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SNOQUALMIE PASS WASTEWATER TREATMENT PLANT
February 9-10, 1988 and March 2, 1988
Class II Inspection Report

by
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ABSTRACT

A Class II inspection was conducted at the Snoqualmie Pass Sewer District (SPSD) Wastewater Treatment Plant on February 9-10, 1988 and March 2, 1988. The facility consists of a two-cell aerated lagoon system followed by spray irrigation of the treated effluent on forest land. The permit specifies ground water as the receiving water. Survey results indicated that not all discharge was to the ground water. The facility is subject to Ecology Advanced Waste Treatment Guidelines because drainage is tributary to Keechelus Lake. A monitoring program allowing SPSD treatment to be compared to Ecology Advanced Waste Treatment Guidelines is recommended.

INTRODUCTION

A Class II inspection was conducted at the Snoqualmie Pass Sewer District (SPSD) Wastewater Treatment Plant (STP) on February 9-10, 1988 and March 2, 1988. The inspection was a follow-up to a February 26-27, 1984, inspection at the facility (In 1984, the district was called Kittitas County Sewer District #1) (Heffner, 1984). The 1984 inspection was done near the end of the construction grants process.

The facility consists of a two cell aerated lagoon system followed by spray irrigation of the treated effluent on forest land (Figure 1). The second lagoon cell provides both treatment and effluent storage prior to spraying. The facility is subject to Ecology Advanced Waste Treatment Guidelines because drainage is tributary to Keechelus Lake.

The STP is operating under State Discharge Permit No. 9005. The only limit is for a maximum monthly flow of 0.368 MGD of effluent applied to the sprayfield. The permit also includes a testing schedule for other parameters in the plant and the sprayfield. The permit specifies ground water as the receiving water.

During the 1984 survey, runoff from the sprayfield site was observed. Streams running through the sprayfield, springs surfacing within the sprayfield, precipitation falling on the sprayfield, and effluent sprayed on the sprayfield were considered sources of runoff. The runnoff contained nitrogen and phosphorus in concentrations greater than background samples collected above the sprayfield. It was concluded that effluent made up a portion of the sprayfield runoff, thus, complete discharge to the ground water was not occurring. In response to these findings, plant improvements were made, including lining the second lagoon cell to prevent ground water intrusion. Sewer repairs to reduce infiltration and inflow (I/I) have been completed and additional repairs are scheduled. The liner and I/I repairs should reduce the effluent flow and thus, reduce effluent runoff from the sprayfield.

Objectives of the 1988 survey included:

1. Evaluate the quality of sprayfield runoff.

2. Collect samples to m[illegible]re effluent characteristics.

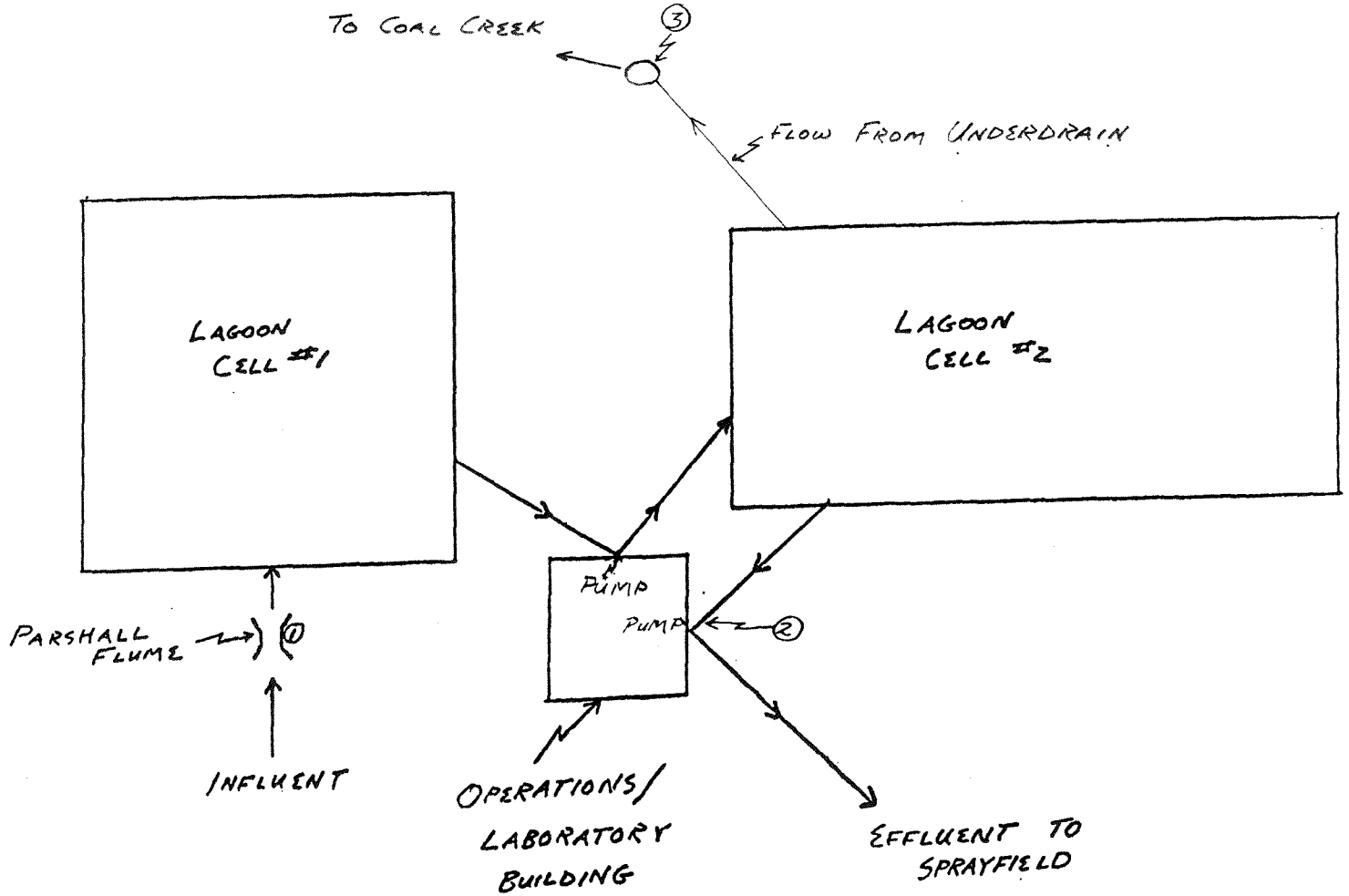

FIGURE 1 – LAGOON SCHEMATIC - SPSD, 2/88.

3. Review laboratory and sampling procedures, including sample splits.

The survey was conducted by Pat Hallinan and Marc Heffner of the Ecology Compliance Monitoring Section and John Hodgson of the Ecology Central Regional Office. Dave Johnston and Dick Kloss of the Snoqualmie Pass Sewer District provided on site help.

PROCEDURES

Procedures were similar to those followed in 1984 (Heffner, 1984). Sampling times and parameters analyzed are included with the results presented in Table 1. For many of the analyses, the SPSD contracted with the Yakima Testing Lab (YTL) and/or Herb Hart (HH) in addition to analyzing some parameters themselves.

Lagoon Sampling

Ecology influent and effluent composite samples were collected from the lagoon system. An Ecology Isco sampler was stationed near the influent Parshall flume. A 24-hour composite sample was collected from 1030 on February 9 to 1030 on February 10. Approximately 200 mLs of sample were collected every 30 minutes. The Ecology effluent sample was a hand composite taken while effluent was being pumped to the sprayfield. Equal volumes were collected on February 9 at 1250, on February 9 at 1550, and on February 10 at 1015.

SPSD sampling included an influent composite and an effluent grab. A Manning compositor collected approximately 500 mLs of sample every hour from 1030 on February 9 until 1030 on February 10. The effluent grab was collected at 1015 on February 10.

Ecology influent, effluent, and underdrain grab samples were also collected (Figure 1). Effluent grabs for fecal coliform and chlorine residual analyses were collected at the sprayfield pipe gallery, while samples for other analyses were routinely collected prior to pumping.

The SPSD measures the influent flow rate and effluent pumped to the sprayfields. The meters are routinely calibrated every three months. The influent is measured at a Parshall flume. An Ecology instantaneous measurement was made to confirm influent meter accuracy. The effluent meter accuracy was not checked.

Sprayfield Sampling

Grab samples were collected by Ecology and SPSD. Sprayfield sampling was done on three days: February 9 when field G was sprayed, February 10 when field A was sprayed, and March 2 after all fields had been rested for one week (Figure 2). Samples were collected on February 9 and 10 approximately four to six hours after spraying had begun. The February 9, 1988 sampling and spraying approximated the February 26, 1984 conditions, while the February 10, 1988 sampling and spraying approximated the February 27, 1984 condition. (Note: In the 1984 report, field A was referred to as field 1 and field G was referred to as field 7). Sample times and parameters analyzed are included in Table 1. Runoff flows were measured using an Ecology Marsh-McBernie meter until the meter failed.

Table 1. Sampling Schedule/Results - SPSD, February 1988.

					Laboratory Analyses													Field Analyses			
														Solids (mg/L)							
Sample	Date	Time	Sampler	Lab	Cond. (umhos/cm)	NO2+NO3-N (mg/L)	NH3-N (mg/L)	Total-P (mg/L)	COD (mg/L)	F. coli (#/100mL)	BOD5 (mg/L)	CBOD5 (mg/L)	TS	TNVS	TSS	TNVSS	Alkalinity (mg/L as CaCO3)	Chlorine Residual (mg/L)	Cond. (umhos/cm)	pH (S.U.)	Temp. (C)
Influent	2/26-27/84	Comp	Eco	Eco	598	<0.1	49	8.8	480		280	270	630	220	290	22	290				
	2/9/88	0945	Eco	Eco															103	7.0	3.0
	2/9-10/88	Comp	Eco	Eco	120	0.22	3.1	0.98	77		35	29	130	55	32	2	41				
		Comp	SPSD	Eco	110	0.23	3.3	0.63	52		21		100	40	16	<1	38				
				YTL	107	0.83	3.82	0.05	45.6						0.52						
				HH	106	0.18	2.22	0.69	50						25						
				SPSD							34				27						
Effluent	2/26-27/84	Comp	Eco	Eco	281	1.5	15	1.9	27		9	6	120	66	2	1	80				
	2/9/88	1250	Eco	Eco															440	6.9	1.0
		1320	Eco	Eco	453	0.21	26	3.0	51	53								<0.1			
		1550	Eco	Eco															440	6.9	1.0
	2/9-10/88	Comp	Eco	Eco	450	0.18	25	3.1	52		12	10	190	120	2	<1	160				
	2/10/88	1015	SPSD	Eco	450	0.17	25	3.1	45		12		180	110	5	<1	150			6.6	1.8
				YTL	440	1.04	29.06	3.45	42.6		20.4				8						
				HH	447	0.14	26.62	3.68	55		12				6						
				SPSD		0.8	26.2				12				15						
		1200	Eco	Eco						150								<0.1			
Creek #1 Above	2/10/88	1220	SPSD-Eco	Eco	11	0.01	0.03	<0.01	8	<1											
				YTL	13.1	<0.01	0.18	0.05	10.6												
				HH	9.8	<0.04	0.00	<0.01	8												
				SPSD		0.00	0.10			0											
	3/2/88	1235	SPSD-Eco	Eco	11	0.01	<0.01	0.01	4	<1											
				YTL	11.6	<0.01	0.14	0.10	5.54												
				SPSD		0.00	0.03			0											
Creek #1 Below	2/27/84		Eco	Eco	36	0.51	0.32	0.02	4	<1											
	2/10/88	1155	SPSD-Eco	Eco	50	1.8	0.21	0.06	11	9											
				YTL	52	3.58	0.32	0.05	9.3												
				HH	51	0.74	0.00	<0.05	15												
				SPSD		1.1	0.52			18											
	2/26/84		Eco	Eco	32	0.50	0.08	0.02	4	<1											
	3/2/88	1215	SPSD-Eco	Eco	50	2.1	0.02	0.01	<4	4											
				YTL	55	2.07	0.02	0.15	7.99												
				SPSD		1.5	0.05			2											
Creek #1 Blw road	2/9/88	1345	SPSD-Eco	Eco	41	1.5	0.02	0.02	72	3											
				YTL	39	3.35	0.05	0.10	14.6												
				HH	41.8	0.60	0.00	<0.01	7												
				SPSD		1.5	0.05														
	2/10/88	1205	Eco	Eco	38	1.2	0.07	0.03	10	7											
	3/2/88	1220	SPSD-Eco	Eco	40	1.5	0.01	0.01	<4	<1											
				YTL	43	1.55	0.05	0.15	6.55												
A-line runoff	2/27/84		Eco	Eco	175	2.4	8.7	0.80	15	6est											
	2/10/88	1250	SPSD-Eco	Eco	110	3.6	1.9	0.25	17	19											
				YTL	110	1.16	2.46	0.05	15.5												
				HH	102	1.94	1.73	0.44	36												
				SPSD		2.4	3.8			2											
	3/2/88			no flow in channel																	

Table 1. (Continued)

					Laboratory Analyses													Field Analyses			
													Solids (mg/L)							
Sample	Date	Time	Sampler	Lab	Cond. (umhos/cm)	NO2+NO3-N (mg/L)	NH3-N (mg/L)	Total-P (mg/L)	COD (mg/L)	F. coli (#/100mL)	BOD5 (mg/L)	CBOD5 (mg/L)	TS	TNVS	TSS	TNVSS	Alkalinity (mg/L as CaCO3)	Chlorine Residual (mg/L)	Cond. (umhos/cm)	pH (S.U.)	Temp. (C)
Creek #2 Above	2/26/84		Eco	Eco	24	0.02	0.01	0.01	4	<1											
	2/9/88	1405	SPSD-Eco	Eco	13	0.01	<0.01	<0.01	7	<1											
				YTL	17.6	<0.01	0.14	0.05	18												
				HH	12.3	<0.05	0.00	3.12	5												
				SPSD		0.20	0.00			1											
	2/10/88	1240	Eco	Eco	14	0.01	<0.01	<0.01	6	2											
	3/2/88	1255	SPSD-Eco	Eco	15	0.01	<0.01	0.01	<4	1											
				YTL	14.5	<0.01	0.08	0.10	7.82												
				SPSD		0.20	0.02			0											
Runoff upper-G	2/26/84		Eco	Eco	173	0.90	6.4	0.55	57	<1											
	2/9/88	1430	SPSD-Eco	Eco	185	0.31	7.8	0.91	27	180											
				YTL	176	1.3	1.42	0.55	33.3												
				HH	180	0.23	7.98	0.92	26												
				SPSD		0.30	9.5														
	3/2/88	1310	SPSD-Eco	Eco	99	0.36	<0.01	0.01	5	<1											
				YTL	100	0.05	0.01	0.10	7.72												
Runoff lower-G	2/26/84		Eco	Eco	153	1.4	6.8	0.65	27	1est											
	2/9/88	1440	SPSD-Eco	Eco	192	0.83	17	0.98	27	44											
				YTL	180	1.94	1.57	0.55	24.2												
				HH	183	0.58	8.92	1.33	31												
				SPSD		1.0	9.3														
	3/2/88	1320	SPSD-Eco	Eco	72	3.8	0.17	0.02	6	1											
				YTL	75	3.36	0.30	0.40	10.64												
				SPSD		2.5	0.41														
Creek #2 Below	2/26/84		Eco	Eco	121	0.95	5.0	0.45	15	<1											
	2/9/88	1455	SPSD-Eco	Eco	42	0.29	0.87	0.09	13	14											
				YTL	47.5	0.76	1.34	0.05	20.7												
				HH	47	0.20	0.59	0.13	11												
				SPSD		0.30	1.10			8											
	2/27/84		Eco	Eco	36	0.20	0.30	0.02	4	<1											
	2/10/88	1305	Eco	Eco	21	0.09	0.05	0.01	6	3											
	3/2/88	1330	SPSD-Eco	Eco	19	0.18	<0.01	0.01	11	1											
				YTL	20	0.22	0.05	0.05	9.92												
				SPSD		0.80	1.58			1											
Btwn 1&2	3/2/88	1335	Eco	Eco	38	1.3	0.01	0.01	5	<1											
Underdrain	2/10/88	1130	SPSD-Eco	Eco	140	1.0	1.4	0.21	<4	1			110	54	2	<1					
				YTL	140	2.4	1.6	0.05	7.7		12.9				1.33						
				HH	130	0.47	<0.45	0.19	10		4				6						
				SPSD		0.70	2.2			0	3										
	3/2/88	1155	SPSD-Eco	Eco	109	1.1	0.92	0.18	11	<1			60	20	1	<1					
				YTL	107	1.16	0.89	0.80	6.97												
				SPSD		0.80	1.58														

est = estimated

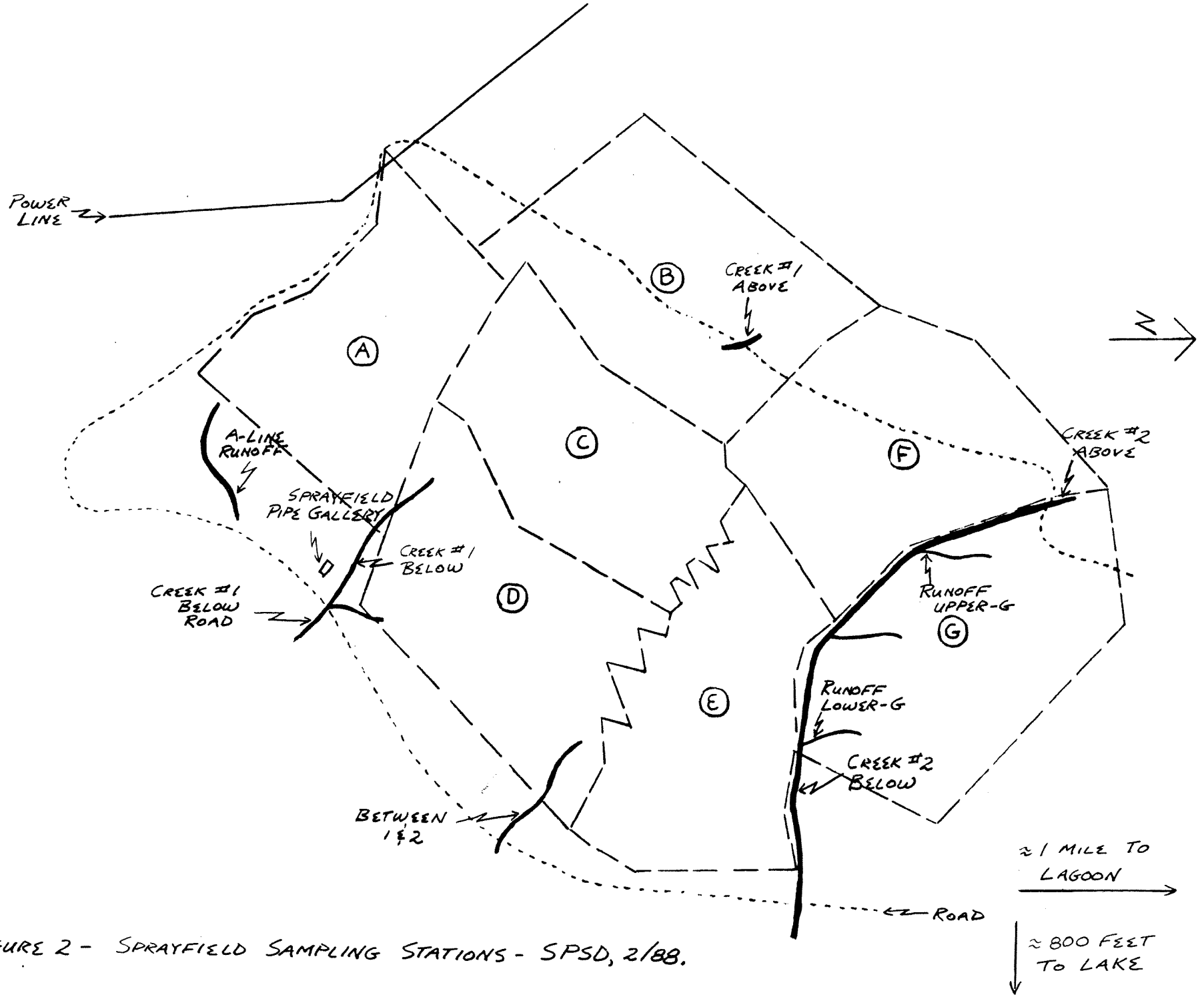

FIGURE 2 - SPRAYFIELD SAMPLING STATIONS - SPSD, 2/88.

RESULTS AND DISCUSSION

Ecology results are summarized in Table 2 and compared to the 1984 sampling data in Table 3. Flow data are included in Table 4. The inspection was conducted during a wet snow/cold rain weather pattern that created high influent flows due to I/I (3.03 inches of rainfall fell during the four day period of February 7-10, 1988). Thus, influent was weak and with the long detention time provided by the lagoons, treatment appeared minimal. In fact, NH_3-N and Total-P concentrations appeared to increase through the plant. A more accurate assessment of the lagoon loading would require both weekday and weekend monitoring to quantify light and heavy loading days. Routine plant monitoring should include influent data collection for both weekends and weekdays. Influent data should be collected whether effluent is being sprayed or not.

Underdrain grab samples were also collected. The underdrain routes ground water trapped under the lagoon 2 liner to nearby Coal Creek. NH_3-N concentrations in the 1 mg/L range were found (Table 2). Underdrain flow measurement was not possible during the inspection due to excessive deposition of Coal Creek sediments near the underdrain discharge pipe. Background nutrient concentrations for the underdrain are not available for comparison. Routine collection of conductivity, NH_3-N, $NO_2 + NO_3$-N, Total-P, and fecal coliform data from the underdrain is recommended.

The precipitation created less than ideal conditions for effluent application to the sprayfield. Application was made because available lagoon storage space was minimal due to the recent high influent flow rates and to allow the inspection to be conducted. Stations upstream of the sprayfields (Creeks 1 and 2 above) had $NO_2 + NO_3$-N, NH_3-N, and Total-P concentrations of <0.01-0.01 mg/L with one 0.03 mg/L NH_3-N measurement. These parameters were detected at significantly higher concentrations in the below sprayfield stations during spraying (Table 2). Thus, at least partial effluent discharge to surface waters rather than complete discharge to the ground water is indicated. Data collected during the March 2 sampling showed low NH_3-N and Total-P concentrations while $NO_2 + NO_3$-N concentrations remained elevated.

The lagoon/sprayfield facility was not operating optimally during the inspection. Two problems were significant:

1. I/I in the system increased spray volumes in excess of SPSD estimates. Storage time is reduced necessitating more frequent spraying and spraying during poor conditions such as those during the inspection. The SPSD hopes the sewer rehabilitation program undertaken this summer will significantly reduce I/I. Thus, spraying frequency reductions and the ability to wait for better climatic conditions will be realized.

2. Poor physical condition of the sprayfield components was a problem. The runoff upper-G and runoff lower-G samples were near broken risers or missing sprinkler heads. Three broken risers were observed in field G while walking along Creek 2. The SPSD is rehabilitating parts of the system this summer to allow winter repair of winter damage. Checking lines for damage immediately after application is begun on a sprayfield is suggested so direct runoff problems are minimized.

Table 2. 1988 Ecology Analytical Results - SPSD, February 1988.

					Laboratory Analyses														Field Analyses			
														Solids (mg/L)								
Sample	Date	Time	Sampler	Lab	Cond. (umhos/cm)	NO2+NO3-N (mg/L)	NH3-N (mg/L)	Total-P (mg/L)	COD (mg/L)	F. coli (#/100mL)	BOD5 (mg/L)	CBOD5 (mg/L)	TS	TNVS	TSS	TNVSS	Alkalinity (mg/L as CaCO3)	Chlorine Residual (mg/L)	Cond. (umhos/cm)	pH (S.U.)	Temp. (C)
Influent	2/9/88	0945	Eco	Eco															103	7.0	3.0
	2/9-10/88	Comp	Eco	Eco	120	0.22	3.1	0.98	77		35	29	130	55	32	2	41				
		Comp	SPSD	Eco	110	0.23	3.3	0.63	52		21		100	40	16	<1	38				
Effluent	2/9/88	1250	Eco	Eco															440	6.7	1.0
		1320	Eco	Eco	453	0.21	26	3.0	51	53								<0.1			
		1550	Eco	Eco															440	6.9	1.0
	2/9-10/88	Comp	Eco	Eco	450	0.18	25	3.1	52		12	10	190	120	2	<1	160				
	2/10/88	1015	SPSD	Eco	450	0.17	25	3.1	45		12		180	110	5	<1	150			6.6	1.8
		1200	Eco	Eco						150								<0.1			
Creek #1	2/10/88	1220	SPSD-Eco	Eco	11	0.01	0.03	<0.01	8	<1											
Above	3/2/88	1235	SPSD-Eco	Eco	11	0.01	<0.01	0.01	4	<1											
Creek #1	2/10/88	1155	SPSD-Eco	Eco	50	1.8	0.21	0.06	11	9											
Below	3/2/88	1215	SPSD-Eco	Eco	50	2.1	0.02	0.01	<4	4											
k #1	2/9/88	1345	SPSD-Eco	Eco	41	1.5	0.02	0.02	72	3											
road	2/10/88	1205	Eco	Eco	38	1.2	0.07	0.03	10	7											
	3/2/88	1220	SPSD-Eco	Eco	40	1.5	0.01	0.01	<4	<1											
ine	2/10/88	1250	SPSD-Eco	Eco	110	3.6	1.9	0.25	17	19											
ff	3/2/88			no flow in channal																	
k #2	2/9/88	1405	SPSD-Eco	Eco	13	0.01	<0.01	<0.01	7	<1											
Above	2/10/88	1240	Eco	Eco	14	0.01	<0.01	<0.01	6	2											
	3/2/88	1255	SPSD-Eco	Eco	15	0.01	<0.01	0.01	<4	1											
Runoff	2/9/88	1430	SPSD-Eco	Eco	185	0.31	7.8	0.91	27	180											
upper-G	3/2/88	1310	SPSD-Eco	Eco	99	0.36	<0.01	0.01	5	<1											
Runoff	2/9/88	1440	SPSD-Eco	Eco	192	0.83	17	0.98	27	44											
lower-G	3/2/88	1320	SPSD-Eco	Eco	72	3.8	0.17	0.02	6	1											
Creek #2	2/9/88	1455	SPSD-Eco	Eco	42	0.29	0.87	0.09	13	14											
Below	2/10/88	1305	Eco	Eco	21	0.09	0.05	0.01	6	3											
	3/2/88	1330	SPSD-Eco	Eco	19	0.18	<0.01	0.01	11	1											
Btwn 1&2	3/2/88	1335	Eco	Eco	38	1.3	0.01	0.01	5	<1											
Underdrain	2/10/88	1130	SPSD-Eco	Eco	140	1.0	1.4	0.21	<4	1			110	54	2	<1					
	3/2/88	1155	SPSD-Eco	Eco	109	1.1	0.92	0.18	11	<1			60	20	1	<1					

Table 3. 1984-1988 Ecology Data Comparison - SPSD, February 1988.

Sample	Date	Time	Sampler	Lab	Cond. (umhos/cm)	NO2+NO3-N (mg/L)	NH3-N (mg/L)	Total-P (mg/L)	COD (mg/L)	F. coli (#/100mL)	BOD5 (mg/L)	CBOD5 (mg/L)	Solids (mg/L)				Alkalinity (mg/L as (CaCO3)
													TS	TNVS	TSS	TNVSS	
Influent	2/26-27/84	Comp	Eco	Eco	598	<0.1	49	8.8	480		280	270	630	220	290	22	290
	2/9-10/88	Comp	Eco	Eco	120	0.22	3.1	0.98	77		35	29	130	55	32	2	41
		Comp	SPSD	Eco	110	0.23	3.3	0.63	52		21		100	40	16	<1	38
Effluent	2/26-27/84	Comp	Eco	Eco	281	1.5	15	1.9	27		9	6	120	66	2	1	80
	2/9-10/88	Comp	Eco	Eco	450	0.18	25	3.1	52		12	10	190	120	2	<1	160
Creek #1	2/27/84		Eco	Eco	36	0.51	0.32	0.02	4	<1							
Below	2/10/88	1155	SPSD-Eco	Eco	50	1.8	0.21	0.06	11	9							
	2/26/84		Eco	Eco	32	0.50	0.08	0.02	4	<1							
	3/2/88	1215	SPSD-Eco	Eco	50	2.1	0.02	0.01	<4	4							
A-line	2/27/84		Eco	Eco	175	2.4	8.7	0.80	15	6est							
runoff	2/10/88	1250	SPSD-Eco	Eco	110	3.6	1.9	0.25	17	19							
Creek #2	2/26/84		Eco	Eco	24	0.02	0.01	0.01	4	<1							
Above	2/9/88	1405	SPSD-Eco	Eco	13	0.01	<0.01	<0.01	7	<1							
	2/10/88	1240	Eco	Eco	14	0.01	<0.01	<0.01	6	2							
	3/2/88	1255	SPSD-Eco	Eco	15	0.01	<0.01	0.01	<4	1							
Runoff	2/26/84		Eco	Eco	173	0.90	6.4	0.55	57	<1							
upper-G	2/9/88	1430	SPSD-Eco	Eco	185	0.31	7.8	0.91	27	180							
Runoff	2/26/84		Eco	Eco	153	1.4	6.8	0.65	27	1est							
lower-G	2/9/88	1440	SPSD-Eco	Eco	192	0.83	17	0.98	27	44							
Creek #2	2/26/84		Eco	Eco	121	0.95	5.0	0.45	15	<1							
Below	2/9/88	1455	SPSD-Eco	Eco	42	0.29	0.87	0.09	13	14							
	2/27/84		Eco	Eco	36	0.20	0.30	0.02	4	<1							
	2/10/88	1305	Eco	Eco	21	0.09	0.05	0.01	6	3							
	3/2/88	1330	SPSD-Eco	Eco	19	0.18	<0.01	0.01	11	1							

est = estimated

Table 4. Flow Measurements - SPSD, February 1988.

	Date	Time	Plant Meter Instantaneous (mgd)	Plant Meter Totalizer
INFLUENT:				
	2/9	0920	0.40*	68767
		1125		72012
		1540	0.45	78321
	2/10	0950	0.54	105426
		1100	0.41	107240
		Average flow for inspection = 0.36 mgd**		
SPRAYFIELD:				
2/9	450,000 gallons pumped from 0720-1715; flow rate = 45,380 gph = 1.1 mgd			
2/10	117,700 gallons pumped from 0815-1105; flow rate = 41,540 gph = 1.0 mgd			

* Ecology Measurement = 0.41 mgd
** 1984 Inspection Flow = 0.10 mgd

Evaluation of the data in terms of Ecology's Advanced Waste Treatment Guidelines is suggested as a method to evaluate system adequacy. This allows Ecology guidelines/requirements to be compared to system performance. Requirements are outlined in Table 5. BOD_5, TSS, and fecal coliform concentrations sent to the sprayfield approximate the guidelines, so only minimal sprayfield treatment is necessary for those parameters. Removal of NH_3-N and Total-P in the sprayfield will be necessary to meet the guidelines. Accurate measurement of sprayfield treatment will require a mass balance approach rather than concentration comparisons. Mass balances will correct for dilution due to upstream flow coming onto the field and snowmelt.

Ecology flow measurements were attempted so inspection runoff loads from the sprayfield could be estimated. Unfortunately the metering equipment failed under the adverse inspection conditions before the task was completed. The data collected indicated flows at Creek #1 below the road and Creek #2 below were between 2 and 3 cfs (1.3-2.0 mgd) on February 9. Table 6 shows the load allowable for the volume sprayed and estimates the rate NH_3-N and Total-P were leaving the sprayfield on February 9. Because the runoff concentration would be expected to gradually increase and decline as the spraying started and stopped the table only provides an estimate. The NH_3-N load was estimated at over one-half of the guideline, suggesting a need for monitoring.

Modified Ecology inspection techniques are suggested for compliance monitoring. Installation of flumes or weirs in the four major run-off channels from the sprayfield is suggested so flows can be accurately measured. Accompanying NH_3-N and Total-P data should be collected at least four hours into the spraying cycle so loadings can be calculated. Two or three time studies should be done to see how rapidly concentrations increase and decrease in conjunction with spraying starting and stopping. These studies should be repeated at least once annually to confirm accuracy. Adequate information should then be available to calculate runoff loads and determine system capacity. Comprehensive data collection through a winter is recommended so data can be analyzed and a reasonable permit issued.

Conductivity measurements are being considered as an indicator of effluent runoff from the sprayfield. Figure 3 compares Ecology nutrient and conductivity inspection measurements. During the inspections the NH_3-N and Total-P concentrations were low when conductivity was less than 100 umhos/cm. With more data, a correlation that could prove useful in the future might be developed.

Laboratory Review

Laboratory procedures were reviewed with the operator. The procedures were generally good. A copy of the completed Ecology lab review sheet is included in the Appendix. Recommendations to improve compliance with approved techniques are identified with a circle around the item number on the review sheet.

Sample split comparison is included in Table 1. Only two samples were analyzed by both labs for BOD_5 and TSS allowing only a rough comparison. Laboratory accuracy appeared acceptable for those two samples.

Table 5. Advanced Waste Treatment Guidelines/Inspection Data Comparison - SPSD, February 1988

Parameters	Advanced Waste Treatment Guidelines	Inspection Lagoon Effluent Data*
BOD_5	10 mg/L 95% Removal	12 mg/L
TSS	10 mg/L 95% Removal	2 mg/L
NH_3-N	3 mg/L	25 mg/L
Total-P	0.5 mg/L 95% Removal	3.1 mg/L
F. coli	50/100 mL median; <10% of samples with >230/100 mL	53 and 150/100 mL

* Ecology analysis of Ecology samples.

Table 6. NH_3-N and Total-P Allowable Loads/Inspection Loads Comparison - SPSD, February 1988.

	NH3-N Conc. (mg/L)	Total-P Conc. (mg/L)	Flow Rate (mgd)	Spray Duration (Hours)	NH2-N Load (lbs/D)	Total-P Load (lbs/D)
Guidelines	3	0.5	1.1	9.92+	11.3	1.9
Stream #2 Below+	.87	0.09	2.0*	9.92**	6.0	0.62

+2/9 Ecology data

*Flow estimated to be 1.3-2.0 MGD by Ecology instantaneous measurements.

**Runoff duration assumed to correlate directly with spraying duration on this table.

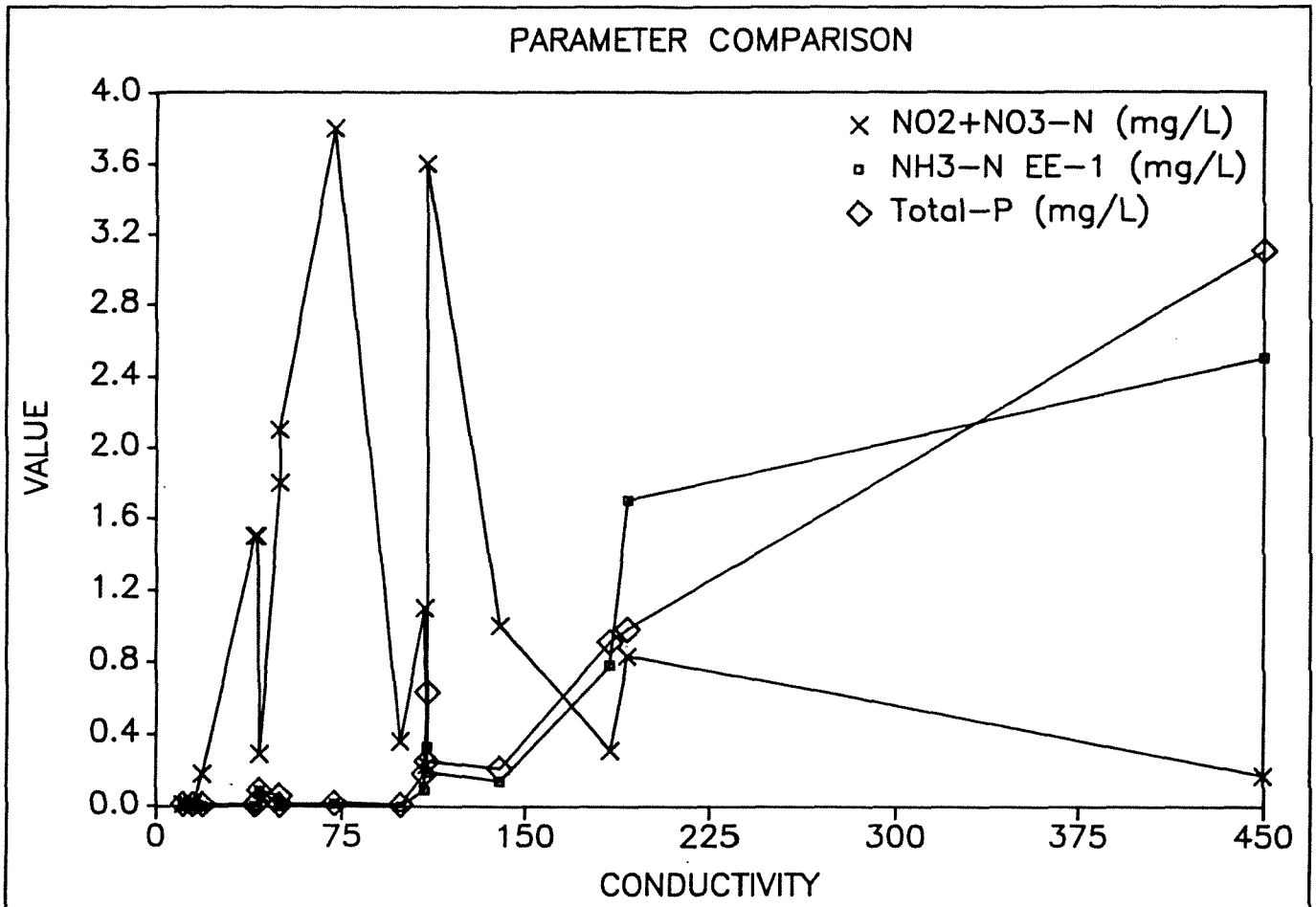

Figure 3. Nutrient - Conductivity Ecology Data Comparison - SDSD, 2/88.

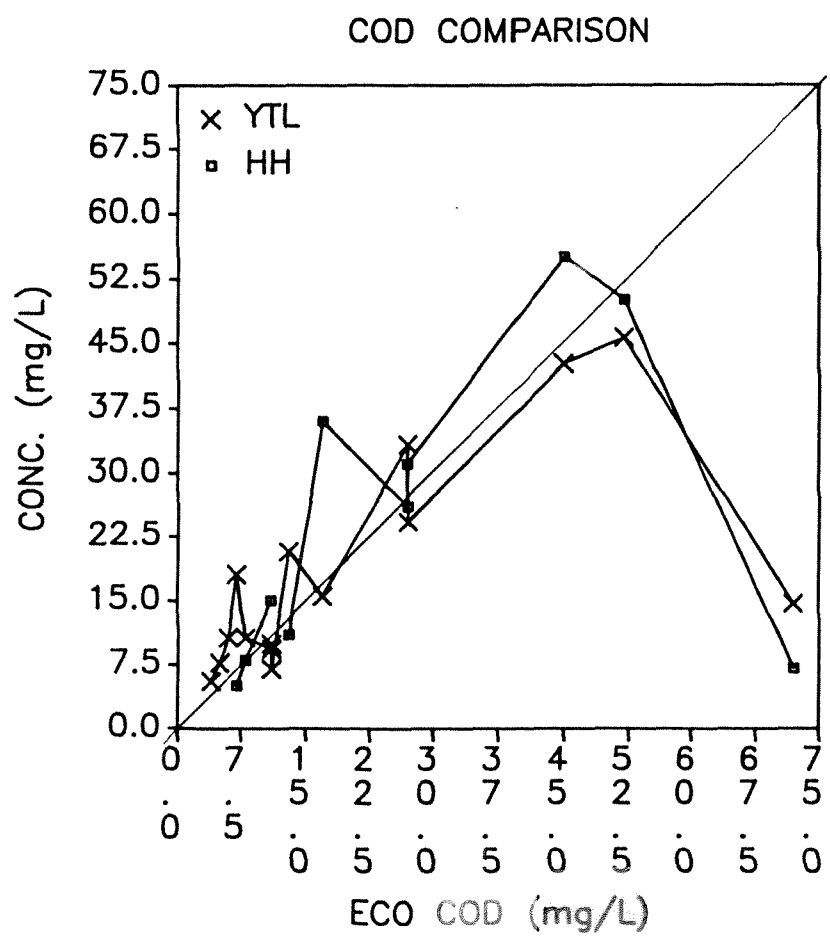

Figure 4. COD Comparison - SPSD, 2/88.

The SPSD elected to split samples with two testing labs in Yakima in addition to analyzing some parameters themselves. Results for parameters of interest are summarized in Table 1 and compared to Ecology data in Figures 4-8. Ecology laboratory QA information is included in the Appendix. Comments based on performance with the inspection samples include:

Conductivity - Comparison good between Ecology and both YTL and HH labs.

COD - Ecology 72 mg/L data point may be in error. Comparison fair between Ecology and both YTL and HH labs.

NH_3-N - Ecology 17 mg/L data point may be too high. Comparison good between Ecology and both the HH and SPSD labs. Comparison fair between Ecology and YTL lab.

$NO_2 + NO_3$-N - Comparison fair between Ecology and both HH and SPSD labs. Comparison poor between Ecology and YTL lab.

Total-P - Comparison good between Ecology and HH lab. Comparison poor between Ecology and YTL lab.

Some laboratory quality assurance work will be necessary to assure good nutrient data are collected for the mass balance of the sprayfield (Kirchmer, 1989). Each batch of samples analyzed should include one check standard (a known other than a calibration standard), a lab duplicate (a sample split before analysis is begun and each portion analyzed as an individual sample), and a lab blank (analysis of distilled water). Collection of a field duplicate (two samples of the same flow collected in rapid succession) and a field blank (distilled water poured into a field sampling container) are also useful. Field duplicate and field blank samples should be collected routinely as the study starts, with less frequent collection after field techniques are shown to be satisfactory.

RECOMMENDATIONS AND CONCLUSIONS

The 1988 survey results indicated that not all discharge was to the ground water. A similar conclusion was reached for the 1984 survey.

A monitoring program to allow SPSD treatment to be compared to Ecology Advanced Waste Treatment Guidelines is recommended. As outlined in the discussion, the program should allow mass loadings from the sprayfield to be compared to the guidelines to eliminate the effects of dilution. Flow rate, NH_3-N, and Total-P would be parameters of primary concern. Recommended quality assurance techniques for nutrient sampling and analysis are included in the laboratory discussion. Conductivity measurements may prove useful for screening in the future if correlations with NH_3-N and Total-P can be developed. Inspection data suggest that such a correlation may be possible.

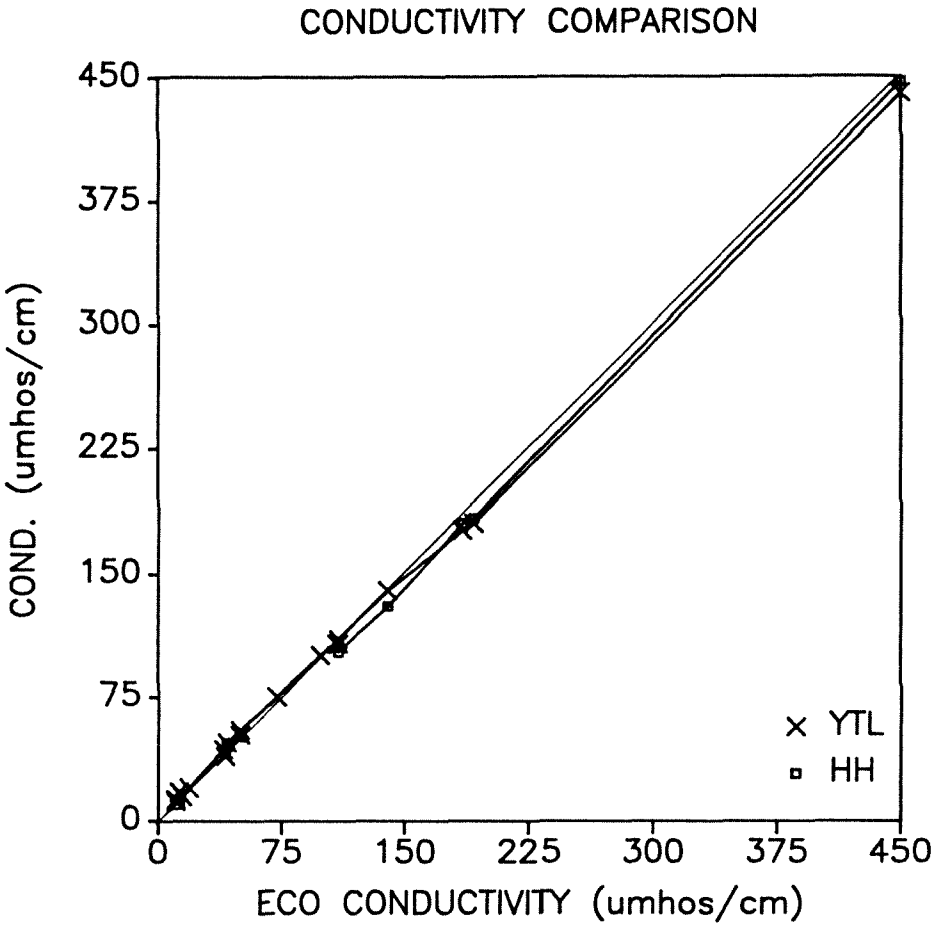

Figure 5. Conductivity Comparison - SPSD, 2/88.

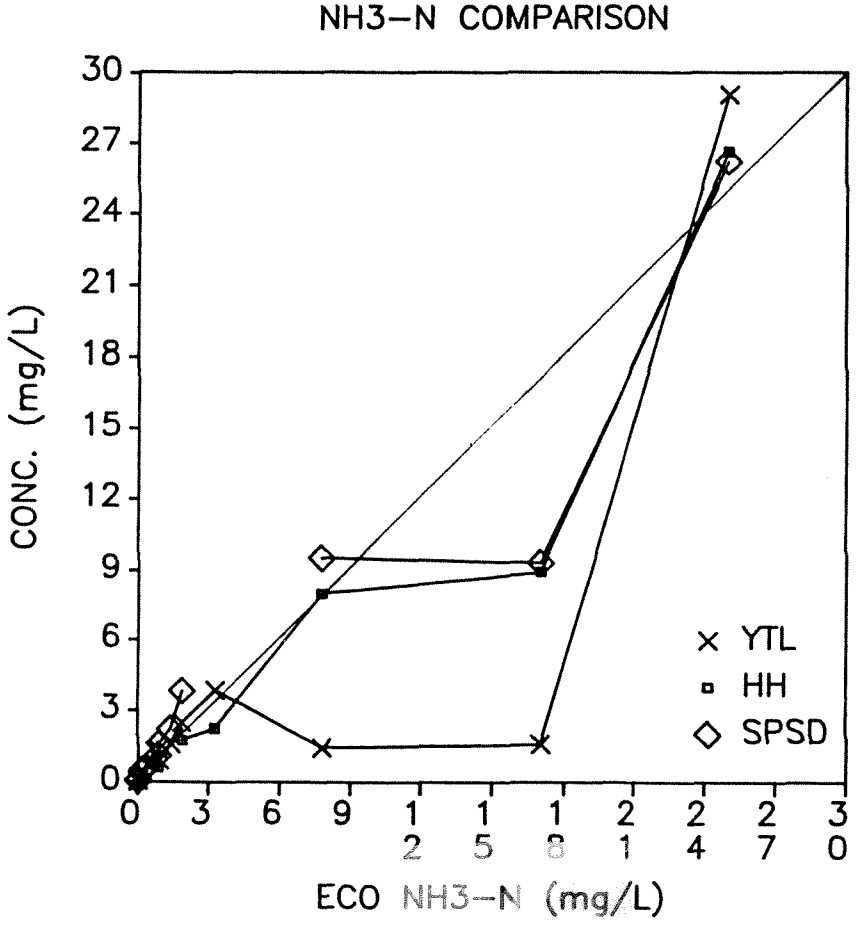

Figure 6. - NH_3-N Comparison - SPSD, 2/88.

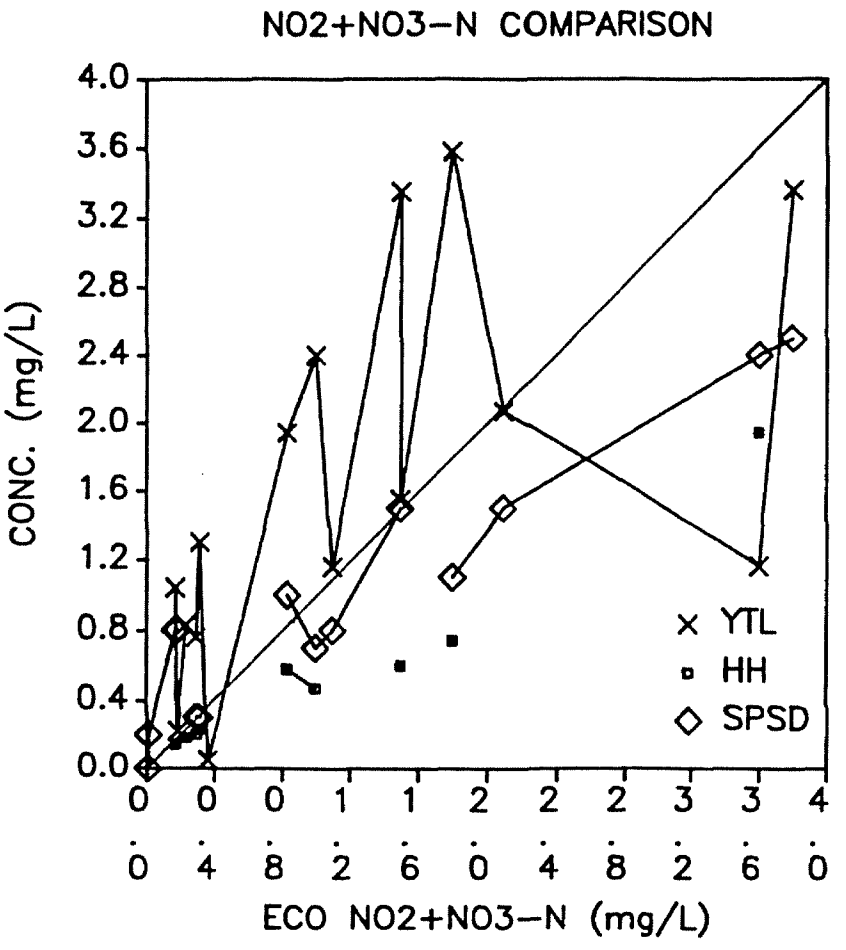

Figure 7. NO_2+NO_3-N Comparison - SPSD, 2/88.

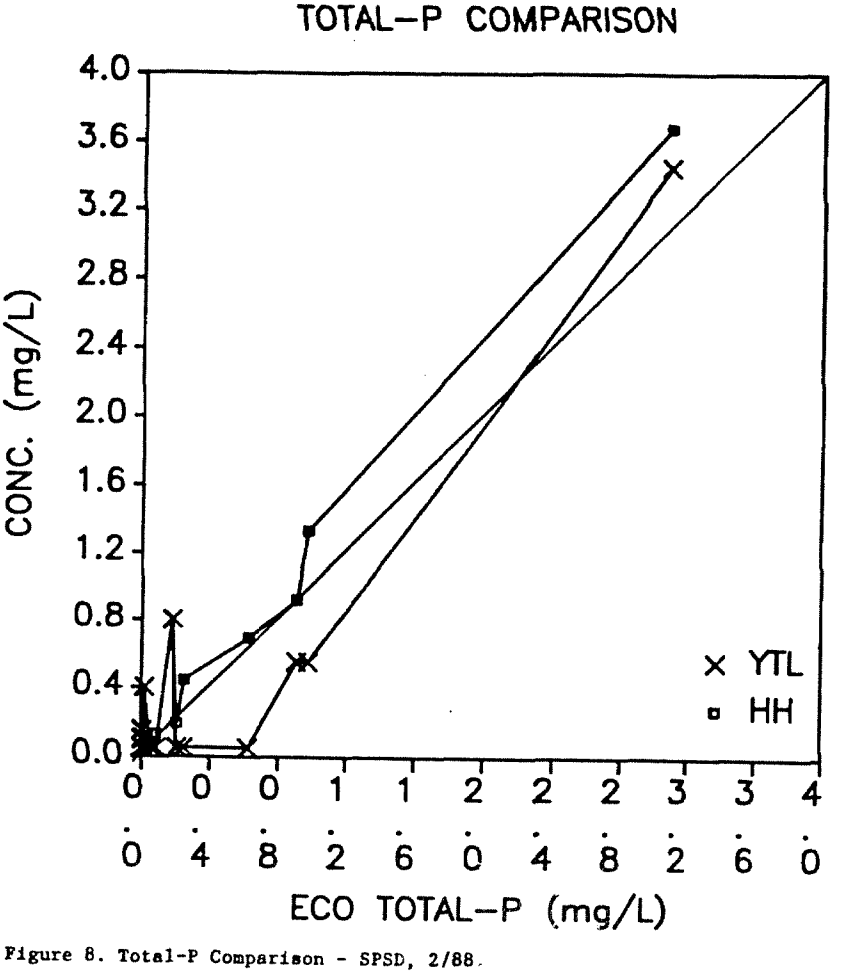

Figure 8. Total-P Comparison - SPSD, 2/88.

Problems apparent during the inspection were:

1. I/I coming from the collection system into the lagoon resulting in a greater volume to spray and less discretion in choosing spraying times.

2. Broken sprayfield equipment resulting in poor effluent distribution and concentrated runoff.

The SPSD had sewer and sprayfield rehabilitation projects scheduled for summer 1988 that should improve the situation. Even a small number of riser failures can affect runoff quality. Ability to do wintertime repairs should be a goal. Checking spraylines immediately after turning them on is recommended to assure that recent damage will not reduce system efficiency.

Other recommendations include:

1. Weekend and weekday influent monitoring is recommended to accurately assess plant loading. Influent monitoring should be done whether effluent is being sprayed or not.

2. The underdrain should be routinely monitored. Recommended parameters include conductivity, NH_3-N, $NO_2 + NO_3$-N, Total-P, and fecal coliforms.

3. Lab adjustments noted on the lab review sheet in the appendix should be made.

REFERENCES

Heffner, Marc, 1984. Class II Inspection at the Kittitas County Sewer District #1 Wastewater Treatment Plant, February 26-27, 1984, Ecology Memo to Al Bolinger and Harold Porath, June 7, 1984.

Kirchmer, Cliff, 1989. Ecology Manchester Laboratory, personal commununication.

APPENDIX

Laboratory Procedure Review Sheet

Discharger: Snoqualmie Pass STP

Date: 2/9/88

Discharger representative: Dave Johnston

Ecology reviewer: Marc Heffner

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? Effluent - grab
Influent - automatic

2. If automatic compositor, what type of compositor is used? Manning
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? Time

4. What is the usual day(s) of sample collection? Thursday or Friday

5. What time does sample collection usually begin? ≈ noon

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? ≈ 500

9. What is the final volume of sample collected? ≈ 2 gal

(10.) Is the composite cooled during collection? → needs to do in summer

11. To what temperature? not checked
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).

12. How is the sample cooled? winter OK - summer needs to be done
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.

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

14. Are the sampling locations representative? OK

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? start immediately
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.
ALLOW SAMPLE TO WARM

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

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

pH Test Review

1. How is the pH measured? Hach
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? every time
The meter should be calibrated every day it is used.

3. What buffers are used for calibration? 7 & 10
Two buffers bracketing the pH of the sample being tested should be used.

If the meter can only be calibrated with one buffer, the buffer closest in pH to the sample should be used. A second buffer, which brackets the pH 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? 4th 13th Ed (SHOULD BE 16TH)
   Standard Methods or the Ecology handout should be used.

2. How often are BODs run? 1x/week
   The minimum frequency is specified in the permit.

3. How long after sample collection is the test begun? immediately
   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? stainless
   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).

6. Are the 4 nutrient buffers of 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).

7. How often is the dilution water prepared? made fresh
   Dilution water should be made for each set of BODs run.

8. Is the dilution water aged prior to use? fresh
   Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
   Dilution water without inhibitor should not be aged.

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

10. Is the pH of all samples between 6.5 and 7.5?
    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).

11. Have any of the samples been chlorinated or ozonated? no
If chlorinated are they checked for chlorine residual and dechlorinated as necesssary?
How are they dechlorinated?
Samples should be dechlorinated with sodium sulfate (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).

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

13. How are DO concentrations measured? Winkler → buy → check shelf life 2-1 yr
If with a meter, how is the meter calibrated?
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.

14. Is a dilution water blank run? ✓
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? 8.3-8.4
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? 0-0.3
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).

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

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

17. How many bottles are made at each dilution? 3
How many bottles are incubated at each dilution? 2
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.).

18. Is the initial DO of each dilution measured? ✓
What is the typical initial DO? ≥ 9 for creeks
The initial DO of each dilution should be measured. It should approximate saturation (see #14). adjusting dilution

19. What is considered the minimum acceptable DO depletion after 5 days? 2.0 mg/L
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). Adjust dilutions to stay in this range.

20. Are any samples seeded? no
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?
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).

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

How is incubator temperature monitored? door thermometer – should have
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? check
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? seldom
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? OK
Assure the switch that turns off the interior light is functioning.

22. 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).

23. Is the method of calculation correct? Looked OK

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)

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

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? 13th

2. What type of filter paper is used?
   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? do
   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?
   The rough side should be up (SM p96, #3a: SSM p23, #1)

   How long are the filters dried? need to do
   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? not
   The filters should be stored in a dessicator (Ibid).

7. How is the effectiveness of the dessicant checked? not used
   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? cylinder
   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? time

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	100	
Effluent	100	

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

	Time
Influent	fast
Effluent	

13. How long is filtering attempted before deciding that a filter is clogged? minutes or 2

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? retest

The filter should be discarded and a smaller volume of sample should be used with a new filter.

15. How are the filter funnel and measuring device rinsed onto the filter following sample addition? rinsed

Rinse 3x's with approximately 10 mLs of distilled water each time (? ?).

16. How long is the sample dried? 1 hr

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? no

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)? should do

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? ✓

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 dechlorinated at the time of collection? ✓
   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). 2 ml 1%

7. Is phosphate buffer made specifically for this test? ✓
   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).

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 are less expensive and more convient for under 50 tests per day (SSM p65, bottom).

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

11. How long is the media stored? 12/86 exp date
Mixed media ahould 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? ✓
This is a necessary sanitazation procedure (SM p831, #1f).

13. Are forceps dipped in alcohol and flamed prior to use? ✓
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? ✓
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? 50 mls used
10-30 mLs of sterile phosphate buffer should be put on the filter. The sample should be put into the buffer water and swirled, then the vacuum should be turned on. More even organism distribution is attained using this technique (SM p890, #5a: SSM P73, #5).

16. Are special procedures followed when less than 1 mL of sample is to be filtered? N/A
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? ✓
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? OK
Incubation should begin within 20-30 minutes (SM p897, #2d: SSM p77, #10 note).

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

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

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

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

23. What magnification is used for counting? ✓
10-15 power magnification is recommended (SM p898, #2e: SSM p78).

go clean to dirty

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

25. How many total colonies are usually on a plate? seldom problem
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? total d, 2 plates
In this case the plates with <20 or >60 colonies should not be used for 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):

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

March 8, 1988

To: Marc Heffner
From: Wayne Krafft WK
Subject: Q.A. results of Snoqualmie STP.

As you requested by telephone conversation I am including the Q.A. information from the Snoqualmie STP study. The Q.A. data and methods are presented parameter by parameter.

Conductivity: The conductivity cell is checked with standard KCl solution.

Alkalinity: Titrant is standarized prior to analysis.

Solids: Duplicate analyses.
TSS: SP-INF, initial result 16, repeat 21
TNVSS: SP-INF, initial result <1, repeat <1
TS: SP-INF, initial result 100, repeat 150
TNVS: SP-INF, initial result 40, repeat 23

BOD: Dillution water D.O. drop .15 mg/l.
200 mg/l check standard result = 215 mg/l.
ECO-INF result is the average of two dilutions, 35 and 35 mg/l.
ECO-EFF result is the average of two dillutions, 12 and 12 mg/l.
SP-EFF result is the average of two dillutions, 12 and 11 mg/l.

COD: Titrant is standardized prior to analysis.
353 mg/l check standard result = 344 mg/l.
ECO-INF result is the average of three analyses due to non-homogeneous nature of the sample. Results are 97, 63, and 71 mg/l.
ECO-EFF result is the average of two analyses, 53 and 50 mg/l.

Nutrients:
AMMONIA: Correlation coeffecient of standard curve = .99997.
0.49 mg/l check standard result = 0.45 mg/l.
0.06 mg/l check standard result = 0.06 mg/l.
Sample 1-5 initial result 1.9, repeat 1.8.
Under-2 initial result 1.4, repeat 1.3.
ECO-EFF initial result 3.1, repeat 3.0.

NITRATE-NITRITE: Correlation coeffecient of standard curve = .99987.
0.39 mg/l check standard result = 0.38 mg/l.
0.05 mg/l check standard result = 0.04 mg/l.
Sample 1-3 initial result .01, repeat .02, spike recovery 80%.
Sample 1-5 initial result 3.6, repeat 3.6.
Under-2 initial result 1.0, repeat 1.0.

ECO-INF initial result .22, repeat .22.
SP-INF initial result .23, repeat .24.
ECO-EFF initial result .18, repeat .19.
SP-EFF initial result .17, repeat .16.

TOTAL P: Correlation coefficient of standard curve = .99998.
0.55 mg/l check standard result = 0.53 mg/l.
0.07 mg/l check standard result = 0.06 mg/l.
Sample 1-1 spike recovery 104%.
Sample 1-5 initial result .25, repeat .26.

Fecal Coliform: Initial and final control filters read zero.