Introduction

To An

INSTREAM FLOW STUDY PLAN

For The

PROPOSED SUSITNA HYDROELECTRIC PROJECT

DRAFT

E. Woody Trihey

Prepared for

Acres American Inc.
Buffalo, New York

May 31, 1981

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June 14, 1981

Mr. Kevin Young, Environmental Coordinator
Susitna Hydroelectric Project
Acres American, Inc.
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Main at Court
Buffalo, New York 14202

Dear Kevin:

Enclosed is the preliminary draft of an instream flow study plan for the Susitna hydroelectric project. This report is submitted as the final product of Task 3 referenced in Mr. Hayden's letter to me dated March 2, 1981.

The draft study plan is intended to introduce the concept of an instream flow assessment and outline several philosophical and technical aspects of an assessment which would be applicable to the proposed Susitna hydroelectric project. Thus, this draft study plan should stimulate discussion and produce decisions at two important levels.

Following internal review, the draft can be submitted to APA, FERC and the project's Steering Committee and Advisory Group. Their comments will be most valuable when deciding what to do after March 1982. Of more immediate interest however is the coordination of pertinent subtasks of the ongoing engineering and environmental studies. I believe this can best be accomplished at the middle-management level.

Table 1 of the draft study plan summarizes my views concerning the likelihood of the output from the ongoing engineering and environmental studies satisfying the expectations of FERC and Alaska's resource and regulatory agencies. It is my opinion that several questions documented in the January instream flow survey can be addressed. In fact, a great deal can be accomplished by March 1982 which could be included in a license application. However, this work would principally serve to indicate what additional studies must be undertaken in concert with the FERC license review process.

During the next two weeks I will concentrate on developing the specific statements and recommendations needed to implement the modifications suggested in Table 1.

Sincerely,

Woody

E. Woody Trihey, P.E.

INTRODUCTION

In November 1979 the Alaska Power Authority (APA) contracted with Acres American Inc. to undertake a feasibility study pertaining to the development of a major hydroelectric project on the Susitna River and to prepare a license application for submission to the Federal Energy Regulatory Commission (FERC).

A major component of the Application for License is an Environmental Report (Exhibit E). In part, this report must provide a general but comprehensive description of the aquatic environment of the project area and must present sufficient baseline streamflow and water quality data for determining project effects on normal and seasonal variability. The Environmental Report must also include a discussion of project effects on existing instream flow uses and on any existing or proposed uses of project water for irrigation, domestic and industrial supplies, or other purposes. Additionally, any proposed mitigative, enhancement, or protective measures to offset the impacts expected during construction and operation of the project are to be discussed. The mitigation plan must be prepared in consultation with appropriate state and federal regulatory and resource management agencies. The applicant is not required to accept the mitigation proposal of any agency. However, if the applicant rejects any measures recommended by an agency, the applicant must submit a written explanation of the basis for the rejection and a description of the applicant's alternative to the agency recommendation.

In order to meet these requirements, it is first necessary to identify and evaluate baseline streamflow and water quality conditions as well as the nature and extent of both existing and anticipated uses of streamflows in the project area. The pre-project aquatic and terrestrial resources likely to be affected by the proposed development must be characterized and seasonal habitat requirements defined. Following the acquisition and assembly of these data and information, a comprehensive

instream flow assessment would be undertaken in order to develop and assemble the technical information needed to substantiate the discussions, impact statements, and mitigation proposals required in Exhibit E.

An instream flow assessment is a technical study undertaken to determine the effects of incremental changes in streamflow on various instream uses. Under a somewhat broader definition, the assessment would include an evaluation of the effects of incremental changes in sediment load, thermal regime, and water quality on instream uses. Instream uses are uses made of the streamflow while it remains in the stream channel as opposed to uses made of water out of the channel. Traditional instream uses include hydroelectric power generation, navigation (commercial or recreational), and waste load assimilation (receiving water standards). Additional uses of streamflows that have more currently been recognized as potential instream flow considerations are: (1) downstream delivery requirements to satisfy existing treaties, compacts, or water rights; (2) freshwater recruitment to estuaries; (3) water requirements for riparian vegetation, fish and wildlife habitats, and river-based recreation; and (4) the amount and timing of streamflow required to maintain desirable characteristics of the river itself (width/depth ratios, sediment and thermal regimes, channel gradient, riffle/pool ratio, reach velocity, etc.).

The specific focus and degree of analysis involved in the instream flow assessment will to a large extent depend upon the nature of the existing and proposed uses, and on the concerns of local citizens, public interest groups, and government agencies regarding the trade offs that are likely to occur between these uses. As a part of APA's public participation program, a survey of federal and state agencies, public interest groups, and native corporations was undertaken in mid-January 1981 (Dwight and Trihey 1981). Interviews were conducted in order to obtain a first-hand impression of the level of understanding and interest of these groups in the proposed Susitna hydroelectric project, and to record specific questions and concerns which the respondents felt

needed to be addressed by an instream flow assessment. An attempt was also made to identify specific data and informational needs of state and federal agencies charged with issuing permits and/or reviewing the license application or environmental impact statements. Results of that survey have served as a principal source for the preparation of this introduction to the instream flow study plan for the proposed Susitna hydroelectric project.

Conceptually, the instream flow assessment will consist of three sequential parts: (A) issue identification and baseline data analysis; (B) impact analysis; and (C) mitigation planning. This document pertains primarily to the first part of the instream flow assessment, "issue identification and baseline investigations." No attempt has been made to define the scope or specific subtasks of the impact analysis and mitigation planning components of the instream flow assessment in this introduction. That detail will be provided in subsequent documents when sufficient background information and insights have been obtained from the ongoing engineering and environmental studies.

The purpose of this introductory report is simply to identify the scope and duration of the instream flow assessment being recommended, and to provide a framework for coordinating selected elements of the ongoing engineering and environmental studies (Acres American Inc. 1980, Alaska Department of Fish and Game 1981) to:

(1) provide conclusive statements by March 1982 for some of the questions documented in the instream flow survey;

(2) provide preliminary statements by March 1982 for the remaining questions documented in the instream flow survey; and

(3) determine those questions and concerns which should be addressed within the context of a detailed instream flow assessment.

The length of time required to complete the instream flow assessment is influenced by several key factors: its comprehensive scope; the lack of requisite baseline data and information on instream uses and resources in the project area; the sequence in which several important questions

must be answered; the complex nature of the river system being analyzed; the necessity (FERC requirement) to involve numerous state and federal agencies; APA's desire to involve public and private interest groups; and the time required for report preparation and decision making.

Consequently the minimum time required for completing the instream flow assessment is expected to be five years. However, an Application for License could be submitted by the applicant and accepted by the FERC prior to completing the instream flow assessment. FERC's licensing process, which itself is likely to require 2 to 3 years to complete, could be initiated as early as 1983 and would proceed concurrently with the instream flow assessment. Given the necessary level of funding, a sequence of credible impact statements could be determined by the instream flow assessment by 1985. However, it is not expected that the applicant and all potential interveners (resource/regulatory agencies and special interest groups) will be in agreement much before 1987 on a final mitigation plan, monitoring program, and operational constraints pertinent to the proposed project. It is expected that attainment of this much needed agreement could be expedited through the direct participation of the resource and regulatory agencies in the instream flow assessment. It would be particularly advantageous to fund an interagency task force to participate in the analysis and author the instream flow reports. This action would provide a cadre of agency personnel familiar with the technical detail of the assessment and the basis for the concluding statements in the various reports.

Many diverse questions have been, and will continue to be, raised concerning the anticipated effects of the proposed Susitna hydroelectric project on instream uses and resources. Each question should be taken seriously and answered with a conclusive statement. However, the degree of investigation and analysis required before a statement is accepted as conclusive should depend to some extent on the consequences that an error in judgement would have on the instream use or resource of concern. To determine the validity of a concern and the level of scientific analysis required to develop a conclusive reply, the question

should first be evaluated with respect to actual impacts experienced at other hydroelectric projects. If the question cannot be substantiated by previous experience, it should next be considered in terms of the uniqueness of the proposed project itself. If the question fails both of these tests (previous experience or uniqueness of the proposed project). Viewed in this context, some questions can be answered conclusively by March 1982, on the basis of the engineering and environmental studies in progress. Others cannot even be addressed until more data are collected and several intermediate level answers are obtained. A conclusive statement negating the concern can probably be offered on the basis of information contained in the literature or derived from a preliminary level of analysis.

Table 1 presents several questions pertaining to effects of the proposed Susitna hydroelectric project on instream uses and resources. The sequence in which the various subject areas and questions are introduced in this table indicates their relative importance within the framework of the envisioned instream flow assessment. This "importance" reflects both the level of interest in the subject area demonstrated by respondents to the instream flow survey (Dwight and Trihey 1981) and the amount of change and the significance of the impacts expected to occur as a result of the project. The likelihood of the march 1982 answers to the questions being acceptable to the resource and regulatory agencies reviewing the Application for License is also indicated. This "acceptability" is based upon the "importance" of the question and the level of confidence a technical audience is likely to have in a statement based upon the March 1982 results of pertinent subtasks of the feasibility study. Each question was considered with respect to the engineering and environmental studies in progress as of May 31, 1981 then placed in one of the following categories:

1. The anticipated March 1982 answer would probably be accepted as *conclusive* by resource and regulatory agencies *without modification* of the ongoing engineering and/or environmental studies.

2. The anticipated March 1982 answer would probably be accepted as *conclusive* by resource and regulatory agencies *following modification* of the ongoing engineering and environmental studies.

3. The anticipated March 1982 answer would probably be accepted as *preliminary* by resource and regulatory agencies *without modification* of the ongoing engineering and/or environmental studies.

4. The anticipated March 1982 answer would probably be accepted as *preliminary* by resource and regulatory agencies *following modification* of the ongoing engineering and environmental studies.

5. At this time it would not be cost-effective to undertake the data collection and analysis required to develop a credible response to this question.

Table 1. Summary of questions pertaining to effects of the proposed Susitna hydroelectric project on instream uses and resources with an indication of the likelihood of the March 1982 answer being acceptable to resource and regulatory agencies.

Question: What effect would the proposed Susitna hydroelectric project have on the following instream flow related topics?	Acceptability of a March 1982 answer based upon the anticipated level of confidence in the results of the ongoing engineering and environmental studies as of that date.				
	Conclusive Without Modification	Conclusive With Modification	Preliminary Without Modification	Preliminary With Modification	Not Cost-effective to address at this time
FLOW REGIME					
pre-project streamflows	X				
flood potential		X			
river stage at downstream locations during different months		X			
backwater from ice					
ice jams during breakup					
winter water temperatures in the reservoirs		X			
downstream water temperatures			X		
winter ice conditions (thickness and period of ice cover)					
channel scour from ice					
aufeis from winter spills					
erosion near bridge piers					
permafrost melt and frost heave near bridges					
ground water levels at reservoir site, and in downstream domestic wells, springs, and slough areas					
stage and sediment deposition at mouth of tributaries			X		
the ability of the river to cleanse itself of debris			X		
channel scour below damsite					
river morphology below Talkeetna			X		
bed load movement associated with storm events			X		
FISHERY RESOURCES					
existing fish populations above and below damsites		X			
spawning and rearing habitat		X			
fish passage and migratory behavior of adults		X			
overwintering of juveniles and resident adults		X			
scour or siltation of spawning areas			X		
egg incubation and developing embryos			X		
out migration		X			
food base for rearing and resident species			X		
post-project reservoir fishery potential		X			
smelt runs in the lower river			X		
WATER QUALITY					
the assimilative capacity of the Susitna River	X				
the present "drinking water" classification for the Susitna River during both construction and operation	X				
level of dissolved gasses in the Susitna River immediately downstream of the dams		X			
suspended sediment and turbidity at various downstream locations				X	
salinity levels in the mouth of the Susitna River			X		
domestic and industrial waste disposal associated with the proposed capitol move	X				
effects of placer mining on water quality during low-flow periods	X				
NAVIGATION					
boat and float plane access to traditional recreation and state land disposal sites		X			
recreational boating on the Susitna River, sidechannels and sloughs		X			
commercial navigation on the lower Susitna River	X				

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Question: What effect would the proposed Susitna hydroelectric project have on the following instream flow related topics?	Acceptability of a March 1982 answer based upon the anticipated level of confidence in the results of the ongoing engineering and environmental studies as of that date.				
	Conclusive Without Modification	Conclusive With Modification	Preliminary Without Modification	Preliminary With Modification	Not Cost-effective to address at this time
RIPARIAN VEGETATION AND WILDLIFE					
production of moose browse in lower river		X			
big game migration					
habitat and populations of small terrestrial mammals and furbearers					
ESTUARY					
entrance of anadromous species into the Susitna River			X		
estuarine survival of pink and chum salmon fry			X		
waterfowl production in wetlands surrounding the estuary			X		
winter ice conditions in Upper Cook Inlet			X		
use of estuary by beluga whales and seals			X		
DOWNSTREAM WATER RIGHTS					
existing water rights	X				
present day out-of-stream diversions	X				
RIVER BASED RECREATION					
recreational access to the Susitna River by water, air or land		X			
winter travel on river ice cover by snow machine			X		
sport fishing access		X			
recreational hunting for moose and waterfowl		X			
status of the Susitna River as a world class whitewater river	X				
wild and scenic aspects of the Susitna River	X				
recreational opportunities associated within the reservoirs		X			

The remainder of this document is organized by same the instream use and resource categories identified in Table 1. The narrative is limited to a description of those elements of the ongoing engineering and environmental studies which are pertinent to the first part (issue identification and baseline data analysis) of the instream flow assessment. No attempt has been made to describe studies or scheduling requirements beyond March 1982.

1. Flow Regime

    a. pre- and post-project streamflows
    b. stream temperature and ice cover
    c. sediment transport and river morphology

2. Fishery Resources

    a. anadromous adults
    b. resident adult and juveniles
    c. aquatic habitat

3. Water Quality

    a. reservoir
    b. riverine

4. Navigation

    a. commercial
    b. recreational

5. Riparian Vegetation and Wildlife

6. Freshwater Recruitment to the Estuary

7. Downstream Water Rights

8. River Based Recreation

Pertinent subtasks of the engineering and environmental studies described in the February 1980 Plan of Study (Acres American Inc. 1980) and in subsequent procedures manuals (Terrestrial Environmental Specialists 1980, Alaska Department of Fish and Game 1981) are referenced in the following sections of this report. A number of modifications to the

work outlined in the 1980 POS were approved by the Alaska Power Authority in March 1981. Those modifications which are pertinent to the instream flow assessment are included in the narrative. Every effort has been made to describe relevant aspects of the engineering and environmental studies which were either underway or approved as of May 31, 1981.

FLOW REGIME

The Environmental Report (Exhibit E) of the FERC Application for License must contain baseline data sufficient to determine the normal and seasonal variability of streamflows. This report must also describe the anticipated changes in pre-project streamflows attributable to the project and determine the resulting environmental impacts.

Nearly twenty groups interviewed during the survey (Dwight and Trihey 1981) had questions and comments pertaining to project effects on the streamflow, temperature (includes ice), and sediment regimes of the Susitna River. Many of these questions are associated with instream uses of water and demonstrate that the majority of those interviewed recognize important relationships exist between the streamflow, thermal, and sediment transport characteristics of the river and a variety of in-stream uses. Several of the questions and concerns pertaining to this topic area are provided below:

> What would the stage be at selected locations during the different times of the year? What would the magnitude of change in flow be under post-project conditions, and how would this affect access to tributaries? What is the dampening effect on stream flows downstream? How would changes in water level affect people living near the river (flood potential)? What is the relationship of groundwater levels to the stream?
>
> Would the changes in water temperature be harmful to fish? What would be the effect of increased winter flows on icing? Would there be a greater accumulation of ice in the upper reach, with larger ice jams during breakup? If power demand or operation of the reservoir required that water be dumped in winter in years that the snow pack indicated a high spring runoff, would there be a buildup of ice on the river (aufeis)? Could this be managed by controlled releases of water under the ice?
>
> The Alaska Railroad was particularly concerned about the effect of annual spring flooding on bridges. They felt that although ice jams at the bridge locations might decrease, there would be increased erosion of bridge piers due to decreased silt concentrations and channelization of the river. Other groups are also concerned about the effect of decreased sediment loads on scouring.

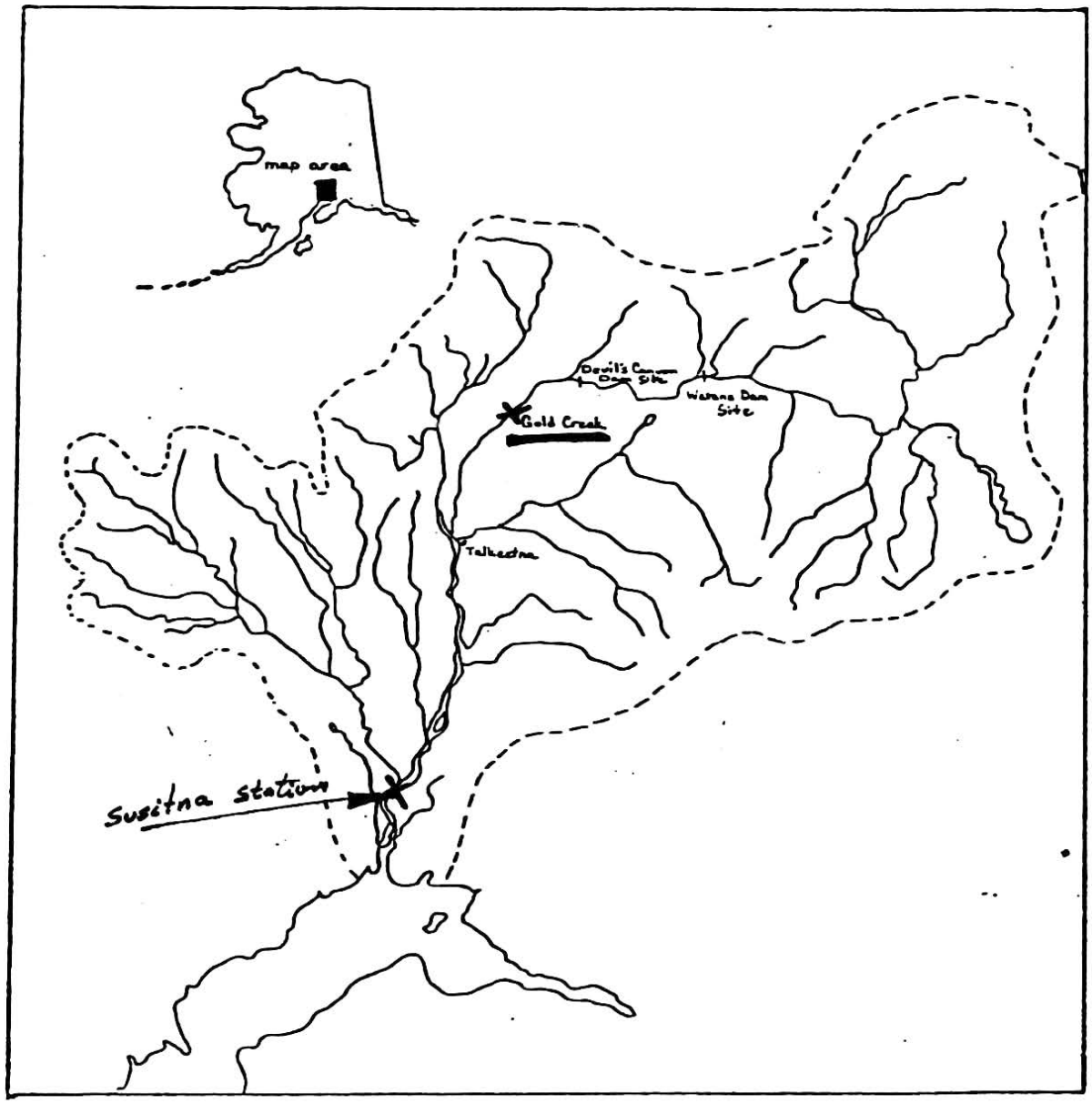
What would be the change in channel characteristics? What would be the effect of peak flow on sediment transport and stream morphology? How would the proposed project affect bedload movement associated with storm events? What would be the effect of reducing the sediment load, and therefore associated nutrients, on downstream biota? How much sediment would be trapped in the reservoir, and would it have to be flushed?

Streamflows

A thorough analysis of the seasonal and long term variability of pre- and post-project streamflows will be completed by December 1981 at two locations on the mainstem Susitna River. This analysis will be performed by Acres American Inc. (Acres), R&M Consultants (R&M), and the Alaska Department of Fish and Game (ADF&G) utilizing average daily streamflow data from the U.S. Geological Survey (USGS) stations at Gold Creek and Susitna Station. The naturally occurring variability among average daily, average monthly, and average annual streamflows will be presented for the respective periods of record.

Average daily streamflows will be analyzed to ascertain the validity of using average monthly streamflows for evaluating project effects on fish habitat. Frequency analysis will be performed and the resultant 1-day, 7-day, 15-day, 30-day, 60-day, and 90-day low flows will be determined for each year of record. Comparisons will be made between the 1-day, 7-day, and 15-day low flows and between these flows and the average monthly streamflow for the month in which they occur. The 30-, 60- and 90-day low flow values will be compared with the lowest average monthly streamflow for the year.

Peak flows will also be analyzed. The 1-day, 3-day, 7-day and 15-day peak streamflows will be determined for the period of actual record during the months of May through October. The ratio of peak flow to average monthly flow for each month will be determined and presented by calendar years. This information will be used to estimate project effects on scouring of spawning areas.



Pre- and post-project stream flow conditions will be compared at two USGS stream gage locations: Gold Creek and Susitna Station.

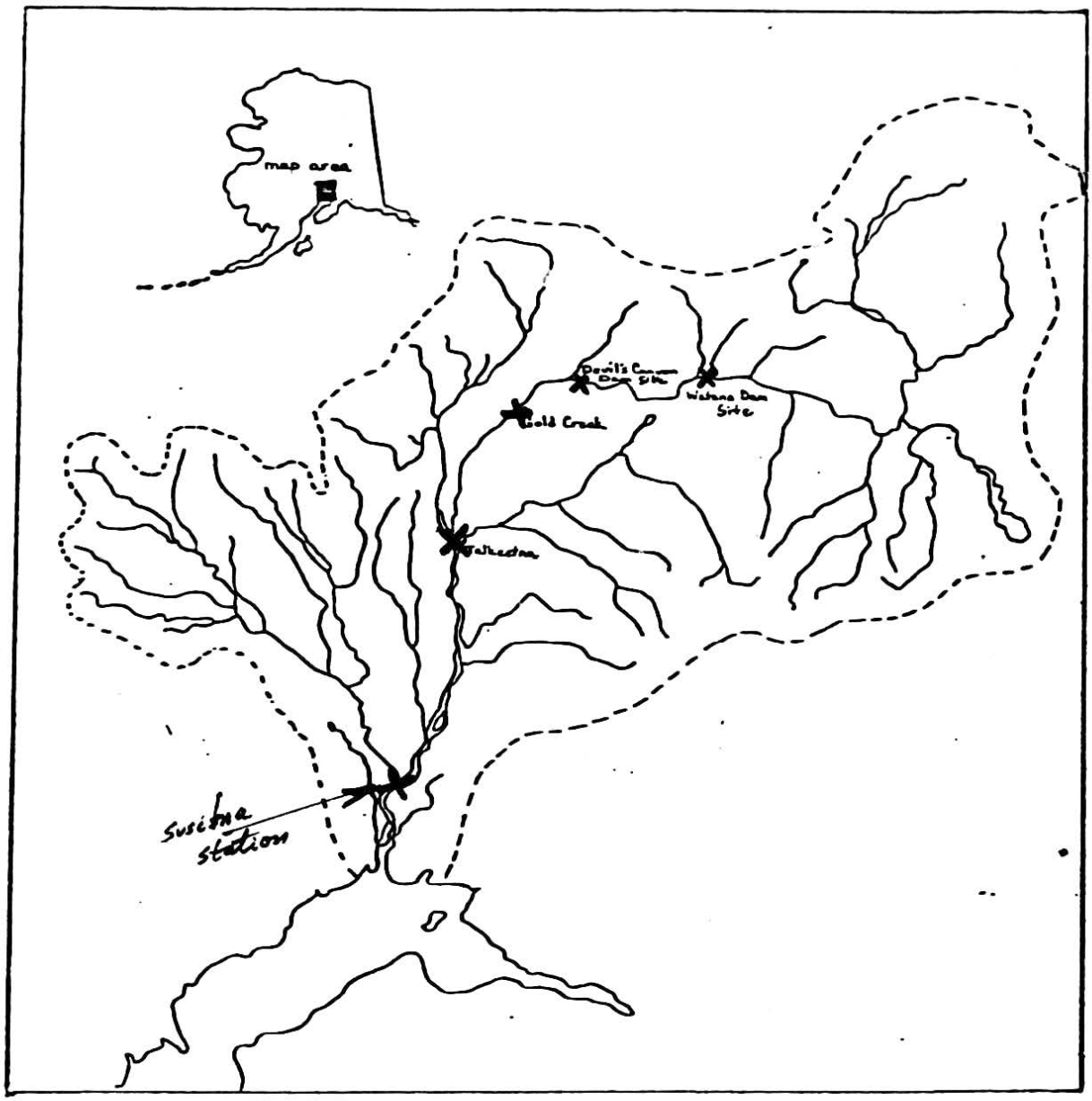
Flow duration curves will be developed for each month of the year based on average daily streamflows for the period of actual record at Gold Creek and Susitna Station.

Monthly post-project streamflows will be generated at Gold Creek and Susitna Station for the 1950-1980 period. Using these data, monthly flow duration curves will be derived and compared to the monthly pre-project flow duration curves. Information will also be provided at Gold Creek and Susitna Station indicating the estimated change in stage and stream velocity attributable to post-project streamflows.

These hydrologic analyses, in conjunction with those outlined in sub-tasks 3.04 and 3.05 of the February 1980 Plan of Study (Acres American Inc. 1980), are expected to provide sufficient understanding of project effects on the long term and seasonal streamflow characteristics of the mainstem Susitna River to satisfy FERC license requirements. Following completion of other Phase I studies, additional work will be required to develop the reach-specific streamflow data required for analysis of specific impact questions within the various fishery habitat study reaches. Numerous staff gages are being installed at strategic locations within the project area during Phase I by ADF&G and R&M as the initial step in developing the correlation coefficients required for generating the reach-specific streamflows.

Water Temperatures

A detailed thermal analysis of the mainstem Susitna River may be required to determine project effects on water quality, ice conditions, and fish habitat. However, the specific questions which need to be addressed within these three topic areas will require different levels of analysis. For example, the required precision of a pre- and post-project stream temperature model to interface with the anticipated water quality and ice modeling studies or to evaluate thermal effects on rearing habitat or the migratory behavior of adult fish need only be



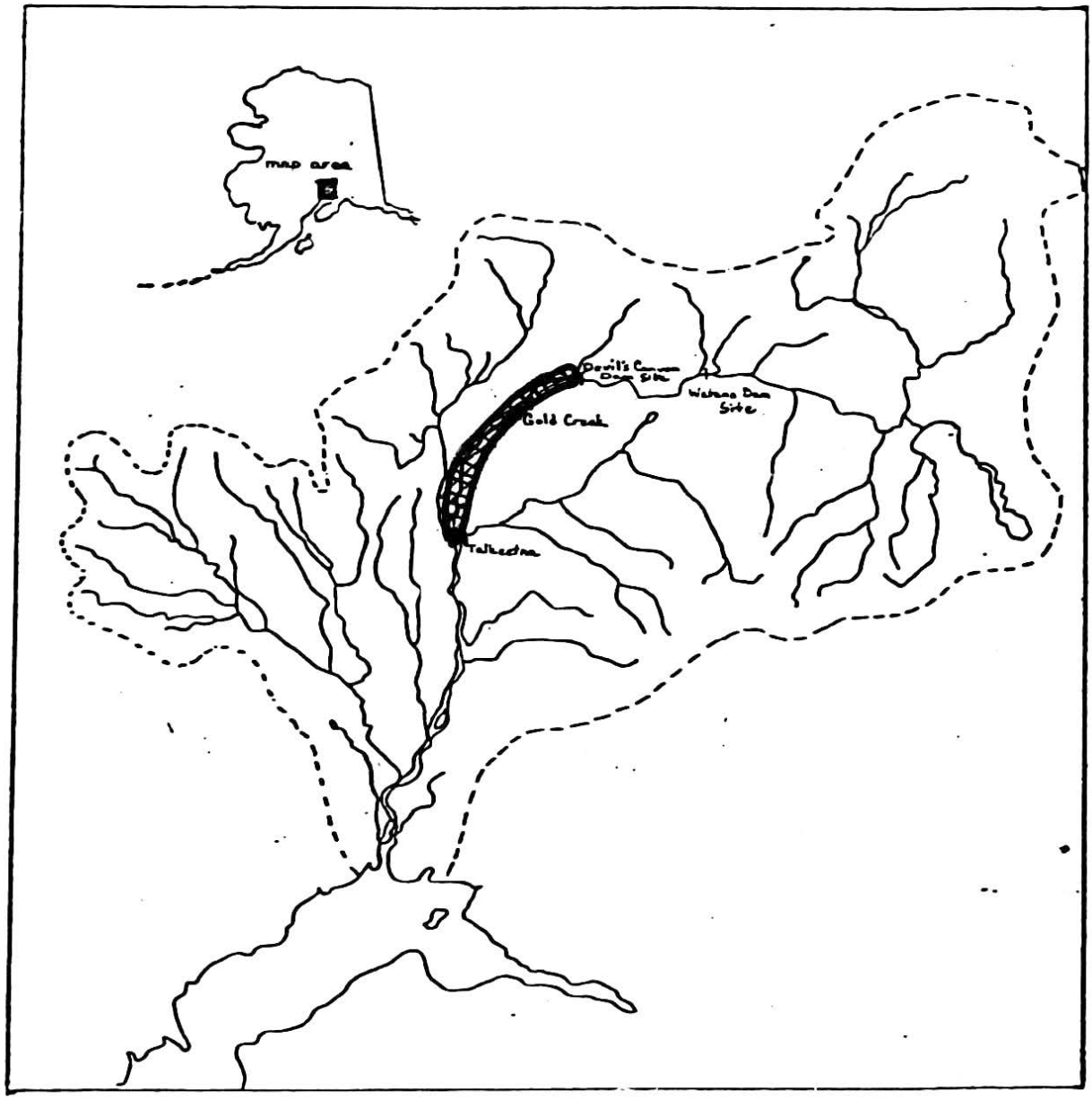
Pre- and post-project stream temperatures will be evaluated at the proposed reservoir sites and three downstream locations.

accurate to $\pm 2^{o}C$. However, a stream temperature model to provide for the evaluation of thermal effects on immature fish or incubating fish eggs would have to accurately forecast monthly post-project stream and intragravel water temperatures within one degree at one half mile intervals from Devil Canyon to Cook Inlet. They type of intensive data collection program necessary to develop such a model cannot be justified on the basis of our present knowledge.

Although salmon may spawn in the mainstem Susitna River, actual spawning areas have yet to be located. Additionally, the seasonal changes in water temperatures within the proposed reservoirs must be estimated. Only after one has knowledge of the locations of the mainstem spawning areas and the general magnitude of expected changes in seasonal stream temperatures can it be decided whether or not the fishery resource is likely to be adversely affected by post-project stream temperatures. And analysis undertaken at this time to provide more than a preliminary statement regarding the effects of post-project stream temperatures on the fishery resources would be unjustified.

During the Phase I feasibility study, continuous water temperature data are being acquired by R&M near the proposed Watana dam site to supplement the USGS data which are available for the Susitna River near Denali, Susitna River near Cantwell, and MacLaren River near Paxson. Collectively these data will be used as one element in a thermal analysis to estimate average monthly water temperatures in the proposed reservoir for purposes of exploring the engineering and economic consequences of multi-level power outlets.

The ADF&G aquatic habitat group will install thermographs at the Sunshine bridge and at their fishwheel and sonar stations above Talkeetna and in the principal tributary streams to the Susitna River between Portage Creek and the Yentna River. These stream temperature data, in conjunction with associated streamflow measurements and estimated reservoir temperatures, will provide the necessary input for a first level thermal analysis to ascertain whether or not additional mainstem



Hydraulic and ice studies are being conducted between Devil Canyon and Talkeetna which will provide an initial assessment of the effects of post-project streamflows on stream channel stability in this river segment.

temperature modeling is necessary and, if so, on what stream reach(es) the work should be focused. This thermal analysis will be done as part of the downstream ice modeling studies conducted by Acres.

Sediment Transport

Determination of the rate of sediment accumulation in the proposed reservoirs and the prediction of the associated effects on the downstream river channel morphology are being addressed at a cursory level under subtask 3.07 of the Plan of Study (Acres American Inc. 1980). Additional insights will be gained as to the likelihood of post-project flows affecting the downstream river channel morphology through work outlined in subtasks 3.05: streamflow and flood analyses, 3.06: hydraulic and ice studies, and 3.10: lower Susitna River studies.

The objective of these subtasks is an initial evaluation of the general hydraulic characteristics of the Susitna River above Talkeetna under pre- and post-project streamflow conditions. No quantitative statements are expected to come from this analysis pertaining to the effects of post-project streamflows on the pre-project river channel morphology. However, this analysis will answer questions pertaining to the general stability of the river channel above Talkeetna. It will also provide the necessary insight to cost-effectively address questions pertaining to local scour and deposition within this river segment in any follow-up studies that may be required.

No analysis is being performed at this time regarding effects of post-project streamflows on the stream channel stability/morphology below Talkeetna. However, R&M is obtaining seasonal aerial photo coverage of the lower river. The ADF&G aquatic habitat group will obtain suspended sediment samples and determine streambed material size and composition. Bedload movement will be sampled by R&M under the direction of USGS or a nationally recognized consultant during August 1981 at Gold Creek and Sunshine bridge, and at the mouths of the Talkeetna and Chulitna rivers. The aerial photos and streambed material/bedload information

will be used along with the results from the detailed streamflow analysis at Susitna Station to develop a work plan for a preliminary assessment of post-project effects on the morphology of the lower Susitna River.

Summary

Relationships between various instream uses and streamflow, stream temperatures, and sediment transport are well recognized (Acres American Inc. 1980; Dwight and Trihey 1981). However, data and information to quantify these relationships are not available to explain or discuss project effects at more than a cursory level. Hence the immediate goal is to rigorously analyze the available streamflow data and to undertake the necessary field work and analysis for acquiring the insight to identify what future studies might be required (justified).

By March 1982, effects of the proposed project on pre-project streamflow conditions will be known in terms of discharge, water surface elevation, and average velocity at several mainstem locations. Sufficient stream temperature data will have been collected to describe pre-project conditions and determine for which river segments additional stream temperature studies are justified. The general stability of the river channel above Talkeetna will have been analyzed and areas of potential scour or deposition identified. Reach specific data on streambed material sizes and aerial photography will be available to assist with formulating work plans for the additional studies that will be required in the lower river.

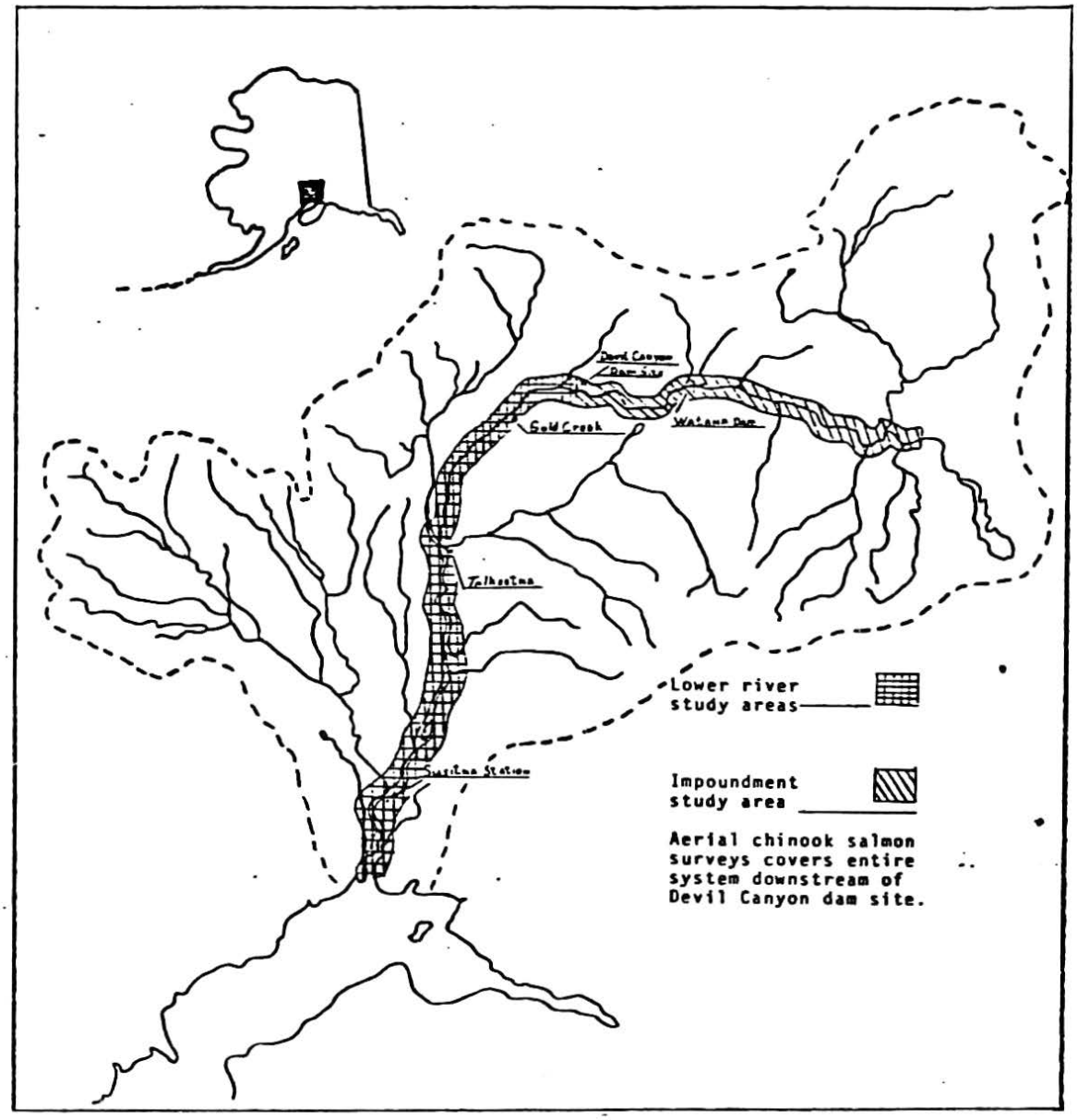
FISHERY RESOURCES

An important component of the FERC Application for License is a documentation of the fishery resources of the project area. This report must describe the nature of the fishery resource; the expected effects of the proposed project on this resource; and the measures proposed by the applicant or agencies to mitigate, enhance, or protect the resource if significant impact is anticipated.

The fishery report must contain a detailed description of the existing resources of the project area including all sites directly or indirectly affected by project activity or features. This includes the downriver segment of the Susitna River and its tributaries, the reservoir inundation areas, and aquatic systems traversed by roads or transmission corridors. Fishery information for these impact areas must include seasonal fish distribution and abundance, species composition, fish production, habitat characterization, and fish movement patterns. Also this discussion must address, if applicable, any fish species proposed or listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS).

A major category of concern expressed in the recently completed survey (Dwight and Trihey 1981) was the effects of the post-project flow regime on the fishery resources of the Susitna River basin. One third of the comments in that report focused on this aspect:

> Would there be enough water to support existing fish populations? Would the reduction of peak flows affect fishery utilization of side channels and backwater areas? How many sloughs, oxbows, and side channels would be dewatered or have limited access? How would changes in flow regime affect spawning, intradrainage movement, outmigration, and seasonal habitat use? Would higher stream velocities associated with increased winter flows affect young-of-the-year that migrate into the mainstem from tributaries during winter months? What overwintering of anadromous juvenile and resident fish occurs in the main channel and how would it be affected?



Fishery investigations will be conducted from Cook Inlet to the Tyone River.

Currently an inadequate information base on the fishery resources of the Susitna River drainage prohibits the preparation of answers to such valid questions and concerns. In order to gather the necessary data, APA has contracted with ADF&G to conduct a five year fishery investigations program. The first phase of the ADF&G study is underway and will culminate with the preparation of a report in spring 1982. This report will provide a compilation of the knowledge gained about the fishery resources in the project area based on their 1981 field investigations.

Three field investigations are currently being conducted by ADF&G: anadromous adult, resident and juvenile, and aquatic habitat. A detailed procedures manual has recently been prepared for each of these investigations. A brief summary of the ADF&G's 1981 field program is provided below.

Anadromous Adult Investigations

The primary objective of this study is to determine the seasonal distribution and abundance of the anadromous fish in the project area, particularly the timing of migrations and spawning. Three major subtasks are involved:

1. Enumerate and characterize the fish runs.
2. Determine the timing and nature of migration, milling, and spawning activities.
3. Identify spawning areas in subreaches of the mainstem, sloughs, side channels, and tributary areas which are likely to be affected by post-project flows and estimate their comparative importance.

Research techniques for these subtasks include use of fish wheels in the mainstem and large tributaries, and creel census, electrofishing, seining, and aerial and foot surveys. Information to be collected will include sexual maturity, parasite load, meristic data, and age.

Attempts will be made to conduct stock separation studies utilizing scale or tissue samples. Estimates of the magnitude of the run to various reaches or tributaries will be performed by mark/recapture studies, sonar counts, aerial or foct surveys of spawning grounds, and carcass counts.

Information on the timing of the spawning runs and the migratory corridors utilized by each species of anadromous fish inhabiting the project area will be required to accurately identify the effects of altered streamflows or other project-related impacts. This knowledge will be gained by several techniques: evaluation of Cook Inlet commercial harvest records, determination of collection rates at fish wheels, evaluation of data collected at sonar counter stations and of creel census data, aerial or ground observations, examination of morphological characteristics of maturing adults captured in certain portions of the river, and radio tracking studies. Various efforts will be made to determine timing of spawning, and characteristics of spawning habitats. The milling behavior of adult salmon in the river segment between Devil Canyon and Talkeetna will be examined, primarily through radiotelemetry studies.

Resident Adult and Juvenile Investigations

The objective of this study is to determine the seasonal distribution, abundance, and movement patterns of resident adult and juvenile fish in the project area. Two major subtasks are involved:

1. Obtain species type, abundance, age class, and habitat utilization information for captured fish and describe seasonal movement patterns.

2. Identify spawning grounds of resident adults and important seasonal habitats of anadromous and resident juveniles. Focus observation and collection efforts on specific reaches of the mainstem, sloughs, side channels, tributaries, lakes, and ponds.

The juvenile stage is a critical portion of the life cycle of anadromous fish in the project area. The use of habitat by these immature fish according to species, season of year, and location in the watershed will be assessed in order to determine the effects of project-induced streamflow change or other impacts on continued successful propagation of these species. Field study methods will include measuring catch rates of fish by use of minnow traps, electrofishing, smolt traps, and tag/recapture studies. Data obtained also will be used to determine which habitat types in the project area are of major importance to juvenile fish on a seasonal basis. Particular attention and emphasis will be placed upon identifying important habitats in the mainstem.

Resident adults will be studied by gillnetting, electrofishing, trapping, and creel census. Although less exploited by man than anadromous adults, resident species (primarily rainbow trout, grayling, Dolly Varden and burbot) are a major component of the fishery resources in the upper portion of the Susitna River basin.

Aquatic Habitat Investigations

The habitat requirements of all fish inhabiting the project area must be determined in order to evaluate the nature and magnitude of project-related impacts and to develop appropriate mitigation proposals. The objective of this study is to work closely with field personnel in the anadromous adult and resident adult and juvenile study teams to locate and characterize various habitat types being utilized by all fish in the project area.

Descriptions of the general range of streamflow-dependent physical and chemical characteristics which appear to be influencing the suitability of habitat for the species and life history stages of interest will be compiled. Preliminary assessments will be made of the physical and chemical characteristics of fish habitats and the character and quantity of habitat available under various streamflows. Streamflow staff gages and thermographs will be deployed and monitored throughout the project

area. Water quality data also will be gathered by ADF&G according to a predetermined sampling schedule in conjunction with water quality investigations of the U.S. Geological Survey.

Summary

Information obtained from these fishery investigations, in concert with data obtained from many other research efforts, will be utilized by Terrestrial Environmental Specialists, Inc.(TES) to prepare an initial report describing the overall effects of the proposed Susitna hydroelectric project on the fishery resources of the watershed. Quantification of project effects, particularly with regard to altered streamflows, is perhaps the most important fishery question which needs to be answered. The data base available by spring 1982 for addressing this question will not be sufficient to support a definitive answer. However, TES should be able to identify many of the generic impacts which are likely to occur and estimate their relative magnitude. But a quantitative assessment of the degree necessary to identify a recommended stream flow regime for the protection and preservation of the existing fishery resources or to formulate mitigation measures cannot be prepared. Thus, the data base and preliminary assessment of anticipated impacts available in March 1982 will only form the basis and framework of a study plan for a comprehensive instream flow assessment to be conducted during the ensuing years.

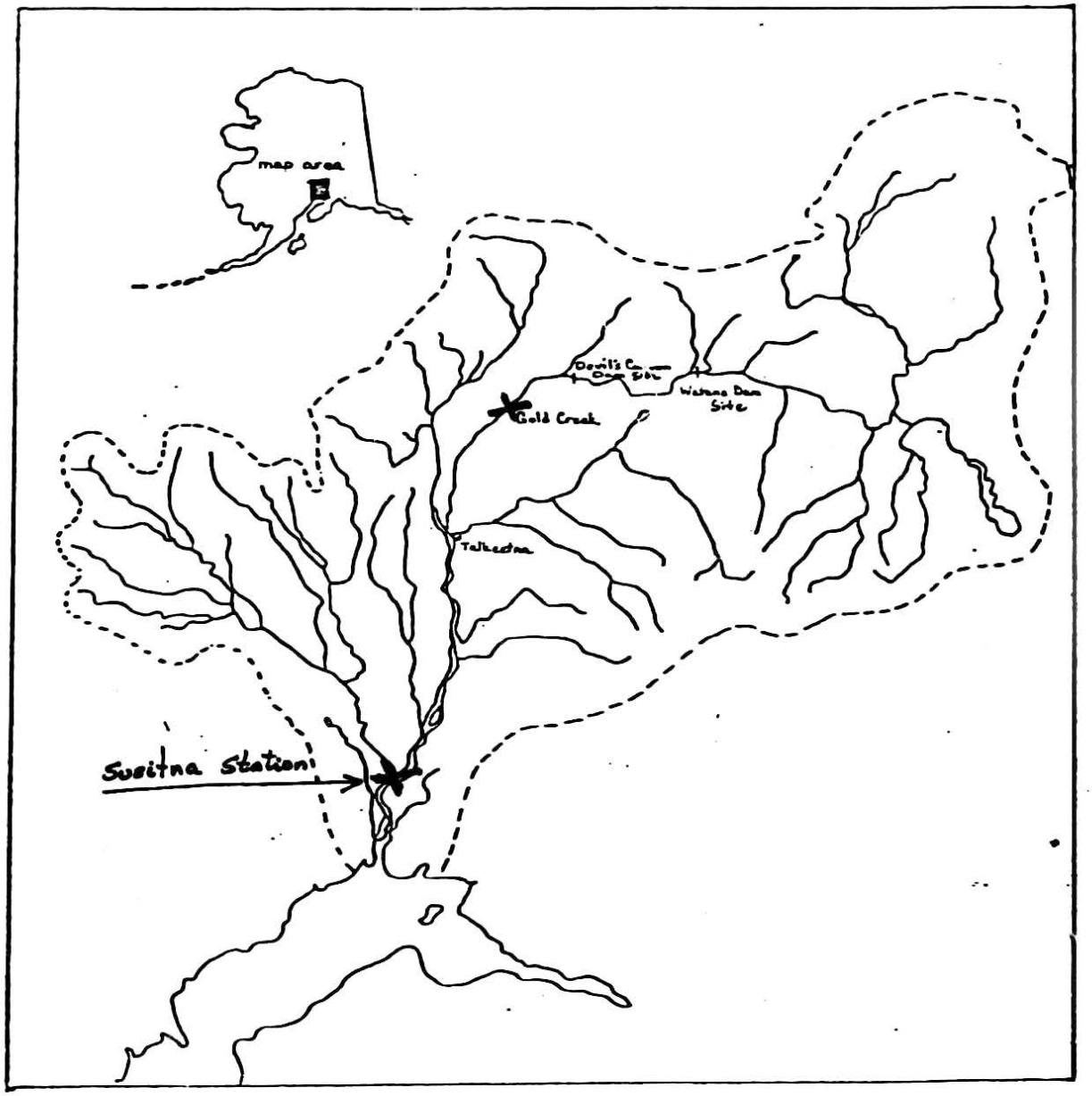
WATER QUALITY

The FERC Application for License is to contain a report on water quality. The report must discuss water quality and contain baseline data sufficient to determine the normal and seasonal variability, the impacts expected during construction and operation, and any mitigative, enhancement, and protective measures proposed.

The report must include a description of existing water quality in sufficient detail to determine seasonal, vertical, and horizontal variation as appropriate for streams, lakes, and reservoirs. The description must include measurements of significant ions, chlorophyll a, nutrients, specific conductance, pH, total dissolved solids, total alkalinity, total hardness, dissolved oxygen, bacteria, temperature, suspended sediments, turbidity, and vertical illumination. Information on the surface area, volume, maximum depth, mean depth, flushing rate, and length of shoreline of the proposed reservoirs must be provided. The gradient and type of substrate present in the stream reach to be inundated by the proposed reservoir must also be provided in the report.

A quantification of the anticipated impacts of the proposed construction and operation on downstream water quality, such as thermal regime, turbidity, and nutrient level, and a description of measures recommended by federal and state agencies and the applicant for the purpose of protecting or improving water quality during project construction and operation must be contained in the report. An explanation of why the applicant has rejected any measures recommended by an agency for the protection or improvement of water quality, and a description of the applicant's alternative measures to protect or improve water quality, must also be included.

During the conduct of the instream flow survey (Dwight and Trihey 1981), agency concerns associated with post-project water quality effects downstream from the reservoir on future users were documented.



Assimilative Capacity will be determined at two locations on the mainstem River.

The Alaska Department of Environmental Conservation (DEC) questioned the general effects of the proposed change in flow regime on the assimilative capacity of the Susitna River. Both the sediment and thermal regimes of the Susitna River are expected to change. Thus, future discharge permit applicants might be required to incur additional treatment costs before meeting Alaska's water quality standards. In a somewhat similar fashion, the U.S. Army Corps of Engineers (USACE) indicated an interest in having the anticipated post-project flow regimes reviewed with respect to the granting of 404 permits to the post-project applicants. The interests of both agencies were accented by renewed discussion of the capital move. Alaskans for Alternative Energy and ADF&G's Su Hydro Team also mentioned the capital move and questioned the effects of post-project flows on domestic and industrial waste disposal.

The principal water quality analyses undertaken to date are intended to estimate the magnitude of the seasonal changes anticipated in suspended sediment, water temperature, dissolved gases, and chemical constituents within the proposed impoundments. Acres is performing this analysis utilizing streamflow and water quality data collected by USGS and R&M.

In response to the question raised by DEC and USACE, R&M will estimate the effects of post-project streamflows on the seasonal assimilative capacity (BOD and COD) of the Susitna River at Gold Creek and Susitna Station. If these preliminary analyses indicate additional water quality data and analysis are required before a definitive statement can be provided, an appropriate work plan will be developed and implemented during mid 1982.

Summary

The principal water quality analysis will focus on determining seasonal post-project conditions within the impoundments. Only a preliminary estimate of the seasonal changes anticipated in suspended sediment, water temperature, and dissolved gases is expected. However, these estimates will provide insight as to the likelihood of post-project water quality conditions being harmful to the fishery resources.

The evaluation of effects of the post-project flow regime on the assimilative capacity of the Susitna River at Gold Creek and Susitna Station will either answer the questions raised by DEC and USACE or determine what additional data and analysis are required before a definitive statement can be provided.

NAVIGATION

Commercial

Based upon the findings of the instream flow survey (Dwight and Trihey 1981), it is unlikely that post-project streamflows will have any affect, either positive or negative, on commercial navigation in the lower Susitna River. The Alaska Department of Transportation and Public Facilities was not aware of any commercial navigation on the river. The Bureau of Land Management (BLM) District Office also indicated that commercial navigation was not an instream use on the Susitna River. The U.S. Coast Guard stated that the head of navigation is defined as being at Gold Creek. They do not maintain any navigational aids downstream from this point and have no jurisdictional concern for structures proposed upstream from Gold Creek.

For purposes of addressing project effects on this "use" in the Application for License, TES will provide a brief narrative on the history of commercial navigation on the Susitna River and the likelihood of it being developed in the foreseeable future. The TES essay will be reviewed by the Susitna Hydroelectric Project Steering Committee prior to being included in the documentation for license application.

Recreational

Questions identified in the instream flow survey which pertain to anticipated effects of the proposed project on recreational navigation fall into two major areas: 1) access to the river by water, air, and land, and 2) movement within the river itself:

> Boat and float plane access to side channels and small tributaries and to the west side of the lower Susitna River was questioned by USFWS's Fishery Resources Program, the Fairbanks Environmental Center, and ADF&G's Su Hydro Team. The Anchorage Fish and Game Advisory Committee and NMFS were concerned about sport fishing access, primarily downstream from Talkeetna. The Sierra Club's Knik Group asked whether recreational access, in general, would be

reduced or enhanced. The main concern of the Alaska Department of Natural Resources (DNR) was whether or not stream flow alteration would affect access to land disposal sites.

The Sierra Club's National Representative was specifically concerned about project related effects on whitewater boating (kayaking, boating, and rafting) between the Denali Highway and Talkeetna. Trustees for Alaska questioned whether movement within the lower Susitna River would become more hazardous as a result of reduced summer streamflows.

Based on the level of interest and the nature of the questions concerning recreational navigation, it is recommended that APA's Application for License contain a description of present-day use patterns (i.e., mode, location, extent) and a preliminary discussion of the likelihood of post-project flows altering the status quo. Toward meeting this objective, present-day patterns, frequently used access points (including float plane landing sites), and known recreational navigation corridors need to be identified. A navigation user needs survey, such as that suggested by DNR's Water Management Section (Harle 1980), might be the most cost effective means of documenting present-day use patterns and user attitudes and preferences.

As a minimum, TES should scope out the type and level of effort that would be required to document present-day recreational navigation use patterns in the lower Susitna River. Maps and photographs conveying this information should accompany APA's Application for License. By supplementing the Phase I engineering and hydrologic studies (Acres American Inc. 1980) with site- or reach-specific water surface elevations determined from staff gage readings, the likelihood of post-project flows adversely affecting recreational navigation can be discussed by March 1982. If warranted, Phase II hydrologic and/or engineering studies could be outlined to estimate the magnitude of post-project impacts on recreational navigation (access or movement) within principal use areas.

RIPARIAN VEGETATION AND WILDLIFE

Although a number of groups contacted during the survey (Dwight and Trihey 1981) acknowledged that riparian vegetation is important, there were few specific questions raised. The major concerns focused on whether or not post-project flows would maintain a disturbed environment conducive to the production of moose browse.

The effect of post-project flows on maintaining moose habitat in the lower reaches of the Susitna River was often mentioned as a possible impact on hunting, as were the effects of post-project flows on boat access to the hunting areas. The USFWS's Western Alaska Ecological Services questioned whether flows to maintain early seral stages of vegetation would need to be designed into the project operation as part of the mitigation plan. However, the U.S. Soil Conservation Service (SCS) felt this would not be necessary, as riparian vegetation would readjust to post-project conditions. Furthermore, SCS was doubtful whether project-induced vegetation changes below the Chulitna River would be measurable.

This topic area will need to be considered at a later date in conjunction with proposed ice and sediment transport studies.

FRESHWATER RECRUITMENT TO THE ESTUARY

The proposed Susitna hydroelectric project will not affect the long-term average annual freshwater inflow into upper Cook Inlet. However, the seasonal variability and timing of the inflows will be altered. The extensive analysis of pre-and post-project streamflows, which will be undertaken by Acres, R&M, and ADF&G (refer to streamflow subtask of Flow Regime section) at Susitna Station, will provide an adequate basis for quantifying the amount of change in seasonal variability and timing of freshwater inflow to the estuary.

Such analysis might also provide sufficient insight to determine the likelihood of post-project flows resulting in a significant change in the estuarine environments, particularly if any relationships could be documented in the literature referencing Upper Cook Inlet commercial salmon catches of escapements, waterfowl hatching success, or biologic conditions within the upper estuary itself to low-flow conditions in the Susitna River.

DOWNSTREAM WATER RIGHTS

The Application for License must evaluate the anticipated effects of the proposed Susitna hydroelectric project on existing instream uses and identify both existing and proposed uses of project water for irrigation, domestic and industrial supplies, or other purposes.

The survey report (Dwight and Trihey 1981) identified the following concerns:

> A fundamental question asked by the Alaska Miners Association and ADF&G's Su Hydro Team was "what permitted or licensed water use rights presently exist in the Susitna River basin?" Two additional questions raised by ADF&G's Su Hydro Team and Susitna Power Now were 1) whether operation of the dam would allow present day out-of-stream diversions to be maintained, and 2) whether post-project flows would result in a change of water table conditions that would adversely affect domestic wells or surface water supplies. DNR's Water Management Section staff indicated that Susitna River basin water rights applications had not been adjudicated, but doubted that any existing out-of-stream diversions would be affected by the proposed Susitna hydroelectric project.

Nonetheless, existing water rights should be identified as a subtask of the instream flow assessment. Pursuant to AS 46.15.080 (criteria for issuance of permit), DNR will require this information before issuing water rights permits and reservations of water for the proposed Susitna hydroelectric project. In addition, AS 46.15.145 (reservation of water) provides for the reservation of streamflows or water levels for the purposes of 1) protection of fish and wildlife habitat, migration, and propagation, 2) recreation and park purposes, 3) navigation and transportation purposes, and 4) sanitary and water quality purposes. DNR's Water Management Section is currently developing rules and regulations for implementing this legislation. After July 1, 1981, public agencies, native groups and private citizens may file a request for instream flow reservation.

The Water Management Section staff at DNR anticipates that they will receive requests for instream flow reservations from several agencies,

groups, and individuals due to the high visibility of the proposed Susitna hydroelectric project. Taken collectively, these requests may precipitate the need for an instream flow assessment to quantify the streamflow requirements of all existing and proposed uses of Susitna River water within the basin before DNR could grant APA a reservation or water rights permit for the proposed Susitna hydroelectric project. An instream flow assessment undertaken to determine the amount of streamflow required by various uses is far more costly and time consuming to conduct than one undertaken to determine effects of a proposed development on those uses.

Therefore it is recommended that the questions pertaining to the nature and extent of existing water rights permits in the Susitna River basin be answered by March 1982. It is further recommended that the head of DNR's Water Management Section be extended an invitation to participate in the further development of a study plan for this element of the instream flow assessment. DNR staff time and resources would be integrated into the work plan to the extent that staff time and state funding would allow.

RIVER BASED RECREATION

Many groups indicated an interest in this topic, but their questions and comments reflected preconceived personal biases rather than an objective consideration of project effects on recreational use (Dwight and Trihey 1981).

> The potential for increased recreational opportunities was recognized by several groups, but both DNR's Water Management Section and the ADF&G's Su Hydro Team questioned the public's acceptance of reservoir recreation as a replacement to an established riverine use in the upper basin. The proposed reservoirs are expected to be very deep glacial lakes with a precipitous shoreline and fluctuating water surface. Such characteristics are not expected to draw many reservoir recreationists.
>
> Several groups, such as the U.S. Heritage, Conservation, and Resource Service concentrated on recreational opportunities that would be lost. BLM's Resources Section questioned to what extent the aura of the wild and scenic aspects of the river would be degraded while the Anchorage Fish and Game Advisory Committee and ADF&G's Sport Fish Division were interested in quantifying project impacts on fishing success. Many respondents raised questions and offered comments pertaining to project affects on sportfishing.

In summary, then the major question to be answered is "To what degree will riverine based recreation be increased or decreased as a result of the project?" Toward answering this, both DNR's Water Management Section and USFWS's Western Alaska Ecological Services felt that a recreational user needs survey is necessary because of the level of opposition to the project due to perceived recreational losses, and the lack of information about what type of recreation is desirable. It is recommended that TES contact these agencies to discuss specific objectives and approaches that might make up such a survey. If their initial discussions are fruitful, additional agencies and special interest groups might be factored into a second round of discussions. The objective of these planning sessions would be to prepare an acceptable questionnaire, sampling technique, and evaluation procedure for a Phase

II recreational user needs survey. A brief statement concerning the development of the recreational user needs survey and its intended use during the Phase II decision-making process would accompany APA's initial request for licensing.

REFERENCES

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