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SUSITNA HYDROELECTRIC PROJECT

TASK 7 — ENVIRONMENTAL

SUBTASK 7.10
FISH ECOLOGY
INSTREAM FLOW ASSESSMENT
FOR THE PROPOSED SUSITNA HYDROELECTRIC PROJECT
ISSUE IDENTIFICATION AND BASELINE DATA ANALYSIS
1981 STUDY PLAN

MAY 1981

Prepared for:

ACRES

ALASKA POWER AUTHORITY

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TASK 7 - ENVIRONMENTAL

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INSTREAM FLOW ASSESSMENT

FOR THE

PROPOSED SUSITNA HYDROELECTRIC PROJECT

ISSUE IDENTIFICATION AND BASELINE DATA ANALYSIS

1981 STUDY PLAN

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Prepared for

Acres American Inc.
Buffalo, New York

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INTRODUCTION

In November 1979 the Alaska Power Authority (APA) contracted with Acres American Inc. (Acres) 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 and quantification 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 preproject 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 dis-

cussions, impact statements, and mitigation proposals required in Exhibit E.

An instream flow assessment is a technical study undertaken to determine the effects that project-induced changes would have on various instream uses and resources. Under a somewhat broader definition, the assessment would include an evaluation of the effects of incremental changes in streamflow, stream temperature, channel morphology, 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: downstream delivery requirements to satisfy existing treaties, compacts, or water rights; freshwater recruitment to estuaries; water requirements for riparian vegetation, fish and wildlife habitats, and river based recreation; and the amount and timing of streamflow required to maintain desirable characteristics of the river itself (width/depth ratios, sediment and thermal regimes, channel gradient, streambed composition, 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 environmental 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 that 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. The results of that survey have served as a principal source for the preparation of this document.

The purpose of this document is to present a framework for coordinating selected elements of the Phase I engineering and environmental studies that have been underway since 1980. Coordination should provide a solid basis for planning a cost-effective instream flow assessment and should increase the potential for producing preliminary answers to several questions pertaining to project effects on instream uses or resources. Instream Flow Studies, per se, were not scheduled to be funded until the summer of 1982 (J. Hayden, pers. comm.). As a result of initiating identification of instream flow issues in 1981 and coordinating various aspects of the current engineering and environmental studies, the length of time required for planning and conducting an instream flow assessment may be shortened as much as eighteen months.

The length of time required to complete the instream flow assessment will ultimately be determined by FERC. This is attributable to several key factors: its comprehensive scope; the lack of essential baseline data on instream uses and resources in the project area; the sequence in which several important questions must be addressed; the complex nature of the river system being analyzed; the necessity (FERC requirement) to involve numerous state/federal agencies; APA's desire to involve public and private interest groups; and the time required for report preparation and decision making.

1981 STUDY PLAN

Many diverse questions have been, and will continue to be, raised concerning the effects of the proposed Susitna hydroelectric project on instream uses and resources. They are all important, but do not require the same amount of information or level of analysis to resolve. Project effects on some instream uses can be defined rather conclusively by March 1982. For other uses, questions concerning project effects cannot be seriously addressed until after the Phase I engineering and environmental studies are complete and intermediate level questions answered.

This study plan pertains primarily to issue identification and baseline data analysis. During the spring of 1982, a detailed study plan will be prepared to provide a quantitative assessment of impacts that will support mitigation planning. The quantitative impact assessment will focus on those areas identified upon completion of the 1981 summary report.

The objective of this first part of the assessment is to identify the full spectrum of questions and impact issues that pertain to project effects on instream uses or resources and to utilize the products from the Phase I engineering and environmental studies to define which of these questions and issues represent potential impacts of such magnitude or interest that they warrant detailed analysis. More specifically, the objective of the first part of the instream flow assessment is 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 some of the questions documented in the instream flow survey; and

(3) define the scope of study that should be undertaken after March 1982 in order to further quantify impacts in some areas and to provide initial quantification of impacts in other areas and provide the information necessary for developing a mitigation plan.

The instream flow survey identified several questions pertaining to effects of the proposed Susitna hydroelectric project on instream uses or resources (Table 1). The sequence in which the various subject areas and questions are listed 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 and the amount of change or the significance of the anticipated impacts. The likelihood of the March 1982 answers to the questions being acceptable to resource and regulatory agencies reviewing the draft feasibility report is also indicated. This "acceptability" is based upon the "importance" of the question and the anticipated level of confidence that a technical audience is likely to have in statements based upon the March 1982 results of the feasibility study.

Each question was considered with respect to the Phase I engineering and environmental studies in progress as of May 31, 1981. A determination was made as to the anticipated "acceptability" of answers based on conducting the ongoing studies without modification or undertaking additional studies as outlined in subsequent subsections of this study plan. Only a minimal amount of effort should be expended at this time to obtain answers for several questions that are dependent upon answers or information from prerequesite studies, which will not be completed until March 1982. These questions are identified by an asterisk in the extreme right column of Table 1 and an accompanying check recommending what level of answer should be sought by March 1982. A check in the fourth column of Table 1 indicates that the question is not being addressed by the engineering or environmental studies currently in progress, while a check in the second column indicates that the preliminary answer currently being sought could be upgraded to "conclusive," were the ongoing study effort expanded.

Upon completion of the Phase I engineering and environmental studies, it is quite likely that preliminary answers could be provided for some of the questions that are being recommended for deferral for reasons of

economy. It may even be possible to show that anticipated study of some questions is unwarranted and that important new questions have arisen that will require studies presently unanticipated.

These determinations must be made in March 1982 independent of any preconceived ideas that might be inferred from Table 1. This table has been prepared for use as an aid in prioritizing questions and allocating available resources to provide a comprehensive approach to undertaking Part A of the instream flow assessment (issue identification and baseline data analysis). It is not intended to serve as an outline for review agencies to use in preparing official comment on the adequacy of specific statements appearing in the feasibility report.

Table 1. Summary of questions pertaining to effects of the proposed [illegible] 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 Phase I engineering and environmental studies.				
	Conclusive Without Modification of Phase I Studies	Conclusive With Modification of Phase I Studies	Preliminary Without Modification of Phase I Studies	Preliminary With Modification of Phase I Studies	Not Cost-effective to address in detail at this time
FLOW REGIME					
preproject streamflows			X		
flood potential	X				
river stage at downstream locations during different months			X		
backwater from ice			X		
ice jams during breakup			X		
winter water temperatures in the reservoirs		X			
downstream water temperatures			X		
winter ice conditions (thickness and period of ice cover)			X		
channel scour from ice				X	
growth of aufeis				X	
erosion near bridge piers				X	
permafrost melt and frost heave near bridges				X	
groundwater levels at reservoir site, and in downstream domestic wells, springs, and slough areas				X	*
stage and sediment deposition at mouth of tributaries			X		
the ability of the river to cleanse itself of debris			X		
channel scour below damsite		X	X		
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	*
postproject 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					
commercial navigation on the lower Susitna River			X		
recreational boating on the Susitna River, sidechannels and sloughs			X		
access to the Susitna River from established launch sites			X		
boat and float plane access from the river to traditional recreation and state land disposal sites			X		
navigation access into major tributaries			X		

Table 1. (Cont.) Summary of questions pertaining to effects of the proposed [illegible] 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 Phase I engineering and environmental studies.				
	Conclusive Without Modification of Phase I Studies	Conclusive With Modification of Phase I Studies	Preliminary Without Modification of Phase I Studies	Preliminary With Modification of Phase I Studies	Not Cost-effective to address in detail at this time
DOWNSTREAM WATER RIGHTS					
future water rights		X			
present day out-of-stream diversions		X			
domestic wells along the river corridor		X			
RIPARIAN VEGETATION AND WILDLIFE HABITAT					
surface area of various vegetation/habitat types in the river corridor			X		
natural succession of vegetation			X		
production of moose browse in lower river			X		*
habitat and populations of small terrestrial mammals and furbearers			X		*
RIVER BASED RECREATION					
winter travel on river ice cover by snow machine		X			
sport fishing access			X		*
recreational hunting for moose and waterfowl			X		*
[illegible]us 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		*
ESTUARY					
entrance of anadromous species into the Susitna River				X	*
estuarine survival of salmon fry/smolts			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		
productivity of intertidal wetlands			X		*

The remainder of this document is organized in accordance with the list of instream use categories identified in Table 1. The narrative is intentionally limited to an identification of those elements of the ongoing engineering and environmental studies that are pertinent to Part A of the instream flow assessment. No attempt has been made to identify specific studies or scheduling requirements beyond March 1982.

1. Flow Regime

   a. pre- and postproject streamflow
   b. stream temperature
   c. sediment transport

2. Fishery Resources

   a. anadromous adult
   b. resident adult and anadromous juvenile
   c. aquatic habitat

3. Water Quality

   a. impoundment
   b. dissolved gas
   c. downstream water quality

4. Navigation

   a. commercial navigation
   b. recreational navigation

5. Water Rights

6. Riparian Vegetation and Wildlife Habitat

7. River Based Recreation

8. Estuarine

FLOW REGIME COMPONENT

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 preproject streamflows attributable to the project and determine the resulting environmental impacts (Federal Register 1981).

Nearly twenty groups interviewed during the instream flow survey 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 that important relationships exist between the streamflow, thermal, and sediment transport characteristics of the river and a variety of instream 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 postproject conditions, and how would this affect access to tributaries? What is the dampening effect on streamflows 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 break up? 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?

Pre- and Postproject Streamflow Study

Objectives

The immediate objective of this element of the instream flow assessment is to describe anticipated project effects on the annual and seasonal variability of streamflows in the Susitna River.

Methodology

Under subtasks 3.04 and 3.05 of the Plan of Study (Acres American Inc. 1980), a thorough analysis of the seasonal and long term variability of preproject streamflows will be conducted at four locations in the Susitna River Basin. R&M Consultants, Inc. (R&M) will complete this analysis by September 1981 utilizing average daily streamflow data from the U.S. Geological Survey (USGS) stream gages on the Susitna River at Gold Creek, Chulitna River near Talkeetna, Talkeetna River near Talkeetna, and the Susitna River at Susitna Station. The naturally occurring variability among average daily, average monthly, and average annual streamflows will be presented for the respective periods of record at each location.

Daily streamflow data will be analyzed to ascertain the validity of using average monthly values to represent actual streamflow conditions in the evaluation of project effects on such downstream concerns as streambed scour, stream temperatures, and ice cover. Frequency analysis will be performed and resultant 1-, 3-, 7-, 14-, 30-, 60-, and 90-day low flows will be determined by month for each year of record. Comparisons will be made among the 1-, 3-, 7-, and 14-day low flows, and between these flows and the average monthly streamflow for the months in

which they occur. The 30-, 60- and 90-day low flow values will be compared to the lowest monthly streamflow for the year. Peak flows will also be analyzed. Monthly 1-, 3-, 7- and 15-day peak streamflows will be determined during the open water season (May through October). The ratio of peak flow to average monthly flow for each month will be determined and presented by calendar year. Preproject flow duration curves will also be developed for each month of the year utilizing average daily flows for the period of actual record at each of the four stream gage locations.

Postproject streamflows for the construction, filling, and operational phases of the project will be determined by Acres under subtask 3.04 of the Plan of Study (Acres American Inc. 1980). Monthly postproject streamflows will be simulated for a 30-year period at four locations on the Susitna River: Devil Canyon, Gold Creek, Sunshine, and Susitna Station. Using these streamflow estimates, postproject flow duration curves will be prepared for each month of the year at Gold Creek, Sunshine, and Susitna Station. Estimated monthly changes in river stage will also be provided.

These hydrologic analyses are expected to provide sufficient understanding of project effects on the long term and seasonal streamflow patterns 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 the Alaska Department of Fish and Game (ADF&G) and R&M as the initial step in developing the correlation coefficients required for generating the reach-specific streamflows.

Stream Temperature Study

Introduction

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 that need to be addressed within these three topic areas will require different levels of analysis. For example, simulated pre- and postproject stream temperatures in the range of ±2 or 3°C have been judged adequate by Acres engineers to support their water quality and ice modeling studies. However, stream temperature forecasts may need to be accurate within a few tenths of a degree to provide for the evaluation of thermal effects on immature fish or incubating fish eggs.

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 knowledge is available on 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 postproject stream temperatures. Hence any analysis undertaken at this time to provide more than a preliminary statement regarding the effects of postproject stream temperatures on the fishery resources would be unjustified.

Objectives

The objectives of the stream temperature study are to:

(1) provide a preliminary indication of the feasibility of controlling adverse effects of the reservoirs on downstream water temperatures by installing multiple level intakes in the dams;

(2) identify the effect of mid-winter reservoir outflows on ice cover; and

(3) identify how far downstream from Devil Canyon the Phase II stream temperature modeling study should extend.

Methodology

Continuous water temperature data are being acquired by R&M near the proposed Watana dam site to supplement the USGS data that 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 preliminary thermal analysis to estimate average monthly water temperatures in the proposed reservoir for purposes of exploring the engineering and economic consequences of multi-level outlets.

A stream temperature model will be developed for the river segment from Watana dam to Talkeetna. The same cross-sectional geometry and reach lengths that were used in the HEC-2 model can be used to define the river surface area vs discharge relationship for the stream temperature model. Average monthly values for air temperature, cloud cover, and solar radiation may be obtained, or estimated, from regional climate records. Long term average monthly streamflows are known at Gold Creek and will be estimated for the project. In total, this information should be adequate to provide an initial assessment of project effects on stream temperatures.

The ADF&G aquatic habitat group will install thermographs at selected mainstem locations above Talkeetna, at their fishwheel and sonar stations, and in the principal tributary streams to the Susitna River between Portage Creek and the Yentna River. These stream temperature data, in conjunction with 1981 climatic data and streamflow measurements, will provide the necessary information to calibrate the stream temperature model, and to ascertain whether or not additional mainstem water temperature data are required. Stream temperature forecasts provided from the model will be useful in determining how far downstream from Devil Canyon additional thermal analyses should extend. This thermal analysis will be done as part of the downstream ice modeling studies conducted by Acres.

Sediment Transport Study

Introduction

Determination of the rate of sediment accumulation in the proposed reservoirs and a preliminary assessment of the effects of postproject streamflows on the downstream river channel morphology are being addressed under subtasks 3.05, 3.06, 3.07 and 3.10 of the Plan of Study (Acres American Inc. 1980). These subtasks are intended to provide an initial evaluation of the general hydraulic characteristics of the Susitna River above Talkeetna under pre- and postproject streamflow conditions. Taken collectively, they will probably answer most questions pertaining to the general stability of the river channel above Talkeetna. Results from these subtasks will also provide the necessary insight to address cost-effectively more specific questions pertaining to channel morphology within this river segment in any follow-up studies that may be required.

Although R&M is obtaining seasonal aerial photo coverage of the lower river, no analysis is being made of postproject effects on the stream channel stability/morphology below Talkeetna. The ADF&G aquatic habitat group will obtain periodic suspended sediment samples and determine streambed material size and composition at selected sites. However, these data are expected to be very limited, and to be sporadically collected, independent of an integrated analysis concept. The aerial photos and streambed data will be most useful as background information for developing a work plan for a preliminary assessment of the morphology of the lower Susitna River.

USGS has recently submitted a proposal to APA for evaluating bedload movement in the project area. Field work would be initiated in early summer 1982.

The following recommendations are provided to improve the overall value of the ongoing Phase I sediment transport studies with regard to the instream flow assessment.

Reservoir Sedimentation Study

Objectives: The objectives of this element of the sediment transport study are to:

(1) estimate the trap efficiency of Watana Reservoir;

(2) determine the degree of influence trapped sediments will have on the long term storage capacity of the reservoir; and

(3) forecast suspended sediment concentrations below Devil Canyon dam.

Methodology: Due to the limited amount of time remaining in the Phase I program, it is recommended that the reservoir sedimentation study be limited to a review and evaluation of pertinent literature and data, supplemented by a small data collection effort.

More specifically, it is suggested that the following tasks be completed by December 31, 1981:

(1) estimate the trap efficiency of a one and two reservoir configuration for particle sizes greater than 50 microns based on literature reviews and interviews with knowledgeable engineers (it is expected that this study effort will indicate that the trap efficiency will be nearly 100 percent for particles greater than 50 microns in size);

(2) estimate trap efficiency of Watana Reservoir for glacial particles less than 50 microns based on an evaluation of literature and agency open-file data (assume Devil Canyon Reservoir will not trap fine particles which pass through Watana). Particular emphasis should be placed on particles less than 10 microns. Since it is unlikely that much information will be found in the literature or agency files, this could be done by collecting and analysing suspended sediment concentrations by particle size at the inflow and outflow of five or six glacial lakes in Alaska or British Columbia. Sediment inflow and detention time characteristics of these lakes should approximate that of the Watana Reservoir;

(3) provide an estimate of postproject suspended sediment concentrations during summer months below Watana reservoir. Multiply the 50 microns or less suspended sediment concentrations in preproject water quality samples for the Susitna River by

the respective inflow:outflow ratios for similar particle size categories determined from analysis of the natural lake samples; and

(4) prepare a cost estimate and work plan outline to sample water temperature and suspended sediment concentrations at 50-foot depth increments in large, ice-covered glacial lakes. Water temperature and suspended sediment profiles should be obtained twice during the period January to April 1982.

Bedload Transport Study

Objectives: The objective of this element of the sediment transport study is to initiate a bedload sampling program during 1981 in order to:

(1) determine safety and effectiveness of using Helley-Smith and P-61 sediment samplers from a river boat (in particular during high flows); and

(2) provide an initial comparisons of bedload transport rates for the Susitna, Talkeetna and Chilitna rivers.

Methodology: Obtain bedload sediment, suspended sediment, and streambed material samples at several points along a transect across the Chilitna, Talkeetna, and Susitna rivers. A minimum of three sampling trips (high, medium, and low flows) should be made to each river during the June to September period. Each river should be sampled during the same two- or three-day sampling trip, and a streamflow measurement is to be made for each river (at the sampling location) as an integral part of the sampling effort.

Detailed analysis of these data is not justified. However, both suspended and bedload sediment data would be converted to an equivalent transport rate (tons per day), and presented in tabular format for high, medium, and low streamflows for each river.

River Morphology Study

Objectives: The objectives of this element of the sediment transport study are to:

(1) provide a conclusive statement regarding the general stability of the river channel above Talkeetna under pre- and postproject streamflows;

(2) provide a preliminary statement regarding pre- and postproject stream channel stability at the confluence of the Chulitna, Talkeetna, and Susitna rivers; and

(3) provide a preliminary statement regarding the likelihood of postproject streamflows altering the existing nature of the Susitna River below Talkeetna.

Methodology: The methodologies employed will be specific to each river segment.

Above Talkeetna: In the Devil Canyon to Talkeetna River segment, visual observations and grid samples will be made to determine streambed material size and sources. Approximately 70 cross sections have been surveyed in reference to a common project datum and their river mile index determined. A limited number of staff gages and crest stage recorders have also been installed to provide water surface elevations. These field data will provide sufficient information to satisfy calibration requirements of a reconnaissance grade HEC-2 hydraulic model. Such a hydraulic model can be used to forecast the magnitude of change in stage and flow velocities attributable to project regulation of natural streamflows.

A draft report will be prepared that describes the morphological characteristics of the river segment between Devil Canyon and Talkeetna. This report will specifically address the anticipated effects of postproject streamflows on the general stability of the river channel. The discussion is to be based on field observations, results from the HEC-2 analysis, data on streambed material composition, and the findings of the reservoir sedimentation and the bedload transport studies. Two or three nationally or internationally recognized experts in river mechanics would be employed to provide a technical review of the draft

report and author a summary statement regarding the general stability (stable, unstable, unknown) of the river segment between Devil Canyon and Talkeetna.

At Talkeetna: Results of the bedload transport and reservoir sedimentation studies will be evaluated to obtain an initial impression of the effect that the proposed project will have on the sediment-discharge relationship in the confluence area.

Below Talkeetna: A comparison of simulated pre- and postproject monthly streamflows will be made at Sunshine and Susitna Station to determine whether or not the forecast change in monthly flow duration curves is likely to alter the general pattern of the Susitna River below Talkeetna. The predicted change in winter ice conditions will also be considered.

FISHERY RESOURCES COMPONENT

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 resources; the expected effects of the proposed project on these resources; 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 instream flow survey was the effects of the postproject flow regime on the fishery resources of the Susitna River basin. One third of the comments reported in that survey pertain to project effects on the fishery resources. Several questions and concerns were repeatedly expressed:

> 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?

Currently there is an inadequate information base on the fishery resources of the Susitna River to provide adequate answers to such questions and concerns. To ensure that adequate information is available to determine the impacts of the proposed hydroelctric project and to design proper mitigative strategies, APA has contracted ADF&G to undertake a two-phase data collection program. The first phase of ADF&G's program is separated into three sections: adult anadromous fisheries, resident and juvenile anadromous fisheries, and aquatic habitat studies. Personnel employed on the anadromous adult and resident and juvenile anadromous fishery studies will coordinate their field activities with personnel on the aquatic habitat study.

ADF&G will produce several basic data reports by spring 1982. These reports will provide a compilation of the knowledge gained about the fishery resources in the project area during the 1981 field season.

A separate procedures manual is available for each of these investigations. Thus only a brief outline of ADF&G's 1981 field program is provided below.

Anadromous Adult Study

Objectives

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. Four major subtasks are involved:

(1) enumeration and characterization of runs of the anadromous adult fish;

(2) determination of the timing and nature of migration, milling, and spawning activities;

(3) identification of spawning locations within the study area (i.e., subreaches of the mainstem, sloughs and side channels, tributary confluences, lakes and ponds, etc.) and estimation of their comparative importance; and

(4) identification and determination of methods, means and the feasibility of estimating the Susitna River's contribution to the Cook Inlet commercial fishery.

Methodology

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, meristic data, and age.

Estimates of escapements into various river segments and tributaries will be made on the basis of mark/recapture studies, sonar counts, aerial or foot 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, aerial or ground observations, examination of morphological characteristics of maturing adults, and radio tracking studies. Field observations will be made to determine timing of spawning and characteristics of spawning habitats. The milling and migratory behavior of adult salmon in the river segment between Devil Canyon and Talkeetna will be examined through radiotelemetry and tag recapture studies. Various efforts will be made to locate mainstem spawners.

Resident Adult and Anadromous Juvenile Study

Objectives

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

(1) identification of spawning and rearing locations of the resident species and the rearing locations of anadromous juvenile species to estimate their comparative importance; and

(2) recording of descriptive information on captured fish (species, location of capture site, age class) and discussion of seasonal migration patterns of selected resident adult species.

Methodology

The juvenile stage is a critical portion of the life cycle of anadromous fish in the project area. The use of various habitat types by these immature fish according to species, season of year, and location will be assessed. Catch rates from minnow traps and electrofishing will be used to determine the seasonal utilization and comparative importance of a variety of habitat types to anadromous juvenile fish in the project area. Particular attention and emphasis will be placed upon identifying important habitats in the mainstem.

Resident species (primarily rainbow trout, Arctic grayling, Dolly Varden, and burbot) are important components of the fishery resources in the Susitna River basin. Seasonal movement patterns and the relative importance of various habitat types to resident species will be discussed on the basis of comparative catch rates. Resident adults will be captured by gillnetting, electrofishing, angling, trapping, and set lines. Adult grayling populations in tributary streams and the mainstem river segment within the impoundment areas will be estimated through a tag-recapture study.

Aquatic Habitat Study

Objectives

The objective of this study is to locate and characterize various habitat types in the project area. Three major subtasks are involved:

(1) a description of the seasonal habitat requirements of selected anadromous and resident species within the study area;

(2) a characterization of the physical and chemical parameters of the various habitat types found in the study area through direct field observations and measurements; and

(3) an identification of the physical and chemical conditions that appear to be influencing the suitability of various habitat types for the species and life history stages of interest through direct field observations and measurements.

Methodology

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.

Descriptions of the general range of streamflow-dependent physical and chemical characteristics that 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. Staff gages and thermographs will be installed 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 USGS water quality investigations.

Identification of Project Impacts

Terrestrial Environmental Specialists, Inc. (TES) will prepare an initial report describing the effects of the proposed Susitna hydroelectric project on the fishery resources of the watershed. This report is to be based on results of the Phase I engineering and environmental studies currently being conducted by Acres, R&M, ADF&G, and various subcontractors.

Quantification of project effects, particularly with regard to altered streamflows and temperatures, is the most important downstream fishery question that needs to be answered. The data base that will be available by spring 1982 is not expected to be sufficient to support a definitive impact statement. However, TES should be able to identify many fishery impacts normally associated with large dams that are likely to occur on the Susitna River and to estimate the relative magnitude. Generalized mitigation options should be identified and their total costs estimated for consideration in determining project feasibility.

A quantitative assessment of the precision necessary to support negotiations of an instream flow regime to protect and preserve existing fishery habitat or to define specific mitigation measures is not possible to complete within the time frame of the Phase I studies. Thus, the data base and preliminary impact assessment that is expected to be available in March 1982 will be most useful as a reference document for developing a study plan for the required instream flow assessment, which will be conducted during the ensuing years.

WATER QUALITY COMPONENT

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 also 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 (Federal Register 1981).

During the conduct of the instream flow survey, agency concerns associated with postproject water quality effects downstream from the reservoir on future users were documented.

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 postproject flow regimes reviewed with respect to the granting of 404 permits to the postproject 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 postproject 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.

Impoundment Study

Introduction

The principal focus of the water quality analysis should be on determining anticipated seasonal water quality conditions within the impoundments. However, only a preliminary estimate of the seasonal changes anticipated in suspended sediment, water temperature, and chemical constituents can be expected on the basis of the existing data collection program.

Objectives

The objectives of this study are to:

(1) provide a preliminary estimate of anticipated water quality conditions in the impoundments; and

(2) develop a study plan for a data collection and analysis program to quantify anticipated water quality conditions in the reservoirs during summer and winter months.

Methodology

A consultant with demonstrated experience in conducting water quality assessments in sub-arctic streams and lakes will be employed. The consultant will become familiar with the available information and data on the size and shape of the proposed impoundments, seasonal inflow-outflow relationships, and the type of outlet structures being incorporated into the dams.

Information on soils and vegetative cover within the impoundment areas, as well as the water quality data available by October 1981, will be reviewed by the consultant. A generalized synoptic assessment of the anticipated water quality conditions within the reservoirs will then be prepared. The principal value of this assessment will be to identify legitimate areas of concern and provide the basis for developing a focused and cost-effective Phase II study.

An essential objective of the Phase II water quality assessment should be to obtain an adequate understanding of water quality conditions within the impoundments to estimate their fishery potential. Development of such a work plan could best be accomplished through discussions with resource agencies, researchers, and project personnel after the feasibility report has been prepared.

Dissolved Gas Study

Introduction

It is not expected that significant levels of naturally occurring supersaturation will be found. However, dissolved gas supersaturation is a potential problem that must be considered in dam spillway design. Supersaturation is common whenever water passing over a dam spillway can entrain air and plunge deeper than four or five feet into the tailwater. Plunging flows of this nature cause gas bubble disease in fish.

For this reason, the dam spillway must be designed to avoid this potential problem, and such design considerations are ongoing. The dissolved gas study will provide information on background levels and decay rates of dissolved gas in the vicinity of Devil Canyon. These naturally occurring conditions can be used as criteria to assist engineers in determining the adequacy of alternative spillway designs.

Objectives

The purpose of this study is to determine background levels and decay rates of naturally occurring dissolved gas (nitrogen supersaturation) in the vicinity of Devil Canyon, and to prepare a report that summarizes the effects of various levels of gas supersaturation on fish.

Methodology

If supersaturated gas levels naturally occur in the Susitna River, they would be near Devil Canyon. Therefore, dissolved nitrogen and oxygen levels will first be measured in the canyon area. Measurements will be taken at various depths using a tensionmeter.

If supersaturated levels are found, additional measurements will be taken at regular downstream intervals (perhaps every five miles) until gas supersaturation levels are no longer detected. A control site will be established upstream of Devil Canyon, and dissolved gas measurements will be repeated several times during the open water season. Special efforts will be made to obtain measurements during the peak runoff period.

Downstream Water Quality Study

Introduction

The question raised by DEC and USACE regarding effects of the post-project streamflows on the assimilative capacity of the Susitna River

below Sunshine is valid, but it is not considered to be a priority area of concern. Summer streamflows are not expected to change significantly below Sunshine, and midwinter streamflows are expected to be two or three times greater. The net effect of such a change in streamflows on the assimilative capacity of the Susitna River near Wasilla is expected to be somewhat of an improvement.

A more important concern to address is identifying the likelihood of postproject water quality conditions (chemical constituents, nutrient and dissolved gas concentrations, and temperature) being harmful to the fishery resources in the Devil Canyon to Talkeetna area.

The anticipated water quality characteristics of the reservoirs and background water quality characteristics of the river and side sloughs must be known before any definitive statements regarding downstream effects on fish or aquatic invertebrates can be made. However, the collection of voluminous amounts of water quality data to describe baseline conditions can be extremely expensive, and the data may never be used for any other purpose. Therefore, the downstream water quality study should emphasize the collection and evaluation of a limited amount of data from selected sites.

Objectives

The objectives of the downstream water quality study are to:

(1) compile water quality data collected by R&M and USGS through September 1981;

(2) report seasonal (summer, winter, and break up) ranges and means of selected parameters at the established sample sites;

(3) compare existing ranges of constituents found in natural water to the state water quality standards; and

(4) identify data gaps.

Methodology

This aspect of the water quality component would be a combined effort between R&M and a water quality consultant. R&M would be responsible for compiling USGS data and data collected each season by R&M into tables reporting ranges, means, and numbers of observations for each parameter.

The water quality data would be compiled for the mainstem Susitna River stations located at Denali, Vee Canyon, Gold Creek, Sunshine, and Susitna Station, and for the Chulitna and Talkeetna rivers. Data would be presented graphically by parameter. Each graph would display a range and mean for each station, by season. This effort could be completed by either R&M or the water quality consultant.

The water quality consultant would be responsible for coordinating the entire effort, and providing information pertaining to state water quality standards.

If these preliminary activities indicate additional water quality data are required before a definitive statement can be provided regarding the comparison of preproject water quality conditions and state standards, an appropriate work plan will be developed and implemented during mid 1982.

NAVIGATION COMPONENT

The Susitna River has been designated "navigable" by the U.S. Bureau of Land Management (BLM) from the mouth to about five miles above Gold Creek. However, navigational use is known to occur beyond this point to Portage Creek. There has been a high level of concern expressed by both federal and state agency personnel regarding the effects of postproject streamflows on river stage and the subsequent impact on navigational use of the river for recreation, commerce, and land access.

Commercial Navigation

Based upon the findings of the instream flow survey, commercial navigation, by traditional lower-48 definition, does not exist on the Susitna River. The Alaska Department of Transportation and Public Facilities was not aware of any commercial navigation on the river. BLM's District Office also indicated that commercial navigation was not an instream use on the Susitna River. The U.S. Coast Guard defines the head of navigation as being at Gold Creek, however, they do not maintain any navigational aids downstream from this point and have indicated that they have no jurisdictional concern for structures constructed upstream from Gold Creek.

It is recognized, however, that navigational use is made of the Susitna River between Cook Inlet and Devil Canyon from which individuals receive income; for a few it is their livelihood. The craft that they operate are similar in size, or are of a type that require flow depths in the same range as those required by recreational water craft using the river. Therefore, a determination of the effects of postproject streamflows on commercial navigation in the Susitna River needs not be addressed by a separate engineering study. A single study can be undertaken to determine the effects of postproject streamflows on the navigability of the Susitna River, and the results of that assessment will apply equally well to both commercial and recreational use of the river.

Recreational Navigation Study

Introduction

Questions identified in the instream flow survey that 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 postproject 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 definitive description of the effects of postproject streamflows on navigational use and shoreline access cannot be determined based upon existing data. What is known at this time is that:

(1) project flows will result in reduced stage during the summer navigation season;

(2) much of the Susitna River and many of its principal tributaries have been used for navigation; and

(3) an array of concerns remain regarding the effects of post-project flows on navigation, traditional float plane landing sites, and access to shoreline areas and major tributary streams.

Additional data collection and investigation of these issues and therefore warranted.

Objectives

The objectives of this element of the instream flow assessment are:

(1) to identify past, present, and anticipated use of the Susitna River between Cook Inlet and Devil Canyon by boats and float planes, and to provide a preliminary assessment of the effects of pre-and postproject stream flows on these uses; and

(2) to locate present and proposed state land disposal sites within or adjacent to this river corridor and determine the effects of pre- and postproject streamflows on access to these sites by boat or float plane.

If the preliminary assessment of postproject streamflows should indicate that navigability of the Susitna River would be significantly affected in an adverse manner, then additional data is likely to be required in order to define realistic levels of use and quantify losses in meaningful economic terms. 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.

Methodology

TES will summarize information on past, present, and anticipated navigational uses of the Susitna River below Devil Canyon. This summary should describe estimated numbers of users, types of craft, seasonal

utilization, and areas of concentration. The principal navigation routes within the lower river (Cook Inlet to Talkeetna) will also be identified.

Data will be obtained primarily from existing documents and interviews, but TES will also conduct overflights of selected reaches of the Susitna River to augment the baseline description of river access and use. The investigation will address use of the river by float planes as well as boats, but it will not include winter use by dogsleds and snowmobiles since reliable information on these uses and postproject ice cover thickness cannot be compiled and evaluated within the time frame of this scope of work.

In consultation with DNR's Southcentral District Office, TES will prepare a map of existing and proposed state land disposal sites from public information. The map will be reviewed by DNR's Water Management Section to determine if any of these disposal sites are adjacent to river reaches for which supplemental field data or project information should be obtained and analyzed in order to assure that the question of postproject effects on access to that parcel can be addressed, at least preliminarily, by March 1982.

R&M and Acres will provide DNR's Water Management Section with a comparison of pre- and postproject streamflows at the Gold Creek and Susitna Station stream gages. R&M will also provide DNR with pertinent data from numerous cross sections and several staff gages that have been installed between Devil Canyon and Talkeetna for other elements of the feasibility study.

Through a cooperative effort, R&M, DNR's Water Management Section, DNR's Division of Geological and Geophysical Surveys, and ADF&G's Su Hydro Team will locate and survey four to six cross sections in the lower Susitna River. In addition, they will install staff gages and collect streambed material samples. (These data will supplement the river morphology work being conducted by R&M and the streambed material survey

being done by ADF&G.) R&M will be responsible for surveying the cross sections and providing DNR with cross section plots.

DNR's Water Management Section will provide TES with an analysis of pertinent staff gage data and a comparison of pre-and postproject water surface elevations at selected transects and shoreline locations on the Susitna River between Portage Creek and Big Island. TES will then determine the effect of the proposed project on navigational uses by evaluating the extent to which present day uses will be impacted by the seasonal changes in river stage. TES will also determine the effects of the proposed project on access to state land disposal sites. Methods for minimizing adverse effects of project flows on navigation will be identified in consultation with Acres, R&M, and DNR's Water Management Section.

WATER RIGHTS COMPONENT

The Application for License must evaluate the anticipated effects of the proposed Susitna hydroelectric project on existing instream uses and on both existing and proposed uses of project water for irrigation, domestic and industrial supplies, or other purposes (Federal Register 1981).

The instream flow survey identified the following agency concerns, which are pertinent to water use.

> 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: whether operation of the dam would allow present day out-of-stream diversions to be maintained; and whether postproject 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, as a subtask of the instream flow assessment, existing water rights in the Susitna River basin should be identified and the likelihood of the proposed project adversely affecting them evaluated. 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 following purposes: protection of fish and wildlife habitat, migration, and propagation; recreation and park purposes; navigation and transportation purposes; and sanitary and water quality purposes. After July 1, 1981, public agencies, native groups, or private citizens may file a request for instream flow reservation under this statute.

DNR is currently developing rules and regulations for implementing this legislation.

The DNR Water Management Section staff anticipates that they may receive requests for instream flow reservations on the Susitna River from agencies, groups, and individuals once these rules and regulations are promulgated. 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 would grant APA a reservation or water rights permit for the proposed Susitna hydroelectric project.

An instream flow assessment to support the negotiated settlement of several conflicting uses is far more costly and time consuming to conduct than one undertaken to determine the effects of a proposed project on existing or anticipated on uses.

Therefore it is recommended that the following study be undertaken to provide answers by March 1982 to questions pertaining to the nature and extent of existing water rights permits in the Susitna River basin.

Objectives

The objectives of this element of the instream flow assessment are to:

(1) compile an inventory of all existing water use rights (certificates, permits, and applications) in the Susitna River basin;

(2) prepare an interpretive summary of the inventoried surface water and groundwater appropriations including amount and location of the diversions and withdrawals; and

(3) assess the likelihood of the proposed Susitna hydroelectric project adversely affecting existing water rights in the basin.

Methodology

A formal request will be made to DNR's Water Management Section to provide a computer printout of all surface and ground water rights information on file for the Susitna River basin. The printout will be carefully reviewed by Linda Perry Dwight (subcontractor to undertake this study) and rechecked with the Water Management Section staff.

Summary tables will be developed that display information on certificates, permits, and applications pending. For each type of water right, as described by the standard industrial code classification, the amount of surface water or groundwater appropriated will be tabulated and the number of days per year that the water right is active will be noted. A summary table will be prepared that lists the total amount of surface water and groundwater appropriated in specific areas of the river basin.

When it is determined that an accurate and complete listing of water rights information has been compiled, the specific points of diversion or withdrawal can be plotted on appropriate maps. It is anticipated that the specific location of each recorded right within the impoundment area and along the mainstem Susitna River corridor will be plotted on 1:250,000 and 1:63,360 scale overlays.

Postproject water surface elevations will be determined by R&M for the Susitna River between Devil Canyon and Talkeetna in conjunction with other facets of the feasibility study. Project-induced changes in seasonal river levels below Talkeetna will be estimated by R&M and the Water Management Section staff (refer to Navitation Component). This information will be used to determine project effects on any surface water diversions that may exist along the Susitna River, and to discuss the likelihood of postproject flows adversely affecting groundwater withdrawals within the river corridor.

RIPARIAN VEGETATION AND WILDLIFE HABITAT COMPONENT

Although a number of groups contacted during the instream flow survey acknowledged that riparian vegetation is important, there were few specific questions raised.

The effect of postproject 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 postproject flows on boat access to the hunting areas. The major concerns focused on whether or not postproject flows would maintain a disturbed environment conducive to the production of moose browse. 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. SCS was doubtful whether project-induced vegetation changes below the Chulitna River would be measurable.

It does not appear to be cost effective to undertake a detailed study to define project effects on riparian vegetation at this time. The comparative importance of spring break up and annual floods for maintaining early seral stages of vegetation within the river corridor has yet to be established. Furthermore, a specific statement regarding effects of postproject ice conditions and flood peaks on stream channel stability has yet to be made. Therefore, a detailed investigation of project effects on riparian vegetation should be deferred until the current (Phase I) river morphology and ice studies are complete.

Introduction

The succession of vegetation communities in the flood plain depends, in part, on the substrate particle size deposited by the river, the available seed source, and time. Particle size distribution (texture) in the substrate material is related to the river velocity and the load it is

carrying. Succession will be affected by the type of disturbance (flood or fire), intensity of disturbance (major flood or minor fluctuation in water level), duration of disturbance (high water for a week or one day), and seasonality of disturbance (winter or summer). Some previous deposits will be disturbed little if frozen compared to disturbance by flooding when thawed. The intensity of the disturbance would regulate the erosional and depositional patterns, while the intensity and duration may regulate the amount of vegetation destroyed. Seasonality of disturbance would affect whether vegetation can regrow that year or if initial recovery must wait until the following year.

Objectives

The objectives of this element of the instream flow assessment should be to:

(1) identify and describe the vegetation community types along the flood plain of the Susitna River from Devil Canyon to the Delta Islands;

(2) determine the percentage of total surface area in typical segments of the flood plain occupied by different vegetation community types and by non-vegetated bars, islands, and dry channels;

(3) define the sequence in which each vegetation community type becomes established; and

(4) provide an initial statement regarding the relative importance of spring break up and summer floods for maintaining early seral stages for typical river segments above and below Talkeetna.

Methodology

A TES reconnaissance in August 1980 indicated that eight vegetation community types may exist in the floodplain. These types will be further identified and described. The extent of coverage of each type will be determined by aerial photo interpretation and ground truthing at selected transects.

In order to determine the ages and characteristics of each seral stage, a number of stands of each vegetation community type will be intensively sampled. Data will be obtained on:

(1) cover for all species by height class;

(2) density and age for woody species;

(3) crown length, width, and plant height for low shrubs;

(4) height and diameter-breast-height (dbh) for tall shrubs and trees;

(5) soil chemical composition, texture, size, and thickness of horizons; and

(6) site parameters (elevation above river, etc.).

Once communities have been described in terms of vegetational and soils characteristics, TES will attempt to determine the succession of plant communities based on ages of dominant species, immature species, and individuals in the understory, and substrate particle size distribution for early stages of succession. A range of ages for each vegetation community type could be estimated.

The apparent degree of influence of spring break up and summer flood peaks on maintaining early seral stages of vegetation will be estimated from field observations and aerial photography.

RIVER BASED RECREATION COMPONENT

Many groups contacted during the instream flow survey 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.

> 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, 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 question, 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. However, it is recommended that the study of river based recreation <u>not be undertaken</u> at this time. It is inadviseable to commit funds to identify or attempt to quantify secondary effects of the project prior to attaining a good understanding of the primary effects. Until enough is known about the limnology of the proposed reservoirs to intelligently discuss a reservoir fishery, it makes little sense to investigate the pro's and con's of increased recreational opportunities provided by the impoundments. Likewise it is premature to undertake the study of

project effects on river recreation below Devil Canyon until more is known about project effects on navigability, winter ice conditions, and existing resident and anadromous fish populations.

It would be desireable however, if time and resources allow, for TES to contact those agencies favoring a recreational user needs survey 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 brought 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 studies would accompany APA's initial request for licensing.

ESTUARINE COMPONENT

The proposed Susitna hydroelectric project will not affect the long-term average annual freshwater inflow into upper Cook Inlet. However, the magnitude and variability of seasonal inflows to the estuary will be altered.

Several concerns were identified in the instream flow survey regarding the effect of anticipated changes in the seasonal freshwater inflow to the estuary.

> The Sierra Club's National Representative, ADF&G's Su Hydro Team, and DNR's Division of Parks were concerned about the effect of altered flows on winter icing in upper Cook Inlet. Furthermore, USACE and the National Audubon Society stated a need for information to determine the productivity and type of wetlands that exist at the estuary and in the Susitna River basin. Others mentioned the possible change of water quality in upper Cook Inlet and questioned the effect that postproject flows might have on waterfowl use at Susitna flats. Concern has also been expressed about the effects on salmon populations in Cook Inlet entering the Susitna River and effects on Beluga whales.

Due to the lack of knowledge about the freshwater requirements of the Cook Inlet estuary, NMFS and ADF&G's Sport Fish Division suggested that a preliminary study be undertaken to first determine whether or not estuarine problems might exist. In general, their suggestion focused on identifying how much change in flow would occur at the mouth of the Susitna River and discussing whether such a change would affect the estuarine environment.

The comparative analysis of pre- and postproject streamflows, which will be undertaken by Acres and R&M at Susitna Station (refer to streamflow subtask of Flow Regime Component), will provide an adequate basis for quantifying project-induced changes in the seasonal freshwater inflow to the estuary. Such analysis might also provide sufficient insight to determine the likelihood of postproject 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 or escapements, waterfowl hatching success, or biologic conditions within the upper estuary itself to summer low-flow conditions in the Susitna River.

Objectives

The objective of this component of the instream flow assessment is to identify the seasonal change in freshwater inflow to the estuary from the Susitna River and discuss the significance with respect to the biological resources of upper Cook Inlet.

Methodology

It is suggested that TES undertake a preliminary estuary study consisting principally of a literature review. An annotated bibliography would be prepared on the marine biology and oceanography of the upper Cook Inlet estuary. Materials are also to be included on waterfowl use of the lower Susitna/Susitna Flats area. Information sources may include the National Oceanic and Atmospheric Administration, the University of Alaska's Institute of Marine Science and Arctic Environmental Information and Data Center, various Alaska-based federal and state agencies, technical journals, and general sources dealing with estuarine processes and environments.

As part of Exhibit E of the Application for License, a brief description of the existing biological conditions will be prepared. Synthesized pre- and postproject streamflows and water quality information furnished by Acres and R&M will be utilized. A general interpretive discussion will be provided, which will identify effects that the proposed hydroelectric project may have on the fish and wildlife resources in the upper Cook Inlet estuary. The primary purpose for this preliminary investigation is to help determine what further estuarine study is warranted during Phase II.

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