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SUSITNA HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

DRAFT
AQUATIC PLAN OF STUDY FISCAL YEAR 1985

DRAFT REPORT

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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

DRAFT
AQUATIC PLAN OF STUDY
FISCAL YEAR 1985

Report by

Harza-Ebasco Susitna Joint Venture

Prepared for

Alaska Power Authority

Draft Report
March 1984

NOTICE

ANY QUESTIONS OR COMMENTS CONCERNING

THIS REPORT SHOULD BE DIRECTED TO

THE ALASKA POWER AUTHORITY

When will you be able to show the relationship of minimum flow to changes in each of the Susitna River Habitats.

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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 is preparing a draft environmental impact statement (DEIS), due to be released on May 5, 1984. The final environmental impact statement (FEIS) is due for release on December 18, 1984. 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 January 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 proposed for fiscal year 1985 (FY85). It is provided at this time so that resource agencies will have an opportunity to review and comment on them prior to actual implementation. The Power Authority has also scheduled a workshop on March 30, 1984, to discuss these plans in detail with the agencies. (The agencies will have an opportunitiy to provide their input and comment at this workshop.)

Will this be our only chance for input. How does this document relate to the budget going to Juneau.

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
Final Environmental Impact Statement	December 28, 1984
License Issued by FERC (tentative)	March 18, 1987

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

How do these items relate to goals on page 4-6

Proposed plans for studies specifically designed for the lower Susitna River (Talkeetna to Cook Inlet) are appended to this document (Appendix A). They are attached for review by the agencies and will be discussed at the March 30, 1984 workshop. These plans are designed to provide additional information on this river reach that can assist the Power Authority in responding to various impact-related questions raised by the agencies. The plans are developed in a step-wise manner which could encompass a number of years of study based on results of the previous year.

Proposed plans to assess potential Project-related impacts on navigation are also appended (Appendix B) for review and comment. These plans are designed to provide the necessary information to forecast the level of impact the Project will have on instream use of the river for transportation. The studies will address both potential restrictions to navigation in general and impacts on customary routes of travel.

Will you be able to describe lower river impacts by end of this year?

Are agencies going to be able to negotiate instream flows that will include the lower river? Will there be quantative instream flow assessment in lower River? to accompany biological information that will be collected under this plan.

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.

Where do agencies fit in with these processes?

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 should be completed by July 25, 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, there will be a potential need for hearings. The Power Authority will develop briefs and directly participate in the hearings. If hearings are necessary, they will be initiated in the 1984-85 winter period. Direct testimony will be provided in September 1985 with an administrative law judge decision due on January 25, 1986.

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 need to be continued so there is a continuity of information collected. This includes both biological (e.g., salmon escapement counts) and physical (e.g., stream discharge) data collection. This information will be used to refine existing analyses and to develop baseline information for potential construction and with-project monitoring programs.

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, hydraulic engineering and instream flow 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. FY85 STUDY DESCRIPTIONS AND PRIORITIZATION

Certain studies must be performed to meet the long-term goals for this Project. This plan specifically addresses those studies proposed by the Power Authority for FY85. The study plan has been divided into tasks that address specific objectives to facilitate review and evaluation. Some of these tasks are more important than others because they are either critical to the licensing and settlement processes or are necessary to maintain baseline data collection. Therefore, the study plans have been prioritized by task description with decreasing priority assigned to increasing task number. This prioritization will provide a basis for budget allocation decisions that may have to be made.

These tasks have been divided into four general levels of importance:

Level 1 - The lowest reasonable level of effort which could be undertaken with some probability of maintaining the licensing schedule but with a substantial degree of risk for schedule delay.

Level 2 - An intermediate level of effort between the minimum reasonable (Level 1) and the required level of effort (Level 3).

Level 3 - The required level of effort for maintaining the licensing schedule with an accepatable degree of risk for schedule delay.

Level 4 - The level of effort desired to maintain the present schedule with a higher degree of certainty.

These levels represent a general consensus among the participants in the Susitna Aquatic Program, achieved during an intensive three week planning period.

who made final decision on priorities and on levels of study

Each task description has an objectives, rationale, description, deliverables and schedule section. These are provided to standardize the task descriptions for ease in review and for comparison. The task descriptions have been based on results and analyses from previous studies and other existing sources of information. A listing of all tasks (Table 2) is provided first followed by a description for each individual task.

It appears that many of these tasks can be combined - which tasks support other tasks are lower level tasks needed to support higher priority tasks

TABLE 2

LISTING OF ALL AQUATIC FY85 TASKS

FOR THE

SUSITNA HYROELECTRIC PROJECT

Level 1

Task No. Priority	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.
4A.	Instream flow relationships studies.
4B.	Flow relationships compositing.
5A.	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.
AA 13A.	Adult salmon-middle river spawning surveys.
AA 13B.	Adult salmon-lower river spawning surveys.
AS 14.	Lower river resident and juvenile anadromous fish studies.
AA 15A.	Lower river-main channel salmon escapement monitoring.

TABLE 2

Continued

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.
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)

Level 2

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.

Level 3

37. Preliminary mitigation studies for the Devil Canyon to Talkeetna reach.

38. Impact asessment of construction-related activities; transmission line and access road.

39. Mitigation planning for construction activities.

40. Impoundment resident fish mitigation planning.

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

42. Evaluation of an alternative method to monitor main channel escapements.

Level 4

43. Glacier studies.

44. Development and refinement of temperature criteria.

45. Primary productivity studies within the Susitna River, other glacial streams and some non-glacial streams.

46. Characterization of turbid water mainstem influenced Talkeetna River salmon spawning habitats.

47. Middle river tributary stability study.

48. Mainstem habitat suitability.

49. Refinement of adult salmon habitat utilization data.

50. Refinement of upwelling component for side-slough habitat analysis.

51. Heavy metal leaching potential for reservoirs.

52. Baseline studty of mercury concentrations in resident fishes.

53. Laboratory studies.

54. Groundwater studies - well pumping tests.

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 will consist of preparing additional information which will strengthen some conclusions reached in the DEIS. The second element will consist of preparing information and substantiation for analyses which differ from those reached in the DEIS. The third element will consist 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	July 24, 1984

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

TASK 2

PARTICIPATION IN WORKSHOPS AND OTHER ASPECTS OF THE SETTLEMENT PROCESS

Rationale

This task is necessary to assure the settlement process progresses with input from participants that can provide the most knowledgeable 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.

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 6: Forecast of Project Induced Water Quality Changes and Their Effects on Fish.	7/29/84
Workshop 7: Findings of the Habitat Relationships Report	9/28/84
Workshop 8: Project Mitigation Opportunities	10/16/84

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 November, 1984 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 User Surveys
- Results of Riparian Vegetation Studies
- 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 a vital aspect of the over-all activities necessary to assure satisfactory integration of all the related but separate study components. The importance of this task increases as the project procedes toward the settlement process and FERC hearings.

Objective

Attain a level of coordination among Aquatic Study Team members necessary to assure effective and efficient progress toward a set of common goals.

Description

This task requires effort from all members of the Aquatic Study Team. H-E has an over-all coordinating function that 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 over-all 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 information reports, correspondence and memos.

4. Frequent meetings and data and information 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 4A

INSTREAM FLOW RELATIONSHIPS STUDIES

Rationale

This work is necessary to complete analyses of existing data and transfer the findings of those analyses into the settlement process and the FERC licensing schedule. This task will directly support the settlement process and associated tasks directed toward flow negotiations and eventual project licensing.

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 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

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

2. Watershed 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 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.

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 and ice processes. During the first half of FY85 review comments will be addressed, the discussion of with-project instream temperature effects on fish will be enhanced and interpretive discussions of instream temperature effects on ice processes and ice effects on aquatic habitat will be added to the review draft. An initial report will be available by the end of FY84. An updated version will be made in FY85 that will incorporate additional modelling refinements based on 1984 temperature data.

5. Aquatic Habitat Report - this report will describe the response of aquatic habitat surface areas to mainstem discharges. The river reach to be analyzed first in FY85 will be from Talkeetna to Devil Canyon. Efforts on the lower river are continuing and will be described in the Lower River Study Plan (see Appendix A).

Three drafts of the Relationships Report will be issued in an effort to transfer available analyses and information into the licensing and settlement processes. Work that had commenced in the latter quarter of FY84 will continue into the first half of FY85.

A preliminary draft of the Relationships Report will be issued in time to contribute to the preparation of the FEIS. However, the major contribution that can be made during the first quarter of FY85 to the FEIS by the Relationships Studies will be derived from the topic area reports. An interim draft of the Relationships Report, envisioned as being a considerable enhancement over the preliminary draft, will be issued by November 30, 1984, to assist with clarifying contradictory statements that might appear in the FEIS. The final draft of the Relationships Report is not expected to contain much new information other than the turbidity and ice effects on habitat. It will be upgraded by responding to comments made on the interim draft and by incorporating more descriptive analyses, graphics and narratives to improve its clarity.

Deliverables/Schedule

Technical Report Series

REPORT	DRAFT	FINAL
Fish Resources and Habitat	8/31/84	
Watershed processes	8/31/84	
Water Quality	FY84	8/31/84
Reservoir and Instream Temp	8/31/84	3/31/85
Response of Habitat to Flow	8/31/84	10/31/84

Relationships Report

Preliminary Draft	8/31/84
Interim Draft	11/31/84
Final Draft	3/31/85

TASK 4B

FLOW RELATIONSHIPS COMPOSITING

Rationale

Compositing of site-specific flow relationships is necessary to quantitatively assess increments of Susitna River discharge in terms of system-wide habitat values. This task is a primary step in the process toward development of a recommended flow regime and flow negotiations in support of the settlement process and Project licensing.

again will this work provide input for analysis No!

Objective

Develop a composite flow relationships hydrographs (FRH) for analyses that will be performed in the comparisons process (Task 5A).

Description

Compositing follows compilation of site-specific habitat relationships and proceeds to completion of an FRH which incorporates relevant information on instream flow habitat relationships and species distribution, abundance and timing. Compositing is a highly analytic step requiring familiarity with detailed Susitna field and refined data, assessment design and quantification techniques. A general compositing process has been established, however, the detailed rationale and analytic techniques must be jointly developed and approved as part of this task.

The flow-habitat and species distribution, abundance and timing data required are largely available from ADF&G SuHydro and EWT&A reports or data files.

Some refinement of current data and some new field data regarding main channel impacts will be required. These field data will be collected during FY85.

ADF&G SuHydro, working jointly with AEIDC, WCC and EWT&A will analyze site-specific flow vs habitat relationships to develop a composite flow relationships hydrograph (FRH) for each evaluation species. The task will rely heavily on ADF&G SuHydro personnel to aid in both providing data and in analytic process. Because the major element of biologic and instream flow credibility and field experience lies with ADF&G SuHydro and EWT&A, their value in coordination and support cannot be overemphasized. AEIDC will serve primarily as coordinator and to maintain focus of this activity as it relates to our subsequent responsibilities in the comparisons process and impact assessment.

Deliverables

The deliverable of this effort will be completed flow relationships hydrographs and a report documenting the process used in their development. Attempts will be made to composite habitat relationships among species where a policy trade-off decision is not required. An ultimate goal for this process will be derivation of a single FRH that includes all evaluation species. However, this task will stop short of making across species trade-off decisions which would have to be arrived at during the settlement process.

Schedule

The flow relationships hydrographs will be completed by January 1, 1985.

TASK 5A

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 is a necessary step toward flow negotiation and an integral part of 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 regime will range from the optimum environmental (aquatic habitat) to the optimum economic regimes and will include natural flows and flows presented in the License Application. Other alternative regimes will be selected based on the needs of navigation, recreation, riparian habitats and water quality.

A project optimization procedure will be used to evaluate the alternative regimes. This is a computer based, iterative process that will be used to narrow the alternatives to a smaller set of regimes that best provide for the needs of both energy and power generation and the various downstream uses of the river. Emphasis during the Project optimization process 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 relationships and 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. This will be required to examine the influence of increasing energy demand levels 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 affect 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	March 1, 1985
Final	Fall, 1985

TASK 5B — This Task not listed on page 10

POWER ANALYSIS — should this be under aquatics studies or economic studies

Rationale

The power analysis will be an element of the Economic and Environmental Comparisons Report. It is a necessary component for the successful undertaking of the comparisons process.

Objective

1. To determine net power benefits and net energy benefits for alternative weekly flow regimes.

2. To provide coordination between the power and environmental studies groups to ensure environmental and power studies are integrated.

Description

why were four levels chosen.

The reservoir operations program will be run for four future energy demand levels using the alternative monthly and weekly flow regime envelopes as operating constraints to produce a weekly time series of energies and flows for 33 years of historical flow. Included in the analyses will be the following three parts:

1. With Watana as the only plant operating on the Susitna River.

2. While Devil Canyon Reservoir is being filled. — reservoir filling schedule will be used.

3. With Devil Canyon completed to augment and modify Watana flow regulation.

The relative net capacity and energy benefits will be compared for each of the alternative flow regimes under baseload constant. Constant discharge, base load variable discharge, load following and peaking operations. The power benefits (1) of each operating scheme will be computed relative to the base load constant discharge operation. Graphs and tables of energy and power benefits versus alternative flow regimes will be produced.

Deliverable

A power analysis report will be prepared based on the alternative flow regimes. This report will then be integrated with the environmental affects to produce the Economic and Environmental Comparisons Report.

which study provides info on previous reports

Schedule

Draft report	March 1, 1985
Final report	Fall, 1985

(1) Power benefits derived from load following at Watana would include capital cost savings from reduced capacity requirements and fuel cost savings from both displacement of more expensive generation units and more efficient operation of base loading thermal units.

TASK 6

RECOMMENDED FLOW REGIMES REPORT— How can you do this without knowing the impacts

Rationale

The Economic and Environmental Comparisons Report will set the basis for defining a detailed flow regime schedule. The next step is to draw together comparisons developed in that report into a single proposed regime. This will be necessary to proceed with the settlement and licensing processes.

Objective

Develop a detailed flow regime schedule, including allowable variance for wet, and dry normal years, that is based on information presented in the Economic and Environmental Comparisons Report (Task 5A) 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 impacts associated with this regime will also be presented.

The report developed under this task will be used as 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 either be: 1) finalized, if no significant comments are received, or 2) a second draft will be prepared (based on comments recieved) in anticipation of actual instream flow negotiations.

no definitive criteria to decide what is significant

Deliverables

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

Schedule

Draft	April 1, 1985

TASK 7

IMPACT ASSESSMENT — How does this relate to previous task

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 to be licensed by FERC will be critical for 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. How can flows be negotiated when the report comes out after settlement process is concluded and hearings may have already begun? It seems that task 6 should not be completed until task 7 is finished.

Description

The Susitna aquatic investigations program includes the following steps: field data collection and analysis, development of habitat relationships, development of composite flow relationships hydrographs and flow optimization. After the tradeoffs between habitat/fish populations and power generation have been examined in the comparisons process, a recommended operating regime will be developed. It is expected that this regime will have some flow-related effects on fishery resources which must be quantified and described in order to plan specific measures to mitigate these effects. This task will quantify the impacts of the recommended operating regime. Impact analyses of alternative flow regimes will be presented in the Economic and Evnironmental Comparisons Report and the Recommended Flow Regimes Report. This impact assessment will be more detailed and comprehensive.

How can we negotiate flows when impacts of other flows may not be known?

Information on potential impacts of the Project is available in ADF&G SuHydro, Power Authority, ETW & A, R&M, AEIDC and H-E reports and other documents. Integration of this information into usable habitat relationships and flow relationships hydrographs will provide the basic analytic tools for impact assessment.

Deliverable

A report detailing expected impacts of a recommended flow regime on aquatic habitat.

Schedule

Draft	May 1, 1985
Final	~~June 30~~ Fall, 1985 — Date doesn't appear to relate to negotiation schedule

TASK 8

FLOW NEGOTIATIONS will impacts be known and available for negotiations particularly for Lower River

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 enter negotiations with various resource agencies to finalize a Project flow schedule. Participation and assistance will be needed from various aquatic study team members (and members from other disciplines) during these negotiations in order that technical assistance be provided to the Power Authority. The coordinator for assuring that this assistance is provided will be H-E. All members of the Aquatic Study Team may be needed to assist the Power Authority in preparing for the actual negotiations.

Deliverables

The overall deliverable is a negotiated flow schedule for Project construction and operation. This will be a memorandum of understanding between the Power Authority and the various resource agencies. More

immediate deliverables will include memoranda, analyses and other documents as requested by the Power Authority.

Schedule

The flow negotiations are scheduled to begin with completion of the Instream Flow Relationships Report and continue with completion of the Recommended Flow Regimes Report.

Well project impacts be known for the river from Davis Canyon to Look Lake by completion of the instream flow relationships 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 information and data must be condensed and summarized into formats appropriate to support the hearings process scheduled to begin December 28, 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 pertaining to the 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	2/1/85
2.	Prehearing conference	4/3/85
3.	Discovery request responses	6/24/85
4.	Additional discovery request responses	7/24/85
5.	Filing of direct testimony	9/25/85
6.	Filing of rebuttal testimony	11/27/85
7.	Cross examination of witnesses	12/27/85

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

	Item	Date
1.	Designation of expert witnesses	7/1/84
2.	Positon papers	3/31/85
3.	Conferences with legal counsel	Periodically
4.	Responses to discovery requests	6/24/85
5.	Draft outline of direct testimony	4/30/85
6.	Draft direct testimony text	6/30/85

TASK 10

MITIGATION AND ENHANCEMENT PLANNING

Bring up to date

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.) - Priority must be given to mitigation of habitat losses. How does enhancement activities fit in with mandated mitigation priorities.

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.

Haven't seen any evidence to support this statement — who is anticipating this? — why is it anticipated.

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.

Deliverables

A mitigation report series will be prepared for the Devil Canyon to Talkeetna reach. It is anticipated that 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	8/31/84	10/31/84
Second Interim Mitigation Report	8/31/85	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 extensively tied together into a single document that is relatively concise and comprehensive and results of the various studies have not been examined in total. Therefore, there is a strong need to develop such a document. It will be particularly useful during the settlement and hearings process as a reference document rather than having to continually examine numerous documents for key information.

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 when the final reports were finished. Much of the existing information is now spread out over dozens of volumes of text, reports, workshop minutes and memoranda. Work under this task will be directed at examining this information, deriving key information and presenting a condensation of this material in one document. There will also be an

examination of information from areas outside the Susitna Basin that might be pertinent to a better understanding and perspective on the habitat relationships that have been found in the Susitna Basin. This report will supplement and expand the Fish Resources and Habitat Report (Task 4A).

Deliverables

The main deliverable will be the final comprehensive report.

Schedule

Draft	November 1, 1984
Final	December 30, 1984

TASK 12

MIDDLE RIVER MAINSTEM HABITAT ANALYSIS

Rationale

The successful completion of this task will provide a quantitative assessment of potential effects that might accrue to existing side-channel and mainstem habitats as a result of 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 of with-project streamflows for improving existing spawning and rearing conditions at mainstem and side channel locations between Talkeetna and Devil Canyon.

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 for the purpose of selecting eight to ten candidate study sites that appear to have channel structure and hydraulic conditions that might provide spawning and rearing habitat when mainstem flows are between 8,000 and 14,000 cfs. A brief narrative will be prepared by July 31, 1984, regarding the rationale supporting the selection of each candidate study site for review by other Project personnel. 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 Collections: 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 their 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 (with-project model). 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 with-project IFG-2 model to reproduce water surface profiles observed at the study site in the 14,000 to 25,000 cfs flow range.

The Susitna River discharge needed to maintain flow at each study site, as well as 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 miscellaneous streamflow measurements at the respective study sites.

Although emphasis will be placed on evaluating with-project rearing potential, habitat utilization curves for chinook, chum and pink salmon spawning (available in Alaskan literature and Project reports) will be used in concert with the calibrated IFG-2 hydraulic models to forecast flow versus weighted usable area indices for natural and with-project streamflows. 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 with the IFG-2 hydraulic models and site specific descriptions of cover availability to augment the 1983 juvenile studies and make a comparative assessment of the natural and with-project rearing habitat potential of mainstem areas.

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.

Schedule

Draft model calibration report May 31, 1985.
Final model calibration report August 31, 1985
Draft mainstem habitat analysis report April 30,1985.
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

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.

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

how will this be done in anything but clear water & only late October

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.

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 by examination of the distribution of juvenile anadromous fish in backwater zones and the incremental watering and dewatering of these areas 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 be planned, based on available information, to 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 (CWT) 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.

Several outmigrant traps will be established near the mouth of Portage Creek during the summer of 1984. Chinook and coho collected at these sites will be fin clipped and released approximately four miles upstream. Recaptured outmigrants will be measured for length and the mark recorded. These unique data will be used to estimate outmigration rates.

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 and rearing of juvenile salmon species has not been established in the lower river. The importance to assess the potential habitat effects of Project flow regulation of habitats associated with the mainstem lower Susitna need to be established.

Monitoring of outmigrant timing and condition will be conducted at a site below the confluence of the Susitna and Yentna Rivers. This outmigrant trap will provide an estimate of the timing, size and relative numbers of juvenile salmon that are leaving the fresh water

system. Chinook movement into the mainstem environments will be estimated at temporary outmigrant traps established and operated intermittently on the Deshka River. The movement of chum, slough sockeye and chinook into the lower river will be evaluated by use of the data obtained from the Talkeetna station trap and intermittent 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 immigrating 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 are available from nine USGS gaging stations in the Susitna River Basin. With project discharge will be estimated using studies of reservoir operations carried out 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 Report	September 30, 1984
Final Report	November 30, 1984

seem that task 25 should be before this task - need biological data before can assess impact of turbidity

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

Doesn't appear appropriate under aquatics program.

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.

How is this task relevant to fisheries. If for winter flow analysis how will the data be used?

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 – Doesn't appear to fall under aquatics program

Rationale

Power studies are currently assessing load following at Watana powerhouse as an alternative to base loading 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. Define this. What is considered environmentally acceptable

How will they be established?

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. The transferability of the operating experiences from Pacific Northwest hydro projects to the Susitna project will be examined. Results from the literature review would provide the biological perspecitve necessary to evaluate effects of varying stage changes and to recommend interim operating criteria for load following 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 4A 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	November, 1984
Item 3	
Draft	November, 1984
Final	November, 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.

what about depths will this task accomplish this.

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.

when will this be done?

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 over flights 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.

will there be any on ground work

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

1. 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 wetland 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 4A).

A technical report will be prepared by EWT&A and R&M Consultants to present the findings of their analysis of streamflow effects on habitat surface areas in the lower river.

Schedule

Technical memorandum	January 15, 1985

TASK 23

LOWER RIVER ICE STUDY

Rationale

Ice-related processes affect the Susitna River environmental during approximately 8 months of the year (October - May). These processes affect: water levels and temperatures in and near habitat areas and morphological changes in habitat induced by scour resulting from ice movement.

- will the impacts on fisheries and habitats be defined?

The significant ice-related impacts to the aquatic habitat are expected to be in the Middle reach of the Susitna River between the Project site and Talkeetna. Impacts in this reach are being evaluated utilizing a mathematical model of ice processes. The downstream end of this model is at the Chulitna-Susitna confluence. 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 when the Lower River is completely filled up with ice which is 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.

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 the middle river to the lower river. Instead, in order to make reasonable estimates of the required parameters, a limited analysis at selected locations is recommended.

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 the progression of the ice cover periods on the Lower River.

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

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

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

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.

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

Where mild impacts on fisheries resources has defined.

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 be elevation of water levels near the town of Talkeetna, at tributary mouths, and at the upstream ends of side channel complexes. The current analysis of impacts embodied in the Lower River Morphological Assessment will assume a fixed streambed.

The results of the sediment study (FY84) presented in "Susitna Hydroelectric Project - Reservoir and River Sedimentation" identified the potetial 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 and

1. affect the results of the Lower River Morphological Assessment

2. significantly increase water levels near the town of Talkeetna.

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 and bedload discharges. To evaluate project impacts downstream from Sunshine, suspended 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 at USGS will be continued for FY85 and they will initiate suspended 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 empirical relationships. The streamflow and flood peaks data required for these computations will be obtained from "Streamflow and Flood Frequency Studies" discussed earlier.

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 utilizing surveyed cross sections of the lower river and a mathematical model of the reach between the Sunshine Bridge and the Chulitna - Susitna confluence. This hydraulic study will also provide necessary information to Lower River Ice and Temperature Studies.

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

1. Selection 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;

3. Surveying of river cross sections;

4. A field program to observe staff gages and to measure mainstem and side channels velocities for a selected range of discharges at 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 dishcarges;

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 Parks Highway Bridge;

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

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 and reduction of data 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 should 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 31, 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 August 31, 1984. The final report will be completed by October 15, 1984.

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.

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

1. Field Operation — June 7 to September 9, 1984

2. Report

   a. Draft — December 21, 1984

   b. Final — February 21, 1985

TASK 28

LOWER RIVER ANALYSIS Tributary access

Rationale

Funding of this study will enable project personnel to assemble the necessary data and analyses about tributary access in the lower river prior to the onset of the hearing process.

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 mouth 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.

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 August 31, 1984 if only the visual interpretation of photography is required; and by December 31, 1984 if field studies and analyses are undertaken. A final report will be available November 15, 1984 or April 15, 1985 depending upon which level of assessment is performed.

TASK 29

EVALUATION OF MIDDLE RIVER MAINSTEM AND TRIBUTARY SPAWNING HABITAT RELATIONSHIPS

Rationale

This study will provide data for a within year 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 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.

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 at 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 at 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.

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 should 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 limits of concern, potential measures to rectify the impact and an alternative 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.

Harza-Ebasco will coordinate the planning efforts for the Power Authority. Assistance will be provided by the Alaska Department of Fish and Game's Su Hydro 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 data. 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 appropriatness 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 recently compiled by R&M will be useful in defining stream width relationships or in identifying new data collection requirements).

Deliverables

1. Model validation report.

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

Schedule

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. Ground water 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 ground water 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 December 31, 1984.

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. 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 11.

Schedule

	Draft	Final
ADF&G-SH FY85 Report Series	5/15/85	6/30/85
Second Interim Mitigation Report	8/31/85	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 construciton 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	2/28/85	4/30/85

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	2/28/85	4/30/85

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. The report will be attached to the report described in Task 38.

Schedule

	Draft	Final
Resident Fish Mitigation Plan	2/28/85	4/30/85

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 42

EVALUATION OF AN ALTERNATIVE METHOD TO MONITOR MAIN CHANNEL SALMON ESCAPEMENTS

Rationale

The current method (tag/recapture) of enumerating adult salmon in the Susitna River, while effective, is very labor intensive and costly. A more cost effective method for enumerating upstream migrant adult salmon is desired for anticipated needs in a long-term monitoring program. This task will test the Biosonics Model 101 hydroacoustic unit.

Objective

To test Biosonics Model 101 hydroacoustic equipment as a cost effective alternative to tag/recapture programs.

Description

In FY84 ADF&G used a Biosonics unit on the Yukon River and, although the report is not yet available, the biologist in charge indicated the unit performed well. ADF&G is proposing to use Biosonics equipment in five Alaskan river systems in FY85. Included are the Stikine, Kenai and Yukon rivers, all glacial systems. Features that are most promising for application in the Susitna River are a long counting range (250 meters) and no requirement for a counting substrate.

The unit will be installed at the Parks Highway Bridge. Two fishwheels will be operated nearby to apportion the counts. The final adult salmon population estimates from the Biosonics unit will be compared to the population estimates generated by the tag-recapture method.

Deliverables

The final product will be a written final report summarizing the capabilities, limitations and overall effectiveness of the Biosonics unit. Included will be recommendations for future applications in the Susitna River.

Schedule

First draft	12/21/84
Final	2/21/85

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. The purpose of this program would be to determine the current physical glacier charateristics and periodic changes in relation to climate. Records of this type might provide insights into glacier performance and data which would be useful 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 prepared by July 31, 1984. This plan would be reviewed and finalized by August 31, 1984. Glacier monitoring would continue upon favorable review of the plan and data would be reported by July, 1985.

TASK 44

DEVELOPMENT AND REFINEMENT OF TEMPERATURE CRITERIA

Rationale

Improvement and refinement of temperature criteria for Susitna River fish stocks are needed to support final impact assessment, the settlement process and mitigation planning.

Objective

Develop Susitna River specific temperature criteria for use in quantifying thermal impacts of the Project on downstream fishery resources.

Description

Aquatic organisms have upper and lower thermal tolerances, optimum temperatures for growth, preferred temperatures in thermal gradients, and temperature limitations for migration, spawning and egg incubation. Salmonid temperature tolerance generally ranges from 0° to 25°C. Extensive literature is available on fish physiology and behavior in the upper tolerance range but there is a paucity of data on lower temperature tolerances. Lower temperatures do not generally cause direct mortality but instead result in poor physiological and behavioral performances. Any Susitna project-related temperature impacts are expected to occur in these lower temperature threshholds.

Any applied temperature criteria used for assessing impacts should be as closely related to the water body in question as possible and to its particular community of organisms. Outside of incubation temperature data for chum and sockeye salmon, little information is available on preferred temperatures for the various life stages of Susitna River stocks.

AEIDC has conducted a literature review to locate published temperature tolerance and preference criteria for the species of fish inhabiting the Susitna River. ADF&G SuHydro has random water temperature data available for fish collection/observation sites at various locations since 1974. This information has been integrated into preliminary temperature tolerance criteria.

Additional data on temperature ranges preferred by Susitna fish species should be gathered. A laboratory experiment is suggested using Susitna River juvenile fish stocks to determine preferred temperatures for various physiological and behavioral events such as growth rate, migration, and rearing. Chinook and coho salmon will be the species of highest priority.

In addition, a small field data collection effort will be undertaken to gather temperature data in the Chulitna, Talkeetna, and Susitna rivers near their confluences to better understand the temperature effects on the milling behavior of adult salmon. On-site water temperatures will also be collected during the various salmon life phase activities. These data will be collected to improve and fill any gaps still existing after the 1983 ADF&G SuHydro program. For example, if there are no site-specific temperature data available for a certain salmon species during spawning, this would need to be collected.

The final exercise in this task will be incorporating the temperature data gathered from the field and the laboratory experiments into the salmon preference criteria established for temperature impacts assessment. Once this is accomplished, impacts due to temperature can be assessed with the best temperature criteria available.

Deliverables

1. A technical report describing the results of the laboratory analysis.

2. A technical memorandum describing the results of temperature monitoring at the confluence area.

3. A technical memorandum describing the results of field temperature measurements (related to life stage)

4. A technical report presenting final temperature criteria and supporting analyses and information.

Schedule

Schedule for reports and memoranda listed above:

No. 1-3	
Drafts	October, 1984
Finals	November, 1984

No. 4	
Draft	November, 1984
Final	January, 1985

TASK 45

PRIMARY PRODUCTIVITY STUDIES WITHIN THE SUSITNA RIVER, OTHER GLACIAL STREAMS AND SOME NON-GLACIAL STREAMS

Rationale

Baseline information related to the temporal quantification of primary productivity by autochthanous sources in various Susitna River habitats and similar habitats in other south central Alaskan glacial and non-glacial streams will provide information needed to describe with-project conditions. Such information may be needed to support the hearings process and complete the settlement process (especially impact assessments).

Objective

To temporarily quantify the benthic, autochthanous primary productivity (or some indicator of the former) as it relates to habitat characteristics such as substrate stability, suspended sediment and turbidity in the Susitna River and other riverine systems in south central Alaska.

Description

Appropriate substrates (either natural or artificial) from various habitats of the Susitna and other rivers will be analyzed for indices of autochthanous primary productivity (e.g., chlorophyll "a" per unit of standing crop organic carbon). Additional physical measurements such as water depth, turbidity, suspended sediment, discharge, temperature, Secchi disc or other photic zone indicators will be made in each sampling site. Physical characteristics will be analyzed to investigate the relationships between benthic primary productivity and habitat physical parameters.

Comparative data from various Susitna River habitats and from other south-central Alaskan rivers will be useful in forecasting with-project impacts to the downstream biological food web, including resident and anadromous fishes.

Deliverable

Report detailing the study and its results.

Schedule

Draft May 1, 1985.

Final June 30, 1985.

TASK 46

CHARACTERIZATION OF TURBID WATER MAINSTEM INFLUENCED TALKEETNA RIVER SALMON SPAWNING HABITATS

Rationale

Turbid water mainstem influenced macrohabitats of the Talkeetna River appear to support more chum salmon spawning (ADF&G SuHydro observations) than similar macrohabitats in the middle reach of the Susitna River. It has been suggested that turbid water mainstem influenced macrohabitats of the Susitna River under with-project conditions might support salmon spawning. Information comparing use of turbid water influenced macrohabitats in the two rivers will provide a better evaluation of the potential of the Susitna River for providing salmon spawning habitat under with-project conditions. This information will support impact assessment, mitigation analyses and the settlement process.

Objectives

1. To identify the principal macrohabitats present in the Talkeetna River basin.

2. To identify salmon spawning areas in the turbid water mainstem influenced macrohabitats of the Talkeetna River.

3. To identify characteristics associated with spawning habitats in these macrohabitats.

Description

Information from aerial surveys and available maps and aerial photographs will be used to identify the various macrohabitat types present in the Talkeetna River basin. Chum salmon spawning areas in the turbid water mainstem influenced macrohabitats of the Talkeetna River will be identified using aerial and boat surveys. Point specific spawning habitat utilization data will be collected at selected identified spawning areas in these macrohabitats. Data to be collected will include: water depth and velocity, substrate, surface and intragravel water quality and temperature and upwelling at identified spawning redds. This information will be used to characterize the general habitat conditions associated with chum salmon spawning in the turbid water mainstem influenced macrohabitats of the Talkeetna River. This information will be compared to existing and expected habitat conditions in the same macrohabitat types in the middle reach of the Susitna River to determine the potential of these macrohabitats for providing suitable salmon spawning conditions.

Deliverables

A report documenting the findings of this sutdy.

Schedule

Draft Report	February 1, 1985
Final Report	March 15, 1985

TASK 47

MIDDLE RIVER TRIBUTARY STABILITY STUDY

Rationale

The report "Susitna Hydroelectric Project - Reservoir and River Sedimentation" concluded that based on a comparison of sediment transportable under with-project conditions with the bed material size near the mouths of the tributaries river bed aggradation near their mouths appears to be likely. The tendency for accumulation would be greatest at Sherman Creek and Indian River.

The size and distributions of bed materials for other tributaries indicate D_{50} smaller than the transportable size, and there would be less aggradation near the mouth of these tributaries. However, because only a few bed material samples were collected in the study reach, additional data will have to be collected an analyzed to confirm or revise this assessment.

Currently, data are not available to quantify the extent of potential aggradation in the mainstem near the mouths of the tributaries. A sediment data collection program has been proposed by the U.S. Geological Survey (USGS) which includes sediment measurements on Indian River and Portage Creek. When data collected under this program become available, a quantitative estimation may become feasible. However, severe aggradations at the mouths of tributaries which will require substantial mitigative measures are not expected. Most of the tributaries will adjust to the new flow regime without detrimental effects on fish access, bridges or railroads. The adjustments will depend upon a number of factors such as the shape of a tributary cross section, size of bed material, increase in the

hydraulic gradient (due to lowering of water surface elevaiton in the mainstem under with-project conditions), magnitude and frequency of high flows in a tributary and the size of sediment transportable by the mainstem flow. The interaction of these factors is not completely understood. Therefore, depending upon these factors, a tributary may adjust to new regime over a period of time, one wet season or a number of years.

Objective

The objectives of this study are to quantify the extent of potential aggradation in the mainstem near the mouths of Indian River and Portage Creek, and to determine whether this aggradation will result in impacts to habitat access.

Description

The following elements will be part of this study:

1. Suspended sediment, bedload and bed materials measurements by the USGS on Indian River and Portage Creek.

2. Surveying cross sections on the tributaries near the mouths and on the mainstem just upstream and downstream of mouth.

3. Periodic discharge measurements and continuous stage recording on the tributaries.

4. Analyses to estimate bedload transporatable by tributaires and to quantify aggradation or degradation of material at tributary mouths.

5. Estimation of impact of aggradation or degradation on tributary access.

Currently available data and results of analyses of these data have been compiled into a report entitled Susitna Hydroelectric Project - Reservoir and River Sedimentation. There are currently no data on suspended sediment and bedload discharge from the tributaries. ADF&G recorded water stage during 1983 on the tributaries. R&M made discharge measurements on these tributaries and some bed material sampling has been made. However, the data available is not sufficient to support a quantitative analysis of sedimentation in the tributaries.

Deliverables

A report documenting the results of the analyses will be provided.

Schedule

USGS sampling will be carried out in the summer of 1984 and should be completed by October or November, 1984. Data should be reduced and available for use by March, 1985.

The report documenting the study will be available by June, 1985.

TASK 48

MAINSTEM HABITAT SUITABILITY FOR SALMON INCUBATION

Rationale

This task will provide baseline information required to make better evaluations of the suitability of mainstem habitats for salmon egg incubation. This information will support mitigation planning and the settlement and hearings processes.

Objective

Determine the suitability of mainstem habitat for successful incubation of salmon embryos under with-project conditions.

Description

With-project conditions in the mainstem Susitna River may result in more favorable spawning conditions for salmon. However, the suitability of these mainstem habitats for providing conditions for successful embryonic development has not been documented. The majority of incubation habitat studies have been directed at determining the conditions associated with chum salmon embryo development in slough habitats. Data on the habitat conditions at incubation sites of other species will be collected and analyzed to evaluate the potential of the mainstem to provide suitable habitat under with-project conditions.

Spawning areas in tributary habitats of salmon will be selected as study sites during the open water season. Embryo incubation chambers

containing salmon embryos will be placed within each study site and periodically removed. Specific data on temperature conditions and time since fertilization will be used to monitor the rate of development of embryos to determine the thermal units required to reach various developmental stages. This information will be compared with that available in published literature. Intragravel and surface water temperature data will be obtained on a continuous basis within each selected tributary throughout the incubation period. Intragravel standpipes will be placed in each study site to determine surface and intragravel water quality conditions (instantaneous temperature, dissolved oxygen, conductivity and pH) associated with embryo development. Substrate samples will be collected to characterize substrate conditions in selected habitats. This information will be combined and used to assess the habitat conditions associated with successful incubation and embryonic development.

The results of this analysis will be compared with habitat information obtained at selected mainstem sites where spawning under with-project conditions is expected.

Deliverables

A final report summarizing the potential suitability of mainstem habitats for providing successful incubation conditions under Project operation.

Schedule

Draft	August 31, 1985
Final	October 15, 1985

TASK 49

REFINEMENT OF ADULT SALMON HABITAT UTILIZATION DATA

Rationale

Additional salmon spawning habitat utilization data will refine the habitat utilization/suitability curves developed during FY84. This task will support the settlement and hearings processes.

Objective

To collect additional spawning habitat utilization data to expand and/or refine the data base used during FY84 and construct improved spawning habitat utilization/suitability curves.

Description

A limited spawning utilization data base is available for developing utilization curves for the Susitna River. Existing curves for pink and sockeye salmon are based principally on professional judgement and available literature. Weighted usable area calculations derived from spawning habitat utilization/suitability curves based on professional judgement and literature may lead to miscalculations of changes in useable spawning habitat as a function of changes in discharge.

Depth, velocity, substrate, surface and intragravel water temperature, and upwelling data will be collected at active salmon spawning sites. Site selection will emphasize IFG modeling sites, however, data will also be collected at other sites.

Deliverables

Refined spawning habitat utilization/suitability curves. Refined calculations of weighted useable area.

Schedule

Data collection will occur from July to October, 1984. Refine curves will be available by December 31, 1984. Revised weighted useable area estimates will be available by February 28, 1984.

Refined curves	December 31, 1984
Refined WUA estimates	February 28, 1985

TASK 50

REFINEMENT OF UPWELLING COMPONENT FOR SIDE-SLOUGH HABITAT ANALYSIS

Rationale

More point specific upwelling data are needed to refine the upwelling component for input to IFG hydraulic models. Refinement of these models with quantitative upwelling data will improve calculated weighted useable areas (WUA). This information will support impact assessment for the hearings and settlement processes.

Objective

Refine upwelling component for input to IFG-4 models used to estimate habitat vs. flow relationships in slough and side channel habitats.

Description

Intragravel water temperature and upwelling data will be obtained at a variety of discharges within each of the FY84 middle river IFG-4 modeling sites. These data will be input to the habitat models and refined estimates of WUA will be provided.

Deliverables

Recalculated estimates of WUA within middle river slough and side channel modeling sites to better evaluate changes in useable area (relative to upwelling) with change in discharge.

Schedule

Revised WUA estimates January 31, 1985.

TASK 51

HEAVY METAL LEACHING POTENTIAL FROM RESERVOIRS

Rationale

Leaching of potentially toxic heavy metals from newly inundated reservoir vegetation and soils is a possible problem during the early life of any reservoir. In the Susitna River some trace metals presently exist in concentrations higher than agency limits (Exhibit E, Chapter 2, pg. E-2-36) for protection of freshwater organisms. Knowledge of the potential for the project reservoirs to create toxic metal problems will be useful for addressing agency concerns and thus completion of the FEIS, settlement process and acquisition of the FERC License.

Objective

Summarize the potential for leaching of heavy metals from soils and organic matter within the newly impounded reservoirs.

Description

A literature search and analysis will be performed and related to the present level of limnological knowledge about the Susitna River. A qualitative assessment will be made of the project related changes which may occur in dissolved or particulate heavy metal cations such as:

- Arsenic
- Barium
- Beryllium
- Boron
- Lead
- Manganese
- Mercury
- Nickel

- Cadmium
- Chromium
- Copper
- Iron
- Selenium
- Silver
- Zinc

Deliverable

An expanded and refined version of the license application discussions and responses to agency concerns related to this topic will be provided in report form.

Schedule

Draft	March 1, 1985
Final	May 1, 1985

TASK 52

BASELINE STUDY OF MERCURY CONCENTRATIONS IN RESIDENT FISHES

Rationale

Determination of natural concentrations of mercury accumulated in the tissues of resident fish will provide baseline information for response to agency concerns regarding potential Project enhanced mercury bio-accumulation in fish. A baseline study will support the settlement process and acquisition of the FERC license. Bioaccumulation of mercury in fish tissue was raised as a potential problem in agency responses to the license application.

Objective

Determine the baseline or preproject levels of mercury in the tissues of fish resident to the Susitna River.

Description

ADF&G will collect and properly preserve representative samples of adult, piscivorous resident sport fish in the Sustina River:

a) upper river including Maclaren, Tyone and Oshetna tributaries;
b) reservior area reaches, including major tributaries;
c) middle reach
d) lower reach including the Chulitna, Talkeetna, Kashwitna, Deshka and Yentna Rivers.

Appropriately preserved samples will be sent to a predetermined laboratory for analyses by approved techniques to determine tissue mercury concentrations.

Discussion and summary of sample locations, sample preservation and analysis techniques, all data, and recommendations for future study will be presented in report form by H-E.

Deliverables

Report of baseline study.

Schedule

Draft report March 1, 1985.

Final report June 1, 1985.

TASK 53

LABORATORY ANALYSES

Rationale

Specific laboratory studies may be identified as important to resolve issues or questions connected to the settlement, hearings or over-all licensing processes.

Objective

Perform specified laboratory analyses that would resolve questions raised pertaining to the Susitna Project and which cannot be performed under field conditions.

Description

Although no specific activities have been determined for this task, potential laboratory studies which might be performed are:

1. incubation studies of chinook and coho embryos;

2. development of thermal preference curves for adult and juvenile andromous and resident fish;

3. interaction of temperature and turbidity affecting juvenile anadromous rearing.

Specific proposals for laboratory studies will be prioritized based on their own merits.

Deliverables

For each laboratory study performed in this task, the deliverables will include:

1. Detailed Plan of Study

2. Draft of Study Report

3. Final Study Report

Schedule

The schedule is not specified for this task.

TASK 54

GROUNDWATER STUDIES-WELL PUMPING TESTS

Rationale

The influence of mainstem flow on water temperature, quality and quantity in sloughs is an important aspect of the over-all assessment of impacts due to Project operation. Results of this study may help refine present estimates of the rates at which changes in mainstem hydraulic or thermal conditions are conveyed through the groundwater regime toward sloughs.

Objective

The purpose of this study is to obtain additional information to confirm the nature of aquifer materials in the vicinities of sloughs and to quantify the degree of hydraulic connections between the river and groundwater aquifers.

Description

This study will consist of field pumping tests of existing wells in slough 9 and analysis of the results. Currently available data have been compiled and analyzed and the results documented in a draft report entitled Susitna Hydroelectric Project Slough Geohydrology Studies. Results of the pumping tests will be utilized along with currently available data to define aquifer materials and the extent of the hydraulic connection between the mainstem and the sloughs.

Deliverables

Results of the analysis will be compiled into a report.

Schedule

Final report	prior to July 31, 1985

Appendix A

DRAFT

LOWER RIVER STUDY PLAN

1.0 INTRODUCTION

How do Tasks relate to this plan.

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.

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 evolve. This study plan provides a step-wise process to provide the Power Authority with data and information necessary to develop reliable descriptions of project-related impacts 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.

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.

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 and 5 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, Goose Creek, Sheep Creek, and the Kashwitna River.

↓ Cancell last sentence

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:

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

2) 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:

1) 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.

2) 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 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. 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 further 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.

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 resulting in downstream flows that 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 moving downstream (Table 4.1) due to the influence of tributaries. 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).

TABLE 4.1

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

4.1.2 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 flow scenarios. These will enable comparison of effects of other regimes on aquatic resources. 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.

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.

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 a river temperature model (SNTEMP) that has some advantage over the HEATSIM model (AEIDC, 1983b) in that it accounts for shading and tributary thermal

impact. Hence, the SNTEMP model enables a refinement of the results of the HEATSIM 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 is anticipated to be normal (i.e., 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.

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

TABLE 4.2

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.

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. 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 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

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.

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. The heavily glaciated basin of the Chulitna River results in considerable bed material movement in the Chulitna River. 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). In general, the total natural bedload measured in the Susitna, Chulitna, and Talkeetna rivers is two to five times larger than at Sunshine, indicting that the excess material is deposited somewhere above Sunshine, (e.g., either between Talkeetna and Sunshine or the Chulitna confluence and the Chulitna measuring station at Chulitna river mile 18). A large portion of the load is derived from the Chulitna which contributes approximately 15 times the bedload volume of the Susitna River near the confluence (page E-2-26, Chapter 2, license application).

Project-related changes in the flow regime (i.e., decreased flow in the summer and increased flow in the winter compared to natural conditions) will affect the amount of bedload material movement. Sediment 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. Thus, 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). Changes in channel morphology will affect bed elevation which affects river stage at a given discharge. 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. 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. However, 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. Therefore, further detailed studies of the lower river are necessary to define these impacts.

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 stage, temperature, and channel morphology. Many of the features affected by the ice are variables that affect the usability of habitat by fish (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).

Ice processes are primarily an interaction of temperature and discharge in addition to other factors (e.g., channel shape). Thus, project-related changes in temperature and flow will cause changes in the natural ice process, which in turn will impact processes (e.g., scour) that may affect fish habitat. An attempt to qualitatively model with-project ice processes was attempted by the Power Authority (pages E-2-124 to E-2-127 of the license application) using an ice simulation model (ICESIM). The downstream temperature model used was HEATSIM. This model could not be successfuly calibrated using available field data, thus current predictions of project-related ice processes are only qualitative. In the lower river, ice cover starts when an ice bridge forms in a constricted bend of the river near RM 10. Heavy slush ice from the upper Susitna, Chulitna, and Talkeetna basins where subfreezing temperatures first occur, begins to backup behind the ice bridge and causes an ice cover to progress upstream. With the project, frazil ice from the upper Susitna basin will be blocked by the dams and ice formation below the dams may be greatly delayed due to release of water that is warmer than natural conditions.

The volume of ice passing Susitna Station from the Yentna and Susitna rivers needs to be quantified and correlated to time of ice bridge formation at RM 10. During ice formation, increases in river stage cause side-channels to be overtopped and large expanses of the floodplain are covered with water and ice. However, these high river levels are temporary, as water levels drop after the ice front progresses upstream and open leads develop. Higher winter flows with the project may increase staging and 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 will affect aquatic habitat. This assessmet is particularly important for potential with-project effects on side-channel and slough habitats.

It must be recognized that ice processes may be so dynamic that quantitative predictions of with-project conditions may be impossible through a modeling effort.

5.0 AQUATIC STUDY COMPONENTS

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

In addition, there is a need to determine escapement numbers for adult salmon for the entire Susitna River. Because such a study would apply to the entire basin, it is not specifically addressed here. However, studies to assess these numbers are needed and will be undertaken by ADF&G.

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 would be 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. If not, no further studies would be pursued.

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. Surveys for spawning by pink, chum, coho, and sockeye have been conducted in lower river tributaries (e.g., Birch Creek) between Sunshine and Talkeetna. These surveys have been limited in scope (e.g., ADF&G 1981AA - Appendix Table EJ).

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. 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
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/

dro

a/ 1976-1980 counts (ADF&G/Kubik, S.W.), 1981 and 1982 from ADF&G Susitna Hy (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 Study Location

Since the lower river had eight major and numerous smaller tributaries plus riverine associated habitats extending over 98 miles, it is necessary to

utilize a site selection procedure for evaluating salmon access. Therefore, study site selection will be based on: 1) degree of potential habitat utilization, and 2) extent of habitat dewatering expected under with-project flows. Representative sites will be selected within each of the river segments described in Section 3.0 to insure evaluation of the entire lower river reach. Sites considered most importance based on this criteria will be studied. Sites of lesser importance but utilized for access will be evaluated from a study of a subsample of representative sites.

5.2 CHANGES IN AVAILABILITY OF SPAWNING HABITAT

5.2.1 Background

The magnitude of spawning in side-channels and the mainstem were evaluated in 1981 and 1982 by the ADF&G (1981, 1983-AA). Other than 6 sites where spawning chum salmon were found in 1981, salmon were not found spawning in side-channel or mainstem sites.

Some data on salmon spawning habitat in the lower river is available in ADF&G Aquatic Habitat and Instream Flow Reports, including depths, velocity, substrate, and temperature (see Table 5-2 for the location of this data).

TABLE 5-2

INFORMATION AVAILABE 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, Appedix C	1983

However, because significant changes may occur in the lower river that may alter the characteristics of habitat in an area, this data may not be comparable with information collected in other years.

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.

5.3 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 habitt (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

TABLE 5-3

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)

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:

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.

5.4 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).

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 SNTEMP 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 relation-ships 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.

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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 component in the establishment of an acceptable flow regime is navigation between Devil Canyon and Cook Inlet.

Previous studies have addressed the navigation issues, 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 Kashwitna Landing, Willow Creek, Alexander Slough and near Talkeetna. The studies have focused on the reach between Devil Canyon and Talkeetna rather than the reach between Talkeetna and Cook Inlet because the percent change in flow in the reach between Devil Canyon 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. Therefore, 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, where 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 range, 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 determine the project related 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 Transportation

1. Determine winter use of the river as a transportation 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 Resources 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-2-138 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.

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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 be undertaking a creel survey this summer. It is proposed that this survey be expanded to include a survey of navigation use of the 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 surveys will include 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 frequency 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, scenic locations, etc. will be identified 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 reaches not dewatered but where navigation could be restricted, will be identified. For those areas 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 determined from a comparison of the aerial photographs 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 natural 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 will be monitored. At high flows, estimates will be made of the surface velocity to determine if the high velocities 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 difficulties would be encountered. This information will be used in conjunction 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 investigated where potential navigation difficulties have been identified.

Since reduced river discharges result in not being able to travel as far upstream in sloughs and side channels, the effects on the ability of boaters to reach their final destination will be assessed. The additional distance that boaters must travel by means other than boat to reach their destinations will be calculated for those routes more frequently travelled. This 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. The tributaries considered will be the lower river tributaries currently used for navigation. This task will be coordinated with lower river sediment and tributary fish access studies.

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. Education (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 corridor, frequency of use, purpose (recreation, trapping, transportation to land disposal areas), and method of transportation (snow machine, all terrain 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 plane access

Periodic overflights 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.

Coordination Requirements

Field data collection will be coordinated with the Alaska Department of Fish and Game and R&M Consultants. The studies 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.