CITY OF KENNEWICK WASTEWATER TREATMENT PLANT
CLASS II INSPECTION
April 1992

by
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ABSTRACT

A Class II inspection was conducted at the city of Kennewick Wastewater Treatment Plant on April 27-29, 1992. The effluent met NPDES permit requirements. The removal efficiencies for BOD_5 and TSS were above the 85% requirement. BOD_5 and TSS loadings, as well as flow to the plant, were well within design criteria. The effluent total ammonia concentration exceeded acute and chronic freshwater quality criteria. However, the receiving water may provide adequate dilution to minimize this toxicity. Among pesticides, three organophosphorus compounds were found present; no organochlorine pesticides or PCBs were detected. Split sample and performance evaluation sample analyses were generally acceptable, though TSS and residual chlorine (performance evaluation samples), and fecal coliform showed some discrepancies. However, an on-site review of laboratory procedures indicated a number of deficiencies that must be corrected. Other minor recommendations are included in the report.

INTRODUCTION

The Washington State Department of Ecology (Ecology) conducted a Class II inspection at the city of Kennewick Municipal Wastewater Treatment Plant (WWTP) in Kennewick, Washington, on April 27-29, 1992 (Figure 1). Tapas Das and Norm Glenn of the Ecology Watershed Assessments Section (WAS) of the Environmental Investigations and Laboratory Services Program (EILS) conducted the inspection. Phelps Freeborn of Ecology's Central Regional

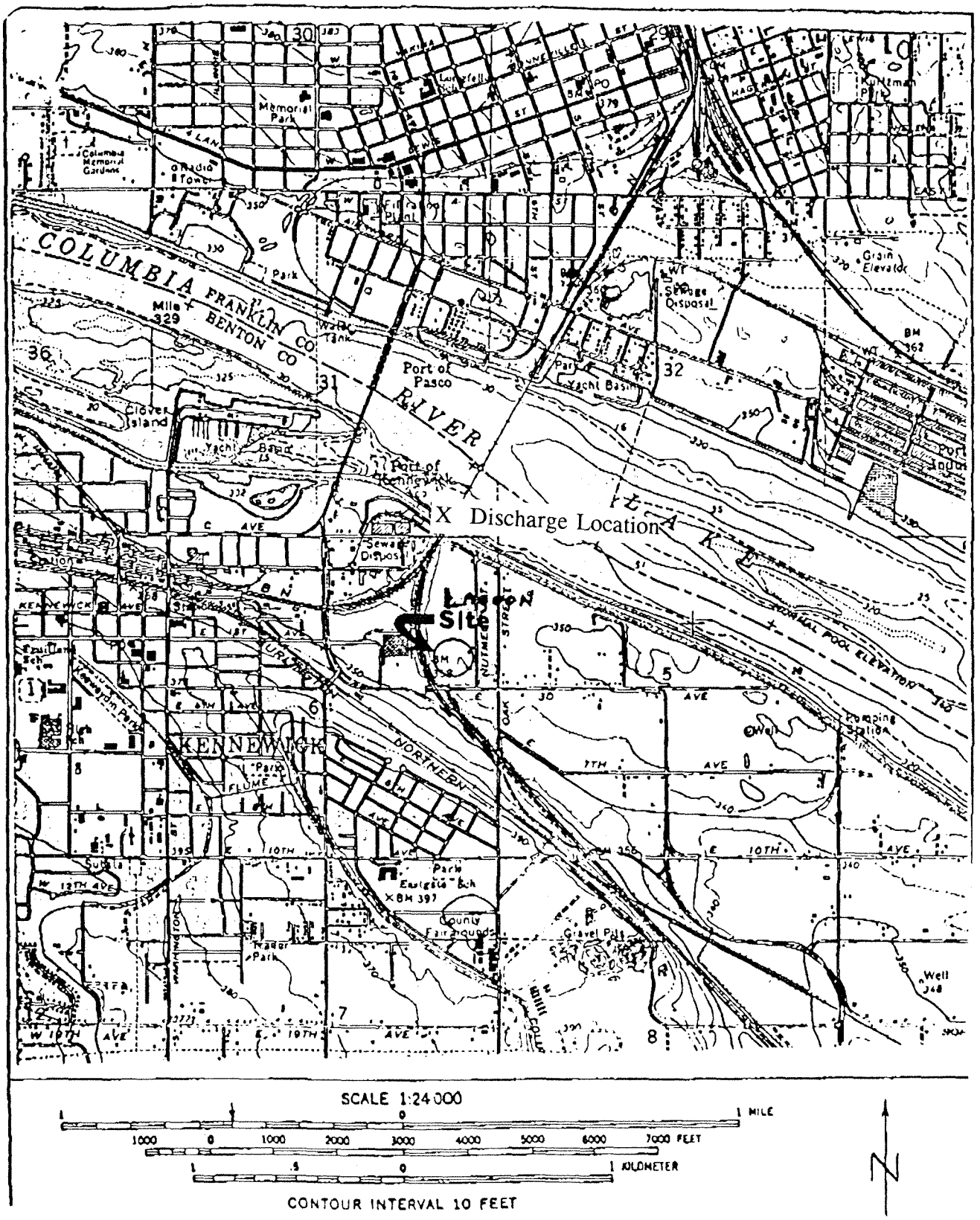

Figure 1. Location Map - Kennewick WWTP, 4/92.

Office (CRO) was present to observe the inspection. Dale Van Donsel and Dennis Julvezan of EILS' Quality Assurance Section conducted an on-site laboratory inspection on April 28, 1992. The CRO wanted an abbreviated Class II inspection conducted on this discharger. Jack Barton, chief plant operator, and Terry Butler, principal laboratory operator, provided assistance during the inspection.

Primary sources of wastewater to the facility are domestic sewage from approximately 35,500 residences and a few small industries, namely: Welch Foods Inc. and Sandvik Ti-Sports. The city of Kennewick is authorized to discharge treated wastewater into the Columbia River under NPDES Permit No. WA-004478-4, which expired on October 30, 1992, but has been administratively extended.

In 1973, the treatment facilities were upgraded to provide secondary treatment (Figure 2). Two large aerated lagoons were put in operation, and the clarifier capacity was doubled by the addition of two clarifiers. Ponds No. 1 and 2 have capacities of 40 and 35 million gallons, respectively. Each pond is about 12 feet deep, which provides approximately 7-8 days of hydraulic detention time at plant average flow of 5.0 MGD. Pond No. 1 has four aerators and pond No. 2 has two. Normal operation of the lagoons is in series. However, in times of very high flow, the headworks would allow parallel operation, which could be used to reduce the loading (lb. BOD/day/square ft.) on the ponds. Wastewater from the ponds is gravity fed to the final clarifiers.

Chlorine gas is mixed with effluent at a point prior to splitting flows to the clarifiers. The four clarifiers serve a dual purpose as secondary clarifiers and chlorine contact chambers. There is also appreciable additional detention time in the plant piping between the clarifiers and the outfall. Residual chlorine levels should also be monitored at the headworks to the diffuser. Solids collected in the clarifiers are returned to the headworks for discharge to (and storage in) the lagoons.

Effluent from the clarifiers flows through a Palmer-Bowlus flume before discharge to the Columbia River. The diffuser is 165 feet long and has 25 ports equally spaced on 4.5 to 5.0 foot high risers along its length. The diameter of each port is four inches. There was no influent flow measuring device, but the flume was on site to be installed.

The plant has had problems in the past meeting effluent TSS limits and the city had been under order to have the lagoons dredged. Dredging of the lagoons was completed in December 1991 (Freeborn, 1992).

Objectives of the inspection were:

- verify compliance with NPDES permit parameters;
- analyze performance of the WWTP by determining loading and efficiency;
- verify flow meter accuracy;
- analyze effluent for organochlorine and organophosphorus pesticides; and

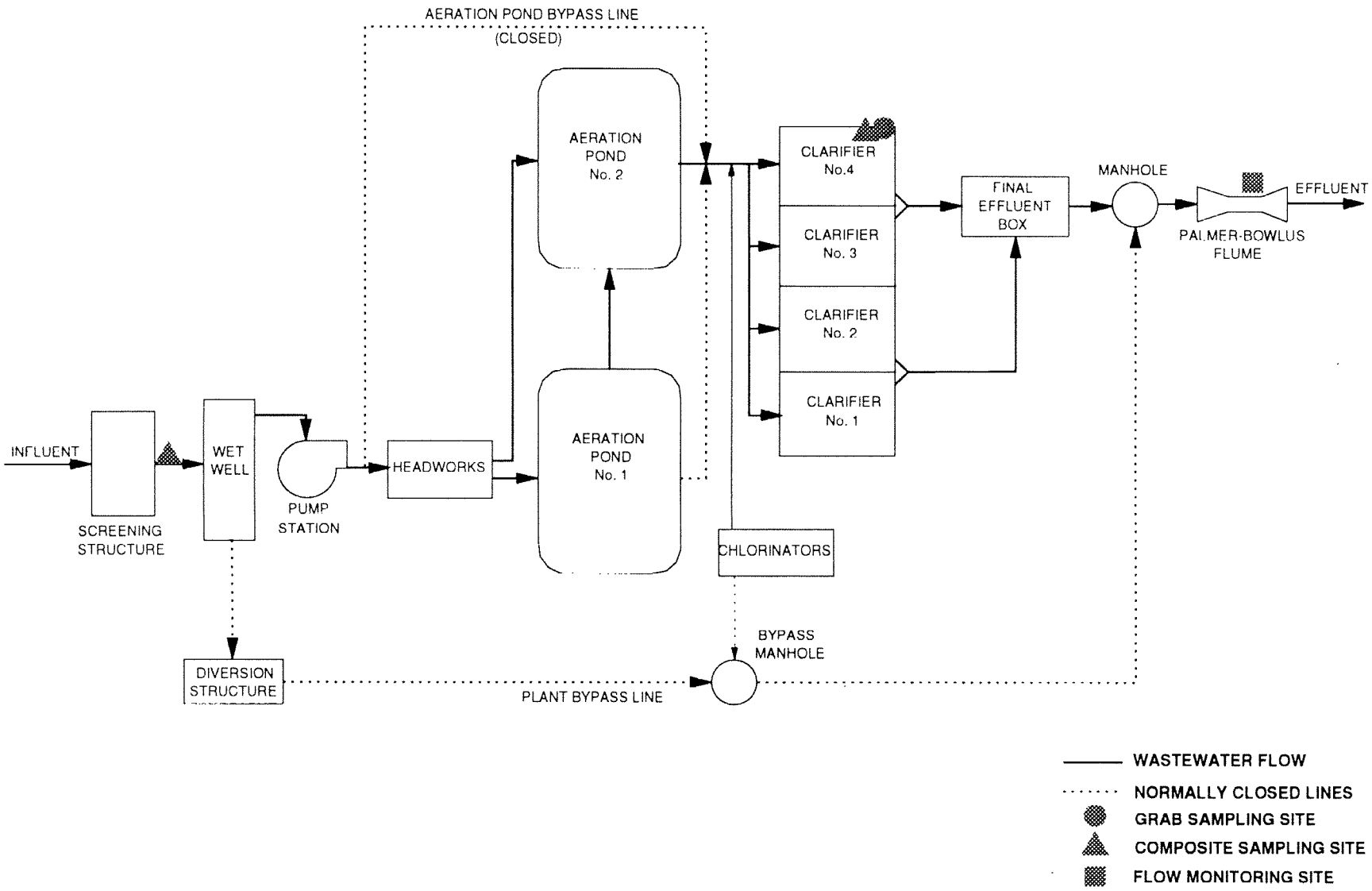

Figure 2. Plant Schematic and Sampling Locations - Kennewick WWTP, 4/92.

- evaluate permittee's sampling and testing procedures using sampling splits and performance evaluation samples.

PROCEDURES

Twenty-four hour composite and grab samples of effluent were taken at the extreme left corner of the No. 4 clarifier (Figure 2). Twenty-four hour composite and grab samples of influent were taken behind the screen. Composite samples of influent were collected to enable loadings and removal efficiencies to be calculated. Ecology's ISCO® compositors were set to collect 320 mL samples every 30 minutes, for a total sample of 15.4 liters. The city of Kennewick's influent and effluent composite samplers were stationed at the same locations.

Ecology samplers were cleaned for priority pollutant organics sampling prior to the inspection as follows:

1. wash with laboratory phosphate-free detergent,
2. rinse several times with tap water,
3. rinse with 10% nitric acid solution,
4. rinse three times with deionized water,
5. rinse with high purity methylene chloride,
6. rinse with high purity acetone, and
7. allow to dry and seal with aluminum foil.

Effluent grab samples for fecal coliform, pesticides/PCBs, and oil and grease were collected at approximately the same location where the 24-hour composite sampler was installed (Figure 2). Due to extensive use of pesticides in local agriculture, it was anticipated that the treatment plant might be receiving pesticides in its influent waste stream. Therefore, effluent was sampled for organochlorine and organophosphorus pesticides.

Composite samples were split for comparative analyses. Influent and effluent samples were split-four ways (*i.e.*, Ecology along with the WWTP lab each analyzed samples collected by both parties). Under proper circumstances, four-way splits can produce revealing information on both sample representativeness and laboratory analytical techniques. Results from samples collected by two different compositors (Ecology and the permittee) but analyzed at the same lab (e.g., Ecology) address the issue of sample representativeness. Results from samples collected by the same compositor (e.g., Ecology) but analyzed at two different labs (Ecology and the permittee) address the issue of lab performance. In addition to splits, a set of performance evaluation standard samples were given to the permittee for analysis in their lab.

The Palmer-Bowlus flume was inspected for correct installation and critical dimensions. Twenty-four hour flow was determined from the plant totalizer. Instantaneous flow was determined by measuring depth of flow through the flume and calculating resultant flow using

the relationship[1] given in the manufacturer's brochure (Plasti-Fab, Inc., 1990). A comparison was then made to the instantaneous reading on the plant flow recorder.

All samples for analysis by Ecology were held on ice until delivery to Ecology's Manchester Laboratory. A summary of the analytical methods and laboratories conducting the analyses is given in Appendix A.

QUALITY ASSURANCE/QUALITY CONTROL

Laboratory quality assurance and quality control (QA/QC) methods used are described by Huntamer and Hyre (1991) and Kirchmer (1988). Recommended holding times were met for all analyses performed.

Matrix spike/spike duplicate (MS/MSD) recoveries and precision data for Pesticide/PCB samples were reasonable and acceptable. No target analytes were detected in either method blank. The Relative Percent Differences (RPDs) from spike recoveries for sample 188089 were high. The low recoveries for the MSD were consistent with the low surrogate recovery and did not indicate a QC problem (Magoon, 1992).

RESULTS AND DISCUSSION

Flow

Critical dimensions of the 36" Palmer-Bowlus flume were measured and found to be correct. Comparison of Ecology's instantaneous flow measurements to the effluent flow meter readings showed acceptable agreement (within 5%). The plant's totalizer reading for a 24-hour time period beginning at 0700 on April 28, 1992, indicated 5.03 MGD; this flow was used to calculate mass loadings for permit parameters. All the loading calculations were based on the concentrations measured by Ecology on the composite sample collected by Ecology.

General Chemistry and NPDES Permit Compliance

Table 1 shows all general chemistry results. The WWTP's influent and effluent total phosphorus concentrations (6.0 mg/L) indicated that there was no phosphorus removal in the facility. This could be cause for concern if an effluent limit for phosphorus were to be required in the future. There was a small, but significant increase in both ammonia and nitrate+nitrite. Ammonia concentrations were 18.7 mg/L-N in influent and 29.4 mg/L-N in effluent, while NO_2+NO_3-N concentrations were 0.05 and 0.24 mg/L, respectively. It is likely that organic nitrogen (in the form of proteins and urea) is being converted to ammonia by the action of bacteria under aerobic conditions (EPA, 1975; Sawyer and McCarty, 1978). Alkalinity concentration in effluent (339 mg/L) was 44% higher than influent concentration, probably due to ammonification. No case

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[1] $Q_{cfs} = 5.42(H+0.08)^{2.0}$, where: Q = volumetric flow rate, ft^3/sec, H = water depth, ft

Table 1. Results of General Chemistry Analyses by the Ecology for Class II Inspection - City of Kennewick WWTP, 4/92

Parameter / Location:	Inf-E	Inf-K	Inf-1	Inf-2	Eff-E	Eff-K	Eff-1	Eff-2
Type:	comp	comp	grab	grab	comp	comp	grab	grab
Date:	4/28-29	4/28-29	4/28	4/29	4/28-29	4/28-29	4/28	4/29
Time:	0800-0800	0800-0800	1430	0920	0800-0800	0800-0800	1500	1030
Lab ID#1880:	-82	-83	-84	-85	-86	-87	-88	-89
GENERAL CHEMISTRY								
Conductivity, µmhos/cm	860	867	783	1440	1030	1030	1040	1030
Alkalinity, mg/L	236	247			339	339		
Hardness, mg/L CaCO3					204	199		
TS, mg/L	878	870			638	599		
TNVS, mg/L	393	419			396	401		
TSS, mg/L	194	258	220	229	24	30	25	10
TNVSS, mg/L	44	42			8	7		
BOD5, mg/L	260	280	490	156	19	22	20	27
TOC, mg/L	139	114			43	43		
NH3-N, mg/L	18.7	18.8			29.4	28.7		
NO2+NO3-N, mg/L	0.07	0.03			0.23	0.26		
T-Phosphorus, mg/L	5.77	6.12			6.06	5.97		
Oil and Grease, mg/L			35.2	34			1.7	1.6
F-Coliform (MF), #/100 mL							330	3 U
FIELD OBSERVATIONS								
Flow, MGD					5.03			
Temperature, °C	7.9*	11.6*	22.1	19.3	6.8*	11.4*	20.4	19.1
pH, S.U.	7.7*	7.5*	7.4	7.6	8.1*	8.0*	7.7	7.7
Conductivity, µmhos/cm	555*+	560*+	590+	440+	380*+	320*+	340+	280+
Chlorine								
Free, mg/L							0.30	0.60
Total, mg/L							0.30	0.60

E - Ecology sample.
Eff - Effluent.
Inf - Influent.
K - Kennewick sample.
U - The analyte was not detected at or above the reported result.
* Iced composite sample.
\+ Field data are not reliable, probably due to malfunctioning of the conductivity meter used (model: TDS-4).

can be made for either the presence or absence of nitrification or denitrification. Conductivity levels in composite and grab effluent samples were significantly higher than the corresponding values found in influent samples. No explanation can be given.

Two influent BOD_5 grab samples produced highly disparate results (490 versus 156, mg/L). There are several possible explanations: 1) an afternoon wastewater which was predominantly commercial in makeup, versus a morning wastewater which was predominantly dilute shower/bath water; and/or 2) a commercial wastewater with a high concentration of soluble BOD_5. Corn starch from Welch's would match this description; it could also explain the reversal in ratio of BOD_5 to TOC between influent (2:1) and effluent (1:2). The soluble BOD_5 would be readily metabolized by bacteria generating log-growth and increased cell synthesis (Metcalf and Eddy, 1991). Much of the endogenous phase could lie outside the BOD_5 window. Analyzing influent for soluble BOD_5 would shed considerable light on this issue.

Sampling of influent and effluent was completed, by necessity, during the same two-day period. But the lagoon system has a long detention time, so influent doesn't become effluent for a number of days (about 15). For this reason, further analysis of performance using these results would be highly conjectural.

The effluent total ammonia concentration (29.4 mg/L-N) was higher than both the acute freshwater quality criterion of 5.6 mg/L-N and the chronic criterion of 0.8 mg/L-N (based on salmonid present at pH = 8.0 S.U. and temp. = 20°C) (EPA, 1986). Concern over these toxicities would be minimized by a dilution factor of 6:1 at the edge of the acute and by 37:1 at the edge of the chronic mixing zones, respectively. Confirmation is required that dilution in an allowed mixing zone is sufficient to eliminate concern about ammonia toxicity as indicated above. Otherwise, methods to reduce the ammonia concentration in the effluent may be required. Plant effluent had marginally high chlorine residuals (0.6 mg/L). An optimum total chlorine residual of 0.1-0.2 mg/L can be maintained while still keeping fecal coliform counts under control. High chlorine residuals cause unnecessary cost and can be a source of toxicity.

A comparison of effluent parameters to NPDES permit limits is presented in Table 2. The effluent met permit limits for BOD_5, TSS, fecal coliform, and pH on the day of the inspection.

The permit specifies that when the hydraulic or waste load reaches 85% of design criteria, the permittee shall submit to the department a plan and schedule for continuing to maintain adequate capacity. Table 2 indicates that BOD_5 and TSS loadings, as well as flow to the plant, are less than 85%. Removal efficiencies for BOD_5 and TSS were 93% and 88%, respectively, well above the 85% (monthly average) removal requirement.

Pesticides/PCBs

A listing of pesticides detected in effluent samples is presented in Table 3. A complete listing of pesticide/PCB results is included in Appendix B. Among pesticides, three organophosphorus compounds were positively identified in the range of 0.29-3.3 μg/L. Principal applications of

Table 2. Comparison of Inspection Results to NPDES Permit Limits – City of Kennewick WWTP, 4/92

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria (DC)	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			260					
(lbs/d)					14,600	10,900	75	85
Effluent BOD5								
(mg/L)	30*	45	19	20;27				
(lbs/d)	2178	3265				800		
(% removal)	85					93		
Influent TSS								
(mg/L)			194					
(lbs/d)					14,950	8,100	54	85
Effluent TSS								
(mg/L)	30*	45	24	25;10				
(lbs/d)	2176	3265				1,000		
(% removal)	85					88		
Fecal Coliform								
(#/100 mL)	200+	400+		31+				
pH (s.u.)	$6.0 \leq pH \leq 9.0$			7.7;7.7				
Flow (MGD)	8.7				8.7	5.03	58	85

* or 15% of the respective influent concentrations, whichever is more stringent.

\+ The average for fecal coliform bacteria is based on the geometric mean of the samples taken.

Table 3. Results of Effluent Organophosphorus Pesticides Analyses - Kennewick WWTP, 4/92.

Organophosphorus Pesticides (µg/L)	Field Station: Type: Date: Lab ID#:	Eff-1 grab 4/28 188088	Eff-2 grab 4/29 188089
Diazinon		0.55	0.63
Monocrotophos/Azodrin		-	3.3
Fensulfothion		-	0.29 J

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

the three pesticides detected are to control soil insects, as well as many pests of fruits and vegetables (Sine, 1988). The acute toxicity test using diazinon on freshwater invertebrate (*i.e. Gammarus fasciatus*) indicated the lethal concentration for 50% of the organisms (LC_{50}) is 0.20 μg/L (Johnson and Finley, 1980). Also, the recommended maximum concentration of diazinon in whole water, sampled at anytime and any place is reported as low as 0.009 μg/L (EPA, 1972). The levels of diazinon found in effluent on both days were higher than the above referred freshwater quality criteria. This potential diazinon toxicity warrants further investigation. However, the monocrotophos/azodrin was found at much lower concentration than the LC_{50} for freshwater organisms (*i.e. G. fasciatus*). There are no LC_{50} data available in the referenced literature for the fensulfothion/dasanit compound. No organochlorine pesticides or PCBs were detected.

Comparison of Split and Performance Evaluation Sample Results

Table 4 compares the results of analyses performed by Ecology and Kennewick on splits of the same samples. In general, the agreement between the results from the two laboratories and from the two sets of samples are within the expected precision of the methods. There are no obvious problems with sampling location or analytical procedure revealed by this comparison. The differences between the Ecology and Kennewick results for effluent BOD_5 concentrations (5 mg/L difference for the sample collected by Ecology and 9 mg/L difference for the same sample collected by Kennewick) are within the acceptable range of variability. No definite conclusions can be drawn while the readings are this low and the data are so limited.

The 62 mg/L difference in TSS for the influent sample collected by Ecology and the 6 mg/L difference for the effluent sample collected by Kennewick are within the expected range of variability. Due to potential variability in splitting samples for TSS, this level of random variability is acceptable.

The differences between the Ecology and Kennewick analyses for fecal coliform appear large. The mean of both sets are similar (31 and 38 #/100 mL, respectively). Given the difficulties of preserving samples for fecal coliform analysis, these differences are not excessive.

A series of performance evaluation (PE) samples (provided by Ecology's QA Section) were analyzed by the permittee's lab. Table 5 compares the results obtained by the WWTP's lab with the samples' true values as well as acceptance and warning limits. Among the samples analyzed, BOD_5, NH_3, and pH results indicate a reasonably close agreement with the acceptable and warning limits. However, one TSS result was less than acceptable and warning limits, and one residual chlorine result was slightly less than the lower point of the warning limits. The results given in Table 5 indicate that the overall performance by the permittee's lab is acceptable.

Dale Van Donsel and Dennis Julvezan of Ecology's Quality Assurance Section conducted an on-site laboratory evaluation on April 28, 1992. Their report indicates that the WWTP's laboratory has a number of deficiencies that should be corrected. Their complete audit report is included as Appendix C.

Table 4. Comparison of Sample Splits - Kennewick WWTP, 4/92

Sample	Sampler	Laboratory	BOD5 (mg/L)	TSS (mg/L)	F-Coliform* (#/100 mL)	Ammonia (mg/L)
Inf-E	Ecology	Ecology	260	194		19
(188082)		Kennewick	252	256		17
Inf-K	Kennewick	Ecology	280	258		19
(188083)		Kennewick	246	233		17
Eff-E	Ecology	Ecology	19	24	330:3 U	29
(188086)		Kennewick	14	23		25
Eff-K	Kennewick	Ecology	22	30		29
(188087)		Kennewick	13	24	41;35	25

* Grab sample.
U - The analyte was not detected at or above the reported result.

Table 5. Performance Evaluation (PE) Sample Analyses, Kennewick WWTP, 4/92.

Analytes	Sample Number	True Value*	Acceptance Limits	Warning Limits	Performance Evaluation+
BOD5, mg/L	1	18.6	13.1-30.9	15.3-28.7	26
	2	59.7	41.7-85.7	47.2-80.3	80
TSS, mg/L	1	29.7	24.2-33.3	25.3-32.2	22
	2	41.9	33.3-46.6	34.9-45.0	40
NH3, mg/L	1	3.00	2.31-3.66	2.47-3.50	3.0
	2	13.0	10.2-15.5	10.9-14.9	13.5
pH, S.U.	3	5.80	5.66-5.91	5.69-5.88	5.8
	4	7.80	7.55-7.97	7.60-7.92	7.7
Total Residual	1	1.4	0.91-1.72	1.01-1.61	1.5
Chlorine, mg/L	2	4.0	2.76-5.01	3.05-4.71	3.0

* Based upon theoretical calculations, or a reference value when necessary.
\+ Analyzed at Kennewick WWTP Lab.

CONCLUSIONS and RECOMMENDATIONS

1. The plant met NPDES permit limits for BOD_5, TSS, fecal coliform, and pH at the time of the inspection.

2. Field observation data indicated that the WWTP's influent and effluent sample temperatures (11.6 & 11.4°C) were higher than the recommended 4°C. The permittee's refrigeration units should be inspected and repaired as necessary to provide sample cooling to 4°C.

3. Critical dimensions of the Palmer-Bowlus flume were measured and found to be correct.

4. The effluent total ammonia concentration exceeded the acute and chronic freshwater quality criteria. It is recommended that the permittee confirm with an additional study that dilution is sufficient to eliminate concern about ammonia toxicity.

5. Split sample results and performance evaluation sample analyses showed good agreement except one TSS and one residual chlorine analyses of PE samples. Ecology's audit report given in Appendix C addressed these issues as well as some corrective actions.

6. Three organophosphorus pesticide compounds were found; among them, diazinon levels were higher than recommended freshwater quality criteria. No organochlorine pesticides or PCBs were detected in the effluent.

7. It is recommended that the city analyze influent for soluble BOD_5.

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APPENDICES

Appendix A. Chemical Analytical Methods and Laboratories - Kennewick WWTP Class II, 4/92

Parameter	Method	Lab used
Conductivity	EPA, 1983: 120.1	Ecology; Manchester, WA
Alkalinity	EPA, 1983: 310.1	Ecology; Manchester, WA
Hardness	EPA, 1983: 130.2	Ecology; Manchester, WA
SOLIDS4		
TS	EPA, 1983: 160.3	Ecology; Manchester, WA
TNVS	EPA, 1983: 160.4	Ecology; Manchester, WA
TSS	EPA, 1983: 160.2	Ecology; Manchester, WA
TNVSS	EPA, 1983: 160.4	Ecology; Manchester, WA
BOD5	EPA, 1983: 405.1	Water Management Laboratories Inc; Tacoma, WA
TOC (water)	EPA, 1983: 415.2	Ecology; Manchester, WA
NUTRIENTS		
NH3-N	EPA, 1983: 350.1	Ecology; Manchester, WA
NO2+NO3-N	EPA, 1983: 353.2	Ecology; Manchester, WA
T-phosphorus	EPA, 1983: 365.1	Ecology; Manchester, WA
Oil and Grease	EPA, 1983: 413.1	Ecology; Manchester, WA
Fecal Coliform (MF)	APHA, 1989:9222D	Ecology; Manchester, WA
ORGANICS (Water)		
Organochlorine Pesticides/PCBs	EPA, 1984: 608	Analytical Resources Inc; Seattle, WA
Organophosphorus Pesticides/PCBs	EPA, 1984: 614	Analytical Resources Inc; Seattle, WA

Appendix B. Results of Effluent Organochlorine and Organophosphorus Pesticide/PCB Analyses - Kennewick WWTP, 4/92.

	Field Station:	Eff-1	Eff-2
	Type:	grab	grab
	Date:	4/28	4/29
	Time:	1500	1030
Organochlorine (μg/L)	Lab sample#:	188088	188089
alpha-BHC		0.05 U	0.05 U
gamma-BHC (Lindane)		0.05 U	0.05 U
beta-BHC		0.05 U	0.05 U
Heptachlor		0.05 U	0.05 U
delta-BHC		0.05 U	0.05 U
Aldrin		0.05 U	0.05 U
Heptachlor Epoxide		0.05 U	0.05 U
Endosulfan I		0.1 U	0.1 U
4,4'-DDE		0.1 U	0.1 U
Dieldrin		0.1 U	0.1 U
Endrin		0.1 U	0.1 U
4,4'-DDD		0.1 U	0.1 U
Endosulfan II		0.1 U	0.1 U
4,4'-DDT		0.1 U	0.1 U
Endrin Ketone		0.1 U	0.1 U
Endosulfan Sulfate		0.1 U	0.1 U
Methoxychlor		0.5 U	0.5 U
Toxaphene		5.0 U	5.0 U
alpha-Chlordane		0.05 U	0.05 U
gamma-Chlordane		0.05 U	0.05 U
PCB-1016		1.0 U	1.0 U
PCB-1221		2.0 U	2.0 U
PCB-1232		1.0 U	1.0 U
PCB-1242		1.0 U	1.0 U
PCB-1248		1.0 U	1.0 U
PCB-1254		1.0 U	1.0 U
PCB-1260		1.0 U	1.0 U

U - The analyte was not detected at or above the reported result.

Appendix B - Cont. - Results of Effluent Organochlorine and Organophosphorus Pesticide/PCB Analyses - Kennewick WWTP, 4/92.

	Field Station:	Eff-1	Eff-2
	Type:	grab	grab
	Date:	4/28	4/29
	Time:	1500	1030
Organophosphorus (μg/L)	Lab sample#:	188088	188089
Dichlorvos		0.07 U	0.07 U
Mevinphos		0.20 U	0.20 U
Demeton-O		0.06 U	0.06 U
Ethoprop		0.03 U	0.03 U
Naled		0.75 U	0.75 U
Phorate		0.04 U	0.04 U
Demeton-S		0.25 U	0.25 U
Diazinon		0.55	0.63
Disulfoton		0.28 U	0.28 U
Atrazine		0.25 U	0.25 U
Simazine		0.50 U	0.50 U
Monocrotophos/Azodrin		1.40 U	3.3
Dimethoate		0.25 U	0.25 U
Ronnel		0.03 U	0.03 U
Chlorpyrifos		0.05 U	0.05 U
Methyl Parathion		0.03 U	0.03 U
Fenthion		0.03 U	0.03 U
Malathion		0.03 U	0.03 U
Ethyl Parathion		0.03 U	0.03 U
Tokuthion		0.08 U	0.06 U
Tetrachlorvinphos		0.13 U	0.13 U
Bolstar		0.04 U	0.04 U
Fensulfothion		0.26 U	0.29 J
EPN		0.07 U	0.07 U
Coumaphos		0.09 U	0.09 U

J - The analyte was positively identified. The associated numerical result is an estimate.
U - The analyte was not detected at or above the reported result.
Shaded area denotes compound detected.

Appendix C

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

Post Office Box 488 • Manchester, Washington 98353-0488 • (206) 895-4649

July 13, 1992

TO: Tapas Das

FROM: Cliff Kirchmer

SUBJECT: Class II Inspection of Kennewick Wastewater Treatment Plant Lab

Dale Van Donsel and Dennis Julvezan of this office completed their audit of the Kennewick lab on April 28, 1992, during the Class II Inspection of the plant. Their report is attached, and I recommend that you forward a copy to the plant, along with the accompanying information which will help the lab improve its QC procedures.

As the report indicates, this laboratory has a number of deficiencies that should be corrected. However, its performance evaluation sample results were fairly good, and this is one of the requirements for accreditation. As of today, we have not received the lab's application or its quality assurance document which are the two other requirements.

CJK:DV:dv

Enclosure
On-site audit report

WASHINGTON STATE DEPARTMENT OF ECOLOGY
ENVIRONMENTAL INVESTIGATIONS AND LABORATORY SERVICES
QUALITY ASSURANCE SECTION

SYSTEM AUDIT REPORT

LABORATORY: Kennewick Wastewater Treatment Plant Laboratory

ADDRESS: P.O. Box 6108, 416 N. Kingwood St.
Kennewick, WA 99336

DATE OF AUDIT: April 28, 1992

AUDITORS:	Dale Van Donsel	Microbiology
	Dennis Julvezan	General Chemistry
PERSONNEL INTERVIEWED:	Jack Barton	Operator
	Terry Butler	Operator

AUTHENTICATION:

Dale J. Van Donsel

Dennis G. Julvezan

GENERAL FINDINGS AND RECOMMENDATIONS

1. General. A system audit was conducted at the Kennewick Wastewater Treatment Plant laboratory on April 28, 1992, in conjunction with the Class II Inspection of the treatment plant. The purpose of the audit was to verify laboratory capabilities pertaining to analyses required in the treatment plant discharge permit (WA0044784) and to review analytical and quality control data. A secondary purpose was to conduct the audit required for laboratory accreditation, although at this time the lab had not yet applied. General audit findings and recommendations are documented below. Significant recommendations for improvement of laboratory operations are highlighted by use of *italics*.

A very significant deficiency in the overall lab operation was the lack of a formal (*i.e.*, documented) quality assurance (QA) program designed to assure reliability of analytical data generated in the lab. *It is recommended that establishment of such a program and publication of a QA manual be made a high priority*. A model QA manual for a wastewater treatment facility lab is being sent to the lab to help with this.

2. Personnel. Both operators would benefit greatly by exposure to outside training courses such as those offered by Green River Community College. Unfortunately, there are no equivalent courses available in eastern Washington. A visit to the Yakima or Walla Walla treatment plant lab would help familiarize personnel with proper laboratory procedures. The Lab Analyst Section of the Pacific Northwest Pollution Control Association (PNPCA) is another source of information through meetings and contact with other analysts.

3. Facility. The lab facility consists of one small room. Current floor and bench space is congested when two analysts are working and is marginally adequate to support current lab operations. Significant expansion of lab operations to include any new analytical capability would require additional bench space.

4. Equipment and Supplies.

A. The lab has a Corning glass still which would be expected to produce a high-quality water to make the phosphate-buffered water for the fecal coliform test. The formulation being used for this was an old one, using $MgSO_4$. The preferred recipe with $MgCl_2$ can be found on page 9-31 of *Standard Methods*, 17th ed. However, the lab does its fecal coliform testing only once per week, so making the buffered water would not be worth the time involved. Sterile phosphate-buffered dilution water in 99-ml bottles can be purchased through most large laboratory supply houses for a reasonable price. There may be several different types of dilution water available; the one that is needed will usually be called EPA or APHA dilution water.

B. The membrane filter funnel base has a very fine screen that was clogged or corroded, with some raised areas. This resulted in material

being concentrated in certain areas of the filter. *It was recommended that the screen be cleaned if possible; otherwise it should be replaced.*

C. The thermometer used in the fecal coliform water bath is graduated in 1.0°C increments. There is only a 0.2° tolerance with this test, so *a thermometer with 0.1 or 0.2° graduations is required. After it is received, it should be calibrated against an NIST-certified thermometer.*

5. Sample Management.

A. Formal chain-of-custody procedures had not been documented (as might be expected, given the absence of a QA program in the lab) to assure samples were being properly secured and accounted for from time of receipt in the lab to disposal. *A recommendation was made to establish and implement such procedures to preclude potential problems should future analytical results be involved in litigation.* With proper documentation, sample handling procedures currently used in the lab will suffice for chain-of-custody purposes. *This documentation should include a record of all dates, times, and sampling locations, and identify the sample collector and analyst.* The lab's QA manual should document the fact that those procedures constitute the chain-of-custody procedures for the lab. A copy of ASTM Standard D 4840-88, "Sampling Chain of Custody Procedures", is being provided to the lab to help with preparing this information.

B. It was noted that for plant composite sampling, ISCO samplers are used with ice to keep the samples chilled to the required temperature of 4°C. These samplers are acceptable; however, there was no provision for monitoring the sample temperature. It was recommended that the composite samplers be modified so that thermometers can be inserted into the inner compartment, preferably without opening the samplers, to monitor the actual sample temperature.

6. Data Management.

A. A large proportion of data recording was being done in pencil and showed numerous erasures. This practice is not acceptable for any NPDES compliance record keeping; the lab will be unable to defend itself if analyses documented in this manner are challenged or questioned. *A recommendation was made to record all data and observations in ink and correct any errors by crossing out with a single line, entering the correct data, and signing or initialling the change.* If initials are used for such purposes or any other purpose in the lab, a permanent record should be retained in the plant matching handwritten initials with each employee to assure identification should lab data be involved in future legal proceedings.

B. During the on-site visit, the audit team asked to review the raw data for the DMR-QA 11 study, but the laboratory staff could not find the data in question. It became apparent that the laboratory did not have an adequate filing system for raw or intermediate analytical data. Also there was no apparent policy in regard to data retention for raw and intermediate data. *It is recommended that the laboratory establish a policy for retaining raw and intermediate data, as well as final data, for a period of*

at least 3 years as required by NPDES. It is also recommended that the laboratory initiate a data filing system so that all stages of data can be easily retrieved.

C. There are no records of any kind for fecal coliform testing except for the final number on the DMR sheet. *It is recommended that a permanent record be maintained that includes identity of analyst, individual counting, volumes filtered, counts, and final results.*

D. Other parameters do have some sort of raw data record; the TSS sheet is a legal pad that indicates sample source, date, final weight, tare, and result; there is a BOD worksheet and an ammonia logbook. In most cases these appear sufficient, except that the identity of the analyst is not always noted.

E. There was no consistent or recorded practice for review of analytical results for calculation or transcription errors. BOD and TSS tests are the ones most subject to such errors. *It is recommended that a procedure for data review or even spot checks be established, and that analytical records indicate who reviewed them.*

7. PE Samples. The lab reported unacceptable results for ammonia and BOD in DMR-QA number 11. At the request of the Class II Inspection Team a set of performance evaluation samples were provided for pH, TSS, ammonia, BOD, and residual chlorine. The lab had acceptable results for all of these, except for the low TSS concentration, for which 22.0 mg/L was reported. The true value is 29.7 mg/L, with acceptance limits of 24.2-33.3.

8. Quality Assurance/Quality Control. The most significant deficiency in the quality assurance area is the lack of a formal QA program, already mentioned above. Within the QA program, the most significant deficiency is the lack of any protocol to establish data quality objectives (in terms of bias and precision) and track the lab's capability to meet those objectives. Because of this deficiency, there is no basis for the lab analysts or outside evaluators to determine whether or not the lab is "in control" on a continuing basis. The following recommendations are being made to assist the lab in setting up a protocol to establish and track data quality objectives:

A. *The lab should establish a schedule for routinely analyzing quality control (QC) samples along with other analyses.*

(1) *First priority should go to analyzing standard solutions (solutions of known concentration) for those parameters where it is appropriate to do so.* One objective in doing this QC test is to discover any bias, or systematic error, in the test by comparing the average of the observed values to the known or expected value. Another objective is to track precision, or random error, as the tests are done repetitively. For the parameters reported by the Kennewick lab, appropriate standard solution tests for BOD would be the glucose-glutamic acid solution described in the method, and for TSS a suspension of a suitable material such as Sigma Cell 20, information on which is being sent to the lab.

(2) *Second priority should go to analyzing duplicate samples, preferably from the effluent stream since duplicates taken elsewhere in the facility are likely to vary widely in concentration.* The objective here is to track precision of analysis on real samples (as opposed to the relatively clean standard solutions). For the facility performance parameters reported by the lab, appropriate duplicate tests (on effluent samples) would BOD, TSS, pH, and (eventually) residual chlorine. Duplicates are appropriate for virtually any chemistry test, should other tests be added in the future. Duplicate tests can also be done on fecal coliforms if time and manpower resources allow.

B. *After running sufficient QC tests to provide statistically significant data (ten tests of a given type are enough but 20 are better), control charts should be constructed and used as a means to check precision as a routine procedure.* Information on how to construct and use control charts for both standard solutions and duplicate analyses can be found in Appendix L of the Procedural Manual for the Environmental Laboratory Accreditation Program. Consistent use of control charts will provide evidence to interested parties, inside and outside the lab, concerning capability of the lab to accurately analyze environmental samples.

C. Except for ammonia, there is no documentation of the methods used. The lab should have its own SOPs or summaries of analytical methods along with any modifications to indicate they are those required in 40 CFR Part 136. The lab should also develop QC logs for reagent and standard preparation, calibration and maintenance of instruments, temperature records (water bath and BOD box).

9. Methods.

A. **BOD.** The laboratory was setting up an additional blank for each glucose-glutamic acid check standard per batch of BOD samples. The oxygen depletions on these blanks were essentially the same as those on the glucose-glutamic acid check standards. It was found that the probable reason for this was that the laboratory was erroneously preparing these "blanks" in the same manner as the glucose-glutamic acid checks, i.e., adding the glucose-glutamic acid solution and seed to the blank dilution water in the same proportions as for the check standards.

(1) The laboratory was informed that an additional blank was not necessary and that the original BOD blank was prepared properly, i.e., the blank consisted only of the BOD dilution water, as is required by the method. It was also pointed-out that the "loss" (average oxygen depletion) on the seeded blanks should be subtracted from the oxygen depletion on the glucose-glutamic acid check standard, when calculating the BOD result of the check standard.

(2) For the initial DO readings on the samples, the laboratory was using the initial DO of the BOD blank. Since the method the laboratory uses for the DO readings is the Winkler titration, it is not convenient to determine initial DOs on each BOD bottle, although this is required by the method. It is recommended that the laboratory switch to the dissolved oxygen probe method. This method is not only more convenient, but it also

allows for direct initial DO measurement on each BOD bottle, which is more accurate.

(3) A daily temperature log was recommended for the BOD incubator (required temperature of 20 ±1°C).

(4) The laboratory is in the process of documenting results for the glucose-glutamic acid check standard. The glucose-glutamic acid standard analysis should be continued at least once per week. The lab should use the guidelines for precision and accuracy given in *Standard Methods*, 17th ed., p. 5-9, as initial Data Quality Objectives (DQOs), i.e., the result of any individual glucose-glutamic check standard should be 198 ±30.5 mg/L. If any given result is not in this range, then corrective measures should be taken to remedy the problem in the laboratory's BOD method. It was also recommended that the laboratory perform a duplicate analysis of the final effluent composite sample dilutions at least once per week. Control charting both check standard and duplicate sample results is highly recommended when the laboratory develops the capability. A LOTUS 1-2-3-based program is being sent to the lab. This automates the control charting procedure and can be used for other parameters beside BOD.

B. **Ammonia Nitrogen**. It was noted that the laboratory has not been performing any quality control analyses for the ammonia test. It was recommended that the lab initiate analysis of a method blank and a check standard with each batch of samples. Also, it was recommended that duplicate samples be periodically analyzed. The check standard and duplicate sample results should be control charted as soon as enough QC data points have been accumulated.

(1) The laboratory has not performed the preliminary ammonia distillation step. It is required by NPDES that the laboratory obtain comparability data on representative effluent samples. This requires performing spit-sample comparisons, one portion of each sample analyzed incorporating the preliminary distillation step and one without. Enough comparability data should be accumulated to determine whether there is a significant difference in the test with and without the distillation step.

(2) It was recommended that samples containing chlorine, i.e., chlorinated final effluent, be de-chlorinated prior to analysis by the addition of sodium thiosulfate as indicated in *Standard Methods*, 17th ed., section 4500 NH_3.B.3.d.

C. TSS.

(1) It was recommended that the balance calibration be checked with at least one Class S weight (suggested 1 gram) prior to each day's sample analyses. The calibration checks should be within ± 0.0002 grams and recorded in a bound laboratory notebook.

(2) It was recommended that a daily temperature log be kept for the solids drying oven (required temperature of 103-105°C).

(3) It was recommended, as required by *Standard Methods*, that the TSS filter papers be pre-washed with the laboratory pure water, then dried at 105°C for 15 minutes, and desiccated for at least 30 minutes prior to obtaining the tare weights. This procedure insures that any residues on the filter papers are rinsed off prior to use.

(4) For quality control, it was recommended that a method blank be analyzed with each set of samples. For this, filter 100 mL of laboratory pure water (instead of sample) and carry it through the entire procedure. The final dry weight of the blank should agree within ±0.0002 grams of the original tare weight. It was also recommended that the lab periodically analyze and control chart duplicate samples (using same sample volume). As a check standard, it was recommended that the laboratory periodically analyze a material of known TSS concentration, such as Sigma Cell 20. This can be used to prepare a stable suspension (suggested 300 mg/L). This check standard can be control charted as a measure of method accuracy.

D. **Chlorine residual.**

(1) The laboratory was using the Hach color disc method, which is not an acceptable method for chlorine residual analysis. The correct colorimetric method is the DPD Colorimetric Method (4500-Cl G.), as indicated in *Standard Methods*, 17th ed. This method requires the use of a spectrophotometer (515 nm wavelength) or filter photometer (490-530 nm wavelength range). Either the Hach DR100 spectrophotometer or the Hach portable pocket colorimeter (information being provided) is suitable for this test and relatively inexpensive.

(2) It is recommended that the laboratory analyze a blank with each set of samples. It is also recommended that a duplicate sample be analyzed on a periodic basis, to monitor for precision.

E. **pH.**

(1) The pH meter being used by the laboratory did not have the capability for automatic temperature compensation. Samples must be measured at the same temperature as the calibration buffers for accurate pH measurements. It is recommended that the laboratory obtain a suitable pH meter, as indicated by *Standard Methods*, which includes automatic temperature compensation capabilities. Alternatively, manual compensation with the existing meter can be used.

(2) It is recommended that a two-point pH calibration be performed prior to each day's analysis to bracket the sample pH range, i.e., pH 7 and 10 buffers if sample pH is normally above 7.

(3) For the quality control check standard, it is recommended that a pH 7 buffer, from a source other than that of the calibration buffers be analyzed with each batch of samples. The pH of this check standard should be within ± 0.1 pH units of 7.0 to be in control.

F. **Fecal Coliforms**. The lab was not doing any sort of QC to demonstrate its methods were capable of adequately recovering fecal coliforms from its chlorinated effluent. There are several methods of accomplishing this; the one usually recommended is periodic sample splitting with a laboratory that is capable of doing the multiple-tube test, which is the reference method for fecal coliforms in chlorinated effluent. However, this laboratory does have another water bath in storage, and it is possible to do periodic testing with a modified two-temperature method. The procedure is found on page 9-44 of *Standard Methods*, 17th ed., (b. Temperature acclimation). This entails a 5-hour incubation at 35°C followed by 18 hours at 44.5°. *It is recommended that this (or other acceptable) comparison be done at least once per month to establish the recovery characteristics of the test with this plant's effluent.* If it can be established that recovery is comparable to the standard test, the number of comparisons can be reduced. If difficulties are encountered with this test, or if more information is needed, the QA Section should be contacted.