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SUSITNA HYDROELECTRIC PROJECT

WATER QUALITY ANNUAL REPORT 1980

APRIL 1981

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PREPARED BY:
R&M
R&M CONSULTANTS, INC.

PREPARED FOR:
ACRES

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SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

WATER QUALITY ANNUAL REPORT - 1980

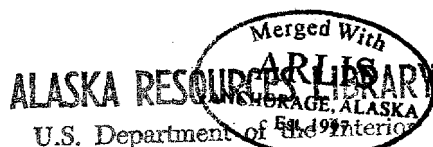
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ATTACHMENT A

WATER QUALITY DATA COLLECTION, PROCEDURES
MANUAL, JULY 1980

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PREFACE

This final version of the original 1980 Water Quality Annual Report is essentially unchanged. The only modifications are incorporation of two items: (1) an addendum to Section 3, which was released with the original report as an addendum; and (2) a number of corrected data tables, which had been modified by a memo dated May 5, 1981.

March 1982

SUSITNA HYDROELECTRIC PROJECT ANNUAL REPORT WATER QUALITY ASSESSMENT

1 - INTRODUCTION

This report presents a summary of work accomplished pertaining to water quality by R&M Consultants, Inc. during the first year of the Susitna Hydroelectric Project and recommendations for the second year.

Work accomplished during the first year is broadly divided into: (1) Procedures Manual, (2) Water Quality Data Collection, (3) Literature Review.

2 - SUMMARY OF 1980 WATER QUALITY PROGRAM

2.1 - Water Quality Data Collection Procedures Manual

The water quality data collection procedures manual was completed and submitted to Acres American, Inc. in July 1980 and is presented in Appendix A. The only significant deviation to the water quality monitoring program as described in the manual is relative to organic carbon. Total organic carbon and total inorganic carbon were not routinely analyzed. Consequently, there are few data points for these parameters.

2.2 - 1980 Water Quality Data Collection

Water quality data were collected during summer at the Vee Canyon site four times (Table 1) and once at Gold Creek (Table 6). Detailed suspended solids analyses were performed on two sets of samples collected using a depth integrated sampler at the Vee Canyon site during summer (Tables 2 and 3). Winter sampling was conducted during October 1980 and January 1981 at both sites. The water quality data are presented in Table 1 (Vee Canyon) and Table 6 (Gold Creek), and the detailed suspended sediment data are presented in Tables 4 and 5 (Vee Canyon) and Tables 7 and 8 (Gold Creek). It should be noted that suspended solids concentrations presented in the tables of water quality data are not comparable to the suspended solids concentrations presented in the tables of detailed suspended sediment analyses because of differing collection techniques. The detailed suspended sediment analyses are representative of the entire water column since the samples were collected using a depth integrated sampler.

2.3 - Watana Continuous Water Quality Monitor

A continuous water quality monitor, recording the date and time as well as temperature, pH, oxidation reduction potential, dissolved oxygen, conductivity, and temperature - corrected conductivity, was established near the Watana site in October 1980. A computer program to process the data tapes is currently under development by the supplier of the instrument, and it will provide summaries of the data on a daily and a monthly basis. The probe assembly is scheduled to be removed from the river just prior to breakup and re-installed as soon after breakup as practicable.

2.4 - Summary of Existing Data

A review of existing water quality data resulted in a compilation of historical U.S. Geological Survey (USGS) data from four sites on the Susitna River. Tables 9 through 12 present the maximum, minimum, and mean values and number of observations for parameters measured by the USGS at the following stations: Near Denali, Vee Canyon, Gold Creek, and Sunshine. Five Alaska Department of Fish and Game (ADF&G) reports, published between 1974 and 1978, were reviewed for water quality data. These reports were primarily concerned with fish distribution and secondarily with water quality. The water quality data contained in these reports has not been summarized because most of it deals with sloughs and tributaries of the Susitna.

The R&M Field Data Index, first published in July, 1980, and revised in January, 1981, identifies data that have been collected by the USGS and others on the Susitna River and its tributaries. Names of sites and periods of record are given for locations where water quality, water temperature, and suspended sediment data are available. Appendix C of the index highlights the ADF&G reports prepared from 1974-1977.

3 - RECOMMENDATIONS FOR 1981 WATER QUALITY DATA COLLECTION

The same sample locations utilized during the 1980 water quality monitoring program will be used during 1981. Samples will be collected at Vee Canyon and Gold Creek during the following periods:

1. Spring breakup
2. Summer low-flow
3. Summer after a heavy rainstorm
4. Immediately prior to freeze-up
5. Winter low-flow

An objective of the 1981 program will be to sample the spring snowmelt and summer rainstorm flood events, during the rising and falling limbs of the hydrograph. These should produce three to five sampling points during each event which will provide an opportunity to determine the variance in short-term water quality.

All field parameters will continue to be measured. Although settleable solids have been 0.1 ml/l or less, another summer's worth of data should be collected to insure that this parameter is determined during a variety of hydrologic events.

All of the nitrogen and phosphate forms, chloride, color, hardness, sulfate, TDS, TSS, and turbidity will be measured. It is also recommended that COD values be determined because of two high values measured during last year's program.

Since all four measurements of uranium were below the detection limit, this parameter will be eliminated. Gross Alpha radioactivity will also be eliminated because the values at both sample stations were less than 15 pCi/l, the drinking water standard.

Total organic carbon and total inorganic carbon will be determined during all sample periods because these parameters were only measured once at each sample station last year. These parameters were added subsequent to initiation of the water quality program last year at the request of Acres American, Inc.

The sampling frequency for organic chemicals will be reduced for this year's program. During 1980, the concentrations of pesticides were essentially at or below their respective detection limits for the procedures used by Chemical & Geological Laboratories of Alaska, Inc. The detection limits for these parameters match the drinking water standards, but are really not low enough to meet the criteria for freshwater aquatic life. Therefore, it is recommended that a PCB and pesticide scan be run on samples collected at the two sites during the summer high-water and summer low-water periods. This scan will quantify PCB's, chlorinated hydrocarbons, and phenoxy acids, the organic chemicals of interest in the study area that appear on EPA's list of priority pollutants.

The ICAP Scan will be continued because many of the elements measured by this method exceed their detection limits. These include aluminum, barium, calcium, iron, potassium, magnesium, manganese, sodium, silicon, strontium, titanium, and tungsten. It is also important to note that Chemical & Geological Laboratories of Alaska, Inc. analyzes all 33 elements in the scan for \$50.00, less than the cost to analyze six of the above using different procedures. Since the detection limits for many of the remaining parameters are not low enough to determine their impact on freshwater aquatic life, it is recommended that the following

parameters be analyzed at both sample stations during the summer low-water period and during the winter low-water period using techniques that provide appropriate detection limits: Arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, strontium, vanadium, and zinc. Additionally, beryllium and cyanide should be determined at the same time as arsenic, etc., using techniques that provide detection limits that will enable a determination of their potential effects on freshwater aquatic life.

The concentrations of suspended sediment during the winter were extremely low at both sites (and have been historically, according to USGS figures). Hence, depth-integrated sediment sampling will be discontinued after freeze-up in 1981. However, the total suspended solids data reported with the water quality parameters will continue to be collected.

TABLE I

WATER QUALITY DATA - SUSITNA RIVER
NEAR CANTWELL (VEE CANYON SITE)

DATE SAMPLED

<u>Field Parameters</u> (1)	Date	Date	Date	Date	Date	Date
	6/19/80	8/8/80	9/5/80	9/17/80	10/17/80	1/13/81
Dissolved Oxygen	12.4	8.7	----	9.7	13.8	10.7
Percent Saturation	98	82	----	84	104	84
pH, pH Units	7.8	7.9	7.8	7.6	7.6	7.2
Conductivity, umhos/cm @ 25°C	—	144	171	124	142	242
Temperature, °C	5.7	9.3	5.3	5.9	-0.1	0.1
Free Carbon Dioxide (2)	2.0	1.7	3.6	4.5	5.5	22.0
Alkalinity, as CaCO ₃	47	54	81	63	88	187
Settleable Solids, ml/l	0.1	< 0.1	< 0.1	< 0.1	≪ 0.1	≪ 0.1
<u>Laboratory Parameters</u> (1)(3)						
Ammonia Nitrogen	0.26	----	0.10	< 0.05	0.26	< 0.05
Organic Nitrogen	< 0.1	----	0.22	0.62	0.28	0.85
Kjeldahl Nitrogen	0.26	----	0.32	0.62	0.54	0.85
Nitrate Nitrogen	0.19	0.15	0.15	0.09	< 0.10	< 0.1
Nitrite Nitrogen	< 0.01	----	< 0.01	< 0.01	< 0.01	< 0.01
Total Nitrogen	0.45	----	0.47	0.71	0.54	0.85
Ortho-Phosphate	< 0.01	0.03	0.05	< 0.05	< 0.01	< 0.01
Total Phosphate	0.05	0.03	0.09	0.10	< 0.01	0.07
Alkalinity	-	-	-	-	66	106
Chemical Oxygen Demand	28	12.6	124	156	6	12
Chloride	3	9	11	8	18	18
Conductivity umhos/cm @ 25°C	-150	-	-	-	190	196
True Color, Color Units	-	40	10	45	10	10
Hardness, as CaCO ₃ (4)	51	76	69	55	90	121

Laboratory Parameters (1)(3) (continued)

	6/19/80	8/8/80	9/5/80	9/17/80	10/17/80	1/15/81
Sulfate	4	9	9	7	13	16
Total Dissolved Solids	70	90	114	38	115	149
Total Suspended Solids	242	310	25	132	8.3	0.
Turbidity, NTU	94	97	10	33	1.8	0.35
Uranium	----	< 0.05	----	----	----	< 0.05
Radioactivity, Gross Alpha, pCi/l	----	11.6±0.6	----	----	----	10.3±0.5
Total Organic Carbon	----	----	----	----	----	23
Total Inorganic Carbon	----	----	----	----	21	106
Organic Chemicals						
Endrin	----	< 0.0001	----	----	----	< 0.0001
Lindane	----	< 0.001	----	----	----	< 0.001
Methoxychlor	----	< 0.05	----	----	----	< 0.05
Toxaphene	----	< 0.001	----	----	----	< 0.001
2, 4-D	----	< 0.05	----	----	----	< 0.1
2, 4, 5-TP Silvex	----	< 0.005	----	----	----	< 0.005
ICAP Scan						
Ag, Silver	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Al, Aluminum	1.6	< 0.1	0.28	2.2	0.18	< 0.05
As, Arsenic	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Au, Gold	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B, Boron	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ba, Barium	< 0.1	0.11	< 0.05	0.07	< 0.05	< 0.05
Bi, Bismuth	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ca, Calcium	13	16	22	18	28	36
Cd, Cadmium	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Co, Cobalt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cr, Chromium	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, Copper	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe, Iron	2.1	4.0	0.46	2.7	0.37	< 0.05
Hg, Mercury	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
K, Potassium	< 1.0	2.3	2.1	5.0	< 1.0	2
Mg, Magnesium	1.4	3.4	3.1	1.2	4.5	7.6
Mn, Manganese	< 0.05	0.10	< 0.05	0.07	< 0.05	< 0.05
Mo, Molybdenum	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Laboratory Parameters (1)(3) (continued)

	6/19/80	8/8/80	9/5/80	9/17/80	10/17/80	1/13/81
Na, Sodium	2.6	2.4	5.1	3.5	7.2	6.6
Ni, Nickel	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb, Lead	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pt, Platinum	< 0.05	< 0.05	< 0.05	< 0.10	< 0.05	< 0.05
Sb, Antimony	< 0.1	< 0.1	< 0.05	< 0.1	< 0.1	< 0.1
Se, Selenium	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Si, Silicon	4.8	5.3	3.6	6.9	4.1	5.0
Sn, Tin	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Sr, Strontium	< 0.05	0.06	0.07	0.07	0.10	0.13
Ti, Titanium	0.13	0.24	< 0.05	0.17	< 0.05	< 0.05
W, Tungsten	< 1.0	< 1.0	< 1.0	----	< 0.1	0.4
V, Vanadium	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Zn, Zinc	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Zr, Zirconium	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

- (1) Table values are mg/l unless noted otherwise.
- (2) All values for free CO₂ determined from nomograph on p. 297 of Standard Method, 14th edition.
- (3) Samples for all parameters except chemical oxygen demand, dissolved and suspended solids, and turbidity were filtered.
- (4) Hardness calculated by R&M personnel.

TABLE 2

SUSPENDED SEDIMENT ANALYSIS - September 5, 1980
 SUSITNA RIVER NEAR CANTWELL (VEE CANYON SITE)

SIZE, Microns	-----COUNT/sq mm - %-----		
	SAMPLE 4	SAMPLE 9	SAMPLE 14
<1-5	3207-99.57	2335-98.52	1779-97.21
5-10	7 - 0.22	23-0.97	26 - 1.42
10-20	4 - 0.12	6-0.25	12 - 0.66
20-50	1 - 0.03	1-0.04	7 - 0.38
> 50	2 - 0.06	5-0.22	6 - 0.33

SAMPLE NO.	DATE/TIME	STATION*	INT. TIME	Milligrams/Liter SUSPENDED SOLIDS
1	9-5-80 5:15 p.m.	0 + 15	49 sec	33
2	9-5-80 5:26 p.m.	0 + 35	42 sec	36
3	9-5-80 5:30 p.m.	0 + 55	42 sec	35
4	9-5-80 5:35 p.m.	0 + 75	42 sec	54
5	9-5-80 5:45 p.m.	0 + 95	40 sec	63
6	9-5-80 5:50 p.m.	1 + 15	44 sec	36
7	9-5-80 5:55 p.m.	1 + 35	44 sec	68
8	9-5-80 6:00 p.m.	1 + 55	44 sec	62
9	9-5-80 6:05 p.m.	1 + 75	52 sec	74
10	9-5-80 6:08 p.m.	1 + 95	52 sec	68
11	9-5-80 6:10 p.m.	2 + 15	48 sec	73
12	9-5-80 6:13 p.m.	2 + 35	42 sec	72
13	9-5-80 6:15 p.m.	2 + 55	48 sec	78
14	9-5-80 6:20 p.m.	2 + 75	48 sec	84
15	9-5-80 6:25 p.m.	2 + 95	50 sec	67
16	9-5-80 6:30 p.m.	3 + 15	48 sec	82
17	9-5-80 6:35 p.m.	3 + 35	51 sec	53
18	9-5-80 6:45 p.m.	3 + 55	80 sec	56

* Right Bank (edge of water) is at Station 0+05.
 Left Bank (edge of water) is at Station 3+85.

TABLE 3

SUSPENDED SEDIMENT ANALYSIS - September 17, 1980
 SUSITNA RIVER NEAR CANTWELL (VEE CANYON SITE)

Sample No.	SAMPLE DESCRIPTION	Particle Size Distribution, Microns (%)				
		< 5	5-10	10-20	20-50	> 50
3	Sta 0+70, 9-17-80, 5:46 p.m.	98.53	0.96	0.30	0.15	0.06
8	Sta 1+70, 9-17-80, 6:11 p.m.	98.83	0.44	0.23	0.10	0.40
13	Sta 2+70, 9-17-80, 6:19 p.m.	99.19	0.30	0.10	0.07	0.34

SAMPLE NO.	DATE/TIME	STATION*	INT. TIME	Milligrams/Liter SUSPENDED SOLIDS
1	9-17-80 5:30 p.m.	0 + 30	30 sec	167
2	9-17-80 5:39 p.m.	0 + 50	50 sec	170
3	9-17-80 5:46 p.m.	0 + 70	55 sec	174
4	9-17-80 5:48 p.m.	0 + 90	55 sec	185
5	9-17-80 5:51 p.m.	1 + 10	55 sec	196
6	9-17-80 6:06 p.m.	1 + 30	36 sec	425
7	9-17-80 6:09 p.m.	1 + 50	36 sec	325
8	9-17-80 6:11 p.m.	1 + 70	30 sec	331
9	9-17-80 6:13 p.m.	1 + 90	30 sec	218
10	9-17-80 6:14 p.m.	2 + 10	30 sec	201
11	9-17-80 6:16 p.m.	2 + 30	30 sec	513
12	9-17-80 6:18 p.m.	2 + 50	30 sec	169
13	9-17-80 6:19 p.m.	2 + 70	30 sec	436
14	9-17-80 6:21 p.m.	2 + 90	35 sec	418
15	9-17-80 6:23 p.m.	3 + 10	35 sec	591
16	9-17-80 6:24 p.m.	3 + 30	35 sec	322
17	9-17-80 6:26 p.m.	3 + 50	40 sec	342
18	9-17-80 6:30 p.m.	3 + 70	45 sec	163
19	9-17-80 6:35 p.m.	3 + 85	60 sec	300

* Right edge of water is at Station 0+00.
 Left edge of water is at Station 4+00.

WATER QUALITY ANNUAL REPORT
TABLE 4

Suspended Sediment Analysis - October 18, 1980
Susitna River Near Cantwell (Vee Canyon Site)

----- Particle Size Distribution-% -----

<u>Size Microns</u>	<u>Sample 3</u>	<u>Sample 6</u>	<u>Sample 9</u>
< 5	77.0	82.6	79.5
5-10	12.7	8.1	15.5
10-20	5.4	4.5	3.2
20-50	4.4	4.2	1.2
> 50	<u>0.5</u>	<u>0.6</u>	<u>0.6</u>
	100.0%	100.0%	100.0%

<u>Sample No.</u>	<u>Date/Time</u>	<u>Station*</u>	<u>Int. Time</u>	<u>Milligrams/Liter Suspended Solids</u>
1	10-18-80/12:30 p.m.	0+07	120 sec.	6.0
2	10-18-80/12:35 p.m.	0+36	90 sec.	6.6
3	10-18-80/12:40 p.m.	0+70	75 sec.	4.8
4	10-18-80/12:43 p.m.	1+05	60 sec.	4.2
5	10-18-80/12:49 p.m.	1+38	60 sec.	4.6
6	10-18-80/12:51 p.m.	1+74	60 sec.	6.3
7	10-18-80/12:55 p.m.	2+07	72 sec.	4.4
8	10-18-80/12:59 p.m.	2+38	72 sec.	5.0
9	10-18-80/1:02 p.m.	2+73	72 sec.	7.7
10	10-18-80/1:06 p.m.	3+08	80 sec.	7.4
11	10-18-80/1:10 p.m.	3+39	80 sec.	5.8

* Right edge of water is at Station 0+00.
Left edge of water is at Station 3+78.

WATER QUALITY ANNUAL REPORT
TABLE 5

Suspended Sediment Analysis - January 13, 1981
Susitna River Near Cantwell (Vee Canyon Site)

Particle Size Distribution Sample No. 11		
<u>Size, Microns</u>	<u>Count/Sq. mm</u>	<u>%</u>
< 10	1600	98.7
10-20	15	0.9
20-50	5	0.3
50-100	2	0.1
>100	0	0.
		100.0%

<u>Sample No.</u>	<u>Date/Time</u>	<u>Station</u>	<u>Int. Time</u>	<u>Milligrams/Liter Suspended Solids</u>
10	1-13-81/2:20 p.m.	Left bank	40 sec.	0.1
11	1-13-81/2:30 p.m.	Center	40 sec.	1.0
12	1-13-81/2:35 p.m.	Right bank	54 sec.	1.7

TABLE 6

WATER QUALITY DATA - SUSITNA RIVER
AT GOLD CREEK

<u>Field Parameters</u> (1)	DATE SAMPLED		
	<u>Date</u> 08/08/80	<u>Date</u> 10/14/80	<u>Date</u> 1/14/81
Dissolved Oxygen	8.6	14.0	13.3
Percent Saturation	81	100	101
pH, pH Units	7.8	7.8	7.1
Conductivity, umhos/cm @ 25°C	169	167	249
Temperature, °C	11.7	0.0	0.3
Free Carbon Dioxide (2)	2.1	3.2	23.0
Alkalinity, as CaCO ₃	55	74	144
Settleable Solids, ml/l	< 0.1	≤ 0.1	≤ 0.1
<u>Laboratory Parameters</u> (1)(3)			
Ammonia Nitrogen	----	0.32	< 0.05
Organic Nitrogen	----	0.34	0.81
Kjeldahl Nitrogen	----	0.66	0.81
Nitrate Nitrogen	0.18	< 0.10	0.18
Nitrite Nitrogen	----	< 0.01	< 0.01
Total Nitrogen	----	0.66	0.99
Ortho-Phosphate	< 0.02	< 0.01	< 0.01
Total Phosphate	< 0.02	< 0.01	< 0.01
Alkalinity, as CaCO ₃	-	57	90
Chemical Oxygen Demand	13.8	8	16
Chloride	14	16	29
Conductivity, umhos/cm @ 25°C	-	165	----
True Color, Color Units	45	10	10
Hardness, as CaCO ₃	62	74	121

<u>Field Parameters</u> (1)(3) (continued)	Gold Creek (cont.)		
	<u>08/08/80</u>	<u>10/14/80</u>	<u>1/14/81</u>
Sulfate	12	10	16
Total Dissolved Solids	74	100	188
Total Suspended Solids	175	7.7	< 1
Turbidity, NTU	58	0.9	0.30
Uranium	<0.05	----	<0.05
Radioactivity, Gross Alpha, pCi/l	2.6±0.4	----	
Total Organic Carbon	----	----	39
Total Inorganic Carbon	----	----	90
Organic Chemicals			
Endrin	<0.0001	----	<0.000
Lindane	<0.001	----	<0.004
Methoxychlor	<0.05	----	<0.1
Toxaphene	<0.001	----	<0.005
2, 4-D	<0.05	----	<0.1
2, 4, 5-TP Silvex	<0.005	----	<0.01
ICAP Scan			
Ag, Silver	<0.05	<0.05	<0.05
Al, Aluminum	0.7	0.18	<0.05
As, Arsenic	<0.1	<0.1	<0.1
Au, Gold	<0.05	<0.05	<0.05
B, Boron	<0.05	<0.05	<0.05
Ba, Barium	0.08	<0.05	<0.05
Bi, Bismuth	<0.05	<0.05	0.07
Ca, Calcium	15	23	32
Cd, Cadmium	<0.01	<0.01	<0.01
Co, Cobalt	<0.05	<0.05	<0.05
Cr, Chromium	<0.05	<0.05	<0.05
Cu, Copper	<0.05	<0.05	<0.05
Fe, Iron	2.3	0.35	<0.05
Hg, Mercury	<0.1	<0.1	<0.1
K, Potassium	1.8	<1	2
Mg, Magnesium	2.7	3.7	10
Mn, Manganese	0.05	<0.05	<0.05

<u>Field Parameters</u> (1)(3) (continued)	Gold Creek (cont.)		<u>1/14/81</u>
	<u>08/08/80</u>	<u>10/14/80</u>	
Mo, Molybdenum	<0.05	<0.05	<0.05
Na, Sodium	3.3	8.5	13
Ni, Nickel	<0.05	<0.05	<0.05
Pb, Lead	<0.05	<0.05	<0.05
Pt, Platinum	<0.05	<0.05	<0.05
Sb, Antimony	<0.10	<0.1	<0.1
Se, Selenium	<0.1	<0.1	<0.1
Si, Silicon	4.6	4.2	5.0
Sn, Tin	<0.1	<0.1	<0.1
Sr, Strontium	<0.05	0.11	0.1
Ti, Titanium	0.14	<0.05	<0.05
W, Tungsten	<1.0	<0.1	<0.1
V, Vanadium	<0.05	<0.05	<0.05
Zn, Zinc	<0.05	<0.05	<0.05
Zr, Zirconium	<0.05	<0.05	<0.05

- (1) Table values are mg/l unless noted otherwise.
- (2) All values for free CO₂ determined from nomograph on p. 297 of Standard Method, 14th edition.
- (3) Samples for all parameters except chemical oxygen demand, dissolved and suspended solids, and turbidity were filtered.
- (4) Hardness calculated by R&M personnel.

WATER QUALITY ANNUAL REPORT
TABLE 7

Suspended Sediment Analysis - October 16, 1980
Susitna River at Gold Creek

----- Particle Size Distribution-% -----

<u>Size Microns</u>	<u>Sample 2</u>	<u>Sample 5</u>	<u>Sample 8</u>
< 5	77.4	78.1	74.1
5-10	13.2	11.6	13.4
10-20	5.6	7.4	6.4
20-50	3.3	2.3	5.7
> 50	<u>0.5</u>	<u>0.6</u>	<u>0.4</u>
	100.0%	100.0%	100.0%

<u>Sample No.</u>	<u>Date/Time</u>	<u>Station*</u>	<u>Int. Time</u>	<u>Milligrams/Liter Suspended Solids</u>
1	10-16-80/4:22 p.m.	12+45	120 sec.	8.4
2	10-16-80/4:28 p.m.	12+76	90 sec.	9.0
3	10-16-80/4:34 p.m.	13+11	54 sec.	9.2
4	10-16-80/4:40 p.m.	13+46	40 sec.	7.2
5	10-16-80/4:43 p.m.	13+81	48 sec.	11.0
6	10-16-80/4:48 p.m.	14+16	49 sec.	8.0
7	10-16-80/4:54 p.m.	14+51	60 sec.	7.8
8	10-16-80/5:01 p.m.	14+86	68 sec.	8.0
9	10-16-80/5:05 p.m.	15+21	100 sec.	1.2

* Left edge of water is at Station 12+01.
Right edge of water is at Station 15+64.

WATER QUALITY ANNUAL REPORT TABLE 8

Suspended Sediment Analysis - January 14, 1981
Susitna River at Gold Creek

<u>Size, Microns</u>	<u>Particle Size Distribution</u> <u>Sample No. 4</u>	
	<u>Count/Sq. mm</u>	<u>%</u>
< 10	96	80.0
10-20	9	7.5
20-50	11	9.2
50-100	3	2.5
>100	1	0.8*
		100.0%

<u>Sample No.</u>	<u>Date/Time</u>	<u>Station*</u>	<u>Int. Time</u>	<u>Milligrams/Liter</u> <u>Suspended Solids</u>
4	1-14-81/3:00 p.m.	Left bank	55 sec.	0.4
5	1-14-81/3:15 p.m.	Center	70 sec.	10.6
6	1-14-81/3:35 p.m.	Right bank	120 sec.	10.4

* There were a few specimens of fibrous material approximately 1000 microns in length.

WATER QUALITY DATA SUMMARY
SUSITNA RIVER

Agency: U.S. Geological Survey
Station: Nr. Denali Elevation: 2440 Ft.
1957-1978

TABLE 9

<u>Field Parameters</u> (1)	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter</u>			
Dissolved Oxygen				
Percent Saturation				
pH, pH Units	7.8/7.6	7.1/7.1	7.5/7.4	15/4
Conductivity, umhos/cm @ 25°C.	205/467	121/194	157/349	18/4
Temperature, °C	10.5/-	0.5/-	5.5/-	50/-
Free Carbon Dioxide	5.8/25	1.5/4.5	3.2/10.8	11/4
Alkalinity, as CaCO ₃	68/161	42/57	54/116	11/4
Settleable Solids, ml/l				
<u>Laboratory Parameters</u> (1)				
Ammonia Nitrogen				
Organic Nitrogen				
Kjeldahl Nitrogen				
Nitrate Nitrogen	.09/-	.00/-	.05/-	15/-
Nitrite Nitrogen				
Total Nitrogen				
Ortho-Phosphate				
Total Phosphate				
Chemical Oxygen Demand				
Chloride	11.0/30.0	2.0/3.8	4.8/19.0	11/4
True Color, Platinum-Cobalt Unit				
Hardness, as CaCO ₃	87/181	50/84	64/139	11/4

Laboratory Parameters ⁽¹⁾ (continued)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter</u>			
Sulfate	23/39	9/31	15/36	11/4
Total Dissolved Solids	120/270	72/109	91/204	11/4
Total Suspended Solids	5690/-	85/-	1350/-	32/-
Turbidity, NTU				
Uranium				
Radioactivity, Gross Alpha, pCi/l				
Total Organic Carbon				
Total Inorganic Carbon				
Organic Chemicals				
Endrin				
Lindane				
Methoxychlor				
Toxaphene				
2, 4-D				
2, 4, 5-TP Silvex				
ICAP Scan				
Ag, Silver				
Al, Aluminum				
As, Arsenic				
Au, Gold				
B, Boron				
Ba, Barium				
Bi, Bismuth				
Ca, Calcium	29/51	17/23	21/40	11/4
Cd, Cadmium				
Co, Cobalt				
Cr, Chromium				
Cu, Copper				

Laboratory Parameters (1)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter</u>			
Fe, Iron	4.0/.06	0/0	1.0/.03	11/4
Hg, Mercury				
K, Potassium	3.0/6.6	1.3/3.6	2.5/5.8	11/4
Mg, Magnesium	3.8/16	1.7/6.2	3.1/9.3	11/4
Mn, Manganese	.06/.02	0/.01	.008/.01	10/3
Mo, Molybdenum				
Na, Sodium	10/23	2.1/3.8	4.3/15	11/4
Ni, Nickel				
Pb, Lead				
Pt, Platinum				
Sb, Antimony				
Se, Selenium				
Si, Silicon				
Sn, Tin				
Sr, Strontium				
Ti, Titanium				
W, Tungsten				
V, Vanadium				
Zn, Zinc				
Zr, Zirconium				

(1) Table values are mg/l unless noted otherwise.

WATER QUALITY DATA SUMMARY SUSITNA RIVER

Agency: U.S. Geological Survey

Station: Vee Canyon
(Nr. Cantwell)
1962-1972

Elevation: 1900 Ft.

TABLE 10

<u>Field Parameters</u> (1)	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer Values Only</u>			
Dissolved Oxygen				
Percent Saturation				
pH, pH Units	8.1	7.2	7.7	10
Conductivity, umhos/cm @ 25°C	250	91	150	25
Temperature, °C	13.0	1.0	7.7	38
Free Carbon Dioxide	6.8	.7	2.6	10
Alkalinity, as CaCO ₃	59	39	51	10
Settleable Solids, ml/l				
<u>Laboratory Parameters</u> (1)				
Ammonia Nitrogen				
Organic Nitrogen				
Kjeldahl Nitrogen				
Nitrate Nitrogen	0.88	0.0	.20	10
Nitrite Nitrogen				
Total Nitrogen				
Ortho-Phosphate				
Total Phosphate				
Chemical Oxygen Demand				
Chloride	9.2	2.1	5.5	10
True Color, Platinum-Cobalt Unit	40	5	14	9
Hardness, as CaCO ₃	76	42	62	10

Laboratory Parameters (1) (continued)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer Values Only</u>			
Sulfate	18	7.5	14	10
Total Dissolved Solids	110	66	90	10
Total Suspended Solids	2790	34	804	38
Turbidity, NTU				
Uranium				
Radioactivity, Gross Alpha, pCi/l				
Total Organic Carbon				
Total Inorganic Carbon				
Organic Chemicals				
Endrin				
Lindane				
Methoxychlor				
Toxaphene				
2, 4-D				
2, 4, 5-TP Silvex				
ICAP Scan				
Ag, Silver				
Al, Aluminum				
As, Arsenic				
Au, Gold				
B, Boron				
Ba, Barium				
Bi, Bismuth				
Ca, Calcium	27	14	21	10
Cd, Cadmium				
Co, Cobalt				
Cr, Chromium				
Cu, Copper				

Laboratory Parameters (1)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer Values Only</u>			
Fe, Iron	12.0	.05	2.9	10
Hg, Mercury				
K, Potassium	7.3	1.8	3.4	10
Mg, Magnesium	4.4	1.1	2.7	10
Mn, Manganese				
Mo, Molybdenum				
Na, Sodium				
Ni, Nickel	6.3	2.1	3.9	10
Pb, Lead				
Pt, Platinum				
Sb, Antimony				
Se, Selenium				
Si, Silicon				
Sn, Tin				
Sr, Strontium				
Ti, Titanium				
W, Tungsten				
V, Vanadium				
Zn, Zinc				
Zr, Zirconium				

(1) Table values are mg/l unless noted otherwise.

WATER QUALITY DATA SUMMARY

SUSITNA RIVER

Agency: U.S. Geological Survey
 Station: Gold Creek Elevation: 676.5 Ft.
 1949-1978

TABLE 11

<u>Field Parameters</u> (1)	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter/Break-up</u>			
Dissolved Oxygen	12.6/-/-	11.1/-/-	12.0/-/-	3/-/-
Percent Saturation	106/-/-	96/-/-	102/-/-	3/-/-
pH, pH Units	8.0/8.1/8.0	6.6/7.0/6.5	7.4/7.4/7.1	31/20/8
Conductivity, umhos/cm @ 25°C	227/300/121	90/164/82	162/248/65	60/25/7
Temperature, °C	13.5/0.5/8.0	1.0/0.0/1.0	8.6/0.5/3.4	22/5/7
Free Carbon Dioxide	20/16/24	1.1/1.2/5.6	5.6/6.3/8.0	60/22/5
Alkalinity, as CaCO ₃	87/88/80	30/49/29	52/70/48	64/23/3
Settleable Solids, ml/l				
<u>Laboratory Parameters</u> (1)				
Ammonia Nitrogen				
Organic Nitrogen				
Kjeldahl Nitrogen				
Nitrate Nitrogen	.36/.32/.29	.02/.05/.05	.13/.14/.17	58/22/3
Nitrite Nitrogen				
Total Nitrogen				
Ortho-Phosphate				
Total Phosphate				
Chemical Oxygen Demand				
Chloride	15/35/4.5	1.4/9/1.8	5.4/22/3.2	60/25/4
True Color, Platinum-Cobalt Unit	20/5/50	0/0/10	8/3.5/28	52/20/6
Hardness, as CaCO ₃	107/114/113	35/60/32	61/97/60	58/24/3

Laboratory Parameters ⁽¹⁾ (continued)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter/Break-up</u>			
Sulfate	28/38/27	4/13/5.5	17/21/16	63/22/2
Total Dissolved Solids	134/167/70	51/102/48	93/149/55	59/26/4
Total Suspended Solids	2630/76/1330	23/1/120	832/18/652	59/8/11
Turbidity, NTU				
Uranium				
Radioactivity, Gross Alpha, pCi/l	50/-/-	2.7/-/-	20/-/-	3/-/-
Total Organic Carbon				
Total Inorganic Carbon				
Organic Chemicals				
Endrin				
Lindane				
Methoxychlor				
Toxaphene				
2, 4-D				
2, 4, 5-TP Silvex				
ICAP Scan				
Ag, Silver				
Al, Aluminum				
As, Arsenic				
Au, Gold				
B, Boron				
Ba, Barium				
Bi, Bismuth				
Ca, Calcium	37/11/-	37/24/-	19/30/-	58/26/-
Cd, Cadmium				
Co, Cobalt				
Cr, Chromium				
Cu, Copper				

Laboratory Parameters (1)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter/Break-up</u>			
Fe, Iron	.46/.03	0/0/-	.16/.01	27/21/0
Hg, Mercury				
K, Potassium	4.4/5.0/1.7	1.0/1.2/1.3	2.4/2.3/1.6	49/18/3
Mg, Magnesium	6.3/8.3/7.4	1.4/3.6/.3	3.3/5.7/2.5	55/27/4
Mn, Manganese	.18/.0	0/0/-	.010/0/-	23/2/0
Mo, Molybdenum				
Na, Sodium	6.5/17.0/2.9	2.4/5.2/2.8	4.1/11.0/2.9	48/19/2
Ni, Nickel				
Pb, Lead				
Pt, Platinum				
Sb, Antimony				
Se, Selenium				
Si, Silicon				
Sn, Tin				
Sr, Strontium				
Ti, Titanium				
W, Tungsten				
V, Vanadium				
Zn, Zinc				
Zr, Zirconium				

(1) Table values are mg/l unless noted otherwise.

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WATER QUALITY DATA SUMMARY SUSITNA RIVER

Agency: U.S. Geological Survey
Station: Sunshine Elevation: 270 ft.
1971-1977

TABLE 12

<u>Field Parameters</u> (1)	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter</u>			
Dissolved Oxygen	12.8	10.6	12.0	3
Percent Saturation	102	97	99	3
pH, pH Units	7.6	7.1	7.4	3
Conductivity, umhos/cm @ 25°C	170	100	132/242	6/1
Temperature, °C	12.0	4.0	8.0	6
Free Carbon Dioxide	3.9	2.1	3.2	3
Alkalinity, as CaCO ₃	43	25	37/71	3/1
Settleable Solids, ml/l				
<u>Laboratory Parameters</u> (1)				
Ammonia Nitrogen			-.05	
Organic Nitrogen			-.18	
Kjeldahl Nitrogen				
Nitrate Nitrogen				
Nitrite Nitrogen				
Total Nitrogen			-.42	
Ortho-Phosphate	.12	.00	.07	4
Total Phosphate				
Chemical Oxygen Demand				
Chloride	7.3	2.7	5.3/21	3/1
True Color, Platinum-Cobalt Unit				
Hardness, as CaCO ₃	72	37	54/91	3/1

Laboratory Parameters ⁽¹⁾ (continued)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter</u>			
Sulfate	12	5.7	9.6/17	3/1
Total Dissolved Solids	51	102	77/137	3/1
Total Suspended Solids	3510	288	1419	6
Turbidity, NTU				
Uranium				
Radioactivity, Gross Alpha, pCi/l				
Total Organic Carbon				
Total Inorganic Carbon				
Organic Chemicals				
Endrin				
Lindane				
Methoxychlor				
Toxaphene				
2, 4-D				
2, 4, 5-TP Silvex				
ICAP Scan				
Ag, Silver				
Al, Aluminum				
As, Arsenic				
Au, Gold				
B, Boron				
Ba, Barium				
Bi, Bismuth				
Ca, Calcium	23	12	17/29	3/1
Cd, Cadmium				
Co, Cobalt				
Cr, Chromium				
Cu, Copper				

Laboratory Parameters (1)

	MAXIMUM	MINIMUM	MEAN	NUMBER OBSERVATIONS
	<u>Summer/Winter</u>			
Fe, Iron	.18	.06	.12/.01	2/1
Hg, Mercury				
K, Potassium	2.8	1.1	1.7/2.1	3/1
Mg, Magnesium	3.5	1.6	2.7/4.5	3/1
Mn, Manganese	.02	0	.01/0	2/1
Mo, Molybdenum				
Na, Sodium	4.4	1.9	3.0/11	3/1
Ni, Nickel				
Pb, Lead				
Pt, Platinum				
Sb, Antimony				
Se, Selenium				
Si, Silicon				
Sn, Tin				
Sr, Strontium				
Ti, Titanium				
W, Tungsten				
V, Vanadium				
Zn, Zinc				
Zr, Zirconium				

(1) Table values are mg/l unless noted otherwise.

ATTACHMENT A

SUSITNA HYDROELECTRIC
PROJECT
PROCEDURES MANUAL
WATER QUALITY DATA COLLECTION

JULY, 1980

By
R&M Consultants, Inc.

For
Acres American, Incorporated

PROCEDURES FOR WATER QUALITY DATA COLLECTION

1) PURPOSE

The aim of the data collection program is to provide basic water quality information for fisheries studies, reservoir studies and for the establishment of baseline parameters on the Susitna River. From the data, regional and local variations in water quality will be defined, as well as seasonal variations as they relate to streamflow and climate. This information can then be used to determine the effects that dam construction, impoundment and regulated flow might have on water quality upstream and downstream of the proposed damsites.

2) SAMPLING: LOCATIONS AND FREQUENCY

Tables 1 and 2 outline the proposed water quality data collection program. The first table shows locations of data collection sites, parameters to be measured, frequency of observation and agencies collecting the data. Table 2 lists field and laboratory parameters to be collected by R&M and the U.S. Geological Survey.

A summary of additional comments on the data collection program follows Table 2.

Table 1:

PROPOSED WATER QUALITY DATA COLLECTION PROGRAM

STATION/LOCATION	PARAMETER	TIME BETWEEN OBSERVATIONS	TO BE COLLECTED BY		COMMENTS
			R&M	USGS	
Susitna River Near Cantwell	Water Quality	Summer: 1 month Winter: 2-3 months	X		See Table 2 for list of parameters
	Water Temperature	Continuous		X	
Susitna River at Walana Damsite	Water Quality	Continuous Monitor	X		To begin Fall, 1980
Susitna River at Gold Creek	Water Quality	Summer: 1 month Winter: 2-3 months	X	X	R&M to conduct event-oriented sampling.
-2- Chulitna River Near Talkeetna	Water Temperature	Continuous Monitor		X	
Talkeetna River Near Talkeetna	Water Quality	Summer: 1 month Winter: 2-3 months		X	
Susitna River Near Sunshine	Water Quality	Summer: 1 month Winter: 2-3 months		X	Data collection delayed until 1981
Yentna River Near the mouth	Water Temperature	Continuous Monitor		X	To begin late summer 1980
Susitna River Near Susitna	Water Quality	Summer: 1 month Winter: 2-3 months		X	

Table 2:

WATER QUALITY PARAMETERS TO BE MEASURED

PARAMETER	R&M	USGS
FIELD:		
Dissolved Oxygen	X	X
pH	X	X
Specific Conductance	X	X
Temperature	X	X
Carbon Dioxide	X	X
Alkalinity	X	X
Settleable Solids	X	
LABORATORY:		
Turbidity	X	
Total Dissolved Solids	X	X
Total Suspended Solids	X	
Total Phosphorous	X	X
Ortho-Phosphate	X	X
Kjeldahl Nitrogen	X	
Total Nitrogen	X	
Nitrate Nitrogen	X	
Ammonia Nitrogen	X	
Chemical Oxygen Demand	X	
Hardness	X	
Chloride	X	
Color	X	
Sulfate	X	
ICAP Scan	X	
Uranium	X	
Radioactivity, Gross Alpha	X	
Organic Chemicals	X	
Total Organic Carbon	X	
Total Inorganic Carbon	X	
Trace Metals		X

Summary: Additional Comments to Tables 1 and 2.

- ° R&M will collect all the data at two locations along the Susitna River at least five times during the first year. The five times will include:
 - a) Spring Breakup
 - b) Summer (maximum effect of the glaciers)
 - c) Immediately after a heavy rainstorm (as close to hydrograph peak as possible)
 - d) Just prior to freeze-up
 - e) Winter low flow (under ice cover)
- ° Both R&M and the USGS will be collecting data at the Gold Creek station so there should be a very good record at this site. This will allow more accurate extrapolation of data collected at other sites. R&M will conduct event-oriented sampling at Gold Creek. The site will be occupied during flood events and water quality sampled three to five times through the hydrograph.
- ° R&M will install a continuous water quality recorder for key parameters at the proposed Watana damsite. These parameters will include:
 - a) pH
 - b) Dissolved Oxygen
 - c) Temperature
 - d) Specific Conductance
- ° Laboratory testing for uranium, organic chemicals and radioactivity, gross alpha will be done three times at two sites on the Susitna River during the 1980 season.
- ° As part of the National Stream Quality Accounting Network (NASQAN) The U.S.G.S. is conducting an expanded data collection program at Sustina Station. A more detailed description of the program can be found in Geological Survey Circular 823-A.

3) FIELD PROCEDURES

This section describes sample collection and handling, procedures for measuring field parameters (dissolved oxygen, pH, temperature, carbon dioxide, conductivity, alkalinity, and settleable solids), analytical methods, detection limits, and procedures for preservation and shipment of samples for laboratory analyses.

A. Sample Collection and Handling

Three grab samples are collected at each water quality station - one at the left over-bank, one at the right over-bank, and the third at mid-channel. Grab samples are collected with a 2.2-liter Van Dorn sampler at least one foot below the surface. Dissolved oxygen, settleable solids and temperature are determined on each grab sample and the values averaged to provide one "composite" value. Conductivity, pH and alkalinity, are determined on a composite sample made from equal parts of each grab sample. Samples for laboratory analyses are collected from the composite sample (see below for preservation and shipment).

B. Field Parameter Procedures

Standardize YSI Model 51B Dissolved Oxygen Meter as follows:

1. Shake 500-ml bottle containing about 300 ml distilled water to saturate the water with oxygen, wait 15 minutes to allow oxygen bubbles to rise to the surface and disappear,
2. measure temperature of water and record,
3. record barometric pressure,
4. select standard dissolved oxygen value from chart of oxygen saturation versus temperature and barometric pressure to calibrate meter,
5. set "zero" and "full scale" using appropriate knobs, and
6. calibrate meter to value determined in step 4.

Temperature and dissolved oxygen are determined on each grab sample. Immediately after securing each grab sample, attach

tubing to Van Dorn sampler and fill 300-ml beaker from the bottom, allowing at least three times the volume of the beaker to overflow into a 3-liter container. Insert oxygen probe into 300-ml beaker and determine dissolved oxygen in mg/l. Samples should be stirred continuously by raising and lowering the probe at a rate of about one foot per second during measurement. While one field team member measures dissolved oxygen, the other empties the remaining sample from the Van Dorn sampler into the 3-liter container and measures temperature.

Settleable solids is determined by filling an Imhoff cone to the 1000-ml level with each grab sample. Allow to remain undisturbed for 45 minutes, then run a rod around the inside of the cone (once), and wait 15 minutes. Read the settleable solids from the graduations on each Imhoff cone and report in ml/l. These values can be averaged to provide one "composite" value.

Conductivity, pH and alkalinity, are determined on a composite sample.

Conductivity (or specific conductance) is measured using a YSI Model 33 S-C-T meter. The probe is placed in the sample to be tested, the instrument "red lined", and the conductivity read off the appropriate scale. Make temperature correction and report results in umhos/cm at 25°C.

pH is determined with a VWR Scientific Model 55 pH meter. The meter is calibrated by placing the probe in 7.00 pH buffer, adjusting the temperature knob to the temperature of the buffer, and adjusting the pH to 7.00 with the calibrate knob. The probe is rinsed with distilled water and placed in pH 4.00 buffer. Adjust the meter to 4.00 by using the span control (temperature) knob. pH of the sample can be measured after rinsing the probe with distilled water.

Alkalinity is measured using a potentiometric titration to an end point pH determined by the alkalinity concentration as follows:

<u>Alkalinity, mg/l</u>	<u>1st End Point (C)</u>	<u>2nd End Point (D)</u>
30	5.1	4.8
150	4.8	4.5
500	4.5	4.2

Calibrate the pH meter. Measure 100-ml sample and pour into beaker. Titrate with 0.020 normal sulfuric acid to appropriate end points. Calculate alkalinity as follows:

$$A = \frac{(2C - D) \times 0.020 \times 50,000}{100}$$

where, C = ml titrant to 1st end point,

D = ml titrant to 2nd end point.

Report alkalinity in mg/l as CaCO_3 .

Note: If initial pH exceeds 8.3, record the ml titrant used to reduce the pH to 8.3 and proceed as above. The table below is taken from page 281 of Standard Methods, 14th edition, and shows alkalinity relationships for determining the concentrations of bicarbonate, carbonate, and hydroxide alkalinity.

TABLE 403: I. ALKALINITY RELATIONSHIPS *

Result of Titration	Hydroxide Alkalinity as CaCO_3	Carbonate Alkalinity as CaCO_3	Bicarbonate Alkalinity as CaCO_3
P=O	O	O	T
$P < \frac{1}{2}T$	O	2P	T-2P
$P = \frac{1}{2}T$	O	2P	O
$P > \frac{1}{2}T$	2P-T	2(T-P)	O
P=T	T	O	O

* Key: P - phenolphthalein alkalinity; T - total alkalinity

The following table presents the methods and detection limits of the field parameters:

<u>Parameter</u>	<u>Method</u> ^(a)	<u>Detection Limit</u>
Dissolved Oxygen	SM 422F	0.1 mg/l
Temperature	SM 212	0.1 °C
Conductivity	EPA 275	1 umhos/cm
pH	EPA 239	±0.01
Alkalinity	EPA 3	2 mg/l
Carbon Dioxide ^(b)	SM 407A	±1%
Settleable Solids	EPA 273	0.1 ml/l

(a) SM - Standard Methods for the Examination of Water and Wastewater, 14th edition

EPA - Methods for Chemical Analysis of Water and Wastes, 1974, page number appears after EPA

(b) Free carbon dioxide will be determined by R&M personnel with the nomograph on page 297 of Standard Methods, 14th edition.

C. Preservation and Shipment

Samples for laboratory analysis are collected from the composite sample, and placed in separate containers as follows:

<u>Container</u>	<u>Parameters</u>
Plastic, no preservative	Turbidity Total Dissolved Solids Total Suspended Solids
Plastic, no preservative, filtered on site	Total Phosphorus Ortho-phosphate Chloride Color Sulfate Hardness
Plastic, sulfuric acid, filtered on site	Kjeldahl Nitrogen Total Nitrogen Nitrate Nitrogen Ammonia Nitrogen
Plastic, sulfuric acid	Chemical Oxygen Demand
Plastic, nitric acid, filtered on site	Metals (ICAP Scan)
Glass, organic solvent rinsed, filtered on site	Organic Chemicals
Glass or plastic, nitric acid, filtered on site	Uranium
Glass or plastic, nitric acid, filtered on site	Radioactivity, Gross Alpha

Filtration will be done on site using 0.45-um membrane filter. Sample bottles with appropriate preservatives are provided for each sampling trip by Chemical & Geological Laboratories of Alaska, Inc. All laboratory samples are placed in insulated sample boxes with ice to keep the samples cool during shipment to the laboratory.

4) LABORATORY PROCEDURES

Chemical & Geological Laboratories of Alaska, Inc., has been contracted to provide laboratory analyses. They are one of two private laboratories in Alaska certified by the Alaska Department of Environmental Conservation to provide water quality analyses. The parameters, methods, and detection limits follow:

<u>Parameter</u>	<u>Method</u> ^(a)	<u>Detection Limit</u> ^(b)
Turbidity	EPA295	0.05 NTU
Total Dissolved Solids	EPA266	1
Total Suspended Solids	EPA268	1
Total Phosphorus	EPA249	0.01
Ortho-phosphate	EPA249	0.01
Kjeldahl Nitrogen	EPA175	0.1
Total Nitrogen	EPA175	0.1
Nitrate Nitrogen	EPA197	0.1
Ammonia Nitrogen	EPA159	0.05
Chemical Oxygen Demand	EPA20	1
Hardness	EPA 68	1
Chloride	EPA 29	0.2
Sulfate	EPA277	1
ICAP Scan	Proposed ^(c)	-
Uranium	Fluorescence ^(d)	0.075
Radioactivity, Gross Alpha	EPA 264 (ASTM 31)	3pCi/l ^(e)
Organic Chemicals	Proposed ^(f)	

(a) EPA - Methods for Chemical Analysis of Water and Wastes, 1974, page number appears after EPA

ASTM 31 - American Society for Testing Materials, 1975, Annual Book of ASTM Standards, Part 31, Water

(b) mg/l unless noted otherwise

- c) Recommended method outlined in the Federal Register, Vol. 44, No. 233, pt. III, Appendix IV
- d) Following accepted method outlined by G.K. Turner Associates,
- e) Reported as picocurie/liter
- f) Recommended method outlined in the Federal Register, Vol 38, No. 75, Pt. II, Appendix A.

5) REPORTING

Data will be compiled to provide a range and mean for each parameter during each of three seasons. The seasons and their respective definitions are: breakup - from the time ice begins to break up until recession of spring runoff, summer - from the end of breakup until the water temperature drops to essentially 0°C in the fall, and winter - from the end of summer until breakup begins.

The format for data collected will consist of an alphabetical listing of field parameters followed by an alphabetical listing of laboratory parameters. There will be one page per sample site and the heading will have the site, date, sample time, personnel doing the sampling, and other relevant observations.