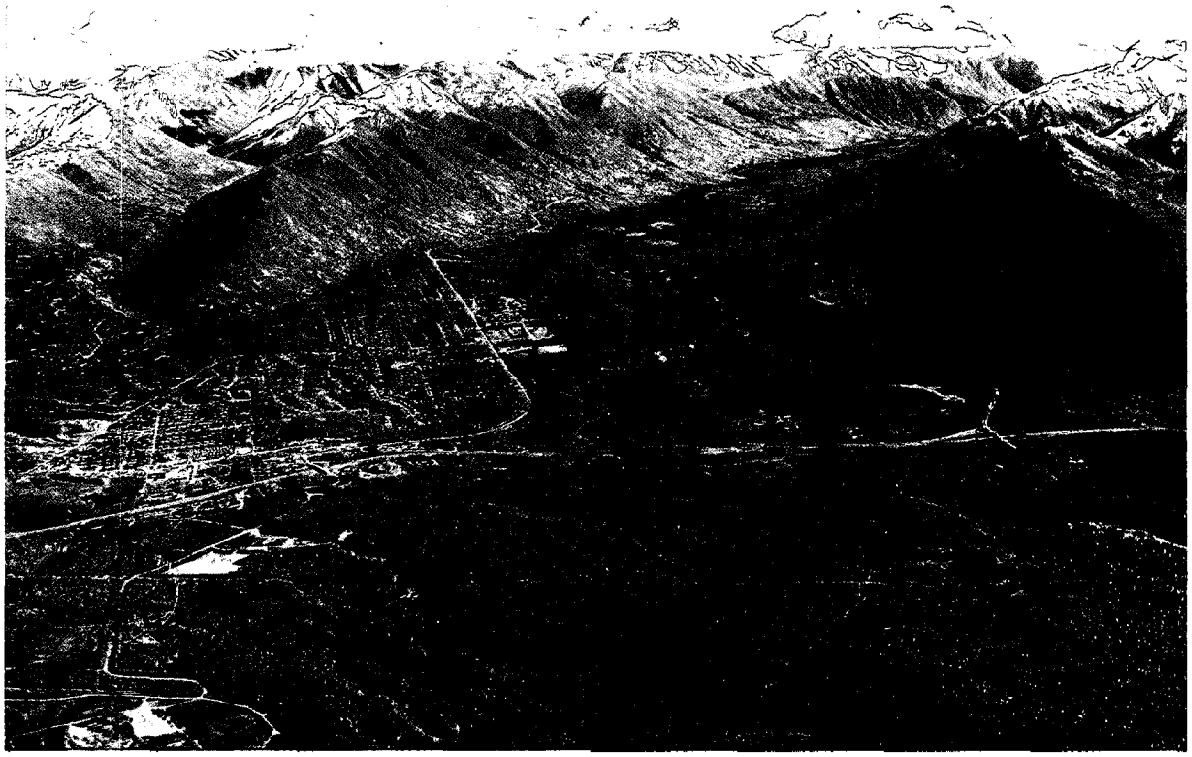
TASK 3
FLOUR WATER TREATMENT STUDY

Appendix

III

Eagle River Water Resource Study



Municipality of Anchorage
Water and Sewer Utilities

December 1981

TASK 3
FLOUR WATER TREATMENT STUDY

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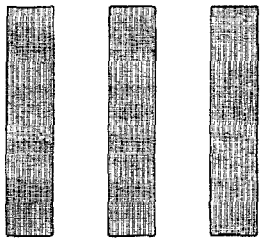

Eagle River Water Resource Study

Municipality of Anchorage
Water and Sewer Utilities

CH2M HILL

December 1981

Cover photo by: Air Photo Tech, Inc.

This report was prepared under the supervision of a registered professional engineer.

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PREFACE

To pursue the recommendations for further study that were prescribed in the Metropolitan Anchorage Urban Study, completed by the U.S. Corps of Engineers in 1979, the Municipality of Anchorage engaged CH2M HILL to conduct the Eagle River Water Resource Study. The purpose of the study is to investigate the potential sources of water supply from the Eagle River Valley. The original scope of the study comprised four tasks:

Task 1	Well Drilling Program
Task 2	Preliminary Damsite Investigation
Task 3	Flour Water Treatment Study
Task 4	Transmission Main Design

Task 5, Eklutna Lake Alternative Water Source Evaluation, was added to the scope after the completion of the first four tasks.

The report for each task is bound separately and is an appendix to the Executive Summary of the entire study. This Appendix III is the report for Task 3, Flour Water Treatment Study.

ACKNOWLEDGMENTS

We wish to express our appreciation to the Anchorage Water and Sewer Utilities staff for their contributions at the weekly meetings, updating of task scopes, and overall administrative assistance.

Also, we thank Eklutna, Inc., for providing pertinent information at the weekly meetings and ready access to its property.

SUMMARY AND CONCLUSIONS

The objectives of Task 3 are to (1) determine whether surface water from the Eagle River can be treated by conventional processes to remove glacial rock flour in order to meet current drinking water standards and (2) estimate costs for such treatment.

Field and laboratory testing indicated that Eagle River water is treatable. Treatment facilities will require two different seasonal treatment processes that can be provided in a single water treatment plant. Transition between processes would occur in June and September correlating with melting of the glaciers at the river's headwaters.

The recommended treatment processes are: (1) flocculation, sedimentation, high-rate filtration, and disinfection for the high-turbidity, glacial melt period; and (2) coagulation, high-rate filtration, and disinfection for the low-turbidity period during the colder months.

To provide flexibility and to meet increasing water demands, the treatment plant could be constructed in three equal increments of 23.33 mgd each until the full capacity of 70 mgd was reached. Additions could be made when needed with little disruption to continuing operation of existing facilities. Capital costs and annual operation and maintenance costs were estimated in January 1981 dollars for a 23.33-mgd and a 70-mgd plant. These estimated costs are $17.4 million (capital) and $1 million (operation and maintenance) for a 23.33-mgd plant and $41.4 million (capital) and $2.7 million (operation and maintenance) for a 70-mgd plant.

Prior to starting final design but after selection of Eagle River surface water as the source for additional water supply, we recommend the following:

- Pilot treatment plant tests for a full year, using at least a 1-mgd plant, to determine applicable process design criteria. This testing program should address iron, color, and turbidity removal; chemical dosages required over the full range of raw water parameters; filtration rates and media selection; and effectiveness of the recommended treatment processes.

- Investigation of disinfection alternatives to identify their trihalomethane formation potential (formation of potentially carcinogenic substances during the disinfection process).

- Identification of sludge disposal alternatives and the associated cost research.
- Selection of a treatment plant site.
- Groundwater quality analysis and monitoring program for the old Eagle River dump.

DEFINITION OF TERMS

Alum	Metallic salt, aluminum sulfate, coagulant used in removal of turbidity from water
Coagulation	A chemical process for combining particles into larger aggregates
Degrees C	Degrees centigrade 7° C = 45° F (Fahrenheit) and 20° C = 68° F
EPA	United States Environmental Protection Agency
Flocculation	The process of gentle mixing following coagulation so that particles come in contact with one another, aggregating or growing into larger more dense particles that settle readily
Flour	Material ground by glaciers
Jar Testing	A bench-scale procedure using multiple stirrers to compare coagulation and settling results in beakers having varying coagulant dosages
mgd	million gallons per day
mg/l	milligrams per liter
Micron	Unit of measure equalling one thousandth of a millimeter
NTU	Nephelometric Turbidity Unit - unit for measuring turbidity
Sedimentation	Process by which coagulated or suspended matter separates from the water by subsidence and deposition
THM (trihalomethane)	Organic compounds formed when certain natural organic compounds (particularly humic acids) come in contact with chlorine. These compounds are thought to cause cancer in animals.
Turbidity	A measurement of water clarity by the amount of particulate matter in the sample

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Chapter 1
INTRODUCTION

BACKGROUND

The population and, thus, the water supply needs of the metropolitan Anchorage area are growing rapidly. Presently, surface water from Ship Creek and groundwater wells in the Anchorage Bowl supply most of the municipality's water. However, if present growth trends continue, these sources will not meet future needs.

In 1974 the United States Congress authorized the U.S. Army Corps of Engineers to perform the Metropolitan Anchorage Urban Study (MAUS), which was completed in 1979. The purpose of the MAUS was "to evaluate the adequacy of the developed water supply in the metropolitan Anchorage area, to determine future water demands, to assess sources for water supply development, and to formulate water supply plans to meet the increased future demand" (U.S. Army Corps of Engineers, 1979). The MAUS study area comprised the Anchorage Bowl and the area northeast to the town of Eklutna (Figure 1-1).

The projected future water demand increases, determined in the MAUS, are shown in Figure 1-2. It is expected that by the year 2025 an additional 81.5 million gallons per day (mgd) of water will be needed to meet the increased demands in the area.

The MAUS report identified many potential sources of supply: Eagle River Valley groundwater; Anchorage Bowl groundwater; and surface water from Campbell Creek, Ship Creek, Eagle River, and Eklutna Lake. Two plans were recommended by MAUS for future study. Plan IV, which ranked first environmentally and socially, included a combination of supply from Ship Creek, Anchorage Bowl groundwater, and Eklutna Lake. Plan VI, which ranked first on an economic basis, included an increased supply from Ship Creek, winter diversion from Eagle River, further development of Anchorage Bowl groundwater, and exploration for Eagle River Valley groundwater.

To implement portions of these plans, the Municipality increased the water supply from within the Anchorage Bowl by recently constructing a 36-inch supply main to its water treatment plant from the military diversion facility on Ship Creek. Future developments are expected to include new wells to increase groundwater supply and the expansion of the capabilities of the plant that treats Ship Creek water. However, rapidly growing demands in Anchorage will require development of a new source outside the Anchorage Bowl within the next 10 years. The Eagle River-Chugiak-Eklutna area, northeast of Anchorage, needs a new source now.

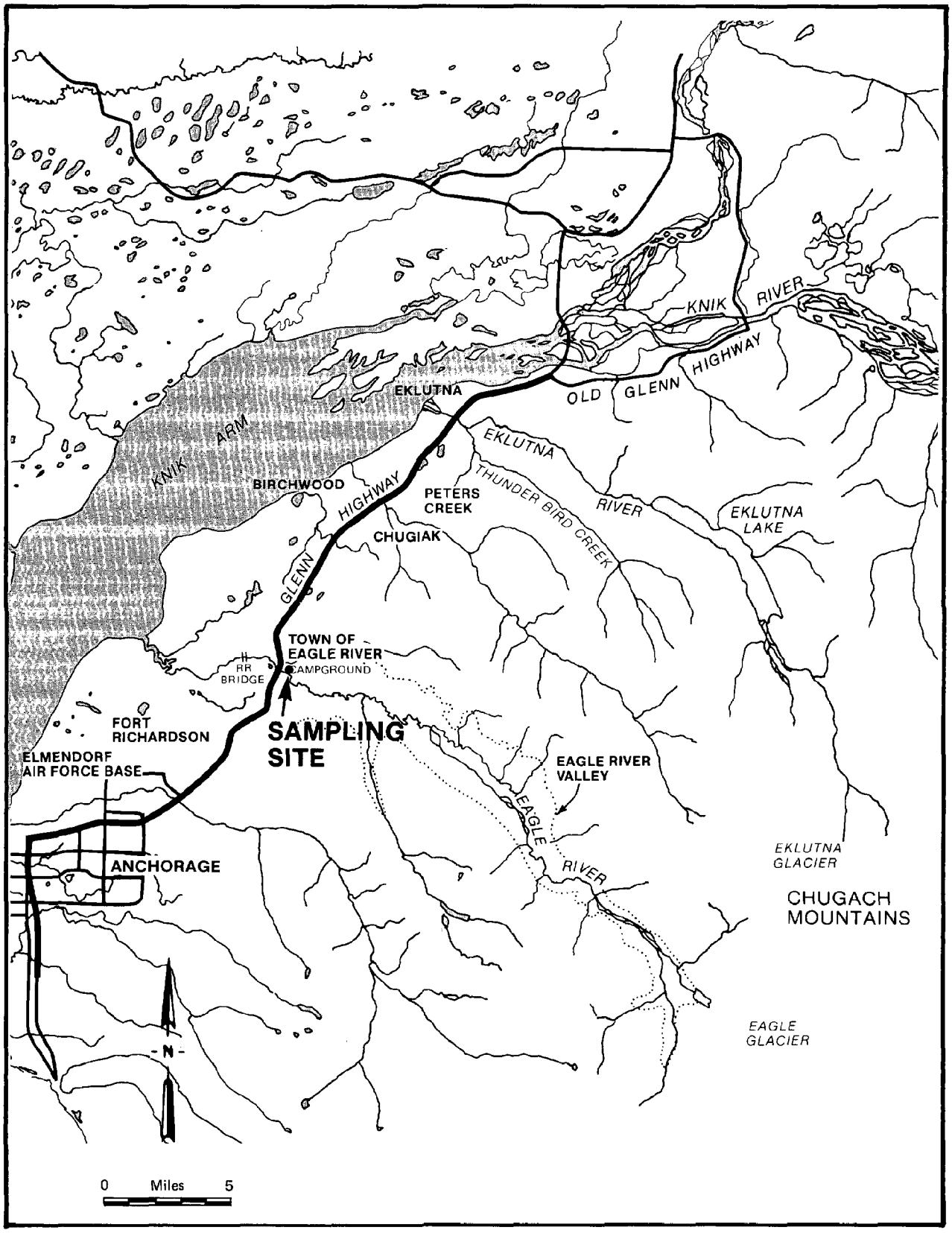
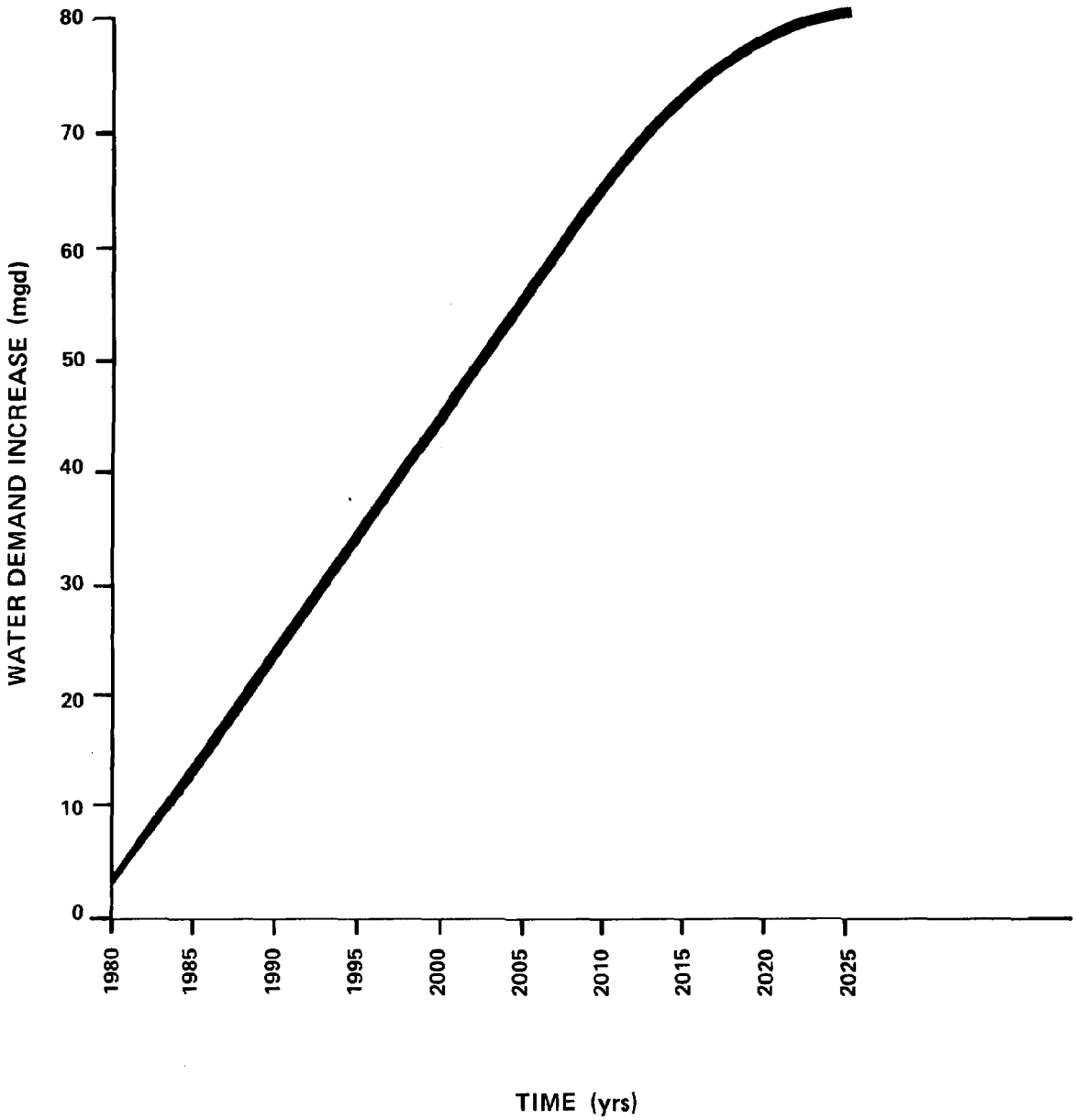


Figure 1-1
Vicinity Map



NOTE: Increase Based on 1977 Total Demand.

SOURCE: U.S. Corps of Engineers. 1979.

Figure 1-2
Projected Water Demand Increase 1980-2025

As a result of the MAUS findings, the Municipality decided to investigate potential sources outside the Anchorage Bowl that could supply 70 mgd of water. On the basis of the MAUS population projection, this diversion would satisfy the demands of the entire study area through the year 2012. The future increases in water supply capacity that are expected to be developed within the Anchorage Bowl will delay the need for the full 70-mgd capacity of the new water source outside the Bowl until approximately the year 2020 or later.

The Eagle River Valley is one possible source of water from outside the Anchorage Bowl that was suggested in the MAUS, Plan VI. To investigate the potential of this valley to supply the 70-mgd requirement, the Municipality engaged CH2M HILL to conduct the Eagle River Water Resource Study. The original scope of the study comprised four separate tasks:

- Task 1, a well drilling program to study the feasibility of developing the Eagle River Valley as a groundwater source
- Task 2, a preliminary damsite investigation to determine the feasibility of developing the Eagle River as a surface water source
- Task 3, an investigation of the suitability of conventional treatment processes for removal of glacial rock flour from the Eagle River water
- Task 4, a preliminary design of a pipeline to transport groundwater or surface water from the Eagle River Valley to Anchorage

Each task was conducted independently.

The results of the first four tasks clearly indicate that a substantial dam and reservoir are required to develop Eagle River as a water source. Before committing itself to this dam and reservoir project, the Municipality of Anchorage increased the study scope to include Task 5, Eklutna Lake Alternative Water Source Evaluation. The purpose of Task 5 was to analyze the capability of Eklutna Lake to supply the 70 mgd of water to the area. Eklutna Lake is included in Plan IV of the MAUS. The lake is 30 miles northeast of downtown Anchorage and 16 miles northeast of the Eagle River (Figure 1-1).

The report for each task appears as an appendix to the Executive Summary of the entire study. This Appendix III is the report for Task 3, Flour Water Treatment Study.

PURPOSE AND SCOPE

The objective of Task 3 is to investigate the suitability of the Eagle River as a potable water supply source, especially during the summer glacial melt period. It is intended to complement the MAUS and to augment water quality data collected by the United States Geological Survey (USGS) between 1948 and 1973.

If the 70-mgd source of water for the Municipality of Anchorage is to come from Eagle River surface water (assuming it can be made potable), a plant to treat this water should be located near the river. This will allow potable water to be pumped south to the Anchorage Bowl and north to various communities as far away as Eklutna (Eagle River, Chugiak, Birchwood, Peters Creek, and Eklutna). Initially, when demands are still low, untreated water could be pumped to the existing Municipal Water Treatment Plant. However, it is likely that the Eagle River treatment plant would be constructed when the dam (Appendix II of this study) is constructed so the areas north can be served. To provide flexibility and to meet increasing demands, the treatment plant could be constructed in stages.

This appendix contains the following:

- Results and evaluations of field and laboratory tests
- Identification of treatment criteria and the best treatment processes for both the summer glacial melt period and the winter clear water periods
- Estimated project and annual operation and maintenance costs for a treatment plant suitable for operation of the recommended processes

The Municipality of Anchorage suggested that we study flour concentration, exchange capacity, particle size, mineral concentration, solution characteristics, and treatment agents and methods. These suggested areas of the study, except for the exchange capacity and particle size, influence the treatment required to produce potable water and were considered throughout this task. Exchange capacity relates to ion exchange, which is a common process in water softening. Eagle River water is naturally soft and does not require softening. Particle size, though of interest, does not relate directly to its removal. Particle size distribution was measured but is not considered as having a direct bearing on either the jar tests performed or the treatment conclusions resulting from these tests.

Data were collected during the entire glacial melt period, June through September 1980. During this period, data were gathered regularly, and observations were made of variations in river water quality.

SITE DESCRIPTION

The Eagle River, situated about 10 miles northeast of Anchorage, is fed primarily by the Eagle Glacier at the upper end of the Eagle River Valley (Figure 1-1). During the summer, melt water from the glacier contributes to high flows. This melt water contains glacial rock flour, which produces high turbidity in the water. In the winter months when the glacier is frozen, streamflow and turbidity are low. Its turbidity makes the Eagle River water unsuitable for drinking. A method for reduction of turbidity must be determined before the Eagle River can be identified as a potential drinking water source.

LIMITATIONS

This report was prepared for the use of the Anchorage Water and Sewer Utilities for specific application to the Eagle River Water Resource Study, Flour Water Treatment Study, in accordance with generally accepted engineering practice. No other warranty, expressed or implied, is made. In the event of any changes to the conditions considered under this study, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed and the conclusions or recommendations are modified or verified in writing by CH2M HILL.

The purpose of this task is to investigate whether conventional treatment processes can remove glacial rock flour from Eagle River water. No design criteria were developed. The treatment concepts presented in this report are believed to be workable but are not refined enough for incorporation into a final design. Additional investigations, such as pilot testing, will be required prior to final design.

Chapter 2
DATA COLLECTION AND EVALUATION

SAMPLING SITE

All samples for testing were collected from the right bank of the Eagle River immediately upstream of both the Glenn Highway bridge and the confluence of Meadow Creek with the Eagle River (Figure 1-1). This site was readily accessible during all weather conditions and permitted an undisturbed location to park the mobile laboratory. Because the river at this location is extremely turbulent; grab sampling from the river bank was considered as representative of the entire river. This was confirmed by taking samples upstream, near the center of the river, and measuring turbidity.

Other sites further upstream were considered for regular sampling but were eliminated because they were less convenient and required permits for access. No significant tributaries enter the river between the sampling site and either of the two prospective damsites, identified in Appendix II of this study.

EQUIPMENT

The mobile laboratory was equipped with a four-paddle stirrer, a Hach Model DREL turbidimeter, a pH meter, and miscellaneous other glassware and equipment for titrating.

TESTS

The testing started on June 11, 1980, and continued into September, covering the entire rock flour, glacial melt period.

Temperature, pH, hardness, alkalinity, and turbidity tests were performed at the sampling point. Also, jar testing was used to determine optimum coagulant dosage, effects of rapid and slow mixing, and floc settling rate. These tests were conducted daily until repeatable results to primary variables were established. Testing frequency was then reduced to 3 days per week unless significant changes in weather or stream condition occurred.

In addition to on-site testing, samples were collected and transported to an off-site laboratory for particle size analysis and other routine chemical and physical analyses. These tests were performed bimonthly throughout the testing period.

Results of the on-site and off-site tests are shown on Table 2-1. Additional Eagle River raw water quality data, obtained between January and June 1981, is contained in Exhibit B at the end of this appendix.

Table 2-1
CHEMICAL AND PHYSICAL ANALYSES
SUMMER 1980

	Dates							
	7-23	7-28	8-8	8-15	8-25	8-29	9-5	9-16
Ca (mg/l)	12	11	12	13	19	19	21	12
Fe (mg/l)	4.4	4.6	1.6	1.0	0.5	1.3	0.4	4.2
Mn (mg/l)	0.07	0.08	0.04	<0.05	<0.05	0.06	<0.05	0.07
Si (mg/l)	13.2	14.4	-	-	-	-	2.8	10.4
SiO_2 (mg/l)	28	30.9	8.8	6.8	5.1	2.7	-	22.3
Nitrate (mg/l)	0.26	<0.10	0.18	0.26	0.17	0.19	0.21	0.67
Sulfate (mg/l)	8.4	<1	4.5	0.5	7.5	9.5	9.0	3.5
Total Dissolved Solids (mg/l)	137	79	99	71	92	110	105	85
Turbidity (NTU)	160	300	180	80	35	26	12	-
Suspended Solids (mg/l)	242	400	232	99	44	18	6.4	361
Hd $CACO_3$ (mg/l)	44	-	43	55	64	70	78	52
Alkalinity as $CaCO_3$								
Bicarb. HCO_3 (mg/l)	52	60	51	97	110	84	88	55
Carb. CO_3 (mg/l)	0	0	0	0	0	0	0	0
Conductivity (umhos)	100	84	92	96	120	140	165	100
Color (cu)	10	30	>70	50	45	35	30	30
Chloride (mg/l)	2	30	8	5	2	2	<1	<1

Temperature

Figure 2-1 shows a plot of both air and river water temperatures throughout the test period. While air temperatures were generally in the 15-degree- to 20-degree-C range, water temperatures held fairly constant at 6 degrees to 7 degrees C.

During the test period there was a general relationship between air and water temperature. This is illustrated by the drop in both air and water temperature between August 29 and September 8.

Turbidity

Turbidity ranged from 30 to 400 NTU, with the normal at about 150 NTU (Figure 2-2). Turbidity in the Eagle River is directly

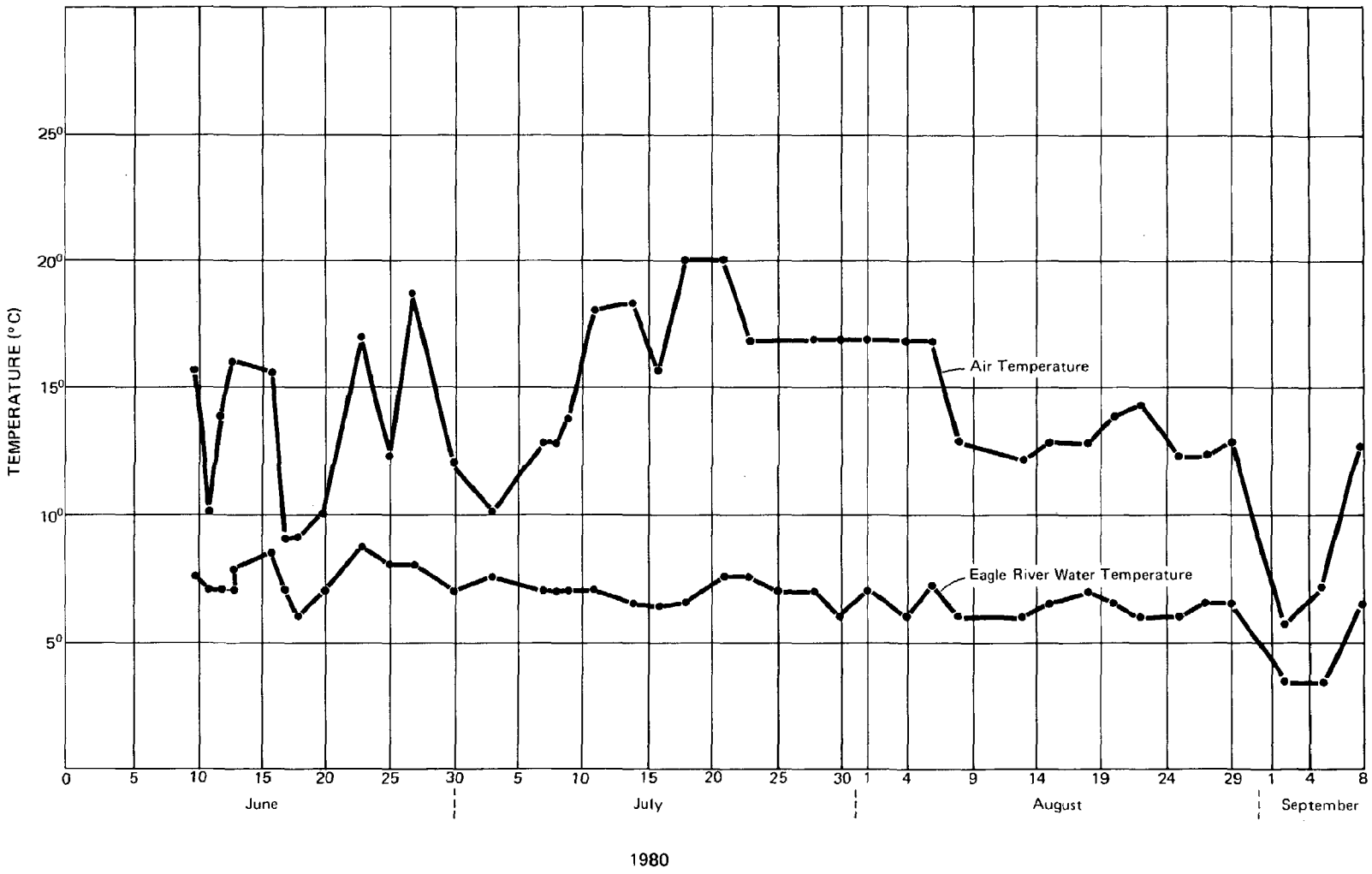


Figure 2-1
Air and Water Temperature

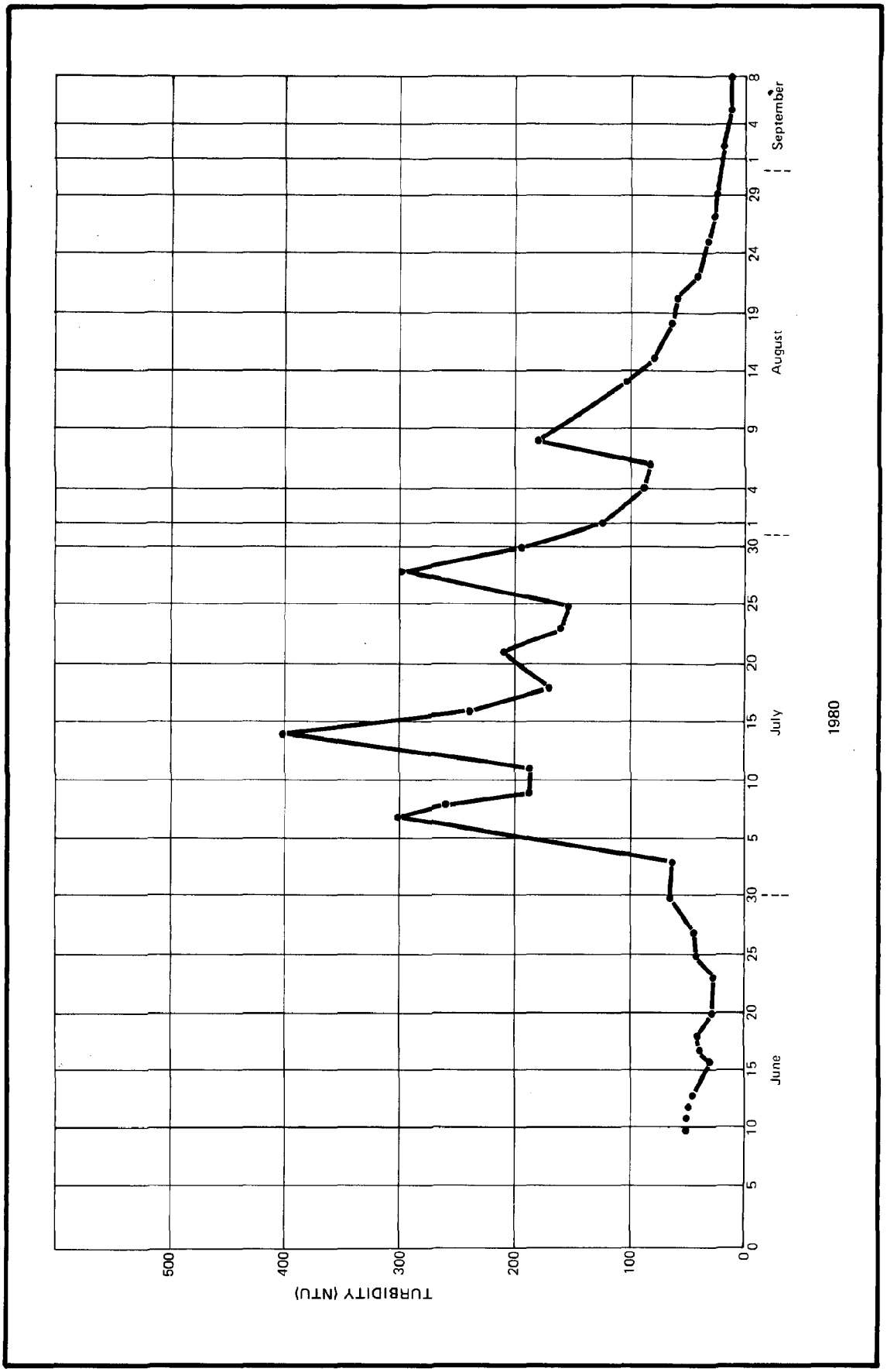


Figure 2-2
Turbidity

linked to air temperature and rate of melt of the glaciers feeding the river. The river appears greyish in color, which is typical of the rock flour solids that create the turbidity.

Periodically, samples were analyzed for both dissolved and suspended solids. Occurrence of these solids was plotted against turbidity (Figure 2-3). This plot indicates a rough correlation between turbidity and suspended solids, a turbidity of 75 NTU equaling approximately 100 mg/l of suspended solids. Dissolved solids remain more or less constant regardless of turbidity or suspended solids.

Suspended solids particles that cause turbidity were analyzed for size distribution. The six samples analyzed showed that 90 percent of the particles were smaller than 2 microns, and 87 percent were larger than 0.5 micron. The particle count mean averaged 0.86 micron.

The data from tests taken during the summer of 1980 closely resemble water quality data gathered by the USGS during the period 1948 to 1973. (The USGS data are included as Exhibit A at the end of this report.) Suspended solids measurements and turbidity generally agree with historic data; however, the previous high suspended solids loadings of 1,200 to 1,400 mg/l were not observed. Our maximum observation was 400 mg/l. Either the high loadings did not occur this year or they were missed, even though a conscious effort was made throughout the summer to take samples when changes in temperature, runoff, and rainfall were observed.

pH

The pH of Eagle River water was fairly constant, generally between 7.3 and 7.5. This information is plotted in Figure 2-4.

Alkalinity and Hardness

Alkalinity and hardness vary seasonally and seem to correlate with turbidity. Both alkalinity and hardness decrease during the summer months, which are associated with higher streamflow and turbidity. Alkalinity varies from 50 to 60 mg/l in the winter to 30 to 45 mg/l in the summer. Similarly, hardness varies from 70 to 80 mg/l during the winter to 40 to 50 mg/l in the summer. Both the alkalinity and hardness of the Eagle River water during the sampling period are expressed in milligrams per liter as $CaCO_3$ in Figure 2-5.

Jar Testing

Jar testing is a bench-scale test that gives insight into full-scale coagulation and settling processes. The primary purpose for jar testing in this task was to determine how different coagulant

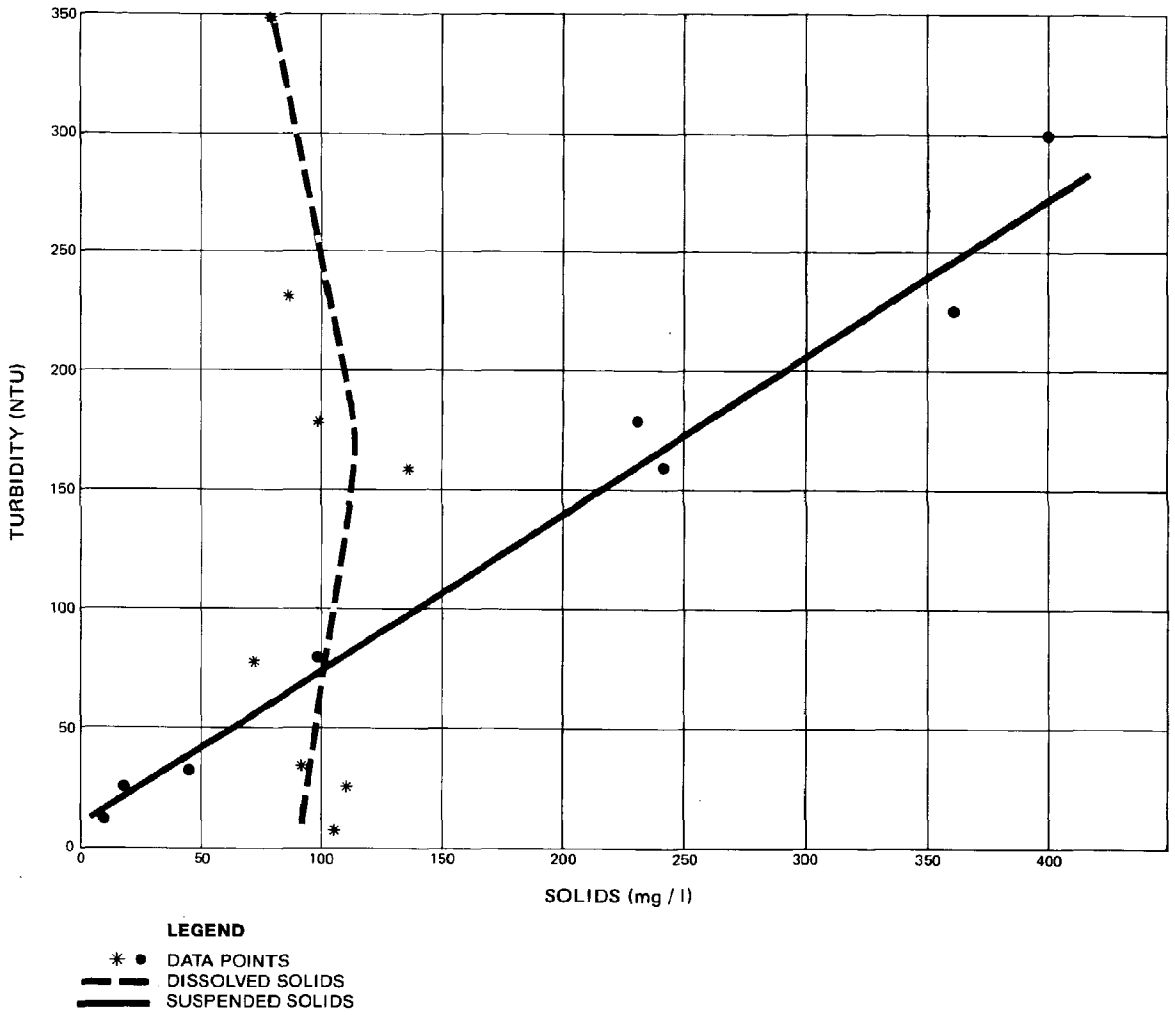


Figure 2-3
Turbidity vs Dissolved and Suspended Solids

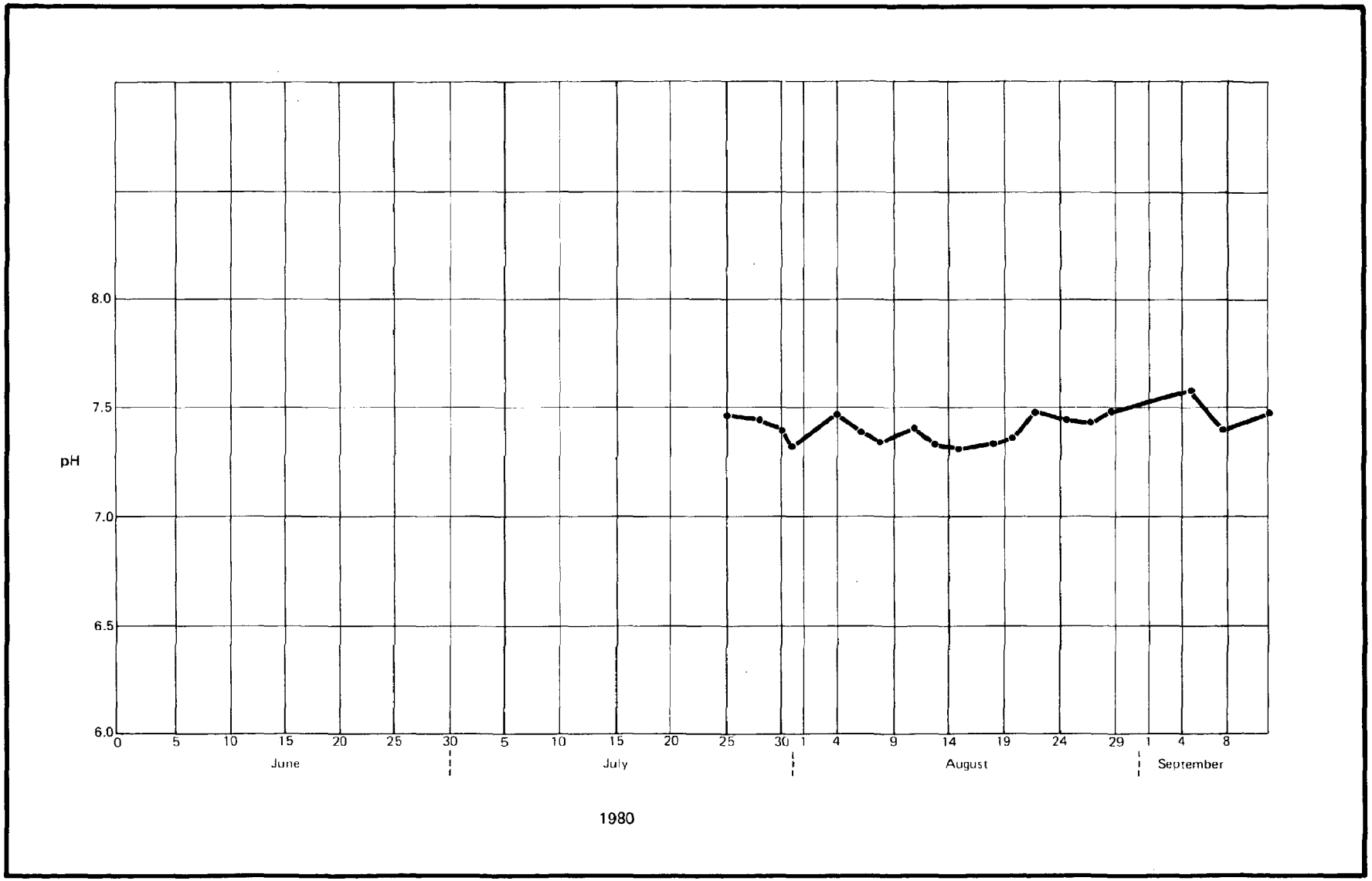

8.0
7.5
7.0
6.5
6.0
pH
0
5
10
15
20
25
30
5
10
15
20
25
30
1
4
9
14
19
24
29
1
4
8
June
July
August
September
1980

Figure 2-4
pH

Figure 2-5
Hardness and Alkalinity

(alum) dosages reacted with the range of raw water quality during the highly turbid glacial melt period. The effects of changing water temperatures, rapid and slow mixing rates, and rapid and slow mixing durations were then investigated to refine the treatment requirements of the Eagle River water.

Initial jar testing showed that two separate alum dosage ranges achieved coagulation and clarification within a broad range of alum dosage. Figure 2-6 shows alum dosage plotted against turbidity after mixing and settling. The plot shows four distinct zones that occur frequently in treating highly turbid river water. When proceeding from left to right the zones can be described as follows: (1) insufficient alum, thus no coagulation, (2) effective alum dosage that achieves coagulation-clarification through destabilization of turbidity particles, (3) another zone of ineffective coagulation, and (4) a second zone of effective coagulation-clarification, this time resulting by adsorption and enmeshment of turbidity particles.

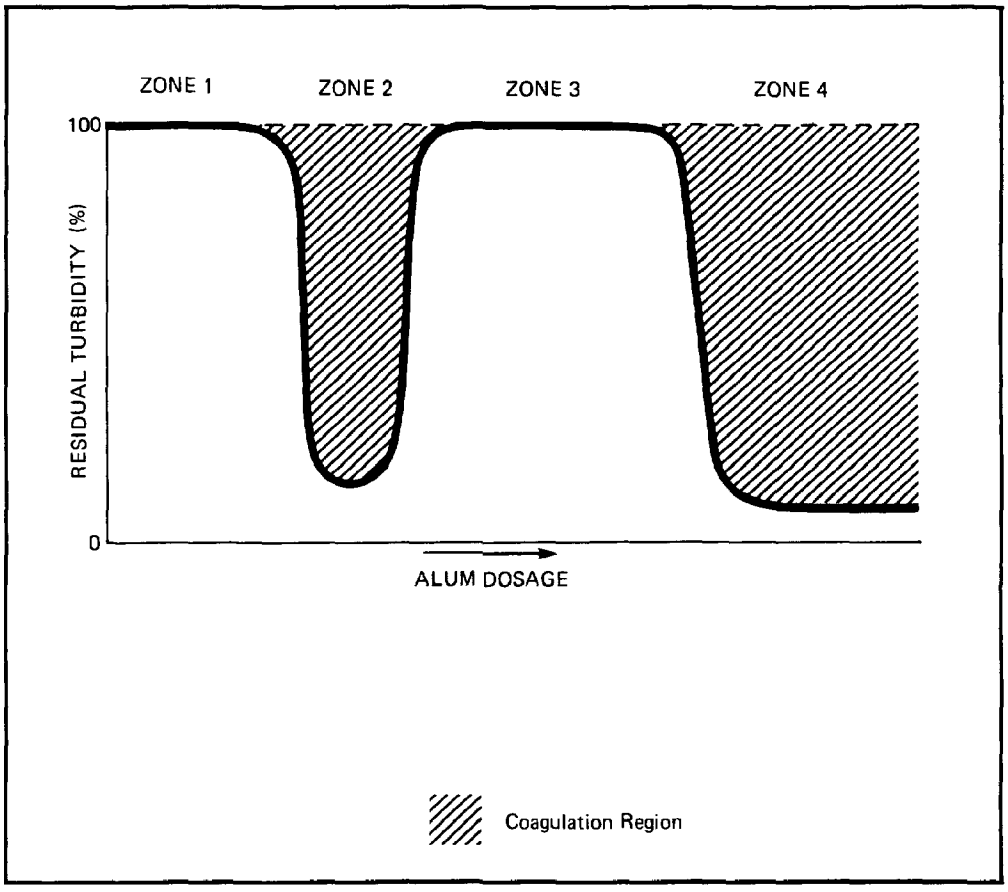


Figure 2-6
Coagulation of Water With High Turbidity

Plant-scale operation would use Zone 2 rather than Zone 4 because less alum is used and a reduced volume of sludge is produced. Subsequent testing focused on this lower dosage zone to establish how dosage requirements varied with changing river turbidity and temperature. The optimum alum dosage for the summer's test program was between 10 and 15 mg/l.

The jar testing results showed that turbidity can be removed effectively through use of coagulation, flocculation, and sedimentation. The settled water produced from these procedures has a turbidity of 10 NTU or less for raw river water temperatures between 3 degrees and 7 degrees C regardless of turbidity. Figure 2-7 shows a typical plot of alum dosage against turbidity after settling.

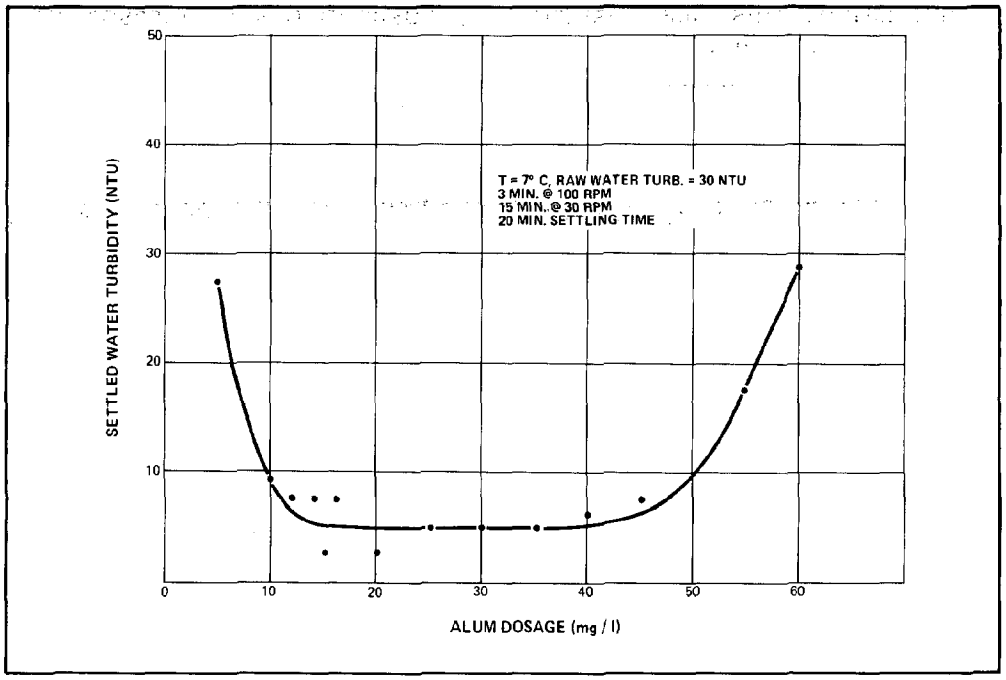


Figure 2-7
Settled Water Turbidity vs Alum Dosage

Once the optimum dosage of 10 to 15 mg/l of alum was established, testing then turned to identifying whether an increase in water temperature above the natural river temperature would have a significant effect on coagulation, flocculation, and sedimentation (Figures 2-8, 2-9, and 2-10). In general, settling occurred more rapidly as the water temperature increased; however, the end

turbidity was the same. There is a possibility that river water could be preheated as it enters the treatment plant by waste heat energy from a future fossil-fuel-fired electric power plant being considered.

Additional testing established, in a general sense, the effect of varying either or both rapid mixing and slow mixing on floc formation and settling characteristics. Rapid mixing performed best with the stirrer set at 90 rpm for 3 to 5 minutes, and the slow mixing appeared to be most effective at 30 rpm for 12 to 15 minutes. Using optimum rapid and slow mixing, the best observed settled water characteristics resulted after 20 to 25 minutes. No attempt was made to correlate the jar stirrer with plant-scale mixing equipment.

Because the alum dosage requirement was so low, little subsequent testing was done using polymers as a substitute coagulant or as a coagulant aid.

Use of alum as a coagulant has a side effect of lowering the pH of the water, which often increases the corrosiveness of the water to piping systems and household plumbing. Because the decrease of the pH using 10 to 15 mg/l of alum was observed to be small (from 7.5 to 7.2), it may not be necessary to add lime to raise the pH after coagulation to reduce corrosion. Lime systems are typically a nuisance to both operate and maintain. Further investigation of this matter should be conducted during pilot plant testing.

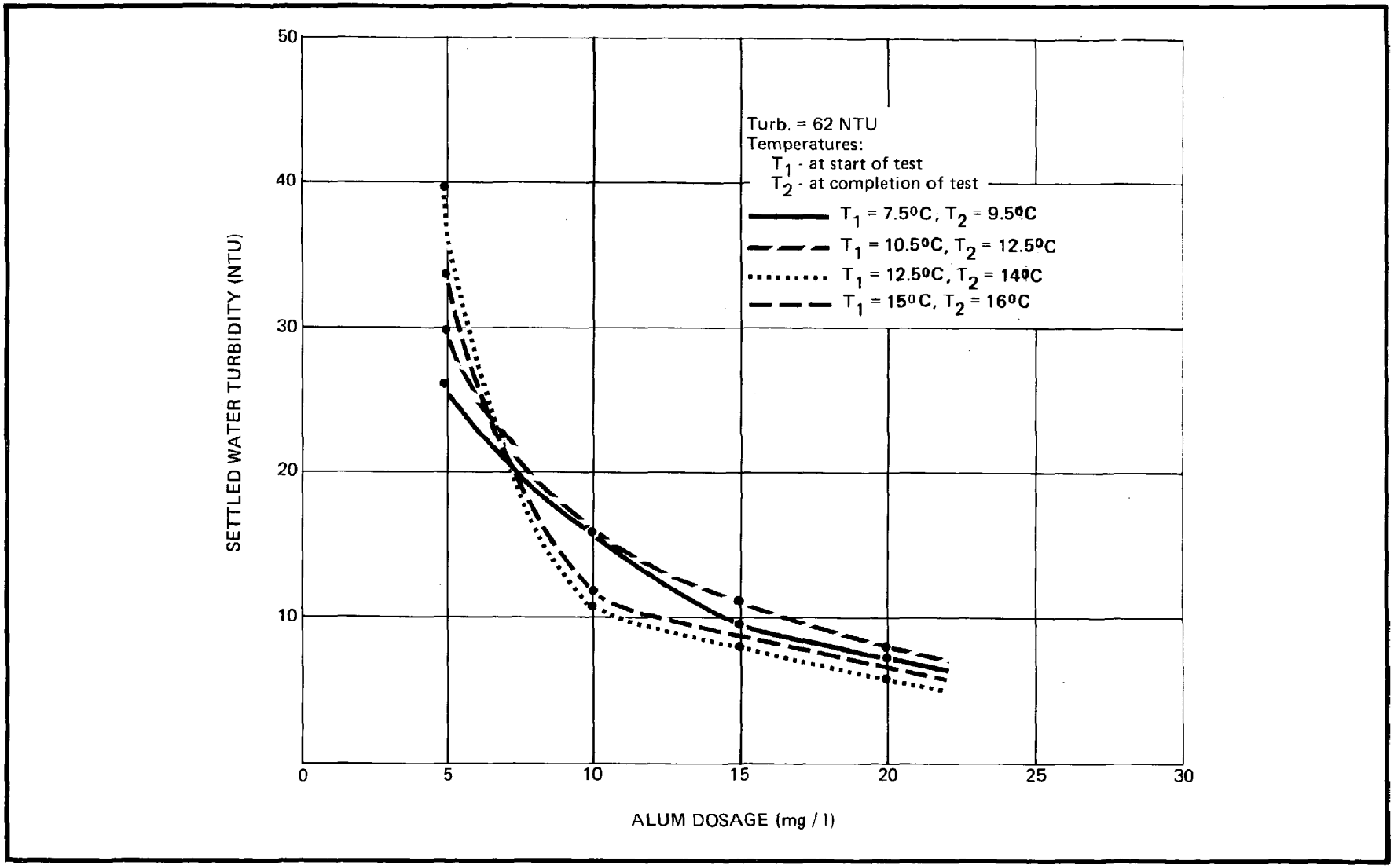


Figure 2-8
Settled Water Turbidity vs Alum Dosage at Various Water Temperatures

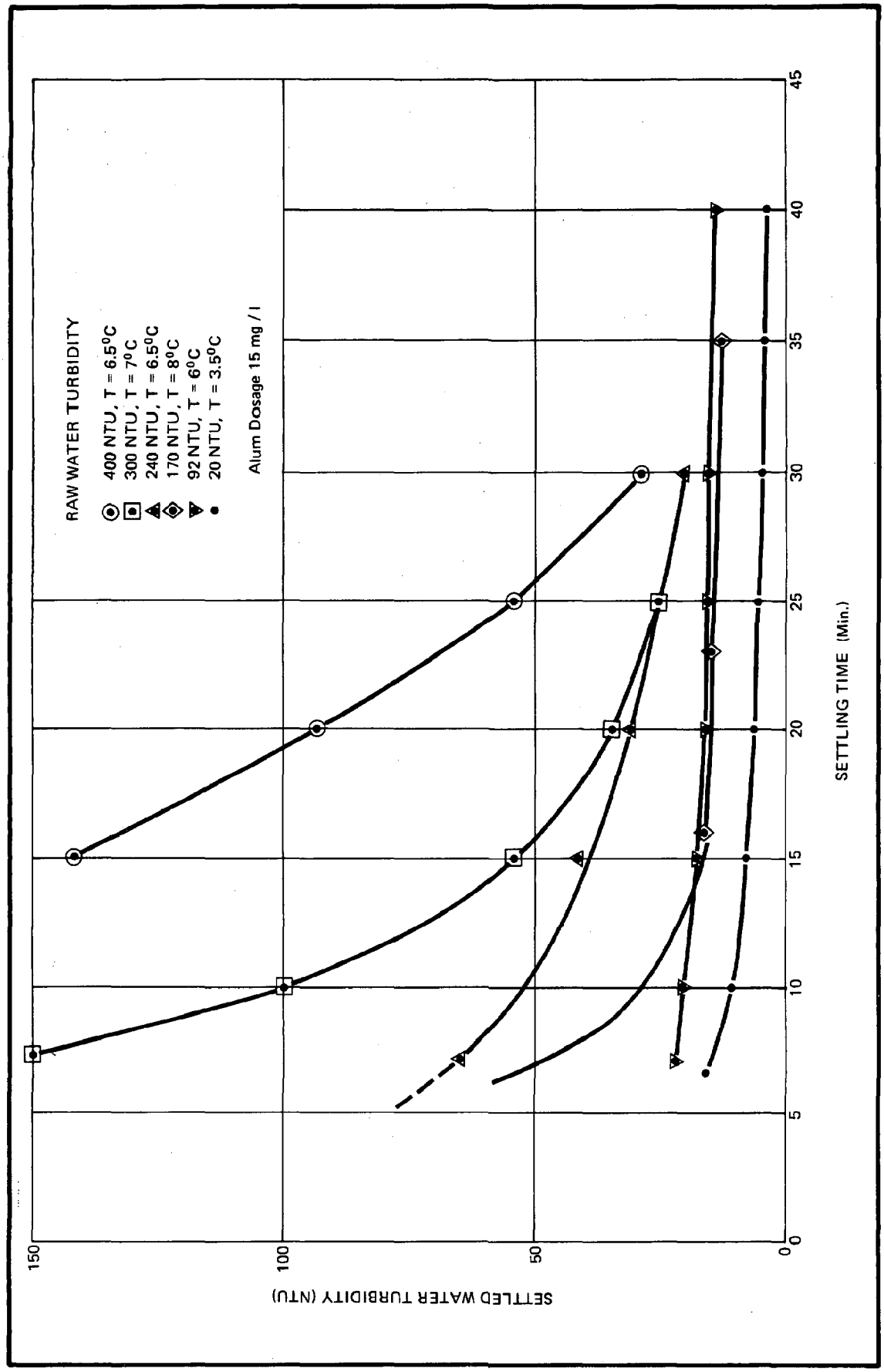


Figure 2-9
Settled Water Turbidity vs Settling Time at Various Water Temperatures

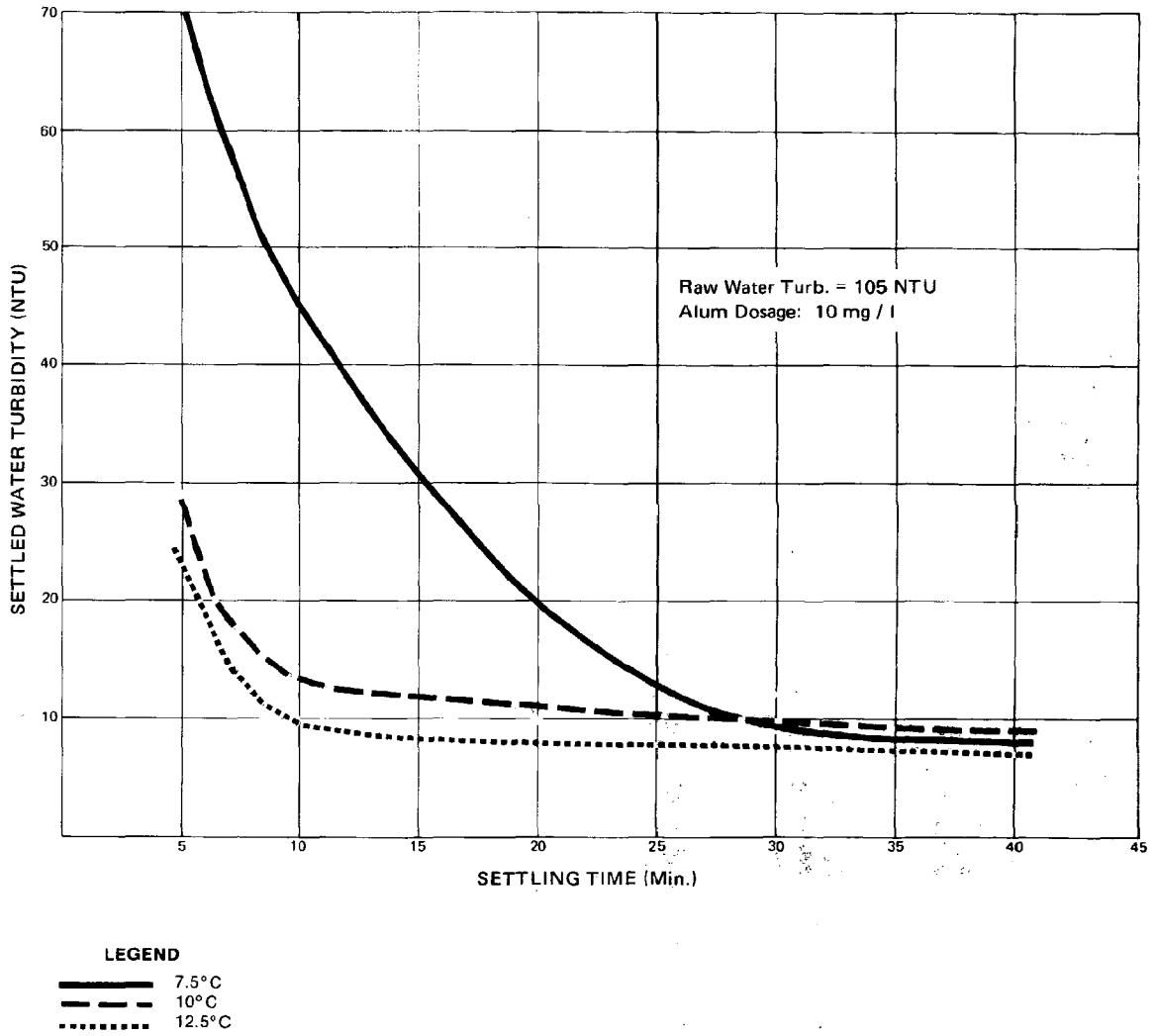


Figure 2-10
Settled Water Turbidity vs Temperature and Settling Time

Chapter 3
TREATMENT REQUIREMENTS AND RECOMMENDATIONS

TREATMENT REQUIREMENTS

Treatment goals should achieve or exceed the State of Alaska drinking water regulations and the EPA standards as set forth in the National Interim and Secondary Drinking Water Regulations. Table 3-1 lists several of the more common water quality parameters and shows both EPA Maximum Contaminant Level (MCL) requirements and natural levels of these parameters in the Eagle River. The Eagle River water exceeds MCL requirements in only turbidity, color, iron, and manganese.

Table 3-1
WATER QUALITY STANDARDS AND RAW EAGLE RIVER QUALITY

	EPA (MCL)[a]	Raw Eagle River
Physical Factors		
Color (platinum cobalt units)	15	10-70[b]
Odor (threshold odor No.)	3	-
Turbidity (NTU)	1	5-400
Chemical Factors (mg/l)		
Iron	0.3	4.6
Manganese	0.05	0.1
Chloride	250	0.3-30
Sulfate	250	0.5-38
Nitrate-N		0.26
Fluoride	2.4[c]	0.3
Hardness		34-134
Dissolved Solids	500	41-167
pH	6.5-8.5	6.4-8.1 (avg. 7.5)
THM	0.10[c]	

[a] Maximum contaminant level.

[b] Raw water color is influenced by turbidity; raw water samples were not centrifuged or filtered before color was measured.

[c] Maximum for annual average maximum daily air temperature 50 degrees F.

After it was found in Task 1, Well Drilling Program, that the Eagle River Valley does not contain enough groundwater to fulfill the Anchorage area water needs, the Municipality requested that additional testing of Eagle River surface water be conducted for biological quality and for heavy metal and organic chemical content. The results of these analyses (conducted from January to June 1981) are documented in Exhibit B of this report. These results also indicate an excess of color in Eagle River water.

During the eight coldest months when glacial melt ceases, the river is cold (zero to 4 degrees C) with low turbidity (2 to 40 NTU). During the summer, streamflow swells considerably, reflecting glacial melting. In the summer, the river exhibits temperatures ranging from 6 to 8 degrees C and turbidities ranging from 50 to over 400 NTU. The high turbidity caused by glacial flour may seem to present a treatment problem, but highly turbid water actually is more readily treatable. It is cold, low-turbidity water that generally presents the greatest treatment problems.

Experience with Ship Creek water at the Municipal Water Treatment Plant indicates that removal of color and turbidity during periods of low raw water turbidity requires special treatment beyond the addition of 10 to 15 mg/l of alum. The same may be true of Eagle River water. To enhance the coagulation, sedimentation, and filtration processes for effective color and low turbidity removal, lime addition at the headworks or other treatment methods might be required.

In general, Eagle River raw water should be an excellent source of potable water but, prior to final design, it is strongly recommended that a full 1-year pilot plant testing program, using at least a 1-mgd plant, be conducted to establish process design criteria. This testing program should address iron, color, and turbidity removal; chemical dosages required over the full range of raw water parameters; filtration rates and media selection; and effectiveness of the recommended treatment processes.

TREATMENT PROCESSES

To satisfy the water treatment requirements most efficiently, the plant will require different operational modes to accommodate summer and winter variations. Figure 3-1 illustrates three possible operational modes: conventional treatment, direct filtration, and in-line filtration. Conventional treatment uses flash-mixing of coagulants, flocculation, sedimentation, and filtration processes. This mode would be applicable during the summer months when the river turbidity is high--over 50 NTU.

Direct filtration uses most of the above processes but would bypass the sedimentation basins. In-line filtration would bypass the flocculation and sedimentation basins but would move the coagulant application point closer to the filters. Both direct and

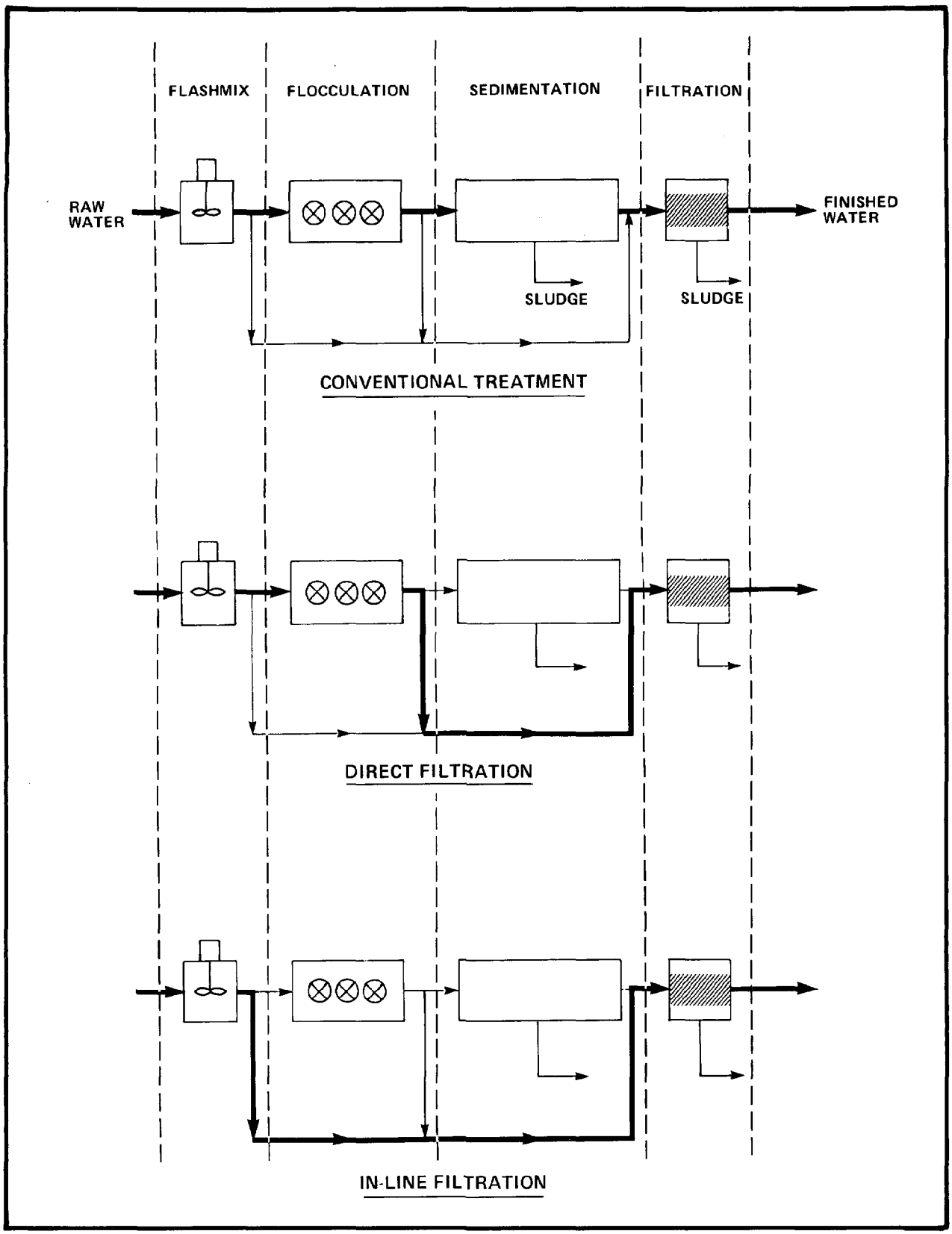


Figure 3-1
Treatment Process Options

in-line filtration should be applicable for Eagle River water treatment during the fall, winter, and spring months when glacial melt is at a minimum and, therefore, raw water turbidity is less than 50 NTU. The feasibility of using direct and in-line filtration should be confirmed by the pilot testing program.

Conventional treatment is compatible with either the direct or in-line process. The transition, seasonally, from one process to the other would be easy. Bypass channels or piping is all that is needed to achieve operational flexibility. As might be expected, operational cost for either direct or in-line filtration will be substantially lower than for conventional treatment because of lower chemical dosages, reduced sludge production, and less equipment maintenance.

TREATMENT PLANT

Figure 3-2 shows a typical filtration plant flow schematic, and Figure 3-3 shows a preliminary layout for a 70-million-gallon-a-day plant. The plant could be constructed in increments with basins and filters added when needed with little disruption to continuing operation of existing facilities. From the layout, it can be seen that a 7-acre site will be required.

Although plant site selection is beyond the scope of this task, desirable sites would be those that provide easy access during all weather conditions, minimize pumping requirements through careful site selection at the proper elevation, and eliminate the need for either raw or finished water pumping. Elimination of raw water pumping is more desirable, providing construction cost savings and reduced equipment wear. Finished water pumping can facilitate customer service along the transmission pipeline.

Headworks

The headworks contains facilities for application and mixing of chemicals plus a metering device to measure raw water flow into the plant. Chemicals can be mixed by using either an "in-channel rapid mixer" or a metering device such as a Parshall flume.

Flocculation

Floc nuclei (aluminum hydroxide) resulting from coagulation join together through numerous contacts and envelop suspended particles in the process. Upon sufficient mixing, the floc grows to a size and density that settle readily.

It is important in both the flash-mixing and flocculation zones that equipment be furnished with variable-speed drives to allow variation in energy inputs. Because optimum mixing requirements vary from season to season, chemicals may be wasted if proper adjustments cannot be made.

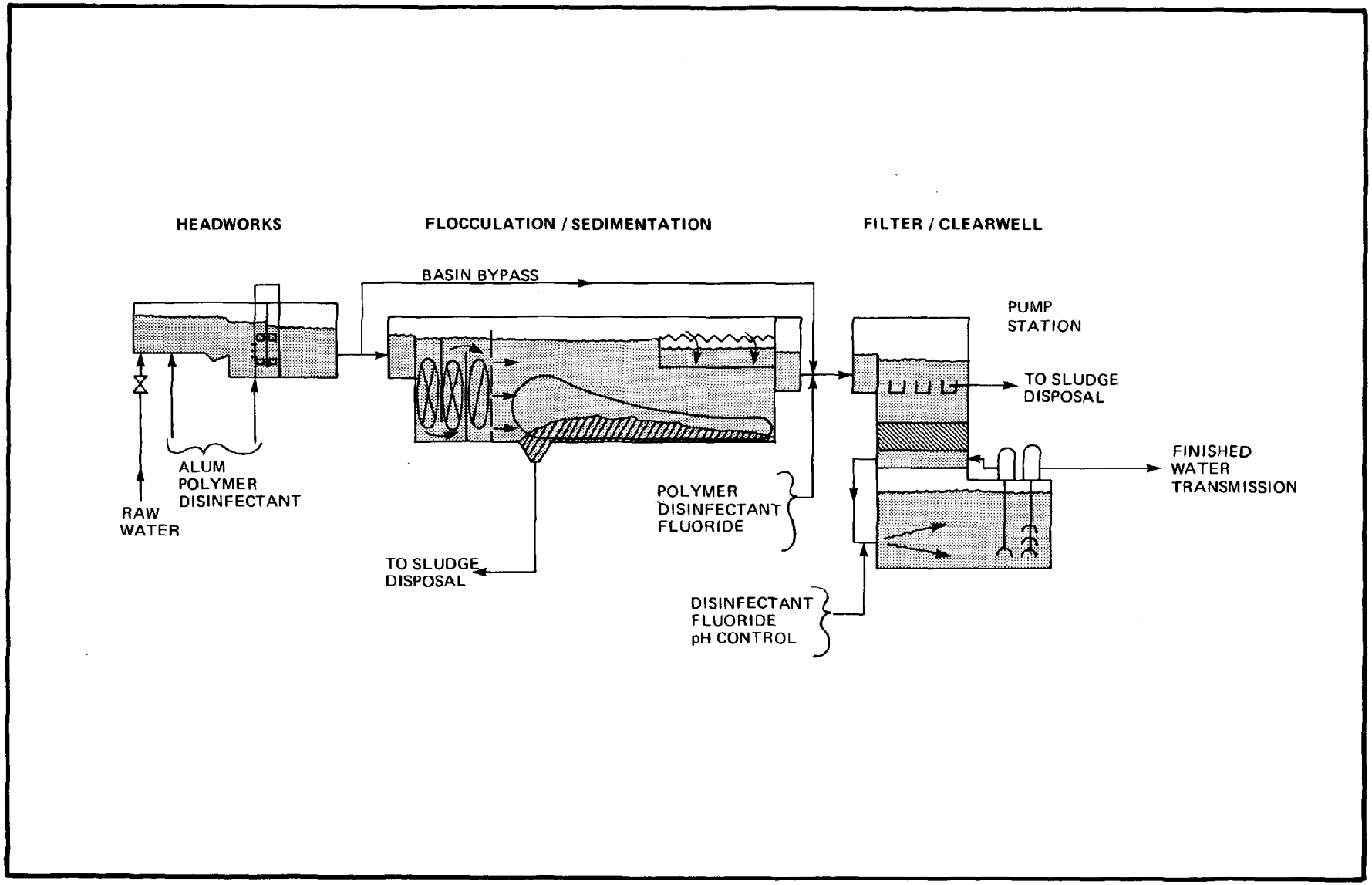
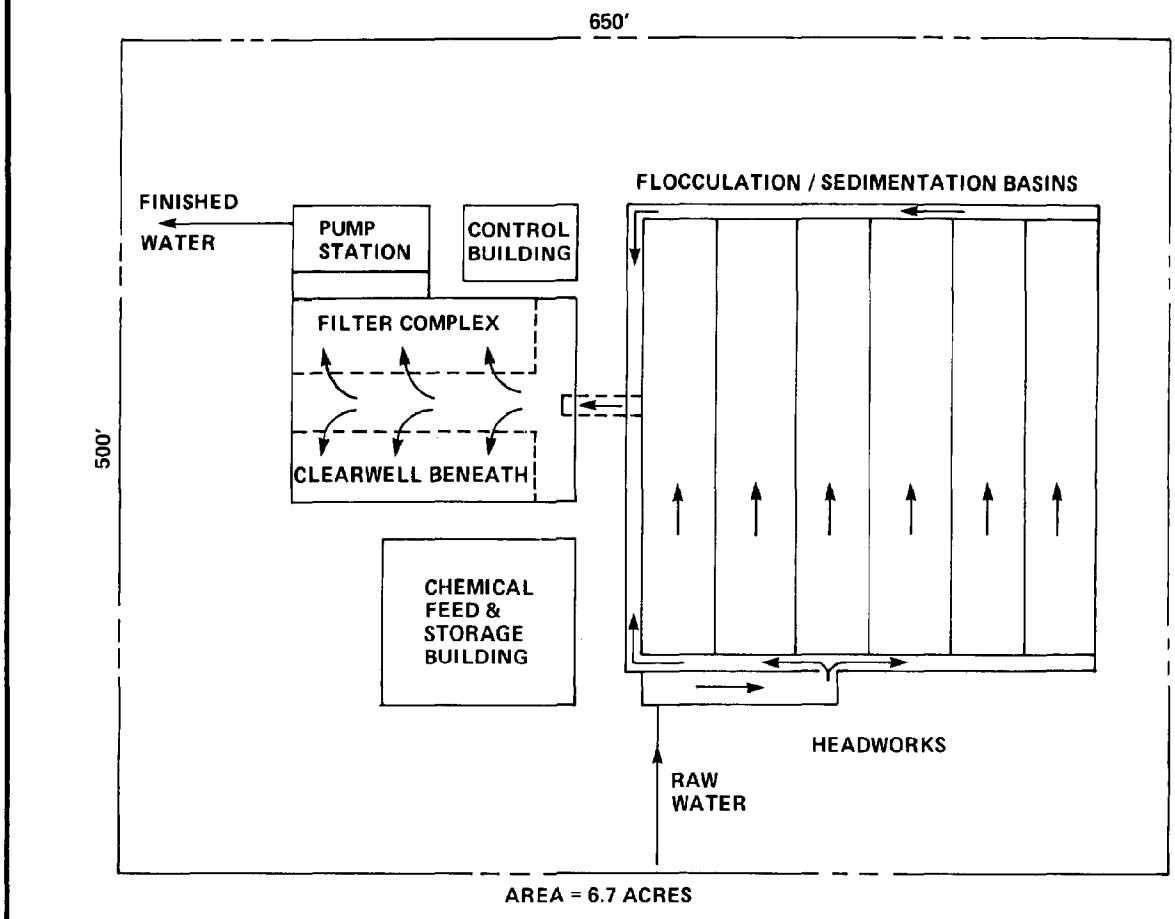


Figure 3-2
Typical Plant Flow Schematic



Scale 1"=100'

Figure 3-3
Preliminary Plant Layout

Sedimentation

Dense floc particles, including suspended solids, settle out in the sedimentation area leaving comparatively clear water containing a minimum of floc. Because of the heavy rock flour load, the sedimentation basins should be equipped with mechanical sludge removal equipment. It is anticipated that between 50 and 150 tons of dry solids sludge will be produced daily during the summer.

Filtration System

The settled water from the sedimentation area, containing a small amount of unsettled floc, proceeds to the filters. The filters remove the remaining floc. Granular media filters consist of either two or three layers, each exhibiting a different size and specific gravity. The largest grain media having the lowest specific gravity is located at the top of the filter with progressively smaller and heavier sizes toward the bottom. This arrangement permits floc and sediment particles to be removed throughout the entire filter rather than mostly at the surface as typically occurs in single-grain-media filters. The addition of polymer as a filter aid immediately ahead of filtration improves floc removal within a filter, even at higher filtration rates. A nominal filtration rate of 6 gallons per minute per square foot is suggested for an Eagle River filtration plant. Pilot filter testing is needed to (1) verify the design filter rates, both summer and winter; (2) select filtering media specifically for local conditions; and (3) identify which chemicals are needed to aid filtration and in what quantity.

Wastewater Disposal

Sludge containing rock flour and sediment from the river is produced in two locations in the plant: the sedimentation basin underflow and the filter backwash water. At a plant flow rate of 70 mgd and a raw water turbidity of 150 NTU, the quantity of sludge produced would equal 55 tons per day of dry solids, which would equal approximately 730 cubic feet per day of solids. Removal of solids from sludge for ultimate disposal is often the most complex problem to be solved in the design of a water treatment plant.

Generally, there are two means for dewatering sludge solids, either by natural means such as evaporation, percolation, and freezing or by mechanical means using such devices as vaccum filters, filter presses, and centrifuges. The cost for mechanical dewatering is usually three to ten times the cost for natural drying.

Natural drying in drying beds or lagoons is the practical choice where climatic conditions permit drying to the degree that the sludge exhibits the characteristics of a solid that can be readily loaded for landfill disposal. Usually two or more beds or lagoons are provided to permit use of one while the other is drying.

More thorough evaluation of the local climatic and geologic conditions is required before a decision can be made regarding sludge disposal.

Disinfection

With the addition of disinfection, the water leaving the filters is of potable quality and ready for transmission and distribution to the public. Although chlorine has been the universal disinfectant in public water works, further consideration should be given to the use of other disinfectants for preliminary disinfecting while continued use of chlorine or hypochlorite will likely remain the choice for post disinfection as the water enters the transmission and distribution systems. Further investigation is required prior to selecting disinfectants and their application points within the plant. Trihalomethane formation potential needs to be determined upon selection of Eagle River surface water as supply source.

ALTERNATIVE TREATMENT METHODS

Alternative treatment methods were considered, some of which were reported by others in previous studies. These methods include hydroclone separators, screening with microstrainers, and precoat filters. Only precoat filtration is applicable for the Eagle River conditions and could be considered an alternative to granular media filtration. Historically, granular media filtration is the choice for public water supplies, especially installations over 5 mgd. The disadvantage of precoat filtration is the possibility of loss of the precoat from the filtering septum, allowing raw water to short circuit through the filter. Loss of precoat can be caused by hydraulic surges, changing flow rate, power failure, and operator error. Granular media filters are subject to operator error only. Further consideration of the precoat filtration is not considered worthwhile.

Chapter 4
COST ESTIMATE

Table 4-1 shows the total project costs for a 70-mgd plant as well as a 23.33-mgd plant, which provides for ultimate plant development in three equal increments.

Table 4-1
ESTIMATED PROJECT COSTS[a]

	Plant Capacity	
	23-1/3 mgd	70 mgd
Capital		
Construction (Anchorage)	$10,900,000	$26,000,000
Contingency, Bonds and Insurance, and Technical, Adm., and Legal Services (Anchorage)	6,459,000	15,400,000
TOTAL Capital Costs[b]	$17,359,000	$41,400,000
Annual O&M		
Labor	443,000	895,000
Chemicals	335,000	1,006,000
Power	193,000	580,000
Maintenance Materials	98,000	212,000
Miscellaneous	6,000	17,000
TOTAL Annual O&M Costs	$ 1,075,000	$ 2,710,000

[a] In January 1981 dollars.

[b] Land costs are not included.

The estimated construction costs and operation and maintenance costs are based on actual experience for plants constructed and operated in the Pacific Northwest and have been adjusted to reflect costs for Alaska. They are also based on the EPA Estimating Water Treatment Costs, Volumes 1 and 2, and on the MAUS, Volume 2. These estimates are considered as order of-magnitude estimates with a -30 to +50 percent reliability range.

Construction costs reflect the use of reinforced concrete construction with all basins and filters being enclosed. The estimates

include finished water pumping (without standby power) but exclude both raw water and finished water transmission piping and raw water pumping.

Construction costs are in January 1981 dollars using an Engineering News Record Construction Cost Index of 347. Although land costs are not included in the estimates, the site requirements are 7 acres for the plant and 23 acres for the lagoons--a total of 30 acres.

Chapter 5
BIBLIOGRAPHY

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U.S. Environmental Protection Agency. Estimating Water Treatment Costs, Volume 1, Summary. EPA-600/2-79-162A. Municipal Environmental Research Laboratory, Office of Research and Development. Prepared by Culp/Wesner/Culp Consulting Engineers, Santa Ana, California. August 1979.

_____. Estimating Water Treatment Costs, Volume 2, Cost Curves Applicable to 200 MGD Treatment Plants. EPA-600/2-79-162B. Municipal Environmental Research Laboratory, Office of Research and Development. Prepared by Culp/Wesner/Culp Consulting Engineers, Santa Ana, California. August 1979.

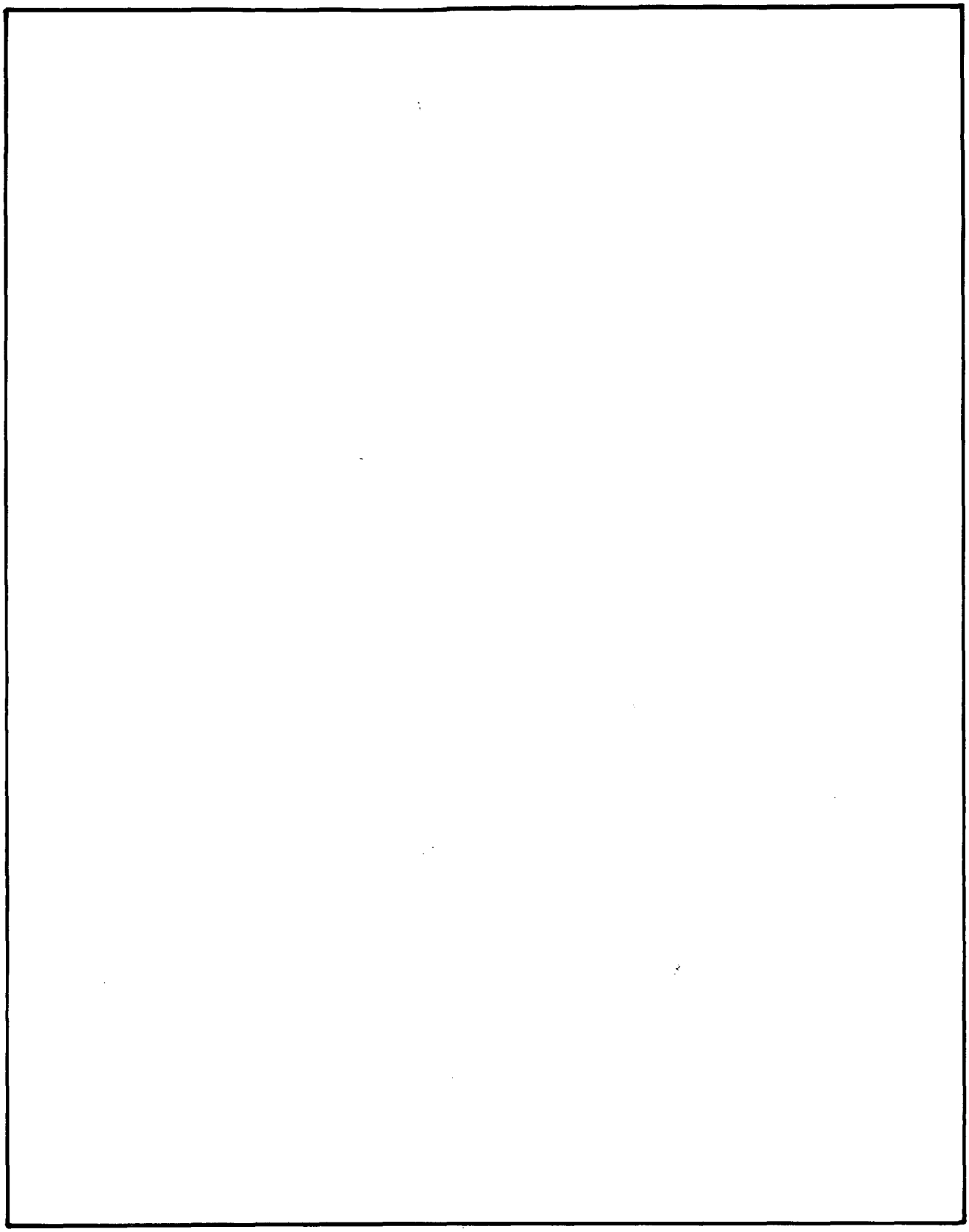

Exhibit A
USGS Water Quality Data

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
15277100 - EAGLE R AT EAGLE RIVER AK

PROCESS DATE 12/02/81
DISTRICT CODE 02

WATER QUALITY DATA

DATE	TIME	TEMPERATURE (DEG C) (00010)	SURFACE AREA / (SQ MI) (00049)	COLOR (PLATINUM-COBALT UNITS) (00080)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	PH (UNITS) (00400)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	ALKALINITY FIELD (MG/L AS CACO3) (00410)	BICARBONATE (MG/L AS HCO3) (00440)	CARBONATE (MG/L AS CO3) (00445)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)
OCT , 1948											
19...	--	--	192	--	174	--	--	67	82	--	.36
19...	0845	--	--	--	--	--	--	--	--	0	--
APR , 1949											
28...	1620	1.5	--	--	198	--	--	81	99	0	--
JUN											
24...	1820	9.0	192	--	133	6.7	19	48	58	0	.27
APR , 1951											
19...	--	--	192	10	146	7.5	3.4	55	67	0	.23
JUN											
06...	--	9.5	192	5	113	7.0	8.5	43	53	0	.16
FEB , 1952											
21...	1000	.0	192	5	209	7.0	16	83	101	0	.27
MAR											
12...	0900	.5	192	5	211	7.5	5.1	82	100	0	.27
APR											
16...	1200	1.0	192	5	194	7.4	5.9	76	93	0	.25
MAY											
08...	1300	7.0	192	5	203	7.5	5.1	82	100	0	.23
JUN											
12...	1600	10.0	192	5	152	7.2	7.5	61	74	0	.32
JUL											
14...	1430	9.0	192	5	92	6.8	11	36	44	0	.16
AUG											
22...	1800	10.0	192	5	98	7.1	6.1	39	48	0	.14
MAY , 1956											
03...	--	--	192	10	190	7.5	4.4	71	86	0	.29
JUL											
04...	--	--	192	5	107	7.6	1.9	39	47	0	.11
OCT , 1957											
02...	1055	1.5	192	5	166	7.6	2.7	55	67	0	.07
NOV											
05...	1030	3.0	192	5	192	7.6	3.4	69	84	0	.27
DEC											
10...	--	.5	192	0	187	7.4	6.2	80	97	0	.38
FEB , 1958											
21...	1500	--	192	0	228	7.4	6.9	89	108	0	.27
MAY											
21...	1700	9.5	192	0	207	7.3	7.5	77	94	0	.66
JUL											
16...	1800	--	192	20	91	6.4	24	31	38	0	.05

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
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WATER QUALITY DATA

DATE	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS, NONCARBONATE (MG/L CACO3) (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM ADSORPTION RATIO (00931)	PERCENT SODIUM (00932)	SODIUM+POTASSIUM DISSOLVED (MG/L AS NA) (00933)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)
OCT , 1948										
19...	86	18	27	4.4	--	--	--	3.2	--	2.0
19...	--	--	--	--	--	--	--	--	--	--
APR , 1949										
28...	--	--	--	--	--	--	--	--	--	3.0
JUN										
24...	64	16	20	3.4	--	--	--	2.3	--	.5
APR , 1951										
19...	67	12	21	3.5	--	--	--	2.7	--	1.2
JUN										
06...	53	10	17	2.6	--	--	--	3.5	--	1.5
FEB , 1952										
21...	105	22	33	5.5	--	--	--	8.3	--	1.2
MAR										
12...	106	24	33	5.7	--	--	--	4.1	--	4.8
APR										
16...	96	20	30	5.1	--	--	--	2.3	--	2.5
MAY										
08...	105	23	32	6.1	--	--	--	4.0	--	2.5
JUN										
12...	75	14	23	4.3	--	--	--	4.7	--	2.5
JUL										
14...	46	10	14	2.6	--	--	--	2.2	--	1.0
AUG										
22...	50	11	15	3.0	--	--	--	3.1	--	.8
MAY , 1956										
03...	91	20	28	5.1	3.0	.1	7	--	1.0	1.8
JUL										
04...	49	10	17	1.5	3.5	.2	13	--	1.4	.5
OCT , 1957										
02...	81	26	24	5.1	1.9	.1	5	--	.4	.5
NOV										
05...	90	21	28	4.8	2.9	.1	7	--	.5	1.0
DEC										
10...	91	11	26	6.3	3.2	.1	7	--	.5	2.0
FEB , 1958										
21...	114	25	32	8.4	3.6	.1	6	--	.6	2.5
MAY										
21...	101	24	31	5.7	2.6	.1	5	--	.4	1.0
JUL										
16...	44	13	13	2.9	.9	.1	4	--	.6	1.5

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
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PROCESS DATE 12/02/81
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WATER QUALITY DATA

DATE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS NO3) (71851)	MANGA-NESE (UG/L AS MN) (71883)	IRON (UG/L AS FE) (71885)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
OCT , 1948										
19...	20	--	3.9	--	102	.14	1.6	--	--	250.00
19...	--	--	--	--	--	--	--	--	--	--
APR , 1949										
28...	24	--	--	--	--	--	--	--	--	--
JUN										
24...	19	--	4.2	--	79	.11	1.2	--	--	250.00
APR , 1951										
19...	14	.3	5.5	--	82	.11	1.0	--	20	250.00
JUN										
06...	13	--	3.0	--	68	.09	.70	--	30	250.00
FEB , 1952										
21...	36	.1	6.4	129	142	.18	1.2	--	40	250.00
MAR										
12...	24	.0	7.1	130	129	.18	1.2	--	40	250.00
APR										
16...	19	.1	6.3	118	112	.16	1.1	--	140	250.00
MAY										
08...	26	.1	6.6	--	128	.17	1.0	--	140	250.00
JUN										
12...	19	.1	5.2	--	97	.13	1.4	--	30	250.00
JUL										
14...	12	.0	3.4	--	58	.08	.70	--	130	250.00
AUG										
22...	15	--	4.1	--	65	.09	.60	--	240	250.00
MAY , 1956										
03...	22	.0	5.0	--	110	.15	1.3	10	0	250.00
JUL										
04...	15	.0	2.6	--	65	.09	.50	0	0	250.00
OCT , 1957										
02...	28	.0	3.2	--	96	.13	.30	0	40	250.00
NOV										
05...	24	.0	7.2	--	111	.15	1.2	0	20	250.00
DEC										
10...	17	.1	9.0	--	114	.16	1.7	0	0	250.00
FEB , 1958										
21...	27	.0	8.9	--	137	.19	1.2	0	0	250.00
MAY										
21...	26	.1	4.4	--	120	.16	2.9	10	20	250.00
JUL										
16...	13	.0	2.3	--	53	.07	.20	--	100	250.00

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
15277100 - EAGLE R AT EAGLE RIVER AK

PROCESS DATE 12/02/81
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WATER QUALITY DATA

DATE	TIME	TEMPERATURE (DEG C) (00010)	SURFACE AREA (SQ MI) (00049)	DISCHARGE, IN CUBIC FEET PER SECOND (00060)	STREAMFLOW, INSTANTANEOUS (CFS) (00061)	COLOR (PLATINUM-COBALT UNITS) (00080)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	PH (UNITS) (00400)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	ALKALINITY FIELD (MG/L AS CACO3) (00410)	BICARBONATE (MG/L AS HCO3) (00440)
AUG , 1958											
12...	1145	6.0	192	--	--	30	76	6.5	16	26	32
SEP , 1966											
13...	1300	6.0	--	--	1160	--	--	--	--	--	--
OCT											
26...	1200	.5	--	--	--	5	243	7.8	2.6	85	104
NOV											
16...	1200	.0	--	--	85	--	222	--	--	--	--
MAR , 1967											
20...	--	.0	--	--	54	5	286	7.5	5.8	94	114
20...	1130	.0	--	--	54	--	286	--	--	--	--
MAY											
04...	1100	4.0	192	--	155	5	197	7.6	3.6	74	90
12...	1330	9.5	--	--	193	5	206	7.7	3.2	82	100
JUN											
05...	1045	7.0	--	--	742	--	151	--	--	--	--
05...	1115	7.0	--	--	742	5	151	7.7	2.2	56	68
29...	1340	6.5	192	--	1650	5	94	7.6	1.6	33	40
29...	1400	6.5	--	--	1650	--	94	--	--	--	--
29...	1715	6.5	--	2000	--	--	94	--	--	--	--
30...	1730	7.0	--	2140	--	--	87	--	--	--	--
JUL											
01...	1745	9.0	--	1500	--	--	95	--	--	--	--
04...	1730	8.0	--	1670	--	--	95	--	--	--	--
05...	1730	8.0	--	1450	--	--	95	--	--	--	--
06...	1800	8.5	--	1580	--	--	95	--	--	--	--
08...	1745	8.5	--	1470	--	--	95	--	--	--	--
09...	1745	8.5	--	1410	--	--	95	--	--	--	--
10...	1730	11.5	--	1510	--	--	95	--	--	--	--
11...	1730	12.0	--	1860	--	--	83	--	--	--	--
12...	1730	12.0	--	2180	--	--	83	--	--	--	--
13...	1800	11.5	--	2130	--	--	83	--	--	--	--
14...	1800	12.0	--	2410	--	--	80	--	--	--	--
15...	1730	7.0	--	2580	--	--	77	--	--	--	--
19...	1730	7.0	--	1790	--	--	77	--	--	--	--
20...	1800	6.5	--	2980	--	--	77	--	--	--	--
21...	1800	10.0	--	2830	--	--	77	--	--	--	--
22...	1800	9.5	--	2310	--	--	77	--	--	--	--
23...	1730	8.5	--	2180	--	--	74	--	--	--	--
24...	1800	8.5	--	2300	--	--	71	--	--	--	--
25...	1830	9.0	--	2510	--	--	71	--	--	--	--

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
15277100 - EAGLE R AT EAGLE RIVER AK

PROCESS DATE 12/02/81
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WATER QUALITY DATA

DATE	CARBONATE (MG/L AS CO3) (00445)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS, NONCARBONATE (MG/L CACO3) (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM ADSORPTION RATIO (00931)	PERCENT SODIUM (00932)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)
AUG , 1958											
12...	0	.05	34	8	9.9	2.4	.8	.1	5	1.2	3.0
SEP , 1966											
13...	--	--	--	--	--	--	--	--	--	--	--
OCT											
26...	0	.18	108	23	36	4.4	2.7	.1	5	.3	1.4
NOV											
16...	--	--	--	--	--	--	--	--	--	--	--
MAR , 1967											
20...	0	.25	134	40	45	5.2	3.1	.1	5	.8	17
20...	--	--	--	--	--	--	--	--	--	--	--
MAY											
04...	0	.23	54	0	32	3.4	3.2	.1	7	.5	1.4
12...	0	.25	99	17	31	5.2	3.8	.2	8	.3	1.1
JUN											
05...	--	--	--	--	--	--	--	--	--	--	--
05...	0	.07	63	7	19	3.8	2.7	.1	8	.6	.4
29...	0	.23	44	11	14	2.0	1.6	.1	7	.4	.4
29...	--	--	--	--	--	--	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
JUL											
01...	--	--	--	--	--	--	--	--	--	--	--
04...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--
06...	--	--	--	--	--	--	--	--	--	--	--
08...	--	--	--	--	--	--	--	--	--	--	--
09...	--	--	--	--	--	--	--	--	--	--	--
10...	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--
12...	--	--	--	--	--	--	--	--	--	--	--
13...	--	--	--	--	--	--	--	--	--	--	--
14...	--	--	--	--	--	--	--	--	--	--	--
15...	--	--	--	--	--	--	--	--	--	--	--
19...	--	--	--	--	--	--	--	--	--	--	--
20...	--	--	--	--	--	--	--	--	--	--	--
21...	--	--	--	--	--	--	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	--	--	--
23...	--	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--	--
25...	--	--	--	--	--	--	--	--	--	--	--

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
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DATE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)	SED. SUSP. FALL DIAM. % FINER THAN .008 MM (70339)	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)	SED. SUSP. FALL DIAM. % FINER THAN .031 MM (70341)
AUG , 1958											
12...	10	.0	2.0	45	--	.06	--	--	--	--	--
SEP , 1966											
13...	--	--	--	--	--	--	30	40	52	62	69
OCT											
26...	24	.1	5.9	127	--	.17	--	--	--	--	--
NOV											
16...	--	--	--	--	--	--	--	--	--	--	--
MAR , 1967											
20...	31	.0	7.2	167	24.3	.23	--	--	--	--	--
20...	--	--	--	--	--	--	--	--	--	--	--
MAY											
04...	26	.3	4.4	117	49.0	.16	--	--	--	--	--
12...	25	.4	4.5	122	63.6	.17	--	--	--	--	--
JUN											
05...	--	--	--	--	--	--	--	--	--	--	--
05...	16	.0	3.5	80	160	.11	--	--	--	--	--
29...	12	.0	3.2	54	241	.07	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
JUL											
01...	--	--	--	--	--	--	--	--	--	--	--
04...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--
06...	--	--	--	--	--	--	--	--	--	--	--
08...	--	--	--	--	--	--	--	--	--	--	--
09...	--	--	--	--	--	--	--	--	--	--	--
10...	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--
12...	--	--	--	--	--	--	--	--	--	--	--
13...	--	--	--	--	--	--	--	--	--	--	--
14...	--	--	--	--	--	--	--	--	--	--	--
15...	--	--	--	--	--	--	--	--	--	--	--
19...	--	--	--	--	--	--	--	--	--	--	--
20...	--	--	--	--	--	--	--	--	--	--	--
21...	--	--	--	--	--	--	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	--	--	--
23...	--	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--	--
25...	--	--	--	--	--	--	--	--	--	--	--

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DATE	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. FALL DIAM. % FINER THAN .500 MM (70345)	SED. SUSP. FALL DIAM. % FINER THAN 1.00 MM (70346)	NITROGEN, NITRATE DISSOLVED (MG/L AS NO3) (71851)	MANGANESE (UG/L AS MN) (71883)	IRON (UG/L AS FE) (71885)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)
AUG , 1958											
12...	--	--	--	--	--	.20	20	20	250.00	--	--
SEP , 1966											
13...	75	84	94	99	100	--	--	--	--	318	996
OCT											
26...	--	--	--	--	--	.80	--	40	--	--	--
NOV											
16...	--	--	--	--	--	--	--	--	--	16	3.7
MAR , 1967											
20...	--	--	--	--	--	1.1	--	320	--	--	--
20...	--	--	--	--	--	--	--	--	--	13	1.9
MAY											
04...	--	--	--	--	--	1.0	--	1300	250.00	50	21
12...	--	--	--	--	--	1.1	--	400	--	33	17
JUN											
05...	68	77	85	99	100	--	--	--	--	176	353
05...	--	--	--	--	--	.30	--	1150	--	--	--
29...	--	--	--	--	--	1.0	--	2300	250.00	--	--
29...	68	76	91	100	--	--	--	--	--	145	646
29...	--	--	--	--	--	--	--	--	--	255	1380
30...	--	--	--	--	--	--	--	--	--	532	3080
JUL											
01...	--	--	--	--	--	--	--	--	--	152	616
04...	--	--	--	--	--	--	--	--	--	132	595
05...	--	--	--	--	--	--	--	--	--	92	360
06...	--	--	--	--	--	--	--	--	--	212	905
08...	--	--	--	--	--	--	--	--	--	72	286
09...	--	--	--	--	--	--	--	--	--	85	324
10...	--	--	--	--	--	--	--	--	--	93	379
11...	--	--	--	--	--	--	--	--	--	192	964
12...	--	--	--	--	--	--	--	--	--	160	942
13...	--	--	--	--	--	--	--	--	--	149	857
14...	--	--	--	--	--	--	--	--	--	236	1540
15...	--	--	--	--	--	--	--	--	--	152	1060
19...	--	--	--	--	--	--	--	--	--	117	566
20...	--	--	--	--	--	--	--	--	--	1200	9660
21...	--	--	--	--	--	--	--	--	--	393	3000
22...	--	--	--	--	--	--	--	--	--	283	1770
23...	--	--	--	--	--	--	--	--	--	139	818
24...	--	--	--	--	--	--	--	--	--	292	1810
25...	--	--	--	--	--	--	--	--	--	292	1980

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DATE	TIME	TEMPERATURE (DEG C) (00010)	SURFACE AREA (SQ MI) (00049)	DISCHARGE, IN CUBIC FEET PER SECOND (00060)	STREAMFLOW, INSTANTANEOUS (CFS) (00061)	COLOR (PLATINUM-COBALT UNITS) (00080)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	PH (UNITS) (00400)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	ALKALINITY FIELD (MG/L AS CACO3) (00410)	BICARBONATE (MG/L AS HCO3) (00440)
JUL , 1967											
26...	1830	6.5	--	2480	--	--	71	--	--	--	--
27...	1730	10.5	--	1930	--	--	80	--	--	--	--
28...	1830	10.0	--	1890	--	--	111	--	--	--	--
29...	1800	10.0	--	1860	--	--	80	--	--	--	--
30...	1800	7.0	--	1900	--	--	77	--	--	--	--
31...	1830	8.5	--	2000	--	--	74	--	--	--	--
AUG											
01...	1830	4.5	--	2770	--	--	71	--	--	--	--
02...	1900	8.5	--	2280	--	--	80	--	--	--	--
03...	1830	9.5	--	2090	--	--	80	--	--	--	--
04...	1830	15.0	--	2170	--	--	80	--	--	--	--
05...	1800	8.5	--	2410	--	--	71	--	--	--	--
06...	1830	9.5	--	2370	--	--	71	--	--	--	--
07...	1900	7.0	--	2910	--	--	69	--	--	--	--
08...	1800	8.0	--	2970	--	--	69	--	--	--	--
09...	1900	8.0	--	2280	--	--	77	--	--	--	--
11...	1900	8.0	--	1950	--	--	80	--	--	--	--
14...	1830	9.5	--	3150	--	--	71	--	--	--	--
15...	1830	8.5	--	3020	--	--	71	--	--	--	--
17...	1100	9.0	--	--	3110	--	64	--	--	--	--
22...	1800	8.5	--	1360	--	--	87	--	--	--	--
SEP											
19...	--	--	--	--	4090	10	124	7.2	6.0	48	59
19...	1250	4.5	--	--	4090	--	124	--	--	--	--
21...	1500	4.5	--	--	1520	--	133	--	--	--	--
OCT											
04...	1200	2.0	--	--	444	--	--	--	--	--	--
MAY , 1968											
06...	0900	4.0	--	--	95	0	223	7.4	6.9	89	108
06...	1100	4.0	--	--	95	--	--	--	--	--	--
JUL											
03...	1500	8.0	192	--	1520	5	113	7.6	2.1	43	52
AUG											
13...	1300	7.0	192	--	1650	5	74	7.5	1.5	25	30
OCT											
03...	1400	4.0	--	--	194	--	175	--	--	--	--
NOV											
27...	1430	.0	--	--	100	--	225	--	--	--	--
MAR , 1969											
26...	1100	.0	--	--	55	--	233	--	--	--	--

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DATE	CARBONATE (MG/L AS CO3) (00445)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS, NONCARBONATE (MG/L CACO3) (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM ADSORPTION RATIO (00931)	PERCENT SODIUM (00932)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)
JUL , 1967											
26...	--	--	--	--	--	--	--	--	--	--	--
27...	--	--	--	--	--	--	--	--	--	--	--
28...	--	--	--	--	--	--	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--
AUG											
01...	--	--	--	--	--	--	--	--	--	--	--
02...	--	--	--	--	--	--	--	--	--	--	--
03...	--	--	--	--	--	--	--	--	--	--	--
04...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--
06...	--	--	--	--	--	--	--	--	--	--	--
07...	--	--	--	--	--	--	--	--	--	--	--
08...	--	--	--	--	--	--	--	--	--	--	--
09...	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--
14...	--	--	--	--	--	--	--	--	--	--	--
15...	--	--	--	--	--	--	--	--	--	--	--
17...	--	--	--	--	--	--	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	--	--	--
SEP											
19...	0	.23	58	10	17	3.5	1.6	.1	6	1.4	.7
19...	--	--	--	--	--	--	--	--	--	--	--
21...	--	--	--	--	--	--	--	--	--	--	--
OCT											
04...	--	--	--	--	--	--	--	--	--	--	--
MAY , 1968											
06...	0	.18	120	29	38	5.5	3.8	.2	7	.4	1.8
06...	--	--	--	--	--	--	--	--	--	--	--
JUL											
03...	0	.02	50	7	16	2.6	1.7	.1	7	.3	.6
AUG											
13...	0	.05	34	9	11	1.7	.9	.1	5	.6	.8
OCT											
03...	--	--	--	--	--	--	--	--	--	--	--
NOV											
27...	--	--	--	--	--	--	--	--	--	--	--
MAR , 1969											
26...	--	--	--	--	--	--	--	--	--	--	--

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DATE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE) (01045)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)	SED. SUSP. FALL DIAM. % FINER THAN .008 MM (70339)	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)
JUL , 1967											
26...	--	--	--	--	--	--	--	--	--	--	--
27...	--	--	--	--	--	--	--	--	--	--	--
28...	--	--	--	--	--	--	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--	--
30...	--	--	--	--	--	--	--	--	--	--	--
31...	--	--	--	--	--	--	--	--	--	--	--
AUG											
01...	--	--	--	--	--	--	--	--	--	--	--
02...	--	--	--	--	--	--	--	--	--	--	--
03...	--	--	--	--	--	--	--	--	--	--	--
04...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--
06...	--	--	--	--	--	--	--	--	--	--	--
07...	--	--	--	--	--	--	--	--	--	--	--
08...	--	--	--	--	--	--	--	--	--	--	--
09...	--	--	--	--	--	--	--	--	--	--	--
11...	--	--	--	--	--	--	--	--	--	--	--
14...	--	--	--	--	--	--	--	--	--	--	--
15...	--	--	--	--	--	--	--	--	--	--	--
17...	--	--	--	--	--	--	--	32	40	49	60
22...	--	--	--	--	--	--	--	--	--	--	--
SEP											
19...	14	.0	7.3	--	76	839	.10	--	--	--	--
19...	--	--	--	--	--	--	--	47	53	64	70
21...	--	--	--	--	--	--	--	45	52	61	68
OCT											
04...	--	--	--	--	--	--	--	--	--	--	--
MAY , 1968											
06...	24	.1	6.0	--	134	34.4	.18	--	--	--	--
06...	--	--	--	--	--	--	--	--	--	--	--
JUL											
03...	13	.1	2.9	1600	65	267	.09	31	40	52	64
AUG											
17...	7.5	.0	1.8	1100	41	183	.06	27	42	53	61
OCT											
03...	--	--	--	--	--	--	--	--	--	--	--
NOV											
27...	--	--	--	--	--	--	--	--	--	--	--
MAR , 1969											
26...	--	--	--	--	--	--	--	--	--	--	--

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DATE	SED. SUSP. FALL DIAM. % FINER THAN .031 MM (70341)	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. FALL DIAM. % FINER THAN .500 MM (70345)	SED. SUSP. FALL DIAM. % FINER THAN 1.00 MM (70346)	NITROGEN, NITRATE DISSOLVED (MG/L AS NO3) (71851)	IRON (UG/L AS FE) (71885)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)
JUL , 1967											
26...	--	--	--	--	--	--	--	--	--	243	1630
27...	--	--	--	--	--	--	--	--	--	200	1040
28...	--	--	--	--	--	--	--	--	--	150	766
29...	--	--	--	--	--	--	--	--	--	172	864
30...	--	--	--	--	--	--	--	--	--	169	867
31...	--	--	--	--	--	--	--	--	--	158	853
AUG											
01...	--	--	--	--	--	--	--	--	--	775	5800
02...	--	--	--	--	--	--	--	--	--	173	1070
03...	--	--	--	--	--	--	--	--	--	179	1010
04...	--	--	--	--	--	--	--	--	--	198	1160
05...	--	--	--	--	--	--	--	--	--	232	1510
06...	--	--	--	--	--	--	--	--	--	215	1380
07...	--	--	--	--	--	--	--	--	--	280	2200
08...	--	--	--	--	--	--	--	--	--	337	2700
09...	--	--	--	--	--	--	--	--	--	233	1440
11...	--	--	--	--	--	--	--	--	--	168	885
14...	--	--	--	--	--	--	--	--	--	523	4450
15...	--	--	--	--	--	--	--	--	--	354	2890
17...	68	77	86	94	99	100	--	--	--	494	4150
22...	--	--	--	--	--	--	--	--	--	172	632
SEP											
19...	--	--	--	--	--	--	1.0	1660	--	--	--
19...	77	85	92	96	98	100	--	--	--	1120	12400
21...	76	85	92	96	97	100	--	--	--	399	1640
OCT											
04...	--	--	--	--	--	--	--	--	--	44	53
MAY , 1968											
06...	--	--	--	--	--	--	.80	110	--	--	--
06...	--	--	--	--	--	--	--	--	--	26	6.7
JUL											
03...	75	85	92	99	100	--	.10	410	250.00	134	550
AUG											
13...	71	80	89	98	100	--	.20	1100	250.00	138	615
OCT											
03...	--	--	--	--	--	--	--	--	--	8	4.2
NOV											
27...	--	--	--	--	--	--	--	--	--	12	3.2
MAR , 1969											
26...	--	--	--	--	--	--	--	--	--	4	.59

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WATER QUALITY DATA

DATE	TIME	TEMPERATURE (DEG C) (00010)	STREAMFLOW, INSTANTANEOUS (CFS) (00061)	STREAM STAGE (FT ABOVE DATUM) (00065)	COLOR (PLATINUM-COBALT UNITS) (00080)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	PH (UNITS) (00400)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	ALKALINITY FIELD (MG/L AS CACO3) (00410)	BICARBONATE (MG/L AS HCO3) (00440)
MAR , 1969										
26...	1200	.0	55	--	0	233	7.9	2.1	85	104
APR										
29...	1230	1.0	106	--	--	217	--	--	--	--
MAY										
27...	1245	7.0	992	--	--	146	--	--	--	--
JUL										
15...	1130	6.0	1660	--	--	81	--	--	--	--
AUG										
20...	1530	7.0	662	--	--	109	--	--	--	--
OCT										
07...	1430	4.0	2940	7.34	10	113	7.7	1.5	38	46
26...	1515	.0	--	--	--	120	--	--	--	--
DEC										
16...	1500	.0	121	--	--	209	--	--	--	--
MAR , 1970										
03...	1200	.0	90	--	0	233	7.9	2.2	89	109
APR										
29...	1000	4.5	78	--	--	172	--	--	--	--
29...	1015	4.5	78	--	--	172	--	--	--	--
MAY										
21...	1030	8.0	279	--	--	212	--	--	--	--
21...	1100	8.0	279	--	0	212	8.1	1.3	82	100
JUN										
16...	1445	8.0	670	--	--	157	--	--	--	--
16...	1450	8.0	670	--	0	157	8.1	.9	59	72
JUL										
22...	1400	8.0	998	--	5	121	7.8	1.3	43	53
22...	1430	8.0	998	--	--	121	--	--	--	--
AUG										
28...	1030	6.0	784	--	5	112	8.0	.8	39	48
28...	1400	6.0	793	--	--	117	--	--	--	--
OCT										
15...	1115	.5	168	--	5	186	8.0	1.3	66	81
15...	1130	.5	168	--	--	186	--	--	--	--
MAR , 1971										
10...	1230	.0	42	--	--	228	7.9	2.1	84	102
MAY										
19...	1030	4.0	120	--	5	195	7.8	2.3	75	91
19...	1300	4.0	120	--	--	195	--	--	--	--
JUN										
21...	1330	6.5	715	--	--	133	--	--	--	--

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
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WATER QUALITY DATA

DATE	CARBONATE (MG/L AS CO3) (00445)	NITROGEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)	PHOSPHATE, TOTAL (MG/L AS PO4) (00650)	PHOSPHATE, ORTHO, DISSOLVED (MG/L AS PO4) (00660)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS, NONCARBONATE (MG/L CACO3) (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)
MAR , 1969										
26...	0	--	--	.36	--	--	106	21	32	6.1
APR										
29...	--	--	--	--	--	--	--	--	--	--
MAY										
27...	--	--	--	--	--	--	--	--	--	--
JUL										
15...	--	--	--	--	--	--	--	--	--	--
AUG										
20...	--	--	--	--	--	--	--	--	--	--
OCT										
07...	0	--	--	.18	--	--	51	13	15	3.2
26...	--	--	--	--	--	--	--	--	--	--
DEC										
16...	--	--	--	--	--	--	--	--	--	--
MAR , 1970										
03...	0	--	--	.32	--	--	114	24	37	5.0
APR										
29...	--	--	--	--	--	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--
MAY										
21...	--	--	--	--	--	--	--	--	--	--
21...	0	1.1	.000	.63	.15	.00	102	20	32	5.1
JUN										
16...	--	--	--	--	--	--	--	--	--	--
16...	0	--	--	.23	--	--	76	17	24	3.8
JUL										
22...	0	--	--	.16	--	--	55	12	18	2.8
22...	--	--	--	--	--	--	--	--	--	--
AUG										
28...	0	--	--	.07	--	--	53	14	17	2.6
28...	--	--	--	--	--	--	--	--	--	--
OCT										
15...	0	--	--	.27	--	--	92	26	29	4.5
15...	--	--	--	--	--	--	--	--	--	--
MAR , 1971										
10...	0	--	--	--	--	--	113	29	--	--
MAY										
19...	--	--	--	.36	--	--	98	23	31	4.8
19...	--	--	--	--	--	--	--	--	--	--
JUN										
21...	--	--	--	--	--	--	--	--	--	--

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
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WATER QUALITY DATA

DATE	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)
MAR , 1969										
26...	3.5	.1	7	1.4	3.2	26	.1	6.4	--	--
APR										
29...	--	--	--	--	--	--	--	--	--	--
MAY										
27...	--	--	--	--	--	--	--	--	--	--
JUL										
15...	--	--	--	--	--	--	--	--	--	--
AUG										
20...	--	--	--	--	--	--	--	--	--	--
OCT										
07...	1.7	.1	6	2.2	.7	18	.0	3.3	--	--
26...	--	--	--	--	--	--	--	--	--	--
DEC										
16...	--	--	--	--	--	--	--	--	--	--
MAR , 1970										
03...	3.6	.1	6	.5	1.4	28	.0	3.5	--	--
APR										
29...	--	--	--	--	--	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--
MAY										
21...	--	--	--	--	--	--	--	--	--	--
21...	3.6	.2	7	.5	.4	23	.1	4.3	--	--
JUN										
16...	--	--	--	--	--	--	--	--	--	--
16...	2.6	.1	7	.4	.4	20	.1	3.1	--	--
JUL										
22...	1.8	.1	6	.4	.3	16	.1	3.3	--	--
22...	--	--	--	--	--	--	--	--	--	--
AUG										
28...	1.8	.1	0	.4	1.5	15	.0	2.8	--	--
28...	--	--	--	--	--	--	--	--	--	--
OCT										
15...	2.9	.1	6	.4	1.5	21	.0	4.1	40	100
15...	--	--	--	--	--	--	--	--	--	--
MAR , 1971										
10...	--	--	--	--	--	--	--	--	--	--
MAY										
19...	3.5	.2	7	.7	1.8	25	.1	4.5	100	110
19...	--	--	--	--	--	--	--	--	--	--
JUN										
21...	--	--	--	--	--	--	--	--	--	--

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WATER QUALITY DATA

DATE	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)	SED. SUSP. FALL DIAM. % FINER THAN .008 MM (70339)	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)	SED. SUSP. FALL DIAM. % FINER THAN .031 MM (70341)	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)
MAR , 1969										
26...	132	19.6	.18	--	--	--	--	--	--	--
APR										
29...	--	--	--	--	--	--	--	--	--	--
MAY										
27...	--	--	--	16	25	35	46	59	73	83
JUL										
15...	--	--	--	39	50	--	66	--	82	85
AUG										
20...	--	--	--	--	--	--	--	--	89	97
OCT										
07...	68	540	.09	36	47	--	65	--	81	89
26...	--	--	--	--	--	--	--	--	--	--
DEC										
16...	--	--	--	--	--	--	--	--	--	--
MAR , 1970										
03...	134	32.6	.18	--	--	--	--	--	--	--
APR										
29...	--	--	--	--	--	--	--	--	--	--
29...	--	--	--	--	--	--	--	--	--	--
MAY										
21...	--	--	--	--	--	--	--	--	--	--
21...	121	91.1	.16	--	--	--	--	--	--	--
JUN										
16...	--	--	--	--	--	--	--	--	--	--
16...	90	163	.12	--	--	--	--	--	--	--
JUL										
22...	68	183	.09	--	--	--	--	--	--	--
22...	--	--	--	--	--	--	--	--	73	84
AUG										
28...	65	138	.09	--	--	--	--	--	--	--
28...	--	--	--	--	--	--	--	--	80	90
OCT										
15...	105	47.6	.14	--	--	--	--	--	--	--
15...	--	--	--	--	--	--	--	--	--	--
MAR , 1971										
10...	--	--	--	--	--	--	--	--	--	--
MAY										
19...	118	38.2	.16	--	--	--	--	--	--	--
19...	--	--	--	27	37	--	60	--	88	97
JUN										
21...	--	--	--	--	--	--	--	--	77	88

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WATER QUALITY DATA

DATE	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. FALL DIAM. % FINER THAN .500 MM (70345)	SED. SUSP. FALL DIAM. % FINER THAN 1.00 MM (70346)	SED. SUSP. FALL DIAM. % FINER THAN 2.00 MM (70347)	NITROGEN, AMMONIA DISSOLVED (MG/L AS NH4) (71846)	NITROGEN, NITRATE DISSOLVED (MG/L AS NO3) (71851)	MANGANESE (UG/L AS MN) (71883)	IRON (UG/L AS FE) (71885)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)
MAR , 1969										
26...	--	--	--	--	--	1.6	--	370	--	--
APR										
29...	--	--	--	--	--	--	--	--	24	6.9
MAY										
27...	96	100	--	--	--	--	--	--	272	729
JUL										
15...	95	100	--	--	--	--	--	--	150	672
AUG										
20...	100	--	--	--	--	--	--	--	56	100
OCT										
07...	97	99	100	100	--	.80	0	160	1002	7950
26...	--	--	--	--	--	--	--	--	13	--
DEC										
16...	--	--	--	--	--	--	--	--	10	3.3
MAR , 1970										
03...	--	--	--	--	--	1.4	50	10	--	--
APR										
29...	--	--	--	--	--	--	--	--	16	3.4
29...	--	--	--	--	--	--	--	--	18	3.8
MAY										
21...	--	--	--	--	--	--	--	--	21	16
21...	--	--	--	--	.00	2.8	0	70	--	--
JUN										
16...	--	--	--	--	--	--	--	--	34	62
16...	--	--	--	--	--	1.0	20	250	--	--
JUL										
22...	--	--	--	--	--	.70	0	40	--	--
22...	95	100	--	--	--	--	--	--	42	113
AUG										
28...	--	--	--	--	--	.30	0	0	--	--
28...	98	100	--	--	--	--	--	--	46	98
OCT										
15...	--	--	--	--	--	1.2	--	--	--	--
15...	--	--	--	--	--	--	--	--	6	2.7
MAR , 1971										
10...	--	--	--	--	--	--	--	--	9	1.0
MAY										
19...	--	--	--	--	--	1.6	--	--	--	--
19...	98	100	--	--	--	--	--	--	193	63
JUN										
21...	99	100	--	--	--	--	--	--	145	280

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WATER QUALITY DATA

DATE	TIME	TEMPERATURE (DEG C) (00010)	SURFACE AREA (SQ MI) (00049)	STREAMFLOW, INSTANTANEOUS (CFS) (00061)	STREAM STAGE (FT ABOVE DATUM) (00065)	TURBIDITY (JTU) (00070)	COLOR (PLATINUM-COBALT UNITS) (00080)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	OXYGEN, DISSOLVED (MG/L) (00300)	PH (UNITS) (00400)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)
JUN , 1971											
21...	1400	6.5	--	715	--	--	--	133	--	8.0	1.0
JUL											
14...	1130	6.0	--	3500	--	--	--	103	--	--	--
AUG											
14...	1130	6.0	--	3050	--	--	--	97	--	--	--
OCT											
04...	1000	3.0	192	304	--	--	--	173	--	8.0	1.3
MAR , 1972											
30...	1100	.0	192	47	--	--	5	231	--	7.7	3.4
JUN											
09...	1100	9.0	192	373	--	--	0	183	--	8.0	1.4
AUG											
03...	1200	6.5	192	1620	--	--	22	77	--	6.6	15
OCT											
04...	1100	--	192	346	--	6	--	162	--	--	--
FEB , 1973											
05...	1130	.0	192	51	--	--	2	227	--	7.6	4.2
MAY											
08...	1115	7.0	192	94	--	5	--	215	--	--	--
JUL , 1974											
12...	1630	8.0	192	1290	6.04	--	--	101	--	7.1	--
MAY , 1981											
12...	1000	7.0	--	378	--	--	--	170	11.8	7.4	--

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WATER QUALITY DATA

DATE	ALKALINITY FIELD (MG/L AS CACO3) (00410)	BICARBONATE (MG/L AS HCO3) (00440)	CARBONATE (MG/L AS CO3) (00445)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	PHOSPHATE, ORTHO, DISSOLVED (MG/L AS PO4) (00660)	PHOSPHORUS, ORTHO, DISSOLVED (MG/L AS P) (00671)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS, NONCARBONATE (MG/L CACO3) (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)
JUN , 1971											
21...	52	63	0	--	--	--	--	64	12	--	--
JUL											
14...	--	--	--	--	--	--	--	--	--	--	--
AUG											
14...	--	--	--	--	--	--	--	--	--	--	--
OCT											
04...	65	79	0	--	--	--	--	85	20	--	--
MAR , 1972											
30...	88	107	0	.20	--	--	--	112	24	36	5.4
JUN											
09...	70	85	0	.25	--	--	--	88	18	27	5.0
AUG											
03...	30	37	0	--	.02	.15	.050	37	7	12	1.8
OCT											
04...	--	--	--	--	--	--	--	--	--	--	--
FEB , 1973											
05...	86	105	0	--	.18	.00	<.010	110	20	34	5.2
MAY											
08...	--	--	--	--	--	--	--	--	--	--	--
JUL , 1974											
12...	--	--	--	--	--	--	--	--	--	--	--
MAY , 1981											
12...	--	--	--	--	--	--	--	--	--	--	--

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WATER QUALITY DATA

DATE	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)
JUN , 1971											
21...	--	--	--	--	--	--	--	--	--	--	--
JUL											
14...	--	--	--	--	--	--	--	--	--	--	--
AUG											
14...	--	--	--	--	--	--	--	--	--	--	--
OCT											
04...	--	--	--	--	--	--	--	--	--	--	--
MAR , 1972											
30...	3.3	.1	6	.5	2.5	26	.1	8.1	0	30	50
JUN											
09...	3.5	.2	8	.5	1.8	19	.3	2.7	--	70	10
AUG											
03...	1.2	.1	7	.2	1.4	8.9	.0	2.1	--	90	30
OCT											
04...	--	--	--	--	--	--	--	--	--	--	--
FEB , 1973											
05...	3.6	.2	7	.4	1.7	28	.1	6.3	--	40	50
MAY											
08...	--	--	--	--	--	--	--	--	--	--	--
JUL , 1974											
12...	--	--	--	--	--	--	--	--	--	--	--
MAY , 1981											
12...	--	--	--	--	--	--	--	--	--	--	--

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WATER QUALITY DATA

DATE	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	ZINC, DISSOLVED (UG/L AS ZN) (01090)	LITHIUM DISSOLVED (UG/L AS LI) (01130)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	SOLIDS, DISSOLVED (TONS PER DAY) (70302)	SOLIDS, DISSOLVED (TONS PER AC-FT) (70303)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)	SED. SUSP. FALL DIAM. % FINER THAN .008 MM (70339)	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)
JUN , 1971										
21...	--	--	--	--	--	--	--	--	--	--
JUL										
14...	--	--	--	--	--	--	33	43	48	58
AUG										
14...	--	--	--	--	--	--	32	39	46	60
OCT										
04...	--	--	--	--	--	--	--	--	--	--
MAR , 1972										
30...	290	0	0	136	17.3	.18	--	--	--	--
JUN										
09...	--	--	--	103	104	.14	--	--	--	--
AUG										
03...	--	--	--	46	201	.06	24	38	--	56
OCT										
04...	--	--	--	--	--	--	--	--	--	--
FEB , 1973										
05...	--	--	--	132	18.2	.18	--	--	--	--
MAY										
08...	--	--	--	--	--	--	--	--	--	--
JUL , 1974										
12...	--	--	--	--	--	--	--	--	--	--
MAY , 1981										
12...	--	--	--	--	--	--	--	--	--	--

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WATER QUALITY DATA

DATE	SED. SUSP. FALL DIAM. % FINER THAN .031 MM (70341)	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. FALL DIAM. % FINER THAN .500 MM (70345)	SED. SUSP. FALL DIAM. % FINER THAN 1.00 MM (70346)	NITROGEN, NITRATE DISSOLVED (MG/L AS NO3) (71851)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)
JUN , 1971										
21...	--	--	--	--	--	--	--	--	--	--
JUL										
14...	68	81	91	97	100	--	--	--	1440	13600
AUG										
14...	70	85	93	97	99	100	--	--	495	4080
OCT										
04...	--	--	--	--	--	--	--	250.00	15	12
MAR , 1972										
30...	--	--	--	--	--	--	.90	250.00	--	--
JUN										
09...	--	86	95	99	100	--	1.1	250.00	41	41
AUG										
03...	--	77	88	98	100	--	--	250.00	99	433
OCT										
04...	--	--	--	--	--	--	--	250.00	20	19
FEB , 1973										
05...	--	--	--	--	--	--	--	250.00	--	--
MAY										
08...	--	--	--	--	--	--	--	250.00	5	1.3
JUL , 1974										
12...	--	--	--	--	--	--	--	250.00	--	--
MAY , 1981										
12...	--	--	--	--	--	--	--	--	--	--

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		OCTOBER			NOVEMBER			DECEMBER	
1	532	---	100	334		40	80		3.0
2	487	---	90	273		30	75		3.0
3	449	---	70	208		20	75		3.0
4	419	44	50	197		20	75		3.0
5	393	---	50	187		10	75		3.0
6	367	---	40	115		8.0	75		3.0
7	352	---	40	85		5.0	70		3.0
8	340	---	40	75		4.0	70		3.0
9	326	---	30	70		3.0	70		3.0
10	316	---	30	70		3.0	70		3.0
11	302	---	30	70		3.0	70		3.0
12	288	---	20	70		3.0	70		3.0
13	284	---	30	80		4.0	70		3.0
14	277	---	20	100		6.0	90		5.0
15	281	---	30	110		5.0	110		9.0
16	260	---	20	115		6.0	100		7.0
17	248	---	20	120		7.0	85		5.0
18	226	---	20	130		8.0	80		4.0
19	225	---	20	150		10	80		4.0
20	219	---	20	170		10	75		3.0
21	229	---	20	216		20	75		3.0
22	226	---	20	208		20	70		3.0
23	213	---	20	186		10	70		3.0
24	189	---	10	117		7.0	70		3.0
25	157	---	10	100		6.0	70		3.0
26	254	---	30	95		5.0	70		3.0
27	227	---	20	90		5.0	70		3.0
28	208	---	20	85		4.0	70		3.0
29	190	---	20	85		4.0	100		6.0
30	222	---	20	80		3.0	170		20
31	227	---	20	---			140		10
TOTAL	8933	---	980	3991		289.0	2540		136.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBE 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JANUARY			FEBRUARY			MARCH	
1	110		8.0	65		2.0	62		1.0
2	95		6.0	65		2.0	62		1.0
3	90		5.0	65		2.0	62		1.0
4	85		4.0	65		2.0	62		1.0
5	80		4.0	65		2.0	62		1.0
6	80		3.0	65		2.0	62		1.0
7	75		3.0	65		2.0	62		1.0
8	75		3.0	65		2.0	62		1.0
9	75		3.0	65		2.0	62		1.0
10	70		2.0	65		2.0	62		1.0
11	70		2.0	65		2.0	60		1.0
12	70		2.0	65		2.0	60		1.0
13	70		2.0	65		2.0	60		1.0
14	70		2.0	65		2.0	60		1.0
15	65		2.0	65		2.0	60		1.0
16	65		2.0	62		1.0	60		1.0
17	65		2.0	62		1.0	60		1.0
18	65		2.0	62		1.0	60		1.0
19	65		2.0	62		1.0	60		1.0
20	65		2.0	62		1.0	60		1.0
21	65		2.0	62		1.0	60		1.0
22	65		2.0	62		1.0	60		1.0
23	65		2.0	62		1.0	60		1.0
24	65		2.0	62		1.0	60		1.0
25	65		2.0	62		1.0	60		1.0
26	65		2.0	62		1.0	60		1.0
27	65		2.0	62		1.0	60		1.0
28	65		2.0	62		1.0	60		1.0
29	65		2.0	62		1.0	60		1.0
30	65		2.0	---			60		1.0
31	65		2.0	---			60		1.0
TOTAL	2220		83.0	1843		44.0	1880		31.0

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		APRIL			MAY			JUNE	
1	60		1.0	80	---	4.0	698	50	94
2	60		1.0	80	---	4.0	638	40	69
3	60		1.0	85	---	5.0	621	33	55
4	60		1.0	85	---	5.0	590	25	40
5	60		1.0	90	---	6.0	579	15	23
6	60		1.0	95	26	7.0	579	17	27
7	60		1.0	100	---	7.0	570	17	26
8	60		1.0	105	---	8.0	560	15	23
9	60		1.0	110	---	8.0	585	20	32
10	60		1.0	115	---	10	656	27	48
11	60		1.0	120	---	10	773	53	111
12	60		1.0	138	---	10	906	105	257
13	60		1.0	169	---	20	1170	215	679
14	60		1.0	205	---	40	1300	220	772
15	60		1.0	224	---	40	1410	185	704
16	60		1.0	225	---	30	1450	175	685
17	60		1.0	224	---	30	1290	130	453
18	60		1.0	247	---	40	1170	90	284
19	60		1.0	282	---	50	1120	84	254
20	60		1.0	370	---	100	1200	80	259
21	65		2.0	500	---	230	1180	75	239
22	65		2.0	615	242	402	1070	65	188
23	65		2.0	700	175	331	970	60	157
24	65		2.0	720	130	253	866	55	129
25	70		3.0	730	96	189	843	50	114
26	70		3.0	736	80	159	986	55	146
27	70		3.0	698	65	122	978	48	127
28	70		3.0	686	55	102	1090	63	185
29	75		4.0	835	140	316	1380	120	447
30	75		4.0	823	207	460	1590	180	773
31	---			855	95	219	---	---	---
TOTAL	1896		48.0	11047	---	3217.0	28818	---	7400

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JULY			AUGUST			SEPTEMBER	
1	1690	198	903	1580	150	640	773	73	150
2	1630	180	792	1480	130	519	704	64	120
3	1550	143	598	1340	106	384	668	64	120
4	1430	125	483	1380	107	399	650	57	100
5	1540	125	520	1550	109	456	780	92	190
6	1700	150	688	1950	240	1260	898	90	220
7	1850	175	874	2310	298	1860	962	78	200
8	2060	320	1780	2290	268	1660	914	65	160
9	2260	417	2540	2270	230	1410	829	45	100
10	2030	315	1730	2130	175	1010	710	30	58
11	1670	215	969	1730	172	803	590	34	54
12	1630	149	656	1560	155	653	530	29	41
13	1590	122	524	1660	151	677	470	30	38
14	1650	121	539	1520	148	607	436	31	36
15	1620	127	555	1320	132	470	404	33	36
16	1550	138	578	1320	108	385	376	30	30
17	1610	152	661	1200	100	324	336	25	23
18	1630	140	616	1120	100	302	317	24	21
19	1500	130	526	1260	101	344	303	20	16
20	1650	130	579	1510	111	453	282	22	17
21	1760	135	642	1750	172	813	270	15	11
22	1750	150	709	1370	105	388	255	15	10
23	1910	190	980	1190	70	220	243	12	7.9
24	1770	230	1100	1220	85	280	233	12	7.5
25	1910	260	1340	1120	155	469	230	14	8.7
26	2200	285	1690	1100	95	280	226	8	4.9
27	2110	325	1850	1010	88	240	220	10	5.9
28	1870	295	1490	970	120	314	220	8	4.8
29	2000	250	1350	954	95	240	222	6	3.6
30	2110	182	1040	914	74	180	220	12	7.1
31	1810	158	772	858	72	170	---	---	---
TOTAL	55040	---	30074	44936	---	18210	14271	---	1801.4
YEAR	177409		62313.4						

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		OCTOBER			NOVEMBER			DECEMBER	
1	201	10	5.4	120	15	4.9	95	9	2.3
2	192	11	5.7	120	15	4.9	90	9	2.2
3	194	14	7.3	120	15	4.9	90	9	2.2
4	189	10	5.1	120	15	4.9	85	9	2.1
5	183	10	4.9	120	15	4.9	85	9	2.1
6	173	19	8.9	110	15	4.5	80	9	1.9
7	173	30	14	110	15	4.5	75	9	1.8
8	170	52	24	110	15	4.5	70	9	1.7
9	170	52	24	110	15	4.5	65	9	1.6
10	173	37	17	110	15	4.5	60	9	1.5
11	168	65	29	110	15	4.5	60	7	1.1
12	164	58	26	110	15	4.5	65	7	1.2
13	161	32	14	110	15	4.5	70	7	1.3
14	164	20	8.9	110	15	4.5	75	7	1.4
15	162	19	8.3	110	15	4.5	75	7	1.4
16	158	27	12	100	12	3.2	70	7	1.3
17	152	30	12	100	12	3.2	70	7	1.3
18	149	20	8.0	100	12	3.2	70	7	1.3
19	119	20	6.4	100	12	3.2	70	7	1.3
20	115	20	6.2	100	12	3.2	70	7	1.3
21	130	20	7.0	100	12	3.2	65	5	.88
22	125	20	6.8	100	12	3.2	65	5	.88
23	140	20	7.6	100	12	3.2	65	5	.88
24	150	20	8.1	100	12	3.2	65	5	.88
25	150	20	8.1	100	12	3.2	65	5	.88
26	140	15	5.7	100	12	3.2	60	5	.81
27	135	15	5.5	100	12	3.2	60	5	.81
28	130	15	5.3	100	12	3.2	60	5	.81
29	130	15	5.3	100	12	3.2	60	5	.81
30	125	15	5.1	95	12	3.1	60	5	.81
31	125	15	5.1	---	---	---	55	5	.74
TOTAL	4810	---	316.7	3195	---	117.4	2170	---	41.49

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JANUARY			FEBRUARY			MARCH	
1	55	4	.59	30	3	.24	36	3	.29
2	50	4	.54	30	3	.24	36	3	.29
3	46	4	.50	30	3	.24	36	3	.29
4	46	4	.50	30	3	.24	36	3	.29
5	44	4	.48	30	3	.24	36	3	.29
6	44	3	.36	30	3	.24	36	3	.29
7	44	3	.36	30	3	.24	36	3	.29
8	42	3	.34	30	3	.24	38	3	.31
9	42	3	.34	30	3	.24	38	3	.31
10	42	3	.34	30	3	.24	38	3	.31
11	40	3	.32	32	3	.26	38	3	.31
12	40	3	.32	32	3	.26	38	3	.31
13	40	3	.32	32	3	.26	38	3	.31
14	40	3	.32	32	3	.26	38	3	.31
15	38	3	.31	32	3	.26	38	3	.31
16	38	3	.31	32	3	.26	38	3	.31
17	38	3	.31	32	3	.26	38	3	.31
18	38	3	.31	32	3	.26	38	3	.31
19	36	3	.29	32	3	.26	40	3	.32
20	36	3	.29	32	3	.26	40	3	.32
21	36	3	.29	34	3	.28	42	4	.45
22	36	3	.29	34	3	.28	44	4	.48
23	34	3	.28	34	3	.28	44	4	.48
24	34	3	.28	34	3	.28	46	4	.50
25	34	3	.28	34	3	.28	48	4	.52
26	32	3	.26	34	3	.28	50	4	.54
27	32	3	.26	34	3	.28	50	4	.54
28	32	3	.26	34	3	.28	50	4	.54
29	30	3	.24	---	---	---	55	4	.59
30	30	3	.24	---	---	---	55	4	.59
31	30	3	.24	---	---	---	55	4	.59
TOTAL	1199	---	10.37	892	---	7.24	1289	---	11.90

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		APRIL			MAY			JUNE	
1	55	5	.74	110	20	5.9	495	62	83
2	60	5	.81	110	20	5.9	465	35	44
3	60	5	.81	120	20	6.5	495	35	47
4	60	5	.81	120	20	6.5	560	38	57
5	60	5	.81	130	20	7.0	565	36	55
6	65	6	1.1	130	20	7.0	520	24	34
7	65	6	1.1	140	20	7.6	535	32	46
8	65	6	1.1	140	20	7.6	632	42	72
9	65	6	1.1	150	20	8.1	773	85	177
10	70	6	1.1	150	20	8.1	882	68	162
11	70	8	1.5	160	20	8.6	898	46	112
12	70	8	1.5	160	20	8.6	1050	72	204
13	75	8	1.6	170	15	6.9	1200	103	334
14	75	8	1.6	170	20	9.2	1310	138	488
15	75	8	1.6	170	20	9.2	1630	165	726
16	80	10	2.2	172	33	15	2210	668	4070
17	80	10	2.2	175	32	15	2350	660	4190
18	80	10	2.2	186	63	32	1890	387	1970
19	85	10	2.3	212	106	61	1620	298	1300
20	85	10	2.3	261	72	51	1470	233	925
21	85	15	3.4	276	52	39	1410	200	761
22	90	15	3.6	416	249	334	1400	185	699
23	90	15	3.6	515	280	389	1430	149	575
24	90	15	3.6	510	150	207	1340	110	398
25	95	15	3.8	644	170	296	1490	136	547
26	95	20	5.1	922	190	473	1590	217	932
27	100	30	8.1	1060	232	664	1760	242	1150
28	100	35	9.5	808	115	251	1890	252	1290
29	105	24	6.8	614	75	124	1830	247	1220
30	105	20	5.7	575	80	124	1860	226	1130
31	---	---	---	520	100	140	---	---	---
TOTAL	2355	---	81.68	9996	---	3327.7	37550	---	23798

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JULY			AUGUST			SEPTEMBER	
1	1790	191	923	1310	84	297	626	39	66
2	1690	168	767	1370	79	292	668	40	72
3	1690	178	812	1520	128	525	644	37	64
4	1890	200	1020	1560	154	649	602	37	60
5	1790	200	967	2000	173	934	495	32	43
6	1730	194	906	1730	168	785	432	26	30
7	1760	184	874	1390	158	593	404	26	28
8	1630	161	709	1190	136	437	404	26	28
9	1580	145	619	1010	110	300	388	26	27
10	1530	129	533	954	100	258	500	42	57
11	1520	116	476	978	87	230	808	95	207
12	1670	110	496	850	67	154	780	76	160
13	1670	123	555	698	61	115	585	42	66
14	1750	147	695	550	53	79	510	40	55
15	1670	147	663	545	48	71	475	37	47
16	1580	121	516	545	46	68	450	32	39
17	1430	116	448	575	42	65	408	26	29
18	1470	112	445	656	48	85	384	26	27
19	1410	105	400	638	48	83	372	25	25
20	1330	102	366	638	56	96	356	21	20
21	1360	94	345	632	32	55	372	26	26
22	1310	92	325	608	37	61	412	28	31
23	1410	94	358	575	34	53	408	28	31
24	1510	147	599	480	28	36	364	26	26
25	1860	220	1100	465	46	58	324	21	18
26	1470	187	742	515	55	76	296	20	16
27	1310	150	531	570	42	65	273	10	7.4
28	1390	147	552	614	42	70	267	10	7.2
29	1570	131	555	620	37	62	356	14	13
30	1410	84	320	674	42	76	348	12	11
31	1300	89	312	632	45	77	---	---	---
TOTAL	48480	---	18929	27092	---	6805	13711	---	1336.6
YEAR	152739		54783.08						

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		OCTOBER			NOVEMBER			DECEMBER	
1	309			320			120		
2	276			340			120		
3	267			300			120		
4	312			270			120		
5	366			250			120		
6	784			230			120		
7	2740			210			120		
8	1460			200			120		
9	1460			190			120		
10	1040			180			120		
11	1170			170			120		
12	1370			160			120		
13	1850			150			120		
14	1340			150			120		
15	943			140			120		
16	754			140			120		
17	656			140			120		
18	644			140			120		
19	570			130			130		
20	485			130			130		
21	438			130			130		
22	382			130			120		
23	326			130			120		
24	303			130			120		
25	285			130			120		
26	258			130			110		
27	230			130			110		
28	210			120			110		
29	200			120			110		
30	220			120			110		
31	280			---			120		
TOTAL	21928			5210			3700		

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JANUARY			FEBRUARY			MARCH	
1	120			90			90		
2	110			90			90		
3	110			90			90		
4	110			90			90		
5	110			90			90		
6	100			90			85		
7	100			90			85		
8	100			90			85		
9	100			90			85		
10	100			90			85		
11	100			90			85		
12	100			90			85		
13	100			90			85		
14	100			90			85		
15	100			90			85		
16	95			90			85		
17	95			90			85		
18	95			90			85		
19	95			90			85		
20	95			90			85		
21	95			90			85		
22	95			90			85		
23	95			90			85		
24	95			90			85		
25	95			90			85		
26	95			90			80		
27	95			90			80		
28	95			90			80		
29	95			---			80		
30	95			---			80		
31	95			---			80		
TOTAL	3080			2520			2630		

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		APRIL			MAY			JUNE	
1	80			84			360		
2	80			84			370		
3	80			84			400		
4	80			84			450		
5	80			84			430		
6	80			86			410		
7	80			94			500		
8	80			96			800		
9	80			98			700		
10	80			106			600		
11	80			127			700		
12	80			165			800		
13	80			202			1000		
14	80			267			800		
15	80			288			700		
16	75			276			662		
17	75			267			632		
18	75			255			698		
19	75			255			698		
20	75			264			728		
21	75			279			754		
22	75			291			775		
23	75			291			845		
24	75			294			929		
25	75			285			1010		
26	77			288			964		
27	79			329			985		
28	81			358			1120		
29	82			366			1210		
30	82			360			1150		
31	---			350			---		
TOTAL	2351			6757			22180		

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611928 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JULY			AUGUST			SEPTEMBER	
1	1180			2090			803		
2	1240			1820			796		
3	1310			1700			775		
4	1340			1450			957		
5	1310			1410			852		
6	1180			1590			728		
7	1080			1740			632		
8	1160			1640			530		
9	1300			1330			458		
10	1310			1180			430		
11	1280			1150			426		
12	1230			1280			638		
13	1200			1440			859		
14	1140			1350			894		
15	1040			1280			845		
16	971			1290			761		
17	936			1210			698		
18	1040			1250			686		
19	1050			1310			620		
20	971			1200			535		
21	1010			1210			470		
22	1010			1090			418		
23	971			985			390		
24	999			866			362		
25	1150			782			350		
26	1390			761			343		
27	1750			782			346		
28	2060			789			358		
29	2110			810			350		
30	2370			838			326		
31	2300			845			---		
TOTAL	40378			38468			17636		
YEAR	166838		166838						

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		OCTOBER			NOVEMBER			DECEMBER	
1	309			160			82		
2	300			120			82		
3	297			110			80		
4	264			130			80		
5	231			170			80		
6	255			140			80		
7	249			130			80		
8	230			120			80		
9	220			115			80		
10	210			110			80		
11	200			105			78		
12	190			100			78		
13	180			98			78		
14	170			96			78		
15	173			94			78		
16	153			92			76		
17	151			90			76		
18	155			90			76		
19	137			88			76		
20	80			88			76		
21	110			86			74		
22	120			86			74		
23	110			86			74		
24	105			84			74		
25	100			84			70		
26	100			84			66		
27	110			84			64		
28	130			82			64		
29	160			82			62		
30	180			82			62		
31	220			---			62		
TOTAL	5599			3086			2320		

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JANUARY			FEBRUARY			MARCH	
1	62			50			46		
2	62			50			45		
3	64			50			45		
4	66			50			44		
5	66			50			44		
6	66			52			43		
7	64			54			43		
8	62			60			42		
9	62			65			42		
10	60			62			42		
11	60			59			41		
12	60			56			41		
13	58			54			40		
14	58			54			40		
15	58			52			39		
16	56			52			39		
17	56			52			39		
18	56			50			39		
19	54			50			39		
20	54			50			39		
21	54			50			38		
22	54			49			38		
23	52			49			38		
24	52			48			38		
25	52			48			38		
26	52			47			37		
27	52			47			37		
28	52			46			37		
29	50			---			37		
30	50			---			37		
31	50			---			37		
TOTAL	1774			1456			1244		

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611829 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		APRIL			MAY			JUNE	
1	37			36			143	---	---
2	37			36			139	36	14
3	37			36			129	38	13
4	37			36			143	45	17
5	37			37			169	140	64
6	36			37			243	325	213
7	36			37			312	295	249
8	36			38			382	325	335
9	36			39			462	365	455
10	36			40			656	400	708
11	36			42			680	268	492
12	36			45			638	158	272
13	36			55			674	155	282
14	36			60			740	200	400
15	36			60			838	174	394
16	35			55			734	110	218
17	35			60			626	87	147
18	35			80			535	71	103
19	35			120			520	72	101
20	35			130			545	100	147
21	35			140			674	136	247
22	35			130			686	90	167
23	35			120			728	110	216
24	35			120			971	140	367
25	35			130			1400	190	718
26	35			140			1640	300	1330
27	35			133			1820	260	1280
28	35			137			1670	240	1080
29	35			143			1470	220	873
30	35			139			1370	198	732
31	---			135			---	---	---
TOTAL	1070			2546			21737	---	11634

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 12-03-81

STATION NUMBER 15277100 EAGLE R AT EAGLE RIVER AK STREAM SOURCE AGENCY USGS
LATITUDE 611828 LONGITUDE 1493332 DRAINAGE AREA 192.00 DATUM 250.00 STATE 02 COUNTY 020

SEDIMENT DISCHARGE, SUSPENDED (TONS/DAY), WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
		JULY			AUGUST			SEPTEMBER	
1	1150	168	522	1800			1290		
2	1010	148	404	1900			1220		
3	922	128	319	1700			1050		
4	901	120	292	1400			898		
5	1030	120	334	1200			881		
6	1210	130	425	1500			804		
7	1390	175	657	2000			662		
8	1500	318	1290	3000			601		
9	1650	405	1800	4500			564		
10	1920	655	3400	4000			531		
11	2180	820	4830	3500			495		
12	2410	725	4720	2800			471		
13	2950	1810	14400	2800			461		
14	3430	1650	15300	2940			468		
15	2940	950	7540	2560			447		
16	2450	640	4230	2200			439		
17	2090	500	2820	1990			456		
18	1950	400	2110	2050			405		
19	1780	325	1560	1870			372		
20	2090	365	2060	1670			402		
21	2030	350	1920	1590			502		
22	1700	---	---	1650			502		
23	1500	---	---	1580			427		
24	1150	---	---	1450			380		
25	1300	---	---	1390			354		
26	1500	---	---	1350			330		
27	1800	---	---	1240			307		
28	2100	---	---	1070			290		
29	1800	---	---	1030			284		
30	1500	---	---	1110			277		
31	1600	---	---	1210			---		
TOTAL	54933	---	70933	62050			16570		
YEAR	174385		82567						

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR

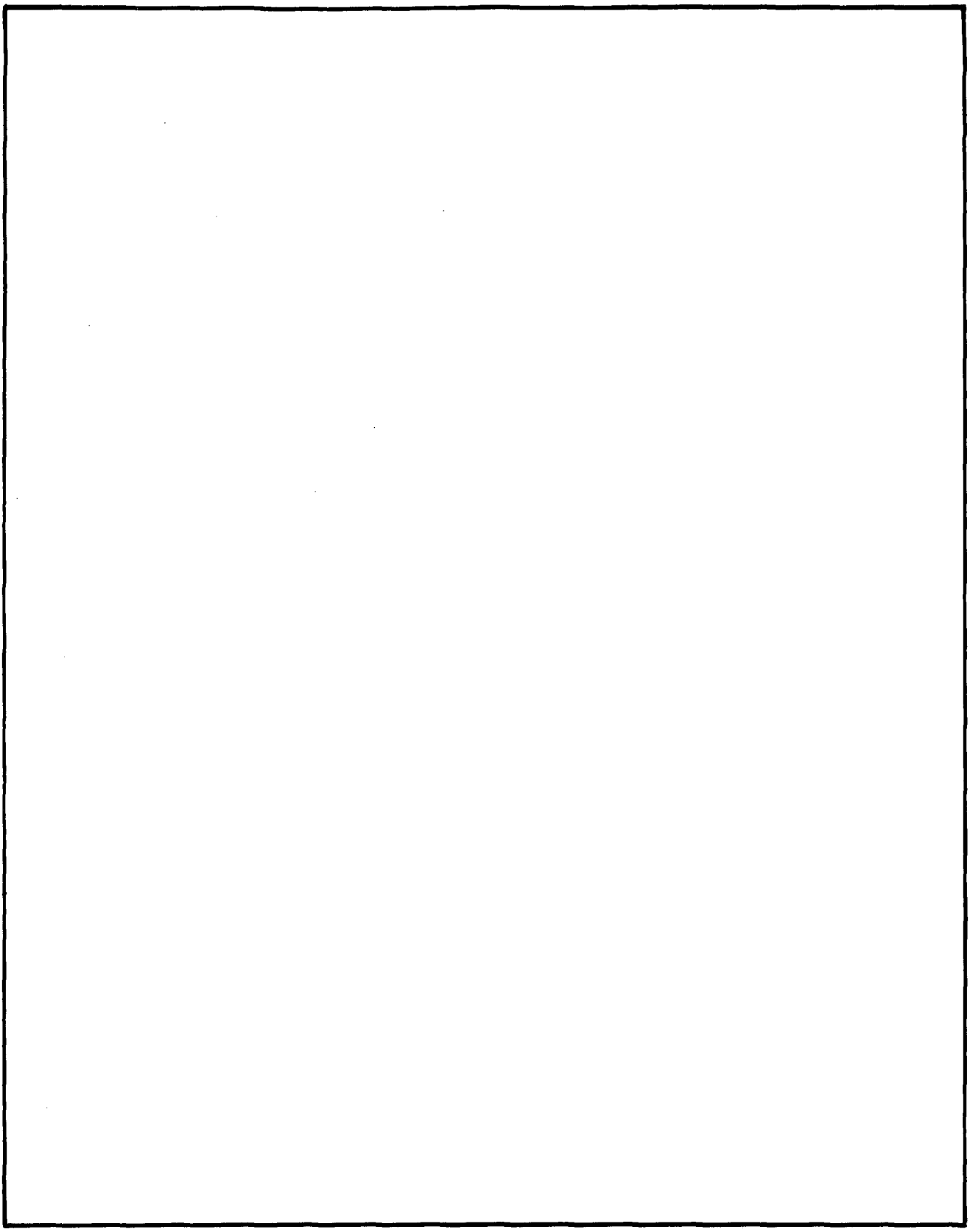

Exhibit B
Additional Testing

Exhibit B
ADDITIONAL TESTING

It was concluded from Task 1, Well Drilling Program, that no significant groundwater supply exists in the Eagle River Valley. Emphasis was then placed on the study of Eagle River surface water as a potential means to meet the growing water demands of the Municipality of Anchorage. To supplement the data presented in this report for Task 3, Flour Water Treatment Study, samples of water were taken from eight sites along the Eagle River between January and June 1981 and were tested for quality. This Exhibit contains the data from this supplemental testing.

The water sampling sites are shown on Figure B-1. Site A, Eagle River 200 Feet Upstream of Glenn Highway, Right Bank, corresponds to the Task 3 testing site. Other sites were chosen at various points to identify potential contamination sources.

Coliform tests were performed on samples from all the sites; however samples from Sites C and E were not tested on a regular basis. The results of these tests are shown in Table B-1.

Complete State of Alaska drinking water standard tests were performed on water from Sites A and D on a regular basis, and from Sites E and H less frequently. The results of these tests are summarized in Tables B-2 and B-3.

Analysis of the results of the additional testing indicates that the Eagle River surface water should be suitable for human consumption if the proper treatment is applied to it. If this water is selected as a future drinking water source, it is recommended that further, more detailed water quality tests be conducted.

Additionally, there are indications that groundwater is moving from the vicinity of the old Eagle River dump to the river. If the lower damsite (see Appendix II) is chosen for development, the potential impacts of the old dump on the river should be thoroughly analyzed.

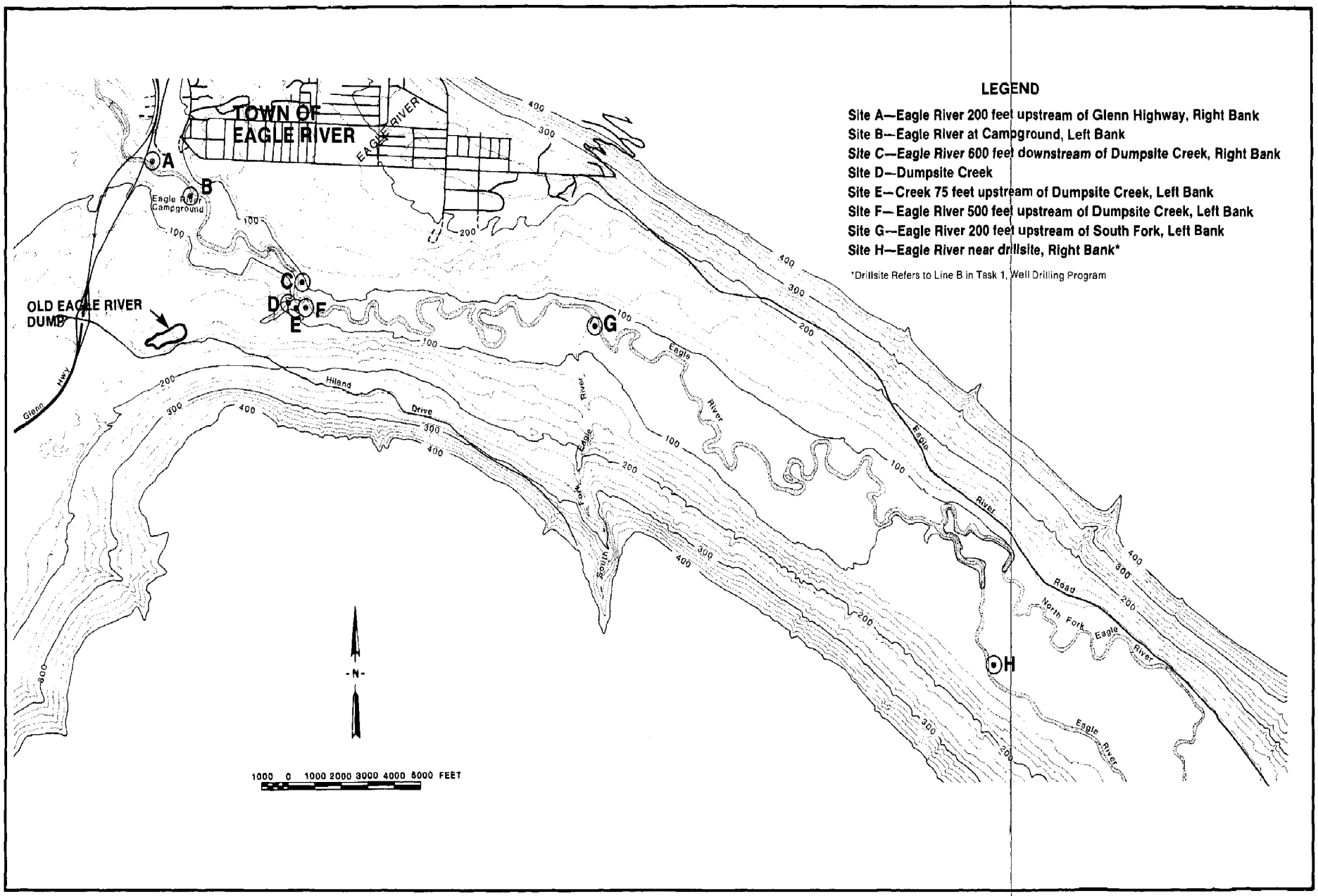

Figure B-1
Sampling Sites for Additional Tests

Table B-1
COLIFORM ANALYSIS
JANUARY THROUGH JUNE 1981

Site[a]	Date	Fecal Coliform	Total Coliform
Site A	01/22/81		9
	02/24/81		33
	03/19/81		TNTC[b]
	04/01/81	0	2
	04/08/81	2	6
	04/22/81	0	TNTC
	05/15/81	0	2
	06/23/81	11	TNTC
Site B	04/01/81	2	3
	04/08/81	1	17
	04/22/81	3	11
	05/15/81	1	0
	06/23/81	25	TNTC
Site C	03/19/81		52
Site D	03/19/81		TNTC
	04/08/81	0	5
	04/22/81	17	TNTC
	05/15/81	0	TNTC
	06/23/81	400	TNTC
Site E	02/24/81		4
	04/01/81	0	0
Site F	04/01/81	1	4
	04/08/81	1	18
	05/15/81	0	2
	06/23/81	28	TNTC
Site G	04/01/81	32	35
	04/08/81	1	0
	04/22/81	3	TNTC
	05/15/81	0	10
	06/23/81	54	TNTC
Site H	04/01/81	8	22
	04/08/81	2	31
	04/22/81	0	3
	05/15/81	0	8

[a] Refer to Figure B-1 for description of sites.
[b] Too numerous to count.

Table B-2
INORGANICS
JANUARY THROUGH JUNE 1981

Site[a]	Date	As	Ba	Cd	Cr	F	Fe	Pb	Mn	Hg	Nitrate-N	Se	Ag	Na
Site A	01/22/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.11	<0.01	0.03	<0.001	0.86	<0.01	<0.01	2.7
	02/24/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.12	<0.01	0.03	<0.001	0.62	<0.01	<0.01	2.9
	03/19/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.50	<0.01	0.04	<0.001	0.38	<0.01	<0.01	2.5
	04/22/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.68	<0.01	0.07	<0.001	0.86	<0.01	<0.01	2.9
	05/15/81	<0.01	0.013	<0.010	<0.01	<0.1	0.21	<0.01	0.02	<0.001	0.90	<0.01	<0.01	2.9
	06/23/81	<0.01	<0.5	<0.010	<0.05	<0.1	1.6	<0.01	0.04	<0.001	0.21	<0.01	<0.01	1.7
Site D	03/19/81	<0.01	<0.5	<0.010	<0.01	0.23	8.9	<0.01	1.0	<0.001	0.15	<0.01	<0.01	2.9
	04/22/81	<0.01	<0.5	<0.010	<0.01	<0.1	2.5	<0.01	0.20	<0.001	0.17	<0.01	<0.01	3.0
	05/15/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.88	<0.01	0.06	<0.001	0.29	<0.01	<0.01	3.7
	06/23/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.1	<0.01	<0.01	<0.001	0.17	<0.01	<0.01	4.2
Site E	02/24/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.13	<0.01	0.03	<0.001	0.60	<0.01	<0.01	3.3
Site H	04/22/81	<0.01	<0.5	<0.010	<0.01	<0.1	0.34	<0.01	0.02	<0.001	0.42	<0.01	<0.01	3.0

[a]Refer to Figure B-1 for site descriptions.

Table B-3
COLOR, TURBIDITY, ORGANICS, AND RADIOACTIVITY
JANUARY THROUGH JUNE 1981

				Organics						Radioactivity		
Site[a]	Date	Color	Turbidity	Endrin	Lindane	Methoxychlor	Toxaphene	2,4D	2,4,5-TP Silvex	Gross A	Gross B	Lab[b]
Site A	01/22/81	5.0	0.55	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	9.0 ± 1.0	4.5 ± 1.1	Chem. & Geo.
	02/24/81	10.0	0.44	<0.0002	<0.004	<0.01	<0.005	<0.01	<0.01	7.2 ± 1.0	8.1 ± 1.3	Chem. & Geo.
	03/19/81	20.0	4.2	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	6.2 ± 1.3		Chem. & Geo.
	04/22/81	15.0	4.8	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	0.2 ± 1.2	1.8 ± 4.7	CH2M HILL
	05/15/81	20.0	2.3	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	7.5 ± 2.3		Chem. & Geo.
	06/23/81	20.0	18.0	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.001	0.0 ± 0.9	2.9 ± 4.3	CH2M HILL
Site D	03/19/81	150.0	64.0	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	1.8 ± 0.6		Chem. & Geo.
	04/22/81	15.0	26.0	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	6.4 ± 0.9		Chem. & Geo.
	05/15/81	70.0	39.0	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	4.5 ± 2.1		Chem. & Geo.
	06/23/81	10.0	0.6	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	0.0 ± 1.3	2.1 ± 5.3	CH2M HILL
Site E	02/24/81	10.0	2.5	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	8.1 ± 1.3	11.7 ± 1.5	Chem. & Geo.
Site H	04/22/81	5.0	2.3	<0.0002	<0.004	<0.1	<0.005	<0.1	<0.01	-0.9 ± 2	4.5 ± 5.0	CH2M HILL
	05/15/81									-0.1 ± 0.8	-0.5 ± 3.6	CH2M HILL

[a]Refer to Figure B-1 for site descriptions.

[b]The reliability of the tests performed by a laboratory in Wyoming for Chemical and Geological Laboratories of Alaska, Inc., is questionable.