SUSITNA HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
CT No. 7114

AQUATIC PLAN OF STUDY FISCAL YEAR 1985

FINAL REPORT

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FISCAL YEAR 1985

Report by
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Prepared for
Alaska Power Authority

Final Report
December 1984

NOTICE

ANY QUESTIONS OR COMMENTS CONCERNING

THIS REPORT SHOULD BE DIRECTED TO

THE ALASKA POWER AUTHORITY

TABLE OF CONTENTS

List of Tables:

List of Figures:

SUSITNA HYDROELECTRIC PROJECT
FISCAL YEAR 1985 AQUATIC PLAN OF STUDY

1. INTRODUCTION

The Alaska Power Authority (Power Authority) submitted a license application to the Federal Energy Regulatory Commission (FERC) for the Susitna Hydroelectric Project (Project) on February 18, 1983 (Table 1). Following initial submission of supplemental information and responses to FERC comments, the application was accepted for review by the FERC on July 19, 1983. The application was then sent (by the FERC) to resource agencies for review and comment. This review is now complete. The Power Authority has responded to the agencies' comments and the FERC has prepared a draft environmental impact statement (DEIS). The Power Authority has filed comments on the DEIS with FERC on August 23, 1984. The final environmental impact statement (FEIS) is due for release in February, 1985. The license is tentatively scheduled to be issued by the FERC on March 18, 1987. This date is based on the FERC Susitna Project Status Report (revised on August 1, 1984) which assumes that there will be no substantial delays in the licensing process prior to that date.

Even though the license application has been accepted by the FERC for review, various aquatic or aquatic - related studies are still needed to assure that the licensing process proceeds on schedule. This document outlines the plans for the studies that are to be conducted during fiscal year 1985 (FY85).

A draft of this document was provided to resource agencies for their review in March 1984. A workshop was held on March 30, 1984 for the purpose of discussing the draft plan of study. Following the workshop, written comments and recommendations for the plan of study were received from the Alaska Department of Fish and Game, the Alaska Department of Natural Resources, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. To the extent possible these recommendations and comments are integrated into The Final Plan of Study. The recommendations and comments are included in Appendix C of this document along with specific responses to these comments.

TABLE 1

SUSITNA HYDROELECTRIC PROJECT
FEDERAL ENERGY REGULATORY COMMISSION
SCHEDULE FOR LICENSING PROCESS*

License Application Submitted to the FERC	February 18, 1983
Submission by the Power Authority of responses to FERC comments and requests for supplemental information	July 11, 1983
License application accepted by the FERC for formal review	July 29, 1983
Agency Review of License Application document complete	December 12, 1983
Responses to agency comments submitted by the Power Authority	January 19, 1984
Draft Environmental Impact Statement	May 5, 1984
Comments on DEIS filed	August 23, 1984
Final Environmental Impact Statement	February, 1985
License Issued by FERC (tentative)	March 18, 1987

*Based on the FERC Susitna Project Status Report - August 1, 1984.

A comprehensive plan of study, specifically designed for the lower Susitna River (Talkeetna to Cook Inlet), is appended to this document (Appendix A). The plan is designed to provide additional information which will enable the Power Authority to assess the potential effects of the project to aquatic habitats located in the lower reach of the Susitna River. The plan provides for a step-wise evaluation of potential effects and an expansion of specific studies if necessary.

A plan of study to assess potential Project-related impacts on navigation is appended (Appendix B). This plan is designed to provide the necessary information to evaluate possible effects of streamflow regulation on the uses of the river for transportation. The study will address both potential restrictions to navigation in general and impacts on customary routes of travel.

2. LONG-TERM GOALS OF THE POWER AUTHORITY

The Power Authority has defined specific long-term goals for aquatic studies that must be accomplished for the Susitna Project. These goals are:

1. Completion of the DEIS review process
2. Completion of the FEIS process
3. Completion of the Settlement Process
4. Completion of (potential) hearings
5. Receipt of an acceptable FERC license for the Project
6. Acquisition of local, state and federal permits for the Project
7. Continuation of studies that provide integrity to maintenance of the aquatic program.

Following is a brief description of the Power Authority's role for each of these goals:

1. Completion of the DEIS review process.

   The Power Authority will review the FERC's DEIS and provide any necessary comments on it. The Power Authority also plans to submit reports during this process that provide additional refinement to existing analyses. These reports will include those developed as part of the aquatic habitat relationships series described in the workshop on February 15, 1984. The Power Authority may also be requested to provide other information to the FERC for completion or clarification of the DEIS. The comment period for the DEIS was completed on August 23, 1984. Additional information pertinent to the preparation of the FEIS was filed with FERC in November, 1984.

2. Completion of the FEIS process

   The Power Authority plans to review and comment on the FEIS and submit any additional information that may be needed.

3. Completion of the Settlement Process.

The Power Authority plans to finish the aquatic impact evaluations, negotiate flow regimes, and develop detailed mitigation and long-term monitoring plans to complete the settlement process. This will be accomplished through workshops, distribution of information and direct negotiations with the resource agencies. Additional information or analyses resulting from on-going studies will be provided to the agencies during this period.

4. Completion of (potential) hearings.

If there are certain issues that cannot be resolved during the settlement process, resolution of the issues will require hearings before an administrative law judge. The Power Authority will directly participate in any necessary hearings. This participation will include responding to Discovery Requests, preparation of direct and rebuttal testimony and cross-examination of opposition witnesses. If hearings are necessary, the hearings process will begin during the spring of 1985.

5. License ordered by the FERC.

Following the settlement process (and potential hearings), the FERC will establish articles for the license that stipulate any additional needs for information and study prior to Project initiation. The Power Authority will review these articles and respond to them with any additional information that may have been developed in the interim. The final order granting license should come from the FERC in March, 1987.

6. Acquisition of permits.

Numerous permits will be needed for Project construction and operation. The Power Authority will develop information that is required for these permits.

7. Program Integrity.

Certain studies will be continued during FY85 and beyond. These will provide a long-term data base for comparison with results of the monitoring program which will be implemented once the Project becomes operational. These study elements include both biological (e.g., salmon escapement counts) and physical (e.g., stream discharge) data collection. The information collected during FY85 will also be used to refine existing analyses.

3. AQUATIC STUDY TEAM PARTICIPANTS

The Power Authority is assisted by various groups and contractors (referred to as the Aquatic Study Team) in assessing potential impacts to the aquatic environmental and in the licensing process. These organizations and their respective primary Project responsibilities are:

A. Harza-Ebasco (H-E) - this firm provides general support and coordination for the settlement and licensing processes and engineering support for simulation models used in impact assessments.

B. Alaska Department of Fish and Game/SuHydro Study Team (ADF&G/SuHydro) - conducts field studies, analyzes baseline fishery data, conducts studies and analyses to support instream flow relationships studies and describes pre-project habitat relationships.

C. E. Woody Trihey and Associates (EWT & A) - responsible for the instream flow relationships studies, habitat specific hydraulic evaluation support to ADF&G SuHydro and assistance in study design, field data collection, and analysis.

D. Arctic Environmental Information and Data Center (AEIDC) - develops necessary simulation modelling systems to analyze existing and with-project conditions and will conduct the quantitative impact assessment.

E. Woodward-Clyde Consultants (WCC) - responsible for mitigation planning and study design. Provides support for interpretation and compilation of fisheries resource data.

F. R and M Consultants (R&M) - assists all study team members with the collection and analysis of hydrologic and meteorologic data and provides field engineering support.

4. DEVELOPMENT OF THE FY85 AQUATIC PLAN OF STUDY

In order to meet the long-term goals of the Power Authority specific study tasks were developed. Certain of these tasks were determined to be more critical to meeting the goals than other tasks. In the Draft Plan of Study, proposed study tasks were presented in a priority sequence in order to facilitate determining which studies could be performed with a given level of funding available to the Power Authority. The priority list was further stratified into four levels. The levels were selected to reflect levels of risk for delay of the licensing schedule.

Level 1 studies included those studies deemed necessary to provide some probability of maintaining the licensing schedule but with a substantial degree of risk for schedule delay. Level 2 studies included those tasks which would reduce the level of risk to some extent. Level 3 studies included all studies which if prepared in addition to the Level 1 and Level 2 studies, would maintain licensing schedule with an acceptable degree of risk for delay. Level 4 studies, if performed in addition to level 3 studies, would result in a high degree of certainty for maintaining licensing schedule.

As a result of further planning efforts by study participants and determination of the level of funding available, the study tasks, through approximately level 3, are included in the final plan of study for FY85. Some study elements are integrated into other study elements as a result of further plan definition. The final study taks which will be conducted during FY85 are presented in this document. Task number designations used in the Draft Plan of Study are retained here as a matter of convenience and for reference to the Draft Plan of Study. A list of all tasks to be performed during FY85 is presented in Table 2.

TABLE 2
SUSITNA HYDROELECTRIC PROJECT
LISTING OF ALL AQUATIC FY85 TASKS

Task No.	Task Identification
1.	Preparation of responses to the Draft Environmental Impact Statement and Final Environmental Impact Statement.
2.	Participation in workshops and other aspects of the settlement process.
3.	General coordination of aquatic program activities.
4.	Instream flow relationships studies.
5.	Economic and environmental comparisons process.
6.	Recommended flow regimes report.
7.	Impact assessment.
8.	Flow negotiations.
9.	Preparation of materials for FERC hearings.
10.	Mitigation and enhancement planning.
11.	Comprehensive fisheries resources report.
12.	Middle river mainstem habitat analysis.
13A.	Adult salmon-middle river spawning surveys.
13B.	Adult salmon-lower river spawning surveys.
14.	Lower river resident and juvenile anadromous fish studies.
15A.	Lower river-main channel salmon escapement monitoring.
15B.	Middle river-main channel salmon escapement monitoring.
16A.	Outmigrant studies of the middle river.
16B.	Outmigrant studies of the lower river.
17.	Streamflow and flood frequency studies.
18.	Suspended sediment-turbidity studies.

Table 2

Continued

19. Hydro-meteorological physical data collection.
20. Load following alternative.
21. Lower river morphological assessment.
22. Mapping and digitizing of middle river habitat surface areas.
23. Lower river ice study.
24. Lower river aggradation.
25. Assessment of the available food source in turbid Susitna River habitats for rearing juvenile chinook salmon.
26. Preparation of a written report for the FY84 incubation study.
27. Middle river - main channel escapement monitoring at Talkeetna Station (RM 103)
28. Lower river tributary access analysis.
29. Evaluation of middle river mainstem and tributary spawning habitat relationships.
30. Slough groundwater and water balance studies.
31. Development of long-term monitoring plan.
32. Lower Susitna stream temperature analysis.
33. Adult salmon stream life study-middle reach sloughs.
34. Winter studies of resident and juvenile anadromous fishes.
35. Refinement of access criteria.
36. Lower river rearing habitat investigations - IFG hydraulic modeling.
37. Preliminary mitigation studies for the Devil Canyon to Talkeetna reach.
38. Impact asessment of construction-related activities transmission line and access road.

Table 2

Continued

39. Mitigation planning for construction activities.

40. Impoundment resident fish mitigation planning.

41. Baseline water quality monitoring at Tsusena and Deadman Creeks.

42. Glacier studies.

5. INTERRELATIONSHIP AMONG STUDY TASKS

Each element of the FY85 aquatic study effort is described in detail under each Task. It is evident from these descriptions, that a high degree of interrelationships exist among the various tasks. It is, therefore, valuable to describe the overall framework of the study plan in order to understand how the tasks are interrelated.

The majority of the study tasks can be grouped into two major study components:

1. Completion of the analyses of the aquatic habitats of the Susitna River between Devil Devil Canyon and,

2. Data collection and analyses of the aquatic habitats of the Susitna River between Talkeetna and Cook Inlet.

These two distinct subject areas are linked primarily through the development of a final mitigation plan for the aquatic habitats adversely affected by the proposed project. The two components are distinguished principally on the basis that an option for minimizing adverse effects to the aquatic habitats in the Devil Canyon to Talkeetna reach is flow regulation. Once a flow regime is negotiated for this reach, anticipated effects to the lower river reach may be identified and quantified followed by development of an acceptable mitigation plan. Options for minimizing adverse effects to the lower river do not include flow alternatives.

The framework into which FY85 study tasks necessary to complete the middle river (Devil Canyon to Talkeetna) component is depicted in Figure 1. Study tasks which address each of the elements in the framework are identified in the figure. Similarly, the basic framework for the lower river study is presented as Figure 2.

Tasks not identified on the two figures generally fall into one of three categories:

1. Studies to refine existing analyses of middle river habitats;

2. Studies to assess impacts and develop mitigation plans for aquatic habitats associated with the impoundment, access road, transmission line and construction activitites, and

3. General program coordination among study team participants and with FERC licensing activities.

Specific tasks associated with each of these categories are listed in Table 3.

In addition to the basic study framework for the aquatic program, each task is designed to provide information necessary to resolve issues raised by the resource agencies pertaining to the effects of the proposed project on the aquatic resources. In March, 1984, twelve specific issues pertaining to fisheries resources were deliniated by the Power Authority in consultation with the resource agencies. The relationships between study tasks and specific issues are presented in Figure 3.

FIGURE 1: Interrelationships of Middle River Study Tasks

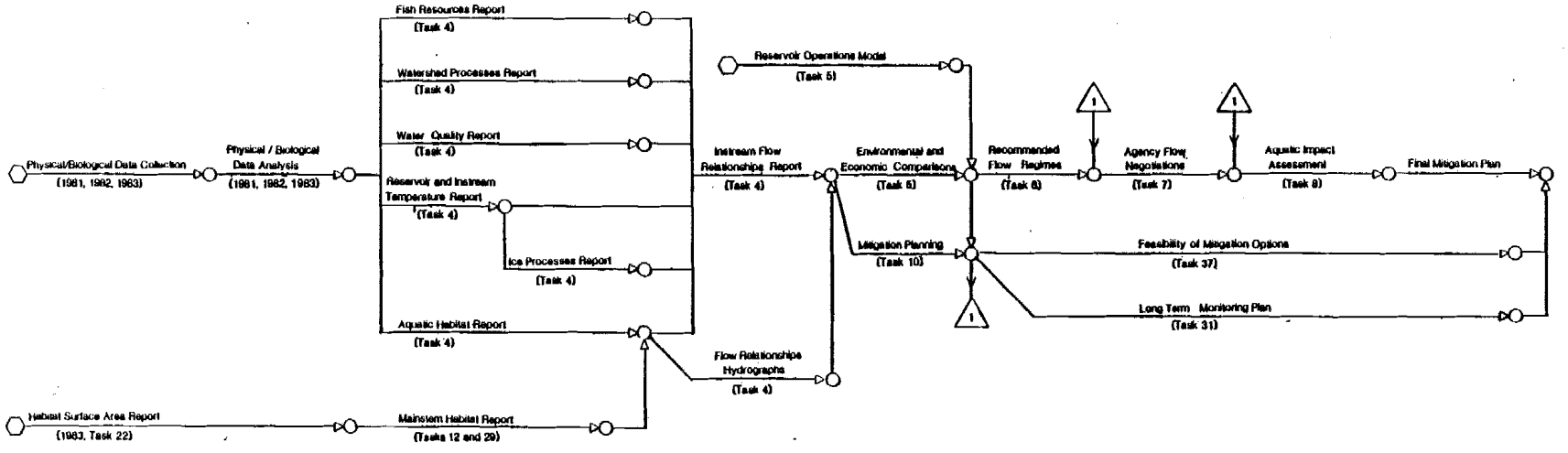

FIGURE 2: Interrelationships of Lower River Tasks

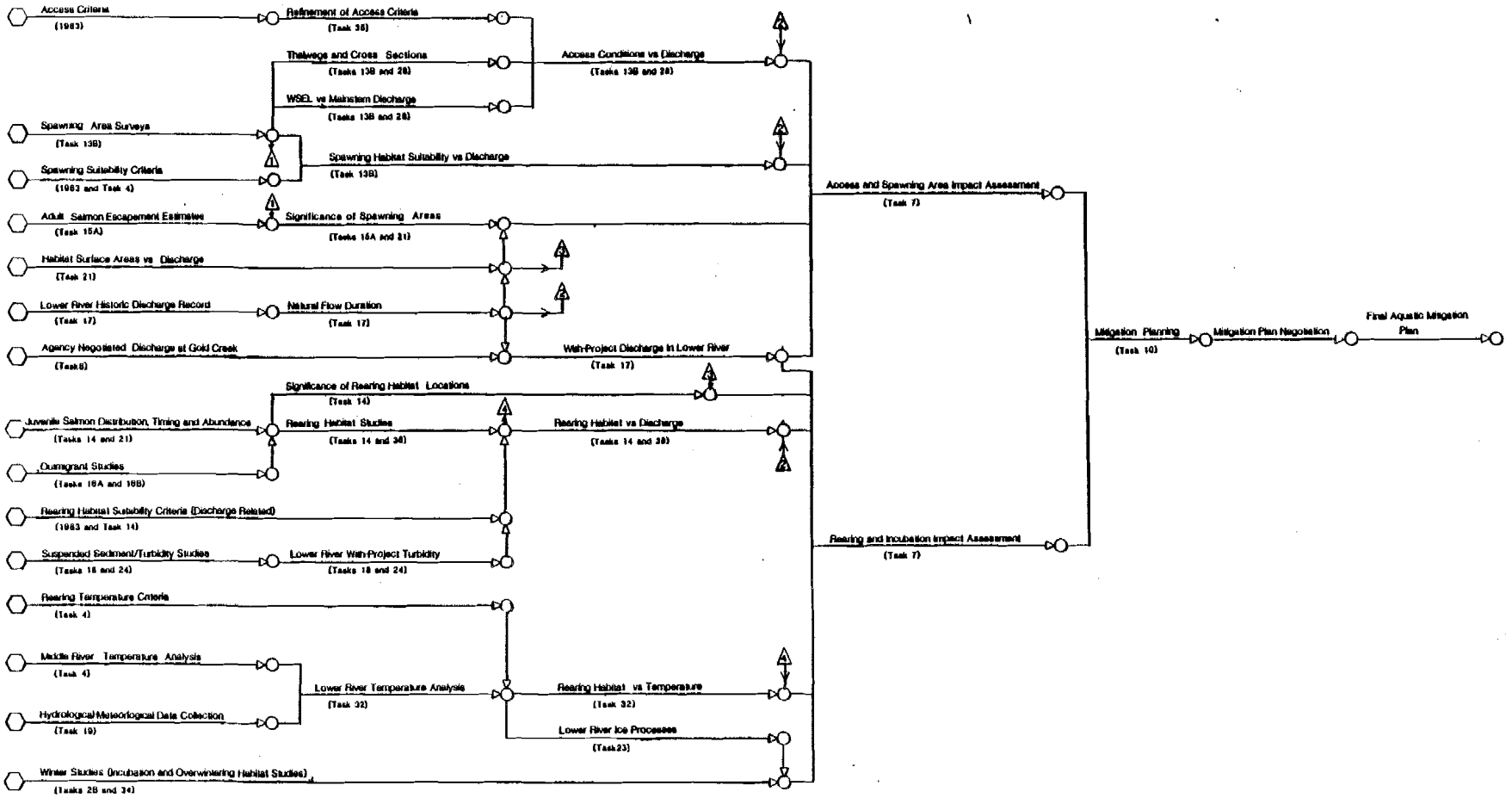

TABLE 3

SUSITNA HYDROELECTRIC PROJECT
TASKS ASSOCIATED WITH MISCELLANEOUS CATEGORIES

Category	Tasks
Refinement of Existing Middle River Analyses And Continuation Studies	13A, 15B, 16A, 25, 26, 27, 30, 33, 43,
Impact Assessment and Mitigation Planning for Impoundment, Access Road, Transmission Line, and Construction Activities	38, 39, 40, 41
Program and FERC Coordination Activities	1, 2, 3, 9, 11

RELATIONSHIP BETWEEN FY 85 AQUATIC PROGRAM WORK PLAN AND ISSUES

TASKS	F-1 SIGNIFICANCE OF ALTERED FLOWS ON FISH	F-2 SIGNIFICANCE OF WATER QUALITY CHANGES	F-3 SIGNIFICANCE OF ALTERED ICE PROCESSES	F-4 SIGNIFICANCE OF CHANGES TO STREAM MORPHOLOGY	F-5 SIGNIFICANCE OF IMPOUNDMENT EFFECTS ON FISH	F-6 SIGNIFICANCE OF ACCESS CORRIDOR EFFECTS ON FISH	F-7 SIGNIFICANCE OF TRANSMISSION LINE EFFECTS ON FISH	F-8 SIGNIFICANCE OF WATER QUALITY EFFECTS DUE TO CAMP AND VILLAGE	F-9 SIGNIFICANCE OF WATER QUALITY EFFECTS IN BORROW AND SPOIL AREAS	F-10 SIGNIFICANCE OF INSTREAM ACTIVITIES ON FISH	F-11 FEASIBILITY OF MITIGATION OPTIONS	F-12 FORMULATION OF LONG-TERM MONITORING PLAN
1. COMMENTS ON DEIS AND FEIS												
2. WORKSHOPS / SETTLEMENT PROCESS	●	●	●	●	●	●					●	●
3. COORDINATION OF AQUATIC PROGRAM ACTIVITIES												
4A. INSTREAM FLOW RELATIONSHIPS STUDIES	●	●	●	●							●	
4B. FLOW RELATIONSHIPS COMPOSITING	●											●
5A. ECONOMIC AND ENVIRONMENTAL COMPARISONS	●	●	●								●	
5B. POWER ANALYSIS	●										●	
6. RECOMMENDED FLOW REGIMES REPORT	●	●	●	●						●	●	
7. AQUATIC IMPACT ASSESSMENT	●	●	●	●	●	●	●	●	●	●	●	●
8. FLOW NEGOTIATIONS	●		●								●	
9. FERC HEARINGS PREPARATION	●	●	●	●	●	●	●	●	●	●	●	●
10. MITIGATION AND ENHANCEMENT PLANNING	●	●									●	●
11. COMPREHENSIVE FISHERIES RESOURCES REPORT	●	●		●	●						●	●
12. MIDDLE RIVER MAINSTEM HABITAT ANALYSIS	●	●		●							●	
13A. MIDDLE RIVER SPAWNING SURVEYS	●										●	●
13B. LOWER RIVER SPAWNING SURVEYS	●										●	●
14. LOWER RIVER RESIDENT AND JUVENILE FISH STUDY	●	●	●								●	●
15A. LOWER RIVER SALMON ESCAPEMENT	●										●	●
15B. MIDDLE RIVER SALMON ESCAPEMENT	●										●	●
16A. JUVENILE OUTMIGRANTS FROM MIDDLE RIVER	●	●	●								●	●
16B. JUVENILE OUTMIGRANTS FROM LOWER RIVER	●	●	●								●	●
17. STREAMFLOW AND FLOOD FREQUENCY STUDIES	●	●		●						●		
18. SUSPENDED SEDIMENT/ TURBIDITY STUDIES		●		●							●	
19. HYDRO-METEROLOGICAL DATA COLLECTION	●	●	●								●	●
20. LOAD FOLLOWING ALTERNATIVE	●			●							●	
21. LOWER RIVER MORPHOLOGIC ASSESSMENT	●			●								
22. MIDDLE RIVER HABITIAT SURFACE AREAS	●			●								
23. LOWER RIVER ICE STUDY			●									
24. LOWER RIVER AGGRADATION		●		●								
25. FISH FOOD AVAILABILITY STUDIES	●	●										
26. REPORT OF INCUBATION STUDIES	●	●	●								●	
27. MIDDLE RIVER ESCAPEMENT AT TALKEETNA	●										●	●
28. LOWER RIVER TRIBUTARY ACCESS	●										●	
29. MIDDLE RIVER MAINSTEM SPAWNING HABITAT RELATIONSHIPS	●	●	●	●							●	●
30. SLOUGH GROUND - WATER STUDY	●										●	
31. LONG-TERM MONITORING PLAN												●
32. LOWER SUSITNA STREAM TEMPERATURE ANALYSIS		●	●									
33. SALMON STREAM - LIFE STUDY	●											●
34. WINTER RESIDENT AND JUVENILE ANADROMOUS STUDIES	●		●								●	
35. REFINEMENT OF ACCESS CRITERIA	●										●	
36. LOWER RIVER REARING HABITAT IFG STUDIES	●	●		●								
37. PRELIMINARY MITIGATION STUDIES											●	
38. CONSTRUCTION IMPACT ASSESSMENT						●	●	●	●			
39. CONSTRUCTION IMPACT MITIGATION						●	●	●	●		●	
40. IMPOUNDMENT RESIDENT FISH MITIGATION					●						●	
41. WATER QUALITY MONITORING-TSUSENA AND DEADMAN CREEKS								●				
42. ALTERNATIVE ESCAPEMENT MONITORING METHOD	●											●
43. GLACIER STUDIES	●											
44. REFINEMENT OF TEMPERATURE CRITERIA		●	●									
47. MIDDLE RIVER TRIBUTARY STABILITY				●							●	
51. HEAVY METAL LEACHING POTENTIAL		●										
52. FISH TISSUE MERCURY CONCENTRATIONS		●										

6. FY85 AQUATIC PLAN OF STUDY TASK DESCRIPTIONS

Detailed description of each study task is provided below. Each task description includes the ratinale, objectives, description of methods, deliverables and schedule for the tasks. The task descriptions result from previous analyses and other existing sources of information.

TASK 1

PREPARATION OF RESPONSES TO THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT AND
FINAL ENVIRONMENTAL IMPACT STATEMENT

Rationale

The Power Authority must review and comment on both the DEIS and FEIS to assure that all analyses and conclusions are based on correct information. This review is a critical part of the licensing process.

Objectives

1. To provide review comments on the DEIS prepared by FERC for the Susitna Hydroelectric Project.

2. To provide review comments on the FEIS.

Description

Activities that will lead to completion of the first objective will involve three elements. The first element consisted of preparing additional information which will strengthen some conclusions reached in the DEIS. The second element consisted of preparing information and substantiation for analyses which differ from those reached in the DEIS. The third element consisted of information, analyses and conclusions for topics not discussed in the DEIS which would alter other conclusions of the DEIS. The Power Authority Comments on the DEIS will include a compilation of these three elements.

The activities leading to accomplishment of the second objective will include preparation of a list of conclusions reached by the FERC in the FEIS with which the Power Authority does not agree. Additionally,

comments prepared by other commenting agencies will be reviewed to identify those conclusions with which a substantial difference of opinion remains. This review will provide a basis for identifying specific conclusions which may need resolution through the settlement and hearings processes.

Deliverables

To meet the first objective the deliverables are:

1. Memoranda identifying conclusions reached in the DEIS.

2. Memoranda containing necessary additional information for each conclusion.

3. Memorandum of Power Authority comments on the DEIS.

Deliverables to accomplish the second objective include:

1. Memoranda identifying conclusions reached in the FEIS.

2. Memoranda describing conclusions for which there is substantial disagreement among licensing participants.

Schedule

	Item	Due Date
1.	Memoranda identifying conclusions of DEIS	May 30, 1984
2.	Memoranda containing additional information for DEIS	July 3, 1984
3.	Memorandum of comments on DEIS	August 23, 1984

4.	Memorandum identifying conclusions of FEIS	March 15, 1985
5.	Memoranda identifying conclusions in FEIS with substantial disagreement	March 25, 1985

TASK 2

PARTICIPATION IN WORKSHOPS AND OTHER ASPECTS OF THE SETTLEMENT PROCESS

Rationale

This task is necessary to assure that the settlement process progresses with input from participants who can provide the most complete information for resolving specific issues.

Objective

To provide the Power Authority with information and support to resolve issues raised by natural resources agencies and negotiate an acceptable project flow regime and mitigation plans.

Description

An important aspect of the settlement process is dissemination of information to familiarize resource agency personnel with project study methodologies, analyses and results directed toward resolution of primary impact issues. The primary method for providing this information will be a series of agency workshops in which specific topics will be discussed. The workshops will be theme-oriented as in previous workshops. Appropriate documents pertaining to the topic areas would be disseminated prior to the workshops in sufficient time for agency familiarization.

Appropriate members of the Aquatic Study Team will participate in preparation for or actually take part in specific workshops depending on particular topics to be covered.

The Power Authority will meet with resource agencies to attempt to reach settlement on various issues and negotiate a project flow regime.

Aquatic Team members will provide various information, analyses, documents and other support as requested by the Power Authority.

Deliverables

Deliverables will consist of prepared materials and/or presentations as requested to support the settlement process.

Schedule

Three specific aquatic workshops are scheduled to occur during FY85. The schedule for these workshops is:

Workshop	Date
Workshop 5: Forecast of Project Induced Water Quality Changes and Their Effects on Fish.	August 9, 1984
Workshop 6: Aquatic Habitat and Instream Flow	October 29, 1984
Workshop 7: Project Mitigation Opportunities	December 4, 1984

Nine additional workshops may be held. Specific topics for each workshop have not been selected at this time. However, these workshops could occur on a monthly basis from January, 1985 through June, 1985. Possible topics for these workshops include:

- Development of Alternative Flow Requirements for Analysis of Environmental and Economic Effects

- Discussion of Results of Comparison of Alternative Flow Regimes

- Development of the Mitigation Plan

- Results of Lower River Studies

- Development of the Long Term Monitoring Program

- Aquatic Program Study Plan for FY86.

TASK 3

GENERAL COORDINATION OF AQUATIC PROGRAM ACTIVITIES

Rationale

Coordination among aquatic study groups is vital to assure satisfactory integration of all components. The importance of this task increases as the project proceeds through the settlement process to FERC hearings.

Objective

Attain a level of coordination among Aquatic Study Team members necessary to assure effective and efficient progress in the stury program.

Description

This task requires effort from all members of the Aquatic Study Team. H-E is responsible for the overall coordination of program activities. This includes monitoring all activities in the aquatic studies to insure that team members are able to accomplish their tasks and that sufficient progress is being made toward study goals. Each team member is responsible for maintaining an appropriate level of communication and coordination with other team members who share common, integrated or related tasks.

Program coordination will be achieved by various means including:

1. Joint preparation of study plans.

2. Weekly team meetings.

3. Team-wide dissemination of technical reports, correspondence and memos.

4. Frequent meetings and data exchange among team members with related tasks.

Deliverables

Study plan development for FY86 will begin in February, 1985. This planning process will produce a Detailed Plan of Study for FY86 as well as specific workscopes for each team member.

There are no other specific deliverables for this task. However, memoranda describing the results of or need for coordination will be prepared when appropriate to affect necessary changes in planned activities, schedules, etc.

Schedule

Aquatic Study Team Meetings	Weekly
Begin FY86 Planning Process	February, 1985
Draft Detailed Plan of Study (FY86)	May 1, 1985

TASK 4

INSTREAM FLOW RELATIONSHIPS STUDIES

Rationale

This work is necessary to complete analyses of existing data and communicate the results to individuals responsible for the settlement process and the FERC licensing schedule. The Instream Flow Relationships Report and its supporting technical reports will provide the basis for negotiating a flow regime.

Objectives

1. Complete the analysis of pertinent physical and biological data on the Talkeetna to Devil Canyon river segment.

2. Prepare final drafts of the technical report series currently in progress.

3. Complete the Instream Flow Relationships Report.

Description

The Instream Flow Relationships Report will describe the relationships between mainstem flow and fish habitat. It will be derived primarily from information contained in a series of technical reports. These technical reports are:

1. Fish Resources and Habitat of the Susitna Basin - this report will be a consolidation of the information on the aquatic resources of the Susitna Basin that is currently dispersed throughout numerous reports, memoranda and workshop minutes. It will be based on

data available through June 1984. This report may be updated as additional information becomes available.

2. Physical Processes Report - this report will describe the physical processes that occur within the Basin. It will be focused primarily on preproject to with-project changes in streamflow, channel stability, bedload transport and groundwater upwelling.

3. Water Quality/Limnology Report - this report will consolidate much of the existing information on water quality in the Basin and focus on preproject versus with-project changes. Some additional modelling and field studies (primarily concerning turbidity and suspended sediments) will be incorporated into this report to refine information from previous studies. The Report will include discussions of standard water quality practices with special emphasis on turbidity and suspended sediments, gas supersaturation, downstream nutrients and mercury bioaccumulation.

4. Reservoir and Instream Temperature - this report will present instream temperature forecasts for a range of operational and climatological conditions and a preliminary commentary of their effects on fish habitats. The report will be based on the results of field studies and the results of reservoir temperature and downstream temperature and ice models.

5. Reservoir and Instream Ice - this report will present insteram and reservoir ice processes forecasts for a range of operational and climatological conditions and a preliminary commentary of their effects on fish habitats. The report will rely on results of the DYRESM reservoir temperature model ice subroutine, SNTEMP instream temperature model and the ICECAL instream ice processes model. The report will also incorporate field observaitons and data collected to evaluate fish habitats under winter conditions.

6. Instream Flow Relationships Report - this report will provide a quantitative discussion of the influence of changes in streamflow, stream temperature, suspended sediments and water quality of the Susitna River on riverine fish habitats between Devil Canyon and Talkeetna. The influence of streamflow on fish habitats will be presented as a set of habitat suitability indices which describe how the habitats change with mainstem discharge changes. In order to accomplish this, a framework for extrapolating information obtained from specific study sites to the remainder of the river reach will be developed and implemented. This analysis will take results obtained from modelled sites which quantify the relationships between discharge and Weighted Usable Areas (WUA) and extrapolate those results to non-modelled sites. Some field studies will be necessary to provide substance to the framework for extrapolation.

   The set of relationships will include separate habitat suitability indices for each life stage of each salmon species inhabiting the river. These indices and the timing of utilization of the habitats by the various life stages will be used to develop annual hydrographs for each species. Those hydrographs, or flow regimes, will be developed to represent the ranges of mainstem discharges which span the discharges which provide optimum habitat suitability for each life stage in a given time period.

   Compilation of a single annual hydrograph which will optimize the aquatic habitat for all species will be developed from the species-specific hydrographs. It is anticipated that conflicts between optimum flows for two species will arise. Resolution of these conflicts will require prioritization of the species. This prioritization will be accomplished through consultations and recommendations of the Resource Agencies.

The process of compiling the annual hydrographs for each species will involve use of the life stage weighting factors in order to resolve any conflicts in optimum flows for different life stages of a given species which may be present during a common time period. The development of species-specific weighting factors for each habitat type described in the surface area report will provide a major basis for the analysis. The weighting factors will be developed on the basis of known distributions and abundances of the species life stages presented in the ADF&G SuHydro Anadromous Adult and Resident and Juvenile Anadromous data reports of FY82, FY83 and FY84. The weighting factors will provide an index of the relative importance of seasonal changes in mainstem discharge on each habitat type with respect to their utilization by the fish. These indices will provide a biological basis for prioritization of habitats based on existing utilization patterns.

The annual hydrographs will serve as a basis for the comparison of alternative flow regimes as discussed in Task 5.

Deliverables/Schedule

Technical Report Series

	REPORT	DRAFT	FINAL
1.	Fish Resources and Habitat	11/30/84	
2.	Physical Processes	01/31/84	
3.	Water Quality	01/31/85	
4.	Reservoir and Instream Temp	10/31/84	11/30/84
5.	Reservoir and Instream Ice	12/15/84	03/31/85
6.	Relationships Report	12/30/84	03/31/85

TASK 5

ECONOMIC AND ENVIRONMENTAL COMPARISONS PROCESS

Rationale

Environmental and economic consequences of detailed alternative flow regimes must be compared and documented for development of a recommended flow regime. This process will be used in the settlement process.

Objective

To provide information and documentation necessary for the Power Authority to select a recommended flow regime and initiate flow negotiations with resource agencies. This information will include comparisons of environmental and economic effects of several flow regimes.

Description

Several alternative weekly flow regimes will be defined and compared. The flow regimes will range from the optimum environmental (aquatic habitat) to the optimum economic regimes and will include the natural flow regime and flow regimes presented in the License Application. Other alternative regimes will be selected based on the needs of navigation, recreation, riparian habitats and water quality. Development of flow regimes for evaluation will be discussed with Agency personnel and, when appropriate, their recommendations will be incorporated into the alternative regimes to be evaluated.

A project optimization procedure will be used to evaluate the alternative regimes. The computer based, iterative process will reduce the number of alternative regimes to be considered further.

These regimes will provide for the needs of both energy generation and the various downstream uses of the river. During the Project optimization process, emphasis will be placed on comparisons of Project economics and fish habitat. At several steps in the procedure the effects of the flow regimes on physical parameters such as water temperature, water quality and ice processes, as well as, impacts of these physical changes on other instream uses will be evaluated. These in-process evaluations are necessary to establish boundaries for the next iterations.

Minimum and maximum environmental flows will be established and input to the weekly reservoir operations model to produce a time series of expected flows and energies (based on a 33 year record of historic flows) for four energy demand levels. The use of four demand levels will be required to examine the influence of increasing energy demand that will occur during the life of the project. Composited habitat relationships will be used to forecast relative fish habitat for the 33 years of record. The resulting time series will be presented as habitat duration curves.

The resultant flow regimes will be analyzed to determine effects (both positive and negative) on each instream flow use. Mitigation opportunities and associated costs will be examined for those instream flow uses that are adversely affected. The effect of each flow regime on project benefits and costs will be determined for comparison with the corresponding environmental effects.

Deliverables

The Economic and Environmental Comparisons Report

Schedule

Draft	May 1, 1985
Final	Fall, 1985

TASK 6

RECOMMENDED FLOW REGIMES REPORT

Rationale

The Economic and Environmental Comparisons Report will set the basis for defining a detailed flow regime schedule. The next step will be to draw together comparisons developed in that report into a single proposed regime. The resulting flow regime will affect the position of the Power Authority for entering flow negotiations and completing the licensing process.

Objective

Develop a detailed flow regime schedule, including allowable variance for wet, normal, and dry years, that is based on information presented in the Economic and Environmental Comparisons Report (Task 5) and discussions with resource agencies and utilities.

Description

The Economic and Environmental Comparisons Report will document economic and environmental consequences of various detailed flow regimes. It will be necessary to combine these comparisons into a proposed flow regime that balances environmental concerns with economic benefits.

The report developed under this task will be the primary document for the flow negotiation process. It will be presented in draft form to the various utilities and resource agencies. Depending on the outcome of this review, the report will be either: 1) finalized if no significant comments are received, or 2) revised based on comments recieved in anticipation of additional instream flow negotiations.

Deliverables

A working report that will be developed in draft form. The final form will depend on results of the review process.

Schedule

Draft	June 1, 1985

TASK 7

AQUATIC IMPACT ASSESSMENT

Rationale

Impact assessment is integral to the settlement process and final licensing and permitting. An acceptable quantitative assessment of impacts of the Project configuration and operation is critical to finalizing and implementing a mitigation plan.

Objective

To prepare a report describing, quantitatively, the discharge-related effects of the recommended flow regime on downstream fishery resources.

Description

The Susitna aquatic investigations program includes the following steps: 1) field data collection and analysis, 2) development of habitat relationships, and 3) development of composite flow relationships hydrographs and flow optimization. After the tradeoffs between habitat/fish populations and power generation have been examined, a recommended operating regime will be developed. It is expected that this regime will affect fishery resources. These effects must be quantified and described to develop specific mitigation measures. This task will quantify the impacts of the recommended operating regime. The impact analyses of alternative flow regimes presented in the Economic and Environmental Comparisons Report and the Recommended Flow Regimes Report will form the basis for the detailed final impact assessment presented in the Aquatic Impact Assessment Report.

Information on potential impacts of the Project will be derived from ADF&G SuHydro, Power Authority, ETW&A, R&M, AEIDC and H-E reports and other documents. Integration of this information with habitat relationships and flow relationships hydrographs will provide the basis for impact assessment.

Deliverable

A report detailing expected impacts of the recommended flow regime on aquatic habitats.

Schedule

Draft	May 1, 1985
Final	Fall, 1985

TASK 8

FLOW NEGOTIATIONS

Rationale

An instream flow regime will be proposed prior to hearings or licensing of the Project. Therefore, negotiation of this regime with resource agencies is an integral part of the settlement process.

Objective

To support negotiation with resource agencies of a filling and operation flow regime schedule that balances environmental considerations with project economics.

Description

The Power Authority will negotiate with various resource agencies to finalize a Project flow schedule. Participation and assistance will be needed from aquatic study team members (and members from other disciplines) during these negotiations to provide technical assistance to the Power Authority. The coordinator for assuring that this assistance is provided will be H-E.

Deliverables

Immediate deliverables will include memoranda, analyses and other documents as requested by the Power Authority. The overall deliverable is a negotiated flow schedule for Project construction and operation. The negotiated flow regime will be described in memoranda of understanding or other appropriate documents between the Power Authority and each of the various resource agencies.

Schedule

The flow negotiations are scheduled to begin with initiation of the Instream Flow Relationships Report and continue with results contained in a draft of the Recommended Flow Regimes Report.

TASK 9

PREPARATION OF MATERIALS FOR FERC HEARINGS

Rationale

A major element of the environmental hearings process will focus on effects of the Susitna Hydroelectric Project on aquatic resources and the potential effectiveness of planned mitigation. Large volumes of data must be summarized into formats appropriate to support the hearings process scheduled to begin December, 1984.

Objectives

Prepare materials necessary to support successful completion of the FERC environmental hearings process.

Description

Steps in the hearing process that will require participation by members of the Aquatic Study Team include the discovery process, filing of direct testimony, filing of rebuttal testimony, possible filing of surrebuttal testimony and cross examination of witnesses. Although most of these steps will not occur in FY85, it is necessary to begin preparation for accomplishing these steps. This is due to the large volume of data and analyses concerning aquatic resources which must be summarized and developed into an appropriate form for hearings.

The primary activities which will occur during FY85 include the selection of persons who will testify on behalf of the Power Authority, consultation with Power Authority Licensing Counsel, responses to discovery requests from FERC and intervenors and preparation of written direct testimony.

Deliverables

Specific deliverables to result from the activities of this task include:

1. Designation of expert witnesses to testify on aquatic resources on behalf of the Power Authority.

2. Position papers by expert witnesses defining areas to be discussed and input required from other participants.

3. Responses to discovery requests.

4. Draft outline of direct testimony from each expert witness.

In addition, the designated expert witnesses will participate in activities leading to deliverables of other aquatic study tasks.

Schedule

The schedule for accomplishing this task will be coupled with the schedule set by FERC for the environmental hearing process. At the present time, the hearing schedule is as follows:

	Item	Date
1.	FERC orders hearings	03/18/85
2.	Prehearing conference	05/17/85
3.	Discovery request responses	08/08/85
4.	Additional discovery request responses	09/06/85
5.	Filing of direct testimony by Applicant	09/25/85
6.	Filing of rebuttal testimony	10/09/85
7.	Cross examination of witnesses	02/11/86

In support of the hearing schedule, activities conducted by the Aquatic Study Team are scheduled as follows:

	Item	Date
1.	Designation of expert witnesses	11/01/84
2.	Position papers	03/31/85
3.	Conferences with legal counsel	Periodically
4.	Responses to discovery requests	06/24/85
5.	Draft outline of direct testimony	04/30/85
6.	Draft direct testimony text	06/30/85

TASK 10

MITIGATION AND ENHANCEMENT PLANNING

Rationale

Development of an acceptable mitigation plan is needed to support the hearing and settlement processes and establish license articles. Enhancement of salmon stocks in the Devil Canyon to Talkeetna reach may be needed to offset losses elsewhere in the system.

Objective

1. Develop a mitigation report, including a mitigation plan, for habitat modification in the Devil Canyon to Talkeetna reach.

2. Identify enhancement opportunities under anticipated project conditions.

Description

A mitigation report is being developed that will identify mitigation opportunities associated with anticipated Project conditions. The report will further develop the mitigation plan identified in the FERC license application and explore additional mitigation alternatives compatible with Project mitigation policy.

A draft report will be produced by the end of the first quarter of FY85. This draft will include input from H-E, ADF&G SuHydro, AEIDC and EWT&A. The report will identify potential areas and methods for habitat modification based on existing information through FY 1984 field efforts.

It is anticipated that Project conditions may improve habitat downstream from Devil Canyon. If habitat improves, there may be an

opportunity to enhance salmon runs into the Devil Canyon to Talkeetna reach. The anticipated habitat conditions under Project operation, based on existing information, will be evaluated for their potential to support enhancement. Specific locations and methods will be identified where possible. An enhancement evaluation will be included as a section of the mitigation report.

Mitigation planning is an iterative process leading eventually to a final mutually acceptable mitigation plan. A part of this iterative plan is to identify mitigation options which could be implemented. Many of these options are described in the License Application. However, there remain some questions regarding the feasibility of these options and the completeness of the range of options available. The first interim report explores in greater detail options proposed in the License Application as well as alternative options suggested by recent studies. Results of feasibility type studies such as those performed under Tasks 37 and 48 will be incorporated in the second interim report. Likewise, the necessity for implementation of specific mitigation options will be determined based on the results of the comparison and impact assessment procedures (Tasks 5 and 6).

Deliverables

A mitigation report series will be prepared for the Devil Canyon to Talkeetna reach. The report series will consist of interim reports in 1984 and 1985, with updating based on new information and agency policy decisions.

Schedule

	Draft	Final
First Interim Mitigation Report	10/30/84	12/30/84
Second Interim Mitigation Report	08/31/85	10/31/85

TASK 11

COMPREHENSIVE FISHERIES RESOURCES REPORT

Rationale

Extensive studies have been performed on the resources of the Susitna River by numerous groups (the Alaska Power Authority, ADF&G SuHydro, U.S. Corps of Engineers, present contractors and subcontractors to the Power Authority and others). These studies have not been tied together into a single document that is relatively concise and comprehensive. Further results of the various studies have not been examined in total. Therefore, there is a strong need to develop such a reference document for use during the settlement and hearings process.

Objective

The main objective is to produce a comprehensive report on the aquatic resources of the Susitna River Basin.

Description

The license application consolidated existing knowledge on the aquatic resources of the Susitna River Basin that was available at that time. Since the application was submitted numerous other studies have been completed or are ongoing. Many of these studies were not interrelated upon completion. Much of the existing information is found in dozens of volumes of text, reports, workshop minutes and memoranda. This task is directed at examining this information, identifying key information and presenting a condensation of this material into one document. Information from areas outside the Susitna Basin will also be examined to assist in interpretation of Susitna-specific data. This report is intended to supplement the Fish Resources and Habitat Report (Task 4)

through incorporation of the 1984 data collected during the field season by ADF&G Su-Hydro.

Deliverables

The main deliverable will be the final comprehensive report.

Schedule

Draft	April 30, 1985

TASK 12

MIDDLE RIVER MAINSTEM HABITAT ANALYSIS

Rationale

The successful completion of this task will provide a quantitative assessment of potential effects which may accrue to existing side-channel and mainstem habitats due to flow and temperature regulation of the Susitna River. This task will support the settlement process and other activities leading to a negotiated flow regime and eventual Project licensing.

Objective

To quantify the potential effects which may accrue to existing side channel and mainstem habitats due to flow and temperature regulation of the Susitna River.

Description

Site Selection: Aerial photographs taken during FY84 (12,000 cfs at Gold Creek) will be systematically reviewed by EWT&A and ADF&G-SuHydro staff. This will result in the selection of eight to ten candidate study sites that appear to have channel structure and hydraulic conditions which may provide spawning and rearing habitats when mainstem flows are between 8,000 and 14,000 cfs. A brief narrative will be prepared by July 31, 1984 describing the rationale for supporting the selection of each candidate study site. Four or five study sites will be selected prior to the third week of July and site specific field work will commence in early August.

Field Data Collection: Field data will be collected by ADF&G-SuHydro, EWT&A and R&M under the general direction of EWT&A. Cross sections

will be established and site specific flow, depth and velocity data collected as recommended by Trihey and Wegner, 1984. Site-specific information on substrate type, cover availability and presence or absence of upwelling will be recorded consistent with the field methods developed by the ADF&G-SuHdro (1983 and 1984 Procedure Manuals).

The study sites will be sampled periodically by ADF&G-SuHydro to determine the extent of utilization by juvenile and adult salmon. Observations will be made of salmon spawning that may occur in side-channel habitats during 1984 for the purpose of collecting physical habitat data to verify literature-based criteria curves.

Analysis: IFG-2 hydraulic models will be calibrated by EWT&A at four sites to forecast site-specific hydraulic conditions when the mainstem discharge at Gold Creek is between 8,000 and 14,000 cfs. These models will be adjusted to simulate site specific hydraulic conditions for mainstem flows in the range of 14,000 to 25,000 cfs by modifying the Manning's "n" values in the IFG-2 models to reproduce water surface profiles observed at the study site in the 14,000 to 25,000 cfs flow range. The relationship between the mainstem flow at Gold Creek and that at the study site will be determined from correlation analyses between the average daily flow at Gold Creek and corresponding streamflow measurements at the respective study sites.

Although emphasis will be placed on evaluating with-project rearing potential, habitat suitability curves for chinook, chum and pink salmon spawning (available in Alaskan literature and Project reports) will be used with the calibrated IFG-2 hydraulic models to forecast weighted usable area indices of potential salmon spawning habitat at the modelled sites. Evaluations will also be made of streambed scour, dewatering and freezing for natural and with-project stream flow conditions at each site. The results of these comparative evaluations will be used in a structured, limited-factor approach to interpret the

weighted usable area indices and discuss the relative difference between existing and with-project mainstem spawning potential.

Habitat criteria developed during 1983 by ADF&G-SuHydro for juvenile chinook and chum salmon will also be used to augment the 1983 juvenile studies. The habitat criteria used for input to the weighted useable area calculations will include juvenile cover criteria.

Necessary data for quantifying light extinction properties will be collected to assess the physical-chemical processes that govern primary production in side channel and side slough habitats.

The proposed additional field activities will include:

1. Measurement of total light extinction coefficients at various levels of turbidity using two LI-COR quantum sensors and an integrating radiometer/photometer.

2. Simultaneous monitoring of dissolved oxygen concentrations using the diurnal oxygen curve method to provide estimates of primary productivity under breached and non-breached conditions for one or more slough and side channel locations during the period August 1 to October 15, 1984. This will require two dissolved oxygen monitors and the chemicals and glassware needed to keep them properly calibrated.

3. Continuous monitoring of incident photosynthetically active radiation (PAR) using an automated LI-CORR 1776 solar monitor.

Analysis of light extinction and dissolved oxygen data will result in: (1) a regression equation for light extinction coefficient vs. turbidity, (2) photosynthetic efficiency response curves for at least one side channel pair, and (3) a quantitative analysis of turbidity

effects on primary productivity. A discussion will also be prepared describing the implications of with-project flow and turbidity levels on mainstem rearing potential

Deliverables

A draft technical report will be prepared which describes the effects of various levels of Susitna River discharge on mainstem habitat potential. A draft report documenting the model calibration procedures will also be prepared. Final reports will be completed in FY86. Although these reports will not be prepared prior to completion of the Instream Flow Relationships Report, much of the informtion will be available and will be incorporated into that report.

Schedule

1.	Technical Memorandum: Selection of Candidate Study Area	July 31, 1984
2.	Technical Memorandum: Data Collection Plan and Site Selection	July 31, 1984
3.	Technical Memorandum: Light Extinction Coefficients	November 30, 1984
4.	Draft mainstem habitat analysis report	April 30, 1985
5.	Technical Memorandum: Hydraulic Model Calibration	May 31, 1985
6.	Final mainstem habitat analysis report	July 31, 1985

TASK 13A

ADULT SALMON - MIDDLE RIVER SPAWNING SURVEYS

Rationale

A description of the distribution, abundance and timing of adult spawning salmon is necessary to characterize pre-project conditions and assess potential with-project impacts. This task will support the settlement and hearings processes and serve to maintain program monitoring integrity.

Objective

Define where, when and to what level salmon spawn in the middle Susitna River reach.

Description

Routine escapement surveys of streams, sloughs, side channels and the main channel Susitna River will be performed in 1984 to meet the study objective. The surveys will be performed on the ground except for selected tributaries and the main channel which will be surveyed by helicopter. Surveys will be performed by the following schedule:

Sloughs	Weekly, August 15 - October 7, 1984
Tributaries	Weekly, July 21 - October 7, 1984
Mainstem and Side Channel	Weekly, September 1 - October 7, 1984

The surveys will provide information regarding species composition at specific locations, relative abundance, timing and distribution of spawner activities.

Deliverables

A report will be prepared that specifically answers the study objectives.

Schedule

Draft	December 21, 1984
Final	February 21, 1985

TASK 13B

ADULT SALMON - LOWER RIVER SPAWNING SURVEYS

Rationale

The proposed project may impact lower river salmon spawning areas, including side channel, slough, tributary and mainstem areas, due to flow, water quality and temperature changes. Information on the magnitude and timing of salmon spawning in these habitats is necessary to assess potential impacts. This task will support the hearing and settlement processes and mitigation planning.

Objective

Determine where, when and to what extent salmon spawn in sloughs, side channels, tributaries and the mainstem of the lower river reach.

Description

In 1981 and 1982 lower river main channel and side channel habitats were surveyed for salmon spawning using drift gill nets and electroshocking equipment. Few spawning locations were identified. Sloughs in the lower Susitna River reach have not been surveyed.

Between August 15 and October 7, slough, side channel, tributary and mainstem habitats associated with the lower Susitna River will be surveyed weekly from the air. Suspected spawning areas where adult fish are observed will be inspected from the ground to determine if the area is an actual spawning location and the extent of its use.

Deliverables

A report will be produced that specifically answers the study objective.

Schedule

Draft	December 21, 1984
Final	February 21, 1985

TASK 14

LOWER RIVER RESIDENT AND JUVENILE ANADROMOUS FISH STUDIES

Rationale

Successful completion of the settlement process for negotiations of instream flow requires assessment of operation of the proposed hydroelectric project on fisheries habitat. This task will quantify the response of habitat in areas that support rearing resident and juvenile species to flow changes in the mainstem Susitna River downstream of the Chulitna River confluence.

Objective

1. Determine the distribution and abundance of rearing salmon juveniles and selected resident species in the reach of river between Cook Inlet and the Chulitna River confluence.

2. Estimate the response of habitat for rearing salmon juveniles and resident species, as appropriate, as a function of changes in mainstem discharge at the Sunshine gage station.

Description

Approximately 40% of the annual discharge of the Susitna River, at the Park's Highway bridge, originates from the mainstem Susitna River above the Chulitna River confluence. Operation of the proposed hydroelectric project may alter the natural flow regime of this reach. The flow regime during the winter may be beyond natural fluctuations of the system with several times the amount of water flowing through this reach of river. Studies of resident and juvenile anadromous abundance and distribution during winter months are described under Task 34.

To assess the effects of these changes in flow regime on the habitat of resident and juvenile anadromous fish it is necessary to determine distribution of the species over different seasons and to develop the predictive capability to estimate changes in available rearing habitat as a function of mainstem discharge to assess the effects of changes in flow regime on the habitats of resident and juvenile anadromous fish. This study will address only the open water season because ice compounds a quantitative assessment of the rearing habitat.

Studies conducted by ADF&G SuHydro (1981-82) in this reach of river have provided limited insight into distribution of the species and responses of habitat in the backwater zones near slough and tributary mouths to mainstem stage changes. The distribution information has provided some insight into the year round distribution of coho and chinook salmon but has provided limited information on pink, chum, and sockeye salmon juveniles. Analysis of the response of habitat to mainstem discharge of the Susitna River provided a general insight as to how the different species present would respond to changing stages of the mainstem Susitna. However, during this analysis, we observed that the cover value of the habitat in these backwater areas and in free flowing areas often changed disproportionately to changes in measured surface area. This observation suggested that monitoring cover response to mainstem discharge would be of importance. Studies conducted in the middle river used habitat models based on cover in addition to hydraulic analysis of areas of use. This methodology will also be used in the lower river studies.

The studies will examine the habitat availability in different reaches and morphological components of the lower Susitna River for juvenile salmon as well as selected resident species. This habitat availability study will utilize both the Sunshine USGS gaging station at the Park's Highway bridge and site specific discharge to provide incremental assessment of habitat availability as a function of discharge at each study site.

Selected areas, based on the fish distributional information and on the morphological and reach mapping performed by R&M during 1983, will be studied for seasonal distribution of fish and the response of physical habitat parameters to mainstem discharge. Approximately 15 different sites will be selected for study using the approach mentioned above for sites where water quality and/or cover are the dominant variables influencing habitat quality. Other sites where the dominant hydraulic variables of the habitat are influenced by water depth and velocity are discussed in Task 36. Habitat criteria developed for the upper reach will be supplemented with additional information for this lower reach to simulate the habitat response of fish to mainstem discharge changes.

Distributional data over the seasons will be used to estimate the relative seasonal importance of rearing habitat for the different species. This information will be supplemented by the outmigrant trap studies (Tasks 16A and 16B).

Deliverable

Draft Report on resident and juvenile anadromous habitat studies of the lower river.

Schedule

Data analysis	
Weighted usable area calculations	January 15, 1985
Draft report	April 15, 1985
Final report	June 15, 1985

TASK 15A

LOWER RIVER - MAIN CHANNEL SALMON ESCAPEMENT MONITORING

Rationale

Agencies have indicated there is insufficient information to support a conclusion that lower river salmon resources will not be adversely impacted by Project operation. An intensive lower river escapement monitoring Program will provide some of the information needed to assess potential impacts. This task will support the settlement and hearings process, mitigation planning and provide baseline data for long-term monitoring.

Objective

Determine the 1984 seasonal timing, abundance, distribution and migrational behavior of sockeye, pink, chum and coho salmon escapements at Flathorn (RM 20) and Sunshine (RM 80) stations and into the Yentna River (RM 28). Mointor chinook salmon escapement at RM 80.

Description

Escapements in the lower reach have been monitored from 1981 through 1983 into the Yentna River at RM 28 and in the Susitna River main channel at RM 80. The results document annual escapement numbers, timing distribution and migrational behavior of sockeye, pink, chum and coho salmon at these locations. Similar information on the chinook salmon escapements to RM 80 are available for 1982 and 1983.

This task will quantify the numbers of sockeye, pink, chum and coho salmon that reach RM 20, enter the Yentna River (RM 28) and reach RM 80. This task will also determine their migrational timing and behavior. The same basic data will be collected for chinook salmon escapement in the Susitna River main channel at RM 80.

This information will be obtained by implementing a tagging operation at RM 20, using sonar counters and fishwheels in the Yentna River and operating a tagging site at RM 80.

Deliverables

A report will be produced that specifically answers the study objective.

Schedule

Draft	December 21, 1984
Final	February 21, 1985

TASK 15B

MIDDLE RIVER - MAIN CHANNEL SALMON ESCAPEMENT MONITORING

Rationale

This task will provide additional information on the distribution, abundance and timing of adult spawning salmon in the middle Susitna River. The additional information will allow refinement of previous results and provide escapement information through one complete spawning cycle. This task will support the settlement and hearings processes and assist in developing baseline data for mitigation planning and long-term monitoring.

Objective

Determine the seasonal abundance, timing and migrational behavior of the 1984 chinook, sockeye, pink, chum and coho salmon escapements in the Susitna River middle reach.

Description

Salmon escapements for the three most recent years (1981-83) have been monitored for the middle reach of the Susitna River at Curry Station (RM 120). The results documented escapement numbers, timing, distribution and migrational behavior of sockeye, pink, chum and coho salmon for 1981 through 1983 and of chinook salmon for 1982 and 1983.

This task will quantify the number of fish by species that reach RM 120 and also determine their migration timing and behavior. This will be accomplished by an intensive tagging operation and monitoring of daily fishwheel catch rates at RM 120.

Deliverables

A report will be produced that specifically answers the study objective.

Schedule

Draft	December 21, 1984
Final	February 21, 1985

TASK 16A

OUTMIGRANT STUDIES OF THE MIDDLE RIVER

Rationale

Quantifying the survival of outmigrant juveniles and the seasonal responses of outmigrants to discharge changes and estimating the significance of middle river rearing will be necessary to successfully complete instream flow negotiations. This task will support aspects of the settlement and hearings processes.

Objectives

1. Estimate the timing and relative abundance of outmigrating juvenile salmon of all five species.

2. Estimate the population of emergent chum and sockeye salmon fry and their survival from egg to emergence.

3. Estimate the relative size of outmigrants.

4. Estimate the relative timing and abundance of juvenile resident species.

5. Estimate the timing and size of outmigrant chum salmon from the Talkeetna river.

6. Estimate the effect of changes in mainstem Susitna discharge and other environmental variables on outmigration rates of salmon species.

7. Estimate the production of emergent juveniles from selected sloughs.

8. Estimate the timing and rate of movement of juvenile chinook and coho salmon out of Portage Creek.

Description

A measure of the current production of juvenile salmon can be used to assess potential impacts of Project operation on downstream fishes. This measurement can be used to estimate the relative importance of populations in a particular reach or basin or ultimately to assess the current importance of habitat in the area. These data can also be used as a benchmark to measure future Project effects against and can be used as the basis for determining the extent of mitigation required.

Studies by ADF&G SuHydro of outmigrants from the middle river were begun in 1982 and were expanded in 1983. This data set has provided valuable information as to the success of the previous summers spawning runs, the effects of discharge on redistribution of rearing juveniles and has provided population and survival estimates (when coupled with adult escapement data). Extrapolation of this data set over a longer period of time and at several key sites will provide a comparative index of the production of individual sloughs.

A mark and recapture study of outmigrant juveniles will be conducted to repeat a 1983 study. The juveniles are marked with coded wire tags at selected sites and recaptured at a downstream smolt trap at Talkeetna Station. Emphasis will be placed on increased tagging of chum salmon juveniles. Other data collected during operation of the outmigrant traps will include catch per unit effort and data on daily river stage, turbidity, temperature and other habitat parameters.

The relative production of sockeye and chum salmon in four side sloughs will be estimated by weir counts and recovery of marked fish. Sites near the mouths of sloughs 8A, 9, 11 & 21 will be weired with small mesh seines for three consecutive days. Fish collected on each day

will be marked with a unique dye mark and released. Recaptures on all days will be recorded. This information will be analyzed to estimate emergence and outmigration rates from the sites. These results will be compared with habitat information and results of the egg incubation studies at each site. These comparisons should help determine the applicability of the results of Vibert incubation box studies to explaining overall production limits in sloughs.

Personnel operating the outmigrant trap at Talkeetna Station will also operate an intermittent outmigrant trap on the Talkeetna River during late May, June and early July. These data will be used in conjunction with Talkeetna and Flathorn Stations outmigrant data to estimate the use of the lower river by rearing chum during their fresh water residence period.

Outmigrant traps will be established near the mouth of Portage Creek during the summer of 1984. The length of Chinook and coho juveniles collected at these sites will be measured. The fish will then be fin clipped and released approximately four miles upstream. The length of recaptured outmigrants will be measured to estimate outmigration rates and growth rates of the juveniles.

Deliverables

A report documenting activities and results of this task.

Schedule

Analyzed data from trapping efforts	January 15, 1985
Draft Report	April 15, 1985
Final Report	June 15, 1985

TASK 16B

OUTMIGRANT STUDIES OF THE LOWER RIVER

Rationale

The importance of the lower river reach as a rearing area needs to be determined. Monitoring of migrant fish into and out of the system will help establish the importance of these habitats. This task will support the settlement and hearings processes and provide data for impact assesment.

Objective

1. Estimate the timing and rate of outmigration of rearing chinook juveniles from the Deshka river into the mainstem Susitna.

2. Estimate the rate of outmigration of juvenile salmon from the Susitna River.

3. Estimate the rate of growth of juvenile chum and chinook salmon from the time they enter the lower river until they enter the estuarine environment.

Description

The timing of presence and extent of rearing of juvenile salmon species have not been described for the lower river. In addition, the importance of rearing habitat associated with the mainstem Susitna between Cook Inlet and the Chulitna River has not been determined. Inference of the importance of this reach of the Susitna to rearing of juvenile salmon will be determined from data collected near the confluence of the Talkeetna and Chulitna Rivers and data collected near the mouth of the Susitna River at Cook Inlet.

Monitoring of outmigrant timing and condition will be conducted below the confluence of the Susitna and Yentna Rivers using outmigrant traps. Sizes and relative numbers of juvenile salmon that are leaving the fresh water system will be determined from captures of juveniles in the traps. Chinook movement into the mainstem environments will be estimated at temporary outmigrant traps placed near the mouth of the Deshka River. The movement of chum, sockeye and chinook juveniles into the lower river will be evaluated by use of the data obtained from the Talkeetna station trap and periodic sampling of the Talkeetna River.

Deliverables

A technical report documenting activities and results of Task 20 studies.

Schedule

Analyzed data	January 15, 1985
Draft Report	April 15, 1985
Final Report	June 15, 1985

TASK 17

STREAMFLOW AND FLOOD FREQUENCY STUDIES

Rationale

The most basic physical change in the Lower River resulting from Susitna Project operation will be in streamflow. Altered streamflow and reduced peak flood discharges may result in:

1. Changes to the Lower River morphology as a result of decrease sediment transport capacity, and changes in the frequency of flow through habitat areas, particularly side channels and near the mouths of tributaries,

2. impacts to riparian vegetation resulting from changes in the frequency and magnitude of flooding of vegetated areas,

3. impacts to inmigrating adult salmon resulting from reduced peak floods which serve as a stimulus to migration, and

4. impacts to navigability of the stream.

Therefore, in order to make assessments of potential impacts in this reach it is necessary to develop information on natural and with-project streamflows.

This information will be utilized by aquatic study team members to assess the significance of potential flow-related impacts in the Lower River and to evaluate whether further studies are required in FY86.

Objective

The objective of this study is to define natural and with-project flow duration and flood frequency curves for key locations in the Lower River.

The discharges for a given duration or frequency derived from these curves will be used in other studies to evaluate project impacts due to changes in flow regimes.

Description

Daily streamflow measurements are available for nine USGS gaging stations in the Susitna River Basin. Average weekly with-project discharges will be estimated using the reservoir operation model by Harza-Ebasco.

Monthly and weekly streamflow data and flow duration and flood frequency curves will be developed both for natural and with-project conditions for the Susitna River near Sunshine and at Susitna Station stream gaging stations. The natural flows of these stations will be modified based on reservoir releases to develop data for with-project conditions.

Deliverables

A report will be prepared which documents the results of the study.

Schedule

	Draft	Final
Flow Duration Curves Report	03/01/85	04/30/85
Streamflow/Flood Frequency Report	03/01/85	04/30/85

TASK 18

SUSPENDED SEDIMENT - TURBIDITY STUDIES

Rationale

Further analysis of with-project suspended sediment concentrations, chemical and physical characteristics and the with-project turbidity are important for:

1. responding to the DEIS;

2. supplying supplemental information to FERC and completion of the FEIS;

3. support of the hearing process;

4. completion of the settlement process.

Objective

The primary objective is to relate predicted with-project suspended sediment concentrations and characteristics to their potential turbidity related biological effects downstream from the Project reservoirs.

Description

Studies and data existing prior to May 1984 will be used to produce a draft report of expected biological impacts to the Middle Susitna River reach to be included in the IFRS report on Water Quality/Limnology.

Future studies, including DYRESM model predictions, will be used to refine the knowledge presented in the IFRS reports.

Analyses and assessments of pre- and with-project suspended sediments and turbidity and predictions of potential water quality changes during winter periods will include the lower river reach. Predictions of with-project turbidity will provide information for other studies related to potential impacts on the biological food web (Tasks 25, 45 and 14).

Data needed for predicting biological effects include:

1. Temporal quantification (at least monthly means and ranges for data) of suspended sediment concentrations and their cumulative size distribution analysis for Project reservoir discharges (these data will come from reservoir operations simulations);

2. Computation of a relationship between with-project turbidity in nephelometric turbidity units (NTU) and suspended sediment quantities and characteristics;

3. Computation of the area of substrate per unit discharge in selected habitats which may support viable benthic periphyton populations.

Analyses and discussions will summarize the most probable effects of with-project suspended sediment and turbidity conditions on the mainstem Susitna River in terms of benthic productivity and salmonid incubation and rearing.

Deliverables

Position paper(s) on the with-project suspended sediment issues.

Schedule

Draft report(s)	February, 1985
Final report(s)	May 31, 1985

TASK 19

HYDRO-METEOROLOGICAL
PHYSICAL DATA COLLECTION

Rationale

This task is designed to meet requirements for collection of baseline meteorological and hydrological field data for engineering and environmental studies within the Susitna River Basin. As such, it will continue to define pre-project conditions of damsite river flow and regional climate, two necessary elements under FERC provisions for monitoring and water-supply forecasting during project operation.

Objective

Provide basic quantitative descriptions of specific physical parameters necessary for development of other components supporting the licensing process.

Description

Physical data collection will encompass measurement, reduction, and reporting of physical field parameters. Efficient reservoir and powerplant operation will require knowledge of seasonal snowpack, rainfall, temperature, and winds and their relationships to runoff timing and volumes. Forecasts of energy availability will depend on water supply forecasts based on past years' correlations, making collection of simultaneous streamflow and meteorologic data very important.

Recording instrumentation is already in place for measurement of climatic and snow parameters and discharge at the Watana gaging site so no new installations are foreseen for this year. The physical data collection will be of three primary types:

- o Climatic data
- o Snow surveys
- o River discharge at the Watana damsite

Climatic Data: Operation and maintenance of six Susitna Basin recording weather stations (Glacier, Denali, Kosina, Watana, Devil Canyon and Sherman) will continue through the year. The seventh existing station at Eklutna Lake, will be decommissioned in May 1984 and kept as a spare unit which should greatly enhance system reliability.

Snow Surveys: The cooperative snow surveys with SCS will continue January through June 1985. They will include aerial and on-the-ground surveys conducted primarily in the upper basin to provide seasonal snowpack data for water supply studies and to support the special glacier studies (Task 43).

Watana Discharge: The streamgage at Watana will be maintained through the open-water season and through 1984 freeze-up. Monthly discharge measurements will be made by boat during July through September to verify the stage-discharge rating curve. One winter discharge measurement will be made through the ice.

Deliverables

Climatic Data: Data will be summarized on a water year basis (October - September).

Snow Surveys: Data will be published monthly (February - June) by SCS in Snow Surveys and Water Supply Outlook for Alaska.

Watana Discharge: Report on July average discharge data for the water year through September 1984.

Schedule

Climatic data summary report	December 31, 1984
Snow Surveys	Monthly
Watana discharge report	December 31, 1984

TASK 20

LOAD FOLLOWING ALTERNATIVE

Rationale

Power studies are currently assessing load following at Watana powerhouse as an alternative to baseload generation during the years that Watana will operate alone. If this alternative has economic benefits relative to base loading, the downstream environmental impacts caused by load following will need to be assessed. Environmentally acceptable maximum daily flow changes and maximum hourly flow changes (ramping rates) will need to be established for various periods of the year.

Objectives

1. To examine the environmental implications of load following alternatives.

2. To provide environmental operating rules for power studies.

3. To examine natural rates of flow change with project flow conditions used as a basis.

Description

1. Examine naturally occurring rates of flow and stage change at Gold Creek in the range of with-project flow (i.e. 5,000 to 20,000 cfs) for the available USGS gage traces from the Gold Creek gage.

2. Observe rates of change of stage during 1984 storm events at several locations in the mainstem.

3. Perform a literature review and an evaluation of the downstream effects on aquatic resources from water surface fluctuations caused by hydroelectric generation. Results from the literature review will provide the biological perspective necessary to evaluate effects of varying stage changes and to recommend interim operating criteria for load-following operation at Watana dam.

4. Perform dynamic routings of various load-following alternatives using the model DMBRK. Using recommendations for interim operating criteria obtained in Task 4 and other alternatives, dynamically route Watana discharges downstream. Evaluate the environmental effects of these load following alternatives.

Data required for successful completion of this task include:

1. Several continuous stage recorders will be required for the successful completion of Item 2.

2. Hourly discharge data will be required from the hourly load program for item 4.

Deliverables

Items 1 & 2 - Technical memorandum on natural stage discharge fluctuation and on 1984 stage changes.

Item 3 - Report on findings of literature review and interim operations criteria.

Schedule

Items 1 & 2	June, 1985
Item 3 Draft	June, 1985

TASK 21

LOWER RIVER MORPHOLOGICAL ASSESSMENT

Rationale

Completion of this task is necessary to visually identify changes in lower river conditions with varying flow and will support impact assessments and the settlement process.

Objective

Document and assess the effects of different flow rates on the morphology of the Susitna River between Talkeetna and Cook Inlet. The study will provide the information necessary to forecast changes in wetted surface areas in the mainstem and side-channels due to Project operation.

Description

Photography (scale: 1" = 2000') of the lower Susitna River was obtained in 1983 for flow rates at Sunshine of 56,500, 37,500, 22,000 and 13,600 cfs. Additional sets of photography at flow rates of about 75,000 cfs (with-project 5-year flood) and 95,000 cfs (pre-project 2-year flood) are needed. This photography will define wetted areas at flood levels which control channel morphology. Wetted areas will be digitized and summed to characterize flow related changes in the lower river.

A preliminary determination of important aquatic habitat sites in the lower river will be made by EWT&A and R&M based upon discussions with ADF&G SuHydro. The location of these areas will be identified on blue line prints of the lower river and a brief narrative prepared describing the rationale for their selection. The blue line prints and rationale will be discussed with other members of the aquatic study

team and a concensus sought regarding the number of priority of areas to be analyzed. Photo enlargements of these areas will be obtained through R&M for the 1983 lower river photography. Helicopter overflights will be made by R&M and EWT&A personnel at approximately the same mainstem discharges (Sunshine) that the 1983 photography was obtained. During the helicopter overflights habitat types will be identified using the same (or a slightly modified) definition of habitat types used in the middle river and their locations delineated on blue line prints. The wetted surface areas of these locations will be digitized for entry into the computerized data base developed by EWT&A during 1983. Analysis of the response of habitat surface areas to changes in mainstem flow at Sunshine will be completed by EWT&A.

Deliverables

A technical report will be prepared by EWT&A and R&M to present the findings of their analysis of streamflow effects on habitat surface areas in the lower river. The report will be integrated with findings from lower river sediment studies to estimate effects of aggradation below the Chulitna River Confluence.

Schedule

Draft report prior to January 31, 1985.

TASK 22

MAPPING AND DIGITIZING OF MIDDLE RIVER HABITAT SURFACE AREAS

Rationale

This work will provide a photographic assessment of incremental flow effects on the availability of aquatic habitat between Devil Canyon and the confluence of the Talkeetna and Susitna Rivers. The successful completion of this work will support preparation of the Instream Flow Relationships Report as well as the settlement and over-all licensing process.

Objective

Expand the 1983 evaluation of mainstem flow effects on aquatic habitat surface areas in the middle river to include with-project flood and filling flows.

Description

EWT&A will obtain air photography of the middle river through R&M at streamflows (USGS Station Gold Creek) of approximately 45,000, 30,000 and 6,000 cfs. Helicopter overflights will be made of the river coincident with aerial photography flights so that aquatic habitat types can be identified and their locations delineated on blue line prints of aerial photography obtained at mainstem flows of 18,000 cfs and 12,500 cfs. The wetted surface areas of the habitat types will be digitized by EWT&A using the same equipment and methodology as in their 1983 evaluation of photography of the middle river.

Deliverables

A technical memorandum will be prepared to update EWT&A's 1983 report on streamflow effects on habitat surface areas in the middle river.

Results of the 1983 and 1984 habitat mapping work on the middle river will be incorporated into the Final draft of the Instream Flow Relationships Report (Task 4).

Schedule

Technical memorandum	February, 1985
Draft Report	April 30, 1985
Final Report	August 31, 1985

TASK 23

LOWER RIVER ICE STUDY

Rationale

Ice-related processes affect the Susitna River environment during approximately 8 months of the year (October - May). These processes annually affect water levels and temperatures in the river and adjacent aquatic and terrestrial habitats. Ice processes are also responsible for major river habitats induced by scour resulting from ice movement.

The significant ice-related impacts to the aquatic habitat are expected in the middle reach of the Susitna River between the Project site and Talkeetna. An important consideration in the Middle River ice analysis is the determination of when the ice cover begins to progress upstream of the confluence of the Chulitna and Susitna Rivers. It is currently thought that this will occur after the Lower River is completely filled with ice generated downstream of the Project and in the Chulitna, Yentna and Talkeetna Rivers. In order to estimate how long this process will take it is necessary to:

1. Estimate when the ice bridge will occur near the mouth of the Susitna River at Cook Inlet.

2. Estimate the volume of ice required to fill the Lower River under with-project conditions.

There may also be significant impacts in the Lower River if ice processes are significantly altered. These would result from:

1. Water levels associated with with-project flows which would be significantly greater than natural,

2. Delays in ice cover formation,

3. Potentially thicker ice where it occurs, and

4. Altered break-up processes.

Due to the complexity of the lower river it is not considered feasible, at this time, to extend the mathematical model of middle river ice processes to the lower river. Instead, in order to make reasonable estimates of the required parameters, a limited analysis at selected locations will be performed.

Objective

The objectives of this study will be to obtain a better understanding of lower river ice processes. Specific study objectives will be to:

1. Refine the estimate of when ice cover progression at the Susitna-Chulitna confluence begins.

2. Estimate the magnitude of staging with-project on the lower river.

3. Document the impact of mainstem freeze-up on existing and potential side channel and slough habitats.

4. Make field observations of significant hydraulic parameters related to ice cover progression on the lower river.

Description

Ice process observations were carried out on the lower river during this past winter. Observations of ice generation in the Chulitna and Talkeetna Rivers have been carried out for several years. Estimates of ice production in the middle reach of the Susitna River will be available from the ice process modeling studies carried out in FY84 and ongoing in FY85.

This study will be conducted using field observations and hydraulic computations.

Data to be collected in the field include:

1. River channel cross sections at six locations in the Lower River chosen to be representative of their respective reaches,

2. Observations of staging and ice thicknesses at these cross sections during open water season, freeze-up and ice cover periods on the Lower River,

3. Observations of staging at selected habitat locations in the Lower River during the freeze-up and ice cover period,

4. Observations of ice bridge formation at the mouth of the Susitna River at Cook Inlet,

5. Observations of the progression of the ice cover upstream to the Talkeetna and Chulitna rivers confluence,

6. Observations of frazil ice generation in the Yentna, Chulitna and Talkeetna Rivers, and

7. Observations of break-up in the Lower River including maximum water levels resulting from ice jams.

Analyses of the data will include:

1. Analysis of factors leading of formation of an ice bridge at the mouth of the Susitna River at Cook Inlet,

2. Analysis of the natural volume of ice in the Lower River,

3. Estimation of the volume of ice required to cover the Lower River with-project,

4. Estimation of the with-project staging at the six cross sections, and

5. Estimation of the time required to form an ice cover on the Lower River, with-project.

Deliverables

Two reports will be prepared. The first will document field observations. The second will document the analytical results.

Schedule

Field observations will be carried out during the winter of 1984-85. A report documenting these will be available in spring, 1985. Hydraulic studies will be carried out after receipt of field observations and a report will be prepared by July, 1985.

TASK 24

LOWER RIVER AGGRADATION

Rationale

Approximately 80 percent of the total sediment load in the lower reach of the Susitna River originates in the Chulitna and Talkeetna Rivers. After project implementation, regulation of flood and high flows by the project will reduce the sediment discharge capacity of the Lower River to 55 percent of its present capacity. However, the total sediment load will not be reduced proportionately and aggradation of sediments in the Lower River is expected to occur. The potential impacts resulting from this aggradation would include increased water levels near the town of Talkeetna, at tributary mouths, and at the upstream ends of side channel complexes.

The results of the sediment study (FY84) presented in "Susitna Hydroelectric Project - Reservoir and River Sedimentation" identified the potential for aggradation in the confluence area and downstream of the Susitna and Chulitna Rivers. These analyses were not sufficient to define the temporal and spatial distribution of the aggradation. Further studies of lower river aggradation are necessary to determine if the expected aggradation in the lower reach will be significant.

Objective

The objectives of these studies are to evaluate sedimentation processes in various sections of the lower river and to identify the potential impacts. The study area will include the reach of the river between Susitna Station and the Chulitna - Susitna confluence.

Description

Two years of data are currently available from the USGS at four locations near the confluence area. Suspended sediment data are also available from the USGS at the Gold Creek and Susitna Station gaging stations.

The stations where the data are being collected for the evaluation of project impacts in the Lower reach, include:

1. Susitna River near Talkeetna,

2. Chulitna River near Talkeetna,

3. Susitna River below the confluence of the Susitna and Chulitna Rivers (new station established in 1983), and

4. Susitna River at Sunshine.

The sediment data collected at these stations include suspended sediment and bedload discharges. To evaluate project impacts downstream from Sunshine, suspended sediment and bedload discharge measurements also will be required on the Susitna River at Susitna Station and Yentna River near Susitna Station. USGS is currently collecting suspended sediment data on the Susitna River at Susitna Station.

The current sediment sampling program of the USGS will be continued for FY85 and expanded to collect suspended sediment and bedload discharge measurements on the Susitna River at Susitna Station and on the Yentna River.

Bed material samples will be collected at selected locations in the lower reach in the mainstem. The sampling will be done twice, once

during high flow season and second time prior to freeze-up of the river.

The lower reach will be sub-divided into 8 to 10 sub-reaches depending upon locations of sloughs and major tributaries to estimate potential aggradation/degradation. Computations of total sediment load transport (bedload plus suspended) will be made at the stream gaging locations. Aggradation/degradation in each sub-reach will be computed using book empirical relationships and a mathematical model "IALLUVIAL" developed by the Iowa Institute of Hydraulic Research. The streamflow and flood peaks data required for these computations will be obtained from "Streamflow and Flood Frequency Studies" discussed in Task 17.

As part of the evaluation of sediment processes, relationships of discharge to stream velocities and depths are necessary. This information will be derived from staff gage readings obtained by ADF&G as part of their lower river Resident and Anadromous Fish Program, cross sections of the lower river surveyed by R&M Consultants, Inc. and a mathematical model of the sedimentation processes in the reach between the Chulitna-Susitna confluence and the Sunshine Bridge.

This study will have two components; field observations and data collection, and office analysis. The field work will include:

1. Survey of river cross sections at locations most significant for ice and sedimentation studies;

2. Installation of staff gages at the selected river cross sections and also at other locations where stage-discharge relationships are required; and

3. Measurement of water surface elevations and measures of mainstem and side channels water velocities within a range of discharges at the Sunshine gage.

The office analyses will include:

1. Calibration of HEC-2 for the reach between the confluence of the Chulitna and Susitna Rivers and Sunshine gage using surveyed river cross sections and river stages observed for a range of discharges;

2. Computations of water surface profiles for 8 to 10 selected discharges for the above reach which can be used to support sediment, ice and temperture studies;

3. Preparation of relationships betweens discharge, stage, depth and velocity and water surface profiles at significant locations, in the reach upstream of the Sunshine Bridge;

4. Computations of relationships between discharge, stage, depth and velocity for the reach downstream of Sunshine Bridge using steady, uniform flow assumptions.

5. Computations of aggradation/degradation processes resulting from altered discharge characteristics described above.

Deliverables

Two reports will be prepared. The first will summarize the results of water surface profile and stage-discharge relationship work. The second will summarize the results of the aggradation studies.

Schedule

Cross sectional surveys and field observations of stage and discharge will be collected in during the period May - September, 1984.

Hydraulic analysis, reduction of data and calibration and production of results using the sediment transport model will take place in the winter of 84-85. A report will be available by July, 1985.

The USGS will collect sediment data on the Yentna and Susitna Rivers throughout the open-water season of 1984. These data should be available for analyses by March, 1985. The analyses will be carried out upon receipt of these data and the report will be available by July 1, 1985.

TASK 25

ASSESSMENT OF THE AVAILABLE FOOD SOURCE IN TURBID SUSITNA RIVER HABITATS FOR REARING JUVENILE CHINOOK SALMON

Rationale

Project related changes in the habitat conditions associated with the development of the Susitna Hydroelectric Project may have impacts on the density and timing of emergence of the invertebrate communities presently utilized as a food source by rearing juvenile chinook salmon. With-project changes in these invertebrate communities could have secondary impacts on the condition and survival of juvenile chinook salmon. Examination of these invertebrate communities would serve as a basis for predicting the rearing capabilities of potentially affected habitats under with-project conditions.

Objective

Provide the data and analyses needed to predict the potential rearing capabilities of certain turbid water habitats for juvenile chinook salmon.

Description

Previous investigations by the ADF&G SuHydro have shown that juvenile chinook salmon are most often found in turbid water habitats in or near the mainstem (ADF&G, 1983). In habitats where the turbid mainstem flow comes together with the flow from clearwater tributaries and/or sloughs, chinook salmon juveniles are most often found in the turbid water environment (RJ 1984 report). Other ADF&G SuHydro (1982) studies examined the food habits of rearing juvenile salmon, including chinook, in regard to percent stomach composition, species electivity, etc. However, it is unclear whether juvenile chinook salmon that utilize

turbid water mainstem affected macrohabitats are dependent on invertebrate organisms which are present in these areas for their food source or which are produced elsewhere.

The invertebrate food sources presently available to juvenile chinook salmon in these areas may be affected by physical and chemical changes associated with Project operation. There is a need to provide quantification of the response of the invertebrate community and the food habitats of juvenile chinook salmon to potential changes in the habitats they presently utilize. This information will serve to relate changes in the condition and survival of these fish to changes in physical and chemical habitat parmeters.

Previous investigations by ADF&G SuHydro have provided a good data base on the abundance and distribution of chinook salmon juveniles within the middle river reach and a preliminary evaluation of their food habits. In addition, IFG-4 modeling of selected side channels within this reach has provided velocity, depth, cover and substrate data along specified transects within these sites. Locations of study sites will be selected to utilize established transects of IFG-4 modeling sites within this reach. Other sites may be established in other areas that have been found to contain large numbers of chinook juveniles.

Habitat data to be collected along transects at each study site will include: point specific water depths, velocities, substrates, and general water quality. Drift invertebrate samples will be collected and analyzed along transects to quantify the availability of food sources with changes in discharge. Stomach analysis will also be performed on a limited number of chinook salmon to correlate the available food source with that being utilized by fish. Comparisons will be made of the available invertebrate drift between the various habitats to determine the dominant available food source at each site. An indication of the effects of possible with-project changes in

habitat conditions on the available food source will be made utilizing flow, temperature and fish data.

Deliverables

A technical report of the findings of this study.

Schedule

A final report will be available April 30, 1985.

TASK 26

PREPARATION OF A WRITTEN REPORT FOR THE FY84 INCUBATION STUDY

Rationale

Completion of this task will provide data and information for subsequent impact assessment to support the settlement and hearings processes.

Objective

To complete the analysis of incubation-related data (intragravel water quality, embryo survival and substrate composition) collected from August, 1983 to May, 1984 and prepare a report synthesizing this information and previous data with information available in published literature.

Description

Four types of data will be analyzed: intragravel and surface water quality data, surface and intragravel temperature data, development and survival of embryos and substrate composition. The report will include a discussion of the analyzed data and a section comparing the results of this study to results of similar studies.

There are three primary sources of data that will be used for report preparation: 1) data collected during the FY82 - FY84 field studies, 2) a report by Wangaard and Burger (1983) and 3) other published literature.

Deliverables

Final Report: Incubation Study for the period August 1983 - May 1984.

Schedule

A draft report will be circulated for review December 28, 1984. The final report will be completed by February 15, 1985.

TASK 27

MIDDLE RIVER - MAIN CHANNEL ESCAPEMENT MONITORING AT TALKEETNA STATION (RM 103)

Rationale

Based on results of field studies during 1981, 1982 and 1983 it has been determined that the RM 103 area of the middle river is a site of significant milling by chinook, sockeye, pink, chum and coho salmon. Continued escapement monitoring, through a complete escapement cycle, would provide refined estimates of natural variability in salmon use of the middle river reach and milling at RM 103. This task will directly aid resource managers in establishing baseline data for potential project monitoring and will support the settlement and hearing processes.

Objectives

Determine the seasonal abundance, timing and migrational behavior of the 1984 chinook, sockeye, pink, chum and coho salmon escapements in the Susitna River at Talkeetna.

Description

Four fishwheels will be operated at RM 103 from June 7 to September 9, to record daily catches and tag and release all intercepted adult salmon. The catch data will define species timing distribution and migrational behavior. The tagging operation will provide escapement estimates for each species.

Deliverables

A report will be produced that presents results of the FY85 sampling.

Schedule

Field Operation	June 7 to September 9, 1984
Report Draft	December 21, 1984
Report Final	February 21, 1985

TASK 28

LOWER RIVER TRIBUTARY ACCESS ANALYSIS

Rationale

This study will evaluate the potential effects on access conditions to tributaries in the lower Susitna River. Additionally, potential changes to tributary mouth habitats will be evaluated to assess potential effects to adult salmon which utilize these areas as resting areas during upstream migrations. Results of this evaluation will enable assessment of possible project-induced changes to the sport fishery in the Lower River.

Objective

This study is to determine whether or not alteration of discharge by the proposed Project will result in reductions of mainstem water surface elevations of sufficient magnitude in the lower river that access by adult salmon into tributary streams would become unacceptably restricted without mitigative actions.

Description

Tributary mouths that might warrant investigation will be identified during July through discussions with ADF&G SuHydro, R&M and other Aquatic Team members. Photographic enlargements of each tributary mouth area will be obtained by R&M from the available lower river photography. Streamflow records will be reviewed by R&M to identify mainstem and tributary flows.

A visual interpretation of the photography will be completed by EWT&A, R&M and ADF&G SuHydro. If exposed streambed gravels or shallow riffles are not visible, it will be assumed that depth of flow at the tributary

mouth for the flow condition photographed is not shallow enough to impair access. The tributary mouths will be visited by ADF&G SuHydro and R&M at a low flow period (probably September) and representative depth measurements obtained. The location of these depth measurements will be noted on a copy of the tributary mouth photograph. At the time of this site visit, a visual assessment of channel stability will also be made. Sufficient photographic evidence (channel structure and steambed particle size) will be obtained for documentation. Additionally, changes in the tributary mouth habitats with respect to their extent and position in relationship to mainstem discharge will be conducted to evaluate the possible effects to holding or migrating anadromous fish.

A first level of analysis would be undertaken if exposed streambed gravels or shallow riffles appear to be present. A study site would be established on the lower 0.25 miles of the tributary and cross sections and thalweg profiles surveyed. Staff gage readings would be obtained in the mainstem or side channel above and below the tributary mouth and at three cross sections along the thalweg profile. An analysis of these data would demonstrate the effects of mainstem discharge on depth of flow in the tributary.

A higher level of analysis would be applied by EWT&A and R&M if it were thought, after viewing the available photography and making a site visit, that the tributary mouth area might be unstable due to sand/gravel deposition or the side channel into which the tributary discharged might dewater upstream of the tributary due to with-project reductions in mainstem flow. These analyses are not described in detail because of the unlikelihood they will be required. Field data collection beyond that necessary for the first level of analysis would principally consist of streamflow and bedload material measurements.

Deliverables

A technical report detailing results of this task and an assessment of tributary access will be produced.

Schedule

A draft report will be prepared prior to January 31, 1985 if only the visual interpretation of photography is required; and a final report will be available April 15, 1985.

TASK 29

EVALUATION OF MIDDLE RIVER MAINSTEM AND TRIBUTARY SPAWNING HABITAT RELATIONSHIPS

Rationale

This study will provide data for an overview of the dynamics of mainstem, side channel and tributary spawning habitats. These data will be used to assess possible effects of with-project water temperature regimes and to plan potential mitigation measures.

Objective

Evaluate mainstem, side channel and tributary salmon spawning habitat temperature and substrate relationships.

Description

During the open water field season, survey crews will locate mainstem, side channel and tributary salmon spawning areas in the middle river reach. These spawning areas will be stratified by sub-reach. Representative areas will be selected and temperature recording devices situated to monitor intragravel and surface water temperatures. In addition, porosity samples will be collected at each of the selected sites. During the ice covered period, open leads in the middle reach of the Susitna River will be identified and categorized as velocity or warm water upwelling leads. The middle reach will again be stratified by sub-reach and accessibility for purposes of selecting representative warm water upwelling leads, which may be potential salmon spawning areas, to measure intragravel and surface water temperatures and substrate composition.

Results of this study will be used in the process of extrapolation of side slough and river channel model results to the river system as a

whole (Task 4). Results of this Task and Task 12 will also be used in Task 10 to evaluate potential mitigation options.

Deliverables

The deliverable product will be in the form of a final report and will include:

1. Analysis of the intragravel and surface water temperature relationships between mainstem, side channel and tributary salmon spawning areas.

2. Substrate composition analysis of mainstem, side channel and tributary salmon spawning areas.

3. An index of the warm water upwelling leads with intragravel and surface water temperatures and porosity samples collected at representative sites.

4. Provide a summary of the pre-FY85 temperature information collected in mainstem, side channel and tributary salmon spawning areas.

Schedule

First Draft	June 15, 1985
Final Draft	August 15, 1985

TASK 30

SLOUGH GROUNDWATER AND WATER BALANCE STUDIES

Rationale

Slough studies conducted to date have been inconclusive in quantifying the changes in groundwater upwelling slough hydrology caused by Project operation. Refinement of the relationship of groundwater flow and mainstem discharge and a water balance study are necessary to assess the effect of project operation on aquatic habitat.

Objectives

1. Obtain data on aquifer properties, particularly hydraulic conductivity and storage coefficient.

2. Conduct a complete water balance of selected sloughs to determine the contribution of slough discharge from groundwater upwelling and tributary inflow.

3. Refine relationships between seepage, slough discharge and mainstem discharge.

Description

Aquifer testing at existing wells in the vicinity of Slough 9 will be conducted to obtain data on hydraulic conductivity and storage coefficient. Potential tests include constant-head tests, constant-rate pumping tests and constant rate injection tests.

Water levels in existing deep wells and in selected shallow wells will be monitored at Slough 9, along with open-water stages on the mainstem, side-channels and sloughs. Using the results from the aquifer testing and water

level monitoring, estimates will be made of the theoretical temporal variations of groundwater flow into Slough 9. The estimates will be verified by conducting a water balance study of Slough 9. Precipitation will be measured at the Sherman Station, with accumulating precipitation cans located at other portions of the basin in order to determine the spatial distribution of precipitation, including orographic effects. Evaporation will be estimated from data gathered at Watana Camp. Streamflow will be continuously monitored in the slough and in the tributary which enters Slough 9 approximately halfway upstream from the mouth. Frequent discharge measurements will be made to establish reliable rating curves.

Up to 10 seepage meters will be installed in both Slough 9 and Slough 11 to determine the relationship between seepage rate and mainstem discharge at Gold Creek. Approximately 20 readings will be made at each seepage meter. All visible upwelling locations will be mapped.

Deliverables

Results of the data collection and analyses will be presented on a report on slough groundwater relationships.

Schedule

Field studies will be conducted in July, August and September. Data analysis will be performed through January 1985. A draft report is planned for March 1 and a final report by April 1, 1985. Results of this may also be incorporated into one or more of the Task 4 reports.

TASK 31

DEVELOPMENT OF LONG-TERM MONITORING PLAN

Rationale

Preproject studies have been designed to predict potential impacts due to Project construction and operation and to describe means with which to avoid or minimize these impacts. To assure the mitigation plans incorporated into the license are achieving their intended goals, a long-term monitoring program must be developed and initiated. The detailed plans of this program will be incorporated into the license.

Objective

To develop plans for a Project construction and operation monitoring program that will assess the effectiveness of mitigation procedures.

Description

A long-term monitoring program must be sufficiently rigorous to detect potential adverse impacts that occur due to the Project. However, it must also be a reasonable program that can be conducted within project economic constraints. Furthermore, the program plan must stipulate measures to be taken if adverse impacts are detected.

Efforts under this task will concentrate on developing a detailed planning document that can be presented to the various resource agencies. This document will describe the potential impacts to be monitored, the methods and parameters to be monitored, the methods for monitoring the parameters, the limits of concern, potential measures to rectify the impact and a schedule for completion of certain elements of the monitoring program if no impacts are detected.

The Power Authority, with the assistance of Harza-Ebasco, organizations in the aquatic study team and individuals from other disciplines, will develop a working document that will be presented to the various resource agencies for review and comment. If needed, a meeting will be held to resolve any areas of disagreement. The document will then be finalized and submitted for incorporation into the license.

Although this Task will develop an aquatic monitoring plan only, the plan will eventually be incorporated into the environmental monitoring plan for the overall project, which will utilize the terrestrial and social sciences monitoring plans.

Harza-Ebasco will coordinate the planning efforts for the Power Authority. Assistance will be provided by the Alaska Department of Fish and Game's SuHydro Aquatic Study Team and Harza-Ebasco subcontractors.

Deliverables

A draft monitoring program document will be the first deliverable developed. Responses to agency comments on the draft will be the second deliverable.

The third deliverable will be the finalized document that will be incorporated into the license.

Schedule

The draft document will be completed in winter 1985. Agencies will be allowed approximately 60 days for review. Following this period, another 30 days will be needed to finalize the draft by submittal of responses to agency comments and/or a meeting between the reviewing agencies and the Power Authority. The final document will be completed in the spring of 1985.

TASK 32

LOWER SUSITNA STREAM TEMPERATURE ANALYSIS

Rationale

This task is intended to provide estimates of with-project instream temperatures and their effects on Susitna fishery resources in order to provide a tool useful in optimizing reservoir operations, mitigation planning and to aid the settlement process and provide data and analyses for potential hearings.

Objective

Prediction of weekly average mainstem water temperatures from Sunshine Station to the downstream-most location not influenced by tidal effects.

Description

If biologically significant instream temperature differences between pre- and with-project conditions are predicted for the Susitna River below the Chulitna and Talkeetna confluences, a lower river instream temperature analysis will be required. This analysis will involve setting up a data base to use the instream temperature model (SNTEMP) for prediction of weekly average water temperatures. AEIDC will be responsible for the data collection coordination, model implementation and fishery resource impact analysis. The instream temperature estimates produced by this task will be integrated with estimates of flow effects and slough habitat changes to quantify fisheries impacts by species and life stage. The predicted stream temperature and heat transfer relationships will also be useful for improving estimates of the lower river ice processes.

The data requirements of the stream temperature model are of three types: structural, hydrologic and meteorologic. Most of the structural data can be developed from topographic maps and reconnaissance field work. The exception is stream width data. Representative stream transects will be surveyed for a range of flow events.

Required hydrologic data include mainstem flows and temperatures, tributary flows and temperatures, and estimates of distributed flows and temperatures. Mainstem flow data are necessary for simulating mainstem temperatures and estimating distributed flows. Mainstem temperatures are required to validate the stream temperature predictions. Tributary flows and temperatures are necessary for validation studies and to provide estimates of tributary influences on the mainstem for with-project simulations.

ADF&G SuHydro has collected some water temperature data on the lower river between 1980 and 1983. Further data collection is necessary to construct a base adequate for simulation and prediction. Mainstem temperature recorders will be installed above the confluences of large tributaries and at the end-of-simulation point. Mainstem flows can be estimated from historical data and flows observed during the stream width data collection.

Tributary temperatures should be collected for all major tributaries. A major tributary can be defined as one which contributes at least 5% of the mainstem flow under any condition, pre- or with-project. Tributary flow data will be collected on these major tributaries.

Distributed flows and temperatures will be estimated using the techniques developed from the upper river SNTEMP study and from the mainstem and tributary data collection.

Necessary meteorologic data include air temperature, wind speed, humidity, and solar radiation. As with the upper river SNTEMP

simulations, the data collected at the NWS station at Talkeetna will be adjusted to represent local conditions. A meteorological collection station located in a representative lower river location might be recommended to verify the appropriateness of using adjusted Talkeetna data to represent lower river conditions.

Much of the data required for lower river temperature analysis will be available through the work necessary to complete other tasks (for example, the lower river morphological data compiled by R&M will be useful in defining stream width relationships or in identifying new data collection requirements).

Deliverables

1. Technical Memorandum: Evaluation of Need for Modeling of Lower River Temperature

2. Model validation report.

3. Report documenting with-project simulations and associated fisheries resource analysis.

Schedule

Technical Memorandum	October, 1984
Model validation report	May, 1985
Final Report	FY86

TASK 33

ADULT SALMON STREAM LIFE STUDY - MIDDLE REACH SLOUGHS

Rationale

The results of this task will refine existing stream life estimates and provide more accurate estimates of the numbers of slough spawning salmon for the purpose of identifying the level of mitigation measures that may be required. This task will suppport the settlement process and mitigation planning.

Objective

Quantify sockeye and chum salmon escapements into sloughs of the middle Susitna River reach above RM 98.6.

Description

Total sockeye and chum salmon escapements into sloughs above RM 98.6 have been quantified for 1983. The numbers are based on stream life observations and periodic escapement survey counts for each species. An index of slough salmon escapements is available for 1981 and 1982. These are based on peak survey counts and do not quantify total escapements.

Individual chum and sockeye salmon will be tagged and monitored every three days for stream life in representative spawning sloughs above RM 98.6. Concurrent slough survey counts of live fish will be conducted weekly from August 1 to October 15, 1984. Chum and sockeye salmon escapements will be quantified for each spawning slough using the mean average stream life of the respective species and the total corresponding live fish days as determined from the escapement surveys.

Deliverable

A report will be produced that specifically answers the study objective.

Schedule

Draft	December 21, 1984
Final	February 21, 1985

TASK 34

WINTER STUDIES OF RESIDENT AND JUVENILE ANADROMOUS FISHES

Rationale

Assessment of the importance of overwintering habitat for rearing resident and juvenile anadromous fishes and the response of winter habitats to mainstem discharge will support the development of instream flow requirements and the settlement and hearings processes.

Objectives

1. Describe the distribution of rearing chinook and coho salmon by macro-habitat types in areas associated with the mainstem Susitna River.

2. Describe the distribution and habitats associated with overwintering rainbow trout in the mainstem lower Susitna River.

3. Estimate the response of overwintering habitat for rainbow trout and chinook salmon at selected sites to hydraulic changes during the winter period (assuming habitat response parallels open channel hydraulics).

Description

Data on the distribution of overwintering juvenile salmon and resident species are small when compared to data available for the open water season. Many of the problems in understanding overwintering habitat are caused by very difficult sampling conditions that prevail during the winter months. Sampling techniques are often limited to baited gear because of the ice cover and the prevalence of slush ice under the cover. The decreased activity of fish associated with colder

temperatures often lower the effectiveness of this type of sampling equipment. Although catch data over a wide variety of habitats has been accumulated during previous winter periods, the lack of trends and small numbers of fish collected do not provide strong conclusions as to the importance of different types of mainstem habitat. Relatively low catch rates of chinook and coho salmon have occurred at many sites associated with the mainstem that have some thermal influence from ground water sources. The distribution of fish appears to be rather broad but not associated with mainstem flows. This suggests that the near zero degree (centigrade) water does not provide suitable conditions for overwintering, probably because of continual formation of anchor ice and unstable flows as ice processes continue to develop throughout the winter. Groundwater sources in the side sloughs and tributary mouth areas appear to be of major importance but there is limited data to support this statement.

Radio telemetry data for burbot and primarily for rainbow tagged in the upper river suggest these species will often be found in areas of higher conductivity and warmer temperatures. This suggests they may seek groundwater sources in the winter. These areas are usually in deeper and faster water than the areas where chinook and coho juveniles are thought to overwinter. Fall movements suggest that essentially all of these species that rear in clear water tributaries enter the mainstem Susitna to overwinter. Currently, we have a very small number of data points to support these conclusions.

Further studies on distribution of rearing salmon and resident species will be conducted to evaluate the effects of with-project discharges on overwintering habitat. This study will obtain more information on winter utilization of sloughs using temporary beach seine wiers across the mouths of sloughs that do not have mainstem water breaching their upper heads. This data collection effort will be associated with the coded wire tagging program planned for spring, 1984.

Outmigrant trapping proposed for Portage Creek will provide the needed information to assess the outmigration of chinook and coho into the mainstem Susitna. From this information and the outmigration observed from the sloughs, the overwintering habitat importance will be inferred.

The microhabitat utilized within sloughs and the response of juveniles to habitat discharge changes will be estimated by intensive winter studies on one slough/side channel complex. Juvenile chinook and coho salmon collected in the slough 9 complex of the upper river will be marked with a series of fin clip combinations. These fish will be collected by beach seines, minnow traps and electrofishing equipment. A wier will be installed under the ice near the mouth of the slough to capture fish moving in or out. These fish will also be marked and checked for marks.

Discharge will be monitored throughout the slough during the entire winter period and habitat conditions, including temperature, dissolved oxygen, conductivity, cover, substrate, depth, and water velocity, will be recorded at all collection sites.

These data will be used to describe the responses of juvenile salmon to discharge changes and the utilization of micro-habitat within the slough complex.

Further information will be obtained on rainbow trout overwintering habitat by use of radio telemetry. Habitat requirements and winter distribution will be established by relocation of radio tagged fish and measurement of habitat conditions at the relocation sites.

Results of these studies can be used together with ice modeling investigations to forecast with-project conditions and assess potential changes in habitat suitability.

Deliverables

A report presenting the results of these studies

Schedule

Analyzed data	June 30, 1985
Draft Report	September 1, 1985
Final Report	November 1, 1985

TASK 35

REFINEMENT OF ACCESS CRITERIA

Rationale

The access and passage criteria are important parameters for accurate derivation of habitat/discharge relationships which will be used for development of composite hydrographs, project optimization and mitigation planning. Further studies to verify or refine the present criteria will strengthen subsequent analytic steps and support the settlement and hearing process.

Objective

To verify and refine interim criteria developed for the FY84 analysis of access and passage conditions for chum salmon in slough and side channels of the middle river.

Description

The access and passage criteria developed during FY83 and FY84 were evolutionary steps in the understanding and quantification of conditions needed for access and passage of salmon into slough and side channel spawning areas. This process has produced the present product of an access/passage criteria curve which will be presented in the FY84 report. This curve was produced as a result of review of field data and observations collected over the past two field seasons and professional judgement of fishery biologists and the project hydraulic engineer. Field data are necessary to refine these access and passage criteria.

Side channel and slough sites in the middle river where access and passage problems have been documented will be selected as study sites.

Observations of fish passage activity will be made at each site noting whether successful passage, successful passage with difficulty and exposure, or unsuccessful passage occurs. Measurements of length and depth of the access/passage reach at each site will be collected. These data will be used to refine the access/passage criteria curve developed during FY84.

Deliverables

Refined access/passage criteria curves for chum salmon. Refined estimates of mainstem discharge required for access and passage for all sites where passage and access have been evaluated previously in the middle river.

Schedule

Refinement of access/passage criteria curves will be available by November 30, 1984. Refinement of slough and side channel access and passage evaluations will be completed by January 31, 1985.

TASK 36

LOWER RIVER REARING HABITAT INVESTIGATIONS - IFG HYDRAULIC MODELING

Rationale

Forecasting with-project changes in habitat availability is a major objective of the aquatic studies. Results of this task will support impact assessment, mitigation planning and the settlement and hearings processes.

Objective

To provide calibrated IFG hydraulic models at lower river rearing study sites at which the dominant variables influencing habitat are water depth and velocity. These models will be used by RJ personnel to quantify changes in rearing habitat as a function of change in discharge.

Description

Two approaches have been used to quantify the responses of rearing habitat to changes in discharge. The two approaches differ in their applications. The first approach is applied to sites where the dominant hydraulic variables of the habitat are influenced by water quality and/or cover (Task 17). The other is applied to sites where water depth and velocity are the dominant hydraulic variables of the habitat. This task emphasizes the second approach.

IFG hydraulic models of water velocity, water depth, substrate and cover will be developed for a maximum of six selected sites at which the dominant hydraulic variables of the habitat are influenced by water depth and velocity. The study sites will be selected on the basis of previous studies on the distribution of juveniles in the Lower River,

characteristics of habitats similar to those in the middle river in which juveniles were observed and the representativeness of the study sites of other areas in the Lower River, and results of the FY84 and FY85 Lower River Morphological Assessment, Task 2A. These hydraulic models, which will be developed by ADF&G SuHydro staff with the assistance of a hydraulic engineer, will be meshed with rearing habitat utilization data to relate changes in rearing habitat with changes in discharge (WUA or equivalent).

Water depth and velocity, substrate, and cover data will be obtained along selected representative transects under a variety of discharge conditions. These data will be input to IFG hydraulic models and used to calibrate the model to predict changes in hydraulic conditions as a function of change in discharge. Study site selection will be based on degree of habitat utilization and extent of habitat dewatering expected with project flows based on lower river morphological assessments (R&M, 1984).

Deliverables

Final products will include calibrated IFG hydraulic models for use in juvenile anadromous fish studies to estimate the response of rearing habitat to changes in mainstem discharge (Task 14).

Schedule

Calibrated hydraulic models will be ready for use no later than December 30, 1984.

TASK 37

PRELIMINARY MITIGATION STUDIES FOR THE DEVIL CANYON TO TALKEETNA REACH

Rationale

Identification of sites for and methods of habitat modification to maintain existing salmon runs will be needed to demonstrate the feasibility of the proposed mitigations. The successful resolution of the hearings and settlement processes will require that proposed mitigations be shown to have a high probability of success.

Objective

1. To identify potential sites for habitat modification in the Devil Canyon to Talkeetna Reach.

2. To evaluate the feasibility of various habitat enhancement techniques.

Description

The task will consist of field surveys and studies to identify potential mainstem, side channel, and slough areas for habitat modification. Habitat characteristics demonstrated to be important components of presently utilized habitats such as depth, temperature, substrate and presence of upwelling, will be used to develop evaluation criteria.

After candidate locations are identified, an analysis will be performed to evaluate the conditions likely to exist under Project operation and identify methods to promote use of these areas by spawning or rearing salmon. Side and upland slough sites exist within the Devil Caynon to

Talkeetna reach that exhibit some characteristics expected under Project operation. These slough sites will be used as models of Project conditions and examined to evaluate modifications that would promote their use as habitat. Efforts in FY85 will be restricted to physical and/or biological monitoring of habitat conditions. Project conditions to be evaluated include wetted areas with improper substrate, areas of suitable substrate with insufficient flow and suitable spawning habitat that is inaccessible because of low mainstem water levels.

Candidate areas in the mainstem and side channels will be surveyed in fall as flows drop to levels that approximate anticipated Project flows. A physical assessment of habitat will be performed to evaluate their potential suitability as habitat under Project conditions. Key parameters include temperature, substrate, depth, velocity and presence or absence of upwelling.

WCC, H-E and EWT&A will provide input to study design and methodologies. Field data collection and habitat evaluation will be performed by ADF&G SuHydro. The mitigation analysis will be conducted by WCC, in consultation with ADF&G SuHydro.

Deliverables

The results of the FY85 field investigations and habitat analysis will be presented in the ADF&G SuHydro 1984 field season report series. This analysis will be used by WCC to evaluate the feasibility of the proposed habitat modifications as effective mitigations and will be included in the Second Interim Mitigation Report described in Task 10.

Schedule

	Draft	Final
ADF&G-SH FY85 Report Series	05/15/85	06/30/85
Second Interim Mitigation Report	08/31/85	10/31/85

TASK 38

IMPACT ASSESSMENT OF CONSTRUCTION-RELATED ACTIVITIES; TRANSMISSION LINE AND ACCESS ROAD

Rationale

The assessment of impacts associated with construction activities is needed to complete the Project impact assessment. This assessment is needed for the hearings and settlement processes and will provide the basis for developing final details of the Project mitigation plan.

Objective

Refine and quantify the impacts associated with construction of the dams.

Description

An impact assessment report will be prepared by WCC to address impacts associated with construction activities. Specific areas to be covered include construction of the dams, floodplain gravel mining, construction of the camps and permanent village, diversion tunnel, access roads and transmission lines. The report will refine and quantify the assessment provided in the FERC license application based on current construction planning, to be provided by H-E, and available Project information. Input will be needed from ADF&G-SuHydro and R&M.

Deliverables

A construction impact assessment report will be produced.

Schedule

	Draft	Final
Construction Impact Assessment Report	02/28/85	04/30/85

TASK 39

MITIGATION PLANNING FOR CONSTRUCTION ACTIVITIES

Rationale

An acceptable mitigation plan is needed to complete the hearings and settlement processes. Elements of the plan will be incorporated as articles of the license. The information will also be used when applying for specific state and federal permits.

Objective

Develop acceptable mitigations for aquatic impacts related to construction activities.

Description

Task 37 will identify aquatic impacts associated with construction related activities. Activities anticipated to produce aquatic impacts include construction of the access roads, transmission lines, floodplain gravel pits, camps, permanent village and other project facilities. The mitigation planning effort will identify appropriate mitigation, such as siting, scheduling and designs, that will avoid or minimize impacts for the construction activities and facilities. The mitigation plan will be included in the construction impact assessment report described in Task 38. H-E and ADF&G SuHydro will provide input into and review of the planning effort.

Deliverables

A detailed construction mitigation plan will be developed. The plan will be organized by activity or facility.

Schedule

	Draft	Final
Construction Mitigation Plan	02/28/85	04/30/85

TASK 40

IMPOUNDMENT RESIDENT FISH MITIGATION PLANNING

Rationale

A mitigation element that compensates for lost resident fish habitat (primarily Arctic grayling habitat) in the reserviors needs to be developed to support the hearings and settlement processes. The resident fish mitigation plans will be incorporated into the license.

Objective

To develop an acceptable mitigation that compensates for lost resident fish habitat in the reservoirs.

Description

Available information on resident fishes in the impoundment area will be summarized to update the assessment in the FERC license application. Mitigation options will be refined to further assess their applicability as compensatory measures. The options considered will be submitted for agency review and policy decision. Emphasis will be placed on those options that appear to have the highest probability of success. The evaluation of options will include input and review from H-E and ADF&G-SuHydro.

Deliverables

A report will be prepared describing the impoundment area resident fish populations, the anticipated loss of habitats and expected consequences to fish populations, and the options considered as compensation. A preferred project mitigation alternative will be presented.

Schedule

	Draft	Final
Resident Fish Mitigation Plan	02/28/85	04/30/85

TASK 41

BASELINE WATER QUANTITY AND QUALITY MONITORING AT
TSUSENA AND DEADMAN CREEKS

Rationale

Acquisition of state and federal permits for operation of water supply and wastewater treatment operations are necessary prior to project construction.

Objective

Develop a plan to obtain baseline water quantity and quality information on Tsusena (water supply) and Deadman Creeks (wastewater treatment effluent) to allow for permit application and coordination with various resource agencies.

Description

A water monitoring plan will be developed to produce the information necessary to document water quality and quantity parameters in sufficient detail to assist in facilities designs and to acquire appropriate permits. The plan will be based on a thorough review of permit and design information requirements and produce data sufficient to:

1. determine whether the proposed Tsusena Creek water source is adequate to produce sufficient potable water supply (with treatment).

2. produce design criteria for a potable water supply treatment facility using Tsusena Creek water.

3. provide estimates of the quantity and quality of waste effluents discharged from the potable water treatment facility.

4. estimate the waste assimilative capacity of Deadman Creek and the with-project effects on water quality.

5. produce design criteria for a wastewater treatment facility discharging effluent to Deadman Creek.

Deliverable

A report summarizing necessary monitoring programs for Tsusena and Deadman Creeks which will outline:

1. monitoring schedules.

2. sampling locations.

3. type of samples collected.

4. quantity of samples collected.

5. cost estimates of monitoring program.

Schedule

Draft report	May 1, 1985
Final report	June 30, 1985

TASK 43

GLACIER STUDIES

Rationale

The glaciated portions of the Susitna River Basin upstream of Gold Creek play a significant role in the hydrology of the area. The drainage area upstream of the Denali and MacLaren gages comprises 19.9 percent of the basin above Gold Creek, yet contributes 39 percent of the average annual flow (License Application p. E-2-12).

Glaciers act as reservoirs collecting snow and ice in the winter and releasing melt water to the stream in the summer. The rate at which glaciers store water, melt and contribute to streamflow depends on the climate. Periodic changes in climate may have significant effects on glacier wasting and, thus, on inflow to the project.

Although there is no reliable mechanism for predicting glacier wasting during project life, due to the importance of the glaciated regions to Susitna River streamflow it may be beneficial to conduct a monitoring program. This program would be to determine the current physical glacier charateristics and periodic changes in relation to climate. The purpose of developing records of this type is to provide insights into glacier performance and data which would be useful for developing a predictive model for project operation.

Objective

The objective of this task would be the preparation of a plan for glacial monitoring which would specify how such a program would benefit project operation. A base line monitoring program would be initiated if review of the monitoring program plan was favorable.

Description

Work would consist of three items:

1. Preparation of a plan for glacier monitoring including an assessment of its usefulness for project operation,

2. Review of the plan, and

3. Confirmation of the base line monitoring program already in place.

Deliverables

There would be two deliverables:

1. A report on the proposed glacial monitoring program.

2. A report of the data collected during FY85.

Schedule

A draft monitoring program would be coordinated with the streamflow forecast model feasibility study. A draft glacier monitoring plan will be prepared as part of the model feasibility report due May 1, 1985. This plan would be reviewed and finalized by June 30, 1985. Glacier monitoring would continue upon favorable review of the plan and data would be reported by July, 1985.

APPENDIX A

Appendix A

DRAFT

LOWER RIVER STUDY PLAN

1.0 INTRODUCTION

The Alaska Power Authority (Power Authority) has proposed construction of a two dam hydroelectric project on the Susitna River. The Susitna Hydroelectric Project is a large and complex undertaking that must comply with several state and federal regulations and processess designed, for the most part, to protect the public interest and safety and insure a proper handling of environmental protection. The Federal Energy Regulatory Commission (FERC) is the primary regulatory agency whose rules and procedures govern the present pre-construction phase of the project. FERC regulations (in part) require that the Power Authority provide detailed descriptions of existing water quality and flows as well as description of biotic components of the riverine aquatic and associated riparian habitats, expected impacts on particular fish resources and measures and/or facilities planned for mitigation of project-induced losses to these resources. On February 28, 1983, the Power Authority applied for a FERC license to construct and operate the project. The Exhibit E of the license application described expected project-induced changes of water quantity and quality as well as potential effects on fish and their habitats (Alaska Power Authority, 1983: Exhibit E, Chapters 2 & 3).

Changes of water quantity and quality and, therefore, potential impacts are expected to be greatest near the proposed project site with gradual amelioration of the effects further down river. Environmental studies to date have focused primarily on the Middle Susitna River reach (Devil Canyon to Talkeetna) with lesser efforts on the upper river (headwater to Devil Canyon) and lower river (Talkeetna to Cook Inlet) reaches. Since the acceptance of the license application, resource management agencies have questioned the lack of focus on the lower river. The agencies are concerned that, even though with-project physical changes may be relatively small, there is little quantitative support to justify the conclusions that project-related impacts to the lower river fisheries resources would not be significant. Project-related impacts could be greater than projected either because the fish and/or their habitats in the lower river are more sensitive

to expected physical changes or the fish are much more abundant so relatively small environmental changes could have a larger net effect on fish populations.

During the summer months, project-related effects to the lower river could result from reduced discharge from the middle Susitna River, lower water temperatures, reduced turbidity and reduced sediment transport rates. During winter months, somewhat opposite effects would result from increases in discharge, possibly greater volumes of ice, increased turbidity and increased rates of sediment transport over existing conditions. The principal purpose of this pln is to outline necessary studies to evaluate the significance of these effects.

The Power Authority developed this study plan to emphasize evaluation and quantification of potential project impacts in the lower river. The plan received considerable input from various resource management agencies and Power Authority contractors and subcontractors.[1/]

Project operation has less ability to regulate flow and affect water quality in the lower river so it cannot be expected that flow-related impacts can be mitigated through project operation to the same degree as for the middle river. For this reason, studies in the lower river may not require as high a level of resolution as studies conducted in the middle river. However, the level of effort required will depend upon the existing data base and evaluation of potential impacts as they are identified. This study plan provides a step-wise process to provide the Power Authority with data and information necessary to develop reliable descriptions and, to the extent

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1/ Alaska Department of Fish and Game's SuHydro Study Team, Harza-Ebasco Joint Venture, Arctic Environmental Information and Data Collection Center (AEIDC), R&M Consultants, E. Woody Trihey and Associates (EWT&A) and Woodward-Clyde Consultants (WCC). This group is generally identified as the Aquatic Study Team.

possible, quantification of project-related effects on fish resources of the lower river and formulate appropriate mitigative measures. The remainder of this study plan is separated into the following sections:

2.0 General Plan Scope and Approach

Description of the scope of the study plan and an overall description of the objectives, scopes and approach for the studies.

3.0 Lower River Habitat Stratification and Classification

Description of habitat stratification and classification of the lower river with a rationale for each.

4.0 Physical Study Components

Presentation of information needs and proposed study plans for description of projected physical changes.

5.0 Fish Impact Issues

Presentation of information needs and proposed study plans necessary for adequate resolution of impact issues.

6.0 Summary

Summarization of the initial physical and biological studies for the lower river that need to be done. The results of these studies will be integrated and evaluated to determine if their results will resolve impact issues and questions. If so, no further studies may be warranted. If not, more detailed or alternative studies may be warranted.

2.0 GENERAL PLAN SCOPE AND APPROACH

2.1 SCOPE

This study plan is intended to provide guidance and a general framework to plan and coordinate studies in the lower river. Details of study design, site selection, and methodology are not included. Parties actually performing the studies are responsible for details of study design and methodology. However, review and coordination will be necessary to insure results of various study components are compatible and meet standards necessary for subsequent applications and analyses.

2.2 APPROACH

The lower river studies will provide basic data and information necessary to evaluate potential project-related impacts and to plan appropriate mitigation measures. The general approach will follow the rationale used for middle river studies. The basic rationale utilizes a sequential process to determine potential significant impacts, to estimate the actual magnitude and significance of potential impacts and to plan measures to mitigate for significant adverse impacts. The sequence of steps underlying the basic approach are as follows:

1. Predict the physical changes to aquatic habitat which are attributable to project construction and operation (qualitative and quantitative).

2. Evaluate the anticipated physical changes to predict potential effects (qualitative and quantitative) these changes could have on utilization of the aquatic habitat by fish species of interest.

3. Plan and implement studies and analyses to evaluate, quantify and adequately assess the magnitude of each impact.

4. Plan a set of measures to mitigate for those impacts anticipated to have significant adverse effects on production of the fish species of interest.

Results from prior studies of the Susitna River System and some time-constraints will alter the sequential nature of this process to some degree. However, the essence and intent will be preserved. The sequence can be followed presently at a qualitative level but efforts to better quantify steps 1 through 3 will occur in parallel during most of Fiscal Year 1985 (FY85).

Meaningful evaluation of impact issues requires integration of predicted with-project physical characteristics (see Section 4.0) with measures of fish abundance and utilization of the potentially impacted habitats. Existing quantification and descriptions of the distribution and abundance of and habitat utilization by the species of interest are limited for the lower river. Studies will be implemented (see Section 5.0) in FY85 to gather additional information and data on distribution and abundance of fish species and the habitat utilization by the species. Toward the end of FY85 the physical and biological data will be analyzed and integrated for assessing the adequacy of results to resolve impact issues and determine if further resolution and studies are warranted.

The length (nearly 100 miles) and morphologic complexity of the lower river, together with the expected amelioration of with-project changes passing downstream, complicate the selection of representative sites and an analytical expansion. A stratified approach will be used to minimize this problem. A lower river morphological assessment is being performed (see Section 3.0) by R & M Consultants (R&M) to provide the basic (macro-habitat) measurements that will be used for extrapolating anticipated effects at specific sites to impacts on the lower river as a whole. R&M, with assistance from AEIDC, has stratified the river into segments and habitat classifications based on river morphology and hydrology. These strata will provide the basis from which study designs and site selections are

developed. The basic stratification is described in detail in Section 3.0. Also described in that section are continuing studies to refine the basic data and to provide support for interpretation of the physical and biological study components described in Sections 4.0 and 5.0 respectively.

Several anticipated project-induced physical changes have been identified. These are changes in water discharge, water temperature, ice processes, suspended sediment (turbidity) and bedload transport processes. The expected changes in each physical factor are only qualitative at this time. The major plan objective for physical component studies in FY85 is to quantify the expected magnitude of with-project changes for specified river segments (see Section 3.0). The ability to quantify physical factors in the lower river may be limited by a lack of baseline or historic data and the relatively dynamic and unstable nature of instream flow processes. In those cases, the qualitative projections will be refined and documented as a part of the activities described in this section.

3.0 LOWER RIVER STRATIFICATION AND HABITAT DEFINITION

3.1 Background

R & M has conducted a lower river morphological assessment and, with assistance from AEIDC, has stratified the lower river into contiguous segments with common morphological characteristics. The defined segments are (from R&M, 1984):

Segment I: RM 98.5 to RM 78

This segment extends from the Chulitna River confluence with the Susitna River downstream to the head of the side-channel complex (see below for differentiation) just upstream of the mouth of Montana Creek. In this Segment, the river is braided, with the main channel meandering through a wide gravel floodplain. Large expanses of gravel bars are exposed at low flows. The channel is constricted to a single channel at the Parks Highway Bridge (RM 83.8). Significant tributaries in this segment include Talkeetna River, Birch Creek, Trapper Creek, Sunshine Creek, Rabideaux Creek, and Whitefish Slough. A total of six side-channel complexes were identified.

Segment II: RM 78 to RM 51

This segment extends from the side-channel complex upstream from Montana Creek to the head of the Delta Islands where the river splits into two main channels. The morphology in this reach is complex, with a total of nine side-channel complexes along the edge of the river, and two side-channel complexes in large island groups in mid-channel. Significant tributaries in this segment include Montana Creek, Caswell Creek, Goose Creek, Sheep Creek, and the Kashwitna River.

Segment III: RM 51 to RM 42.5

This segment encompasses the Delta Islands reach where two main channels exist, one on the east and one on the west. A total of five side-channel complexes exist in this segment, with a major complex between the two main channels. The segment ends where the two main channels rejoin. Significant tributaries in this segment include Little Willow Creek and Willow Creek.

Segment IV: RM 42.5 to RM 28.5

This segment extends from the lower end of the Delta Island to the confluence with the Yentna River. The reach is characterized by a braided pattern, with seven side-channel complexes. The Deshka River enters the upper end of this reach. Kroto Slough branches off from this segment, and extends to the Yentna River.

Segment V: RM 28.5 to RM 0

This segment extends from the Yentna River confluence to the mouth of the Susitna River in Cook Inlet. The segment is primarily a split-channel configuration down to RM 19, the head of Alexander Slough. The Susitna River has 2 channels from RM 19 to Cook Inlet, with the east side channels conveying the largest proportion of the river water. The west channel is primarily an overflow channel and the upper section dewaters at low flow. The lower portion of the west channel is fed by Alexander Creek. Other tributaries entering this segment include Anderson Creek and Fish Creek.

These river segments will provide the basic stratification for both physical and biological components of the study plans.

Within the river segements, four major habitat categories were defined based on morphological characteristics (from R&M, 1984):

1. Mainstem Channel

The mainstem channel is that portion of the river floodplain between the vegetated boundaries, including wide gravel floodplains and isolated vegetated islands in mid-channel. Two subcategories exist:

a) Mainstem river, consisting of the thalweg channel and major subchannels.

b) Alluvial island complexes, which are areas of broad gravel islands with numerous subchannels which dewater as flow decreases.

2. Side-Channel Complex

The side-channel complexes are groups of side-channels flowing through vegetated islands. These are normally along the edge of the mainstem river, but may also include areas in the middle of the river, such as the Delta Islands. Two subcategories exist:

a) Lateral side-channel, which is the outside channel of the complex, closest to the edge of the floodplain. This channel collects any groundwater seepage or tributary flow from the river banks, so usually will not completely dewater, even when its upstream berm is not breached.

b) Medial side-channels are the overflow side-channels between the mainstem and the lateral side-channel. These side-channels generally dewater as mainstem flow decreases. Flow may be maintained in some of these medial side-channels from groundwater sources.

3. Sloughs

Sloughs are simple, regular channels which are generally overtopped only at high flows. They are differentiated from side-channel complexes by the fact that sloughs are isolated channels, not fed by a series of medial side-channels.

4. Tributary Mouths

Tributary mouths include the area between the downstream extent of a tributary plume and the upstream effect of backwater. The area is variable, and depends both on the tributary discharge and the mainstem discharge. The length of the tributary plume may sharply increase when the tributary flows into a side-channel in which the upper end is no longer breached.

The combination of river segment stratification and habitat categorization will be used by all study participants to insure that the various study designs and eventual results are both complimentary and compatible. Also, study participants will coordinate in a joint process to establish a common set of priority study sites.

3.2 Information and Study Needs

With the completion of the stratification and habitat classification into the respective categories, the next step will be to provide more detailed information on the responses of specific habitat surface areas to mainstem discharge. In order to define these responses, information describing the extent of each habitat type through a range of mainstem discharges is needed. The system-wide responses will be based on wetted-surface areas of the various habitat types and extrapolation of specific relationships at representative sites. This information will be used as an important component of predictions of potential physical and biological impacts for the lower river as well as in the extrapolation to the river as a whole.

3.3 Study Plans

The morphological assessment will quantify the relationships between mainstem, side-channel complex, and tributary mouth habitat categories and how they respond to mainstem discharges. These relationships will be used to estimate the magnitude and location of changes in habitat area resulting from with-project flows. The results of this analysis can be combined with information on habitat utilization and a more detailed and expanded habitat mapping to assess project-related impacts on the species of interest and their habitats for the entire lower river reach. Variations in mainstem and side-channel complex habitats will be expressed as charges in wetted surface areas of each habitat type. Variations in tributary mouth habitats will be expressed as changes in the linear length of each tributary mouth habitat. Measurements will be taken from four sets of aerial photographs representing mainstem flows (measured at Sunshine Station) of 13,600 cubic feet per second (cfs), 22,000 cfs, 37,500 cfs, and 56,500 cfs which were obtained in 1983 and from two sets of aerial photographs which will be obtained at mainstem discharges of 75,000 cfs and 90,000 cfs during 1984.

Results of the morphological assessment will provide an index of habitat sensitivity to discharge, by river segment, that can be used to establish and prioritize study sites. Typical study sites will be chosen which will represent each habitat classification in each river segment. This will be a general guideline for initial site selection which can then be altered or reinforced based on well described judgements and priorities. However, prioritization should not sacrifice the basic guideline of choosing sites representative of each habitat in each river segment.

The above studies are expected to be completed during early FY85.

3.4 Tables Related to this Component

The following 1985 Aquatic Program Tasks, described previously, are related to completing this component of the study:

a) Task 14: Lower River resident and juvenile anadromous fish studies.

b) Task 17: Streamflow and flood frequency studies.

c) Task 21: Lower River morphological assessment.

d) Task 23: Lower River ice studies.

e) Task 28: Lower River tributary access analysis.

f) Task 36: Lower River rearing habitat investigaitons - IFG hydraulic modeling.

4.0 PHYSICAL STUDY COMPONENTS

Identification and assessment of impacts on fish resources in the lower river require that project-related changes in the physical conditions of the lower river be established. This requires an assessment of current conditions and a prediction of conditions during initial reservoir filling and project operation. Several anticipated project-induced physical changes have been identified. These are changes in water discharge, water temperature, ice processes, suspended sediment (turbidity) and bedload transport processes. The expected changes in each physical factor are only qualitative at this time. The major plan objective for physical component studies in FY85 is to quantify the expected magnitude of with-project changes for specified river segments (see Section 3.0). The ability to quantify physical factors in the lower river may be limited by a lack of baseline or historic data and the relatively dynamic and unstable nature of instream flow processes. In those cases, the qualitative projections will be refined and documented as a part of the activities described in this section.

4.1 DISCHARGE

4.1.1 Background

Proposed operation of the Susitna Hydroelectric Project will be based on a power production scenario that provides beneficial economics while maintaining sufficient discharge to provide for downstream aquatic resources (Alaska Power Authority 1983). Project reservoirs will be drawn down during the peak energy-demand months of winter and filled during the summer months. The overall effects of this operation is that downstream flows will be greater than natural conditions in the winter and less than natural conditions in the summer (Table 4.1).

The magnitudes of change from natural flows clearly decrease further downstream from the Project (Table 4.1). This is due to the influence of

tributaries and reduced influence of the Project in regulating river discharges. However, efforts to statistically define river reaches where with-project flows do not differ significantly from natural conditions have been unsuccessful. Consequently, the area where predicted project impacts occur cannot be limited based on analysis of existing streamflow data and it will be necessary to include the entire lower river for assessing discharge-related impacts (AEIDC 1983).

4.1.2 Information and Study Needs

Expected with-project flow changes at USGS gage stations in the lower river have been adequately forecast on a monthly basis for the case C flow scenario presented in the license application. Shorter term (weekly and and possibly daily) forecasts are needed as well as representative forecasts for other project operation scenarios. These will enable comparison of effects of other regimes on aquatic resources. In order to evaluate the effects of alternative flow regimes on aquatic resources, comparison of streamflow duration plots with rating curves developed for various locations along the lower river reach and responses of surface areas in various habitat types is a necessary step in evaluating potential effects in the lower river.

There is a need to provide information on flood duration, flood flows, and flow frequency for use in evaluating potential project impacts on aquatic habitat. Such information is also needed to better understand how changes in flow affects sediment transport capability in the lower river and its interactions with aggradation, degradation and potential changes to aquatic habitat.

In addition, the magnitude and duration of short term high flow events (floods) can influence timing and relative success of adult migration, spawning habitat access and juvenile distribution. Hence, flood frequency curves, given alternative operations regimes will be developed for the lower river.

Table 4.1

SUSITNA HYDROELECTRIC PROJECT
PREDICTED AVERAGE MONTHLY DOWNSTREAM FLOWS AND PERCENT CHANGE
AT SUNSHINE (RM 87) AND SUSITNA STATION (RM 26) FOR THE
TWO DAM SUSITNA HYDROELECTRIC PROJECT SCENARIO (FROM AEIDC 1983a)

	Sunshine			Susitna Station		
Month	Natural (cfs)	With-Project (cfs)	Percent Change	Natural (cfs)	With-Project (cfs)	Percent Change
October	14,287	16,271	+14	31,427	33,411	+6
November	6,139	13,196	+115	13,500	20,558	+52
December	4,318	13,7731	+219	8,517	17,973	+111
January	3,614	12,722	+252	8,030	17,137	+113
February	3,045	11,969	+293	7,148	16,072	+125
March	2,706	10,856	+301	6,408	14,558	+127
April	3,271	9,993	+206	7,231	13,953	+93
May	28,021	23,381	-17	61,646	57,006	-8
June	64,597	46,581	-28	124,614	106,597	-15
July	64,953	48,834	-25	134,549	118,431	-12
August	57,262	47,630	-17	113,935	104,314	-8
September	32,104	29,258	-9	67,652	64,806	-4

4.1.3 Tasks Related to this Component

The following FY85 Aquatic Program tasks, described previously in detail, are related to completing this component of the study:

a) Task 5: Economic and environmental comparisons process.
b) Task 6: Recommended flow regimes report.
c) Task 17: Streamflow and flood frequency studies.
d) Task 19: Hydro-meteorological physical data collection
e) Task 21: Lower River morphological assessment.

4.2 WATER TEMPERATURE

4.2.1 Background

The temperature regime of the Susitna River downstream of the proposed project is expected to change during both filling and operation. Predicting downstream temperature regimes and relating these predictions to temperature preferences and tolerances of aquatic resources is an important component in evaluating impacts in the lower river (further discussion of biological effects of temperature changes are provided in Section 5.0)

In the FERC license application, predictions of downstream temperatures were made using the HEATSIM instream temperature model. Input data to this model includes simulated reservoir temperatures (using the DYRESM model), reservoir operations, water balance data, and historical temperature data. Results of these simulations are discussed in Chapter 2 of the FERC license application. The AEIDC has further evaluated downsteam temperatures using the SNTEMP instream temperature model.

Based upon review of simulations of both AEIDC (1983 b) and Acres American, Inc. (Alaska Power Authority, 1983) the following statements can be made regarding with-project temperatures in the lower river:

1. During the second year of filling, the temperature regime during June to August in the reach downstream of Talkeetna is predicted to be 1°C (or less) lower than the natural regime, regardless of hydrologic and meteorologic conditions in whatever year the filling occurs.

2. During operations, there will be observable temperature changes downstream of Talkeetna. The extent and magnitude of these changes cannot be predicted at present. Expected changes include:

   a. Lower summer temperatures because of the reduced mainstem flow and a resultant proportional increase in contribution by the colder Chulitna and Talkeetna rivers.

   b. During early fall, downstream temperatures would remain above 0°C for some length of the river downstream of Talkeetna and for an undetermined period of time (depending on meteorologic and hydrologic conditions).

   c. In late fall and winter, the river water temperature is anticipated to be 0°C by the time it reaches Talkeetna.

   d. Between Talkeetna and the Sunshine gaging station, June through August water tempertures will be reduced and those in September increased as compared to natural conditions (two dam scenario) (Table 4.2).

4.2.2 Information and Study Needs

There is a need to complete the assessment of potential temperature changes that may occur in the lower river as a result of the project. This information will be coupled with biological studies to determine if potential effects on aquatic organisms are significant in the lower river.

In order to evaluate potential temperature effects downstream of Talkeetna, completion of the analysis of temperature effects from the dam(s) to Talkeetna is needed. Application of the SNTEMP model to date has extended to the Sunshine Station. Depending upon the results of the temperature simulations currently being completed, a determination will be made of the necessity to extend the model simulation further downstream. In anticipation of possible extrusion of the modelled reach, temperature calibration data including stream width measurements will be collected within the representative segments in the lower river downstream from Sunshine.

4.2.3 Tasks Related to this Component

The following FY85 Aquatic Program tasks, described in detail previously, are related to completion of this study component:

a) Task 4: Instream Flow Relationships Study: Instream Temperatur and Ice report.
b) Task 14: Lower River resident and juvenile anadromous fish studies.
c) Task 16B: Outmigrant studies of the lower river.
d) Task 19: Hydro-meteorological physical data collection.
e) Task 23: Lower river ice studies.
f) Task 32: Lower river stream temperature analysis.

4.3 SUSPENDED SEDIMENT (TURBIDITY)

4.3.1 Background

Sediment particles that are transported in a stream while being held in suspension by the turbulent components of the water are classified as suspended sediments. Within the Susitna, glacial outwash contributes mostly fine sediment (<5 microns in diameter). Analyses of suspended sediment and turbidity in the Susitna River has been conducted by R&M (1982c, see page

E-2-200 of the license application) and the USGS (unpubl.), while periodic measurements of turbidity at specific habitat locations in the lower river have been obtained by ADF&G as part of their Aquatic Habitat and Instream Flow Study program (e.g., Figures E.5.7 to E.5.34, ADF&G [AH] 1981, Chapter 2 of the FERC License Application [p. E-2-28 to E-2-30], and Table 4-D-45 ADF&G [AH] 1983). These measurements indicate that under natural conditions, summer turbidities are high (up to 1,056 NTU or 1,620 mg/l as measured at Sunshine by the USGS); and winter turbidities are low (e.g., 0-2 mg/l in March as measured at Sunshine).

Most suspended sediment in the lower river is derived from the three major tributaries, especially the Chulitna River. Downstream of the confluence, the Yentna River, also a glacial river, is the major additional source of sediment. Although the glacier-fed rivers are the major sediment source, some bank erosion and resuspension of deposited sediment occurs. Because of the dilution of water by tributaries and sedimentation of some suspended sediments due to the low gradient of the streambed, turbidities and suspended sediment concentrations may decrease between Sunshine and Susitna stations (Figures E-2-78 and E-2-81 in the license application).

During filling and operation of the project, the reservoirs will act as sediment traps that will decrease the overall amount of suspended sediment moving downstream. On the other hand, it is possible that, during filling some slumping of the reservoir margins may occur which could cause some increase in suspended sediment and turbidity transported downstream. A significant decrease in turbidity may enhance light penetration (thus increasing biological production) but eliminate the use of turbid water as cover by salmonid juveniles rearing in the river. A modeling study (on Watana Reservoir) was conducted by Peratrovich, Nottingham, and Drage (1982) to predict downstream turbidities in the middle river. The study predicted that with-project turbidities in the middle river would range from 20-50 NTU in the summer and 10-20 NTU in the winter, and that the reservoir would retain about 80 percent of the natural sediment load (see Figure E.2.80 in

Table 4.2

SUSITNA HYDROELECTRIC PROJECT
MONTHLY TEMPERTURES (°C) AT THE CONFLUENCE WITH CHULITNA RIVER (RM 98) AND SUNSHINE (RM 84) IN JUNE-SEPTEMBER FOR SEVERAL PROJECT STAGES*

Month	Natural[a] °C	Year 2 of Filling[a] °C	One Dam Operation[b] °C	Two Dam Operation[b] °C
June				
Confluence	7.2-9.9	6.1-8.1	8.0	7.6
Sunshine	8.2-10.3	7.8-9.2	8.2	7.9
July				
Confluence	8.7-10.6	7.6-9.1	8.1	7.9
Sunshine	9.1-11.2	8.4-10.2	8.2	8.0
August				
Confluence	7.5-9.7	6.5-8.2	8.2	7.5
Sunshine	7.9-10.2	7.1-9.0	8.2	7.6
September				
Confluence	4.7-6.6	4.6-6.1	6.7	6.6
Sunshine	4.3-6.1	4.3-5.7	6.7	6.6

a/ 15 year simulation (1968-1982).

b/ Using 1981 hydrologic and meteorologic data and results of DYRESM model for 1981.

*AEIDC 1983b.

the license application). The relative change in suspended sediment/ turbidity levels downstream from the confluence of the Chulitna, Talkeetna, and Susitna rivers has been estimated using a mass balance relationship. The license application (Chapter 2) predicted that at a flow of 12,000 cfs, the suspended sediment downstream from the confluence would be decreased by 3 percent in summer, whereas at a filling flow of 6,000 cfs, the suspended sediment concentration could increase by approximately 8 percent. Decreases in the suspended sediment concentrations and turbidity of this level in summer will not likely be of significance to the aquatic resources in the lower river. For turbidity decreases to be significant to benthic production or to decrease cover available for rearing fish, turbidity must be in the lower end of the 20-50 NTU range (AEIDC 1983b). As a result of the high suspended sediment load of the Chulitna River (twice the Susitna above the confluence), decreases below 50 NTU will not occur.

During winter, suspended sediment concentrations have not yet been predicted quantitatively. Because the suspended sediment concentration of water released from the reservoir will be increased over natural conditions, concentrations in the lower river will also be elevated. Although the inflow of tributaries below the confluence will dilute the suspended sediments, concentrations will still be higher than under natural conditions. Juvenile and resident salmonids utilize riverine habitats during the winter. Therefore, unnaturally high suspended sediment levels at this time may affect fish behavior and adversely affect fish populations.

4.3.2 Information and Study Needs

A consolidation of existing information and analysis on turbidity is necessary to determine if any potential impacts might occur in the lower river. Results of additional studies to refine suspended sediment and turbidity relationships in the reservoir and middle reach of the Susitna River are also necessary to predict effects to the lower river. This refinement will be afforded through additional characterization of suspended seidiment and turbidity in the natural system and incorporation of a suspended sediment/turbidity subroutine to the DYRESM temperature model.

4.3.3 Tasks Related to this Component

The following FY85 Aquatic Program tasks, described in detail previously, are related to the completion of this study component:

a) Task 4: Instream Flow Relationships Studies: Water Quality Report.
b) Task 12: Middle River mainstem habitat analysis.
c) Task 17: Streamflow and flood frequency studies.
d) Task 18: Suspended sediment and turbidity studies.

4.4 BEDLOAD SEDIMENT

4.4.1 Background

In addition to the sediment that is suspended in the river, there is also considerable bedload sediment discharge. Bedload is coarse sediment (usually gravel, but in some cases sand) that is transported on or near the streambed. Because the Chulitna River basin is heavily glaciated, the Chulitna River is characterized by a considerable bed material movement It has been estimated that the Chulitna River contributes approximately 15 times the bedload volume of the Susitna River near the confluence (page E-2-26, Chapter 2, license application). Measurements of natural bedload sediment discharge for the Susitna River basin are available from the USGS (unpubl.) and R&M (1982c), (page E-2-200 in the license application), although data are only available for the summer months (June-September) in 1981 and 1982. At Sunshine in 1982, bedload discharge in the summer ranged from approximately 1,000 ton/day to 13,600 ton/day (USGS unpubl). However, the sum of the natural bedloads measured in the Susitna, Chulitna, and Talkeetna rivers is two to five times larger than the total measured at Sunshine. This indicates that under natural conditions excess material is deposited somewhere between the measuring stations on the Chulitna, Susitna and Talkeetna Rivers and the Sunshine Station.

Project-related changes in the flow regime (i.e., decreased flow in the summer and increased flow in the winter compared to natural conditions) and the reduced amount of sediment transported from upstream of the project will affect the amount of bedload material movement. Sediments will be deposited if the supply exceeds the transport capacity of the stream (a function of sediment load and discharge) and picked up if the reverse situation develops. Deposition of sediment (i.e., oversupply of sediment) will cause the channel to rise and widen (aggradation), whereas an undersupply results in the removal of sediment which leads to a channel shape that is narrower and deeper (degradation). This process is complicated by affects to bedload transport capacity resulting in changes to discharge regimes, particularly amelioration of peak flow events. The deposition i.e. transport of bedload in conjunction with changes in stramflow regimes will probably alter the shape/discharge relationships within the river channel. Since the surface area of backwater areas are influenced by stage, available fish habitat and tributary access in the vicinity of the three river confluence could be changed. At this time only a qualitative evaluation of bedload sediment is possible.

During summer, decreases in flow and the trapping effect of the reservoirs will result in less bedload material movement in the Susinta upstream of Talkeetna; thus, below the confluence of the Talkeetna, Chulitna, and Susitna, the total amount of bed material being moved will be less than at present. It is possible that the decrease in flow will cause the Chulitna and Talkeenta to deposit some of their bed material at the three rivers confluence and could result in increased aggradation of the channel in this area even though the total amount of sediments transported into this reach will be reduced. Below the three rivers confluence, less bed material will move because of the decreased discharges. The combination of decreased flow, lower suspended sediment discharge, and lower bedload discharge may result in less streambed scour downstream which might cause some areas to become more favorable areas for fish spawning.

In the winter, flows will be increased. This may result in an increase in the amount of bedload discharge over natural winter levels. As the glaciers do not discharge sediment during this period, material moved by the rivers will be existing bed material (such as from the three rivers confluence area). Channel degradation during winter in the three rivers conflunce area may conteract the increased aggradation that may occur during the summer.

4.4.2 Information and Study Needs

There is a need to refine existing information on sediment transport and how it affects aquatic habitats, particularly in the aggradation/degradation process. This refinement is very important in the mainstem near mouths of major tributaries and sloughs. In order to resolve these questions, a two-dimensional sediment transport model will be developed for the confluence reach. Results of this model will be used to evaluate potential effects of the project on fish habitats in the confluence area.

4.4.3 Tasks Related to this Component

The following FY85 Aquatic Program tasks, described in detail previously, are related to the completion of this study component:

a) Task 17: Streamflow and flood frequency studies.
b) Task 18: Suspended sediment-turbidity studies.
c) Task 19: Hydro-meteorological physical data collection.
d) Task 24: Lower river aggradation studies.
e) Task 28: Lower river tributary access studies.

4.5 ICE PROCESSES

4.5.1 Background

Ice processes dominate the Susitna River and its hydraulic features for a major part (7-8 months) of the year. The presence of river ice and the

dynamics of its formation and breakup significantly influence river stage, water temperature, and channel morphology. Many features of flow in the river are affected by the ice and are variables that affect fish habitat. (e.g., depth and velocity).

Natural ice processes in the Susitna River have been qualitatively evaluated (i.e., observation) by R&M (1981, 1982a, 1982b, 1982c, 1983, Steve Bredthauer Personal Communication) and Schoch (1983). These studies and studies in progress have led to a partial understanding of natural ice processes (i.e., formation, ice cover, breakup), a description of which is provided in Chapter 2 of the License Application (p. E-2-22 to E-2-25). In the lower river, ice cover is initiated when an ice bridge forms in a constricted bend of the river near RM 10. Heavy slush or frasil ice from the upper Susitna, Chulitna and Talkeetna basins, where subfreezing temperatures first occur in the fall, is transported downstream and backs up behind the ice bridge. This results in ice cover progression downstream. Depending upon the volume of ice contributed and the ice temperatures in the area, the rate of ice cover progression upstream will vary.

Ice processes result primarily from an interaction of temperature, discharge and river channel morphology. Hence, project-related changes in water temperature and discharge will cause changes in the natural ice process. Changes in the ice processes may in turn affect fish habitats. For the middle river, a quantiative model of with-project ice processes was developed by the Power Authority (p. E-2-124 to E-2-127 of the License Application) to predict possible alterations induced by the Project. The instream ice model, ICESIM, was used in conjunction with the reservoir and instream temperature models (DYRESM and HEATSIM) to make these predictions. Due to a lack of sufficient data to calibrate the model accurately, the modelling effect yielded only qualitative results. The basis conclusions of the ICESIM model are that, with the project, frazil ice from the upper Susitna basin will be blocked by the dams, with the result that a smaller volume of frazil ice will be available to form the ice cover on the Lower Susitna. Frazil ice formation will occur below the dams. However, the

reduced volume of frazil ice will result in ice cover progression rates to be reduced and ice cover will progress up the middle Susitna Basin at a later time than under natural conditions.

Under natural conditions, ice formation causes increases in river stage immediately upstream of the ice front. A result is that side channels and sloughs may e overtopped at mainstem discharges considerably less than those required for overtopping under open-water conditions. Overtopping of sloughs will cause cold, mainstem water to be conveyed through spawning (incubation) areas and overwintering habitats. Also, large expanses of gloodplain may be inundated with river water and masses of ice. This does occur under existing conditions but may be exacerbated under with-project conditions due to the higher discharge regime and associated higher water surface elevations.

High river stages due to the formation of the ice cover are temporary and will recede after the ice front progresses upstream of a given location. The higher than natural discharges in the winter resulting from project operation may increase staging and could affect the availability of winter fish habitat.

4.5.2 Information and Study Need

There is a need to refine the current understanding of ice-processes in the lower river and assess how they affect aquatic habitat. This includes further observation and measurements of ice processes under natural conditions. Additionally, completion of the quantification of ice cover formation processes in the middle river is needed such that some extrapolation to the lowe river reach can be achieved.

4.5.3 Tasks Related to this Component

The following FY85 Aquatic Program tasks are related to the completion of this component:

a) Task 4: Instream Flow Relationships Studies - Instream Temperature and Ice Report

b) Task 17: Streamflow and Flood Frequency Studies

c) Task 19: Hydro-meteorological physical data collection

d) Task 23: Lower river ice study

e) Task 24: Lower river aggradation

f) Task 32: Lower Susitna stream temperature analysis

5.0 AQUATIC STUDY COMPONENTS

The primary focus of the initial aquatic studies conducted in the lower river will be on salmon, primarily due to their commercial and recreational importance. This does not preclude the potential need to study other species in the future if warranted by results of the initial studies.

Through discussions with the Aquatic Study Team (see footnote on page 2) and review of agency comments on the license application, the following were identified in as potentially significant impact issues concerning these species:

1. Change in access conditions for adult salmon to spawning habitat

2. Changes in availability of adult spawning habitat

3. Changes in availability of suitable rearing and overwintering habitat for juvenile salmon and resident fish.

4. Altered juvenile outmigration patterns.

5. Changes in the availability and configuration of salmon holding and milling areas at tributary mouths.

The aquatic study plan will follow a step-wise approach to examining the impact issues. For example, one of the first steps will be to determine if any significant spawning occurs in the lower river. If not, no additional studies on egg incubation or emergence are warranted. However, if significant numbers are found, results from the physical studies (Section 4.0) would be used to determine if potential impacts may occur at spawning/incubation sites. If so, additional studies may be needed.

5.1 ACCESS TO SPAWNING GROUNDS

5.1.1 Background

The ADF&G has examined potential mainstem and side-channel spawning sites in the lower river using electroshockers and drift gill nets. Very little spawning was observed. In 1981, six locations were found in the mainstem where chum salmon were spawning (ADF&G 1981a [AA]). In 1982, 811 sites were surveyed between RM 7.0 and RM 98.5 and no spawning salmon were found (ADF&G 1983a Appendix 2-F [AA]). Turbid water in the lower river prevents visual observation of spawning; thus, it is possible that more spawning may occur than was detectable with electrofishing gear.

Between Talkeetna and Cook Inlet there are eight major and numerous smaller tributaries that are utilized by adult salmon to varying degrees. Escapement indices for chinook salmon have been conducted in most of the tributaries for up to 10 years (see Table 5-1). As part of the earlier Susitna Project studies, some surveys for spawning by pink, chum, coho, and sockeye have been conducted in lower river tributaries between Sunshine and Talkeetna.

In addition to receiving the bulk of the salmon spawning in the lower river, tributaries in the lower river also provide spawning habitat for Arctic grayling and rainbow trout. Studies by the ADF&G (1981, 1983AA) suggest resident fish migrate into tributaries to spawn and feed after overwintering in mainstem, sloughs, or side-channel habitats. Dolly Varden apparently enter tributaries to spawn in the fall whereas most of the other species spawn in the spring.

Other than tributaries, tributary mouth habitats and adjacent sloughs may receive the remainder of the escapement of anadromous and resident fish. Also, migrating salmon will mill or rest in tributary mouth habitats during their upstream migration. Sloughs without tributaries might provide spawning habitat, but there has been no intensive evaluation of the magnitude of slough spawning in the lower river.

Table 5-1

SUSITNA HYDROELECTRIC PROJECT

CHINOOK SALMON ESCAPEMENT COUNTS IN THE LOWER SUSITNA RIVER BASIN STREAMS FROM 1975 TO 1982a/

Stream	Year						
	1976	1977	1978	1979	1980	1981	1982
Alexander Creek	5,412	9,246	5,854	6,215	b/	b/	2,546
Deshka River	21,693	39,642	24,639	27,385	b/	b/	16,000f/
Willow Creek	1,660	1,065	1,661	1,086	b/	1,357	592e/
Little Willow Creek	833	598	436	324d/	b/	459	216e/
Kashwitna River (North Fork)	203	336	362	457	b/	557	156e/
Sheep Creek	455	630	1,209	778	b/	1,013	527e/
Goose Creek	160	133	283	c/	b/	262	140e/
Montana Creek	1,445	1,443	881	1,094d/	b/	814	887e/
Prairie Creek	6,513	5,790	5,154	b/	b/	1,900	3,844
Clear Creek	1,237	769	997	864d/	b/	b/	982
Chulitna River (East Fork)	112	168	59	b/	b/	b/	119e/
Chulitna River (MF)	1,870	1,782	900	b/	b/	b/	644e/
Chulitna River	124	229	62	b/	b/	b/	100e/
Honolulu Creek	24	36	13	37	b/	b/	27e/
Beyers Creek	53	69	b/	28	b/	b/	7e/
Troublesome Creek	92	95	b/	b/	b/	b/	36e/
Bunco Creek	112	136	b/	58	b/	b/	198
Peters Creek	2,280	4,102	1,335	b/	b/	b/	b/
Lake Creek	3,735	7,391	8,931	4,196	b/	b/	3,577
Talachulitna River	1,319	1,856	1,375	1,648	b/	2,129	3,101
Canyon Creek	44	135	c/	c/	c/	84	c/
Quartz Creek	c/	8	c/	c/	c/	8	c/
Red Creek	c/	1,511	385	c/	c/	749	c

a/ 1976-1980 counts (ADF&G/Kubik, S.W.), 1981 and 1982 from ADF&G Susitna Hydro (1981, 1983).
b/ No total count due to high turbid water.
c/ None counted.
d/ Poor counting conditions.
e/ Counts conducted after peak spawning.
f/ Estimated peak spawning count (ADF&G/Delaney, K).

Specific studies of access into lower river tributaries or sloughs have not been conducted. However, R&M (1982b - hydraulic studies) studied perching at the mouths of tributaries within the middle river (Talkeetna to Devil Canyon) and concluded that flows in most tributaries would be sufficient to downcut through the tributary deltas to establish channels at new gradients. Using this information and other data collected by ADF&G and R&M, Trihey (1983) conducted an incremental analysis of access into two tributaries in the middle river: Portage Creek and Indian River. He concluded that access into these tributaries would not be a problem at Gold Creek flows as low as 8,000 cfs because downcutting by the tributaries will establish new entrance conditions that allow access to spawning areas.

5.1.2 Information and Study Needs

Because of the large number of spawners that utilize the lower river tributaries, it is important that access be assessed in the lower river. Results of access studies conducted in the middle river cannot be extrapolated to the lower river because of differences in channel morphology and differences in the response of stage to flow. Due to the lack of information on salmon utilization of all riverine habitat types (see Section 3.0 for description of habitat types) and limited data on access, the following studies are needed:

1. Survey of riverine habitat types and tributaries to determine utilization by salmon (i.e., timing, abundance, and species composition).

2. Evaluation of salmon access vs mainstem flow for selected tributaries, side-channels, and sloughs in the lower river.

5.1.3 Tasks Related to this Components

The following FY85 Aquatic Program tasks are related to completion of this component:

a) Task 13B: Adult salmon-lower river spawnig surveys.

b) Task 15A: Lower river, main channel salmon escapement monitoring.

c) Task 17: Streamflow and flood frequency studies.

d) Task 21: Lower river mosphological assessment.

e) Task 28: Lower river tributary access analysis.

5.2 CHANGES IN AVAILABILITY OF SPAWNING HABITAT

5.2.1 Background

The extent of spawning by adult salmon in side-channel and mainstem habitats were evaluated in 1981 and 1982 by the ADF&G (1981, 1983-AA). Spawning salmon were found in only 6 side-channel or mainstem sites in 1981.

Some data on salmon spawning habitats in the lower river are available in ADF&G Aquatic Habitat and Instream Flow Reports. These data include depths, velocities, substrates, and temperatures at specific spawning sites (see Table 5-2 for the location of this data).

Table 5-2

SUSITNA HYDROELECTRIC PROJECT

INFORMATION AVAILABLE IN ADF&G REPORTS ON
HABITAT CHARACTERISTICS IN THE LOWER RIVER

Location and Variable	Citation	
Chum Channel		
Velocity	AH, Table 4-B-1	1983
Depth	AH, Table 4-B-1	1983
Discharge	AH, Table 4-A-1	1983
Rabideux Slough		
Velocity	AH, Table 4-B-2	1983
Depth	AH, Table 4-B-2	1983
Discharge	AH, Table 4-A-1	1983
Thermograph Sites (1981)		
(see page E--149 ADF&G 1981a AH for listing of sites)	AH, Appendix EC	1981
Thermograph Sites (1983)	AH, Appendix C	1983

5.2.2 Information and Study Needs

Although few spawning salmon have been observed in the lower river it is still necessary to examine a few habitats and time periods that were not previously examined in detail, to determine definitively if significant spawning occurs in this reach. If spawner surveys demonstrate a significant number of spawners in riverine habitats, then it will be necessary to examine the results of the physical studies to determine if project flows will potentially affect these habitats. Study needs at this level of investigation include:

1. Survey of riverine habitat types to determine utilization by spawning salmon (i.e., timing, abundance, and species composition).

2. Evaluation of the effects of project flows on the availability of habitat suitable for spawning salmon.

Additional, more detailed studies might be implemented, depending on results of the first step. These may include studies on other life phases that could be affected such as egg incubation and emergence.

5.2.3 Tasks Related to this Component

The following FY85 Aquatic Program tasks, described in detail previously, are related to the completion of this component:

a) Task 13B: Adult salmon-lower river spawning survey.

b) Task 15A: Lower river-main channel salmon escapement monitoring.

5.3 CHANGES IN AVAILABILITY OF SUITABLE REARING AND OVERWINTERING HABITAT

5.3.1 Background

Juvenile anadromous and resident fish rear in Susitna riverine habitats throughout the year. Information on the distribution and abundance and size of these fish in lower river habitats has been collected by ADF&G in 1981 and 1982 (ADF&G 1981c, ADF&G 1983b - RJ). A variety of sampling gears were utilized (e.g., electroshocking, seines, trot lines, gillnets, minnow traps) to capture fish. Samples were obtained in both summer and winter. In the lower river semi-monthly samples were taken in both years from the vicinity of five designated fish habitat (DFH) sites: Rabideux Creek, Whitefish Slough, Birch Creek and Slough, Sunshine Creek and Side-Channel and Goose Creek and Side-Channel (see Appendix A, ADF&G 1982 (RJ) and Appendix B ADF&G 1981c (RJ) for catch data). Summary tables are also available in each report (for example ADF&G 1981 -Table E.3.2.8 and E.3.2.9). A number of other sites (i.e., selected fish habitat (SFH sites) were also intermittently sampled (see same appendices). Some information on water quality (e.g., temperature, turbidity), discharge, and water surface elevations are available at some sites in addition to the five creeks listed above (Table 5-3).

Results of fish surveys suggest the following major conclusion:

1. Early during outmigration, juvenile coho and chinook were more abundant downstream of Talkeetna than upstream. Towards the end of August, chinook and coho catches increased in the mainstem. In the summer, some fish reared in tributary mouths and sloughs. Coho exhibited strong preference for non-turbid waters and both chinook and coho preferred warmer water conditions.

2. Junvenile chum and pinks were only rarely caught in the lower river. Those that were caught were primarily in sloughs; this is probably a function of collection gear.

3. Rainbow trout were present in small numbers in the lower river and tended to be associated with the clearwater areas near tributary mouths. They overwintered in the mainstem near the mouths of tributaries. Extensive lower river migrations were not apparent from radio-tagging studies

4. Burbot, whitefish, and longnose sucker used some mainstem and side-channel areas for rearing. Catches tended to be very small. Burbot avoided clearwater areas and were mostly associated with the mainstem.

Project-related physical changes in the lower river may have several impacts on resident and juvenile anadromous fish rearing in this reach. A list of potential impacts in order of priority are:

1. Area of hydraulic habitat and cover availability may be increased in the winter and decreased in the summer.

2. Increased stage height and increased probability of side-channel and slough overtopping during ice staging may change availability of overwintering habitat.

3. Increased suspended sediment and turbidity in winter may change the suitability and availability of overwinter habitat in the mainstem, side-channels, and sloughs.

4. Warmer fall-winter temperatures and cooler summer temperatures may have an impact on growth rates.

The ADF&G has analyzed the relationship between mainstem discharge and the availability of hydraulic habitat for juvenile rearing at five lower river Designated Fish Habitat (DFH) sites between June and September (ADF&G 1983d Appendix F Synopsis). This was accomplished by classifying DFH sites into zones (based upon water source, water velocity, and backwater influence). A

habitat index (HI) that could be plotted against discharge was developed by relating catch variations between zones to changes in water surface area of the zones. These results are presented graphically and in tables for juvenile chinook at Goose, Rabideux and Birch creeks (Appendix Table F-13; Figure F-3, F-4, F-5), coho at Sunshine and Birch creeks (Appendix table F-14; Figure 4-7, F-8), sockeye at Birch Creek (Appendix Tale F-15; Figure F-10) and chum at Birch Creek (Appendix Table F-16; Figure F-13). Variations in mainstem discharge changed the relative habitat utilization of each species and there were considerable differences between species (Appendix Figure F-17). Appendix G of the ADF&G 1983d Synopsis report also provided and analysis of major habitat use by species in the summer that incorporated lower river sites (upland slough - whitefish; side sloughs - Rabideux and Birch Creek; side channel - Goose and Sunshine Creeks).

The effects of slough overtopping on winter habitat in the lower river has not been studied. Effects of turbidity on fish behavior at low temperature have not been examined, but a review of literature concerning winter habitats and data on turbidity could be useful in evaluating this. To date, no analyses of growth rate relative to predicted temperature are available, but sufficient knowledge on the subject is available in the literature.

The utilization of lower river habitat for rearing during summer and winter has been documented by ADF&G studies (ADF&G 1981c, ADF&G 1983b - R.J.). But, the relative importance of riverine habitat compared to tributary habitat has not been quantified. Studies that provide the abundance of salmonids in the different habitat types would provide a perspective as to the importance of riverine versus tributary habitat to the fish population.

5.3.2 Information and Study Needs

For initial studies in the step-wise approach, the following information is needed:

TABLE 5-3

SUSITNA HYDROELECTRIC PROJECT
CATCH AND HABITAT DATA FOR RESIDENT AND JUVENILE
ANADROMOUS FISH IN ADF&G REPORTS

DFH Sites	Years	Data
Catch Data	RJ, 1981c, ADF&G	Table E.3.2.8, E.3.2.9, E.3.2.15, E.3.1.4, E.3.1.5, E.3.1.9, E.3.2.1 E.3.2.2, E.3.2.3, Appendix EB.
	RJ, 1983b, ADF&G	3-3-11, B-3-13, 3-13-16, 3-3-18, 3-3-21, 3-3-23, 3-3-32, 3-3-28 Appendix Table 3-A.
Water Quality	AH, 1983c, ADF&G	Appendix 4-D, (pp. 40-44 to 4-D-68), Appendix I (4-I-2 to 4-I-9), Appen.
	AH	
Water Velocity	AH, 1983c, ADF&G	Appendix I (4-I-2 to 4-I-9), Appen. B (Rabideux - 4-b-3).
Discharge, WSEL	AH, 1983c, ADF&G	Appendix A (4-A-46 to 4-A-48) (4-A-173 to 4-A-178)

1. Determination of the species composition, abundance, and timing of riverine habitat utilization by juvenile and resident salmonids during summer and winter.

2. Determination of the relationship between mainstem discharge and availability of suitable rearing habitat for summer and winter periods. Most of the lower river habitat sites that have been studied are located above RM 73. Therefore, information will be needed from habitat sites located further downstream.

3. Determination of the effects of side-channel or slough overtopping as a result of ice staging on habitat utilization and survival of rearing salmonids.

5.3.3 Study Location

Habitat utilization study sites will be stratified to include sampling of the four major riverine habitat types (see Section 3.0) with effort proportioned by river segment according to level of flow related impact. The level of impact among river segments will be determined from results of the lower river morphological assessment study (Section 3.0).

Selection of study sites for determination of the relationship between mainstem discharge and rearing habitat will be based on a stratified sample design. Sites will be stratified on the basis of major habitat type and relative extent of utilization by rearing fish (or proximity to natal spawning area). The level of effort (i.e., number of study sites) will be proportioned within river segments by extent of fish utilization, and between river segments according to the level of flow-related impact.

Habitats representative of the four habitat types that are utilized by rearing fish during winter, and have channel overtopping conditions based on observations during ice formation (R&M 1983, unpublished data) will be selected for studies of overtopping.

5.3.4 Tasks Related to this Component

The following FY85 Aquatic Program tasks, described in detail previously, are related to the completion of this study component:

a) Task 14: Lower river resident and juvenile anadromous fish studies.

b) Task 16B: Outmigrant studies of the lower river.

c) Task 17: Streamflow and flood frequency studies.

d) Task 21: Lower river morphological assessment.

e) Task 24: Lower river ice studies.

f) Task 25: Lower river aggradation

g) Task 31: Lower Susitna stream temperature analysis

h) Task 34: Winter studies of resident and juvenile anadromous fishes.

i) Task 36: Lower river rearing habitat investigations-IFG hydraulic modeling.

5.4 ALTERED JUVENILE OUTMIGRATION PATTERN

5.4.1 Background

The outmigration of juvenile salmonids in the Susitna River has been studied in 1981 and 1982 by the ADF&G (ADF&G 1981c, ADF&G 1983b - R.J.). Limited data are available on the timing of migration, species composition, age structure, and size of outmigrating fish in the lower river. In this reach,

samples were collected with minnow traps, beach seines, and electrofishing gear throughout the spring open water period. Based on these samples plus information from a one smolt trap located above the confluence of the Chulitna River, the general migration timing is known for the middle river. Chinook salmon outmigrants peak during May and June with all age 1+ fish leaving the stream by early August. The coho salmon outmigration also peaks during May and June, but continues throughout the summer to the onset of ice cover. Chum salmon fry rear for one to two months before they outmigrate, most of which occurs during June. The sockeye outmigration is similar to that of chinook with a peak in early July and ending by August. Limited captures of pink fry indicate most fish outmigrate before June.

The relationship between juvenile outmigration and environmental variables (i.e., discharge, water temperature, and day length) was examined for fish emigration from the river above the Chulitna confluence in 1982 (ADF&G 1983d - Appendix H). In general most relationships were significant, but correlation coefficients were moderate to low.

Several physical factors may potentially have a casual relationship with juvenile salmon outmigration. Discharge will effect the travel time of downstream migrants and river stage may influence access of juveniles migrating from sloughs to the mainstem. Spring freshets can displace juveniles resulting in pulses in timing and numbers of outmigrants. In some cases, rearing juveniles may be displaced downstream to the estuary or lower mainstem before reaching a preferred size for migration and smoltification. Survival of the outmigrant population may be dependednt upon the mainstem flow regime. Conceivably, the projected reduction in stream flow during spring as a result of project operation would minimize fish displacements due to flushing flows. On the other hand, reduced flows may increase outmigration travel time.

Turbidity is an important factor in providing cover for outmigrating juvenile salmon. This may be especially important in the Susitna River because periods of darkness (juvenile salmon migrate mostly at night in non-

turbid rivers) are short during spring as a result of the reduction in river discharge (see section on suspended sediment). However the magnitude of change in turbidity in the lower river will be small relative to the naturally high levels. Thus, no changes in fish survival relative to this factor are expected.

5.4.2 Information and Study Needs

Initial studies that are needed to address potential altered outmigration timing are:

1. Determination of the relationship between mainstem discharge and timing of habitat utilization, and types of riverine habitat utilized during the outmigration period.

2. Determination of the relationship between short term (i.e., daily) and longer term (seasonal) mainstem flow fluctuations, and migration timing and travel time of juvenile salmon outmigrants. Other factors such as photoperiod, temperature and size should also be examined.

5.4.3 Study Location

Studies on the timing of habitat utilization and types of habitat utilized during the outmigration period will be conducted at the same sites selected for the juvenile salmon habitat utilization study (Section 5.4.3). Studies or outmigration timing and travel time for the lower river between Cook Inlet and Talkeetna will be evaluated from outmigrant monitoring stations located at Talkeetna (RM 98) and near Flathorn Lake (RM 20).

5.4.4 Tasks Related to this Component

The following FY85 Aquatic Program tasks are related to the completion of this component:

a) Task 16A: Outmigrant studies of the middle river.

b) Task 16B: Outmigrant studies of the lower river.

c) Task 17: Streamflow and flood frequency studies.

6.0 SUMMARY

The intent of this study plan is to outline the study needs and general approach to these needs necessary to resolve questions and issues raised about the lower river. Table 6.1 (a and b) summarizes the physical and aquatic study components for the lower river and briefly describes the initial studies needed to resolve the questions and issues. These studies will be based on the need for additional refinement or may be initiated as a result of previous findings. An important part of all of these studies will be to integrate the biological and physical results to determine if the questions or issues can reasonably be answered with the information available. If they can, no additional studies will be undertaken. If the information is not sufficient, further studies may be warranted if they can reasonably be justified and can achieve a better understanding for resolution of the issue. If further information is needed and can be obtained, then additional (Table 6.1) studies may be implemented. If it is determined that a significant advserse impact potentially exists, mitigation plans will be developed and presented to the resource agencies for discussion. Following these discussions, final mitigation plans will be incorporated into the overall mitigation plan for the project.

TABLE 6.1a - SUMMARY OF STUDY COMPONENTS FOR THE LOWER RIVER

Physical Study Components	Existing Information	Proposed Initial Study(s)	Use for other Components	Potential Other Studies*
1. Lower River Stratification	A. Habitat stratification and classification complete (by use of R&M aerial photos)	A. Determine surface areas for mainstem and slough habitat for various flow B. Determine linear values for tributary mouth habitat for various flow	A. Use for physical and aquatic studies site selection B. Coupled with biological studies to better understand flow versus habitat for impact assessment.	A. Expansion of photo coverage to other flows B. Detailed examination of habitats via photo enlargement
2. Discharge	A. Extensive streamflow data available from USGS. B. Forecasts (through modeling) of with-project flow changes have been made on a monthly basis.	A. Provide flow forecasts on a daily and weekly basis, primarily to look at flood and low flow frequency and duration	A. Coupled with biological studies to determine changes in lower river habitat.	A. None - depends on outcome of step 1 study.
3. Temperature	A. Temperature simulations have been performed by use of HEATSIM and SNIEMP models. B. Predictions have concentrated on some of the open-water months and on data from selected years.	A. Expansion of the simulations to encompass additional months and cover a broader range of years.	A. Temperatures will be coupled with information in the literature, from Susitna studies and personal communications to understand if temperature predictions will results in a signficant impact to existing resources.	A. None - depends on outcome of step 1 study.

TABLE 6.1a - SUMMARY OF STUDY COMPONENTS FOR THE LOWER RIVER
(Continued)

Physical Study Components	Existing Information	Proposed Initial Study(s)	Use for other Components	Potential Other Studies*
4. Suspended Sediment (turbidity)	A. Periodic measurements of turbidity have been made in conjunction with other studies B. Analysis of suspended sediment and turbidity relationships has been used to predict with-project turbidity.	A. Consolidate literature and information on effects of glacially orientated turbidity on aquatic resources.	A. Physical predictions will be used to determine with-project aquatic relationships and responses	A. Limited to existing data collection. Potential for examining other glacial systems if warranted by literature review.
5. Bedload Sediment	A. Measurements of natural bedload sediment and discharge made for the Susitna Basin by the USGS for summer months only	A. Existing suspended and bedload discharge studies will be continued to refine existing data with additional efforts concentrated on locations in the mainstem and near mouths of tributaries and sloughs	A. Physical predictions for with-project conditions will be used to describe potential changes in aquatic habitat.	A. None - depends on outcome of step 1 study.
6. Ice Processes	A. Natural ice processes have been documented for several years to observe formation, ice cover and breakup B. Attempts to use HEATSIM model to predict ice processes was not successful. Therefore, only qualitative data is available.	A. The lower river is considered too complex to extend middle river models into this reach. Therefore, a limited analysis at selected locations is suggested.	A. Information from the ice-processes studies will be used to predict potential impacts on lower river aquatic habitats.	A. None - depends on outcome of step 1 study.

TABLE 6.1 - SUMMARY OF STUDY COMPONENTS FOR THE LOWER RIVER

Biological Study Components	Existing Information	Proposed Initial Study(s)	Use for other Components	Potential Other Studies*
1. Access of Adult Salmon to Spawning Grounds	A. Most spawning appears to be in lower river tributaries. B. Studies on middle river tributaries has shown that downcutting under low flows will still allow access of spawners to tributary spawning sites. C. Little or no adult salmon has been observed in the lower river.	A. Field studies at selected lower river tributaries will be undertaken to assess relationships to flow. B. Extensive observaitons will be made during the late season to determine if mainstem, side-slough or side-channel spawning exists and is significant.	A. The results of these studies will be used to determine if lower river mainstem spawning is significant and if access under with-project conditions would be a potential problem.	A. None - however, if significant mainstem, side-channel, or side-slough spawning is found, additional studies may be warranted - see number 2 under biological components
2. Changes in Availability of Spawning Habitat	A. Little or no adult salmon has been observed in the lower river.	A. Additional observations will be made, particularly during late season.	A. Information will be used to determine significance of spawning habitat, if such habitat exists.	A. If few adult salmon spawning sites are found, no additional studies are warranted. B. If spawning fish are found in significant numbers, additional studies on: i. egg incubation success ii. habitat relationships to mainstem flow iii. other physical studies iv. other biological studies may be warranted.

TABLE 6.1b - SUMMARY OF STUDY COMPONENTS FOR THE LOWER RIVER
(Continued)

Biological Study Components	Existing Information	Proposed Initial Study(s)	Use for other Components	Potential Other Studies*
3. and 4. Changes in Availability of Suitable Rearing and Overwintering Habitat/ Habitat Utilization	A. Extensive sampling has occurred in the lower river in all seasons. Summer work has provided some information on distribution and abundance. Winter sampling has been difficult and few fish have been located.	A. Provide refinement of existing information on distribution and abundance via increased sampling, particularly for the winter period. B. Develop habitat relationships at selected sites (based on previous distribution and abundance studies, habitat stratifications and classification, and other physical studies). These would relate mainstem flow to rearing habitat. Numerous sites would be selected for study with linear regression methods. C. Attempt more extensive sampling for winter period. D. Couple A through C with physical studies to determine potential with-project impacts.	A. Information will be used to determine impact and suggest possible mitigation measures if needed.	A. Will depend on outcome of initial step 1 studies.

TABLE 6.1b - SUMMARY OF STUDY COMPONENTS FOR THE LOWER RIVER
(Continued)

Biological Study Components

Physical Study Components	Existing Information	Proposed Level 1 Study(s)	Use for other Components	Potential Other Studies*
5. Altered Juvenile Outmigration Pattern	A. Limited data are available on timing of migration, species composition, age structure, and size of outmigrating fish. This data was gathered during the 1981 and 1982 field seasons of ADF&G in the lower river.	A. Extensive sampling for distribution and abundance will occur (see 3 and 4 of Aquatic Study Components). As part of this, there would be a mark recapture program at selected sites to determine outmigration patterns survival and growth. Two primary collection sites would be Talkeetna and Flathorn stations where outmigrant traps would be located. B. The information collected would be coupled with information from the physical studies to determine the relationship between mainstem flow and outmigrant timing and travel time.	A. The analysis will be used to determine if significant impact exists.	A. None - the need for additional studies will depend on the outcome of the step 1 studies.

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APPENDIX B

Appendix B

DRAFT

NAVIGATION STUDY PLAN

Navigation and Transportation

Plan of Study

Susitna Hydroelectric Project

Introduction

A key element of the settlement process is the establishment of an acceptable flow regime. An important consideration is the navigability of the river between Devil Canyon and Cook Inlet.

Previous studies have addressed the navigationissues, but several concerns have not been resolved. Of particular concern to resource agencies is navigation in the lower river and access to land disposal areas. Studies of the effect of project operation on navigation in the lower river have been at a reconnaissance level using personal interviews, aerial photographs, topographic maps and miscellaneous stage-discharge and cross section data at Kaswitna Landing, Willow Creek, Alexander Slough and near Talkeetna. More intensive studies have focused on the reach between Devil Canyon and Talkeetna because the percent change in flow in the reach between Devil Canlyon and Talkeetna will be much greater during project operation than in the reach downstream from Talkeetna. Nonetheless, significant flow changes may occur in the Talkeetna to Cook Inlet reach. Since boaters use this reach more frequently than the middle river, the effect of project operation on lower river navigation should be more thoroughly addressed.

Information on use of the river as a winter transportation route and use of the river for float plane access has not been compiled. Additionally, a thorough assessment of utilized areas of the river, boat draft requirements, winter use and float plane access have not been made.

Objectives

Open water navigation

1. Determine the summer use of the river, including who is using the river and why, when the boats are used, the type of boat used, whree the boat was used, the access point, how often the boat was used, and depth requirements for navigation.

2. Discuss navigation difficulties, determine the navigation routes and access points potentially affected by reduced discharges and determine the discharge rage, if any, over which navigation is impacted and the percent of time navigation is affected. This determination is to include the effects of high flows.

3. Discuss historical changes in river morphology. Qualitatively dtermine the project realted morphology changes in the lower river and at the mouths of navigable rivers.

4. If navigable areas are affected by with-project flows, identify users affected and determine mitigation opportunities for various flow scenarios where adverse impacts have been identified.

Winter Transporation

1. Determine winter use of the river as a transporation corridor.

2. Determine the effects of the with-project ice regime on winter use and prepare mitigation plans as appropriate.

Float Plane Usage

1. Determine usage of the river by float planes, the level of with-project impacts and mitigation plans as necessary.

Previous Studies

Environmental Studies - Land Use Analysis, Navigational Use. Terrestrial Environmental Specialists, Inc. April, 1982.

Water Resource Analysis, A Preliminary Analysis of Potential Navigational Problems Downstream Of The Proposed Hydroelectric Dams On The Susitna River. Alaska Dept. of Natural Resources, March 1982.

Susitna Hydroelectric Project Application for License for Major Project, Volume 5A, Exhibit E, Chapter 2 pp E-2-44 to E-2-48, E-2-60, E-2-74, E-2-99, E-2-139, E-2-173, Alaska Power Authority, February 1983.

Fish Ecology - A Survey of Questions and Concerns Pertaining to Instream Flow Aspects of The Proposed Susitna Hydroelectric Project. L.P. Dwight and E.W. Trihey, May 1981.

Fish Ecology - Instream Flow Assessment For the Proposed Susitna Hydroelectric Project - Issue Identification and Baseline Data Analysis - 1981 Summary Report, E.W. Trihey, March 1982.

Study Area

Portage Creek to Cook Inlet with emphasis on the reach between Talkeetna and Cook Inlet.

Description of Methods

Open Water Navigation

1. Summer Use. ADF&G Sportfish will undertake a creel survey this summer. It is proposed that this survey be expanded to include a survey of navigatio use of hte river and be extended through September 30, 1984. Surveys will be taken at the following main

access points: Talkeetna (River Mile (RM) 97), Sunshine Bridge at the Parks Highway (RM 84), Kashwitna Landing (RM 61), and Willow Creek (RM 49).

The survey will collect data pertaining to the access point, date, names and addresses of those using the river, the purpose (recreational, commercial or subsistence fishing, hunting, other recreational uses, transportation to land disposal areas, trapping, movement of commercial supplies, guide boat operations, etc), destination, duration of trip, type of craft and type of engine (propeller, jet unit, airboat), frequency of use, navigational difficulties encountered and number of people in the party.

A survey of lodge operators and land owners will be completed to determine their frequecy of navigation use. Periodic aerial overflights will be made to further document navigation use and to determine if additional boat access points are being employed. This will be done in connection with the survey of float plane use.

2. Identification and Quantification of Navigation Impacts. During 1983, sets of aerial photographs were taken of the lower river when discharges at the Susitna River at Sunshine gage were 56,500 cfs, 37,500 cfs, 22,000 cfs and 13,600 cfs. These aerial photographs will be used to help identify locations where potential navigation problems might exist during with-project flow conditions.

Routes from the major access points to fishing and hunting areas, land disposal areas, lodges, navigable tributaries, trapping areas areas, scenic locations, etc. will be indentified on the set of aerial photographs corresponding to the 13,600 cfs discharge at the Sunshine gage. From this set of photographs, routes which

have dewatered reaches, flow control points and other eaches not dewatered byt where navigation could be restricted, will be identified. For those aras which are dewatered at 13,600 cfs, the flow at which the reach becomes watered (i.e. either from backwater or overtopping of a flow control point) will be determine from a comparison of the aerial photographs at the mainstream discharges and the location of the flow control identified.

When flow conditions permit, cross section surveys will be made at the flow control points. Thalweg profiles will be measured for some distance downstream from the cross section to determine the bed slope. At those sites where stage-discharge data are not available, staff gages will be installed and readings taken at flows spanning the range of natrual and with-project conditions. At least five flow conditions will be observed. It is anticipated that flows from 10,000 cfs to 70,000 cfs as measured at the Sushine gaging station will be monitored. At high flows, estimates will be made of the surface velocity to determine if high velocities possibly restrict navigation.

The rating curves, cross section surveys, and thalweg profiles will be used, with navigation depth requirements obtained from the user survey, to determine the discharges over which navigation diffuculties would be encountered. This information will be integrated with the monthly open water rating curves to determine the percent of time navigation will be affected during natural and with-project flow scenarios. Emphasis will be on the lower river, but middle river locations will be investiagted where potential navigation difficulties have been identified.

Since reduced river discharges could restrict travel upstream in to sloughs and side channels, the effects on the ability of boaters to reach their final destination will be assessed if such

areas are used extensively. The additional distance that boaters must travel by means other than boat to reach their destinations will be important to lodge operators and land owners.

3. Navigational Effects of Morphological Changes. Based on the following references, morphological changes in the mainstem Susitna river and at major tributary mouths will be quantitatively assessed to determine the impact on navigation depths:

   Susitna Hydroelectric Project River Morphology. R&M Consultants, January 1982.

   Sediment Discharge Data For Selected Sites In the Susitna River Basin, Alaska, 1981-82. U.S. Geological Survey Open-file Report, 1983.

   Susitna Hydroelectric Project Reservoir and River Sedimentation. Harza-Ebasco, 1984.

4. Mitigation of Summer Navigation. For specific alternative flow regimes where navigation difficulties are identified, mitigation opportunities will be identified. Options such as information centers, channel maps, channel marking and dredging will be investigated as possible mitigation measures.

Winter Use

Based on an aerial reconnaissance of the Susitna River, personal interviews and a survey of residents, a determination of winter use of the river will be made. The following information will be collected: crossing locations, use as a transportation to land disposal areas), and method of transportation (snow machine, all terraine cycle, skis, snow shoe, sled dog, vehicles, etc.).

The prediction of the with-project ice regime will be used to assess the impact on winter use of the Susitna River as a transportation corridor. Appropriate mitigation plans will be formulated as necessary.

Float Plan Access

Periodic overlfights will be made of the Susitna River to document float plane use of the river. This will be supplemented with surveys of pilots to determine areas of use, frequency of use and purpose. Based on the sets of aerial photographs, with-project impacts on the areas of float plane use will be estimated and mitigation plans developed.

Coordiantion Requirements

Field data collection will be coordinated with the Alaska Department of Fish and Game and R&M Consultants. The studes will be coordinated with the lower river sediment studies, tributary fish access studies, and the lower river streamflow and flood frequency studies.

Schedule

A draft of the navigation and transportation report will be completed by November 30, 1984 with the final report scheduled for completion on February 28, 1985.

APPENDIX C

APPENDIX C

Resource Agency Comments

on Draft Plan of Study

and

Power Authority Responses

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ALASKA POWER AUTHORITY

334 WEST 5th AVENUE - ANCHORAGE, ALASKA 99501

Phone: (907) 277-7641
(907) 276-0001

July 31, 1984
Susitna File 1.8.1/6.18.5.2

Alaska Department of Fish and Game
P.O. Box 3-2000
Juneau, Alaska 99802

Attention: The Honorable Donald W. Collinsworth

Subject: Susitna Hydroelectric Project
Comments on Aquatic Workshop 2

Reference: Your letter of April 19, 1984

Dear Commissioner:

The Alaska Power Authority appreciates your staff attending Aquatic Workshop 2 and providing constructive comments and suggestions. We have reviewed your comments on the workshop and on the Aquatic Program Draft Plan of Study for FY85.

Enclosed for your information is a summary of the workshop. We are currently finalizing the study plans for FY85 which will incorporate your suggestions for revising the study plan.

Among your suggestions is a matrix which describes what studies will be used to support the various issues delineated in our letter of March 6, 1984. This matrix will be distributed at Aquatic Workshop 5 (Water Quality) to be held August 6, 1984.

Also, you requested a flow chart which related the planned studies to each other and to previous studies. These flow charts are being developed and will be incorporated into the final plan of study.

Since the majority of your comments refer to specific suggestions for revision of the plan of study, we are not responding to each of your comments at this time. However, the revised plan of study will reflect your comments as well as those received from other agencies and workshop participants.

If you have questions regarding the Plan of Study, please contact Mr. Jon Ferguson (279-6611).

Sincerely,

Larry D. Crawford
Executive Director
Alaska Power Authority

whs

Enc: as noted

cc: w/ Enc:
R. Fleming, Power Authority
W. Larson, HE
J. Thrall, HE
L. Gilbertson, HE

ALASKA POWER AUTHORITY

334 WEST 5th AVENUE - ANCHORAGE, ALASKA 99501

Phone: (907) 277-7641
(907) 276-0001

July 31, 1984
Susitna File 1.8.1/6.18.5.2

U.S. Fish and Wildlife Service
1011 East Tudor Road
Anchorage, Alaska 99503

Attention: Dr. Robert Putz

Subject: Susitna Hydroelectric Project
Comments on Aquatic Workshop 2

Reference: Your letter of April 28, 1984

Dear Dr. Putz:

The Alaska Power Authority appreciates your staff attending Aquatic Workshop 2 and providing constructive comments and suggestions. We have reviewed your comments on the workshop and on the Aquatic Program Draft Plan of Study for FY85.

Enclosed for your information is a summary of the workshop. We are currently finalizing the study plans for FY85 which will incorporate your suggestions for revising the study plan.

Among your suggestions is a matrix which describes what studies will be used to support the various issues delineated in our letter of March 6, 1984. This matrix will be distributed at Aquatic Workshop 5 (Water Quality) to be held August 6, 1984.

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Sincerely,

Larry B. Crawford
Executive Director
Alaska Power Authority

whs

Enc: as noted

cc: w/ Enc:
R. Fleming, Power Authority
W. Larson, HE
J. Thrall, HE
L. Gilbertson, HE

ALASKA POWER AUTHORITY

334 WEST 5th AVENUE - ANCHORAGE, ALASKA 99501

Phone: (907) 277-7641
(907) 276-0001

July 31, 1984
Susitna File 1.8.1/6.18.5.2

National Marine Fisheries Service
P.O. Box 1660
Juneau, Alaska 99801

Attention: Mr. Robert W. McVey
Director, Alaska Region

Subject: Susitna Hydroelectric Project
Comments on Aquatic Workshop 2

Reference: Your letter of April 17, 1984

Dear Mr. McVey:

The Alaska Power Authority appreciates your staff attending Aquatic Workshop 2 and providing constructive comments and suggestions. We have reviewed your comments on the workshop and on the Aquatic Program Draft Plan of Study for FY85.

Enclosed for your information is a summary of the workshop. We are currently finalizing the study plans for FY85 which will incorporate your suggestions for revising the study plan.

Among your suggestions is a matrix which describes what studies will be used to support the various issues delineated in our letter of March 6, 1984. This matrix will be distributed at Aquatic Workshop 5 (Water Quality) to be held August 6, 1984.

Also, you requested a flow chart which related the planned studies to each other and to previous studies. These flow charts are being developed and will be incorporated into the final plan of study.

Since the majority of your comments refer to specific suggestions for revision of the plan of study, we are not responding to each of your comments at this time. However, the revised plan of study will reflect your comments as well as those received from other agencies and workshop participants.

If you have questions regarding the Plan of Study, please contact Mr. Jon Ferguson (279-6611).

Sincerely,

Larry D. Crawford
Executive Director
Alaska Power Authority

whs

Enc: as noted

cc: w/ Enc:
R. Fleming, Power Authority
W. Larson, HE
J. Thrall, HE
L. Gilbertson, HE

ALASKA POWER AUTHORITY

334 WEST 5th AVENUE - ANCHORAGE, ALASKA 99501

Phone: (907) 277-7641
(907) 276-0001

July 31, 1984
Susitna File 1.8.1/6.18.5.2

Alaska Department of Natural Resources
3601 C Street
Pouch 7-005
Anchorage, Alaska 99510

Attention: Ms. Margaret J. Hayes
District Manager

Subject: Susitna Hydroelectric Project
Comments on Aquatic Workshop 2

Reference: your letter of April 23, 1984

Dear Ms. Hayes:

The Alaska Power Authority appreciates your staff attending Aquatic Workshop 2 and providing constructive comments and suggestions. We have reviewed your comments on the workshop and on the Aquatic Program Draft Plan of Study for FY85.

Enclosed for your information is a summary of the workshop. We are currently finalizing the study plans for FY85 which will incorporate your suggestions for revising the study plan.

Among your suggestions is a matrix which describes what studies will be used to support the various issues delineated in our letter of March 6, 1984. This matrix will be distributed at Aquatic Workshop 5 (Water Quality) to be held August 6, 1984.

Also, you requested a flow chart which related the planned studies to each other and to previous studies. These flow charts are being developed and will be incorporated into the final plan of study.

Since the majority of your comments refer to specific suggestions for revision of the plan of study, we are not responding to each of your comments at this time. However, the revised plan of study will reflect your comments as well as those received from other agencies and workshop participants.

If you have questions regarding the Plan of Study, please contact Mr. Marchegiani (279-6611).

Sincerely,

Jon S. Ferguson
Project Manager
Susitna Hdroelectric Project

whs

Enc: as noted

cc: w/ Enc:
R. Fleming, Power Authority
W. Larson, HE
J. Thrall, HE
L. Gilbertson, HE

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

SUMMARY OF PROCEEDINGS

Aquatic Workshop 2

March 30, 1984

Held at Suite 201

711 H Street

Anchorage, Alaska

Aquatic Workshop 2, was convened on March 30, 1984 by the Alaska Power Authority to discuss the draft plans of study to be conducted by the Susitna Aquatic Study Team during Fiscal Year 1985. The draft plan of study (Doc 591) was distributed to the resource agencies prior to the workshop.

Representatives from Alaska Department of Fish and Game, Alaska Department of Natural Resources, Alaska Department of Environmental Conservation, National Marine Fisheries Service, U.S. Fish and Wildlife Service and U.S. Geological Survey attended the Workshop. A complete list of Attendees is provided as Attachment 1.

The workshop was opened by Mr. Marchegiani of the Alaska Power Authority who introduced the participants and presented a brief outline of the agenda for the workshop. Mr. Marchegiani then discussed the FERC licensing schedule, the settlement process and how these fit into the long-term goals of the Power Authority.

Using the long-term goals as a guide, the approach for developing the FY85 study tasks for the aquatic study program was discussed. The framework for prioritization of the study tasks was presented.

Mr. Marchegiani then opened the workshop to general comments from the agency representatives on the specific study tasks presented in the draft study plan. General comments pertaining to the study tasks were as follows:

a. Several agency representatives requested a "road map" be incorporated into the study plan which provided some logic to the interrelationship among study tasks. This road map should identify for each task what the technical goals are, what issues would be affected and at what point agencies would be involved in the study process.

b. Some confusion was expressed by agency representatives as to how the settlement process would be accomplished. What information will agencies have, when will they get it, what is the sequence of topics and how detailed will the topics be for discussion?

c. Where in the process will the "economics of fishery losses" be considered? Who will be responsible for determining the value of the fish?

d. Questioned idea of enhancement of habitats as part of the mitigation planning process.

e. Generally favorable comments were made toward the lower river study plan. Requested more detailed study plan and made some suggestions as to some omissions in the plan which should have been included.

f. Several representatives requested that the participants in each task be identified in the final study plan.

g. Numerous specific comments were made pertaining to specific tasks. These included requests for clarification and suggestions for including some aspects which were omitted.

Mr. Marchegiani closed the workshop with a request for formal written comments on the Study Plan and Workshop from the resource agencies.

ATTACHMENT 1

Aquatic Workshop 2

Attendees

Name	Organization
Eric A. Marchegiani	Alaska Power Authority
J. H. Thrall	Harza-Ebasco
Steve Bredthauer	R & M
Ken Florey	Fish & Game
David Watsjold	Fish & Game
Bob Cambe	USGS
Jim Knott	USGS
Woody Trihey	EWT&A
Erwin Van Nieuwenhuyse	EWT&A
Gary Stackhouse	FWS
John Bizer	Harza-Ebasco
Jack Robinson	Harza-Ebasco
Don Beyer	Harza-Ebasco
Pam Bergmann	Harza-Ebasco
Gary Prokesch	ADNR-Water
Brad K. Smith	NMFS
Dale Herter	LGL
Bill Steigers	LGL
Dana Schmidt	Fish & Game
Don McKay	ADF&G Habitat
Carl Yanagawa	ADF&G Habitat
Lenny Corin	USFWS
Bill Wilson	AEIDC
Ken Voos	AEIDS
Mike Prewitt	AEIDS
Allen Bingham	ADF&G
Steve Zrake	ADEC
Larry Moulton	Woodward-Clyde
Tom Stuart	Harza-Ebasco
Robert Sener	LGL
Tom Arminski	Alaska Power Authority
Christopher Estes	ADF&G/Su Hydro.
E.J. Gemperline	Harza-Ebasco
Richard S. Fleming	Alaska Power Authority
Tom Trent	ADF&G/Su Hydro
Larry Gilbertson	Harza-Ebasco

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

SUMMARY OF PROCEEDINGS

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Steve Bredthauer	R & M
Ken Florey	Fish & Game
David Watsjold	Fish & Game
Bob Cambe	USGS
Jim Knott	USGS
Woody Trihey	EWT&A
Erwin Van Nieuwenhuyse	EWT&A
Gary Stackhouse	FWS
John Bizer	Harza-Ebasco
Jack Robinson	Harza-Ebasco
Don Beyer	Harza-Ebasco
Pam Bergmann	Harza-Ebasco
Gary Prokesch	ADNR-Water
Brad K. Smith	NMFS
Dale Herter	LGL
Bill Steigers	LGL
Dana Schmidt	Fish & Game
Don McKay	ADF&G Habitat
Carl Yanagawa	ADF&G Habitat
Lenny Corin	USFWS
Bill Wilson	AEIDC
Ken Voos	AEIDS
Mike Prewitt	AEIDS
Allen Bingham	ADF&G
Steve Zrake	ADEC
Larry Moulton	Woodward-Clyde
Tom Stuart	Harza-Ebasco
Robert Sener	LGL
Tom Arminski	Alaska Power Authority
Christopher Estes	ADF&G/Su Hydro.
E.J. Gemperline	Harza-Ebasco
Richard S. Fleming	Alaska Power Authority
Tom Trent	ADF&G/Su Hydro
Larry Gilbertson	Harza-Ebasco

5619

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 1668
Juneau, Alaska 99802

April 17, 1984

LARSON
POLIVKA
VAN PATTEN
THRALL
GILBERTSON | GEMPERLINE
ROBINSON | FILES
BIZER
DYOK

Susitna File # 6.18.S.2/
6.18.4.7

Mr. Jon S. Ferguson
Alaska Power Authority
334 West 5th Avenue
Anchorage, Alaska 99501

Dear Mr. Ferguson:

We attended Workshop No. 2 of the Susitna Hydroelectric project and are providing our comment on this effort and the draft Aquatic Plan of Study FY 85 as requested in your March 9, 1984, letter.

Workshop Comments:

The general format of the second workshop was less formal than the first which we felt better facilitated discussion and the open exchange of ideas and opinions. It was apparent that many of the participants were not thoroughly familiar with the documents at hand and were not prepared to present specific concerns or recommendations on the fifty-four FY 85 tasks nor Appendix A, the Lower River Plan of Study. This might be attributed to the workload of the participants, many of whom have several responsibilities in addition to the Susitna Project, the volume of material presented, and the time available to have read this material. The Alaska Power Authority staff should take this into consideration for upcoming workshops and scale down the scope of discussions or make more time available for participants to review pertinent documents. When appropriate, specific agenda should be prepared and distributed prior to the workshops. This would give participants a list of topics to be discussed and allow for a more effective workshop. Some participants may be unable to devote a full day to each workshop and may wish to allocate their time according to the agenda. Because of this, the workshop agenda should be followed as closely as possible.

General Comments, Draft Aquatic Plan of Study FY 85:

We believe that the study tasks described in the Plan of Study would effectively support the overall study effort as it concerns project licensing and post-license impact assessment, mitigation, and monitoring. It is necessarily dependent upon the successful completion of on-going studies to describe such processes as up-welling, reservoir temperature structure, river ice, and other technical reports described under the various tasks. Much of the FY 85 task effort is intended to facilitate project licensing by providing information and support for the settlement process. Because the tasks and the

workshops are intimately linked to this process, the draft Plan of Study should describe the overall process whereby these various tasks will congeal into a discreet analysis of project impacts, mitigation, and monitoring.

We are concerned that many of the tasks described as levels 3 or 4 are unlikely to be funded, thereby hindering or delaying settlement. It would be valuable to show the linkage of these studies to other tasks and the settlement process. Also, the investigators responsible for each task should be clearly identified in the Plan of Study.

We feel that Appendix A, the Lower River Plan of Study, is a necessary step towards providing comprehensive knowledge of the Susitna River System and the impacts attributed to the two-dam project. As identified at Workshop 2, this effort should include an assessment of access to tributaries and an analysis of impact to sport fisheries located at the tributary mouths. We agree with the Plan of Study in classifying Lower River tasks as levels 1 and 2.

Finally, it is evident that few of these tasks will be available prior to publication of the Final Environmental Impact Statement, currently scheduled for December 1984. Certain critical documents, e.g., the Recommended Flow Regimes Report, which would support the Environmental Hearings scheduled for February 1985 will also not be available at that time. Thus, while we have stated our acceptance of a program which involves continuation of necessary studies during the license review and post-licensing periods, we believe that the results of many of these FY 85 tasks must be available to agencies in sufficient time to assist in settlement and the preparation of specific licensing conditions.

Specific Comments - Draft Aquatic Plan of Study FY 85:

Task 3 - An effort should be made to maintain a level of coordination with the concerned resource agencies, beyond that provided through the workshop process. Early coordination on the Plan of Study for FY 86 would be valuable.

Task 4A - The investigators responsible for the various technical reports should be identified. The watershed processes report, which will describe changes in upwelling, would seem to be dependent upon tasks 30 and 50; Tasks for which the described schedules do not mesh and which may not be funded (level 4). How does this task link or depend on others? What would be gained or lost if these supporting studies are not completed?

Task 4B - The evaluation species referred to should be described. The resource agencies have disagreed with those species earlier proposed for this purpose. Also, with whom must the analytic techniques be jointly developed?

Task 5A - The procedure described should allow for a strong foundation from which flow negotiations can occur. It is apparent that the process described involves various iterations and sub-routines which consider such factors as navigation, riparian habitat, water quality, temperatures, and ice processes in addition to selection of "trade-offs" among various species or life history stages in selecting an optimal environmental flow regime. We are concerned that this process would not include agency input until the recommended flow regimes report (Task 6) has been formulated. Discussions at

workshop 2 indicated that the agencies would be provided with the various habitat relationships from which a recommended flow regime would be jointly developed. The method described in Tasks 4, 5, and 6 implies a minimum of agency involvement and, in effect, a pre-selection of those flows which will be analyzed for power costs. We recognize the importance of developing an acceptable flow regime in avoiding or minimizing hearings and therefore suggest that the Plan of Study describe this process in detail. It would seem that a circular process would be most effective, wherein a flow regime is formulated using the output from tasks 4A and 4B and then input into the power analysis. Flows which prove to be economically unfeasible could then be re-formulated using the aquatic species criteria, and again analyzed against power costs.

Task 7 - A draft report scheduled for May 1, 1985, may not be realistic. This would be attainable only if a flow regime could be agreed upon immediately after release of the recommended flow regime report (Task 6).

Task 10 - This task seems to be dependent, in part, on Task 37. This linkage should be discussed and, as Task 37 is a level 3 effort, the consequences of it not being completed should be explained. Task 48 (level 4) would also appear to be linked closely to this task and should be discussed. In past correspondence we have stressed our concern for development of mitigative measures for fishery related impacts. The regulations of the Council on Environmental Quality and the Federal Energy Regulatory Commission (FERC) are specific on the subject, requiring information which, as of this time, remains unavailable. If our review of the environmental statements shows that the level of detail concerning mitigation has not been significantly advanced from those discussions presented within the FERC license application, we would anticipate finding the document to be inadequate. Thus, in addition to study efforts to identify mitigation opportunities, this task should specify preparation of detailed plans for mitigation features and associated costs for construction, operation, and maintenance. Without such details, the costs of mitigation could not be factored into the Economic and Environmental Comparisons Process as described under Task 5A. These considerations, therefore, would appear to relate to Task 5A, and the linkage between the two tasks should be discussed.

Task 12 - The schedule for this task is considerably behind that of Task 8, and would, therefore, not support the flow recommendation report. How does this task differ from Task 4A? Could it have been included under Task 4A?

Task 14 - We feel this task will be one of the most important study efforts concerning the lower Susitna River. The use of the mainstem by overwintering resident and juvenile fish species is particularly important as the task description points out "The flow regime during winter may be beyond natural fluctuations of the system with several times the amount of water flowing through this reach of the river." Yet this study is presently designed to investigate only the open water season. What efforts, if any, will be made to define the use of this reach during the ice covered season? If empirical data cannot be provided, would this task include an analysis of wintertime post-project habitat changes based upon flow regimes, turbidity projections, anticipated temperature changes, and changes in ice formation and breakup?

Task 18 - The schedule of this task would not allow for rationale Nos. 1 or 2 to be met.

Task 20 - If load following is to be considered, we do not believe it is appropriate to minimize the scope of this analysis by assuming a single demand structure or that such operations would occur only during summer months. A worst-case analysis should be done using maximum ramping rates during critical periods when flow fluctuations are normally minimal.

Task 29 - How does this interact with Task 12?

Task 30 - Is this task linked with Task 50? If so, both should be placed in the same category (level 2). No schedule is provided for this task.

Task 39 - We believe that completion of this task is essential to development of specific licensing conditions and, therefore, to project licensing itself. We question the designation of this task as level 3.

Task 54 - How does this task interact with Tasks 30 and 50?

Appendix A, Lower River Study Plan - It is not clear how the Lower River Study Plan interacts with those FY 85 tasks associated with the lower river. Page A-5 of the Study Plan says that the physical and biological data will be analyzed and integrated for assessing the adequacy of results to resolve impact issues and determine if further resolution and studies are warranted, yet we do not find a specific FY 85 task which would perform this analysis. The Lower River Study Plan often states that a particular study will be required or completed in FY 85, yet does not go on to reference the particular FY 85 task which addresses that study effort. This makes it difficult to assess the Study Plan. What level of understanding would be achieved through the FY 85 studies? Would all of the FY 86 studies be dependent upon the initial analysis or would certain studies be continued for several seasons?

We will continue to provide input to the study effort and the settlement process and appreciate this opportunity to comment on the draft Aquatic Plan of Study FY 85.

Sincerely,

Robert W. McVey
Director, Alaska Region

Responses to Comments of National Marine Fisheries Service

Comment: Lack of thorough familiarity with documents discussed at workshop.

Response: The letter and documents were transmitted on March 19, 1984. It is acknowledged that this was not the full two week lead time for providing materials in advance of the workshop. However, we feel that the 10 days advance should have been sufficient to enable scheduling of review of the documents prior to the workshop. In the future, an attempt will be made to provide the documents at least two weeks in advance of the workshop.

Comment: Specific agenda should be transmitted in advance of workshop.

Response: In general, this has been done. For a workshop in which there is an expectation for considerable input from agency personnel, it is not as possible to provide specific agenda items or to schedule discussions of specific topics.

Comment: Need for discussion of how study tasks relate to one another to complete the analysis.

Response: A flow chart depicting the interrelationships of various study tasks is provided in the final FY85. Aquatic Plan of Study.

Comment: Funding of Levels 3 and 4 Tasks is unlikely and therefore could hinder settlement process.

Response: Funding was received to cover study tasks through Level 3. Further discussion within the study team of the study tasks has led to combining of some similar tasks and elimination of others. The final FY85 Plan of Study reflects these decisions.

Comment: Assessment of access to tributaries and analysis of sport fisheries in lower river.

Response: The assessment of salmon access to tributaries is covered in Task 28. Locations of tributary mouth areas and extent of clear water plumes, which are areas in which sport fishing pressure is highest, will be documented in the Lower River Habitat delineation (Task 21).

Comment: Availability of Reports in sufficient time for licensing and settlement processes.

Response: Information to be included in the reports will be dissiminated as it becomes available. For the most part, the currently available data are sufficient to complete the licensing and settlement processes. Additional data and analyses are being performed to refine the existing data bases and provide more accurate assessments of anticipated effects.

Comment on Task 3: Maintenance of coordination with agencies.

Response: Coordination with agencies on progress of existing studies and development of further studies is a prime goal of Task 2 rather than Task 3.

Comment on Task 4A: Investigators responsible for technical reports.

Response: This is included in the Plan of Study.

Comment on Task 4A: Dependence of reports on other tasks.

Response: The instream flow relationships report series will initially rely on information obtained prior to June 1984. Results of 1984 summer studies will be used to revise the reports as the information becomes available.

Comment on Task 4B: Specification of Evaluation Species and joint development of analytical techniques.

Response: This task has been combined with Task 4A. The evaluation species are presented in the License Application with the exception that it now includes sockeye salmon.

Comment on Task 5: Does not allow for input from agencies.

Response: Alternative flow regimes will be developed by the aquatic program study team to begin the comparisons process. Agency participation in the comparisons process will be pursued and encouraged by the Power Authority. Flow preferences or refinements preferred by the agencies will be included in the process for evaluation. The comparison report will provide a detailed discussion of how the regime were selected for evaluationand present results.

Comment on Task 7: Schedule unrealistic.

Response: The impact assessment report will be drawn from the appropriate instream flow reports and the comparisons report. The assessment will consist of summarizing effects pulled from the other reports.

Comment on Task 10: Dependence upon other study tasks.

Response: Task 10 provides for a continuing planning effort. The first intensive report will provide additional detail based upon information obtained since the license application was submitted.

The second interim report will rely upon information obtaied in other study tasks to be conducted during FY85.

Comments on Task 12: Schedule does not allow inclusion in Task 4 reports.

Response: Data obtained in this study will be incorporated into the instream flow reports as they become available. These results will be used to further refine the Task 4 reports.

Comments on Task 14: Inclusion of studies of lower river overwintering by residents and juvenile anadromous.

Response: This task is specifically designed for the open water season. Winter resident and juvenile studies are discussed in Task 34. The feasibility of winter studies still remains a question. Your suggestons of methods for studying overwintering habitats would be welcomed by the Aquatic Study Team.

Comment on Task 18: Schedule conflicts to allow for rationale No. 1 and 2.

Response: Data obtained during these studies will be available for use in preparing responses. The formal reports will not be available.

Comment on Task 20: Minimization of the scope of this task.

Response: This is designed to investigate only one scenario merely as representative of the effects of load following operation. Load following operation is not currently proposed as an operating scenario for the project.

Comment on Task 29: Interaction with Task 12.

Response: This will be used as a basis for extrapolation of the Task 12 results to the remainder of the river. It will also serve to refine the analysis. Task 12 is based principally on the physical environment. Task 29 will address the biological component.

Comment on Task 30: Linkage with Task 50.

Response: Agreed. These studies are incorporated into Task 30.

Comment on Task 39: Importance of this task does not warrant Level 3 designation.

Response: The study has been funded.

Comment on Task 54: Interaction with Tasks 30 and 50.

Response: This task was described as a more detailed component of Task 30. It was decided that this detail was not essential and sufficient funding for this task was not available. It has been dropped from the final plan.

Comment on Appendix A: Intentions of the study tasks and the Lower River Plan.

Response: A flow chart depicting the relatioships among lower river study tasks is provided in the final plan. Results of the lower river studies will be incorporated into an update or appendix of the Instream Flow Relationship Report. In this form the results will be available for use in the aquatic impact assessment and mitigation plan reports. Since the option of flow regulation to avoid or minimize adverse effects to lower river habitats is not feasible, the results will be used directly in planning measures to rehabilitate or replace lost aquatic resources.

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Robinson

STATE OF ALASKA

BILL SHEFFIELD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF LAND AND WATER MANAGEMENT
SOUTHCENTRAL DISTRICT

3601 C STREET
POUCH 7-005
ANCHORAGE, ALASKA 99510-7005
PHONE: (907) 276-2653

April 24, 1984

Susitna File # 2.1.2.5.2/6.1.1.8.4.1

RECEIVED
APR 24 1984
ALASKA POWER AUTHORITY

Jon S. Ferguson
Project Manager
Susitna Hydroelectric Project
334 West 5th Avenue
Anchorage, Alaska 99501

Re: Review Aquatic Plan of Study

Dear Mr. Ferguson:

Thank you for the opportunity to comment on your FY85 Aquatic Plan of Study for the Susitna Hydroelectric Project. Our comments concerning this plan of study are as follows:

1. The document for review should reach the reviewing party no later than two weeks prior to the scheduled workshop. This will allow adequate time for initial review and gathering of notes and questions.

2. Each task outlined in the FY85 Aquatic Plan of Study should show how it relates to the other tasks and how all tasks are linked to the overall evaluation process. This point was also addressed during the March 30, 1984 workshop.

3. The study tasks outlined in the FY85 Aquatic Plan of Study appear to cover all the concern expressed by DL&WM in the past. The actual work within each of these tasks was described in more detail during the March 30th workshop. This workshop was very helpful in relating one task to another and the overall process used to link all task. We have no futher comments on tasks 1 - 54. It would be helpful if the Final Aquatic Plan of Study was revised after the budgeting allocation process has been completed and you actually know which levels of work will be accomplished during FY85.

4. I am pleased to see that considerable time and effort will be put into studies of the lower river. The Lower River Study Plan (Appendix A of the Aquatic Plan) is intended to provide guidance and a general framework to plan and coordinate additional studies as needed. I assume the "as needed" will be definded in the initial studies process. It is understood that if the initial studies on the lower river answer the questions concerning operation of the Su-Hydro Project as expressed in our comments on the Exhibit E, of the FERC License Application, no additional studies will be needed.

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5. The only comments we have concerning the Navigation and Transportation Plan of Study (Appendix B of the Aquatic Plan) are as follows:

   a) Objective #1 should define the word "navigation" so that all agencies and interested parties agree that the definition used expressed their needs. The study should identify those flow rates required by the average Susitna boater to safely navigate the river in areas of traditional transportation and recreation activity.

   b) Throughout the Navigation Plan of Study, the phrase "with project flows" is used. We are assuming that these flows are a range of flows to be studied in order to determine which would be the most economical, taking into account navigation and transportation needs.

Please include these comments as part of the FERC EIS document.

Sincerely,

Margaret J. Hayes

Margaret J. Hayes
District Manager

Responses to Comments of Alaska Department of Natural Resources

Comment 1: Advance receipt of document.

Response: Noted and agreed. In the future, every attempt will be made to assure your receipt of documents at least two weeks in advance of the workshop.

Comment 2: Relationships among tasks.

Response: Flow charts depicting the iterrelationships among tasks are included in the final Plan of Study.

Comment 3: Adequacy of study plans and determintion of which tasks will be funded.

Response: The Final Plan of Study describes all work which has been funded.

Comment 4: Adequacy of Lower River Studies

Response: None needed.

Comment 5a: Objective No. 1 should define navigation.

Response: Comment noted. All levels of navigation and potential effects of the project flow regime will be addressed in the analyses pesented in the final report.

Comment 5b: Use of the phrase "with-project flows."

Response: We concur with your assumption. A range of flows will be investigated. Specific effects of "the with-project flows" will be evaluated during the comparisons process.

Responses to Comments of Alaska Department of Fish and Game

Comment: Provision of flow chart or matrix depicting interrelationships of study tasks.

Response: A flow chart depicting the interrelationships of tasks has been added to the Plan of Study. Also a matrix of the relationship between study tasks and settlement issues has been incorporated into the Plan of Study.

Comment: Level of effort for each study task and identification of contractors responsible for completion.

Response: The Contractors responsible for completing each of the tasks are identified in each task description. Level of effort and funding levels are available at the Power Authority.

Comment: Provision of data collected during FY85 to agency personnel.

Response: As data and analytical reports are developed, agency personnel will be provided copies of the reports. Discussion of these documents will be solicited through the Task 2, Workshop and Issue Settlement Process, activities.

Comment: Identification of tasks to be conducted during FY85 under approved level of funding.

Process: The tasks described in the Final Plan of Study will be conducted.

Comment on Task 4B: Expansion of task description.

Response: As a result of discussion at the workshop and subsequent aquatic study team discussion, the specific activities of this task have been integrated into the Task 4 description in the Final Plan of Study.

Comment on Task 12: Clarification of task objective.

Response: The description of the Task 12 objective has been revised.

Comment on Task 14: Inclusion of lower river winter studies.

Response: The Power Authority agrees. However, the feasibility of conducting such studies and the possible methods to conduct the appropriate analyses is still questionable. Suggestions of methods for conducting winter studies would be welcomed.

Comment on Task 16B: Need for outmigrant studies on East side tributaries.

Response: Comment noted and we concur. The need for studies of outmigrants from east side tributaries will be determined after results obtained from FY85 studies have been reviewed.

Comment on Task 21: Need for ground truthing of aerial photographs.

Response: Groundtruthing of aerial photographs is part of the data collection and analytical processes.

Comment on Task 28: Consideration of tributary mouth habitats as holding areas for migrating salmon.

Response: Response of tributary mouth habitat areas to mainstem discharge will be addressed as part of this task using results obtained from Task 21.

Comment on Task 34: Expansion of winter studies to reach below Talkeetna.

Response: The studies described in Task 34 are for the middle reach. Expansion of these studies to the lower river will be determined based upon the success of these studies. See our response to your comment on Task 14.

Comment on Appendix A: Addition of Caswell Creek to list of tributaries to be studied.

Response: Caswell Creek has been added to this list as well as to the study areas to be studied under Task 28.

Comment on Appendix A: Influence of with-project flows on tributary mouth holding areas.

Response: Refer to our response to your comment on Task 2B.

Comment on Appendix B: Need to facilitate development of creel sensus study agreements with ADF&G.

Response: The agreements have been formalized.

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STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

BILL SHEFFIELD, GOVERNOR

P.O.BOX 3-2000
JUNEAU, ALASKA 99802
PHONE: (907) 465-4100

RECEIVED

APR 23 1984

ALASKA POWER AUTHORITY

April 19, 1984

Mr. Jon S. Ferguson, Project Manager
Susitna Hydroelectric Project
Alaska Power Authority
334 West Fifth Avenue
Anchorage, Alaska 99501

Susitna File # 6.18.5.2 /
6.18.4.2

Dear Mr. Ferguson:

The Alaska Department of Fish and Game (ADF&G) has received your letter of March 19, 1984, wherein we were invited to attend the Settlement Process, Aquatic Workshop Number 2 and to review the Draft Aquatic Plan of Study.

We have reviewed the aquatic plan of study for FY 85 and attended the workshop held on March 30, 1984. Enclosure I contains our comments on the FY 85 Aquatic Plan of Study. We appreciate your efforts in planning and conducting the workshop and for the opportunity to review the Draft Plan of Study. The workshop format was much improved over the first aquatic workshop. It was organized to encourage comment and discussion between participants, the Alaska Power Authority (APA) and its contractors. Materials regarding the subject of the workshop were received well in advance, and thus provided ample opportunity for review. We believe that the workshop was mutually beneficial. It resulted in a better understanding by department staff of APA's proposed FY 85 aquatic plan of study. Should you have questions regarding our comments please contact Mr. Norm Cohen in Juneau at (907) 465-4100.

Sincerely,

LARSON
POLIVKA
VAN PATTEN
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ROBINSON
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Don W. Collinsworth
Commissioner

Enclosure

11-K12LH

cc: L. Pamplin
J. Clark
S. Moberly
D. Logan
S. Behnke
K. Parker
N. Cohen

Enclosure 1. Comments on the "Draft Aquatic Plan of Study Fiscal Year 1985."

General Comments

The Alaska Department of Fish and Game (ADF&G) appreciates the opportunity to comment on the Draft Aquatic Plan of Study for FY 85 prior to development of the final plan. Based on the studies defined in the workplan it appears that the Alaska Power Authority (APA) will gather information important to aquatic impact assessment and mitigation planning. We expect this information to be useful in the issues settlement process as information from the studies becomes available. We are particularly pleased to see work proposed for the Susitna River and tributaries downstream from Talkeetna.

We suggest that the plan of study would be improved by the addition of a flow chart or matrix indicating the relationships of the proposed studies to each other and to work accomplished previously. This would be useful in showing reviewers how some of the tasks, which appear similar, relate to each other. Obviously many of the tasks described in the workplan are necessary to provide information in support of other tasks. However, a brief display or description of their inter-relationships would be helpful.

After reviewing the plan and even after the workshop it is still unclear as to the level of effort that will be expended on each of the tasks outlined in the plan. Some tasks were much more detailed than others but it would be helpful if funding and manpower levels were included with each task. It would also be helpful if the appropriate contractors were identified with each task, to identify who has the lead responsibility for each of the tasks and who is providing support on each task.

We understand that the issues settlement process is planned to occur concurrently with the data collection tasks proposed in the plan of study. To enhance agency participation in this process we understand that information collected this summer will be made available by the APA in a timely manner. Perhaps the mechanism by which this information will be provided to agencies should be addressed in Task 2 of the plan of study. This is particularly

important for the lower Susitna River because the data base for that reach is relatively small.

Presently we are unaware of the level of funding that will be provided for the aquatic study program for FY 85. Once a firm budget has been established we request that the APA provide a copy of the final plan of study indicating those studies funded in FY 85 versus those rescheduled for a later time.

Specific Comments

Page 25 (Task 4B): The description of this task should be expanded to describe the process by which agency input will be factored into composite flow relationships for evaluation species. Resource management agencies should be provided the opportunity to be aware of the flexibility within the compositing process to contribute to any future decisions regarding species trade-offs.

Task 12 (Page 44): This objective was poorly written and a better objective actually existed under the rationale section. At the workshop APA agreed to reword the objective.

Task 14 (Page 53): Although this task will provide information on lower river resident and juvenile anadromous fish it will be conducted only during the open water season. This task is a positive step toward defining impacts but it may not provide sufficient information on winter habitats that will change considerably under project flows. Based on the results of this summer's work it may be feasible to conduct more winter work in the next budget cycle.

Task 16B (Page 64): We view this task as another positive step towards resolving issues in the lower river. While the Deshka River is a good location for outmigrant studies, results should not necessarily be viewed as representing what occurs in the east side Susitna River tributaries. Future outmigrant studies may need to address the east side tributaries.

Task 21 (Page 76): This task to document and assess the affects of different flow rates on the morphology of the

Susitna River between Talkeetna and Cook Inlet appears to rely completely on aerial photography. Ground truthing should be utilized to complement the results of photography.

Task 28 (Page 96): We discussed this task at the workshop at some length. Our past concerns at tributary mouths have been centered on the importance of these areas as holding and milling areas for salmon. These areas are vital to the sport fisheries in the area. While access by fish into tributaries is of some concern, the holding areas are the primary concern. We suggested that this task focus more on the importance of tributary mouths as holding areas for salmon. It is our understanding that this task will be revised to address these concerns.

Task 34 (Page 109): It is not clear whether this task will focus exclusively in the middle river from Talkeetna to Devil Canyon. We assume that the work will occur in the middle river area. Since the work being accomplished on Portage Creek is a considerable distance up river from lower river tributaries, results will not necessarily be applicable to lower river tributaries. Upon completion of these studies, follow-up studies should be accomplished in the lower river eastside tributaries.

Appendix A Draft Lower River Study Plan

Page 7: We requested at the workshop that Caswell Creek be added to the list of tributaries under segment II.

Page 25: Changes in tributary mouth configurations with project flows and how those changes may impact salmon holding and milling areas should be included as significant impact issues.

Appendix B, Draft Navigation and Transportation Study Plan

Page 4: It is stated that ADF&G Sport Fish Division will be undertaking a creel survey and it is proposed that the survey be expanded to include a survey of navigation use of the river. To date there has been no firm proposal, on any such study, presented to Sport Fish. If APA wants such a study completed by Sport Fish it will be necessary to firm up details

immediately as we are now recruiting and hiring staff for our existing field projects. If we do not plan now for any such additional work as APA may wish accomplished we will not be able to work it into this summer's field activities. We request that future inquiries or discussions concerning this topic be directed to David Watsjold, Regional Research Supervisor of the Sport Fish Division in Anchorage at 267-2220.

5712

Jack Robinson

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503
(907) 276-3800

IN REPLY REFER TO:
WAES

RECEIVED
APR 25 1984
ALASKA POWER AUTHORITY

Larry Crawford
Executive Director
Alaska Power Authority
334 West 5th Avenue
Anchorage, Alaska 99501

24 APR 1984

Dear Mr. Crawford:

This responds to the Alaska Power Authority's (APA) letter dated March 19, 1984, requesting our review of the Susitna Hydroelectric Project Draft Fiscal Year (FY) 1985 Aquatic Plan of Study. In addition, our comments were requested on the Susitna Hydroelectric Project workshop held on March 30, 1984.

Aquatic Workshop 2

The format of the workshop was improved over that of the first workshop held on February 15, 1984. The informal setting, as well as the relatively set agenda, allowed for a better exchange amongst participants. In the terrestrial workshop (which will be addressed in a separate letter) held on April 10, 1984, we observed additional improvements in presentation which reflected responsiveness to agency recommendations. We commend APA and its consultants for their efforts in conducting these workshops.

In our letter dated February 29, 1984, on the first aquatic workshop and on the draft Aquatic Impact Assessment Report,we made numerous recommendations. These recommendations and comments from workshop participants should be recorded, distributed to workshop participants, responded to by the APA, and tracked through the settlement process. The responses should be provided to workshop participants with the agenda and other handouts at least two weeks prior to the next workshop.

We recognize the difficult task the APA is facing in trying to effectively involve several agencies in the planning of Susitna Project studies. We believe maximum effort should be placed in facilitating participation by identifying the linkage of the numerous study components and tracking study component progress. In the Aquatic Plan of Study we are confronted with 59 separately identified tasks. All these tasks are linked and focused toward producing a defendable, mutually agreed upon, mitigation plan.

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26 APR 84 2:08

In the terrestial workshop several handouts were provided to facilitate our understanding of the linkages in the program. Of particular note are: Handout 1, Relationships Between FY85 Terrestrial Tasks and Issues; Handout 2, Major Linkages Among FY85 Terrestrial Tasks; and the Impact Assessment and Mitigation Planning Summary, which was circulated during the workshop. We recommend that similar products be provided for the Aquatic Program. It would also be useful to identify when reports are scheduled so that we are assured the tasks properly mesh.

Draft Aquatic Plan of Study, Fiscal Year 1985

The plan appears to be rather comprehensive; however, it is very difficult to provide a satisfactory appraisal of what is intended to be conducted and how it all will come together. We recommend that the following be provided to assist us in understanding the intended FY85 Plan of Study:

1. Matrix displaying the relationship between the tasks and the issues identified in the APA letter dated March 6, 1984.

2. Flow diagram illustrating the linkages of the aquatic tasks with dates when products are scheduled, allowing the next dependent task to proceed.

3. Identification of products which are intended to be circulated to agencies for review and comment, and those which we can request for agency use.

4. Identification of task principal investigator(s) and estimated task budget.

5. Bookkeeping document which tracks issues, and issue settlement. This should be identified as a separate level 1 task. In the draft Terrestrial Plan of Study this is identified as Task 6. The LGL Alaska Research Associates tracking document, Impact Assessment and Mitigation Planning Summary, is a satisfactory format for this task, although it should be more closely linked to the identified issues.

6. Identification of tasks, if any, which would not be funded during FY85 given the proposed $32 million APA Susitna Hydroelectric budget.

7. Detailed Plans of Study, when they are formulated.

Although the task descriptions are frequently vague, we do view the coverage as appropriate. Particularly encouraging is the priority given to the lower river studies. We consider these studies necessary to understanding the project's potential impacts to the Susitna River, and essential to formulating an acceptable mitigation plan.

Specific Comments on Tasks

Task 4B - In Task 5B the following flow regulation alternates are discussed: constant discharge; baseload variable discharge; load following; and peaking operations. How each of these alternatives would effect Task 4B should be described.

Task 5A - The process described would allow for the necessary give and take between the resource agencies and the APA leading to an acceptable instream flow regime if agency participation is integral to this task, and the following tasks, 5B and 6. It would be unfortunate if the APA were to refrain from involving the resource agencies until the draft recommended flow regimes report is completed. Please clarify when and how resource agency participation would be requested for the flow regimes tasks.

Task 7 - If the flow regime is developed through close coordination with the resource agencies, we would anticipate the impacts assessment report would include documentation of the remaining aquatic impacts which would be mitigated by means other than flow regulation. If not, all of the impacts identified in the report would presumably be mitigated by flow regulation and accordingly be the basis of the instream flow negotiations. If this is the case, the report should analyze the anticipated impacts of a wide range of possible flow regime alternatives. Also, the APA should not expect flow negotiations to proceed until the impacts report is circulated if minimal agency involvement occurred during the development of the recommended flow regime.

Task 10 - The relationship to this task of Tasks 5A, 37, and 48 should be discussed. The schedules do not appear to be appropriately synchronized. The preparation of detailed plans for mitigation features and associated costs for construction, operation, and maintenance should be a component of this task.

Task 12 - The objective of this task should be: To quantitatively assess potential effects that might accrue to existing side channel and mainstem habitats as a result of flow and temperature regulation of the Susitna River.

Task 14 - The task description recognizes the importance of understanding the winter distribution of juvenile fish to assess the project's potential to adversely impact the Susitna River fisheries. However, the investigation is apparently being limited to the open water season. If practical, rearing habitat should be examined during the winter, perhaps by sampling open leads.

Chulitna and Talkeetna Rivers should be evaluated. If large numbers of juvenile fish from the Chulitna and Talkeetna Rivers rear in the lower Susitna River, the project's potential to adversely impact the fishery would be substantially greater than if it does not.

Task 20 - The analysis should not assume that because the river system periodically undergoes large, rapid changes in flow naturally on rare occasions, the Susitna fisheries would tolerate project flows simulating these "natural" conditions on a much more frequent basis. The assessment should also provide a worst-case analysis using maximum ramping rates during critical periods when flow fluctuations are normally minimal.

Task 21 - We would expect the two habitats in the lower river most prone to changes in wetted surface area to be the clearwater tributary mouths and the sloughs. These habitats are probably important to recreational fishing (tributary mouths) and for spawning and rearing (sloughs). The study should be extended to these lower river habitats.

Task 23 - The impacts on ice formation, break-up, and timing of constant discharge, base load variable discharge, load following, and peaking operations should be examined. This study should then serve as input to Tasks 5B and 20.

Task 28 - Identification of important spawning and/or rearing sloughs should be followed by an examination of possible access problems.

Task 30 - How information on Slough 9 will be related to other sloughs in the middle river needs to be discussed. An inspection of upwelling in lower river sloughs should also be carried out.

Task 31 - We consider the development of the monitoring plan very important and prefer greater involvement than what is indicated, i.e., review of the formal draft plan. We believe involving the resource agencies early would be more effective. In addition, the monitoring plan should be developed across the environmental program, not separate monitoring plans by the aquatic, terrestrial, and social sciences groups.

Task 35 - The basis for the selection of the six selected sites should be provided.

Task 37 - This task should extend over a second year to include a demonstration that the techniques anticipated to be recommended in the mitigation report are effective.

Specific Comments on Draft Lower River Study Plan

Page 1, paragraph 2: During the winter, project-related impacts on ice conditions, turbidity, suspended sediment, bedload transport, and flows would be substantial. Quantifying how substantial these changes would be is the principal purpose of the proposed studies.

Page 2, paragraph 2: This resource agency, prior to this letter, had not been requested to provide input to the plan. The plan is responsive to our comments on the license application.

Page 2, paragraph 3: The objective should be to document the extent of impacts to the lower river. If the project, through flow releases, cannot adequately mitigate for identified impacts, then other mitigative means would need to be investigated.

Page 8, paragraph 5: Emphasis should also be placed on the river's associated riparian zone.

Page 17, paragraph 2: Suspended sediment and turbidity, although associated, are not the same thing. This is particularly evident in a glacial system like the Susitna River where very fine clay particles occur. These two parameters warrant separate treatment.

Page 19, paragraph 3: During filling and operation of the reservoirs, undercutting of the permafrost with subsequent slumping would probably occur.

These probable sources of suspended sediment and turbidity (and nutrients and heavy metals) should be considered.

Page 22, paragraphs 1 and 2: Given the statement on page 21, paragraph 1 that the bedload in the upper Susitna, Chulitna, and Talkeetna Rivers is two to five times greater than the load identified at the Sunshine Station, it could be hypothesized that, assuming the Susitna River system is in long-term equilibrium, high flow events are necessary to transport bedload that accumulates under more typical flows. Support for this view is also found in the fact that greater flows are needed to resuspend bedload material (due to inertia) than to carry it. The expectation that higher than normal winter flows (post-project), which are still less than typical summer flows, would lead to bedload movement when these flows during the summer do not, is not logical.

Page 23, paragraph 3: The importance of the referenced temporary winter flooding of riparian habitats, sloughs, and side channels should be evaluated.

Page 25, paragraph 1: The timeframe and anticipated future study needs should be discussed. This was done in FY1979 for the Talkeetna to Devil Canyon reach Aquatic Studies Program. Study emphasis should be placed on the five salmon species, arctic grayling, rainbow trout, burbot, and Dolly Varden.

Page 25, paragraph 2: As was discussed during the workshop, the clearwater plumes of several of the tributaries are important to recreational use of the chinook fishery. How these areas would be affected should be examined.

Page 37, paragraph 4: Winter turbidity changes also need to be considered since post-project conditions would be substantially changed from the existing conditions.

Thank you for providing the opportunity to review and comment on the draft FY1985 Aquatic Plan of Study and the workshop. We look forward to continuing our participation in your workshops.

Sincerely,

Regional Director

cc: FWS-WAES
FWS-WO/ES, Yvonne Weber
Keith Goltz, RSO, Anchorage
Kenneth Plumb, FERC, WDC
Mark Robinson, FERC, WDC
Brad Smith, NMFS, Anchorage
Don McKay, ADF&G, Anchorage

Responses to Comments of U.S. Fish and Wildlife Service

Comment: Description of linkages among study tasks and linkages to settlement process issues.

Response: Flow charts depicting how the study tasks are interrelated are presented in the final study plan. Similarly the relationship between study tasks and the fishery issues is depicted in a matrix previously provided to the resource agencies and incorporated into the Final Plan of Study.

Comment 1: Provision of matrix of tasks and issues.

Response: See obove

Comment 2: Flow diagram of task interrelationships

Response: See above

Comment 3: Identification of products to be distributed to agencies.

Response: All final reports will be distributed to the agencies. Requests for earlier data sets and preliminary drafts may be made to the Power Authority.

Comment 4: Identification of Principal Investigators and Estimated Budgets.

Response: Organizations responsible for each study task are identified, Principal Investigators have not been identified in as much as this is at the dicretion of the respective organizations. Estimated budgets for each task can be obtained from the Power Authority.

Comment 5: Need for bookkeeping/tracking document.

Response: Such a document has not been developed for the aquatic program. Settlement of issues will correspond to completion of related tasks.

Comment 6: Identification of tasks not funded if $32 million budget is approved.

Response: The program prioritization was designed to allow funding through Level 3 given a budget of $32 million. Tasks to be performed are described in the Final Plan of Study.

Comment 7: Detailed Plans of Study.

Response: This document contains the Final Plan of Study. Detailed descriptions of the tasks are provided in the subcontractor scopes of work.

Comment on Task 4B: Effect of alternative flow evaluations on Task 4B activities.

Response: The alternative flows investigated under Task 5 will use results of Task 4 and, therefore, should not affect Task 4. Task 5 will make use of results presented in Task 4 reports.

Comment on Task 5A: Involvement of agencies in development of alterntive flows.

Response: The Power Authority is open to recommendations for alternative flow regimes to be evaluated. To the extent possible we have incorporated recommendations into the various flow regimes which have been evaluated. Ample opportunity exists for discussion of various flow regimes under various tasks (both in the past and currently). The Power Authority would welcome suggestions for developing the flow regimes.

Comment on Task 7: Scope of the Impact Assessment Report

Response: Impact assessments are being made as studies are progressing. These assessments refine the Impact Assessment presented in the License Application. Future impact assessments will be utilized to refine mitigation plans and to come to negotiated settlements on fishery related issues.

Comment on Task 10: Relationships between this task and others and schedules for completion.

Response: The mitigation planning process described in Task 10 is an ongoing process. The first interim mitigation plan will be revised as further analyses proceed. Ultimately the Mitigation Plan will incorporate all aspects of mitigation of effects to aquatic resources.

Comment on Task 12: Revision of Objective.

Response: Objective has been revised

Comment on Task 14: Incorporation of winter studies to lower river juvenile studies.

Response: The Power Authority concurs. However, the need to conduct winter studies in the lower river will be determined from information obtained during the open water season. The feasibility of conducting winter studies and the methods to be employed are still questionable. Suggestions of methods for studying juvenile habitats under winter conditions would be welcomed by the Power Authority.

Comment on Task 14: Chulitna and Talkeetna Rivers rearing potential.

Response: Outmigrants from the Talkeetna River will be investigated as part of Task 16B.

Comment on Task 20: Assumption of fish toleration of pre-project rapid flow changes.

Response: Comment noted. Existing flow fluctuations can, however, be used as a starting point in the analysis.

Comment on Task 21: Extension of Lower River habitat delineation to tributary mouths and sloughs.

Responses: All habitats will be delineated in the study and responses of surface area to mainstem discharge evaluated.

Comment on Task 23: Results of study as input to Tasks 5B and 20.

Response: All studies of the response of physical and biological characteristics to changes in flow will serve as input to Task 4 which in turn serves as input to Task 5

Comment on Task 28: Identification of spawning areas followed by study of access.

Response: The Power Authority concurs. Such studies must first have results of Task 13.

Comment on Task 30: Extrapolation of Slough 9 results to other sloughs.

Response: The focus on Slough 9 as representative of groundwater processes throughout the middle reach is admittedly rather tenuous. However, the complexity of the groundwater question and the cost associated with the studies necessary to describe groundwater processes necessitate the focusing of studies on one site. Inference of the processes at other sloughs can be made on the basis of intragravel temperatures, water quality and base flow estimates.

Comment on Task 31: Development of a monitoring plan using involvement of agency personnel.

Response: Agency input to the monitoring program development will be solicited. However, the Power Authority will prepare a draft plan which will form the basis for discussion. The monitoring plan will be finalized only after the resource agencies have agreed to the plan. A cross-disciplinary monitoring plan will be developed after separate terrestrial social sciences and aquatic monitoring plan drafts have been developed. The aquatic monitoring plan developed under this task will likely be a chapter of the Project Monitoring Program.

Comment on Task 35: Basis for selection of the six study sites.

Response: ADF&G SuHydro personnel will select the study sites based upon prior studies and their experience in the Middle River.

Comment on Task 37: Extension of study through FY86.

Response: The plan of study addresses FY85 study tasks. It is likely that further studies will be conducted during FY86.

Comments on Draft Lower River Study

Comment Pg. 1: Quantification of changes due to project during winter.

Response: Concur. Studies of winter conditions are anticipated.

Comment Pg. 2 Para. 2: Input from agencies on development of plan.

Response: We attempted to utilize your comments on the license application in developing the lower river study plan as you state. Additional input was expeted at the workshop and as a part of your comments on the study plan.

Comment on Pg. 2 Paragraph 3: Documentation of extent of impacts to lower river.

Response: The initial step of the lower river studies is to document the extent of use of the lower river habitats by anadromous salmon species. This information coupled with physical changes anticipated as a result of project operation will provide a basis for determining whether or not significant effects are likely. If it is determined that effects are likely documentation of the extent of the impacts will be provided. The assumption that negative effects will occur which will require mitigative measures is as yet, not demonstrated.

Comment on Page 17, Para. 2: Suspended sediment and turbidity treated separately.

Response: Suspended sediment and turbidity are closely associated. Turbidity is in part a function of the chracteristics of suspended sediments. Results of suspended sediment studies will provide input to the turbidity studies.

Comment on Page 19, Para. 3: Sources of suspended sediment from reservoir bank slumping.

Response: Suspended sediment sources include reservoir bank slumping due to thawing of permafrost layers. However, this is likely to be a local, reservoir effect and is expected to be relatively minor compared with the impact of suspended sediments from the upper Susitna River. The influence of suspended sediments generated by slumping of the reservoir banks is expected to have relatively minor influence on the turbidity and suspended sediment loads in water released through the turbines and will be completely overwhelmed by suspended sediment concentrations from the Chulitna and Talkeetna Rivers during the summer months. Distinction between the amount of suspended sediments contributed by the Susitna River upstream of the Watana Impoundment and the amount contributed by bank slumping within the reservoir is extremely difficult and probably inconsequential.

Comment on Page 22, Paragraphs 1 and 2: Bedload movement in the reach between the Chulitna River Confluence and the Sunshine gaging station.

Response: This aspect is being considered in detail in hydraulic studies conducted under Task 24. A mathematical model (IILUVIAL) will be calibrated using data obtained by the U.S. Geological Survey. The purpose of the modelling effort is to estimate the bedload transport processes expected under with-project conditions.

Comment on Page 23, Para. 3: Importance of temporary winter flooding of riparian habitats, sloughs and side channels.

Response: The effects of ice-staging induced flooding will be investigated as part of the Task 23 study effort.

Comment on Page 25, Para. 1: Time frame and anticipated study needs.

Response: The timeframe for completing the lower river studies is dependent upon the future study needs. The determination of future study needs will be accomplished after results of the present studies have been evaluated.

Comment on Page 25, Para. 2: Examination of effects to tributary, clear-water plumes.

Response: The tributary mouth habitats will be investigated under Task 21 and Task 28.

Comment on Page 37, Para. 4: Consideration of winter turbidity changes.

Response: Suspended sediment and turbidity studies will consider the entire annual cycle and will not be limited to the open water season.