



STATE OF  
WASHINGTON

Dixy Lee Ray  
Governor

DEPARTMENT OF ECOLOGY

7272 Cleanwater Lane, Olympia, Washington 98504

206/753-2353

M E M O R A N D U M

February 23, 1979

To: Dave Wright  
From: Mike Morhous and Darrel Anderson  
Subject: Kitsap County Sewer District #5  
Class II Inspection and Receiving Water Survey

INTRODUCTION

A Class II Inspection was conducted at the above-referenced (KCSD #5) STP on October 17-18, 1978 by Mike Morhous and Darrel Anderson of the Water and Wastewater Monitoring Section of the Department of Ecology. Simultaneously a receiving water study was also conducted on Sinclair Inlet, October 17, by Darrel and Mike. Other persons in attendance during this inspection were Dave Wright, DOE N.W. Regional Office and Marlow (Skip) Blasberg, Plant Supervisor.

This report is composed of two parts. Part I presents the results of the Class II Inspection. Part II provides the results of the Receiving Water Survey.

PART I - CLASS II INSPECTION

Findings and Conclusions

The KCSD #5 STP is an older primary package treatment facility. The clarifier and digester are contained in a single Imhoff tank. The plant is in the process of upgrading to secondary or best practical treatment.

At the time of this inspection, DOE's 24-hour composite data indicated that the STP was meeting NPDES permit limitations for BOD<sub>5</sub> and TSS although compliance with the BOD<sub>5</sub> concentration limitation was borderline. DOE grab samples showed the STP was out of compliance with fecal coliform (FC) limitations (Table III). The geometric mean of the two samples collected by DOE on the morning of October 18 was greater than 5,700 colonies per 100 mls. The respective chlorine residuals were 2.0 ppm and 1.25 ppm. The STP's FC result from a sample collected that morning between 0800 and 0830 was too numerous to count (TNTC).

The effluent loading values (lbs/day) in Table III were calculated using the STP's totalizer/recorder flow value. It should be noted that these results may only represent 71 percent of the true loading values if the accuracy of the totalizer is equal to that of the script recorder.

The STP collects 8-hour (0800-1600) manual composites for compliance analyses. The STP's final effluent composite is collected from the clarifier effluent prior to chlorination. As part of this inspection, the STP collected, as usual, an influent and unchlorinated effluent composite samples, for analysis and comparison with DOE's 24-hour results (Tables I and III). These results provide the following comparison:

Table I

Parameter	Influent		Unchlorinated Effluent	
	DOE 24-hour Composite	STP 8-hr. Comp.- % Difference	DOE 24-hour Composite	STP 8-hr. Comp.- % Difference
BOD <sub>5</sub>	180 mg/l	220 mg/l - 22% greater	180 mg/l	180 mg/l - none
TSS	140 mg/l	192 mg/l - 37% greater	66 mg/l	78 mg/l - 18% greater

From this comparison, it appears that 24-hour compositing would improve the accuracy of the STP's influent loading data and plant efficiency data (% reduction). Skip Blasberg indicated the purchase of 24-hour composite samplers was being considered. At the very least, 24-hour composite samplers should be included as part of upgrading the plant.

During this inspection, plant efficiency was poor in both percent reduction of BOD<sub>5</sub> and disinfection of the final effluent. An expressed lack of manpower and time for sludge removal and disposal may have contributed to the plant's poor BOD<sub>5</sub> removal. On October 18, 1978, digester sludge was bulking into the clarifier. Doe composite data provided the following percent reduction results:

Table II

Parameter	Influent	Chlorinated Effluent	Percent Reduction
BOD <sub>5</sub>	180 mg/l	165 mg/l	8
TSS	140 mg/l	60 mg/l	57

What appeared to be an inadequate retention time in the contact chamber probably contributed to the level of effluent disinfection observed. Total residual chlorine results of 2.0 ppm and 1.25 ppm, measured simultaneously with the collection of FC samples, would normally be sufficient for adequate disinfection purposes. A dye test conducted on October 17 at 1540 indicated that additional contact time in the discharge line was about 45 minutes. This should provide for improved disinfection as detention time in the contact chamber is probably less than 10 minutes.

It was also indicated during this inspection that the chlorine contact chamber is cleaned almost daily. This procedure involves raising the weir plate at the discharge end of the contact chamber, hosing down the contact chamber, and flushing accumulated solids out the discharge line to the receiving water. These slugs of organic solids probably reduce chlorine residuals and may result in excessive coliform discharges.

The STP monitors plant flows with a 90° V notch weir located at the discharge end of the chlorine contact chamber. The weir recorder was checked for accuracy by comparing the actual instantaneous flow with the recorded script chart flow. The script chart was recording an average of 71 percent of the actual flow. For this reason, it is recommended that the totalizer/recorder be calibrated. If the accuracy of the totalizer is equal to that of the script recorder, then .49 MGD would be a more accurate 24-hour flow for this inspection period.

Laboratory procedures were reviewed and the findings are included in "Review of Laboratory Procedures". The analyses for BOD<sub>5</sub>, TSS, and fecal coliforms are run at the Kingston STP. Kingston's results from the split 8-hour composite samples compared quite well with DOE's results (Table III).

In summary, the following are recommended:

1. Consideration should be given to the collection of 24-hour composite samples in place of existing 8-hour composites.
2. Flow totalizer (digital readout) and script recorder should be calibrated.
3. Sludge wasting should be conducted on a regular schedule to preclude an excessive buildup of sludge in the digester.

In conjunction with the regional followup inspection (mid April, 1979), the following recommendations should be reviewed with the operator, noting those which have been implemented:

1. A sludge wasting routine to prevent an overloaded digester situation.

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2. Calibration of the flow totalizer (digital readout) and script recorder.
3. Minimize flushing of the chlorine contact chamber to that which is necessary for proper operation.
4. Measuring final effluent dissolved oxygen prior to chlorination.
5. Measuring total residual chlorine with an accepted test kit.
6. Reading settleable solids results an hour after beginning the test.

### Review of Laboratory Procedures and Techniques

Laboratory procedures were reviewed with Skip Blasberg. Dissolved oxygen, pH, chlorine residual, and settleable solids are analyzed at KCSD #5 STP, while BOD<sub>5</sub>, TSS, and fecal coliforms are analyzed at the Kingston STP laboratory. The Kingston analyses compared quite well with DOE's results.

#### Dissolved Oxygen:

The STP measures D.O. using a Hach Model OX-10 D.O. kit with pre-measured reagent pillows and titrating with phenylarsine oxide (PAO). It was noted that D.O. was monitored from the chlorinated effluent. Because chlorine is an oxidizer, the D.O. results from chlorinated effluents using reducing titrants gives higher D.O. results than those which actually exist. It was recommended that effluent D.O. samples be collected prior to chlorination.

#### Total Residual Chlorine:

The STP is using an orthotalidine colormetric kit for measuring total residual chlorine. This method is no longer accepted and it was recommended that an acceptable alternative be acquired; i.e., DPD or amperometric titration.

#### Settleable Solids:

It was indicated that on occasions the sample is left in the Imhoff cone overnight, stirred in the morning, and read a half hour later. This procedure does not comply with acceptable analytical procedures for this test. It was recommended that the well-mixed sample be poured into the Imhoff cone, gently stirring the sides of the cone with a rod or by spinning after 45 minutes, and reading the solids level an hour after initiating the test (Standard Methods, 14th Edition).

In summary, the following recommendations are made in conjunction with laboratory procedures:

1. Final effluent samples collected for D.O. be collected prior to chlorination.
2. Obtaining an acceptable kit or equipment for measuring total residual chlorine.
3. Reading the settleable solids result an hour after beginning the test.

Class II Field Review and Sample Collection  
24 Hour Composite Sampler Installations

Sampler	Date and Time Installed	Location
1. Influent aliquot -	10/17 at 1008 250 ml/30 min.	Immed. below comminutor
2. Unchl. Eff. aliquot -	10/17 at 1000 250 ml/30 min.	Clarifier outfall
3. Chl. Eff. aliquot -	10/17 at 1005 250 ml/30 min.	Contact chamber outfall
4. A manual composite was collected from the Olney Rd. sewer line at the bypass jct. box - manhole #1. Aliquot - 500 mls collected	10/17 at 1030, 1225 and 1530, 10/18 at 0955.	

Date and Time	Analysis	Sample Location
1. 10/78 @ 0955	Totals/Fecals	Olney Road Manhole
2. 10/18 @ 1005	Totals/Fecals	Chlorinated Eff. Contact Chamber Outfall
3. 10/18 @ 1100	Totals/Fecals	Chlorinated Eff. Contact Chamber Outfall
4. 10/18 @ 1115	Heavy Metals	Spirogester Sludge
5.		
6.		

Flow Measuring Device

1. Type - 90° V Notch Weir
2. Dimensions -
  - a. Meets standard criteria  Yes
  - No Explain:

b. Accuracy check	Actual Instan. Flow	Recorder Reading	Recorder Accuracy (% of inst. flow)
1.	200 gpm (.29 mgd)	145 gpm (.21 mgd)	73%
2.	548 gpm (.79 mgd)	380 gpm (.55 mgd)	69%
3.			

is within accepted 15% error limitations

is in need of calibration

Field Data

Parameter	Date and Time	Sample Location	Result
Temp., pH, sp. cond.	10/17 @ 1400	Inf., same as sampler #1	19.2°C, 7.6, 650 µmhos/cm
Temp., pH, sp. cond.	10/17 @ 1411	Unchl. Eff., same as sampler #2	20.2°C, 7.3, 775 µmhos/cm
Temp., pH, sp. cond.	10/17 @ 1406	Chl. Eff., same as sampler #3	19.8°C, 7.3, 750 µmhos/cm
Total Resid. Chl.	10/18 @ 1005	Contact Chamber Outfall	2.0 ppm
Total Resid. Chl.	10/18 @ 1100	Contact Chamber Outfall	1.25 ppm

Table III

The following table is a comparison of laboratory results from 24-hour composite(s) together with NPDES permit effluent limitations. Additional results pertinent to this inspection have also been included.

	DOE						KCS D #5 STP		NPDES (Monthly average)
	Inf. <sup>1/</sup>	Inf. <sup>2/</sup>	Unchl. <sup>1/</sup> Eff.	Unchl. <sup>2/</sup> Eff.	Chl. <sup>1/</sup> Eff.	Manhole #1	Inf. <sup>2/</sup>	Unchl. <sup>2/</sup> Eff.	
pH	7.5	7.6	7.2	7.4	7.3	7.5			6.5-8.5
BOD <sub>5</sub> mg/l	180	220	180	180	165	260	190	190	165
lbs/day	525	642	525	525	482		555	555	650
TTS mg/l	140	192	66	78	60	174	212	80	100
lbs/day	409	560	193	228	175		619	234	400
Total Plant Flow MGD					.35				
Fecal Coliforms Colonies/100 mls @ 1005					660				700
@ 1100					>50,000				
Total Coliforms Colonies/100 mls @ 1005					>3.9x10 <sup>5</sup>				
@ 1100					>5x10 <sup>5</sup>				
*Total Resid. Chlorine ppm @ 1005					2.0				
@ 1100					1.25				
COD	380	680	340	360	330				
NO <sub>3</sub> -N (filt.) mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			
NO <sub>2</sub> -N (filt.) mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			
NH <sub>3</sub> -N (unfilt.) mg/l	26	27	25	26	24	32			
O-PO <sub>4</sub> -P (filt.) mg/l	8.0	10	7.4	8.0	3.7	9.8			
T. Phos.-P (unfilt) mg/l	12	17	13	13	11	17			
Total Solids (mg/l)	497	617	425	489	434	630			
T. Non Vol. Solids mg/l	268	322	252	290	254	325			
T. Sus. Non Vol. Solids mg/l	12	20	4	4	2	14			
Sp. Conductivity µmhos/cm	671	681	590	649	574	728			

\*Field Analysis  
DPD chlorine kit

"<" is less than and ">" is "greater than"

<sup>1/</sup>Collected by DOE - 24-hr. period

<sup>2/</sup>Collected by STP - 8-hr. period

Table IV  
Heavy Metals Analyses

	Digester Sludge	DOE			
Percent Solids	8.4				
Zinc mg/kg dry wt.	770				
Lead mg/kg dry wt.	120				
Copper mg/kg dry wt.	160				
Chromium mg/kg dry wt.	30				
Cadmium mg/kg dry wt.	4.8				
Nickel mg/kg dry wt.	35				

\* Field Analysis

"<" is "less than" and ">" is "greater than"

## PART II - RECEIVING WATER SURVEY

### DESCRIPTION

Sinclair Inlet is an arm of Puget Sound connected with Port Washington Narrows to the north and Rich passage to the east. It measures about 3.5 miles in length and averages 50 feet deep at MLL tide (Figure 1). Kitsap Sewer District's treatment plant is located along the inlet about 1/2 mile east of Annapolis (Figure 1). The plant discharges sewage wastewater from a submerged outfall located approximately 400 yards from shore in about 40 feet of water, MLL tide water depth.

The 1977 Washington Water Quality Standards classify the waters of Sinclair Inlet as Class AA - extraordinary (1). This report documents results of an October 17, 1978 survey conducted to evaluate impacts of Kitsap S.D. #5 wastes on the receiving waters of Sinclair Inlet. The intent was to collect receiving water data that coincided with a Class II inspection conducted on the facility on the same date. Also, the survey will provide a baseline of information that can be used should the facility be upgraded or similar surveys are conducted in the future.

### METHODS

Surface water samples were collected at 13 stations established along four transects extending north, south, east, and west from the outfall (Figure 1). Two sampling runs were made, one during low slack tide (1145 hrs. Seattle tide) and the second during high slack (1730 hrs.). Both sampling runs began 15 minutes before slack tide and ended 15 minutes after the change.

Ten parameters were measured for each station sampled. Temperature (°C), pH and specific conductivity (umhos/cm) were measured in the field. Samples were collected and transported to the DOE Tumwater Laboratory for the remaining analyses:

Total Coliforms (Col./100 m.)	Nitrate-N (mg/l)
Fecal Coliforms (Col./100 ml)	Orthophosphates-P (mg/l)
Ammonia - N (mg/l)	Total-phosphates-P (mg/l)
Nitrite - N (mg/l)	

All samples were analyzed as per Standard Methods for the Examination of Water and Wastewater (2).

### RESULTS

The wastewater from Kitsap S.D. #5 did appear to have a moderate impact on water quality in Sinclair Inlet. Although 95 percent of the fecal coliform counts exceeded Class AA standards of 14 organisms/100 ml, the excess was not to the point of a serious violation.

The Fecal Coliform levels did not appear to change significantly from low to high tide at any of the four transects. This indicates little flushing occurred during the sampling period. A dye study conducted at high tide confirmed a slow mixing rate in this area during slack tide. The red dye appeared in the receiving waters approximately one hour after added to the chlorinated effluent, then remained in the plume area for about 45 minutes before dissipating. Also, the fecal contamination appeared to be local. At nearby DOE routine monitoring station, SIN 001 (Sinclair Inlet at Naval Shipyards), 90 percent of the 1978 fecal values have been less than two organisms/100 ml (Table 3).

There appeared to be a slight increase in the concentrations of ammonia, nitrates, orthophosphates, and total phosphates at all stations during high tide (Table 2). There may have been an increase in ammonia and total phosphates near the outfall; however, the total amount was not significantly different from the SIN 001 ambient data (Table 4).

#### COMMENTS

It would be beneficial to conduct a bacteriological receiving water survey during the wet period. Significant bypassing reportedly occurs during these conditions.

DA:cp



Table 1

DOE Water Quality Sampling Data Collected from Sinclair Inlet During Low Tide, October 17, 1978

Station Number	Parameter									
	Temp. (°C)	pH	Conductivity at 25°C Micromho	Total Coli. (Col./100 ml)	Fecal Coli. (Col./100 ml)	NH <sub>3</sub> -N (mg/l)	NO <sub>2</sub> -N (mg/l)	NO <sub>3</sub> -N (mg/l)	O-PO <sub>4</sub> -P (mg/l)	T-PO <sub>4</sub> -P (mg/l)
IC	12.8	7.5	39200	38	20	0.16	<0.01	0.14	0.08	0.13
N1	12.8	7.7	39000	30	20	0.03	<0.01	0.19	0.04	0.05
N2	12.9	7.8	38800	28	16	0.03	<0.01	0.19	0.04	0.06
N3	12.5	7.8	38800	120	30	<0.01	<0.01	0.23	0.04	0.07
E1	13.0	7.8	38500	52	19	<0.01	<0.01	0.13	0.05	0.08
E2	12.7	7.8	38900	50	13	0.04	<0.01	0.01	0.09	0.09
E3	12.5	7.8	39300	33	14	0.13	<0.01	0.16	0.04	0.08
S1	12.8	7.8	38700	56	16	0.05	<0.01	0.19	0.02	0.07
S2	12.8	7.8	38700	14	19	0.03	<0.01	0.21	0.04	0.05
S3	12.9	7.8	38800	100	22	0.04	<0.01	0.19	0.04	0.08
W1	12.8	7.8	38700	55	9	<0.01	<0.01	0.20	0.04	0.07
W2	12.8	7.8	39000	46	17*	0.04	<0.01	0.19	0.04	0.09
W3	12.8	7.8	39000	78	9	0.01	<0.01	0.16	0.04	0.08

\* Median Value

Table 2

DOE Water Quality Sampling Data Collected from Sinclair Inlet During High Tide, October 17, 1978

Station Number	Parameter									
	Temp. (°C)	pH	Conductivity at 25°C Micromho	Total Coli. (Col./100 ml)	Fecal Coli. (Col./100 ml)	NH <sub>3</sub> -N (mg/l)	NO <sub>2</sub> -N (mg/l)	NO <sub>3</sub> -N (mg/l)	O-PO <sub>4</sub> -P (mg/l)	T-PO <sub>4</sub> -P (mg/l)
IC	12.7	7.8	39300	78	23	0.23	<0.01	0.24	0.12	0.19
N1	12.7	7.8	39300	90	36	0.13	<0.01	0.24	0.08	0.14
N2	12.7	7.9	39300	77	19	0.07	<0.01	0.22	0.07	0.11
N3	12.7	7.9	39300	52	18	<0.01	<0.01	0.21	0.05	0.06
E1	12.7	7.9	39300	130	25	0.01	<0.01	0.22	0.08	0.09
E2	12.7	7.9	39200	90	42	0.08	<0.01	0.22	0.07	0.13
E3	12.8	7.9	39200	56	11	0.01	<0.01	0.21	0.04	0.07
S1	12.7	7.9	39100	98	29	0.06	<0.01	0.21	0.06	0.11
S2	12.7	7.9	40000	79	19*	0.04	<0.01	0.21	0.06	0.10
S3	12.7	7.9	39700	44	11	0.03	<0.01	0.21	0.04	0.08
W1	12.7	7.9	38800	90	**20	0.08	<0.01	0.22	0.07	0.12
W2	12.7	7.9	39200	74	18	0.04	<0.01	0.22	0.06	0.11
W3	12.7	7.9	39700	40	18	0.02	<0.01	0.22	0.05	0.09

\* Median Value

\*\* Estimate

## LITERATURE CITED

- (1) Anon., 1977. "Washington State Water Quality Standards", State of Washington, Department of Ecology. 33 pg.
- (2) Anon., 1976. "Standard Methods for the Examination of Water and Wastewaters", American Public Health Association, 1015 Eighteenth Street N.W., Washington, D.C. 20036. Fourteenth Edition, 1193 pg.

STORET RETRIEVAL DATE 78/10/30  
 SIN001  
 47 32 58.0 122 38 32.0 2  
 SINCLAIR INLET AT NAVAL SHPYARDS  
 53035WASHINGTON A  
 PACIFIC NORTHWEST 131115  
 PUGET SOUND (KITSAP-15)  
 21540000  
 0000 METER DEPTH CLASS 00

Table 3

/TYPA/AMBNT/OCEAN

DATE FROM TO	TIME OF DAY	DEPTH METER	00010 WATER TEMP CENT	00300 DO MG/L	31616 FEC COLI MFM-FCBR /100ML	00400 PH SU	00070 TURB JKSN JTU	00095 CNDUCTVY AT 25C MICROMHO	70305 SALINITY CNDUCTVY G/L	00760 SWL PBI MG/L	00078 TRANSP SECCHI METERS
77/10/25	10 40	00.0	11.0		25B	8.20	2.0	42500	30.1		4.3
	10 45	09.8	10.5			8.20	3.0	43000	30.2		
78/04/17	10 05	00.0	8.5	12.6L	2K	8.20	2.0	40000	27.2		4.0
	10 10	09.8	8.2	10.5		7.90	2.0	41800	28.8		
78/05/22	10 05	00.0	13.5	12.8L	1K	8.40	2.0	35900	28.2		
	10 10	09.8	12.5	9.7		8.00	3.0	36300	28.6		
78/06/19	11 15	00.0	15.0	11.1	1K	8.30	2.0	38700	28.9		
	11 20	09.8	14.0	8.2		8.10	2.0	38700	29.2		
78/07/17	11 25	00.0	16.5	10.1	1K	8.20	4.0	35800	28.8		
	11 30	09.8	15.0	5.6		7.60	3.0	36300	29.2		
78/08/23	10 05	00.0	14.6	9.5	56	8.10	3.0	37300	29.4		
	10 10	09.8	14.2	8.6		8.00	2.0	37800	29.7		
78/09/18	10 20	00.0	13.0	10.4	2	8.20	2.0	38500	29.7		
	10 25	09.8	12.5	7.6		8.00	1.0	38600	30.0		

STORET RETRIEVAL DATE 78/10/30

SIN001

47 32 58.0 122 38 32.0 2

SINCLAIR INLET AT NAVAL SHPYARDS

53035 WASHINGTON A

PACIFIC NORTHWEST 131115

PUGET SOUND (KITSAP-15)

21540000

0000 METER DEPTH CLASS 00

Table-4

/TYPA/AMBNT/OCEAN

DATE FROM TO	TIME OF DAY	DEPTH METER	00610 NH3-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00615 NO2-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	32210 CHLRPHYL A UG/L	32218 PHEOPHTN A UG/L
77/10/25	10 40	00.0	0.040	0.270	0.000	0.040	0.080		
	10 45	09.8	0.040	0.280	0.000	0.040	0.060		
78/04/17	10 05	00.0	0.020	0.020	0.000	0.000	0.040		
	10 10	09.8	0.050	0.220	0.000	0.050	0.060		
78/05/22	10 05	00.0	0.030	0.020	0.000	0.000	0.080		
	10 10	09.8	0.040	0.080	0.000	0.010	0.060		
78/06/19	11 15	00.0	0.000	0.000	0.000	0.010	0.050		
	11 20	09.8	0.060	0.160	0.000	0.040	0.070		
78/07/17	11 25	00.0	0.020	0.010	0.000	0.040	0.050		
	11 30	09.8	0.200	0.100	0.000	0.090	0.090		
78/08/23	10 05	00.0	0.000	0.000	0.000	0.050	0.070		
	10 10	09.8	0.020	0.040	0.000	0.050	0.050		
78/09/18	10 20	00.0	0.080	0.070	0.000	0.060	0.070		
	10 25	09.8	0.230	0.190	0.000	0.060	0.070		