AN EVALUATION OF ELK AND CATTLE ON THE CHEMICAL AND MICROBIOLOGICAL WATER QUALITY OF FLAT CREEK, TETON COUNTY, WYOMING

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Objectives:

The National Elk Refuge in Jackson Hole, Wyoming (administered by the Bureau of Sport Fisheries and Wildlife) covers an area of 23,754 acres and provides winter range for approximately 60 percent of the Jackson Hole elk herd. When deep crusted snow prevents the elk from grazing normally, a supplemental feeding program is put into operation. In order for Teton County to meet the 1983 National Goal on water quality (PL 92-500) it is important to determine to what extent the winter feeding of elk is influencing the water quality of Flat Creek which flows through the National Elk Refuge.

The purpose of the present study will be to determine to what extent the winter feeding of elk is influencing the water quality of Flat Creek and to aid in the development of management policies for the Teton County Section 208 Waste-treatment Management Planning Program and National Elk Refuge personnel.

The objectives of the present sutdy are:

1. To determine the influence of elk populations on aquatic indicator bacterial populations in Flat Creek.

2. To determine the influence of elk populations on selected water chemistry parameters.

3. To examine elk fecal material from winter and summer ranges for the presence or absence of bacteria that are pathogenic for man and to test for such microorganisms in natural waters.

4. To evaluate the water quality potential of Flat Creek as a municipal water supply for Jackson, Wyoming.

Procedures:

Location of study sites: The main study area (Fig. 1) is Flat Creek and adjoining creeks and springs on the National Elk Refuge. Other study areas include two locations on Flat Creek below the town of Jackson and one site on Spring Creek between the East and West Gros Ventre Buttes. The sample stations

On Flat Creek below the town of Jackson are located above and below the South Park Elk Refuge enabling one to determine the influence of elk on this section of Flat Creek. The Spring Creek station is influenced by cattle grazing as are the two Flat Creek stations below the town of Jackson. Although there are cattle on the National Elk Refuge at Twin Creek Ranch they are not free ranging, so essentially the main influence on Flat Creek above the town of Jackson will likely be due to elk.

The sample sites shown on Figure 1 are as follows:

F-1 - Flat Creek as it enters the National Elk Refuge.

F-2 - Flat Creek where the public access road on the Refuge crosses it.

F-3 - Flat Creek adjacent to the National Fish Hatchery.

F-4 - Flat Creek approximately 1 mile south of Fish Hatchery.

F-4A - Nowlin Creek where it joins Flat Creek.

F-5 - Miller Springs on Elk Refuge.

F-6 - Flat Creek as it exits the National Elk Refuge.

F-7 - Flat Creek as it flows under South Park Road (above South Park Elk Refuge).

F-8 - Flat Creek as it flows under Highway 187 (below south Park Elk Refuge).

S-1 - Spring Creek as it flows under Highway 22.

Sampling: Samples at sites F-1, F-3, F-4, F-4A, F-5, F-6, F-7, F-8 and S-1 were collected and analyzed three different times during the period beginning 8/4/76 and ending 10/13/76. During this period elk were not present on the National Elk Refuge and water from the Gros Ventre River was no longer being diverted into Flat Creek. Discharge at this time was still above winter lows but was below peak flows experienced in previous sampling periods. Samples collected on 9/22/76 of this sampling period were obtained during a heavy rain shower and reflect conditions of a typical storm runoff period. Samples collected on 8/4/76 and 10/13/76 however, reflect stable conditions in which there is very little influence on the water quality by extraneous factors, i.e. large elk populations or diverting water, and provide background data with which other sampling periods may be compared. Sites S-1, F-7 and F-8 were probably influenced to some degree, during the last sampling period, by cattle being moved to winter feeding grounds in the South Park and Spring Gulch areas. However, the number of cattle present did not reflect winter conditions which has a greater cattle population.

Results:

The results of each sampling date can be seen in Table 1 and Figure 2. In general bacterial counts (total coliform, fecal coliform, fecal streptococci and standard plate count) are comparable to counts obtained during September and October of last year. Bacterial counts did increase on sites located on the elk refuge during sampling period 9/22/76 (Fig. 2). This corresponds with the storm runoff witnessed during that period. Sites below the town of Jackson and on Spring Creek however, showed either no major change or a decrease in bacterial numbers during the same sampling cycle. Total phosphates and nitrates were the nutrients which best corresponded with the storm runoff. Physical factors such as turbidity, residue and conductivity as well as B.O.C., pH, alkalinity and minerals did not appear to be affected by the storm runoff.

As the water temperature decreased and flow rates approached those of winter, bacterial counts (in particular fecal coliform) approached counts comparable to last winter. Fecal coliform:fecal streptococci ratios (FC/FS) were below 0.7 for sites on the elk refuge. The FC/FS ratio increased below the town of Jackson and on Spring Creek but remained below 0.7 except for the final sampling period. As before bacterial counts, minerals, nutrients and physical parameters increased as Flat Creek flowed through the elk refuge then increased dramatically below the town of Jackson and beyond the sewage treatment plant.

Discussion:

As before, one sees an increase in bacterial numbers as well as minerals and nutrients in Flat Creek as it passes through the National Elk Refuge lands. There is also a dramatic increase in bacterial numbers during a storm indicating that there is indeed storm runoff. The increase in fecal coliforms indicates that the increase in bacterial numbers during a storm is due, at least in part, to the fecal material left by the elk during the winter months. However, it should be pointed out that even during peak runoff periods bacterial counts on sites located on the refuge are considerable lower than counts obtained in Flat Creek below the sewage treatment plant during stable periods, i.e. no runoff.

Comparing bacterial counts during a dry period with no diversions and no elk present with counts obtained during the winter when elk are present on the refuge tends to indicate a "natural" background level of bacteria in the water. This background level is probably due to a number of factors such as bank erosion, waterfowl and fishing or other activities that might disturb the bottom sediments.

Below the town of Jackson on Flat Creek one sees an increase in bacterial counts as well as nutrients and minerals. This dramatic increase is most likely due to the sewage treatment plant as explained by the following observations. One: the bacterial counts in lower Flat Creek were not effected by the storm runoff, as on the elk refuge, indicating that the major contaminating source is probably not due to runoff from agricultural lands. Two: bacterial counts as well as nutrients and minerals did not appear to fluctuate as cattle are moved to and from the winter range indicating contamination from some other source. Three: the FC/FS ratios increased in Flat Creek below the sewage treatment plant and increased from site F-7 to F-8 indicating human contamination. Although the FC/FS ratio is usually below 0.7 this indicates an infiltration problem at the sewage treatment plant which would lower the FC/FS ratio.

The effect of cattle on the water quality of Flat Creek is probably comparable to that of the elk on the refuge. Undoubtedly the water is influenced by the cattle as witnessed by an increase in bacterial counts in Spring Creek during storm runoff and when cattle are brought back onto the winter range. However this influence on the water quality again, is not comparable to the influence the sewage treatment plant has on the water.

Looking at the biochemical oxygen demands for Flat Creek and other physical parameters, it is evident that the drainage does have the capacity to withstand the cattle and elk operations that occur in the valley as well as the sewage treatment plant (although the latter is highly undesirable from the sanitation point of view).

Conclusions:

Based on the one year's data obtained so far it is evident that the elk and cattle do have an influence on the water quality of Flat and Spring Creeks. However at this time it appears that this is not necessarily an undue stress on these streams and that they can probably handle the pollution which they receive. It is apparent that the major influence on Flat Creek is 1) the sewage treatment plant and runoff from the town of Jackson and 2) the diversion of Gros Ventre water into Flat Creek.

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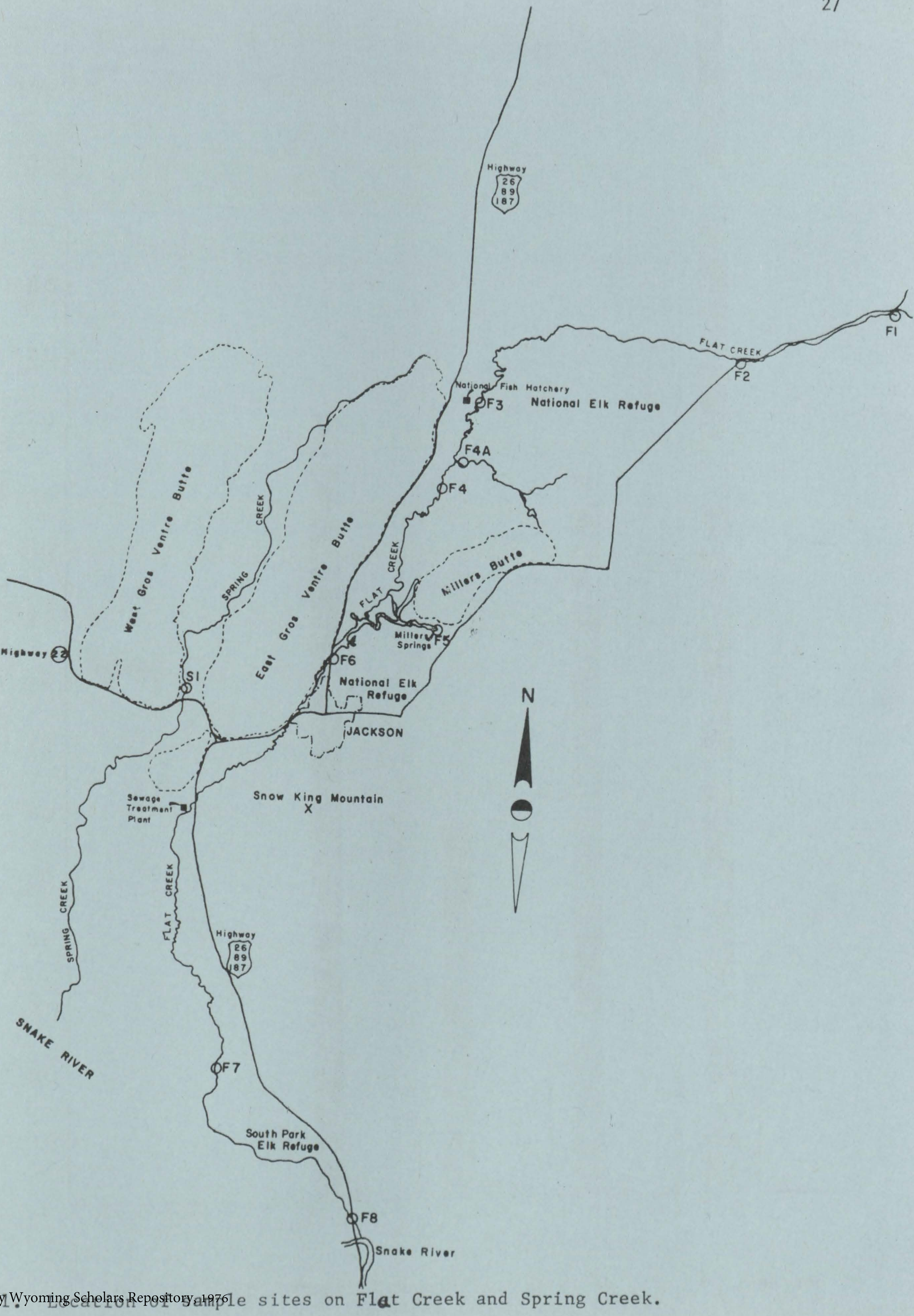

Fig. 1. Location of sample sites on Flat Creek and Spring Creek.

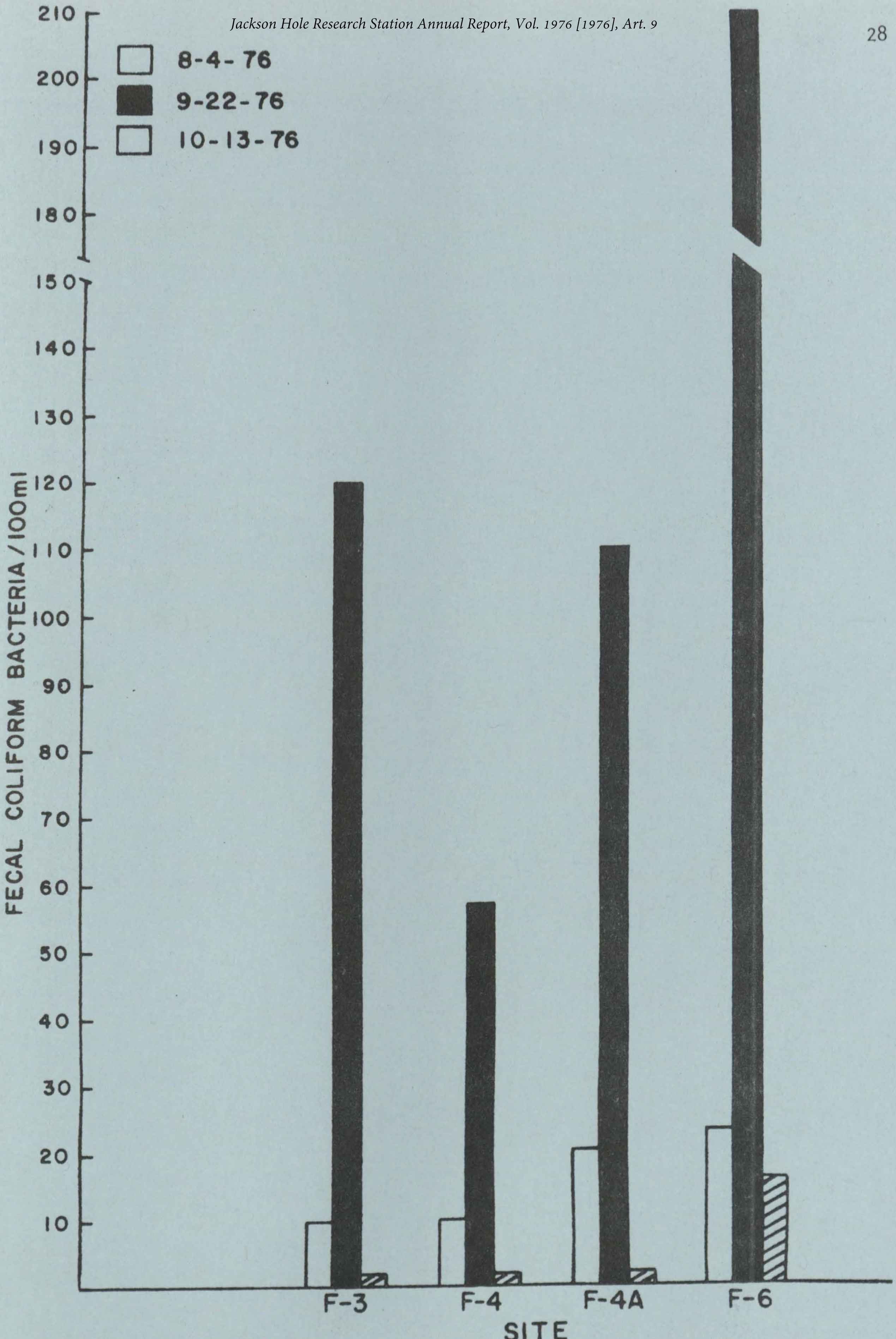

Fig.2 . Fecal coliform bacterial populations at sites F-3, F-4, F-4A and F-G for various sampling dates during this quarter.

Table 1. Chemical, physical and microbiological parameters obtained during the months starting 8/4/76 and ending 10/13/76

Site	Date	Total Coliform #/100 ml	Fecal Strep #/100 ml	Fecal Coliform #/100 ml	Standard Plate Count #/ml	FC/FS	Temp ^{o}C	pH	Specific Conductance	D.O.	B.O.D.
F-1	8-4-76	23	55	<1	130		8.6	8.3	203	8.7	.70
	9-22-76	27	59	<1	340		9.1	8.3		8.4	.90
	10-13-76	24	57	<1	100		4.6	8.2	224	9.4	.80
F-3	8-4-76	46	60	10	440	.167	10.0	8.0	296	9.2	.90
	9-22-76	270	280	120	3.3x10^3	.428	9.5	7.9		8.2	1.05
	10-13-76	<1	40	2	410	.050	5.8	8.2	281	9.5	.72
F-4	8-4-76	100	100	10	980	.100	9.5	8.0	320	9.1	1.30
	9-22-76	160	190	57	1.7x10^3	.300	9.3	7.9		8.2	1.14
	10-13-76	140	88	2	830	.023	5.8	8.1	295	9.6	.72
F-4A	8-4-76	75	120	20	680	.167	10.0	7.9	321	8.8	1.10
	9-22-76	220	390	110	3.6x10^3	.282	9.4	7.9		8.0	1.75
	10-13-76	90	110	2	700	.018	5.9	8.1	301	9.4	.81
F-5	8-4-76	5	17	<1	43			7.7	464		
	9-22-76	7	66	<1	410		9.7	7.6		7.7	1.31
	10-13-76	<1	<1	<1	70		9.4	7.8	459	7.5	.29
F-6	8-4-76	82	240	23	770	.096	9.5	7.9	337	8.4	.30
	9-22-76	310	650	210	1.4x10^3	.323	9.8	7.9		7.7	1.37
	10-13-76	80	170	16	1.3x10^3	.094	6.2	8.1	310	8.8	.83
F-7	8-4-76	2.8x10^3	1.5x10^3	410	5.2x10^3	.273	11.4	7.9	398	6.5	1.00
	9-22-76	400	900	280	4.8x10^3	.311	11.0	7.9		6.8	.83
	10-13-76	TNTC	2.2x10^3	1.9x10^3	2.9x10^3	.864	5.8	8.0	371	8.1	.63
F-8	8-4-76	1.8x10^3	940	480	8.6x10^3	.511	11.7	7.9	415	6.8	1.70
	9-22-76		300	70	2.5x10^3	.233	11.4	8.0		6.8	2.19
	10-13-76	4.2x10^3	1.1x10^3	1.1x10^3	2.0x10^3	1.00	6.2	8.0	394	7.9	.72
S-1	8-4-76	200	230	54	2.0x10^3	.235	8.8	7.7	438	6.8	1.10
	9-22-76	260	280	40	3.1x10^3	.143	9.8	7.7		6.1	1.22
	10-13-76	890	70	270	2.4x10^3	3.86	5.4	7.8	454	6.8	.56

Table 1. Continued

Site	Turbidity NTU	Alkalinity meq/l	Alkalinity mg/l $CaCO_3$	Hardness as $CaCO_3$	Ca mg/l	Mg mg/l	SO_4 mg/l	NH_3 mg/l-N	NO_3 mg/l-N	Ortho PO_4 mg/l-P	Total PO_4 mg/l-P	Residue non-filter-able mg/l
F-1	.40	2.16	108	108	29.68	8.27	2.58	.005	.016	.001	.008	<1
	.25	2.27	113	118	32.80	8.66	3.55	.007	.041	.006	.016	<1
	.80	2.38	119	125	34.40	9.48	3.57	.008	.033	.005	.018	<1
F-3	.90	3.10	155	162	43.76	12.79	5.53	.005	.012	.001	.011	<1
	1.00	3.01	151	155	47.20	8.90	4.23	.006	.018	.001	.021	2
	.77	3.05	153	156	44.00	11.24	4.21	.006	.017	.002	.019	<1
F-4	.60	3.40	170	174	54.32	9.29	5.25	.005	.008	.002	.016	<1
	.50	3.17	159	164	46.16	11.72	5.40	.006	.022	.003	.021	<1
	.76	3.18	159	161	49.20	9.29	5.68	.006	.022	.002	.021	<1
F-4A	.40	3.53	176	180	50.16	13.33	4.74	.005	.005	.001	.016	<1
	.45	3.24	162	168	50.48	10.21	6.62	.006	.016	.002	.024	<1
	.66	3.21	160	164	46.08	11.92	6.57	.006	.019	.002	.018	<1
F-5	.03	2.91	146	248	71.68	16.68	101.32	.006	.112	.017	.024	<1
	0.00	2.91	145	249	80.32	11.82	101.26	.006	.118	.017	.034	<1
	.02	2.93	146	249	67.20	19.65	98.81	.006	.119	.017	.032	<1
F-6	1.00	3.56	178	188	61.68	8.17	7.80	.005	.003	.001	.016	2.5
	.80	3.15	158	168	53.12	8.66	9.88	.007	.012	.002	.064	2.5
	3.60	3.24	162	166	49.60	10.31	10.39	.012	.015	.002	.041	20
F-7	3.50	3.80	190	218	62.40	15.17	32.76	.078	.026	.051	.095	20
	1.60	3.98	199	226	69.04	12.99	35.25	.014	.070	.037	.036	3.0
	2.60	3.41	170	201	54.24	15.81	32.52	.032	.031	.061	.095	5.0
F-8	3.30	3.97	198	226	69.44	12.79	33.33	.025	.032	.043	.081	8.5
	.70	3.78	189	246	71.12	16.59	50.30	.007	.044	.029	.052	1
	1.80	3.57	178	213	59.92	15.37	35.07	.015	.038	.059	.090	5.0
S-1	.70	3.90	195	236	87.52	4.23	46.97	.005	.019	.026	.041	1
	.70	3.83	192	230	69.12	13.91	51.55	.012	.052	.018	.041	4.0
	.85	3.94	197	232	76.88	9.78	49.09	.011	.056	.017	.042	7.5