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STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

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MEMORANDUM

July 7, 1983

To: Dave Nunnallee

From: Lynn Singleton and Joseph Joy

Subject: Friday Harbor Receiving Water Survey

At the request of the Northwest Regional Office, a receiving water quality survey was conducted on May 17, 1983, in conjunction with a Class II facility inspection at Friday Harbor STP (Heffner, 1983).

Background

The current wastewater treatment plant (WTP) provides inadequate treatment of the Friday Harbor (population 1,200) wastewater. Wastewater is presently pumped to the WTP via a lift station which, when operating, hydraulically charges the system. The pulsing flow directly affects the volume of effluent released, and its quality. The effluent fluctuates from a relatively clear, over-chlorinated effluent with almost no flow to a very turbid effluent of large flow with inadequate disinfection. The WTP is scheduled for upgrade to secondary treatment and construction will be completed during 1984 (Nunnallee, 1983).

Effluent is discharged to Friday Harbor (Class AA) via a 10-inch pipe. The discharge point is located inside the Port of Friday Harbor's breakwater at a depth of roughly 10 meters (mllw) (Figure 1).

Historically, Friday Harbor has experienced elevated bacteria levels in and around the Port and outfall area (Moore and Anderson, 1978). The two main objectives for this survey were: (1) to determine the impact of the WTP discharge on the water quality of Friday Harbor; and (2) to follow the effluent plume during a period of large tidal exchange when maximum flushing would occur and dilution would be at its greatest.

Methods

In response to the first objective, surface and depth (10 meters or the bottom, whichever was less) samples were collected at six fixed sites (Figure 1). Collection occurred at a low slack tide of -1.9 feet (mllw). The following measurements were obtained *in situ*: temperature; salinity; conductivity (Kahlsico RS 5-3); secchi disk depth (20cm black-and-white disk); and dissolved oxygen (Winkler method). Collected samples were placed on ice and sent to the WDOE Olympia Environmental Laboratory for the following analyses per USEPA (1979): conductivity; salinity; turbidity; pH; nitrate-nitrogen; nitrite-nitrogen; ammonia nitrogen; total phosphate-P; orthophosphate-P; and fecal coliform (membrane filter). Toxic parameters were not sampled because information on the users of the sewer system did not suggest a need.

The same measurements and analyses were performed in response to the second objective; however, the sampling sites were dependent on the circulation patterns (Figure 2). Two drogues (Determan, 1982) were placed at the discharge site at a depth of one meter and were followed on the outgoing tide for a minimum of 90 minutes or until the effluent plume was not discernible using field *in situ* measurements. This sampling occurred on the outgoing tidal cycle (-1.9 feet:mllw).

Mussel samples (*Mytilus edulis*) were collected on May 23 for tissue fecal coliform analysis (MPN method). Two samples were collected from the breakwater near the WTP discharge (Figure 2).

Results

The results of the fixed station analyses (Table 1) indicate that the surface to 10-meter stratum was unstratified during the outgoing tide. Three stations (1, 2, and 3) have notable differences in water quality from the background stations (4-6). Station 1 was located adjacent to the effluent boil. Water clarity as noted by both the secchi disk and turbidity results was affected in this area. Bits of toilet paper and other solids were observed in the effluent boil. The fecal coliform samples collected at different times clearly demonstrated the variation in effluent coliform levels discussed by Heffner (1983). The coliform levels at Station 2, located adjacent to the breakwater approximately 60 meters from the boil, were greater than the state water quality standard of 14 col/100 mL for Class AA marine waters. Other parameters at Station 2 were of background levels. Station 3, located inside the Port breakwater, also had fecal coliform levels above the criterion. Surface ammonia and phosphorus concentrations at Stations 1-3 were slightly elevated compared to Stations 4-6.

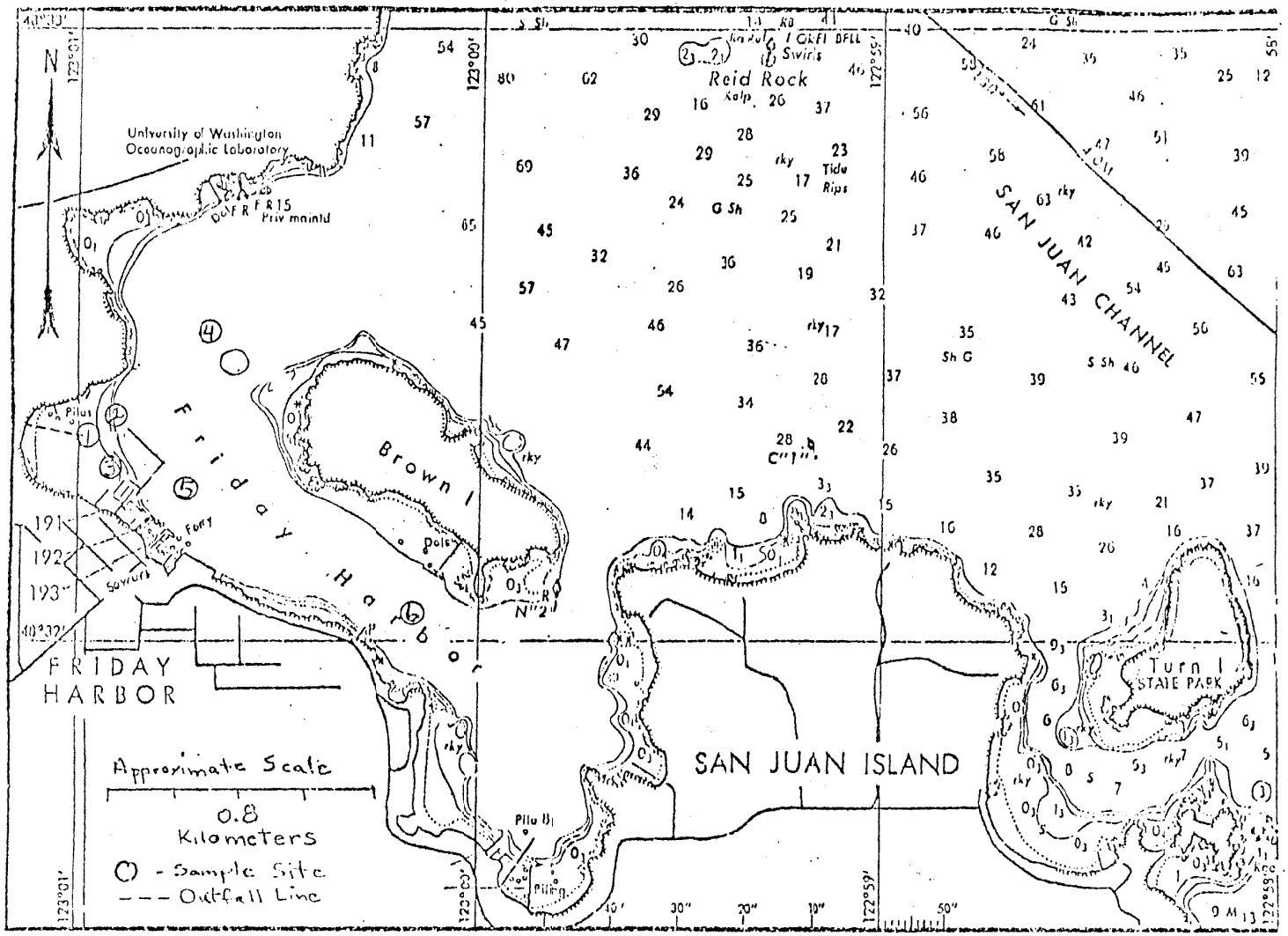

Figure 1. Friday Harbor fixed stations, May 1983 (After NOAA Nautical Chart 184-5C April 1972).

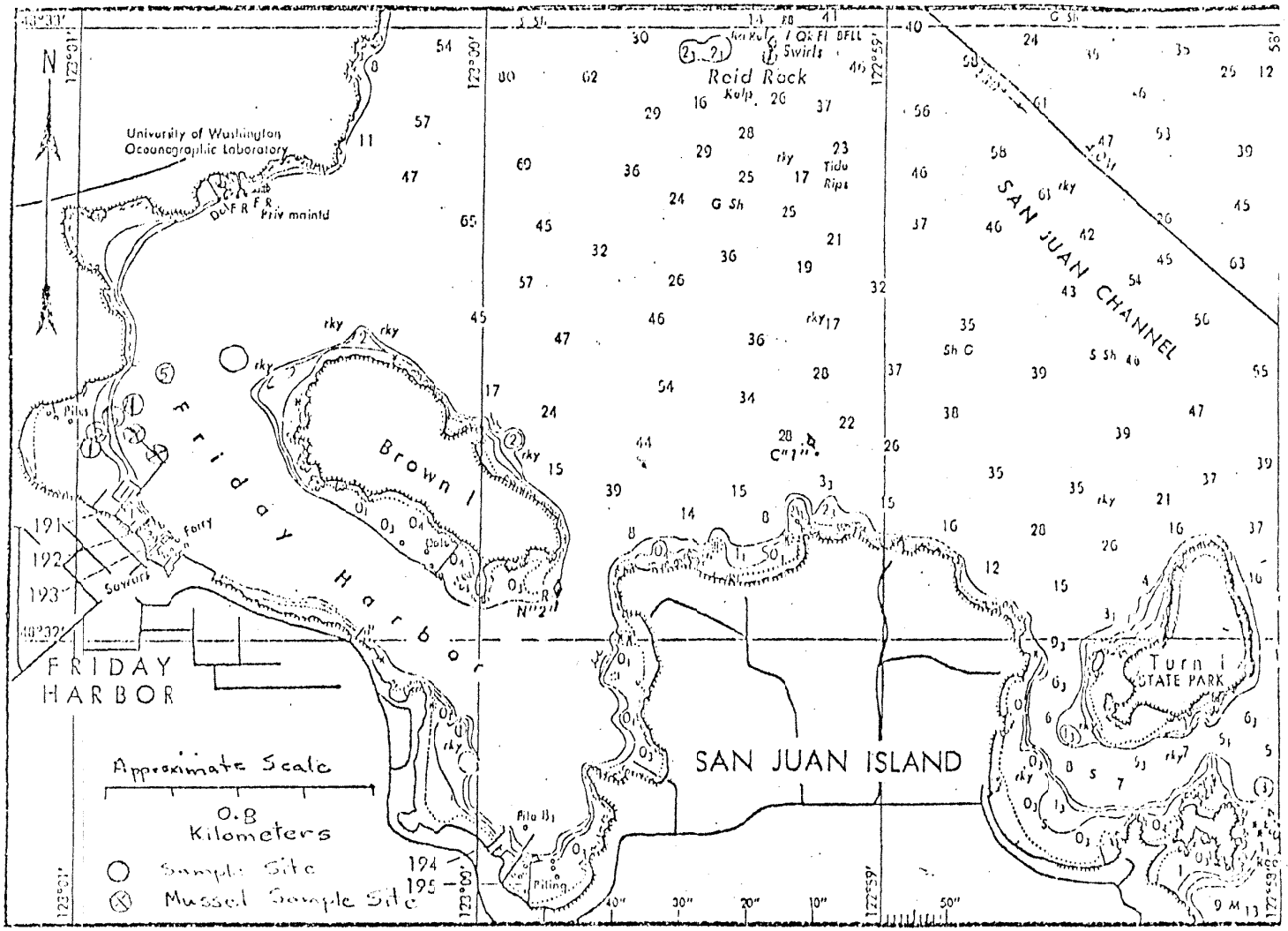

Figure 2. Friday Harbor drogue survey path, May 1983 (After NOAA Nautical Chart 184-5C, April 1972).

Table 1. Results from Friday Harbor receiving water survey, May 1983.

Station	Time	Flow (MGD)	Field Analyses: Temperature	Secchi Disk (ft.)	Conductivity (mmhos/cm)	Dissolved Oxygen (mg/L)	Salinity (o/oo)	Turbidity (NTU)	Laboratory Analyses: pH (S.U.)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia-N (mg/L)	Total Phos.-P (mg/L)	Orthophos.-P (mg/L)	Fecal Coliform (org/100 mL [MF])	Fecal Coliform (org/100 g [MPN])	BOD_5 (mg/L)	COD (mg/L)	Solids (mg/L): Total	Total Non-Vol.	Total Susp.	TNVSS
1-S[1]	1645		8.8	16.0	32.2	8.6	29.0	10	8.0	0.20	<0.01	0.14	0.08	0.06	170/4200[3,4]							
-D[2]			8.9		32.6	8.7	29.5	6	8.0	0.20	<0.01	0.02	0.05	0.03								
2-S	1700		8.9	19.0	32.1	8.7	29.0	3	8.0	0.20	<0.01	0.04	0.05	0.04	18[3]							
-D			8.9		32.4	8.7	29.4	3	8.0	0.22	<0.01	0.02	0.05	0.03								
3-S	1720		9.0	18.5	32.1	8.7	28.9	3	8.0	0.22	<0.01	0.04	0.06	0.04	77							
-D			8.8		32.2	8.5	29.2	3	8.0	0.22	<0.01	0.02	0.04	0.03								
4-S	1710		9.6	19.0	32.2	8.8	29.1	3	8.0	0.21	<0.01	0.02	0.04	0.03	<1							
-D			8.8		32.4	8.6	29.3	4	8.0	0.21	<0.01	0.02	0.04	0.03								
5-S	1630		9.0	20.0	32.4	9.0	29.2	4	8.0	0.24	<0.01	0.02	0.04	0.03	<1							
-D			8.8		32.5	8.4	29.5	4	8.0	0.22	<0.01	0.02	0.04	0.03								
6-S	1615		9.0	20.0	32.2	8.7	29.2	1	8.0	0.22	<0.01	0.02	0.04	0.03	<1							
-D			8.6		32.5	8.3	29.6	6	7.9	0.24	<0.01	0.02	0.05	0.03								
X30																790[5]						
X60																16,000[5]						
DR1-S	1115		9.0	14.3	31.7	8.3	28.7	6	7.9	0.22	<0.01	0.32	0.16	0.10	240							
-D			8.9		32.6	8.4	29.6	4	8.0	0.22	<0.01	0.02	0.05	0.03								
DR2-S	1133		8.9	18.3	32.1	8.5	29.0	2	8.0	0.22	<0.01	0.06	0.06	0.04	200							
-D			8.9		32.5	8.5	29.6	3	7.9	0.22	<0.01	0.02	0.04	0.03								
DR3-S	1149		8.9	18.0	32.1	8.6	29.2	5	7.9	0.22	<0.01	0.04	0.05	0.04	80							
-D			8.8		32.4	8.6	29.2	3	8.0	0.22	<0.01	0.02	0.06	0.03								
DR4-S	1208		8.8		32.0	8.7	29.0	5	8.0	0.22	<0.01	0.04	0.04	0.04	120							
-D			8.8		32.4	8.9	29.3	3	7.9	0.23	<0.01	0.02	0.04	0.03								
DR5-S	1248		8.9		32.0	9.1	29.0	5	7.9	0.23	<0.01	0.02	0.05	0.04	8[3]							
-D			8.8		32.5	8.5	29.6	4	7.9	0.23	<0.01	0.02	0.08	0.06								
WTP Eff. 24-hr Comp.[6]		0.2			3.1		1.9	140	7.4	.15	<.05	15	4.6	3.4	530,000/3,900		200	340	2180	1700	160	24

[1] Surface sample

[2] Sample at 10 meters or the bottom

[3] Estimated count

[4] Collected at 1435

[5] Samples collected May 23 from breakwater approximately 30 m and 60 m from discharge site

[6] Obtained from Heffner (1983)

The results of the mussel tissue analysis for fecal coliform levels indicate that high bacteria levels are a problem in the Port area. Concentrations substantially exceeded the standard for shellfish -- 230 fecal coliform organisms per 100 grams of tissue.

The drogues were placed in the effluent boil and followed for a 90-minute period. They remained within five meters of each other for the duration of sampling. The field sampling results indicated rapid dilution and dispersion with most parameters reaching background conditions within a relatively short time and distance from the discharge. Perturbations were most evident in the fecal coliform levels and possibly the dissolved oxygen levels. The coliform concentrations showed an overall decline as the distance from the outfall increased. Dissolved oxygen levels appeared to be slightly lower than the mean of 8.6 mg/L calculated for the background stations. Figure 2 shows the position of the sampling points, and the elapsed time of sampling at each site is given in Table 1. The drogues moved approximately 300 meters in about 90 minutes. The distance covered by the drogues represents flushing under better-than-average conditions since large tidal exchange occurred during the sampling. Water quality conditions could therefore be poorer during average flushing conditions.

As indicated by the data, fecal coliform loading in the Port area is excessive and results in water quality violations. The WTP discharge is the predominant source; however, the problem is aggravated by the boats in the Port area. Conversations with Mike Valiga (1983) indicate Friday Harbor is used extensively by recreational boaters during the summer season. The Port has moorage facilities for 250 boats -- about 185 permanent and 65 transient. Additional boats are also moored in the area. The Port maintains holding tank pump-out (cost 25¢) and porta-potty disposal facilities for boaters. Usage appears to be minimal in light of the gross receipts of $119 for last year; however, people are fairly conscientious about not emptying tanks in the harbor.

These potential septic sources however should not be disregarded as sewage is likely discharged from some of the boats having full-time occupants and indiscriminant transient boaters. For example, one boater was observed emptying the contents of a cat box overboard while moored at the Port. These problems reportedly are sporadic and on-going.

Summary

Fecal coliform bacteria are the predominant water quality problem in Friday Harbor. The high levels mainly result from the Friday Harbor WTP discharge. Solids associated with the discharge affect water clarity in the area of the discharge and are aesthetically displeasing. Sewage discharged by permanent and transient boaters potentially aggravate the present conditions.