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WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

EDMONDS WASTEWATER TREATMENT PLANT
CLASS II INSPECTION
APRIL 17-19, 1989

by
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Water Body No. 25-00-01
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ABSTRACT

A Class II inspection was conducted on April 17-19, 1989, at the Edmonds Wastewater Treatment Plant. The plant was providing primary treatment and is currently undergoing an upgrade to secondary treatment. At the time of the inspection, the effluent was within permit requirements for BOD_5 (Biochemical Oxygen Demand - 5 day), TSS (Total Suspended Solids), and pH. Fecal coliform numbers were high, probably due to the sampling location and method used by Ecology. Copper, mercury, silver, lead, zinc, cyanide and un-ionized ammonia were found at levels above water quality criteria in the effluent. An acute (96-hour) effluent bioassay test on Rainbow trout resulted in 100% mortality in 65% effluent. The effluent was also highly toxic to Microtox, echinoderm and Pacific oyster. A sediment sample collected at the outfall in Puget Sound showed phenol and mercury to be above Ecology's Interim Sediment Quality Evaluation criteria. Several polyaromatic hydrocarbons were found at levels exceeding sediment criteria in the outfall and background samples. Sediment bioassay results did not indicate toxicity in the sediments.

INTRODUCTION

A Class II inspection was conducted on April 17-19 1989, at the Edmonds Wastewater Treatment Plant (WTP). Conducting the inspection were Carlos Ruiz and Keith Seiders from the Department of Ecology (Ecology) Compliance Monitoring Section. Mike Dawda from Ecology's Northwest Regional Office requested and assisted in the inspection. The WTP was operating as a primary treatment facility and was undergoing an upgrade to secondary treatment as required by the Federal Clean Water Act. The City of Edmonds expects the entire secondary treatment plant to be completed in 1991.

Objectives of the survey were to:

1. Verify compliance with permit parameters, notably the effluent limitations.

2. Analyze performance of the WTP by determining plant loading and efficiency.

3. Characterize the WTP influent and effluent chemically to identify toxic pollutants prior to an upgrade.

4. Assess the toxic effect of whole effluent and sediments surrounding the outfall using biological indicators.

5. Assess the permittee's self-monitoring by reviewing laboratory, sampling, and flow measurement procedures.

LOCATION AND DESCRIPTION

The Edmonds WTP is located at the corner of Dayton Street and S.R. 104 in the City of Edmonds (Figure 1). The original primary treatment facility was built in 1957, expanded in 1959 and again in 1967. The WTP processes sewage from Edmonds, Mountlake Terrace and the Ronald Sewer District.

A schematic of the plant as it appeared in April 1989 is shown in Figure 2. The plant has two raw wastewater influent streams which undergo separate primary treatment. The streams are combined in a wet well and chlorinated before being pumped approximately 2000 feet through a 30-inch discharge pipe which provides additional mixing and chlorine contact time. The outfall consists of a 36-inch pipe with a 160-foot long diffuser, located approximately 1000 feet offshore in Puget Sound.

Influent flow on the Edmonds side is measured with a Parshall flume. The combined effluent flow from both sides is measured by a Sparling propeller meter located on the discharge pipe below the effluent pumps. The flow on the Mount Lake Terrace side is considered to be the difference between the Edmonds influent and the combined effluent.

Sludge from the five primary clarifiers is thickened, centrifuged and incinerated. The sludge ash is disposed of in a landfill. The liquid fraction from the centrifuge (centrate) is

combined with the liquid fraction from the sludge thickener and returned to a point in the Edmonds side influent stream below the influent sampler and Parshall flume locations.

The Edmonds plant is currently discharging under NPDES Permit No. WA-002405-8. This permit expires August 1, 1990. The current effluent limits are contained in Order No. DE 85-639 (First Amendment).

METHODS

A complete listing of sampling times, stations, and parameters analyzed is given in Table 1. Sampling locations are noted on Figures 1 and 2.

Ecology collected influent and effluent composite and grab samples from the waste streams on both the Edmonds and Mountlake Terrace sides. The influent samples were analyzed for nutrients, conventional pollutants and priority pollutants. The effluents were analyzed for nutrients and conventional pollutants.

In order to assess the permittee's self-monitoring ability, the Edmonds side influent and effluent composites collected by Ecology, as well as the Edmonds side composite samples routinely collected by the WTP, were split for analysis by each laboratory.

Ecology also collected combined chlorinated effluent composite and grab samples at the point where the combined effluent exited the wet well. These samples were analyzed for nutrients, conventional pollutants and priority pollutants. A manually collected composite for acute (trout and Microtox) and chronic (echinoderm and Pacific oyster) bioassays was collected concurrently with the grab samples at this site. Samples for fecal coliform analysis were collected from the final effluent discharge pipe approximately 50 feet from the wet well exit.

An additional composite sample was collected from the first primary clarifier on the Mountlake Terrace side (construction activities associated with upgrading the WTP had created standing water problems and this water was removed by pumping it to the first Mountlake Terrace side primary clarifier). This sample was analyzed for nutrients and conventional pollutants.

The composite samples (with the exception of the manual composite for bioassays) were collected with ISCO automatic samplers. The samplers were specially cleaned following the priority pollutant cleaning protocol included in Appendix A. The sample collection jugs were iced to cool the samples as they were collected. The sampling scheme for each was as follows:

Influent (Edmonds side)	335 mLs every 30 minutes for 24 hours
Influent (Mt Lake Terrace side)	240 mLs every 30 minutes for 24 hours
Effluent (Edmonds side)	240 mLs every 30 minutes for 24 hours
Effluent (Mt Lake Terrace side)	250 mLs every 30 minutes for 24 hours

Effluent (Combined)	340 mLs every 30 minutes for 24 hours
Effluent (Mt Lake Terrace primary clarifier)	information not available

A sludge ash sample was collected for priority pollutant metals and EP toxicity metals analysis. A sample of the centrate from the sludge centrifuge was analyzed for nutrients and conventional pollutants.

Composite sediment samples for priority pollutant and amphipod bioassay analysis were collected in and around the outfall area in Puget Sound (see Figure 1). Samples were collected using a 0.1 m^2 van Veen grab sampler following Puget Sound Protocols (Tetra Tech, 1986). Sample A was collected 25-35 feet perpendicular to the outfall ridge, approximately 1000 feet from shore. Sample B was collected 500 feet southwest of the outfall, 150 feet off the end of the Dayton Street fishing pier. A background sample (sample C) was collected roughly 6000 feet northeast of the outfall, 1500 feet from shore.

The analytical methods used by Ecology are listed in Table 2, along with the laboratory performing the analysis.

RESULTS

Analytical results obtained by Ecology are summarized in Table 3.

Comparison of Inspection Results to NPDES Permit Limits

A comparison of effluent analytical results to the effluent limits as detailed in Order No. DE 85-639 (First Amendment) is shown in Table 4. Ecology did not verify flows during the inspection. The combined effluent flow of 5.5 MGD and the Edmonds side flow of 1.5 MGD were obtained from WTP totalizers for the period that the composites were collected.

BOD_5, TSS and pH discharge requirements were being met at the time of the inspection. BOD and TSS removals were 32% and 66% respectively.

Fecal coliforms were reported by Ecology as 'too numerous to count'. Ecology's grab samples were collected approximately 50 feet from the effluent wet well discharge point and immediately dechlorinated. The effluent wet well was not designed to function as a chlorine contact chamber and did not provide sufficient detention time for disinfection.

Edmonds' fecal coliform samples were collected at the same location as Ecology's. The samples were held for a time, determined from the effluent flow rate, equivalent to the detention time achieved in the 2000 feet of discharge pipe. Samples were then dechlorinated and analyzed. Using this method the WTP reported a monthly average fecal coliform count of 54/100 mLs in April 1989.

Influent and Effluent Chemistry

Nutrients

Ammonia nitrogen was measured in the composite effluent at 26.6 mg/L. The un-ionized ammonia level at this concentration exceeds chronic and acute water quality criteria for freshwater over a wide range of pH and temperature conditions (EPA, 1986). Criteria for saltwater have not been derived.

Priority Pollutants

The results of influent and effluent priority pollutant analyses for organics and metals are contained in Appendix B.

Priority pollutant organics and metals found in the influent and effluent along with water quality criteria are summarized in Table 5.

A number of organics were found at low levels in both influents and the combined effluent. No organics were detected at levels exceeding water quality criteria.

Acute and/or chronic water quality criteria for metals were exceeded in the effluent by copper, silver, lead, mercury, and zinc (EPA, 1986). Influent levels of the metals were comparable to effluent concentrations indicating that metals are not being removed by primary treatment.

Cyanide was present in the effluent at a concentration of 8 μg/L. The acute and chronic criteria established for saltwater is 1.0 ug/L (EPA, 1986).

Effluent Bioassay

Chlorine residuals were not detected when the samples were evaluated at the Manchester Laboratory, therefore, a chlorine neutralizing agent was not added before transferring the samples to contract laboratories for bioassay analysis.

The acute bioassay tests (trout and Microtox) showed the effluent to be highly toxic. The trout bioassay resulted in 100% mortality in 65% effluent in 96 hours. Microtox results showed an EC_{50} of 6.1 percent.

Chronic toxicity was also high. The echinoderm bioassay using green sea urchin resulted in an EC_{50} of 11.3%, NOEC of 1.0%, and LOEC of 3.0 percent.* Pacific oyster results showed an EC_{50} of 3.8%, NOEC of 3.2%, and LOEC of 5.6 percent.

Chronic bioassay data are included in Appendix C.

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* EC_{50} - the 'effective concentration' at which half of the test organisms are affected by the response of interest.
NOEC - the 'no observable effect concentration' which produces no statistically significant response by the test organism.
LOEC - the 'lowest observable effect concentration' which produces a statistically significant response by the test organism.

The effluent's effect on these organisms could be due to copper, silver, lead, mercury, zinc and/or cyanide present at levels exceeding water quality criteria for fresh and/or saltwater (Table 5). The pH and temperature conditions under which the trout bioassay was conducted were such that the acute and chronic criteria for un-ionized ammonia in freshwater were exceeded.

Sludge Chemistry

The sludge ash priority pollutant metal results are presented in Table 6.

Due to laboratory error, the sample was not analyzed for EP Tox metals. This analysis is required to determine the solid waste designation (Ecology, 1989) and would have given information about the potential for sludge ash leachate toxicity in a landfill setting. Using the priority pollutant data for total metals concentration to calculate a maximum possible EP Tox concentration for each of the metals concerned (with the exception of barium for which a total concentration is not available) shows that the maximum possible EP Tox concentration is below the dangerous waste designation for each of the metals but lead (Ecology, 1989 and Table 6).

The total metal concentrations used in these calculations are obtained from a much more rigorous extraction procedure (Tetra Tech, 1986) than the EP Tox procedure so the actual EP Tox metal concentrations are most likely much lower than these calculated values. Therefore, the lead concentration can probably be assumed to be below the dangerous waste designation.

Sediment Chemistry - Puget Sound

A number of organic pollutants were found in the sediments (Table 7). Several PAHs (polyaromatic hydrocarbons) were detected in the outfall (Sample A) and background sediment (Sample C) at levels exceeding Ecology's criteria for sediments (Betts, 1989). Most of these PAHs were also found in Sample B, collected 500 feet from the outfall, but at lower levels. Phenol was found in Sample A, collected at the outfall, at a concentration exceeding sediment criteria. Phenolic compounds measured by EPA method 420.1 (EPA, 1983) were found at a higher concentration in Sample A than in the other samples.

A number of metals were detected in all three sediment samples (Table 8). Sediments collected at the outfall (Sample A) showed the highest metals concentration, and the background sediments (Sample C) showed the lowest. At the outfall, mercury is currently at the Ecology sediment criteria level of .41 mg/Kg dry wt and silver at 5.88 mg/Kg dry wt, is close to the criteria level of 6.1 mg/Kg dry wt (Betts, 1989).

Sediment Bioassay

Rhepoxynius bioassays were conducted on the sediments (Table 9). The samples met the sediment criteria for the amphipod test with mean mortalities of less than 25% (Betts, 1989). The control and background samples were within the performance guidelines for a valid test.

The background sample had the lowest survival and the highest avoidance response. This could be due to the elevated levels of PAHs found in that sample.

Assessment of Self-Monitoring

A comparison of laboratory results obtained by the Edmonds laboratory and Ecology on split samples is presented in Figures 3 and 4. Edmonds' BOD_5 results on split samples are consistently and significantly (>20%) lower than Ecology's for both influent and effluent samples. Agreement between labs on individual TSS splits is excellent.

There are major differences between the influent samples collected by the Edmonds and Ecology composite samplers. Each lab found approximately 50% more BOD_5 and 60-70% more TSS in the Ecology influent sample than in the Edmonds influent sample. Both labs actually measured more BOD_5 in the Edmonds effluent than the Edmonds influent. Based on these observations, the representativeness of the Edmonds influent sample is suspect.

Edmonds did not adequately cool their composite samplers as is evident by the temperatures listed under field observations in Table 3. Composite samplers should be cooled to 4^0C.

A complete laboratory review sheet is included in Appendix D of this report. The following comments are made concerning laboratory procedures:

Sample Collection--Compositors were cooled with blue ice. This may not be an adequate method.

pH--The pH meter should be calibrated every day it is used.

TSS--The drying cycle should be repeated every two months to assure that constant filter weight has been reached.

Fecal Coliform--The work bench should be disinfected before and after testing. 10-15 power magnification is recommended for counting.

CONCLUSIONS AND RECOMMENDATIONS

The Edmonds Wastewater Treatment Plant was operating within its permitted requirements for BOD_5, TSS and pH at the time of the inspection. Fecal coliforms were 'too numerous to count', probably due to Ecology's sampling method which did not allow for adequate chlorine contact time before neutralization. Edmonds neutralized their samples after a pre-determined chlorine contact time based on flow rate in the 2000-foot discharge pipe. Edmonds should verify that this method accurately reflects the disinfection achieved. Once the new plant is on-line, split samples for fecal coliform are recommended for self-monitoring assessment.

Plant loading was below the effluent limits specified in the first amendment to Order No. DE 85-639 of the NPDES permit. Removal efficiencies were 32% for BOD and 66% for TSS.

Copper, silver, lead, mercury, zinc and cyanide exceeded acute and/or chronic marine water quality criteria.

The final effluent proved to be highly toxic to a variety of fresh and saltwater organisms, both in acute and chronic tests. Elevated concentrations of copper, mercury, silver, lead, zinc, cyanide and/or ammonia may be responsible. The secondary treatment facility now under construction should reduce the concentrations of these toxicants (as well as the concentration of volatile and semi-volatile organics) in the effluent. If these chemicals are responsible for the toxicity, future bioassay analysis using the same organisms may show improved results.

Another attempt should be made to conduct an EP Tox metals analysis of the sludge ash to determine its suitability for landfill disposal.

Analysis of sediment samples showed that the levels of phenol and mercury at the outfall exceed Ecology's Interim Sediment Quality evaluation criteria. Several PAHs were found in the outfall and background samples at concentrations exceeding Ecology's criteria. *Rhepoxynius* bioassays conducted on the outfall samples met Ecology's sediment criteria for the amphipod test.

The discrepancies in BOD_5 results between Ecology and Edmonds in the inter-laboratory comparison need to be addressed. Further split samples or performance evaluation samples are recommended. Composite samplers should be maintained at 4^0C. A laboratory visit by the roving operator to observe BOD_5 procedures may also be beneficial.

The sampling locations chosen for the new plant should be carefully evaluated to ensure representative samples.

REFERENCES

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FIGURES

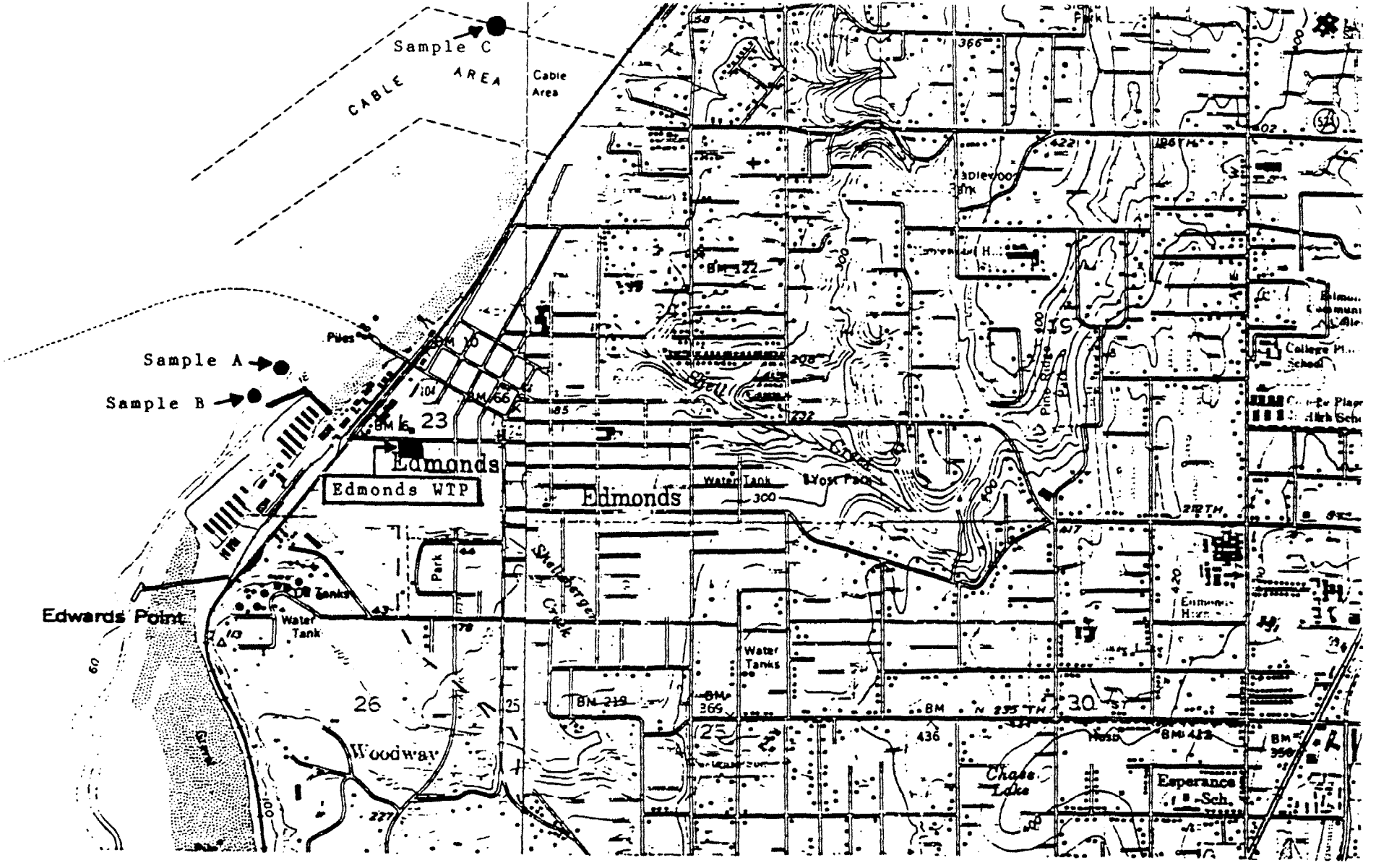


FIGURE 1
Edmonds WTP - Site Location
(Showing sediment samples)
April 1989

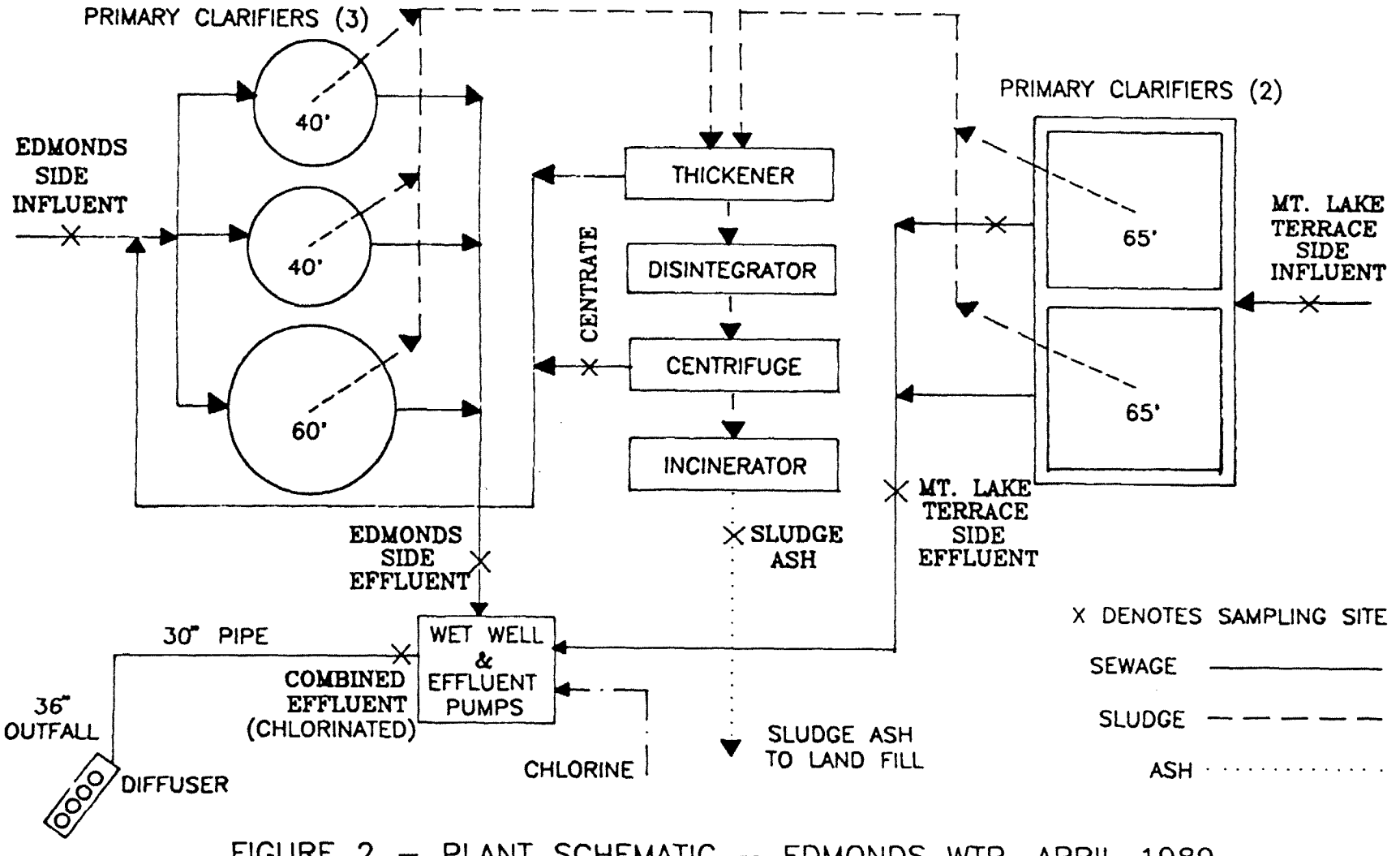


FIGURE 2 – PLANT SCHEMATIC – EDMONDS WTP, APRIL 1989

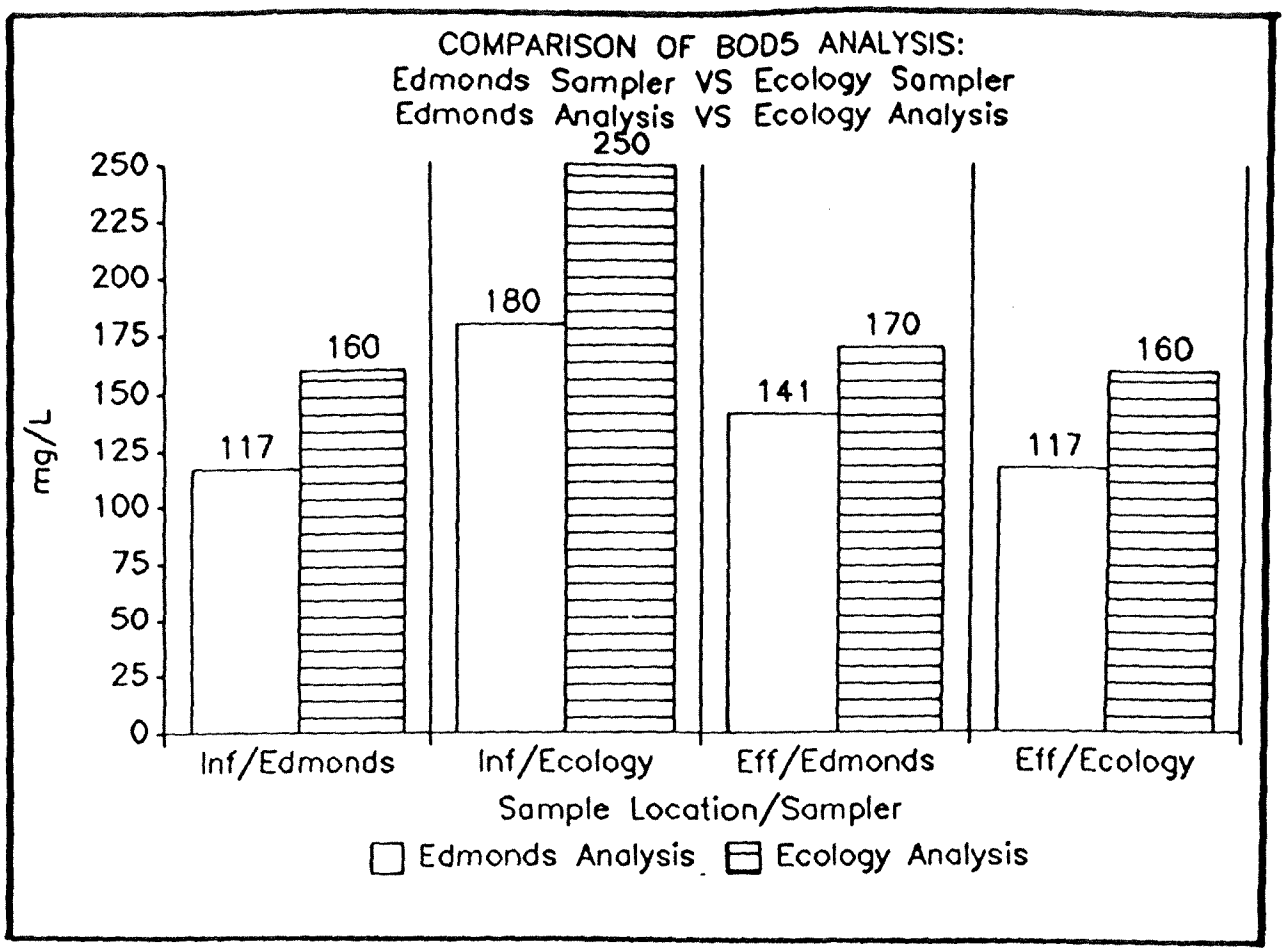
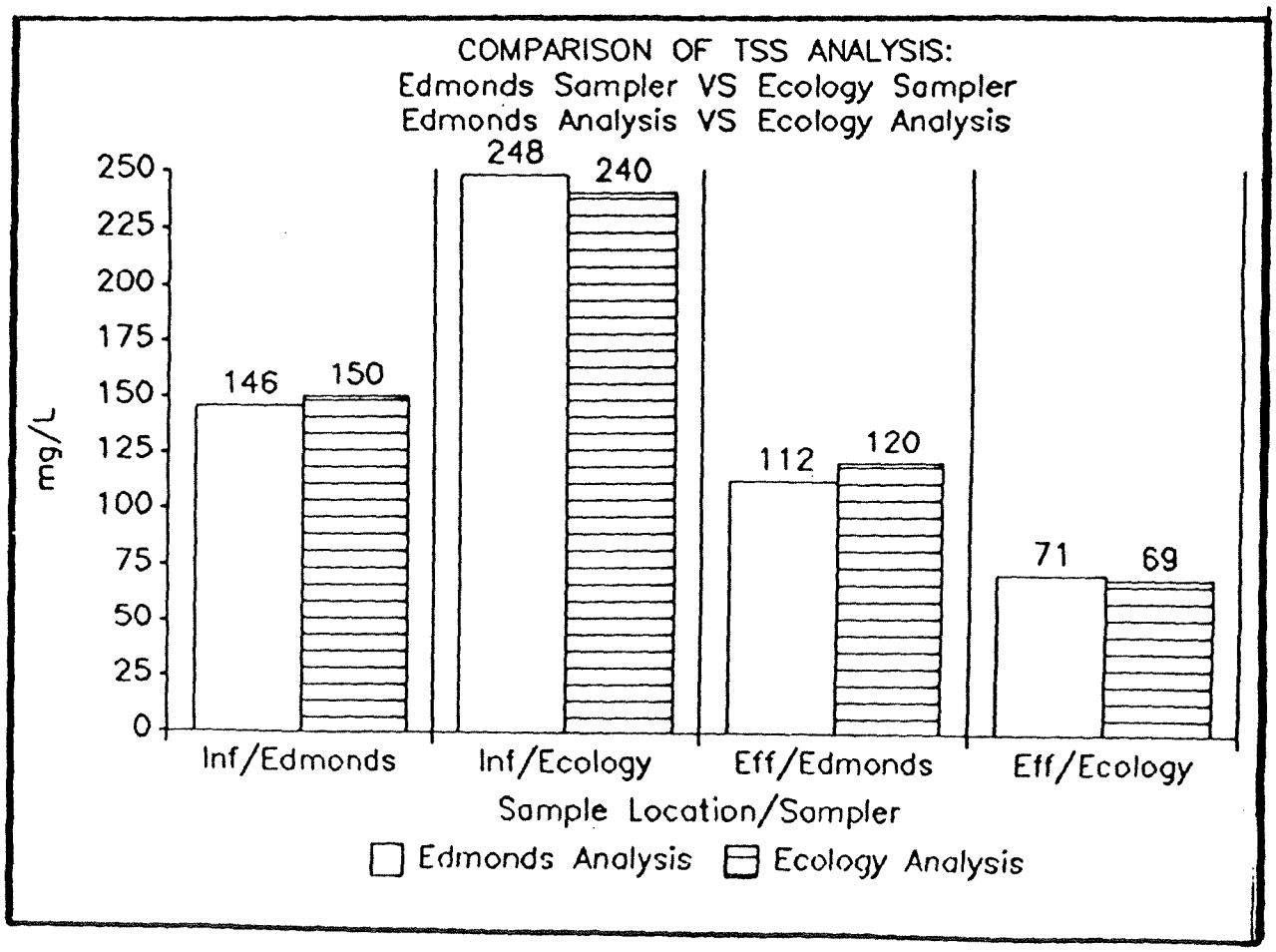


Figure 3



Figure

TABLES

Table 1 - Sampling times and parameters analyzed - Edmonds WTP - April 1989.

Station:	Edmonds Influent				Mountlake Terrace Influent			Edmonds Effluent				Mountlake Terrace Effluent			Combined Effluent		
Sampler:	Ecology	Edmonds	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Edmonds	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
Type:	Comp.	Comp.	Grab	Grab	Comp.	Grab	Grab	Comp.	Comp.	Grab	Grab	Comp.	Grab	Grab	Comp.	Grab	Grab
Date:	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-18-89	4-19-89
Time:			13:45	08:25		14:10	09:05			13:45	08:42		14:15	09:25		15:20	09:45
Parameter / Sample ID:	168093	168098	168081	168080	168094	168083	168082	168096	168099	168087	168086	168097	168089	168088	168095	168085	168084
GENERAL CHEMISTRY																	
Turbidity (NTU)	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Conductivity (umhos/cm)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Alkalinity (mg/L as $CaCO_3$)	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Hardness (mg/L as $CaCO_3$)	X				X			X				X			X		
Cyanide (ug/L)*	X				X										X		
SOLIDS (mg/L)																	
TS	X				X			X				X					
TNVS	X				X			X				X					
TSS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
TNVSS	X				X			X				X					
TVSS		X	X	X		X	X		X	X	X		X	X	X		
BOD_5 (mg/L)	X	X			X			X	X			X					
COD (mg/L)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
NUTRIENTS (mg/L)																	
NH_3-N	X	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	X		
T-Phosphate	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Fecal Coliform (#/100mL)																X	X
% Solids																	
% Volatile solids																	
Phenols (ug/L)*	X		X		X	X				X					X		
TOC (mg/L)*				X			X			X			X		X		
Oil & Grease (mg/L)				X			X				X			X			
Grain Size																	
PRIORITY POLLUTANTS																	
BNA's	X				X	X									X		
Pest/PCB	X				X	X									X		
VOA				X			X									X	X
Metals	X				X	X									X		
EP TOX METALS																	
BIOASSAYS																	
Trout															X		
Microtox															X		
Echinoderm															X		
Pacific oyster															X		
Rhepox. a.																	
FIELD OBSERVATIONS																	
Temp (°C)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
pH (S.U.)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Conductivity (umhos/cm)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chlorine (mg/L)																X	X

* Sediment units are mg/Kg dry weight

Table 1 - Continued

Parameter	Station:	1st Prim MLT	Blank	Sludge Ash	Sludge Centrate	Sediments Sample C	Sediments Sample A	Sediments Sample B
	Sampler:	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
	Type:	Composite	Grab	Grab	Grab	Grab	Grab	Grab
	Date:	4-19-89	4-18-89					
	Time:							
	Sample ID:	168103	168102	168100	168101	168090	168091	168092
GENERAL CHEMISTRY								
Turbidity (NTU)								
Conductivity (umhos/cm)								
Alkalinity (mg/L as $CaCO_3$)								
Hardness (mg/L as $CaCO_3$)						X	X	X
Cyanide (ug/L)*			X					
SOLIDS (mg/L)								
TS								
TNVS								
TSS		X			X			
TNVSS								
TVSS		X			X			
BOD_5 (mg/L)		X			X			
COD (mg/L)		X			X			
NUTRIENTS (mg/L)								
NH_3-N		X			X			
NO_3+NO_2-N		X			X			
T-Phosphate		X			X			
Fecal Coliform (#/100mL)						X	X	X
% Solids								
% Volatile solids						X	X	X
Phenols (ug/L)*			X			X	X	X
TOC (mg/L)*					X			
Oil & Grease (mg/L)						X	X	X
Grain Size								
PRIORITY POLLUTANTS								
BNA's			X			X	X	X
Pest/PCB			X			X	X	X
VOA			X			X	X	X
Metals			X	X		X	X	X
EP TOX METALS				X				
BIOASSAYS								
Trout								
Microtox								
Echinoderm								
Pacific oyster								
Rhepox. a.						X	X	X
FIELD OBSERVATIONS								
Temp (°C)		X			X			
pH (S.U.)		X			X			
Conductivity (umhos/cm)		X			X			
Chlorine (mg/L)								

Table 2 - Analytical Methods and Laboratories used - Edmonds WTP - April 1989.

Laboratory Analyses	Method used for Ecology analysis (Ecology, 1988)	Laboratory performing analysis
Turbidity	APHA, 1985: 214A	Ecology
Conductivity	APHA, 1985: 205	Ecology
Alkalinity	APHA, 1985: 403	Ecology
Hardness	APHA, 1985: 314B	Ecology
Cyanide	EPA, 1983: 335.2-1	Ecology
Total solids	APHA, 1985: 209A	Ecology
Total nonvolatile solids	APHA, 1985: 209D	Ecology
Total suspended solids	APHA, 1985: 209C	Ecology
Total nonvolatile suspended solids	APHA, 1985: 209D	Ecology
Total volatile suspended solids	APHA, 1985: 209D	Ecology
BOD_5	APHA, 1985: 507	Ecology
COD	APHA, 1985: 508C	Ecology
NH_3-N	EPA, 1983: 350.1	Aquatic Research Inc.
NO_3+NO_2-N	EPA, 1983: 353.2	Aquatic Research Inc.
T-Phosphate	EPA, 1983: 365.1	Aquatic Research Inc.
Fecal coliform	APHA, 1985: 909C	Ecology
% Solids	APHA, 1985: 209F	Analytical Resources Inc.
Phenols	EPA, 1983: 420.1	Ecology
TOC (water)	APHA, 1985: 505	Ecology
TOC (sediments)	Tetra Tech, 1986	Analytical Resources Inc.
Grain Size	Tetra Tech, 1986	Laucks
Oil & Grease	EPA, 1983: 413.1	Ecology
BNAs (water)	EPA, 1984: 625	Ecova
BNAs (solids)	EPA, 1986a: 8270	Ecova
PCB/Pesticides (water)	EPA, 1984: 608	Ecova
PCB/Pesticides (solids)	EPA, 1986a: 8080	Ecova
Volatile organics (water)	EPA, 1984: 624	Ecova
Volatile organics (solids)	EPA, 1986a: 8240	Ecova
Metals-priority pollutant (water)	Tetra Tech, 1986	Analytical Resources, Inc.
Metals-priority pollutant (solids)	Tetra Tech, 1986	Analytical Resources, Inc.
Salmonid - acute	Ecology, 1981	Biomed
Microtox - acute	Beckman	Ecova
Echinoderm - chronic	Dinnel, et. al, 1987	E.V.S.
Pacific oyster - chronic	ASTM, 1986	E.V.S.
Rhepoxynius abronius	Tetra Tech, 1986	E.V.S.

Table 3 - General Chemistry results - Edmonds WTP - April 1989

Station:	Edmonds Influent				Mountlake Terrace Influent			Edmonds Effluent				Mountlake Terrace Effluent			Combined Effluent		
Sampler:	Ecology	Edmonds	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Edmonds	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
Type:	Comp.	Comp.	Grab	Grab	Comp.	Grab	Grab	Comp.	Comp.	Grab	Grab	Comp.	Grab	Grab	Comp.	Grab	Grab
Date:	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-18-89	4-19-89	4-19-89	4-18-89	4-19-89
Time:			13:45	08:25		14:10	09:05			13:45	08:42		14:15	09:25		15:20	09:45
Parameter / Sample ID:	168093	168098	168081	168080	168094	168083	168082	168096	168099	168087	168086	168097	168089	168088	168095	168085	168084
GENERAL CHEMISTRY																	
Turbidity (NTU)	60	40	35	51	59	47	50	37	47	36	32	38	30	32			
Conductivity (umhos/cm)	741	696	430	476	500	490	495	611	647	740	550	461	470	471	547		
Alkalinity (mg/L as $CaCO_3$)	150	150	140	170	180	170	180	150	150	150	160	170	170	170			
Hardness (mg/L as $CaCO_3$)	82				42			71				39			47		
Cyanide (ug/L)*	2 U				2 U										8		
SOLIDS (mg/L)																	
TS	700				560			480				360					
TNVS	350				190			300				270					
TSS	240	150	83	380	200	210	190	69	120	71	71	54	54	71	71		
TNVSS	33				50			15				7					
TVSS		139	19	357		26	166		91	19	63		10	29	45		
BOD_5 (mg/L)	250	160			200			160	170			140					
COD (mg/L)	590	359	263	388	587	546	466	309	394	301	270	308	263	239	370		
NUTRIENTS (mg/L)																	
NH_3-N	17.118	22.622	46.759	13.294	20.342	17.692	21.982	18.051	21.127	24.750	11.118	40.770	24.042	25.317	26.588		
NO_3+NO_2-N	0.518	0.446	0.783	0.668	0.100	0.093	0.160	0.164	0.037	0.407	0.561	0.016	0.016	0.103	0.086		
T-Phosphate	5.963	5.661	4.808	5.642	6.039	3.483	3.025	4.463	0.052	6.518	4.399	6.030	7.093	5.727	7.747		
Fecal Coliform (#/100mL)																67000 L,P	67000 L,P
% Solids																	
% Volatile solids																	
Phenols (ug/L)*	12.1		10.1		24.1	20.1				14					22.1		
TOC (mg/L)*				105			118			108			94.3		120		
Oil & Grease (mg/L)				39			42				13			5			
FIELD OBSERVATIONS																	
Temp (°C)	4.8	9.7	15.3	14.4	4.0	15.5	15.7	4.6	10.8	15.3	14.3	5.8	16.1	15.5	5.4	16.9	15.1
pH (S.U.)	7.75	7.63	7.61	8.38	7.60	7.74	7.85	7.36	7.08	7.76	7.26	7.41	7.71	7.73	7.32	7.24	7.32
Conductivity (umhos/cm)	800	845	565	805	504	555	480	750	630	795	559	509	520	494	575	616	572
Chlorine (mg/L) (free available:total residual)																.35:1.4	.095:0.55

* Sediment units are mg/Kg dry weight
U Compound was analyzed for but not detected. The associated numerical value is the sample quantitation detection
L Total plate count greater than 200
P Greater than

Table 3 - Continued

Parameter	Station:	1st Prim MLT	Blank	Sludge Ash	Sludge Centrate	Sediments Sample C	Sediments Sample A	Sediments Sample B
	Sampler:	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology	Ecology
	Type:	Composite	Grab	Grab	Grab	Grab	Grab	Grab
	Date:	4-19-89	4-18-89					
	Time:							
	Sample ID:	168103	168102	168100	168101	168090	168091	168092
GENERAL CHEMISTRY								
Turbidity (NTU)								
Conductivity (umhos/cm)								
Alkalinity (mg/L as $CaCO_3$)								
Hardness (mg/L as $CaCO_3$)								
Cyanide (ug/L)*			2 U			.044 U	.066 U	.064 U
SOLIDS (mg/L)								
TS								
TNVS								
TSS		53			6500			
TNVSS								
TVSS		53			5500			
BOD_5 (mg/L)		120			2900			
COD (mg/L)		288			12300			
NUTRIENTS (mg/L)								
NH_3-N		27.152			42.206			
NO_3+NO_2-N		0.006			0.128			
T-Phosphate		4.238			9.855			
Fecal Coliform (#/100mL)								
% Solids						71.51	49.43	64.79
% Volatile solids								
Phenols (ug/L)*			2.01			0.11	1.46	0.11
TOC (mg/L)*					1040	1300	4300	4900
Oil & Grease (mg/L)								
FIELD OBSERVATIONS								
Temp (°C)		15.3			14.8			
pH (S.U.)		7.31			6.76			
Conductivity (umhos/cm)		503			850			
Chlorine (mg/L)								

Table 4 - Comparison of NPDES Permit Limits to Inspection Results - Edmonds WTP - April 1989.

Parameters	NPDES Permit Limits*		Ecology Inspection Results		
	Monthly Average	Weekly Average	Edmonds	Mt. Lake Terrace	Combined effluent
BOD_5					
mg/L			160	140	145.5 +
lb/D	9,640	10,500	2001	4669 +	6670 +
% Removal			36	30	32
TSS					
mg/L	115	140	69	54	71
lb/D	6,710	8,170	863	1801 +	3256
% Removal			71	73	66
Fecal Coliform (#/100 ml)	700	1500			67,000 LP
Flow					
MGD	7.0 **	10.0 ***	1.5	4 +	5.5
pH	Shall not be outside the range 6.0-9.0		7.36	7.41	7.32

* - First Amendment to Order No. DE 85-639 of Permit No. WA-002405-8
** - Average annual flow
*** - Peak wet weather flow

\+ - Calculated rather than measured concentration, load or flow.

L - Total plate count greater than 200.
P - Greater than.

Table 5 - Priority Pollutants Detected - Edmonds WTP - April 1989.

	Influent Edmonds	Influent Mt. Lake Terrace	Effluent-combined		EPA Water Quality Criteria+* Saltwater Acute (ug/L)	Saltwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)
Volatile Organics (ug/L)								
Chloromethane			1 J		--	--	--	--
Methylene Chloride			64	3 J	--	--	--	--
Acetone		61	730	170	--	--	--	--
Chloroform	7	6	10	9	--	--	28,900 **	1,240**
2-Butanone				7 M	--	--	--	--
Tetrachloroethene		2 J	1 J	15	10,200 **	450 **	5,280 **	840**
Toluene			2 J	2 J	6,300 **	5,000 **	17,500 **	--
Xylenes	1 J		3 J	1 J	--	--	--	--
BNAs (ug/L)								
Phenol	3 J	4 J	5 J		5,800 **	--	10,200 **	2,560**
Benzyl Alcohol	140	42	65		--	--	--	--
4-Methylphenol	18	28	39		--	--	--	--
Benzoic acid	10 J	51	140		--	--	--	--
Diethyl Phthalate	7 J	8 J	9 J		--	--	--	--
Di-n-Butyl Phthalate	1 J	2 J	2 J		--	--	--	--
Butylbenzylphthalate	2 J	3 J	4 J		--	--	--	--
Di-n-Octyl Phthalate	2 J	1 J	2 J		--	--	--	--
Pesticides								
beta-BHC		0.039 J			0.34 ** (total BHC)		100 ** (total BHC)	
gamma - BHC (Lindane)		0.039 J						
Metals (ug/L)								
Arsenic	3.3							
(III)					69	36	360	190
Chromium		5						
(III)					10,300 **	--	936	112
Copper	62	61	59		2.9	--	8.7	6.2
Lead	9.2	16.3	20.8		140	5.6	31	1.2
Mercury	0.5	1.8	0.4		2.1	0.025	2.4	0.012
Silver	14		9		2.3	--	1.1	0.12
Zinc	113	127	107		170	58	172	47
Cyanide (ug/L)			8		1.0	1.0	22	5.2

+ - Hardness dependent criteria based on 47 mg/L hardness as $CaCO_3$ in combined effluent.
* - EPA, 1986
** - L.O.E.L. (Lowest observable effects level)
J - Indicates an estimated value when result is less than specified detection limit.
M - Indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters.

Table 6 - Sludge metal results compared to Ecology criteria - Edmonds WTP - April 1989.

Total Priority Pollutant Metals	Sludge ash analysis (mg/Kg dry wt)	Maximum possible EP Tox conc (mg/L)	Dangerous Waste Concentration* (mg/L)
Antimony	0.580		
Arsenic	2.58	0.029	5.0-500
Beryllium	0.13 U		
Cadmium	1.50	0.075	1.0-100
Chromium	40.6	2.03	5.0-500
Copper	210		
Lead	163	8.15	5.0-500
Mercury	0.05 U	N.D.	0.2-20
Nickel	58.1		
Selenium	0.26	0.013	1.0-100
Silver	40.3	2.02	5.0-500
Thallium	0.132 U		
Zinc	394		

* - Ecology, 1989.
U - indicates compound was anlyzed for but not detect at the given detection limit.

Table 7 - Sediment Chemistry (organics) - Edmonds - April 1989.

	Sample A (outfall)	Sample B (near outfall)	Sample C (background)	Sediment Criteria*
TOC (mg/Kg dry wt)	4300	4900	1300	
Nonpolar Organics (mg/Kg TOC basis)				
LPAH(1)	276	18	803	370
Acenaphthylene			42 J	66
Fluorene	30 J		92 J	23
Phenanthrene	193	18 J	561	100
Anthracene	53 J		108 J	220
Fluoranthene	188	41 J	654	160
Pyrene	226	35 J	646	1000
Benzo(a)Anthracene	84 J	12 M	231 J	110
Chrysene	123	24 J	323 J	110
Bis(2-Ethylhexyl)phthalate	30 J	39 J	42 J	47
Benzo(b)Fluoranthene	63 J	15 J	138 J	230 **
Benzo(k)Fluoranthene	56 J	10 J	200 J	
Benzo(a)Pyrene	79 J	11 J	208 J	99
Indeno(1,2,3-cd)Pyrene	42 J		108 J	33
Benzo(g,h,i)Perylene	49 J		123 J	31
HPAH(2)	910	148	2631	960
Phenol (mg/Kg dry wt)	0.580			0.420
Phenolics (mg/Kg dry wt)	1.46	0.11	0.11	
Grain Size Analysis				
Gravel	3	3	5	
Sand	90.0	96.4	94.3	
Silt	3.4	0.6	0.7	
Clay	2.7	0.1	0.1	

* - Betts, 1989

** - Total benzofluoranthenes (b+k)

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

M - Indicates an estimated value of anlyte found and confirmed by anlyst but with low spectral match parameters.

(1) - LPAH criteria is applicable to the sum of the following compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene.

(2) - HPAH criteria is applicable to the sum of the following compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Table 8 - Sediment Chemistry (metals) - Edmonds - April 1989.

	Sample A (outfall)	Sample B (near outfall)	Sample C (background)	Sediment Criteria*
Metals detected (mg/Kg dry wt)				
Antimony		2.12		150
Arsenic	3.91	2.88	2.57	57
Cadmium	0.64			5.1
Chromium	27.4	24.1	12.5	260
Copper	54.7	14.5	6.53	390
Lead	23.7	7.7	4.9	450
Mercury	0.41	0.07		0.41
Nickel	28.8	24.5	10.6	NV(1)
Silver	5.88	0.91		6.1
Zinc	131	40.2	23.4	410

(1) - A criteria has not been established
* - Betts, 1989

Table 9 - Amphipod Bioassay Results - Edmonds WTP - April 1989.

	Mean Values ± S.D.		
	Survival (1)	Avoidance (2)	% Reburial (3)
Sample C-background	16.6 ± 2.6	1.9 ± 2.0	100
Sample A-outfall	17.0 ± 1.2	0.4 ± 0.9	98
Sample B-near outfall	17.8 ± 1.5	0.1 ± 0.3	100
Analytical control	18.8 ± 1.1	0.9 ± 1.3	98

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

APPENDICES

APPENDIX A.

Priority Pollutant Cleaning Procedures

APPENDIX A

Priority Pollutant Sampling Equipment Cleaning Procedures

1. Wash with laboratory detergent
2. Rinse several times with tap water
3. Rinse with 10% HNO_3
4. Rinse three times with distilled/deionized water
5. Rinse with high purity methylene chloride
6. Rinse with high purity acetone
7. Allow to dry and seal with aluminum foil

APPENDIX B.

Priority Pollutant Scans

Appendix B - Results of priority pollutant scan - Edmonds WTP - April 1989.

	Influent/Effluent					Sediments		
Station:	Inf-Edmonds	Influent-MLT	Eff-comb	Eff-comb	Blank	Sample C	Sample A	Sample B
Type:	grab	grab	grab	grab		grab	grab	grab
Date:	4-19-89	4-19-89	4-18-89	4-19-89	4-18-89	4-17-89	4-17-89	4-17-89
Time:	08:25	09:05	15:20	09:45				
Sample ID #:	168080	168082	168085	168084	168102	168090	168091	168092
VOA Compounds	(ug/L)					(ug/Kg) dry		
Chloromethane	10 U	10 U	1 J	10 U	10 U	13 U	15 U	15 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	13 U	15 U	15 U
Vinyl Chloride	10 U	10 U	10 U	10 U	10 U	13 U	15 U	15 U
Chloroethane	10 U	10 U	10 U	10 U	10 U	13 U	15 U	15 U
Methylene Chloride	5 U	5 U	64	3 J	5 U	7 U	2 J	7 U
Acetone	50 B	61	730	170	10 U	16 B	30 B	17 B
Carbon Disulfide	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
1,1-Dichloroethane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Chloroform	7	6	10	9	10 U	5 U	7 U	8 U
1,2-Dichloroethane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
2-Butanone	10 U	10 U	10 U	7 M	10 U	13 U	6 UJ	2 UJ
1,1,1-Trichloroethane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Carbon Tetrachloride	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Vinyl Acetate	10 U	10 U	10 U	10 U	10 U	13 U	15 U	15 U
Bromodichloromethane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
1,2-Dichloropropane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
trans-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Dibromochloromethane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
1,1,2-Trichloroethane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Benzene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
cis-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Bromoform	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
4-Methyl-2-Pentanone	10 U	10 U	10 U	10 U	10 U	13 U	15 U	15 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	13 U	15 U	15 U
Tetrachloroethene	5 U	2 J	1 J	15	5 U	7 U	8 U	7 U
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Toluene	5 U	5 U	2 J	2 J	5 U	7 U	8 U	7 U
Chlorobenzene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Styrene	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U
Total Xylenes	1 J	5 U	3 J	1 J	5 U	7 U	8 U	7 U
1,2-Dichloroethene (total)	5 U	5 U	5 U	5 U	5 U	7 U	8 U	7 U

Appendix B - Continued

	Influent/Effluent				Sediments		
Station:	Inf-Edmonds	Influent-MLT	Eff-comb	Blank	Sample C	Sample A	Sample B
Type:	composite	composite	composite	transfer	grab	grab	grab
Date:	4-19-89	4-19-89	4-19-89	4-18-89	4-17-89	4-17-89	4-17-89
Sample ID #:	168093	168094	168095	168102	168090	168091	168092
BNA Compounds	(ug/L)				(ug/Kg) dry		
Phenol	3 J	4 J	5 J	10 U	460 U	580	490 U
Bis(2-Chloroethyl)Ether	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2-Chlorophenol	10 U	10 U	10 U	10 U	460 U	520 U	490 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Benzyl Alcohol	140	42	65	10 U	460 U	520 U	490 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2-Methylphenol	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U	10 U	460 U	520 U	490 U
4-Methylphenol	18	28	39	10 U	460 U	520 U	490 U
N-Nitroso-Di-n-Propylamine	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Hexachloroethane	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Nitrobenzene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Isophorone	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2-Nitrophenol	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Benzoic Acid	10 J	51	140	50 U	2200 U	2500 U	2400 U
Bis(2-Chloroethoxy)Methane	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	460 U	520 U	490 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Naphthalene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
4-Chloroaniline	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
4-Chloro-3-Methylphenol	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Haxachlorocyclopentadiene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2,4,5-Trichlorophenol	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2-Nitroaniline	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
Dimethyl Phthalate	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Acenaphthylene	10 U	10 U	10 U	10 U	54 J	520 U	490 U
3-Nitroaniline	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
Acenaphthene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2,4-Dinitrophenol	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
4-Nitrophenol	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
Dibenzofuran	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Diethyl Phthalate	7 J	8 J	9 J	10 U	460 U	520 U	490 U
4-Chlorophenyl-Phenylether	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Fluorene	10 U	10 U	10 U	10 U	120 J	130 J	490 U
4-Nitroaniline	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
4,6-Dinitro-2-Methylphenol	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	460 U	520 U	490 U
4-Bromophenyl-Phenylether	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Pentachlorophenol	50 U	50 U	50 U	50 U	2200 U	2500 U	2400 U
Phenanthrene	10 U	10 U	10 U	10 U	730	830	86 J

Appendix B - Continued

	Influent/Effluent				Sediments		
Station:	Inf-Edmonds	Influent-MLT	Eff-comb	Blank	Sample C	Sample A	Sample B
Type:	composite	composite	composite	transfer	grab	grab	grab
Date:	4-19-89	4-19-89	4-19-89	4-18-89	4-17-89	4-17-89	4-17-89
Sample ID #:	168093	168094	168095	168102	168090	168091	168092
BNA Compounds	(ug/L)				(ug/Kg) dry		
Anthracene	10 U	10 U	10 U	10 U	140 J	230 J	490 U
Di-n-Butyl Phthalate	1 J	2 J	2 J	10 U	81 UJ	810 B	490 U
Fluoranthene	10 U	10 U	10 U	10 U	850	810	200 J
Pyrene	10 U	10 U	10 U	10 U	840	970	170 J
Butylbenzylpthalate	2 J	3 J	4 J	10 U	460 U	520 U	490 U
3,3'-Dichlorobenzidine	20 U	20 U	20 U	20 U	920 U	1000 U	990 U
Benzo(a)Anthracene	10 U	10 U	10 U	10 U	300 J	360 J	60 M
Chrysene	10 U	10 U	10 U	10 U	420 J	530	120 J
Bis(2-Ethylhexyl)phthalate	35 B	27 B	34 B	1 J	54 J	130 J	190 J
Di-n-Octyl Phthalate	2 J	1 J	2 J	10 U	460 U	520 U	490 U
Benzo(b)Fluoranthene	10 U	10 U	10 U	10 U	180 J	270 J	73 J
Benzo(k)Fluoranthene	10 U	10 U	10 U	10 U	260 J	240 J	51 J
Benzo(a)Pyrene	10 U	10 U	10 U	10 U	270 J	340 J	53 J
Indeno(1,2,3-cd)Pyrene	10 U	10 U	10 U	10 U	140 J	180 J	490 U
Dibenzo(a,h)Anthracene	10 U	10 U	10 U	10 U	460 U	520 U	490 U
Benzo(g,h,i)Perylene	10 U	10 U	10 U	10 U	160 J	210 J	490 U
Pesticide/PCB Compounds							
alpha-BHC	0.089 UJ	0.050 UJ	0.05 UJ	0.050 UJ	22 U	25 U	24 U
beta-BHC	0.089 UJ	0.039 J	0.025 UJ	0.050 UJ	22 U	25 U	24 U
delta-BHC	0.089 UJ	0.050 UJ	0.05 UJ	0.050 UJ	22 U	25 U	24 U
gamma-BHC (Lindane)	0.089 UJ	0.039 J	0.15 UJ	0.050 UJ	22 U	25 U	24 U
Heptachlor	0.089 UJ	0.050 UJ	0.05 UJ	0.050 UJ	22 U	25 U	24 U
Aldrin	0.089 UJ	0.050 UJ	0.05 UJ	0.050 UJ	22 U	25 U	24 U
Heptachlor Epoxide	0.089 UJ	0.050 UJ	0.05 UJ	0.050 UJ	22 U	25 U	24 U
Endosulfan I	0.089 UJ	0.050 UJ	0.05 UJ	0.050 UJ	22 U	25 U	24 U
Dieldrin	0.089 UJ	0.050 UJ	0.05 UJ	0.050 UJ	22 U	25 U	24 U
4,4'-DDE	0.18 UJ	0.10 UJ	0.10 UJ	0.10 UJ	44 U	50 U	48 U
Endrin	0.18 UJ	0.10 UJ	0.10 UJ	0.10 UJ	44 U	50 U	48 U
Endosulfan II	0.18 UJ	0.10 UJ	0.10 UJ	0.10 UJ	44 U	50 U	48 U
4,4'-DDD	0.18 UJ	0.10 UJ	0.10 UJ	0.10 UJ	44 U	50 U	48 U
Endosulfan Sulfate	0.18 UJ	0.10 UJ	0.10 UJ	0.10 UJ	44 U	50 U	48 U
4,4'-DDT	0.18 UJ	0.10 UJ	0.10 UJ	0.10 UJ	44 U	50 U	48 U
Methoxychlor	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
Endrin Ketone	0.18 UJ	0.10 UJ	0.10 UJ	0.10 UJ	44 U	50 U	48 U
alpha-Chlordane	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
gamma-Chlordane	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
Toxaphene	1.8 UJ	1.0 UJ	1.0 UJ	1.0 UJ	440 U	500 U	480 U
Aroclor-1016	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
Aroclor-1221	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
Aroclor-1232	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
Aroclor-1242	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
Aroclor-1248	0.89 UJ	0.50 UJ	0.50 UJ	0.50 UJ	220 U	250 U	240 U
Aroclor-1254	1.8 UJ	1.0 UJ	1.0 UJ	1.0 UJ	440 U	500 U	480 U
Aroclor-1260	1.8 UJ	1.0 UJ	1.0 UJ	1.0 UJ	440 U	500 U	480 U

Appendix B - Continued

	Influent/Effluent				Sediments			Sludge
Station:	Inf-Edmonds	Influent-MLT	Eff-comb	Blank	Sample C	Sample A	Sample B	Sludge ash
Type:	composite	composite	composite	transfer	grab	grab	grab	grab
Date:	4-19-89	4-19-89	4-19-89	4-18-89	4-17-89	4-17-89	4-17-89	4-18-89
Sample ID #:	168093	168094	168095	168102	168090	168091	168092	168100
Metals	(ug/L)				(mg/Kg-dry)			(mg/Kg-dry)
Antimony	1.0 U	1.0 U	1.0 U	1.0 U	0.089 U	0.106 U	2.12	0.580
Arsenic	3.3	2.0 U	1.0 U	1.0 U	2.57	3.91	2.88	2.58
Beryllium	1 U	1 U	1 U	1 U	0.12 U	0.16 U	0.13 U	0.13 U
Cadmium	2 U	2 U	2 U	2 U	0.24 U	0.64	0.25 U	1.50
Chromium	5 U	5	5 U	5 U	12.5	27.4	24.1	40.6
Copper	62	61	59	2 U	6.53	54.7	14.5	210
Lead	9.2	16.3	20.8	1.0 U	4.9	23.7	7.7	163
Mercury	0.5	1.8	0.4	0.1 U	0.05 U	0.41	0.07	0.05 U
Nickel	10 U	10 U	10 U	10 U	10.6	28.8	24.5	58.1
Selenium	2.0 U	2.0 U	2.0 U	1.0 U	0.24 U	0.31 U	0.125 U	0.26
Silver	14	3 U	9	3 U	0.35 U	5.88	0.91	40.3
Thallium	1.0 U	1.0 U	1.0 U	1.0 U	0.118 U	0.157 U	0.125 U	0.132 U
Zinc	113	127	107	4 U	23.4	131	40.2	394

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 detection limit.
B - This flag is used when the analyte is found in the blank as well as the sample. Indicates possible/probable blank contamination.
M - Indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters.

APPENDIX C.

Bioassay Raw Data

OYSTER LARVAE BIOASSAY - RAW DATA
WDOE - W.O.# 890110

Conc'n (% v/v)	Rep	Normal Larvae	Abnormal Larvae	Total Larvae	% Abnormal	Weighted Mean % Abnormality	Mean % Mortality[1]
Effluent - 168095							
18.0	A	0	0	0	-	-	100.0
	B	0	0	0	-		
	C	0	0	0	-		
10.0	A	1	4	5	80.0	71.0	97.7
	B	0	0	0	-		
	C	1	1	2	50.0		
5.6	A	1	38	39	97.4	97.3	69.6
	B	0	16	16	100.0		
	C	2	35	37	94.6		
3.2	A	44	13	57	22.8	29.3	50.2
	B	28	12	40	30.0		
	C	35	19	54	35.2		
1.0	A	72	9	81	11.1	15.4	18.8
	B	69	13	82	15.9		
	C	67	16	83	19.3		
0.5	A	72	17	89	19.1	18.4	5.9
	B	84	23	107	21.5		
	C	76	13	89	14.6		
0.1	A	74	14	88	15.9	18.0	9.9
	B	75	19	94	20.2		
	C		No data available.				
Salinity Checks							
18.0	A	69	16	85	18.8	21.3	18.3
	B	61	19	80	23.7		
10.0	A	91	18	109	16.5	16.9	0
	B	86	18	104	17.3		
5.6	A	69	24	93	25.8	19.1	9.9
	B	78	11	89	12.4		
3.2	A	55	21	76	27.6	24.3	24.7
	B	60	16	76	21.0		
1.0	A	81	17	98	17.3	15.5	11.4
	B	70	11	81	13.6		

Conc'n (% v/v)	Rep	Normal Larvae	Abnormal Larvae	Total Larvae	% Abnormal	Weighted Mean % Abnormality	Mean % Mortality[1]
0.5	A	76	15	91	16.5	15.2	8.4
	B	81	13	94	13.8		
0.1	A	82	11	93	11.8	14.1	14.9
	B	66	13	79	16.5		
Control Seawater	A	74	7	81	8.6	8.8	17.8
	B	59	6	65	9.2		
	C	98	10	108	9.3		
	D	82	8	90	8.9		
	E	79	7	86	8.1		
	F	62	6	68	8.8		
Reference Toxicant - Cadmium Chloride							
0.1 ppm	A	112	12	124	9.7	12.5	37.9
	B	105	19	124	15.3		
0.33 ppm	A	109	18	127	14.2	13.5	33.4
	B	121	18	139	12.9		
1.0 ppm	A	74	123	197	62.4	62.7	20.8
	B	44	75	119	63.0		
3.3 ppm	A	22	122	144	84.7	91.7	43.4
	B	1	81	82	98.8		
10.0 ppm	A	1	132	133	99.2	99.6	38.1
	B	0	114	114	100.0		
Control (Reference Toxicant)	A	132	6	138	4.3	9.1	22.6
	B	133	10	143	7.0		
	C	161	17	178	9.6		
	D	124	15	139	10.8		
	E	150	24	174	13.8		

1. Mean mortality (%) = 100 - $\frac{\text{(no. of surviving embryos)(100)}}{\text{no. embryos introduced}}$

$$= 100 - \frac{\text{(mean no. total larvae)}\frac{\text{(100 mL test vol)(100)}}{\text{(5 mL subsample vol.)}}}{\text{2,020 embryos introduced}}$$

= 100 - (mean no. total larvae)(0.99)

SEA URCHIN SPERM CELL FERTILIZATION BIOASSAY - RAW DATA
WDOE - W.O.# 890110

Conc'n (% v/v)	Rep	Fertilized Eggs	Unfertilized Eggs	Total Eggs	% Unfertilized	Weighted Mean % Unfertilized
Effluent - 168095						
50.0	A	3	97	100	97.0	97.3
	B	0	100	100	100.0	
	C	5	95	100	95.0	
25.0	A	8	92	100	92.0	92.3
	B	7	93	100	93.0	
	C	8	92	100	92.0	
12.5	A	25	75	100	75.0	54.0
	B	50	50	100	50.0	
	C	63	37	100	37.0	
6.0	A	81	19	100	19.0	40.7
	B	75	25	100	25.0	
	C	22	78	100	78.0	
3.0	A	25	65	90	72.2	30.3
	B	90	10	100	10.0	
	C	87	13	100	13.0	
1.0	A	91	9	100	9.0	9.3
	B	92	8	100	8.0	
	C	89	11	100	11.0	
0.1	A	90	10	100	10.0	7.0
	B	95	5	100	5.0	
	C	94	6	100	6.0	
Salinity Controls						
50.0	A	2	98	100	98.0	97.5
	B	3	97	100	97.0	
25.0	A	81	19	100	19.0	20.5
	B	78	22	100	22.0	
12.5	A	90	10	100	10.0	12.5
	B	85	15	100	15.0	
6.0	A	89	11	100	11.0	11.5
	B	88	12	100	12.0	
3.0	A	99	1	100	1.0	1.0
	B	99	1	100	1.0	

Conc'n Mean(% v/v)	Rep	Fertilized Eggs	Unfertilized Eggs	Total Eggs	% Unfertilized	Weighted % Unfertilized
1.0	A	70	30	100	30.0	20.0
	B	90	10	100	10.0	
0.1	A	98	2	100	2.0	2.5
	B	97	3	100	3.0	
Control Seawater	A	92	8	100	8.0	4.7
	B	91	9	100	9.0	
	C	98	2	100	2.0	
	D	98	2	100	2.0	
	E	99	1	100	1.0	
	F	94	6	100	6.0	
Reference Toxicant - Sodium Dodecyl Sulfate (SDS)						
1 ppm	A	88	12	100	12.0	6.3
	B	98	2	100	2.0	
	C	95	5	100	5.0	
10 ppm	A	0	100	100	100.0	99.3
	B	0	100	100	100.0	
	C	2	98	100	98.0	
100 ppm	A	0	100	100	100.0	100.0
	B	0	100	100	100.0	
	C	0	100	100	100.0	

DATA REVIEW

BY: Margaret Stinson

FOR: Edmonds WTP Samples 16-8090; -91; -92; 95

DATE: May 26, 1990

E.V.S. Consultants has submitted the attached results of Bivalve Larvae and Echinoderm Bioassays on an effluent sample, and a Marine Amphipod Bioassay from the Tacoma Central Wastewater Treatment Plant Class II inspection.

The Marine Amphipod Test was using Rhepoxynius abronius. Test conditions, QA/QC, and chemistry data submitted were all appropriate for testing this organism. No significant differences were seen between survival in the test sediments and in control sediments.

The Bivalve Larvae test was using Pacific Oysters. Control mortality and abnormality was within the limits defined by ASTM for test validity. Reference toxicant and salinity control results were appropriate for the analysis. Results of water chemistry analyses were satisfactory for survival of the test species. Variability in the results from the reference toxicant made it impossible to estimate an LC50. Results for the Bivalve Larvae test were as follows:

ABNORMALITY

EC50	NOEC	LOEC
3.8%	3.2%	5.6%

MORTALITY

EC50	NOEC	LOEC
3.2%	1.0%	5.6%

Salinity controls: The NOEC (mortality) for the Oyster bioassay salinity controls was 18%. The abnormality NOEC was 1.0%, which at first glance is alarming. A review of the raw data, however, shows that all the abnormality values are <24%, compared with the sample abnormalities, which approach 100%. The salinity test is apparently more sensitive simply because the data show very little variability compared to the sample results. The salinity at the 18% concentration was 30 o/oo; the minimum salinity requirements for this test are about 22-24 o/oo. It is doubtful that salinity was an important factor in the toxicity observed in this test.

The Echinoderm Sperm Cell test was conducted using green sea urchins (Strongylocentrotus droebachiensis). QA and chemistry data, including reference toxicants, were appropriate for the test. Fertilization in the controls was approximately 95%, within the recommended range. Test results were as follows:

EC50	NOEC	LOEC
11.3%	1%	3%

Salinity controls: The highest concentration for which there were no adverse salinity effects was 12.5%; the effect on fertilization at 25% was significant. It is doubtful if salinity was an important factor in the toxicity observed in this test.

APPENDIX D.

Laboratory Review

Edmonds Class II

Laboratory Procedure Review Sheet

Discharger: Edmonds (City of Edmonds)

Date: 4/19/89

Discharger representative: William Branson, Robert DeCoy

Ecology reviewer: Carlos E. Ruiz

Instructions

Questionnaire for use reviewing laboratory procedures. Circled numbers indicate work is needed in that area to bring procedures into compliance with approved techniques. References are sited to help give guidance for making improvements. References sited include:

Ecology = Department of Ecology Laboratory User's Manual, December 8, 1986.

SM = APHA-AWWA-WPCF, Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

SSM = WPCF, Simplified Laboratory Procedures for Wastewater Examination, 3rd ed., 1985.

Sample Collection Review

1. Are grab, hand composite, or automatic composite samples collected for influent and effluent BOD and TSS analysis?

2. If automatic compositor, what type of compositor is used?
   The compositor should have pre and post purge cycles unless it is a flow through type. Check if you are unfamiliar with the type being used.

3. Are composite samples collected based on time or flow?

4. What is the usual day(s) of sample collection? Twiece a week

5. What time does sample collection usually begin? 9:00 am

6. How long does sample collection last? 24 hrs

7. How often are subsamples that make up the composite collected? 1 hr

8. What volume is each subsample? 100

9. What is the final volume of sample collected? 1 gal - 1.5 gal

10. Is the composite cooled during collection? Refrigerated

14 °C

11. To what temperature? 35°F Refrigerate
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).

12. How is the sample cooled? Refrigerate & Blue Ice
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.

13. How often is the temperature measured? sometimes
The temperature should be checked at least monthly to assure adequate cooling.

14. Are the sampling locations representative? yes

15. Are any return lines located upstream of the influent sampling location? NO
This should be avoided whenever possible.

16. How is the sample mixed prior to withdrawal of a subsample for analysis? yes
The sample should be thoroughly mixed.

17. How is the subsample stored prior to analysis? 1 hr
The sample should be refrigerated (4 degrees C) until about 1 hour before analysis, at which time it is allowed to warm to room temperature.

18. What is the cleaning frequency of the collection jugs? Weekly
The jugs should be thoroughly rinsed after each sample is complete and occasionally be washed with a non-phospate detergent. and rinsed every time

19. How often are the sampler lines cleaned? Weekly w/ chlorine
Rinsing lines with a chlorine solution every three months or more ofte where necessary is suggested.

pH Test Review

1. How is the pH measured? meter
A meter should be used. Use of paper or a colorimetric test is inadequate and those procedures are not listed in Standard Methods (SM p429).

2. How often is the meter calibrated? 6 months
The meter should be calibrated every day it is used.

3. What buffers are used for calibration? 4 - 7
Two buffers bracketing the pH of the sample being tested should be use

If the meter can only be calibrated with one buffer, the buffer closes in pH to the sample should be used. A second buffer, which brackets the p of the sample should be used as a check. If the meter cannot accurately determine the pH of the second buffer, the meter should be repaired.

BOD Test Review

1. What reference is used for the BOD test? SM
   Standard Methods or the Ecology handout should be used.

2. How often are BODs run? twice a week
   The minimum frequency is specified in the permit.

3. How long after sample collection is the test begun? hours
   The test should begin within 24 hours of composite sample completion (Ecology Lab Users Manual p42). Starting the test as soon after samples are complete is desirable.

4. Is distilled or deionized water used for preparing dilution water?

5. Is the distilled water made with a copper free still? bottled
   Copper stills can leave a copper residual in the water which can be toxic to the test (SSM p36).

6. Are any nitrification inhibitors used in the test? NO What?
   2-chloro-6(trichloro methyl) pyridine or Hach Nitrification Inhibitor 2533 may be used only if carbonaceous BODs are being determined (SM p 527, #4g: SSM p 37).

7. Are the 4 nutrient buffers or powder pillows used to make dilution water?
   If the nutrients are used, how much buffer per liter of dilution water are added?
   1 mL per liter should be added (SM p527, #5a: SSM p37).

8. How often is the dilution water prepared? Every time
   Dilution water should be made for each set of BODs run.

9. Is the dilution water aged prior to use? NO
   Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
   Dilution water without inhibitor should not be aged.

10. Have any of the samples been frozen? NO
    If yes, are they seeded?
    Samples that have been frozen should be seeded (SSM p38).

11. Is the pH of all samples between 6.5 and 7.5? yes
    If no, is the sample pH adjusted?
    The sample pH should be adjusted to between 6.5 and 7.5 with 1N NaOH or 1N H_2SO_4 if 6.5 > pH >7.5 if caustic alkalinity or acidity is present (SM p529, #5e1: SSM p37).
    High pH from lagoons is usually not caustic. Place the sample in the dark to warm up, then check the pH to see if adjustment is necessary.

    If the sample pH is adjusted, is the sample seeded?
    The sample should be seeded to assure adequate microbial activity if the pH is adjusted (SM p528, #5d).

12. Have any of the samples been chlorinated or ozonated? NO
If chlorinated are they checked for chlorine residual and dechlorinated as necessary?
How are they dechlorinated?
Samples should be dechlorinated with sodium sulfite (SM p529, #5e2: SSM p38), but dechlorination with sodium thiosulfate is common practice. Sodium thiosufate dechlorination is probably acceptable if the chlorine residual is < 1-2 mg/L.
If chlorinated or ozonated, is the sample seeded?
The sample should be seeded if it was disinfected (SM p528, #5d&5e2: SSM p38).

13. Do any samples have a toxic effect on the BOD test? NO
Specific modifications are probably necessary (SM p528, #5d: SSM p37).

14. How are DO concentrations measured? Meter
If with a meter, how is the meter calibrated? Air Calibration / Winkler Azide
Air calibration is adequate. Use of a barometer to determine saturation is desirable, although not manditory. Checks using the Winkler method of samples found to have a low DO are desirable to assure that the meter is accurate over the range of measurements being made.

How frequently is the meter calibrated?
The meter should be calibrated before use.

15. Is a dilution water blank run? Yes
A dilution water blank should always be run for quality assurance (SM p527, #5b: SSM p40, #3).

What is the usual initial DO of the blank? near saturation
The DO should be near saturation; 7.8 mg/L @ 4000 ft, 9.0 mg/L @ sea level (SM p528, #5b). The distilled or deionized water used to make the dilution water may be aged in the dark at ~20 degrees C for a week with a cotton plug in the opening prior to use if low DO or excess blank depletion is a problem .

What is the usual 5 day blank depletion? 0.2 or less
The depletion should be 0.2 mg/L or less. If the depletion is greater the cause should be found (SM p527-8, #5b: SSM p41, #6).

16. How many dilutions are made for each sample? 2
At least two dilutions are recommended. The dilutions should be far enough apart to provide a good extended range (SM p530, #5f: SSM p41).

17. Are dilutions made by the liter method or in the bottle? bottle
Either method is acceptable (SM p530, #5f).

18. How many bottles are made at each dilution? 1
How many bottles are incubated at each dilution?
When determining the DO using a meter only one bottle is necessary. The DO is measured, then the bottle is sealed and incubated (SM p530, #5f2)
When determining the DO using the Winkler method two bottles are necessary. The initial DO is found of one bottle and the other bottle is sealed and incubated (Ibid.).

19. Is the initial DO of each dilution measured? yes
What is the typical initial DO?
The initial DO of each dilution should be measured. It should approximate saturation (see #14).

20. What is considered the minimum acceptable DO depletion after 5 days? 0%
What is the minimum DO that should be remaining after 5 days?
The depletion should be at least 2.0 mg/L and at least 1.0 mg/L should be left after 5 days (SM p531, #6: SSM p41).

21. Are any samples seeded? NO; occasionally when pre chlorination, then seed.
Which?
What is the seed source?
Primary effluent or settled raw wastewater is the preferred seed. Secondary treated sources can be used for inhibited tests (SM p528, #5d: SSM p41).

How much seed is added to each sample? (2ml) generally
Adequate seed should be used to cause a BOD uptake of 0.6 to 1.0 mg/L due to seed in the sample (SM p529, #5d).

How is the BOD of the seed determined?
Dilutions should be set up to allow the BOD of the seed to be determined just as the BOD of a sample is determined. This is called the seed control (SM p529, #5d: SSM p41).

22. What is the incubator temperature? 20°C – 22°C
The incubator should be kept at 20 +/- 1 degree C (SM p531, #5i: SSM p40, #3).

How is incubator temperature monitored? temperature of air
A thermometer in a water bath should be kept in the incubator on the same shelf as the BODs are incubated.

How frequently is the temperature checked?
The temperature should be checked daily during the test. A temperature log on the incubator door is recommended.

How often must the incubator temperature be adjusted? not often
Adjustment should be infrequent. If frequent adjustments (every 2 weeks or more often) are required the incubator should be repaired.

Is the incubator dark during the test period?
Assure the switch that turns off the interior light is functioning.

23. Are water seals maintained on the bottles during incubation? yes
Water seals should be maintained to prevent leakage of air during the incubation period (SM p531, #5i: SSM p40, #4).

24. Is the method of calculation correct?
Check to assure that no correction is made for any DO depletion in the blank and that the seed correction is made using seed control data.

Standard Method calculations are (SM p531, #6):

for unseeded samples;

$$BOD\ (mg/L) = \frac{D1 - D2}{P}$$

for seeded samples;

$$BOD\ (mg/L) = \frac{(D1 - D2) - (B1 - B2)f}{P}$$

Where: D1 = DO of the diluted sample before incubation (mg/L)
D2 = DO of diluted sample after incubation period (mg/L)
P = decimal volumetric fraction of sample used
B1 = DO of seed control before incubation (mg/L)
B2 = DO of seed control after incubation (mg/L)

$$f = \frac{\text{amount of seed in bottle D1 (mL)}}{\text{amount of seed in bottle B1 (mL)}}$$

$\frac{5}{30}$ 1.4 $\frac{300}{5}$ 60

$$BOD_5 = \frac{Q_E BOD_5 + Q_R BOD}{Q_T}$$

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? SM

2. What type of filter paper is used? GELMAN A/E
   Std. Mthds. approved papers are: Whatman 934AH (Reeve Angel), Gelman A/E, and Millipore AP-40 (SM p95,footnote: SSM p23)

3. What is the drying oven temperature? 103°
   The temperature should be 103-105 degrees C (SM p96, #3a: SSM p23).

4. Are any volatile suspended solids tests run? NO
   If yes--What is the muffle furnance temperature?
   The temperature should be 550+/- 50 degrees C (SM p98, #3: SSM p23).

5. What type of filtering apparatus is used?
   Gooch crucibles or a membrane filter apparatus should be used (SM p95, #2b: SSM p23).

6. How are the filters pre-washed prior to use? 100 ml
   The filters should be rinsed 3 times with distilled water (SM p23, #2: SSM p23, #2).

   Are the rough or smooth sides of the filters up? Yes
   The rough side should be up (SM p96, #3a: SSM p23, #1)

   How long are the filters dried? 1h
   The filters should be dried for at least one hour in the oven. An additional 20 minutes of drying in the furnance is required if volatile solids are to be tested (Ibid).

   How are the filters stored prior to use? dessicator
   The filters should be stored in a dessicator (Ibid).

7. How is the effectiveness of the dessicant checked? blue indicator
   All or a portion of the dessicant should have an indicator to assure effectiveness.

Test Procedure

8. In what is the test volume of sample measured? graduated
   The sample should be measured with a wide tipped pipette or a graduated cylinder.

9. Is the filter seated with distilled water? NO
   The filter should be seated with distilled water prior to the test to avoid leakage along the filter sides (SM p97, #3c).

10. Is the entire measured volume always filtered? yes
The entire volume should always be filtered to allow the measuring vessel to be properly rinsed (SM p97, #3c: SSM p24, #4).

11. What are the average and minimum volumes filtered?

	Volume	
	Minimum	Average
Influent	50	
Effluent		100

12. How long does it take to filter the samples?

	Time
Influent	minute or less
Effluent	

13. How long is filtering attempted before deciding that a filter is clogged? too long
Prolonged filtering can cause high results due to dissolved solids being caught in the filter (SM p96, #1b). We usually advise a five minute filtering maximum.

14. What do you do when a filter becomes clogged? abandon or discard
The filter should be discarded and a smaller volume of sample should b used with a new filter. sample

15. How are the filter funnel and measuring device rinsed onto the filter following sample addition? 25 ml
Rinse 3x's with approximately 10 mLs of distilled water each time (? ?).

16. How long is the sample dried? 1 hour
The sample should be dried at least one hour for the TSS test and 20 minutes for the volatile test (SM p97, #3c; p98, #3: SSM p24, #4). Excessive drying times (such as overnight) should be avoided.

17. Is the filter thoroughly cooled in a dessicator prior to weighing? yes
The filter must be cooled to avoid drafts due to thermal differences when weighing (SM p97, #3c: SSM p97 #3c).

18. How frequently is the drying cycle repeated to assure constant filter weight has ben reached (weight loss <0.5 mg or 4%, whichever is less: SM p97, #3c)? once a year
We recommend that this be done at least once every 2 months.

19. Do calculations appear reasonable?
Standard Methods calculation (SM p97, #3c).

$$\text{mg/L TSS} = \frac{(A - B) \times 1000}{\text{sample volume (mL)}}$$

where: A= weight of filter + dried residue (mg)
B= weight of filter (mg)

Fecal Coliform Test Review

1. Is the Membrane Filtration (MF) or Most Probable Number (MPN) technique used?
   This review is for the MF technique.

2. Are sterile techniques used? yes

3. How is equipment sterilizated? Autoclave
   Items should be either purchased sterilized or be sterilized. Steam sterilization, 121 degrees C for 15 to 30 minutes (15 psi); dry heat, 1-2 hours at 170 degrees C; or ultraviolet light for 2-3 minutes can be used. See Standard Methods for instruclions for specific items (SSM p67-68).

4. How is sterilization preserved prior to item use?
   Wrapping the items in kraft paper or foil before they are sterilized protects them from contamination (Ibid.).

5. How are the following items sterilized?

	Purchased Sterile	Sterilized at Plant
Collection bottles		✓
Phosphate buffer		✓
Media		
Media pads	✓	
Petri dishes	✓	
Filter apparatus		✓
Filters		✓
Pipettes		✓
Measuring cylinder		✓
Used petri dishes		

6. ~~How are samples dech~~lorinated at the time of collection? yes
   Sodium thiosulfate (1 mL of 1% solution per 120 mLs (4 ounces) of sample to be collected) should be added to the collection bottle prior to sterilization (SM p856, #2: SSM p68, sampling).

7. Is phosphate buffer made specifically for this test? yes
   Use phosphate buffer made specifically for this test. The phosphate buffer for the BOD test should not be used for the coliform test (SM p855, #12: SSM p66). dilution water pillow Phosphate pillows

8. ~~What~~ kind of media is used?
   M-FC media should be used (SM p896, SSM p66).

9. Is the media mixed or purchased in ampoules? Ampoules
   Ampoules are less expensive and more convient for under 50 tests per day (SSM p65, bottom).

10. How is the media stored? Refrigerated
    The media should be refrigerated (SM p897, #1a: SSM p66, #5).

11. How long is the media stored? 3 months
Mixed media should be stored no longer than 96 hours (SM p897, #1a: SSM p66, #5). Ampoules will usually keep from 3-6 months -- read ampoule directions for specific instructions.

12. Is the work bench disinfected before and after testing? NO
This is a necessary sanitazation procedure (SM p831, #1f).

13. Are forceps dipped in alcohol and flamed prior to use? yes
Dipping in alcohol and flaming are necessary to sterilize the forceps (SM p889, #1: SSM p73, #4).

14. Is sample bottle thoroughly shaken before the test volume is removed? yes
The sample should be mixed thoroughly (SSM p73, #5).

15. Are special procedures followed when less than 20 mLs of sample is to be filtered? yes
10-30 mLs of sterile phosphate buffer should be put on the filter. Th sample should be put into the buffer water and swirled, then the vacuum should be turned on. More even organism distribution is attained using thi technique (SM p890, #5a: SSM P73, #5).

16. Are special procedures followed when less than 1 mL of sample is to be filtered? NO don't use less than 2
Sample dilution is necessary prior to filtration when <1 mL is to be tested (SM p864, #2c: SSM p69).

17. Is the filter apparatus rinsed with phosphate buffer after sample filtration? yes 10-20 ml
Three 20-30 mL rinses of the filter apparatus are recommended (SM p891 #5b: SSM p75, #7).

18. How soon after sample filtration is incubation begun? 15 minutes
Incubation should begin within 20-30 minutes (SM p897, #2d: SSM p77, #10 note).

19. What is the incubation temperature? 44.5 °C
44.5 +/- 0.2 degrees C (SM p897, #2d: SSM p75, #9).

20. How long are the filters incubated? 24 hr
24 +/- 2 hours (Ibid.).

21. How soon after incubation is complete are the plate counts made? immed
The counts should be made within 20 minutes after incubation is complete to avoid colony color fading (SSM p77, FC). blue

22. What color colonies are counted?
The fecal coliform colonies vary from light to dark blue (SM p897, #2 SSM p78).

23. What magnification is used for counting? No magnification
10-15 power magnification is recommended (SM p898, #2e: SSM p78).

24. How many colonies blue colonies are usually counted on a plate? 20-4.
Valid plate counts are between 20 and 60 colonies (SM p897, #2a: SSM p78).

25. How many total colonies are usually on a plate? less than 20
The plate should have <200 total colonies to avoid inhabition due to crowding (SM p893, #6a: SSM p63, top).

26. When calculating results, how are plates with <20 or >60 colonies considered when plates exist with between 20 and 60 colonies?
In this case the plates with <20 or >60 colonies should not be used fo calculations (SM p898, #3: SSM p78, C&R).

27. When calculating results how are results expressed if all plates have < 20 or > 60 colonies?
Results should be identified as estimated.
The exception is when water quality is good and <20 colonies grow. In this case the lower limit can be ignored (SM p893, #6a: SSM p78, C&R).

28. How are results calculated?
Standard Methods procedure is (SM p893, #6a: SSM p79):

$$\text{Fecal coliforms/100 mL} = \frac{\text{\# of fecal coliform colonies counted}}{\text{sample size (mL)}} \times 100$$