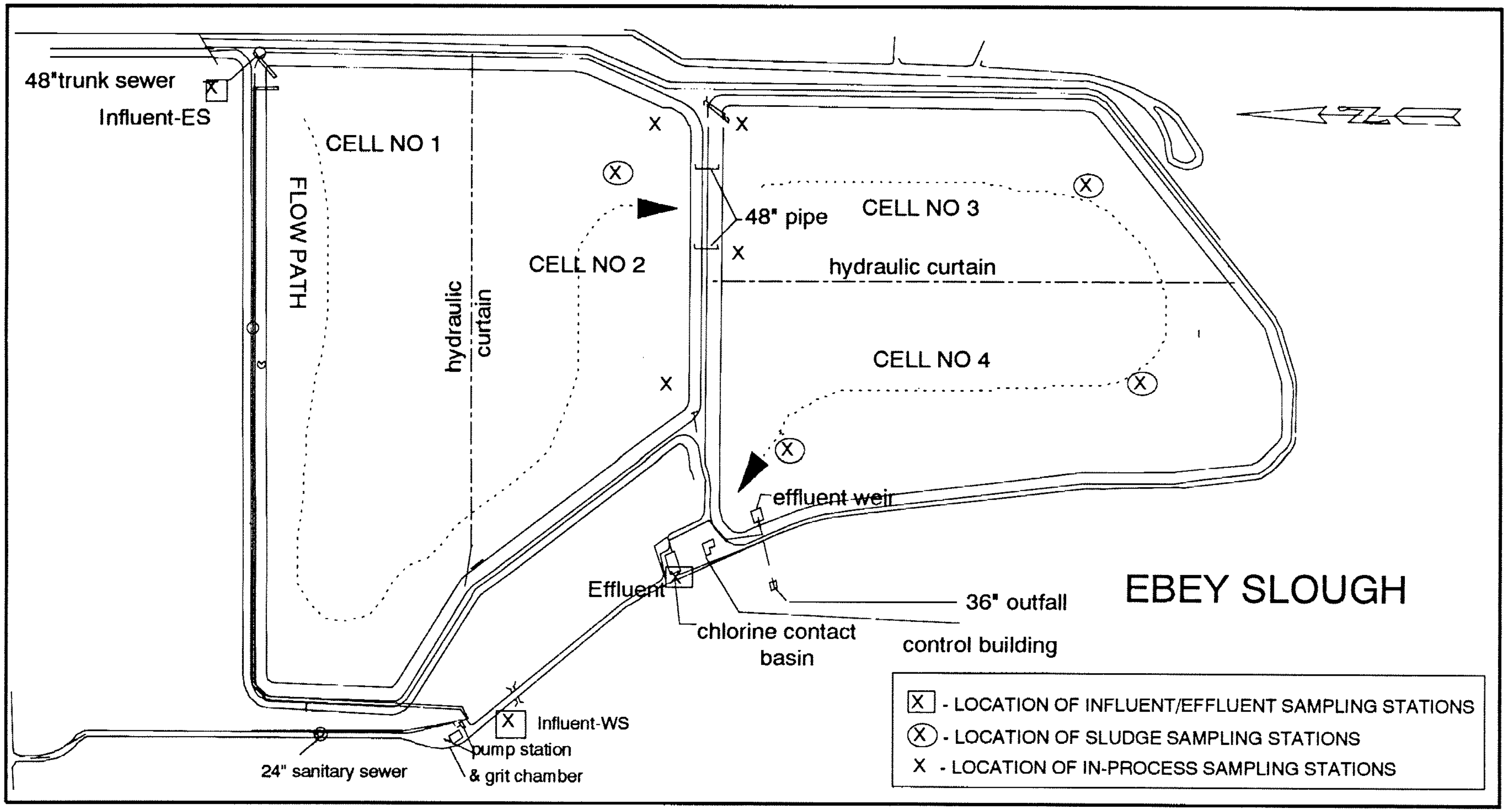

FIGURE 2 - WWTP SCHEMATIC SHOWING SAMPLING LOCATIONS - MARYSVILLE, 7/90

Lagoon effluent is subjected to flow-proportional chlorination upstream of a baffled chlorine contact chamber. A small mixing chamber proceeds the contact chamber. The propeller-driven flowmeter which directs chlorine injection is located at the headend of the mixing chamber. The wastewater level in the contact chamber is influenced by tidal action, which can raise the level 18 inches from low to high tide. Following chlorination, effluent is discharged to Ebey Slough a sluggish, secondary channel of the lower Snohomish River.

METHODS

Grab and composite samples of influent and effluent wastewater were collected on July 16 and 17, 1990. Sludge samples were collected from four locations in three of the cells and composited. The sampling schedule and list of parameters analyzed are shown in Table 1. Sampling locations are shown in Figure 2. Split sample analyses were performed for BOD_5 and TSS.

Two stations were established for collecting influent samples. The first station was established in the eastside line. Marysville refers to this as line "A"; we call it Influent-ES in this report. The specific location was at the bar screen/comminutor. Marysville staff sampled at the same location.

The second influent station (Influent-WS) was located at the bar screen/grit chamber near the end of the 24 inch westside line. Our samples were taken immediately downstream of the Parshall flume, while the City's samples were taken just upstream of the flume.

Marysville's effluent sampling station was located upstream of chlorination. Our station was located at the end of the chlorine contact chamber in order to check for suspected elevated BOD due to sludge build-up in the chamber.

ISCO automatic compositors collected about 330 mL of sample every 30 minutes for 24 hours. The samples were continually iced. All three Ecology compositors were fitted with teflon tubing and glass sampling bottles. Marysville used refrigerated compositors which started sampling within 10 minutes of the Ecology compositors. Two grab samples were also taken at each composite sampling site.

Two additional sets of grab samples were taken, and are referred to in this report as in-process samples. Each in-process grab consisted of two samples from cell 2 and two from cell 3, as shown on Figure 2.

Sludge samples were gathered from the lagoon system using a peristaltic pump, teflon tubing, and stainless steel bucket and utensils. The composite was comprised of grabs from 4 different locations (Figure 2).

Table 1 - Sampling times and parameters analyzed - Marysville, 7/90.

Station:	Influent-WS				Influent-ES				In-Process		Effluent				Sludge	Blank
Type:	Grab	Grab	Composite	Composite*	Grab	Grab	Composite	Composite*	Grab	Grab	Grab	Grab	Composite	Composite*	Composite	Transfer
Date:	16	17	16-17	16-17	16	17	16-17	16-17	16	17	16	17	16-17	16-17	17	16
Time:																
Parameter / Sample ID #:																
GENERAL CHEMISTRY																
Turbidity	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Conductivity	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Alkalinity	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Hardness			x				x						x			
Cyanide			x				x						x		x	x
SOLIDS																
TS			x	x			x	x					x	x		
TNVS			x	x			x	x					x	x		
TSS	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
TNVSS			x	x			x	x					x	x		
BOD_5			x	x			x	x	x	x			x(x)+	x		
COD	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
NUTRIENTS																
NH_3-N	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
NO_3+NO_2-N	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
T-Phosphate	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Fecal Coliform											x	x				
%Solids															x	
Oil & Grease											x	x				
Phenols			x				x						x			
TOC															x	
ORGANICS AND METALS																
BNAs			x				x						x		x	x
Pest/PCB			x				x						x		x	x
VOA	x	x			x	x					x	x			x	x
Metals			x				x						x		x	x
BIOASSAYS																
Rainbow trout													x			
Fathead minnow													x			
Ceriodaphnia													x			
Echinoderm													x			
FIELD OBSERVATIONS																
Temp	x	x	x		x	x	x		x	x	x	x	x			
pH	x	x	x		x	x	x		x	x	x	x	x			
Conductivity	x	x	x		x	x	x		x	x	x	x	x			
Chlorine											x	x				
D.O.									x	x						

* - Samples collected by Marysville.
\+ - Number in parentheses ( ) is carbonaceous BOD_5.

All sampling equipment was cleaned before use by washing with non-phosphate detergent and rinsing successively with tap water, ten percent nitric acid, deionized water (three rinses), pesticide-grade methylene chloride, and pesticide grade acetone. Collection equipment was air-dried and wrapped in aluminum foil until used.

Influent flumes were inspected for their physical condition and appropriate dimensions. Instantaneous flow determinations were made based on measured head for later comparison to WWTP flow recording devices. The flumes' floors and sides were probed with a bamboo pole to determine shape, debris/sediment trappings and physical integrity. The manhole providing access to the Palmer-Bowlus was not entered for safety reasons; so flume levelness, upstream channel straightness and slope, and flume exit flow were not assessed.

Effluent exits the chlorine contact chamber through a 6 inch wide concrete channel. This structure does not clearly fit the description of either a sharp- or broad-crested weir, so flows could not be calculated based on head height. The effluent flowmeter, a propeller device, was not inspected; these devices are factory calibrated and are difficult to independently assess.

Chain-of-custody procedures were followed during sample collection and transport. Analytical methods and laboratories used are shown in Appendix A.

DATA QUALITY ASSURANCE

Sampling equipment contamination was assessed by rinsing a field transfer blank through the Ecology effluent compositor. The transfer water was subsequently analyzed for priority pollutant organics and metals. Acetone was positively identified, but at less than the specified detection limit. This is not uncommon since acetone is used to clean the equipment. No other organics or metals were detected.

Laboratory quality assurance and quality control (QA/QC) methods are described by Huntamer and Hyre (1991). Recommended holding times were met for all analyses performed. Matrix spike recoveries and relative percent difference duplicate spikes (a measure of precision) were within acceptable QC limits, with one exception: A spike recovery for ammonia was 3% below the 70% acceptable limit. Sample results are not qualified based on matrix spike/matrix spike duplicates results, as recommended by Kirchmer (1988). Lead was positively identified in a lab blank sample, requiring "B" qualifiers on several of the lead results. There were no other analytical problems with the analysis of water samples.

Rainbow trout, fathead minnow larvae, water flea, and echinoderm sperm fertilization bioassays were conducted on effluent and laboratory controls containing dilution water. In addition, a copper reference toxicant test was conducted concurrently with the echinoderm test (Snyder, 1990). The trout control met the protocol requirement of 90 percent survival for acute tests (EPA, 1985). Fathead minnow larvae and water flea control survivals met 80 percent requirements specified in the protocols for 7-day chronic testing (EPA, 1989). Fertilization in the echinoderm control was about 82 percent. Target control fertilization of about 80 percent is desired since any effluent toxic effect must be observed relative to the health of the control (Dinnel *et al.*,1987). The no observed effect concentration (NOEC) for reference toxicant test, calculated by Dunnett's Test, was determined to be 2.5 ppb copper.

RESULTS AND DISCUSSION

Flow

The eastside transducer for head measurement was correctly positioned. At 0952 on July 17, the depth of water below the transducer was measured to be 14 inches and remained constant during our time at the manhole. This depth corresponds to a head of 9.5 inches, which represents an instantaneous flow of 2.2 MGD (ISCO, 1985). The continuous flow recorder reading for the same time was approximately 1.9 MGD (allowing for noise on the chart scale).

A review of city records shows that the flow recorder was adjusted 0.27 MGD downward on February 26, 1990 (City Instrument Company letter of May 18, 1990 to the city of Marysville). No explanation was given for this adjustment. When this adjustment value is added to the chart reading (1.9), the resultant value is 2.17 MGD - very close to the flow measured by Ecology at the flume. Palmer-Bowlus flumes are not standardized, but Plasti-Fab Company verified that our table references were the most recent version of their flume flow/head relationship.

It is reasonable to assume that the totalizing device for this flume was also recording consistently low. For this reason, the average 24-hour flow from the eastside, as developed on Table 2, has been adjusted upward by 0.27 MGD to reflect the findings of the Class II Inspection.

The transducer for the westside Parshall flume was located about 14 inches upstream of the entrance to the converging section of the flume. Head determinations should be made at a point one-third of the distance downstream from the beginning of the converging section. A grit chamber baffle lies between the transducer and flume. This baffle appeared to induce undesirable turbulence in flow through the flume and may cause a slight difference in head downstream. This turbulence was observed when the grit chamber was full and there were low (morning) flows. Solids were also spilling over and around this baffle and accumulating directly downstream in the converging section of the flume.

The operator indicated that the transducer was moved to the upstream location to solve problems with signal echoes off flume walls. Some adjustment (angling of the transducer beam) was made to correct the level recording to correspond with head determinations made at the proper location.

The Parshall flume dimensions were checked and found to be inconsistent with standards (ISCO, 1985). The floor at the entrance to the throat section was found to have a projection about one inch high. The floor of the converging section had a large hole adjacent to the flume wall.

Table 2. Flow Measurements - Marysville WWTP, 7/90.

Date	Time	Instantaneous Flow (MGD)		
		Influent -WS	Influent - ES	Effluent
7/16	0900		1.72	
	1000	1.03	1.85	
	1100	1.25	2.00	2.35
	1200	1.12	1.95	2.35
	1300	1.24	1.90	2.35
	1400	1.03	2.00	2.35
	1500	1.25	1.78	2.35
	1600	1.04	1.72	2.35
	1700	1.04	1.73	2.35
	1800	0.89	1.85	2.35
	1900	0.89	1.73	2.35
	2000	1.00	1.85	2.35
	2100	0.92	1.85	2.35
	2200	1.00	1.90	2.03
	2300	1.00	1.78	0.72
	2400	0.69	1.70	1.25
7/17	0100	0.50	1.60	2.00
	0200	0.59	0.95	2.37
	0300	0.43	1.00	2.37
	0400	0.42	0.80	2.30
	0500	0.42	0.80	2.15
	0600	0.50	1.00	2.00
	0700	0.70	1.30	1.95
	0800	0.80	1.50	1.95
	0900	1.35		2.44
	1000			2.50
Average recorded flow:		0.88	1.59	2.16
Adjustment to reflect observed instantaneous flow readings:		0.00	0.27	0.00
Flow (MGD):		0.88	1.86	2.16

Also, the floor slope of the diverging section was much less than standard, and flume walls were not smooth. The operator observed during cleaning that there was excessive erosion of the flume floor and that the projection was part of the original concrete mix used during construction. Such rough surfaces are unacceptable for flow measuring devices.

Nevertheless, this flume had significant shortcomings that affect its accuracy and reliability as a primary flow measuring device. Some instantaneous determinations of flow were compared to the chart recorder on July 17. At 0650, flume flow based on head was 0.63 MGD; the chart recording showed a similar value. At 1255, we measured a flow of 1.29 MGD; the chart record showed about 1.2 MGD. This discrepancy is not considered significant because of the considerable noise on the chart record. Therefore, no adjustment was made to the average 24-hour westside flow determination in Table 2.

As noted earlier, the propeller meter for measuring effluent flow could not be independently checked. This meter is considered a primary flow measuring device by EPA, which presents problems for flow verification during facility inspections. The effluent recording chart indicated a fairly constant discharge rate except during periods of tidal influence. This can be expected from a lagoon system. The end of the chlorine contact chamber has a 6-inch wide concrete lip over which the effluent discharges. This structure should be modified to install a sharp-crested weir.

The dramatic difference between influent (2.74) and effluent (2.16) flows is attributable largely to evaporation during summer months. This amounts to a 21 percent loss.

Loadings, Performance, and Comparison to Order Limitations

The two days of the inspection were hot and sunny, stimulating the photosynthesis process in the ponds. Green color, a moderately high pH, and relatively large concentrations of TSS in the effluent signalled the prolific growth of algae. In-process field observations made in the late afternoon showed D.O. readings of 9 mg/L near the bottom (4½ feet depth). Very early the following morning D.O. readings averaged 0.2 (same depth) when no aerators were operating. Table 3 contains results of general chemistry analyses.

Organic loading to the lagoon system was about 7200 pounds per day of BOD_5 and 5200 pounds per day of TSS. This was determined by using influent flow (0.88 + 1.86) from Table 2 and influent BOD (313 mg/L) and TSS (226 mg/L) from Table 4. This results in a surface loading of 99 lb.BOD_5/day/acre (assuming use of the entire 72 acres).

The system was recently reconfigured to operate as aerated facultative lagoons in series with a sedimentation lagoon. (Cells 1, 2 and 3 were aerated, while cell 4 served as a quiescent area). It was not performing to its capability. Even under winter conditions, a surface loading of 220 lb. BOD_5/day/acre should be achievable. Thirty-three acres under aeration and a detention time of about 20 days would seem to be sufficient (Metcalf & Eddy, 1991). (Detention time would be 11 days in summer because of the different specific reaction-rate constants involved.)

Table 3 - Results of General Chemistry Analyses - Marysville WWTP, 7/90.

Location:	Influent - WS				Influent - ES				In-process		Effluent				Sludge	Blank
Field Station:	WSg-1	WSg-2	EcoIn-W	MarIn-W	ESg-1	ESg-2	EcoIn-E	MarIn-E	Ip-1	Ip-2	Efg-1	Efg-2	EffEco	MarEff		
Type:	Grab	Grab	Comp	Comp*	Grab	Grab	Comp	Comp*	Grab	Grab	Grab	Grab	Comp	Comp*	Comp	Transfer
Date:	16	17	16-17	16-17	16	17	16-17	16-17	16	17	16	17	16-17	16-17	17	16
Time:	1840	1255	24 hour	24 hour	1910	1020	24 hour	24 hour	1730	0600	1755	1155	24 hour	24 hour	1400	1030
Lab Sample #: 2981	-30	-31	-32	-33	-34	-35	-36	-37	-38	-39	-40	-41	-42	-43	-44	-45
LABORATORY																
Turbidity (NTU)	52	185	52	62	92	60	75	70	26	26	24	24	24	24		
Conductivity (umhos/cm)	975	1662	763	914	661	534	608	567	568	615	590	601	594	593		
Alkalinity (mg/L as CaCO3)	205	290	181	207	246	200	220	218	180	190	180	190	188	186		
Hardness (mg/L as CaCO3)			79				65						73			
Cyanide (mg/L) **			0.015				0.01						0.008		<0.6	<0.005
SOLIDS (mg/L)																
TS	800		711	736			658	629					398	379		
TNVS	436		342	428 J			124	146					130	68		
TSS	156	225	190	231	213	167	243	251	95	119	55	58	46	62		
TNVSS	45		43	45			39	74					15	24		
BOD5 inhibited (mg/L)													22			
BOD5 (mg/L)			308	280			316	340	58	61			29	47		
COD (mg/L)	630	676	585	561	698	378	681	640	270	247	173	189	190	190		
NUTRIENTS (mg/L)																
NH3-N	24.7	38.3	37.7	33.9	27.8	36.9	27.8	34.4	22.6	22.7	25.8	28.6	43.8	23.5		
NO3+NO2-N	0.167	0.056	0.067	0.03	0.027	0.109	0.13	0.033	0.146	0.036	0.119	0.097	0.209	0.136		
T-Phosphate	6.3	6.85	5.95	6.3	9.1	5.95	8.35	7.7	6.9	6.9	7	6.76	6.6	6.6		
Fecal Coliform (#/100mL)											49	14				
% Solids															3.2	
Phenols (mg/L)			0.098				0.022						0.012			
TOC %									9.0	0.2					5.50	
Oil and Grease (mg/L)											<1.0 B	4.2 B				3.8
FIELD OBSERVATIONS																
Temp (C)	20.5	20.9	6.9^	16.0^	17.4	17.9	4.8^	16.7^	26.4	21.3	26.6	23.7	9.2^	16.2^		
pH (S.U.)	6.79	8.27	7.3	7	7.6	7.92	7.66	7.86	8.05	7.53	7.85	7.52	7.78	7.8		
D.O. (mg/L)																
Chlorine (mg/L)											<0.1	0.1	<0.1			

* Samples collected by Marysville.
** Units for sludge are mg/kg - dry.
^ Temperature of iced or refrigerated 24-hour composite samples.
J Indicates an estimated value when result is less than specified quantitation limit.
B Analyte found in blank, possible blank contamination.

WSg means grab sample of westside influent.
EcoIn means composite of influent collected by Ecology.
MarIn means composite of influent collected by Marysville.
ESg means grab sample of eastside influent.

Ip means In-process grab sample.
Efg means grab sample of effluent.
EffEco means composite of effluent collected by Ecology.
MarEff means composite of effluent collected by Marysvil

Table 4. - Comparison between Inspection Data and Consent Order Effluent Limitations - Marysville WWTP, 7/90.

	Inspection Data			Consent Order Limitations
Parameters	Ecology composite	Marysville composite	grab sample	monthly average
Influent BOD5* (mg/L)	313	321		
Effluent BOD5 (mg/L)	29	47		30
(lbs/day)	522	847		700
Percent removal of BOD5	91	85		85
Influent TSS* (mg/L)	226	245		
Effluent TSS (mg/L)	46	62		75
(lbs/day)	829	1117		1750
Percent removal of TSS	80	75		
Fecal coliform (#/100ml)			49;14	200
pH	7.78		7.85;7.52	6.0•pH•9.0

*Weighted average based on prorated flows from westside and eastside influent lines.

Marysville officials were not able to explain why aerators were not operating during the night and early morning or how long this had been going on. They should be operating. This could explain much of the reduced performance.

Undoubtedly, short-circuiting is a major factor. Much of the acreage in the aerated portion of the system is probably dead-space. The present system is operating more like a plug-flow reactor than complete-mix. The single inlet is probably also limiting performance of the system. Multiple inlet arrangements are preferred to achieve better hydraulic and settleable solids distribution, and better performance.

The 13 existing aerators supply 325 horsepower (hp). Using Metcalf & Eddy (1991), the calculated power requirement for surface aerators is 298 hp. (This assumes oxygen-transfer capacity of the aerators will be twice the value of BOD_5 applied per day and that the typical aerator will transfer 48 lb.O_2/hp/day.) There appears to be sufficient oxygen, if other short-comings are corrected.

Very little in-plant nitrification was taking place during the inspection. There were only slight changes in alkalinity, NH_3-N, and NO_3+NO_2-N between influent and effluent. Comparison of effluent BOD_5 (29 mg/L) and effluent carbonaceous BOD_5 (22 mg/L) also suggests very little nitrification. Short-circuiting of flow in the system was undoubtedly contributing to the minimal nitrification.

The WWTP was probably not meeting effluent limitations for BOD contained in the Consent Order (Table 4). (Comparison of the four effluent BOD results found in Table 8 suggests that 47 mg/L is a better figure to use.) It is questionable whether the limitations could be met during low temperatures under the present operating mode because bacteria may not multiply fast enough to handle the wasteload.

Effluent chemical characterization

Table 5 compares pollutants found in the effluent to water quality criteria. Both freshwater and marine criteria are presented because Ebey Slough is an estuary. The ammonia concentration far exceeded freshwater criteria. A dilution factor of more than 30:1 at the edge of a mixing zone would be required to minimize the potential for chronic toxicity under existing conditions. Even greater dilution would be required under critical receiving water conditions.

Chlorine is another conventional parameter of concern. As mentioned earlier, high tides cause effluent to back up in the chlorine contact chamber. This results in chlorine effluent levels with a high potential toxicity. Residual chlorine readings taken during the inspection did not occur at high tide. Discharges of TSS at present concentrations could result in dissolved oxygen sags.

Table 5 - Comparison of Effluent Pollutants to Water Quality Criteria - Marysville WWTP, 7/90.

Location:	Effluent	Water Quality Criteria* (µg/L)			
Field Station:	EffEco	Freshwater		Saltwater	
Parameter / Lab Sample #:	298142	Acute	Chronic	Acute	Chronic
Inorganics (µg/L)					
Ammonia	27,200	6,423	862	7,100**	1,100**
Arsenic	2.3 J	360	190	69	36
Cadmium^	0.23 J	2.8	0.9	43	9.3
Copper^	12	13.2	9.0	2.9	2.9
Lead^	5.7 B	54.7	2.1	140	5.6
Zinc^	20 J	89.6	81.2	95	86
Cyanide	0.008	22	5.2	1.0	1.0
Organics (µg/L)					
Acetone	7 J; 10^^	--	--	--	--
Toluene	5; 4 J^^	17,500***	--	6,300***	5,000***
4-Methylphenol	2 J	--	--	--	--
Bis(2-Ethylhexyl)phthalate	6 UJ	--	--	--	--

* EPA, 1986. Arsenic criteria are for Arsenic(III).
** Based on salinity of 10 ppt, temperature of 25 C, pH of 7.8 SU.
*** Insufficient data to develop criteria; value presented is lowest observed effect level (LOEC).
^ Freshwater criteria based on 73 mg/L hardness from Table 3.
^^ Duplicate samples collected for VOCs. Lab sample #s -40 & -41.
U Indicates compound was analyzed for but not detected at the given detection limit.
J Indicates an estimated value when result is less than specified quantitation limit.
B Indicates the analyte is found in the blank as well as the sample.

Some priority pollutants were also detected in the effluent. Most were found in low concentrations. Copper and lead exceeded chronic criteria for fresh and marine waters, and copper also exceeded the acute criterion for saltwater. These pollutants would likely pose no threat if receiving water dilution factors exceeded 6:1 under critical design conditions.

Organic toxicants in the effluent can be generally classified as either solvents or plasticizers (phthalates). Criteria exist for only toluene and are actually LOEC's - not criteria (Table 5); they were not exceeded. A complete listing of priority pollutant scan results is included as Appendix B.

Effluent bioassays

The results of effluent bioassays are shown in Table 6. The trout bioassay measured acute toxicity, while fathead minnow, water flea, and urchin bioassays measured chronic toxicity. Mild acute toxicity was indicated, but in an amount that would probably be minimized with an effluent dilution factor of 2:1. Chronic toxicity indicated by impaired reproduction in the urchin test was high. Dilutions of at least 24:1 at the edge of a mixing zone would be needed to alleviate this toxicity. Whole-effluent testing using bioassays does not establish a cause, but ammonia toxicity is strongly suspected. Further testing on a regular schedule by the permittee is warranted.

Sludge chemical characterization

A number of inorganic and organic priority pollutants were found in lagoon sludge (Table 7). Results were compared to findings of a national survey conducted by EPA (1990) for 28 pollutants of concern. Among inorganics, only arsenic appeared in a concentration that was significantly higher (several magnitudes) than the national average; it warrants attention.

Among 10 organic compounds found, only Bis(2-Ethylhexyl)phthalate, 4,4'-DDD, and the PCB compound (Aroclor-1254) were included in the survey. Concentration of Aroclor-1254 was well above the national average. The survey results for PCB concentrations are not considered realistic because they indicate a violation of the Lognormal Distribution assumption used to generate estimates. Nevertheless, this pollutant warrants attention; the other two were insignificant.

Self-monitoring and laboratory evaluation

All three of Marysville's composite samples had temperatures ranging from 16.0 to 16.7 degrees Celsius. Apparently very little cooling was provided by the refrigeration equipment at the sampling sites. Algal growth was visible along the inside of compositor suction tubes. These lines should be flushed out monthly with a chlorine solution to avoid biomass buildup that could affect sample representativeness.

Table 6 - Results of Bioassays on Effluent - Marysville WWTP, 7/90.

Rainbow Trout *(Oncorhynchus mykiss)* 96-hour acute

concentration (%vol/vol)	Replicate	# of live organisms Initial	Final	Percent mortality
Control	A	10	9	10
	B	10	10	0
6.25%	A	10	10	0
	B	10	9	10
12.5%	A	10	10	0
	B	10	10	0
25.0%	A	10	10	0
	B	10	10	0
50.0%	A	10	8	20
	B	10	10	0
100.0%	A	10	0	100
	B	10	0	100

LC50* = 65.6% Effluent.

Fathead Minnow Larvae *(Pimephales promelas)* 7-day chronic

concentration (%vol/vol)	initial	percent mortality	ave. wt. per larvae (mg)
Control	30	14	0.66
6.25%	30	24	0.73
12.5%	30	7	0.7
25.0%	30	0	0.72
50.0%	30	14	0.59
100.0%	30	80	0.19

NOEC = 50.0% Effluent**

Water flea *(Ceriodaphnia dubia)* 7-day chronic

concentration (%vol/vol)	# of live organisms initial	final	percent mortality	ave. young per female
Control	10	10	0	27.9
6.25%	10	10	0	26.5
12.5%	10	9	10	25.5
25.0%	10	8	20	26.5
50.0%	10	6	40	20.5
100.0%	10	3	70	8

NOEC = 25.0% Effluent.**

Table 6 - Results of Bioassays on Effluent, Marysville WWTP, 7/90. - Continued.

Purple sea urchin *(Stronglocentrotus purpuratus)* 2-hour chronic

concentration (%vol/vol)	replication	percent of eggs fertilized	ave. percent per concentration
Control	A	87	
	B	83	
	C	89	
	D	68	81.8
Brine Control	A	84	
	B	88	
	C	79	
	D	80	82.8
4.2%	A	53	
	B	69	
	C	81	
	D	74	69.3
8.3%	A	38	
	B	64	
	C	33	
	D	35	42.5
16.3	A	20	
	B	10	
	C	13	
	D	17	15
33.0%	A	27	
	B	14	
	C	22	
	D	19	20.5
66.0%	A	18	
	B	17	
	C	15	
	D	19	17.3

NOEC = 4.2% Effluent**

* LC50 means the percentage effluent lethal to one-half the test population.

** NOEC means No Observable Effects Concentration.

Table 7 - Results of Sludge Priority Pollutant Analyses - Marysville WWTP, 7/90.

Field Station:	Sludge		National Sewage Sludge Survey+	
Type:	grab-comp			
Date:	17			
Time:	1400	Number of	Percent	Geometric
Lab Sample#:	298144	Samples	Detected++	Mean
Inorganics (mg/kg)				
Arsenic	1.42	70	83	0.0097
Cadmium	0.52	69	78	9.16
Chromium	77.6	70	99	160.6
Copper	25.8	70	100	670.7
Lead	26	70	87	157.0
Mercury	0.311	70	79	4.0
Nickel	64 J	70	81	48.4
Selenium	0.29 JB	70	64	5.59
Silver	18	--	--	--
Zinc	73.4	70	100	1,708
Cyanide	<0.6	--	--	--
Organics (μg/Kg)*				
Methylene Chloride	94 J	--	--	--
Acetone	1,594	--	--	--
4-Chloroaniline	34,375	--	--	--
Phenanthrene	2,188 J	--	--	--
Fluoranthene	2,063 J	--	--	--
Pyrene	2,125 J	--	--	--
Bis(2-Ethylhexyl)phthalate	78,125	70	86	148,607
Di-n-Octylphthalate	1,000 J	--	--	--
4,4'-DDD	59	69	0	**
Aroclor-1254	1,906	69	4	133

J Indicates an estimated value when result is less than specified quantitation limit.
\+ EPA, 1990. Values presented are for WWTPs with flows between 1 and 10 MGD.
++ Percent of samples in which the compound was detected above the quantitation limit.
* Sludge sample was 3.2 percent solids; organics were analyzed as water matrix.
** Nonestimable.

Table 8. Comparison of Sample Splits – Marysville WWTP, 7/90.

Sample	Sampler	Laboratory	BOD (mg/L)	TSS (mg/L)
EcoIn–W	Ecology	Marysville	288	144
(298132)		Ecology	308	190
MarIn–W	Marysville	Marysville	285	168
(298133)		Ecology	280	231
EcoIn–E	Ecology	Marysville	314	174
(298136)		Ecology	316	243
MarIn–E	Marysville	Marysville	310	198
(308157)		Ecology	340	251
EffEco	Ecology	Marysville	45	56
		Ecology	29	46
MarEff	Marysville	Marysville	49	61
		Ecology	47	62

Influent composite samplers were observed to have some other problems. The eastside sampling location appears to be appropriate, but the suction line was routed such that a sag, or low point, was present. This should be avoided because trapped sample residue may change biochemically and become part of the next discrete sample if it is not purged prior to sampling. Also, a spot-check during the evening of July 16 revealed that very little sample had been taken. A sampling event was observed, and it was found that no sample was collected. The eastside composite sample cannot be representative under these conditions.

The westside influent sample line location is acceptable as long as it doesn't interfere with desirable approach flow characteristics for the flume. This line was observed to be out of the water at low flow on the morning of July 17 (0550 hour). Flow records indicate no sample would be taken for at least four to six hours each day. In addition, the relatively large diameter PVC suction line may be hampering the ability of the vacuum system on this sampler. Also, there may have been enough turbulence at the suction point to admit air and thus prevent a sample from being drawn. Again, this composite sample can't be representative.

Table 8 compares data from the 4-way split of composite samples during the inspection. Results from samples collected by two different compositors (Ecology & Marysville) but analyzed at the same lab (e.g., Marysville) address the issue of sample representativeness. Comparison of these data is quite good. This is noteworthy considering the self-monitoring problems we found and the fact that the Marysville effluent sample was taken pre-chlorination while Ecology's was taken post-chlorination.

Results from samples collected by the same compositor (e.g., Marysville) but analyzed at two different labs (Marysville & Ecology) address the issue of lab performance. Influent TSS results from the Marysville lab were consistently lower than results from Ecology's lab. There was no apparent reason for this disparity.

A laboratory evaluation was conducted on July 17 by Perry Brake of Ecology's Quality Assurance Section. His findings and recommendations are included in Appendix C. Generally, there were no significant problems and the lab was well run. However, the operator appeared to be fully committed with present duties.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. The WWTP was not performing as a 4-cell lagoon system because the hydraulic curtain creating cells 1 & 2 had been swept away during a storm event.

2. The instrumentation for recording flows in the eastside influent line appeared to be out of adjustment. Accuracy of both instantaneous and total flows is suspect.

3. The westside Parshall flume and instrumentation had significant shortcomings that affect its accuracy and reliability as a primary flow measuring device. The transducer was incorrectly located, and physical dimensions of the flume itself were inconsistent with standards.

4. The effluent recording chart showed a fairly constant discharge rate of 2.4 - 2.5 MGD. However, effluent totalizer readings indicate daily total flows which were consistently 20 percent higher.

5. The system was experiencing about a 20 percent hydraulic loss, largely due to evaporation.

6. Very little nitrification was occurring in the lagoons.

7. Short-circuiting, limited use of available aerators and a single inlet in the system were contributing to reduced performance.

8. The WWTP was probably not meeting effluent limitations for BOD_5 contained in the Consent Order, raising serious concerns about its ability to meet them during colder weather in its present operating mode.

9. A dilution factor of at least 30:1 at the edge of a mixing zone would be required to minimize the potential for chronic whole-effluent toxicity due to ammonia.

10. Higher high tides cause chlorinated effluent to back up in the chlorine contact chamber. This provides the opportunity for discharges of chlorine in toxic concentrations.

11. Copper and lead exceeded both freshwater and saltwater chronic criteria, and copper also exceeded the acute criterion for saltwater.

12. Whole-effluent testing using the echinoderm bioassay indicated high chronic toxicity. Dilution of at least 24:1 at the edge of a mixing zone would be needed to alleviate this toxicity - suspected to be caused by ammonia.

13. Arsenic and Aroclor-1254 were present in the lagoon sludge in significant concentrations.

14. Marysville's composite samples had elevated temperatures, suggesting that refrigeration equipment was inadequate.

15. There were a number of problems with suction tubes on the Marysville compositors, creating the opportunity for collection of unrepresentative samples.

16. Influent TSS results from the Marysville lab were consistently lower than results from Ecology's lab.

17. A laboratory evaluation found a well run lab with no significant problems. However, the lone plant operator/lab technician appeared to be fully committed with present duties.

Recommendations

1. Marysville should devote considerable effort to correcting problems associated with all three flow measuring/recording devices.

2. A sharp-crested weir should be installed at the end of the chlorine contact chamber to serve as a primary flow measuring device.

3. Short-circuiting of flow through the lagoon system must be prevented. Other avenues must also be explored for increasing performance and reducing effluent TSS and BOD_5 concentrations.

4. Aerators should be placed on an automatic timer.

5. Instrumentation which feeds chlorine to the effluent must be changed to prevent the build-up of elevated, atypical concentrations during high tide conditions.

6. The permittee should be required to conduct further bioassay testing on a regular schedule. Echinoderm should be included among the species used.

7. Considerable effort should be given to correcting a number of existing and potential problems with the composite sampling equipment.

8. Many of the concerns expressed in this report are evidence that the present operator/lab technician is fully committed and that additional staff should be hired.

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APPENDICES

Appendix A – Analytical Methods and Laboratories Used – Marysville WWTP, 7/90.

Parameter	Method used	Laboratory
General Chemistry		
Turbidity	EPA, 1983: 180.1	Ecology; Manchester, WA
Conductivity	EPA, 1983: 120.1	Ecology; Manchester, WA
Alkalinity	EPA, 1983: 310.1	Ecology; Manchester, WA
Hardness	EPA, 1983: 130.1	Ecology; Manchester, WA
Cyanide	EPA, 1983: 335.3	AMTEST; Redmond, WA
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
BOD5-inhibited	EPA, 1983: 405.1	Ecology; Manchester, WA
COD	EPA, 1983: 410.1	Ecology; Manchester, WA
NH3-N	EPA, 1983: 350.1	AMTEST; Redmond, WA
NO3+NO2-N	EPA, 1983: 353.2	AMTEST; Redmond, WA
T-Phosphate	EPA, 1983: 365.2	AMTEST; Redmond, WA
Fecal coliform	APHA, 1989: 9222D	Ecology; Manchester, WA
% Solids	APHA, 1989: 2540G	AMTEST; Redmond, WA
Phenols	EPA, 1983: 420.1	AMTEST; Redmond, WA
TOC (water)	EPA, 1983: 415.2	AMTEST; Redmond, WA
TOC (sediments)	APHA, 1989: 5310	AMTEST; Redmond, WA
Oil & Grease	EPA, 1983: 413.2	AMTEST; Redmond, WA
Metals		
PP (water)	EPA, 1983:200	Ecology; Manchester,WA
Organics		
BNA's (water)	EPA, 1984: 625	Laucks; Seattle, WA
Pesticides/PCBs (water)	EPA, 1984: 608	Laucks; Seattle, WA
VOCs (water)	EPA, 1984: 624	Laucks; Seattle, WA
Bioassays		
Rainbow trout	EPA,1985	ERCE Bioassay Laboratory; San Diego, CA
Ceriodaphnia dubia	EPA, 1989.	ERCE Bioassay Laboratory; San Diego, CA
Echinoderm	Dinnel, et.al, 1987	ERCE Bioassay Laboratory; San Diego, CA
Fathead minnow larvae	EPA, 1989.	ERCE Bioassay Laboratory; San Diego, CA

Appendix B - Results of Priority Pollutant Scans - Marysville WWTP, 7/90.

Location:	nfluent-WS		Influent-ES		Effluent		Sludge		Blank	
Field Station:	EcoInf-W		EcoInf-E		EffEco					
Type:	Comp		Comp		Comp		Comp		Transfer	
Date:	16-17		16-17		16-17		17		16	
Time:	24 hour		24 hour		24 hour		1400		1030	
Lab Sample #: 2981	-32		-36		-42		-44		-45	
Metals*										
Antimony	3	U	3	U	3	U	0.12		3	U
Arsenic	4.1	J	4.8	J	2.3	J	1.42		1.5	U
Beryllium	2	U	2	U	2	U	0.2	U	2	U
Cadmium	0.43	J	0.2	U	0.23	J	0.52		0.2	U
Chromium	35		10	U	10	U	77.6		10	U
Copper	5	U	6.9	J	12		25.8		5	U
Lead	48.6		7.4	B	5.7	B	26		1	U
Mercury	0.36		**		**		0.311		**	
Nickel	40	U	40	U	40	U	64	J	40	U
Selenium	2	U	2	U	2	U	0.29	JB	2	U
Silver	4	U	8.4	J	4	U	18		4	U
Thallium	2.5	U	2.5	U	2.5	U	0.25	U	2.5	U
Zinc	151		59		20	J	73.4		10	U

* units are μg/L for water matrices; mg/kg for sediment matrix (lab sample # -44).

** no data available (Smith, 1992).

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

J indicates an estimated value when result is less than specified quantitation limit.

B indicates the analyte is found in the blank as well as the sample.

Appendix B - Results of Priority Pollutant Scans - Marysville WWTP, 7/90. (continued)

Location:	Influent-WS/ES				Effluent		Sludge	Blank
Field Station:	WSg-1	WSg-2	ESg-1	ESg-2	Efg-1	Efg-2		
Type:	Grab	Grab	Grab	Grab	Grab	Grab	Comp	Transfer
Date:	16	17	16	17	16	17	17	16
Time:	1840	1255	1910	1020	1755	1155	1400	1030
Lab Sample #: 2981	-30	31	34	35	40	41	44	45
VOCs ($\mu g/L$)								
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
Vinyl Chloride	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
Methylene Chloride	5 U	5 U	5 U	5 U	5 U	5 U	3 J	5 U
Acetone	18	18	70	32	7 J	10	51	8 J
Carbon Disulfide	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,1-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,2-Dichloroethene (total)	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Chloroform	1 J	1 J	5	2 J	5 U	5 U	10 U	5 U
1,2-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
1,1,1-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Carbon Tetrachloride	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Vinyl Acetate	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
Bromodichloromethane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,2-Dichloropropane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
cis-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Dibromochloromethane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,1,2-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Benzene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
trans-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Bromoform	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
4-Methyl-2-Pentanone	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U
Tetrachloroethene	1 J	1 J	5 U	5 U	5 U	5 U	10 U	5 U
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Toluene	5 U	1 J	4 J	2 J	5	4 J	10 U	5 U
Chlorobenzene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Styrene	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
Total Xylenes	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U

Appendix B - Results of Priority Pollutant Scans - Marysville WWTP, 7/90. (continued)

Location:	Influent-WS		Influent-ES		Effluent		Sludge		Blank	
Field Station:	EcoInf-W		EcoInf-E		EffEco					
Type:	Comp		Comp		Comp		Comp		Transfer	
Date:	16-17		16-17		16-17		17		16	
Time:	24 hour		24 hour		24 hour		1400		1030	
Lab Sample #: 2981	-32		-36		-42		-44		-45	
BNA Compounds (μg/L)										
Phenol	32		9	J	10	U	400	U	10	U
Bis(2-Chloroethyl)Ether	10	U	10	U	10	U	400	U	10	U
2-Chlorophenol	10	U	10	U	10	U	400	U	10	U
1,3-Dichlorobenzene	10	U	10	U	10	U	400	U	10	U
1,4-Dichlorobenzene	3	J	10	U	10	U	400	U	10	U
Benzyl Alcohol	14		8	J	10	U	400	U	10	U
1,2-Dichlorobenzene	10	U	10	U	10	U	400	U	10	U
2-Methylphenol	10	U	10	U	10	U	400	U	10	U
Bis(2-chloroisopropyl)ether	10	U	10	U	10	U	400	U	10	U
4-Methylphenol	55		38		2	J	400	U	10	U
N-Nitroso-Di-n-Propylamine	10	U	10	U	10	U	400	U	10	U
Hexachloroethane	10	U	10	U	10	U	400	U	10	U
Nitrobenzene	10	U	10	U	10	U	400	U	10	U
Isophorone	10	U	10	U	10	U	400	U	10	U
2-Nitrophenol	10	U	10	U	10	U	400	U	10	U
2,4-Dimethylphenol	10	U	10	U	10	U	400	U	10	U
Benzoic Acid	170		110		50	U	2000	U	50	U
Bis(2-Chloroethoxy)Methane	10	U	10	U	10	U	400	U	10	U
2,4-Dichlorophenol	10	U	10	U	10	U	400	U	10	U
1,2,4-Trichlorobenzene	10	U	10	U	10	U	400	U	10	U
4-Chloroaniline	10	U	10	U	10	U	1100		10	U
Hexachlorobutadiene	10	U	10	U	10	U	400	U	10	U
4-Chloro-3-Methylphenol	10	U	10	U	10	U	400	U	10	U
2-Methylnaphthalene	5	J	1	J	10	U	400	U	10	U
Hexachlorocyclopentadiene	10	U	10	U	10	U	400	U	10	U
2,4,6-Trichlorophenol	10	U	10	U	10	U	400	U	10	U
2,4,5-Trichlorophenol	50	U	50	U	50	U	2000	U	50	U
2-Chloronaphthalene	10	U	10	U	10	U	400	U	10	U
2-Nitroaniline	50	U	50	U	50	U	2000	U	50	U
Dimethyl Phthalate	10	U	10	U	10	U	400	U	10	U
Acenaphthylene	10	U	10	U	10	U	400	U	10	U

Appendix B - Results of Priority Pollutant Scans - Marysville WWTP, 7/90. (continued)

Location:	Influent-WS		Influent-ES		Effluent		Sludge		Blank	
Field Station:	EcoInf-W		EcoInf-E		EffEco					
Type:	Comp		Comp		Comp		Comp		Transfer	
Date:	16-17		16-17		16-17		17		16	
Time:	24 hour		24 hour		24 hour		1400		1030	
Lab Sample #: 2981	-32		-36		-42		-44		-45	
BNA Compounds (μg/L)										
2,6-Dinitrotoluene	10	U	10	U	10	U	400	U	10	U
3-Nitroaniline	50	U	50	U	50	U	2000	U	50	U
Acenaphthene	10	U	10	U	10	U	400	U	10	U
2,4-Dinitrophenol	50	U	50	U	50	U	2000	U	50	U
4-Nitrophenol	50	U	50	U	50	U	2000	U	50	U
Dibenzofuran	10	U	10	U	10	U	400	U	10	U
2,4-Dinitrotoluene	10	U	10	U	10	U	400	U	10	U
Diethyl Phthalate	7	J	9	J	10	U	400	U	10	U
4-Chlorophenyl-Phenylether	10	U	10	U	10	U	400	U	10	U
Fluorene	10	U	10	U	10	U	400	U	10	U
4-Nitroaniline	50	U	50	U	50	U	2000	U	50	U
4,6-Dinitro-2-Methylphenol	50	U	50	U	50	U	2000	U	50	U
N-Nitrosodiphenylamine	10	U	10	U	10	U	400	U	10	U
4-Bromophenyl-Phenylether	10	U	10	U	10	U	400	U	10	U
Hexachlorobenzene	10	U	10	U	10	U	400	U	10	U
Pentachlorophenol	50	U	50	U	50	U	2000	U	50	U
Phenanthrene	10	U	10	U	10	U	70	J	10	U
Anthracene	10	U	10	U	10	U	400	U	10	U
Di-n-Butyl Phthalate	13		3	J	10	U	400	U	10	U
Fluoranthene	10	U	10	U	10	U	66	J	10	U
Pyrene	10	U	10	U	10	U	68	J	10	U
Butylbenzylpthalate	16		6	J	10	U	400	U	10	U
3,3'-Dichlorobenzidine	20	U	20	U	20	U	800	U	20	U
Benzo(a)Anthracene	10	U	10	U	10	U	400	U	10	U
Chrysene	10	U	10	U	10	U	400	U	10	U
Bis(2-Ethylhexyl)phthalate	38		43		6	UJ	2500		10	U
Di-n-Octyl Phthalate	3	J	4	J	10	U	32	~~U~~ J	10	U
Benzo(b)Fluoranthene	10	U	10	U	10	U	400	U	10	U
Benzo(k)Fluoranthene	10	U	10	U	10	U	400	U	10	U
Benzo(a)Pyrene	10	U	10	U	10	U	400	U	10	U
Indeno(1,2,3-cd)Pyrene	10	U	10	U	10	U	400	U	10	U
Dibenzo(a,h)Anthracene	10	U	10	U	10	U	400	U	10	U
Benzo(g,h,i)Perylene	10	U	10	U	10	U	400	U	10	U

Appendix B - Results of Priority Pollutant Scans - Marysville WWTP, 7/90. (continued)

Location:	Influent-WS		Influent-ES		Effluent		Sludge		Blank	
Field Station:	EcoInf-W		EcoInf-E		EffEco					
Type:	Comp		Comp		Comp		Comp		Transfer	
Date:	16-17		16-17		16-17		17		16	
Time:	24 hour		24 hour		24 hour		1400		1030	
Lab Sample #: 2981	-32		-36		-42		-44		-45	
Pesticides/PCBs (µg/L)										
alpha-BHC	0.050	U	0.050	U	0.050	U	0.50	U	0.050	U
beta-BHC	0.050	U	0.050	U	0.050	U	0.50	U	0.050	U
delta-BHC	0.050	U	0.050	U	0.050	U	0.50	U	0.050	U
gamma-BHC (Lindane)	0.050	U	0.11		0.050	U	0.50	U	0.050	U
Heptachlor	0.050	U	0.050	U	0.050	U	0.50	U	0.050	U
Aldrin	0.050	U	0.050	U	0.050	U	0.50	U	0.050	U
Heptachlor Epoxide	0.050	U	0.050	U	0.050	U	0.50	U	0.050	U
Endosulfan I	0.050	U	0.050	U	0.050	U	0.50	U	0.050	U
Dieldrin	0.10	U	0.10	U	0.10	U	1.0	U	0.10	U
4,4'-DDE	0.10	U	0.10	U	0.10	U	3.4	J	0.10	U
Endrin	0.10	U	0.10	U	0.10	U	1.0	U	0.10	U
Endosulfan II	0.10	U	0.10	U	0.10	U	1.0	U	0.10	U
4,4'-DDD	0.10	U	0.10	U	0.10	U	1.9		0.10	U
Endosulfan Sulfate	0.10	U	0.10	U	0.10	U	1.0	U	0.10	U
4,4'-DDT	0.10	U	0.10	U	0.10	U	1.0	U	0.10	U
Methoxychlor	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
Endrin ketone	0.10	U	0.10	U	0.10	U	1.0	U	0.10	U
alpha-Chlordane	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
gamma-Chlordane	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
Toxaphene	1.0	U	1.0	U	1.0	U	10	U	1.0	U
Aroclor-1016	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
Aroclor-1221	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
Aroclor-1232	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
Aroclor-1242	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
Aroclor-1248	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U
Aroclor-1254	1.0	U	1.0	U	1.0	U	61		1.0	U
Aroclor-1260	1.0	U	1.0	U	1.0	U	10	U	1.0	U

U indicates compound was analyzed for but not detected at the given detection limit.
J indicates an estimated value when result is less than specified quantitation limit.
B indicates the analyte is found in the blank as well as the sample.

REPORT OF EVALUATION

Wastewater Treatment Lagoon Laboratory, Marysville, Washington

DATE OF EVALUATION: July 17, 1990

EVALUATOR: Perry Brake, Quality Assurance Section, Environmental Investigations and Laboratory Services Program, Washington State Department of Ecology.

PERSON CONTACTED: Mr. Dale Thayer

GENERAL FINDINGS AND RECOMMENDATIONS:

The purpose of the evaluation was to verify capability of the laboratory to accurately analyze wastewater samples and report data which is representative of the environment from which those samples are taken. General findings and recommendations concerning the evaluation are as documented below. Sampling procedures were observed but not evaluated.

1. Personnel

Laboratory operations are undertaken solely by Mr. Dale Thayer who is also the sole lagoon operator. Mr. Thayer has 22 years experience in wastewater operations, 14 of which included lab work. He is very knowledgeable in laboratory operations and the correlation between laboratory results and the efficiency of lagoon functions. Between operation of the lagoon and lab procedures, Mr. Thayer appears to be fully committed. Any plans for additional analytical procedures to be conducted in support of lagoon operations should include consideration of hiring additional personnel and/or contracting analyses to a commercial laboratory.

2. Facility

The lab facility proper consists of a single room with sufficient space for current operations. The lab area was tidy, with equipment and supplies situated in such a manner as to facilitate efficient lab operations. Office space adjacent to the lab is available for eating, drinking, and administrative functions. Analytical grade (distilled) water is purchased from a commercial source (Pure Water Corporation).

3. Equipment and Supplies. Although most laboratory equipment is relatively old, all appeared to be well-maintained and functional. Major items available were: Beckman 32 ph Meter; YSI 51B Oxygen Meter; Sauter 200 gram balance; Blue M constant temperature water bath; Blue M Single Wall Transite Oven; Fischer Acculite Colony Counter; Swift Stereo-eighty Microscope; and two refrigerators.

4. Sample Management. Samples are collected daily and generally analyzed immediately after sampling. Samples are appropriately logged and marked to indicate time and location of sampling.

5. Data Management. Data is recorded on loose sheets which are temporarily stored in "pockets" hanging on the wall prior to being permanently stored in conventional filing cabinets. Although Mr. Thayer was able to retrieve past data with ease, keeping data sheets in binders would preclude misplacement in the future.

6. PE Samples. The lab is not involved in any type of performance evaluation (PE) sample analysis program. Because analysis of PE samples is the best way to determine whether or not the lab is capable of accurately analyzing environmental samples, a recommendation was made to contact EPA and/or a commercial vendor to obtain such samples on a regular basis for BOD, TSS, pH, and residual chlorine. For instructions on how to procure PE samples, Mr. Thayer was referred to pages 6-8 of the Procedural Manual for Accreditation of Environmental Laboratories, a copy of which was available in the lab. (NOTE: Subsequent to the visit, the QA Section sent performance evaluation samples for pH, TSS, BOD, and residual chlorine to Mr. Thayer. Results of the analysis of those samples were all acceptable as shown in Table 1.

TABLE 1 - RESULTS OF BLIND PERFORMANCE EVALUATION SAMPLE ANALYSES

ANALYTE	CONCENTRATION	REPORTED VALUE	TRUE VALUE	ACCEPTANCE LIMITS
		(mg/L or pH units)		
BOD	1	20.1	18.6	13.1 - 30.9
	2	48.6	59.7	41.7 - 85.7
pH	3	5.7	5.80	5.66 - 5.99
	4	7.8	7.80	7.55 - 7.97
TSS	1	25.8	29.7	24.2 - 33.3
	2	37.0	41.9	33.3 - 46.6
Residual Chlorine	1	1.15	1.40	.906 - 1.72
	2	3.20	4.00	2.76 - 5.01

7. Quality Assurance/Quality Control

a. BOD. The Marysville lab had split BOD_5 (as well as pH and TSS) samples with the Everett WWTP lab for approximately one month during early 1990 and continues to do so on a periodic basis. Results from the two labs show good correlation for the influent BOD_5 but show significant disparity for the effluent BOD_5. Everett typically got higher results (in the 90-100 mg/L range) than Marysville (in the 25-35 mg/L range). The Everett results were used as input to the Discharge Monitoring Report (DMR), even though there was no evidence to indicate a bias in the Marysville procedure. As indicated by duplicate analyses, precision was good for the Marysville results at both high and low concentrations. Analysis of the glucose/glutamic acid standard also indicates the Marysville lab is capable of producing reliable BOD_5 results. In the future, Marysville should report their own data unless there is evidence to indicate results are not valid.

Analysis of a glucose/glutamic acid standard was being conducted only once per month. A recommendation was made to Mr. Thayer to conduct such a test every twenty samples, or every month, whichever is more frequent.

A VWR Digital Dual Thermometer is being used to monitor refrigerator temperature for BOD_5 incubation. The thermometer reads to 0.1 degree as required by the BOD_5 method, but had not been calibrated against a certified thermometer. A second thermometer is used as a check on the digital thermometer but it, too, had not been calibrated. Recognizing the prohibitive cost of certified thermometers, the Marysville thermometer(s) should be calibrated against a thermometer of known accuracy (e.g., a traceable thermometer borrowed from Everett or elsewhere).

b. pH. The pH meter was being standardized against buffer solutions only once per week. The method requires standardization at the beginning of every batch of samples, using two buffer solutions bracketing the pH of the sample(s). If several samples are tested in a batch, a good practice is to also check the meter against the buffers at the end of the batch.

c. Fecal Coliforms. The thermometer used in the coliform incubator (water bath) was not traceable to a certified thermometer and was graduated in 1° increments (0.1° required). A recommendation was made to purchase a good (but not necessarily certified) thermometer, graduated in 0.1° increments, and calibrate it against a traceable thermometer. This could be accomplished during the next visit of Ecology's roving operator (Mr. Mike Meyers) who carries a traceable thermometer specifically for that purpose.

d. General. The practice of periodically splitting samples with Everett and running the glucose/glutamic acid test for BOD_5 is commendable, but the lab must initiate a much more aggressive QA/QC program to ensure it is in control for all analyses. Once the formal QA program is established, it should be documented in a QA manual. A model QA manual had previously been given to Mr. Thayer and a commitment was made to assist him in its revision as necessary to reflect Marysville's QA program. As a minimum, the QC tests in the Table 2 are recommended. Once the QA program has been functional for a period sufficient to generate the necessary QC data, it was recommended that control charts be used to verify that the lab is in control for all parameters tested (except fecal coliforms). (NOTE: Control charting is explained in the previously mentioned model QA manual.) Control over the fecal coliform determination could be checked by splitting samples with Everett or another nearby facility.

8. Methods. Current copies of all methods employed in the lab, including the latest edition of Standard Methods (Ed. 17), are present in the lab and readily available to the analyst at bench level.

TABLE 2 - RECOMMENDED QUALITY CONTROL TESTS

Parameter	Calibration	Check Standards	Blanks	Duplicates	Performance Evaluation Samples[2]
DO (for BOD procedure)	Air calibrate DO probe each day	1 in 20 samples (or monthly)	Each day[1]	1 in 10 final effluent samples	1 each 6 months
TSS	Balance check each month & each year by service rep	1 per quarter	Each day[1]	1 in 10 samples	1 each 6 months
pH	Each day	1 in 10 samples	N/A	1 in 10 samples	1 each 6 months
Chlorine residual	N/A	1 per quarter	Each day[1]	1 in 10 samples	1 each 6 months
Fecal Coliforms	N/A	N/A	With every sample set	1 in 10 samples	

NOTES: 1. "Each day" above means each day that analyses are normally run.

2. Participation in EPA Water Pollution Studies would satisfy this requirement.