86-E11

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M E M O R A N D U M

March 6, 1986

To: John Glynn and Dave Nunnallee

From: Marc Heffner

Subject: Friday Harbor Sewage Treatment Plant Class II Inspection of August 13 and 14, 1985

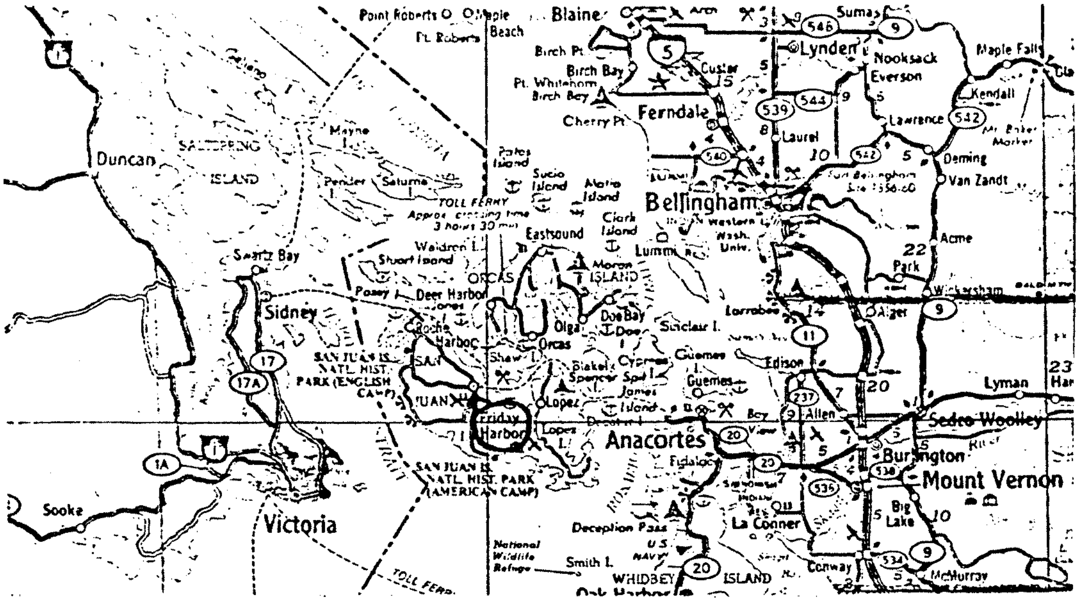
ABSTRACT

A Class II inspection was conducted at the Friday Harbor Sewage Treatment Plant on August 13 and 14, 1985. The inspection was a follow-up to a May 17 and 18, 1983, inspection conducted prior to upgrading the facility to an extended aeration secondary plant. Biochemical oxygen demand (BOD_5), total suspended solids (TSS), and fecal coliform (F.C.) effluent quality were better during the August 1985 inspection than during the May 1983 inspection. Effluent BOD_5 and TSS exceeded some National Pollutant Discharge Elimination System (NPDES) permit limits during the second inspection. Adjusting the solids loading to the secondary clarifiers would likely improve the effluent quality.

INTRODUCTION

A Class II inspection was conducted at the Friday Harbor (FH) Sewage Treatment Plant (STP) on August 13 and 14, 1985 (Figure 1). Participating in the inspection were Marc Heffner of the Washington State Department of Ecology (Ecology) Water Quality Investigations Section (WQIS) and Kevin Kirk, operator of the FH STP. The inspection was done in conjunction with a receiving water study. The receiving water study results are presented in a separate WQIS memorandum (Determan and Kendra, 1986).

The 1985 inspection was a follow-up to a May 1983 inspection. When the 1983 inspection was conducted, FH was operating a primary plant which included a bar screen, a spiragester (a round Imhoff tank), and chlorination facilities (Heffner, 1983). Sludge was dried on drying beds, then sent to a landfill. The upgraded secondary plant went on line in late 1984. Treatment units now include fine screens, a grit channel, an extended aeration basin, two secondary clarifiers, and two chlorine contact basins (Figure 2). Sludge is sent to an aerobic holding tank/digester prior to land application as a liquid on farmland.



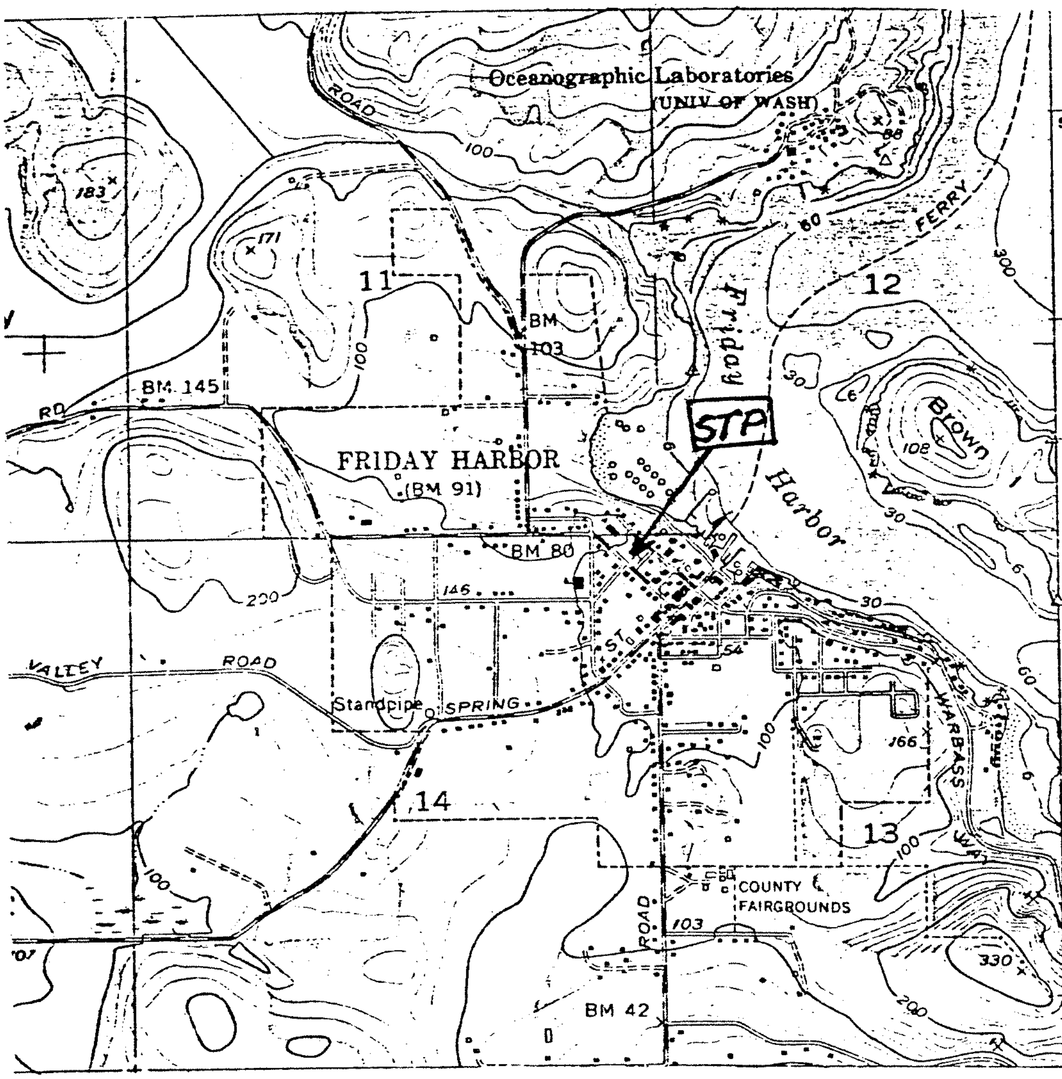


FIGURE 1 - FRIDAY HARBOR STP LOCATION - FRIDAY HARBOR, 8/85.

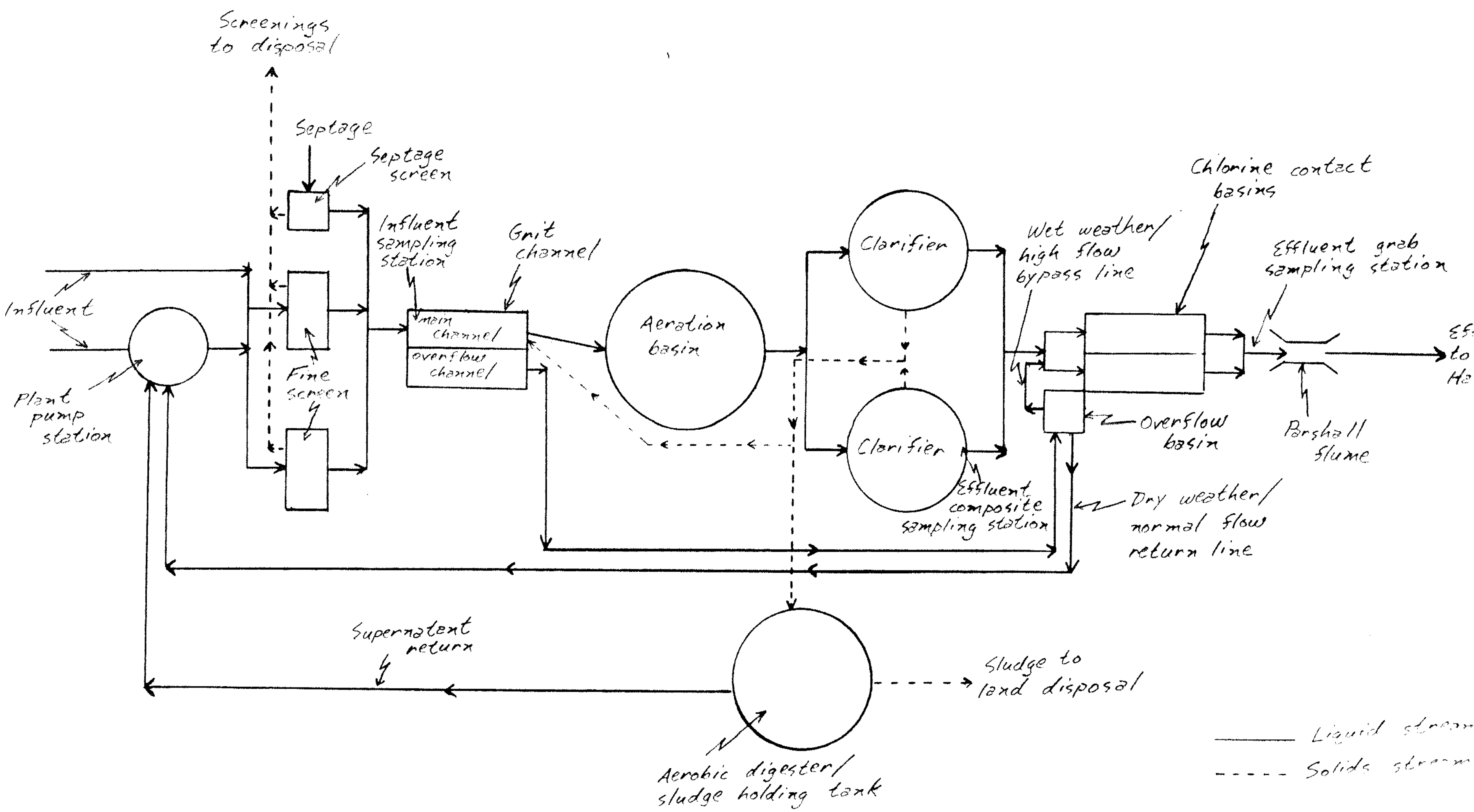


FIGURE 2 - FLOW SCHEME - FRIDAY HARBOR, 8/85.

Memo to John Glynn and Dave Nunnallee
Friday Harbor Sewage Treatment Plant Class II Inspection of August 13-14, 1985

Purposes of the inspection included:

1. Collect samples to estimate plant efficiency.

2. Review laboratory and sampling procedures (including sample splits for NPDES permit parameter analysis) at the STP.

3. Collect samples to provide plant discharge data for consideration in the receiving water study.

PROCEDURES

Sample collection during the inspection included both composite and grab samples. Influent and unchlorinted effluent samples were collected by both the STP operator and Ecology at the locations noted in Figure 2. The Ecology composite samplers were set to collect approximately 200 mLs of sample every 30 minutes while the FH composite samplers were set to collect approximately 500 mLs of sample every hour. Both sets of samplers were set to run from 1000 hours on August 13 to 1000 hours on August 14. The Ecology effluent sampler malfunctioned, resulting in an incomplete sample. All the composite samples were split for analysis by the Ecology and FH laboratories for parameters noted on Table 1.

Grab samples were collected from various stations in the plant. Sampling stations, times, and parametric coverage are noted on Table 1.

Flows at the plant are measured at an effluent Parshall flume. Ecology instantaneous measurements were made at the flume to check the accuracy of the plant meter.

The Ecology laboratory was unable to complete the solids and alkalinity analyses for inspection samples within allowable holding times. Therefore, the solids and alkalinity data are identified as estimated (est.) within the report. The solids data are likely underestimates of actual concentrations.

PLANT OPERATION

This description of plant operation is based on both observations made during the inspection and operator explanations. Operation during the inspection was fairly typical for dry-weather conditions. Influent was routed through only one of the influent screens and to the grit channel. The grit channel overflowed when both the in-plant and waterfront collection system pump stations were operating at once. The overflow went to an overflow basin at the head end of the chlorine contact basin. During the inspection and other dry-weather conditions, the basin drains to the in-plant pump station, and flow is sent back to the screens and through the secondary treatment process. If draining the overflow basin contents back to the pump station is impractical due to a high influent flow, excess overflow bypasses secondary and enters the flow stream prior to the chlorination process.

Table 1. Samples collected - Friday Harbor, August 1985.

					Field Analyses						Laboratory Analyses																	
																		Solids				Nutrients						
Sample	Sampler	Laboratory	Date	Time	Temperature	pH	Conductivity	Chlorine Residual	Dissolved Oxygen	Sludge Depth	Fecal Coliforms	Oil & Grease	COD	BOD_5	pH	Conductivity	Turbidity	TS	TNVS	TSS	TNVSS	NH_3-N	NO_2-N	NO_3-N	Dis-O-PO_4-P	Total PO_4-P	Alkalinity	Sludge Metals & Percent Solids
Composite Samples																												
Influent	Ecology	Ecology	8/13-14	1000-1000									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		FH												X						X								
	FH	Ecology	8/13-14	1000-1000									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		FH												X						X								
Effluent	Ecology	Ecology	8/13-14	1000-1000									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		FH												X						X								
	FH	Ecology	8/13-14	1000-1000									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		FH												X						X								
Ecology Grab Samples																												
Influent			8/13	1010	X	X	X					X																
				1535	X	X	X					X																
			8/14	0925	X	X	X																					
Aeration Basin			8/13	1455					X																			
MLSS			8/13	0930																X	X							
				1525																X	X							
			8/14	0935																X	X							
Clarifier			8/13	1500						X																		
			8/14	0830						X																		
RAS			8/13	0930																X	X							
			8/14	1000																X	X							
Chlorine Contact Basin			8/14	0830						X																		
Effluent			8/13	0945	X	X	X	X			X	X				X	X			X								
				1515	X	X	X	X			X	X				X	X			X								
			8/14	0830				X			X																	
				0920	X	X	X									X	X			X								
Aerobic Digester			8/14	0900																X	X							X

After passing through the grit channel, the influent and return activated sludge (RAS) streams merge and flow into the aeration basin. The aeration basin is a circular tank with a submerged sweep arm rotating near the bottom. Diffusers attached to the arm provide air. The operator indicated that his target concentrations in the aeration basin are a MLSS of 3,000 to 4,000 mg/L and a 5.0. of 1.8 mg/L, but recent operations had been at a MLSS of 5,000 to 6,000 mg/L and a D.O. of 1.0 to 1.2 mg/L. The blowers for aeration were being run very near maximum capacity. Inspection measurements in the aeration basin found a D.O. concentration of approximately 4.0 mg/L immediately after an aeration arm sweep, dropping to 0.8 to 1.2 mg/L just before the next arm sweep. MLSS concentrations of 3,700 (est.) to 4,400 (est.) mg/L were measured in the basin.

Secondary clarification follows aeration. Only one of the two clarifiers was being used. RAS was being pumped at the maximum rate of 200 gpm continuously for the first half of the inspection. At approximately 1500 hours on August 13, the operator adjusted the RAS pumps so they were cycling for 15 minutes on and 15 minutes off. The operator noted that his ability to adjust RAS pump cycle frequently was limited by the timer system that had been installed. The timer is a two-clock system with the master clock cycling on or off in minimum increments of 15 minutes. The second clock allows further adjustment of the on portion of the master clock. Thus, the on portion of the cycle can limit the time the pumps are actually operating to periods less than 15 minutes, but the minimum off time is 15 minutes. Table 2 notes how the operator described what occurs with various adjustments. His chief concern is an inability to operate the RAS pumps on a 5-minutes-on, 5-minutes-off cycle as described in the plant operation and maintenance (O&M) manual.

Table 2. RAS timer system - Friday Harbor, August 1985.

Master Timer Setting		Secondary Timer Setting (minutes)	RAS Pumps	
Minutes On	Minutes Off		Minutes On	Minutes Off
15	15	15	15	15
15	15	5	5	25
30	15	15	15	30
30	15	5	5	40

Following clarification, the flow is chlorinated and routed to the chlorine contact basins. During the inspection only one basin was being used. Flow then passed through a Parshall flume and was discharged into the harbor.

RESULTS AND DISCUSSION

Inspection results are presented in Tables 3 (flow measurement data), 4 (composite sample data), and 5 (grab sample data). Comparison of plant meter and Ecology instantaneous flow measurements at the plant indicate that the meter was accurate (Table 3). Appropriate data are then compared to NPDES permit limits (Table 6).

Table 3. Flow measurements - Friday Harbor, August 1985.

Date	Time	Instantaneous Flow (MGD) Ecology Measurement	Instantaneous Flow (MGD) Plant Meter	Totalizer Reading	Average Flow During Time Increment (MGD)
Effluent Flow					
8/13	0800		0.42	500419	
	0900	0.32	0.30		
					0.27
	1310		0.35	500996	
					0.22
	1530		0.17	501212	
					0.16
8/14	0840		0.35	502360	
	0920	0.49	0.51		
24-hour average flow					0.19
RAS Flow					
8/13	0800		†	7854337	
					0.28
	1310		†	7860339	
					0.28
	1530		†	7863051*	
					0.14
8/14	0840		†	7872810	
24-hour average flow					0.18

†RAS pump capacity = 200 gpm (0.29 MGD).

*RAS pumps reset to cycle on 15 minutes - off 15 minutes.

Table 4. Ecology laboratory results of composite sample analyses - Friday Harbor, August 1985.

Sample	Sampler	Date	COD (mg/L)	BOD5 (mg/L)	pH (S.U.)	Cond. (umhos/cm)	Turb. (NTU)	Solids (mg/L) TS	TNVS	TSS	TNVSS	Nutrients (mg/L) NH_3-N	NO_2-N	NO_3-N	O-PO_4-P	T-PO_4-P	Alkalinity (mg/L as $CaCO_3$)
Influent	Ecology	8/85	510	290	7.3	1820	75	1700†	1300†	160†	10†	26	<0.1	<0.1	5.1	7.8	250††
	Ecology	5/83	600	240	7.4	3500	300	2500	1900	320	62	18	(0.10	0.20	4.0	5.2	
	F.H.	8/85	570	310	7.3	1990	82	1900†	1400†	130†	15†	26	<0.1	<0.1	5.2	6.6	260††
Effluent	Ecology	8/85*	690	120	7.5	1700	44	1400†	1200†	50†	5†	20	<0.1	<0.1	6.2	6.4	210††
	Ecology	5/83	340	200	7.4	3110	140	2100	1700	160	24	15	(0.05	0.15	3.4	4.6	
	F.H.	8/85	250	56	7.4	1720	36	1500†	1300†	41†	8†	22	<0.1	<0.1	6.8	7.1	130††

†Estimated concentration. Samples sent to the Ecology laboratory were analyzed after the allowable holding time (7 days) had been exceeded. Estimated concentrations are likely underestimates of the actual concentration.

††Estimated concentration. Samples sent to the Ecology laboratory were analyzed after the allowable holding time (14 days) had been exceeded.

*Sample incomplete due to compositor failure prior to completion of the 24-hour composite period.

Table 5. Grab sample results - Friday Harbor, August 1985.

			Field Analyses					Laboratory Analyses				Nutrients (mg/L)							
Sample	Date	Time	Temp (°C)	pH (S.U.)	Cond. (umhos/cm)	Chl. Resid. (mg/L) Total	Free	Fecal Coliform (#/100 mLs)	Oil & Grease (mg/L)	Conductivity (umhos/cm)	Turbidity (NTU)	NH_3-N	NO_2-N	NO_3-N	O-PO_4-P	T-PO_4-P	TSS (mg/L)	TVS (mg/L)	% Volatile
Influent	8/13	1010	19.1	7.7	660				60										
		1535	19.3	7.5	>1000				72										
	8/14	0925	18.9	7.6	700														
MLSS	8/13	0930															4400†	3600†	82
		1525															3800†	3300†	87
	8/14	0935															3700†	3100†	84
RAS	8/13	0930															7600†	6400†	84
	8/14	1000															11000†	9100†	83
Effluent	8/13	0945	19.7	7.0	>1000	1.5*	1.5	3 est	20	1840	10	20	<0.1	<0.1	7.1	7.1	19†		
		1515	20.6	7.0	>1000	0.9††		3 est	2	1730	9	24	<0.1	<0.1	6.9	7.2	19†		
	8/14	0830				1.0††		10 est**											
		0920	19.5	7.0	>1000					1820	16	22	<0.1	<0.1	7.2	7.2	20t		
Aerobic Digester	8/14	0900															8200†	5900†	72

†Estimated concentration. Samples sent to the Ecology laboratory were analyzed after the allowable holding time (7 days) had been exceeded. Estimated concentrations are likely underestimates of the actual concentration.

*Operator's result of sample taken at same time - 1.3 mg/L.

††Operator did analysis.

**Operator's result of sample taken at same time - 70/100 mLs.

est = estimated

Table 6. Comparison of Ecology data to NPDES permit limits - Friday Harbor, August 1985.

Parameter	NPDES Permit Limits Monthly Average	NPDES Permit Limits Weekly Average	Ecology Analytical Results Ecology Compositor*	Ecology Analytical Results Friday Hbr. Compositor	Ecology Analytical Results Ecology Grab†
BOD_5					
(mg/L)	30	45	120	56	
(lbs/D)**	75	113	190	89	
(% removal)	85		59	82	
TSS					
(mg/L)	30	45	50††	41††	
(lbs/D)**	75	113	79	65	
(% removal)	85		69	68	
Fecal Coliforms (#/100 mLs)	200	600			3 est, 3 est, 10 est
pH (S.U.)	$6.0 \leq pH \leq 9.0$				7.0, 7.0, 7.0

*The Ecology effluent compositor failed during the sampling period, resulting in an incomplete sample.
**Based on a flow of 0.19 MGD.

†See Table 3 for collection times,

††Estimated concentration. Samples sent to the Ecology laboratory were analyzed after the allowable holding time (7 days) had been exceeded. Estimated concentrations are likely underestimates of the actual concentration.

est = estimated

Table 4 includes data collected during both the 1983 (primary plant) and 1985 (secondary plant) inspections. The data show improved effluent quality for the NPDES permit parameters BOD_5 (1983 - 200 mg/L; 1985 - 56 mg/L) and TSS (1983 - 160 mg/L; 1985 - 41 est mg/L) after the upgrade. Considerable reductions in effluent FC concentrations (1983 range: 3,900 to 530,000/100 mL; 1985 range: 3 est - 10 est/100 mL) were also noted during the 1985 survey. While improvements were noted, the effluent BOD_5 exceeded NPDES limits for monthly and weekly average concentrations and monthly average load, and the effluent TSS exceeded the NPDES limit for monthly average concentration (Table 6, note: 1985 permit comparisons are based on Ecology analytical results of the FH effluent composite sample because the Ecology effluent composite sampler malfunctioned).

Comparison of the plant removal efficiencies to NPDES percent removal requirements is misleading because plant configuration does not allow safe, convenient influent sampling upstream of the fine screens. Thus, the reported removal rates are likely less than actual removals. Moving the influent monitoring station appears difficult, so basing permit compliance on effluent concentrations and loads rather than percent removals is recommended.

The May 1983 report noted that tide-related saltwater contributions to the system may have been occurring (Heffner, 1983). Grab samples collected during the August 1985 survey suggest this may still be occurring. Tides during the survey included low tides in the 0.0- to 1.5-foot range at approximately 1000 hours on August 13 and approximately 1045 hours on August 14, and a high tide in the 9.0- to 10.0-foot range at approximately 1800 hours on August 13. Influent grab sample conductivities of 660 umhos/cm at 1010 on August 13 and 700 umhos/cm at 0925 on August 14 collected during lower tidal periods were less than the >1000 umhos/cm sample collected at 1535 on August 13 which corresponded to a higher tidal phase. The influent composite sample conductivity for the 1985 survey (approximately 1900 umhos/cm) was less than for the 1983 survey (3500 umhos/cm). The reduction could be attributable to differences in the tidal cycle or collection system improvements.

There was a large difference between the 1985 composite sample TSS concentration (41 est. mg/L) and the grab sample TSS concentrations (19 est. to 20 est. mg/L) (Tables 4 and 5). Sludge depth in the 12-foot-deep clarifier was 10 feet of sludge on August 13 at 1500 hours and 5 feet of sludge on August 14 at 0830 hours. This decrease in sludge depth along with the low grab sample and high composite sample TSS concentrations in the effluent suggest a solids loss over the clarifier launder weir may have occurred at night during the inspection.

Table 7 compares operation during the 1985 inspection to selected design criteria. Plant capacity appeared to be adequate. Based on the aerator loading and detention time, additional capacity existed in the aeration basin. The high sludge age and low F:M ratio both suggest that the plant could be operated at a lower MLSS concentration; an operational adjustment that could be made while staying within the design criteria range for MLSS. The operator should be encouraged to set up a wasting schedule that will gradually drop the MLSS concentration in an attempt to find an optimum concentration.

Table 7. Comparison of plant operational parmeters to design criteria - Friday Harbor, August 1985.

	Parameter	Plant Operation	Plant Design Criteria†	Ecology Design Criteria††
Aeration Basin influent BOD_5* = 300 mg/L @ 0.19 MGD = 475 lbs/D Basin† = 52,840 ft3 = 6.395 MG MLSS* = 3700 - 4400 mg/L = 12,200 - 14,500 lbs MLVSS* = 3100 - 3600 mg/L = 10,200 - 11,900 lbs Recycle* = 100% of capacity = 0.28 MGD 50% of capacity = 0.14 MGD				
	Aerator loading (lbs BOD_5/D/ 1000 ft3 of tank)	9	--	10 - 25
	Detention Time (hrs)	49	32	10 - 24
	MLSS (mg/L)	3700 - 4400	--	2000 - 6000
	F:M (lbs BOD_5/D/ lb MLVSS)	0.04 - 0.05	--	0.05 - 0.15
	Sludge Age (days)**	50 - 76	--	10 - 30
	Recycle Ratio**		0.6 (average)	0.25 - 1.5
	at 100% of recycle capacity	1.45		
	at 50% of recycle capacity	0.74		
Secondary Clarifiers As operated (one used) Surface Area† = 530 ft^2 Depth† = 12 ft. Flow* - average = 0.19 MGD peak = 0.42 MGD MLSS* = 3700 - 4400 mg/L Recycle* = 100% of capacity = 0.28 MGD 50% of capacity = 0.14 MGD				
	Surface Overflow Rate (gpd/ft^2)			
	at average flow	360	565	200 - 400
	at peak flow	790	942	800
	Solids Loading Rate (lb/D/ft^2)			
	at 100% of recycle capacity			
	at average flow	27 - 33		25
	at peak flow	41 - 48	21	40
	at 50% of recycle capacity			
	at average flow	19 - 23		25
	at peak flow	33 - 39	21	40
If both were used Surface Area† = 1060 ft^2				
	Surface Overflow Rate (gpd/ft^2)			
	at average flow	180	565	200 - 400
	at peak flow	400	942	800
	Solids Loading Rate (lb/D/ft^2)			
	at 100% of recycle capacity			
	at average flow	14 - 16		25
	at peak flow	20 - 24	21	40
	at 50% of recycle capacity			
	at average flow	10 - 11		25
	at peak flow	16 - 19	21	40
Chlorine Contact Basin as operated (one tank used) Volume† - 1970 ft3 = 14,700 gal Flow* - average = 0.19 MGD peak = 0.42 MGD				
	Detention Time (min)			
	at average flow	110	--	60
	at peak flow	50	--	20
	maximum			120

*Inspection data (solids data are estimated concentrations). Solids samples sent to the Ecology laboratory were analyzed after the allowable holding time (7 days) had been exceeded. Estimated concentrations are likely under-estimates of the actual concentration.
†Design data from plant schematic.
**Based on operator's estimate of 2000 gallons of sludge wasted per day and inspection RAS concentrations of 7,600* and 11,000 mg/L*. Effluent TSS of 40 mg/L used. Only aeration basin solids used in calculation.
††From (Ecology, 1980).
**Based on average flow (0.19 MGD).

Comparison of 1985 clarifier loadings to design criteria suggests this may be a problem area. Although the surface overflow rates fall within criteria, the solids loading rates appear to be too high at 100 percent of recycle capacity and borderline at 50 percent of recycle capacity when only one clarifier is used. Calculations indicate that at the recycle rates and associated RAS concentations, the recycle rate should have been adequate to return the solids from the clarifier without solids loss (Table 8).

Table 8. Solids return during inspection - Friday Harbor, August 1985.

Date	Recycle Capacity being Utilized (percent)	MLSS Concentration (mg/L)	Flow to Clarifier Q + R (MGD)	Solids to Clarifier (lbs/D)	RAS Concentration (mg/L)	Recycle Flow-R (MGD)	Solids Returned (lbs/D)
8/13	100	3800-4400†	0.47	14,900-17,200	7,600†	0.28	17,700
8/14	50	3700†	0.33	10,200	11,000†	0.14	12,800

†Estimated concentration. Samples sent to the Ecology laboratory were analyzed after the allowable holding time (7 days) had been exceeded. Estimate concentrations are likely underestimates of the actual concentration.

Figure 3 is a graph of the acceptable flow to the clarifier(s) (effluent plus recycle) at given MLSS concentrations. It is recommended that the operator either maintain a lower MLSS concentration, use both clarifiers, or adjust the sludge recycle rate so that the solids loading rate is maintained below design criteria. This should continue until the operator has a feel for rates acceptable for his specific system.

The comparison of the chlorine contact chamber to design criteria indicates the unit was adequate to handle the inspection flow. The 1985 coliform counts were quite low (3 est. to 10 est./100 mL, from Table 5), also suggesting good unit operation. During the inspection, chlorine residual concentrations appeared somewhat high, ranging from 0.9 to 1.5 mg/L. The operator should determine the minimum chlorine residual necessary to maintain satisfactory effluent fecal coliform counts. Sludge depth in the contact chamber was approximately two feet in the eight-foot-deep unit at 0830 hours on August 14. Sludge depth should be monitored and sludge removed before it substantially reduces contact time. A three-foot maximum depth could serve as a guideline unless inadequate disinfection is noted at a lesser sludge depth.

Many of the suggestions in this report involve the operator making adjustments at the plant and learning how the plant responds. Because it is a new facility, this will take some time. The operator should be encouraged to keep an operational log during this time, noting his operational strategy and results for future reference.

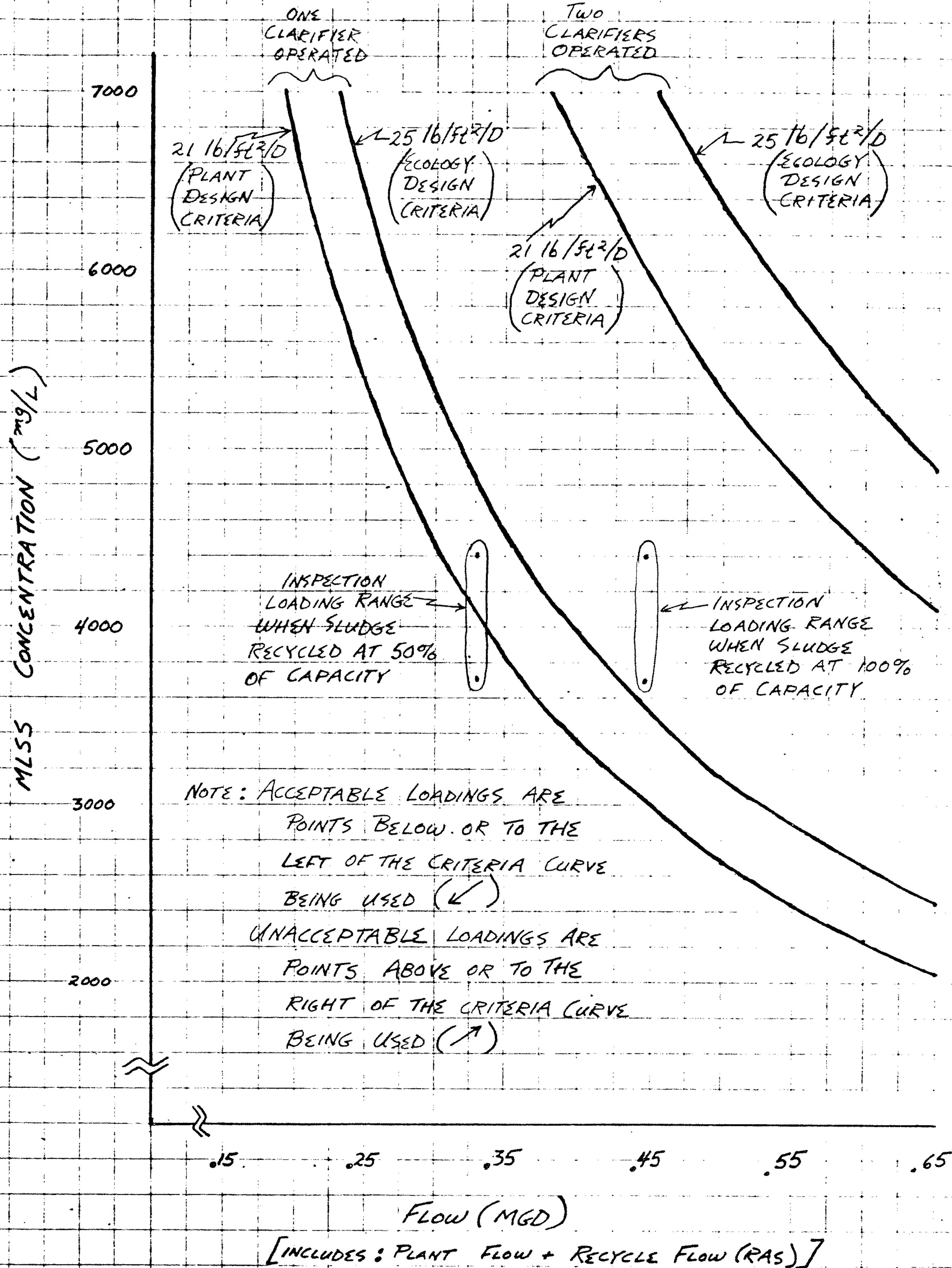


FIGURE 3 - CURVES DESCRIBING ACCEPTABLE CLARIFIER SOLIDS LOADINGS - FRIDAY HARBOR, 8/85.

Sludge metals data from a sample collected in the aerobic sludge holding1 digester tank are presented in Table 9. Sludge metals concentrations were higher during the August 1985 survey than during the May 1983 survey, but still fell well within the range of concentrations found in sludges during previous Class 11 inspections at activated sludge plants.

Table 9. Sludge metals concentrations - Friday Harbor, August 1985.

	Friday Harbor Sludge		Previous Inspection Data*		
Metal	May 1983** (mgKg dry weight)	August 1985 (mg/Kg dry weight)	Geometric Mean (mg/Kg dry weight)	Range (mg/Kg dry wt.)	Number of Samples
Cadmium	4.2	5.3	6.9	<0.1 - 25	28
Chromium	14	37	60	15 - 300	28
Copper	400	1,200	370	75 - 1,700	28
Lead	64	130	220	34 - 600	28
Nickel	14	24	22	<0.1 - 62	24
Zinc	690	2,050	1,160	165 - 3,370	28
Arsenic	--	5.3	--	--	--
% Solids	2.6	1.12			

*Summary of data collected during previous Class II inspections at activated sludge plants.

**May 1983 sample collected at Friday Harbor STP when plant was a primary plant (Heffner, 1983).

LABORATORY REVIEW

Review of the laboratory procedures with the operator found no major problems. Comments pertinent to routine procedures include:

Sampling

The influent sampling station is located downstream of the influent fine screens and the digester supernatant return. Moving the station farther upstream would be extremely difficult. Presently the operator does not return supernatant during sampling periods. This practice should be continued to the extent possible. As noted earlier, sampling downstream of the screen likely underestimates the influent load resulting in an underestimation of treatment plant efficiency. This should be considered when the permit requirement for 85 percent removal of BOD_5 and TSS is evaluated.

Twenty-four-hour composite samples at the plant are routinely collected during the Wednesday morning to Thursday morning time period. Because this is a tourist-oriented community, weekend sampling (a 24-hour composite collected sometime between 1500 hours on Friday and 1500 hours on Sunday) once a month during the heavy tourist season is suggested so maximum loads can be estimated.

pH

The range of pH measurements observed at the plant suggests that buffers of pH 7 and 10 should be used for meter standardization rather than buffers of pH 4 and 7. A daily meter check with the 7 buffer and weekly check with the 10 buffer should be adequate.

BOD_5

PAO is used as a titrant for the Winkler Method D.O. analyses used for the BOD_5 tests. The operator checks the normality of each new bottle of PAO to assure the labeled normality is accurate. Additional normality checks when the bottle is two-thirds full and one-third full are recommended.

TSS

The mercury in the thermometer used to monitor the drying oven had split making temperature readings inaccurate. The mercury should be rejoined or the thermometer replaced. An accurate thermometer should always be in place to monitor the oven temperature. Other suggestions include:

1. Filters should be pre-rinsed three times prior to drying and use to assure adequate cleaning.

2. Duplicate analyses when less than 50 mLs of sample can be filtered are recommended. This technisue minimizes the effect of small measurement errors and samples which are not completely homogeneous, thus improving test accuracy.

3. Redrying and reweighing filtered samples until a constant weight is attained (<0.5 mg weight loss between reweighings) is a suggested quality assurance technique. Quarterly checks of proper solids drying using the redry/reweigh technique are recommended.

Results of the sample splits for Ecology and FW laboratory analyses are presented in Table 10. Because of the Ecology effluent sampling and laboratory problems, confidence in statements about sampler and laboratory comparisons is minimal. BOD_5 and fecal coliform splits compared only marginally well, but based on the discussion, no need for major changes in technique were apparent.

Table 10. Compairson of Ecology and Friday Harbor split sample results: Friday Harbor, August 1985.

Sample	Sampler	Laboratory	Fecal Coliforms (#/100 mLs)	BOD_5 (mg/L)	TSS (mg/L)
Influent	Ecology	Ecology		290	160†
		Friday Harbor		385	165
	Friday Harbor	Ecology		310	130†
		Friday Harbor		354	205
Effluent	Ecology	Ecology		120	50†
		Friday Harbor		72	97
	Friday Harbor	Ecology		56	41†
		Friday Harbor		56	100
	Grab	Ecology	10 est		
		Friday Harbor	70		

est = estimated

†Estimated concentration. Samples sent to the Ecology laboratory were analyzed after the allowable holding time (7 days) had been exceeded. Estimated concentrations are likely underestimates of the actual concentration.

CONCLUSIONS

Effluent quality during the August 1985 Class II inspection (secondary plant) was improved in comparison to the quality during the May 1983 Class II inspection (primary plant). Improvement was most dramatic in reduction of fecal coliform counts (May 1983 range: 3,900 to 530,000/100 mL; August 1985 range: 3 est. to 10 est./100 mL). Although quality improved, BOD_5 (concentration and load) and TSS (concentration) in the effluent exceeded some of the NPDES average permit limits. Use of the concentration and load permit limits rather than percent removal limits for permit compliance monitoring is suggested because of the influent sampling station. The station is downstream of the influent fine screens, likely resulting in lower influent concentration measurements than are actually coming to the plant, and thus causing lower efficiency ratings. Moving the influent station upstream of the screens would be difficult.

Solids spilled from the clarifier during the night probably were responsible for effluent concentrations greater than NPDES average permit limits. The primary problem appears to be related to the solids loading to the clarifier. One or a combination of the following should be used to correct the situation:

1. Lowering the MLSS concentration in the aeration basin. Experimentation to find an optimum MLSS concentration and development of a wasting schedule to maintain that concentration are necessary for good long-term plant operation.

2. Using both clarifiers rather than one to handle the load. This option should help keep solids in the plant during critical situations.

3. Reducing the sludge recycle rate. The operator noted that flexibility of recycle rate adjustment is limited by the timer system. Changing the timer system may be necessary to fully utilize this option.

Effluent fecal coliform counts were low during the inspection, but chlorine residual concentrations were fairly high (0.9 to 1.5 mg/L). The operator should experiment with chlorine feed to minimize the chlorine residual concentration while still maintaining the lower fecal coliform counts.

Because the plant is relatively new, some operator experimentation is required to determine an optimum operational system at the plant. The operator should keep a log outlining operational changes he makes and observations on plant performance, This will help with the learninq process and provide a record for reference.

Laboratory and sampling procedures at the plant appeared to be acceptable. Minor changes are recommended in the Laboratory Review section of this report.

MH:cp

Attachment

REFERENCES

Determan, T.A. and W Kendra, 1986. "Post-Upgrade Receiving Water Study of the Town of Friday Harbor Sewage Treatment Plant," memorandum to Dave Nunnallee, January 23, 1986.

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Heffner, M., 1983. "Friday Harbor Sewage Treatment Plant (STP) Class 11 Inspection, May 17-18, 1983," memorandum to John Glynn, August 18, 1983.