SUSITNA HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

TERRESTRIAL PROGRAMS

FISCAL YEAR 1984 DETAILED PLAN OF STUDY

HARZA-EBASCO
SUSITNA JOINT VENTURE

DOCUMENT No. 1190

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

TERRESTRIAL PROGRAM
DETAILED PLAN OF STUDY
FISCAL YEAR 1984

Report by

Harza-Ebasco Susitna Joint Venture

Prepared for

Alaska Power Authority

January 1984

TABLE OF CONTENTS

Table of Contents (cont'd)

Table of Contents (cont'd)

LIST OF FIGURES

1.0 INTRODUCTION

1.1 BACKGROUND

Task 4, the Environmental Program for the Susitna Project, is subdivided into three major areas of activity. These are: Social Sciences, dealing primarily with cultural, socioeconomic, recreation, aesthetic and land use resources issues; Terrestrial, dealing with wildlife and botanical resources issues; and Aquatic, dealing with fisheries, aquatic habitat and water quality resource issues.

The general and specific objectives for each of these three programs have been presented, along with the overall methodologies by which these objectives will be accomplished in the general investigation memoranda.

This document presents a detailed plan of study for Terrestrial Program Impact Assessment and Mitigation Plan Refinement Efforts in Fiscal Year 1984. Included are plans to accomplish all field data collection, analysis, assessment and mitigation planning activities scheduled for this period. Study subtasks are defined for each such activity and include, as appropriate, the following elements:

- a clear statement of the objectives of the subtask and the hypotheses to be tested;
- a summary of previous studies;
- a delineation of study area boundaries;
- data specifications and formats;
- detailed descriptions of methods, including sampling locations, frequencies, and techniques as appropriate;

- o data management and analysis techniques;
- o specification of reports, report formats, and schedule for deliverables;
- o requirements and methods for coordination with other studies;
- o quality assurance plans and specifications; and,
- o schedule for study completion.

1.2 TERRESTRIAL PROGRAM

The Terrestrial Program of Task 4 consists of four categories of activities. These are: (1) general and administrative tasks (e.g., subcontractor management, project progress reports); (2) direct FERC support tasks (e.g., responses to agency comments on the license application, responses to FERC supplemental information requests); (3) engineering support-related tasks (e.g., transmission line studies, evaluation of impacts of design refinements); and (4) impact assessment and mitigation plan refinement tasks. The Terrestrial Program General Investigation Memorandum generally covers all four of these categories. This plan of study specifically covers only the fourth category, but at a greater level of detail.

A variety of work activities in the impact assessment and mitigation plan refinement category are either currently underway or planned. All of these activities will support the production of two major reports: an Impact Assessment Update and Refinement Report in April 1984 and a Mitigation Plan Refinement Report in May 1984. Specific activities which will support these reports include field studies, modeling efforts, literature review, and other specific analyses.

Section 2 of this document presents a statement of objectives. Preparation of the Impact Assessment and Mitigation Reports mentioned above and other

general tasks are described in Section 3. A detailed description of the specific study tasks and subtasks that will support the preparation of these major reports is provided in Section 4. Section 5 presents an overview of the schedule and deliverables for Fiscal Year 1984 and a description of the Terrestrial Quality Assurance Program is provided in Section 6.

2.0 STUDY OBJECTIVES

The general objectives of the studies described in this detailed plan are as follows:

1. to develop coordinated, effective data collection and analysis programs which facilitate evaluation of project effects and planning for mitigation of the proposed project adverse effects;

2. based on these programs, develop an updated and refined assessment of project impacts; and

3. based on the data collection and analysis programs and the updated and refined impact assessment, develop a refined mitigation plan showing how the effects of specific impact mechanisms will be avoided, minimized, rectified, reduced, or compensated.

3.0 GENERAL APPROACH

3.1 GENERAL METHODOLOGY

3.1.1 Settlement Process

Refinement of terrestrial impact assessments and mitigation plans is an ongoing process that is necessary to support licensing of the Susitna Project. This process has been organized into four overlapping phases.

The first phase involves identification of issues resulting from FERC, other agency, and public comments concerning wildlife and botanical resource impacts associated with the Susitna Project and in need of resolution for licensing of the project. These issues have been identified through workshops, individual agency meetings, agency letters, formal agency comments on the draft and final FERC License Application, motions to intervene, and the FERC EIS Scoping Process, as summarized in the FERC Scoping Documents. A table providing a preliminary list of the agency-raised issues identified to date, along with the source of the originating concern, is provided as Appendix A.

The second phase of this process is the discussion of each issue with appropriate agency and subcontractor personnel in order to develop a final list of the issues to be addressed during the licensing process. Such discussions will allow the combination of overlapping or interrelated issues into a single, more inclusive issue and the early elimination of issues based on misunderstandings or lack of access to certain data bases or analyses.

Phase three involves meetings with appropriate agency and subcontractor personnel to develop appropriate programs to resolve the remaining issues. This phase will be conducted through a series of technical meetings. The programs can range from a simple written response, defining why the issue does not justify further study, to extensive field programs. A Detailed

Plan of Study will be prepared for each extensive field or office study. The fourth and final phase of the process is the management or conduct of these programs in a manner that will ensure that program results are affectively utilized to resolve the issues and enhance the environmental compatibility of the Project. The goal of this process is the development of an equitable settlement of issues.

3.1.2 Tracking and Documentation System

It is important that a "bookkeeping" system be developed and applied to the Terrestrial Program issue settlement process so that the current status of impact assessment and mitigation planning for each impact mechanism can be documented and tracked through the process. This is necessary even though there is a broader tracking system for the entire settlement process (being maintained by Task 6, Licensing and Permitting) because many agency-raised and other issues are general (i.e., impacts not adequately quantified--Issue T-20 Appendix A) and tracking and documentation of the resolution of these issues requires an examination of each impact mechanism.

The tracking and documentation system being implemented for the Terrestrial Program consists of a table maintained on a word processing system that includes columns listing: (1) each species or other appropriate biological unit; (2) each impact mechanism potentially affecting each species/biological unit; (3) the status of impact assessment for each impact mechanism (i.e., a brief description of how it was assessed, how adequate/inadequate and quantitative/qualitative the assessment was and a reference to the document(s) and page(s) where the assessment is located); (4) a brief description of the additional information or analyses required to complete the assessment; (5) a brief description of how, and to what extent, the impacts resulting from each impact mechanism will be mitigated as described in the License Application; and (6) a brief description of any refinements to the mitigation plan made since submittal of the License Application, along with a reference to the detailed description. Two draft example pages of the Tracking and Documentation System are provided in Appendix C. A draft of the entire Tracking and Documentation System will be available in December 1983. The table will be updated quarterly and will be used at the Terrestrial Program progress review and planning meetings as the basis for reporting progress and planning future activities. The table will provide a means for grasping the total scope of unresolved issues so that prioritization of work efforts can be clearly made.

3.1.3 Impact Assessment Update & Refinement Report

Central to the Terrestrial Program impact assessment and mitigation plan refinement process will be the preparation of an Impact Assessment Update and Refinement Report. This report will supplement the FERC License Application by providing an updated impact assessment which is based on all new information collected since the application was prepared and by refining the analyses conducted for the application where it is apparent that analyses need refinement.

The specific objectives of the Impact Assessment Update and Refinement Report (Assessment Report) are to:

(1) Provide an updated and more quantitative assessment of impacts upon which to base mitigation planning, making full utilization of data collected since the License Application was prepared, as well as previous data;

(2) Resolve as many items in the agency-raised issue list, the agency comments on the License Application, motions to intervene, and the FERC scoping issues list as possible.

(3) Provide FERC with an updated and more quantitative assessment of impacts upon which to base the preparation of their FEIS.

After the License Application was prepared, a complete set of big game studies annual reports was published (spring 1983). Data contained in these reports were only partially considered in the License Application. Another set of annual reports is currently under preparation for publication in April 1984. Also, additional data have been collected on plant phenology in and near the impoundment zones and on beaver colony abundance between Devil Canyon and Talkeetna and downstream of Talkeetna. In addition, refinements have been made to simulation models, which have been prepared to improve our understanding of the net or cumulative effects of the project. These items

represent the new information or refinements that will be considered in the preparation of the Impact Assessment Update and Refinement Report.

Updating the impact assessment with this new information will, in itself, allow resolution of many terrestrial issues. Additional analyses and refinements to existing analyses will be conducted as necessary, in order to resolve additional issues raised by the agencies and intervenors, or identified by FERC.

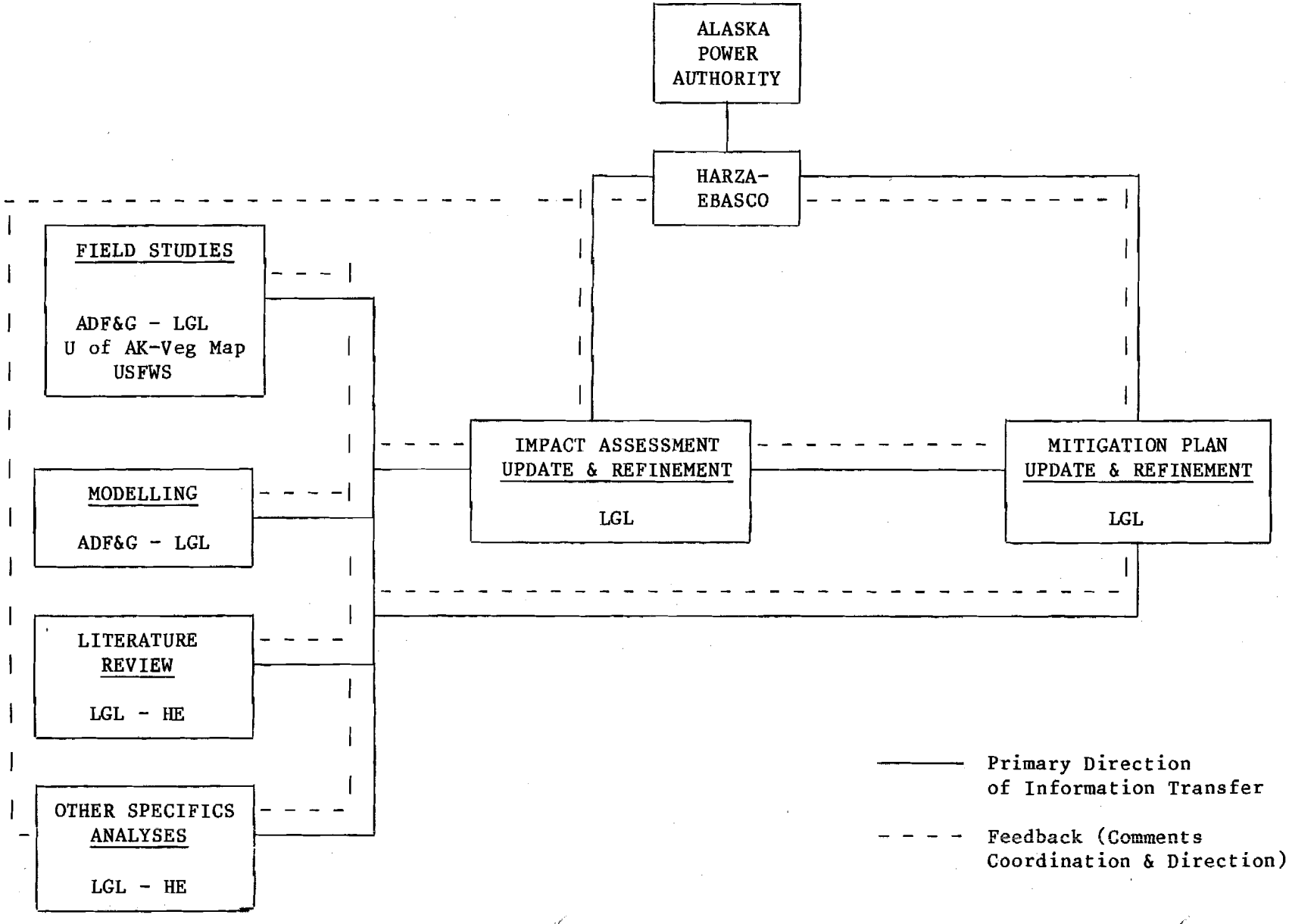
All updates and refinements will be documented by describing and referencing them in the Impact Assessment/Mitigation Plan Tracking & Documentation System. This system will also be used to indicate when an issue is addressed or resolved by an update or refinement.

The Impact Assessment Update and Refinement Report will be prepared by a core team from LGL who will receive direction and technical review from Harza-Ebasco. The core team will coordinate directly and frequently with the principal investigators responsible for conducting the specific study tasks described below, in order to obtain the most up-to-date information available for the impact assessment. This coordination will ensure that the principal investigators are responsive to the outstanding terrestrial issues in preparing their reports and designing their studies. The relationships among the various impact assessment and mitigation plan refinement efforts, in terms of information transfer and responsibilities, are presented in Figure 3-1.

The schedule for preparation and completion of the Impact Assessment Update and Refinement Report is designed to ensure that the report will be available as input into the FERC Final Environmental Impact Statement (FEIS). Important milestone dates are presented below.

Initiation of Work	December 19, 1983
Preliminary Draft Completed	March 30, 1984
Final Draft Completed	April 15, 1984
Final Report Completed	April 30, 1984

Figure 3-1. Terrestrial Program: Impact Assessment/Mitigation Plan Refinement Information Flow and Responsibilities



3.1.4 Mitigation Plan Refinement Report

A conceptual terrestrial mitigation plan is presented in the License Application. There is a need to develop and describe the specific procedures to be followed in implementation of this plan. In addition, there is a need to make modifications and refinements to the plan in response to agency and public concerns voiced since the License Application was published. Further, the plan will need to be refined based on the updates and refinements made to the impact assessment and described in the Impact Assessment Update and Assessment Report (Section 3.1.3). The Mitigation Plan Refinement Report will provide the documentation for these modifications and refinements.

The specific objectives of the Mitigation Plan Refinement Report are to:

(1) Develop and describe specific procedures to be followed in implementation of the mitigation plan;

(2) Develop and describe modifications and refinements to the plan in response to the ageney-raised issues list, the ageney comments on the License Application, motions to intervene, and the FERC scoping issues list:

(3) Provide FERC with a refined mitigation plan for incorporation into their FEIS; and,

(4) Refine and describe the long-term plan for resolving outstanding issues and finalizing the mitigation plan.

Following review and approval by the Power Authority, Mitigation plan refinements will be documented by describing and referencing them in the Impact Assessment/Mitigation Plan Tracking and Documentation System (Section 3.1.2).

The Mitigation Plan Refinement Report will be prepared by a core team from LGL with direction and technical review from Harza-Ebasco. The work will be conducted simultaneously with work on the Impact Assessment Update and Refinement Report, but will be completed about one month after the latter report. It will be completed, however, in time to be used as input into the FERC FEIS. Important milestone dates are presented below:

Initiation of Work	December 19, 1983
Preliminary Draft Completed	April 30, 1984
Final Draft Completed	May 15, 1984
Final Report Completed	May 30, 1984

3.2 SPECIFIC STUDY TASKS

In addition to the general work tasks just described many specific study tasks are planned (described in Section 4). These tasks are organized by major species or other appropriate biological unit and often include a variety of subtasks. The subtasks consist of field studies, modeling efforts, literature reviews, or other specific analyses designed to gather or refine data needed to support impact assessment or mitigation plan refinement for the particular species or biological unit. All subtasks are designed to provide direct support for either the Impact Assessment Update and Refinement Report or the Mitigation Plan Refinement Report (see Section 3.1).

3.3.1 Progress Review and Coordination Meetings

A systematic means of ensuring that good coordination occurs will be implemented through regular progress review and coordination meetings. These meetings will be attended by the Harza-Ebasco Terrestrial Group Leader, LGL Project Manager, ADF&G Research Coordinator, ADF&G Habitat Division reviewer, and a USFWS project reviewer. In addition, it is expected that Power Authority Staff will attend as time permits and additional staff members from Harza-Ebasco, LGL, ADF&G, USFWS, U of A Palmer Experiment Station, U of A Museum and U of A Cooperative Wildlife Research Unit, will attend as necessary. Members of the Aquatic, Hydrology and Social Science Study Teams will also attend as appropriate to ensure that activities are coordinated with these groups and to obtain their technical expertise as the need arises.

Progress review and coordination meetings will be conducted monthly, or more or less frequently as the need arises. These meetings will provide a forum for each major entity of the Terrestrial Study Team to report on their activities for the previous period, including preliminary results of field studies, and to discuss their planned activities. The meetings will also provide the opportunity for Terrestrial Study Team members to modify their activities so that they provide more useful input to other activities in a timely manner. These meetins provide an opportunity for regular input from ADF&G Habitat Division and USFWS project reviewers. Minutes covering each of these meetings will be prepared by and distributed to all Terrestrial Team members.

3.3.2 Workshops

Another form of information transfer and coordination is through workshops. A large workshop on terrestrial modeling efforts was held in spring 1983. A draft report was prepared presenting the status of terrestrial models, as refined at the workshop and associated technical meetings, and identifying information needs for further model refinement. This report will be finalized in January 1984, following receipt of review comments from Terrestrial Study Team members.

A 1984 Workshop is currently planned for spring 1984. This workshop will inform all interested parties on the status of the terrestrial model, and issue resolution status, and will provide for critical review and input on further model refinements and issue resolution.

3.3.2 Workshops

Another form of information transfer and coordination is through workshops. A large workshop on terrestrial modeling efforts was held in spring 1983. A draft report was prepared presenting the status of terrestrial models, as refined at the workshop and associated technical meetings, and identifying information needs for further model refinement. This report will be finalized in January 1984, following receipt of review comments from Terrestrial Study Team members.

A 1984 Workshop is currently planned for spring 1984. This workshop will inform all interested parties on the status of the terrestrial model, and issue resolution status, and will provide for critical review and input on further model refinements and issue resolution.

3.4 FY85 WORK SCOPE DEFINITION

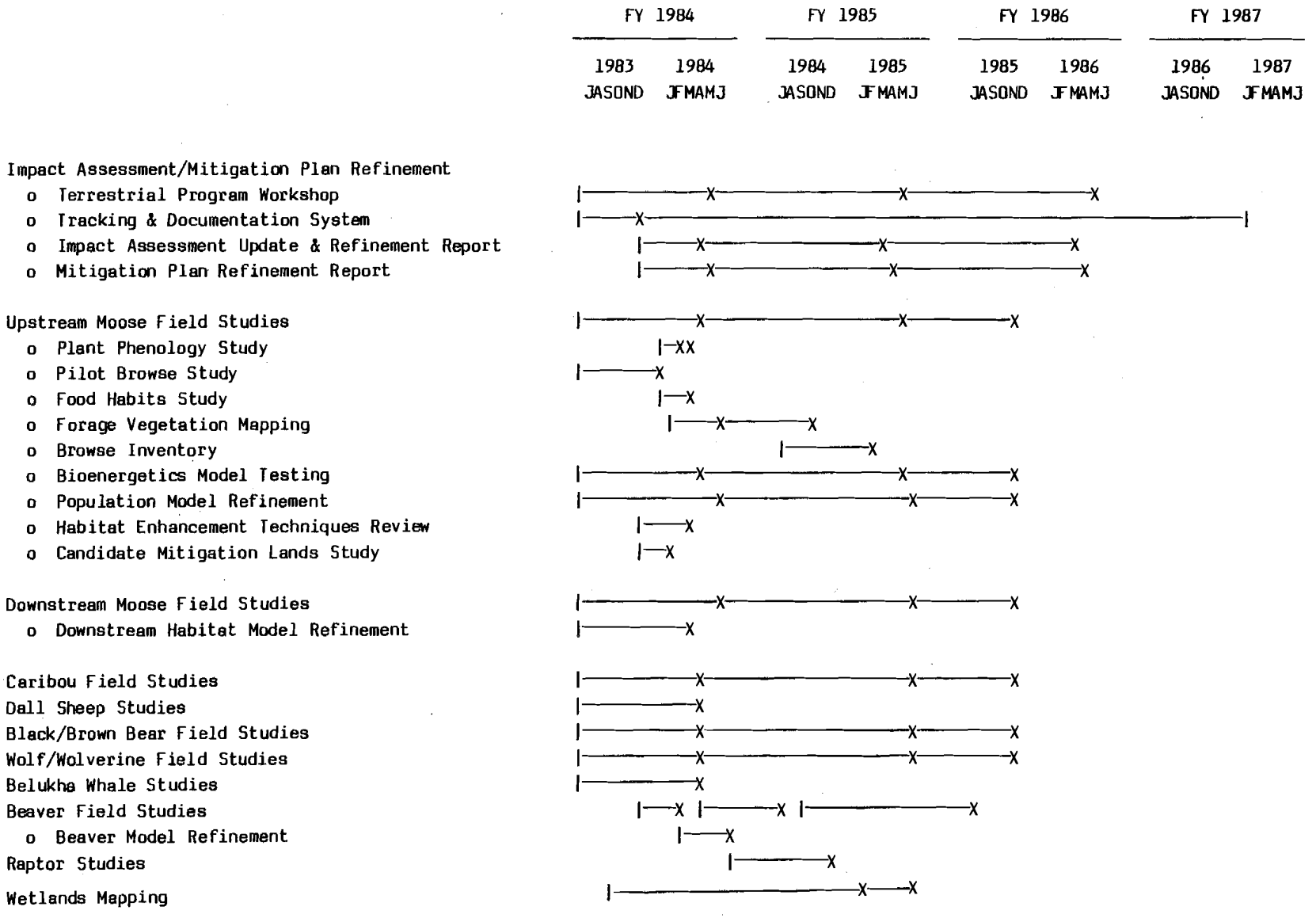
Work scope definition for FY85 will be conducted in a manner that will ensure that all work efforts are designed to resolve or assist in resolving issues pertinent to the Settlement Process. Requests for proposals (RFP) will be prepared by Harza-Ebasco with subcontractor input. These RFPs will reflect the data and other information needs determined through analysis of issues and updating and refining the terrestrial impact assessment and mitigation plan. Following preparation proposals will be reviewed, modifications will be recommended if necessary, and revised proposals will be prepared. These revised proposals will be used as the basis for work scope finalization, upon which subcontracts and RSAs will be prepared. The schedule for these activities is as follows:

Prepare and send RFPs	February 25, 1984
Proposals Prepared	March 25, 1984
Proposal Modifications Recommended	April 10, 1984
Revised Proposals Prepared	April 25, 1984
Work Scopes Finalized	May 10, 1984

3.5 LONG-TERM PLAN

A preliminary long-term plan for terrestrial impact assessment and mitigation plan refinement is presented in Figure 3-2. This plan assumes that all field activities necessary to support impact assessment and mitigation plan refinement will be completed in FY84 and FY85. Model refinement and report writing activities will extend into early FY86 and the Final Impact Assessment Update and Refinement Report and Mitigation Plan Refinement Report will be prepared by the end of 1985 (mid FY86).

Figure 3-2. Preliminary Long Term Schedule: Terrestrial Impact Assessment and Mitigation Plan Refinement



4.0 SPECIFIC STUDY TASK DESCRIPTIONS

4.1 UPSTREAM MOOSE

4.1.1 Backgound

Moose represent one of the most important species which could be significantly impacted by hydroelectric development along the Susitna River. Therefore, in response to various early hydroelectric proposals, some general population assessment work was begun in 1974 (USFWS 1975). This study was funded for 1 year and consisted of a series of reconnaissance flights to identify moose concentration areas. In 1976, limited funds became available to begin gathering baseline data on moose movements and habitat use for areas which could be impacted by the Corps of Engineers two dam proposal (Taylor and Ballard 1978; 1979; Ballard and Taylor, 1980). These initital studies focused on areas lying north of the Susitna River and were conducted from March 1977 through spring 1978, with limited follow-up work from spring 1978 through spring 1979. Results of these preliminary studies identified some potential problem areas and data gaps which required additional study for better assessing the impacts of the two dam system on moose.

The most significant data gaps identified in these preliminary studies were: the lack of moose movement data for areas lying south of the Susitna River; and, accurate moose population estimates for the entire project area (Ballard and Taylor 1980). Funding for the original project terminated in spring 1979 and little work was conducted until January 1, 1980, when the Alaska Power Authortity contracted the ADF&G to conduct more intensive studies. The purpose of these studies were to gather more intensive data on moose movements, habitat use and the size and trend of moose populations inhabiting areas which could be impacted by the two dam system. In depth field studies were initiated in March 1980, when radio telemetry equipment was received. Results of the studies conducted from March 1980 through September 1981 are presented by Ballard et al. (1982a). Results of the continuation of these studies through early June 1982 are presented in

Ballard et al. (1983b). Intensive field studies are continuing with a new annual report due in April 1984. These efforts are described in Section 4.1.3.

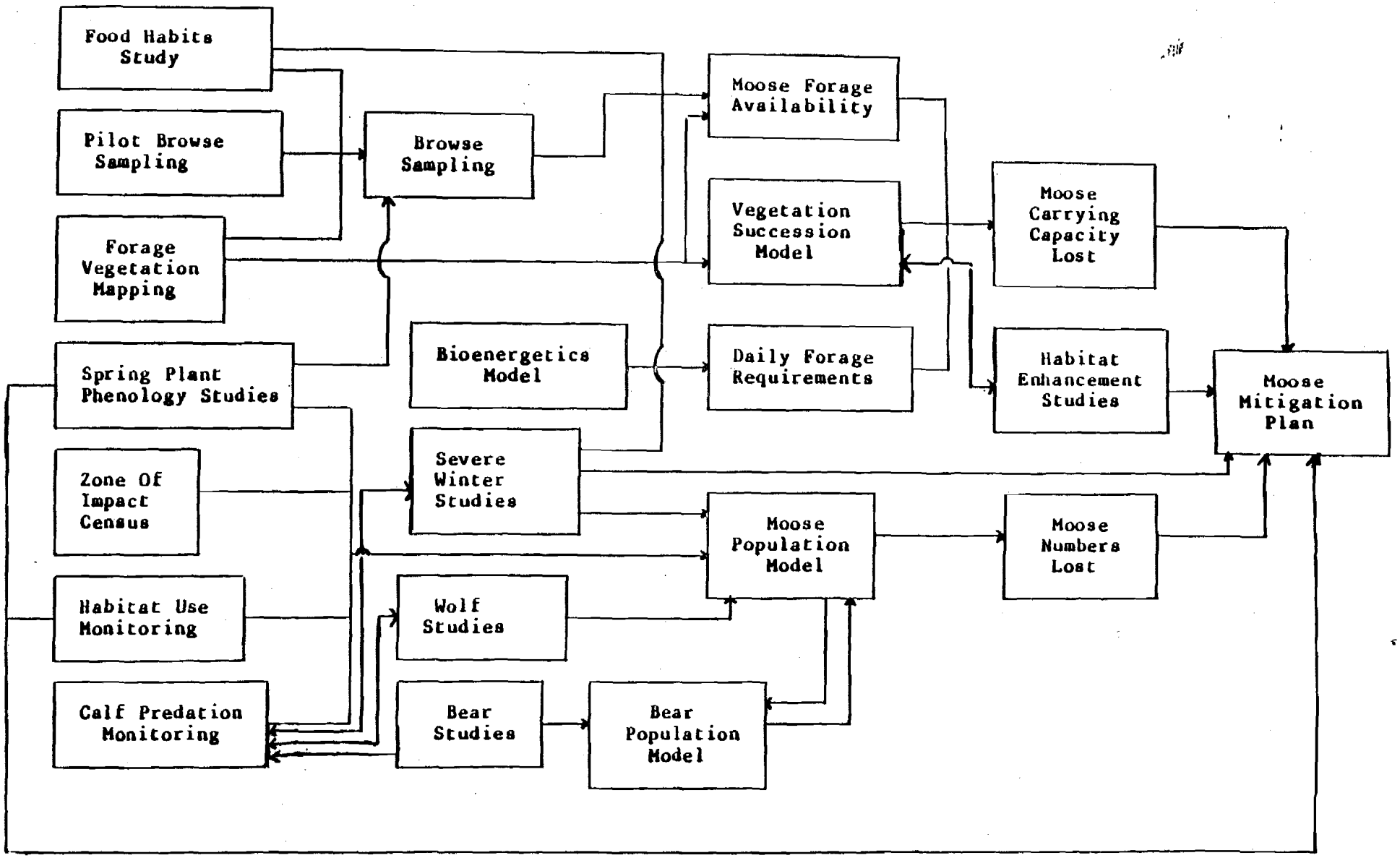
For purposes of home range determination, analysis of habitat utilization, elevational use, movement patterns, and other analyses, data from moose captured and studied in other areas of Game Management Unit 13 have been utilized. Details of these other studies are provided by Ballard and Taylor (1978, 1980), Ballard and Gardner (1980), Ballard et al. (1980, 1981b, 1982c, In Prep.), and Taylor and Ballard (1979).

4.1.2 Approach

Two approaches to refining the impact assessment for moose upstream of Devil Canyon are being followed. The first is based on studies of the existing population and attempts to predict how this population will respond to the project over time. The second is a habitat-based approach which attempts to estimate the potential to support moose of the habitat that will be altered or lost. The population approach has the advantage of predicting actual changes in moose numbers. It allows estimation of impacts that are not habitat-based, such as accidents and human-induced mortality. The habitat-based approach is useful for estimating changes in potential carrying capacity when existing populations are not fully utilizing their habitat and for direct comparison of specific acreages and the benefits of habitat enhancement techniques. Each approach will provide information necessary for evaluating the other and the integrated results of both are expected to provide the basis for mitigation planning. The linkages among the various work efforts designed to support these two approaches are shown in Figure 4-1.

The overall schedule for upstream moose impact assessment/mitigation planning work indicates that carrying capacity estimates will be available in early 1985 after completion of the browse inventory.

Figure 4-1: Linkages Among Components of Upstream Moose Impact Assessment and Mitigation Plan Refinement Efforts



Final estimates will be available in late 1985 after completion of the bioenergetics model testing. Final population model predictions, which are partially based on the final carrying capacity estimates, will also be available in late 1985. These estimates will be incorporated into the Final Impact Assessment Update Report and will be used to make the final refinements to the Mitigation Plan, both of which will be completed in early 1986.

Work efforts to be conducted during FY 1984 along with the responsible organization include:

1. Zone of Impact Census - ADF&G
2. Impact Area Habitat Use Monitoring - ADF&G
3. Calf Predation Monitoring - ADF&G
4. Severe Winter Studies (if severe winter occurs) - ADF&G
5. Spring Plant Phenology Study - U of A, Palmer
6. Forage Vegetation Mapping - Unknown subcontractor
7. Pilot Browse Sampling - U of A, Palmer
8. Moose Food Habits Study - U of A, Palmer
9. Browse Sampling - U of A, Palmer
10. Wolf Studies - ADF&G
11. Bear Studies - ADF&G
12. Bioenergetics Model Testing - ADF&G/USFWS
13. Bear Population Model Refinement - ADF&G/LGL
14. Moose Population Model Refinement - ADF&G/LGL
15. Habitat Enhancement Studies (monitoring winter use of downstream disturbed sites) - ADF&G
16. Habitat Enhancement Studies (literature review of habitat enhancement techniques)-Harza-Ebasco
17. Mitigation plan refinement (identification of candidate lands for habitat enhancement) - LGL

Plans of study for these work efforts including deliverable due dates and the specific issues each work effort is designed to address are provided in the following sections.

4.1.3 Upstream Moose Field Studies

Upstream moose field studies are described on pages 1-3 and 23-24 of ADF&G's FY 1984 Plan of Study, provided as Attachment B. The studies consist of four general work efforts: (1) the zone of impact census (designed to address Issues T-17, T-20, and T-39 in Attachment A); (2) impact area habitat use monitoring (designed to address Issues T-17, T-20, T-33, and T-39); (3) calf predation monitoring (designed to address Issues T-17, T-20, T-39, and T-44); and, (4) severe winter studies (designed to address Issues T-17, T-20, T-39 and T-41). The annual report for upstream moose field studies is due on April 1, 1984. This report will cover field studies conducted through the fall of 1983.

4.1.4 Plant Phenology Studies

4.1.4.1 Background. Studies on moose and bear subpopulations in the middle Susitna River Basin have documented general movement patterns of these animals into relatively low elevations within the proposed impoundment zones during late spring and early summer. It was suggested that this general movement pattern may be a response of the moose to earlier snow melt and the early development of vegetative growth at these lower elevations (Ballard et al. 1982;102). Ballard et al. (1982;102) suggested that the spring period was critical for moose. In a nutritionally stressed population, gestating cow moose may be the most deleteriously affected due to the demands placed upon them by the developing fetus. This trend is abruptly reversed when melting snow exposes previously unavailable forage and new plant growth becomes available. Ballard et al. (1982;102) suggested that the moose population may suffer significant mortality if prevented from moving to areas where early spring growth of vegetation, such as in the proposed impoundment zones, may occur.

Brown bear use of proposed impoundment zones was also most prevalent during early spring, soon after they emerge from their winter dens (Miller and McAllister 1982;55). They hypothesized that brown bear movements to the proposed impoundment zones during May were motivated by relatively earlier snow melt, especially
on south-facing slopes, which made these the first areas where overwintering berries could be found and also the first areas where new vegetative growth was available. Some of the areas of overwintered berries and early spring growth of vegetation currently used by bears will be inundated by the impoundments.

4.1.4.2 Objectives/Hypothesis. The objectives of the 1983 early spring plant phenology studies are to:

1. Document the spatial and temporal distribution of snow-free areas and of early spring growth of moose and bear forage vegetation adjacent to and within the impoundment zones of the Susitna Hydroelectric Project.
2. Evaluate phenological development of vegetation over elevational gradients and/or site-specific locations to determine the extent of planar area within each impoundment that provides early spring plant growth for moose and bear and that would be lost by inundation.
3. Describe and document relative utilization, by foraging, of early growth vegetation based on elevational gradients and/or site-specific locations.
4. Estimate relative abundance of overwintered berries for bears.
5. Evalute phenological development and relative abundance of species of Equisetum by elevational gradient, site-specific location and/or prioximity to the proposed impoundments for bears.
6. Collect spring moose and bear fecal matter for diet analysis, to be analyzed in a concurrent food habits study.

4.1.4.3 Study Area. Phenological development of forb, graminoid, and shrub species will be monitored between approximately April 25, and June 3, 1983, along line transects that will originate at a point above the maximum proposed pool elevation of each impoundment (Watana 2,193 ft., Devils Canyon 1,450 ft.) and extend down to the Susitna River. Placement of transects will be based on: 1) identification of areas known to contain local concentrations of moose and/or bear as defined by ADF&G biologists; 2) slope, aspect, and elevational gradients; and 3) prospective unique areas, such as sites where plant phenology on paired north-and-south-facing slopes are suspected to be substantially different.

4.1.4.4 Detailed Methodology. Approximately 32 line transects will be established at selected locations in the 2 impoundment zones. Two 1-person teams, spaced 50-100 m apart, will conduct parallel transects down the slope to the Susitna River. Each transect will follow a general compass bearing

and will be flagged at regular intervals to "permanently" mark each transect course for the duration of the field study. Two transects on opposing slopes of the Susitna River will be conducted by each person each day, totalling 8 transects per day. Each transect will be located on low altitude aerial photographs and contour maps, from which elevation information will also be taken. Each transect will be separated into 100 ft. elevational bands based on contour maps and an altimeter reading. Beginning and ending elevations for each elevation will be recorded. Transect lengths will vary from approximately 1 to 3 km, with information on vegetation recorded at 10 m intervals along the transect. Transects will be monitored at 7-day intervals unless rapid, early vegetation development indicates that shorter time intervals should be used.

Moose and bear fecal matter identifiable as early spring deposits will be collected when the opportunity presents itself, placed in plastic bags, labelled (date, transect #, stop #), and then frozen. Selected samples will be analyzed as part of a separate food habits study.

A 100 m line transect will also be established on the riverbank, parallel to the Susitna River, at the base of each downslope transect. The river transect will be located approximately midway between the riverbank and the edge of the area influenced by river dynamics. The same information on vegetation will be collected for the downslope transects, but at 5 m rather than 10 m intervals.

4.1.4.5 Data Management and Reports. Statistical analyses will evaluate the relationship between phenological state and the variables under study (elevation, slope, aspect, transect, snow depth, vegetation type), singly and in combination. For example, certain elevations may be associated with early greenup on the south-facing slopes but different elevations on the north-facing slopes. Snow depth at the time of an observation may not be relevant for phenological development during the period of observation, but may be relevant for the observation at a later period and will be analyzed with this purpose in mind. Utilization will be analyzed in the same way as

early greenup sites. These results will provide ranges of topographical, elevational and vegetation types that are associated with early greenup sites or sites where foraging has been observed. Maps can then be elevated for the extent of these topographical or elevational features, as well as the extent of later developing areas that are in the potential impoundment zones. This will be used to assess potential losses of early greenup areas due to flooding.

Once areas are stratifed by time of vegetation development, means can be obtained for the relative abundance of overwintered berries for bears. Statistical analyses for phenological development of Equisetum can be developed similar to those for vegetation in general. Additionally, the area can be stratified by presence or absence of Equisetum.

The spatial distribution of snow-free areas and of phenological stages of forage vegetation will be graphically presented for each transect for each observation period.

Deliverables will include the following:

1. A draft report of analyzed data and a discussion of results will be available on March 23, 1984.
2. A final report of analyzed data and a discussion of results will be available on April 30, 1984.

4.1.5 Forage Vegetation Mapping

This effort is designed to provide more detailed vegetation mapping, to be used for quantification of habitat-based impacts in general and, more specifically, to provide a more accurate basis for stratification of the browse inventory. In addition, the mapping will allow more precise habitat use/availability analyses to be conducted for big game species, thus, refining our ability to assess impacts.

The FY 1984 effort is designed to provide a product of sufficient quality to allow for improved statistical efficiency in the browse inventory. A preliminary draft map will be available on June 20, 1984. A final draft map is scheduled to be available on January 15, 1985. Completion of the mapping effort and the final product will be in FY 1985.

A detailed plan of study for completion of this subtask will be available by February 28, 1984. This subtask is designed to address Issues T-20, T-30, T-31, T-32, and T-33 (Appendix A).

4.1.6 Pilot Browse Study

4.1.6.1 Background. An inventory of standing crop biomass of plants important as moose browse is needed for the middle Susitna River Basin. Sampling vegetation to estimate standing crop biomass in the middle Susitna River Basin is difficult because there are many vegetation types that are important to moose, the area under consideration is very large, and vegetation patterning and distribution is mosaic with vegetation types intermixed, yet distinct. Biomass sampling is extremely labor intensive, both in the field and laboratory.

For these reasons, it has been decided that a pilot study be conducted to determine the most cost-efficient procedure to sample browse biomass, considering time and data variation constraints.

4.1.6.2 Objectives/Hypothesis. Specific objectives are to:

1. Determine optimal plot size for browse density estimations. Circular plot sizes examined will be 1 m^2, 2 m^2 and 4 m^2.

2. Determine the number of plots required to adequately estimate within 1% of the mean with 95% confidence density and number of plants to estimate biomass per sampling area within a vegetation type for each browse species.

3. Determine biomass by height strata for each browse species and vegetation type to account for snow accumulation making some forage unavailable.

4. Develop regression equations to predict browse biomass from shrub basal diameter, height, and/or width, twig counts and twig diameter-length-weight relatioanships.

5. Test the predictive ability of the equations.

4.1.6.3 Study Area. From past studies, we have determined that at least 13 vegetation tyes are important to moose in the middle Susitna River Basin. These are: woodland spruce-birch forest, open spruce-birch forest, open birch forest, woodland black spruce forest, open black spruce forest, woodland white spruce forest, open white spruce forest, low willow, low alder-willow, open dwarf birch, open dwarf birch-willow, white spruce-cottonwood forest, and aspen forest.

At least 3 sites in each vegetation type will be sampled. Emphasis will be placed on 10 plant species that bare important moose forage. Those plants are Betula papyrifera, B. glandulosa, Salix pulchra, S. glauca, S. lanata, S. alaxensis, Salix spp., Alnus spp., Populus tremuloides, P. balsamifera, and Rosa acicularis.

(R

4.1.6.2 Objectives/Hypothesis. Specific objectives are to:

1. Determine optimal plot size for browse density Circular plot sizes examined will be 1 m^2, 2 m^2 and 4

2. Determine the number of plots required to adequate within 1% of the mean with 95% confidence density a plants to estimate biomass per sampling area within type for each browse species.

3. Determine biomass by height strata for each browse vegetation type to account for snow accumulation maki age unavailable.

4. Develop regression equations to predict browse biomas basal diameter, height, and/or width, twig counts a meter-length-weight relatioanships.

5. Test the predictive ability of the equations.

land white spruce forest, open white spruce forest, low willow willow, open dwarf birch, open dwarf birch-willow, white spruc forest, and aspen forest.

At least 3 sites in each vegetation type will be sampled. Empl placed on 10 plant species that bare important moose forage. are Betula papyrifera, B. glandulosa, Salix pulchra, S. glauca S. alaxensis, Salix spp., Alnus spp., Populus tremuloides, P. and Rosa acicularis.

4.1.6.4 Detailed Methodology. To estimate browse density by species and vegetation type, two 60-m line transects will be established at each sampling site. Distance between transects will vary from 20 to 5 m in order to keep both transects within a homogeneous stand of vegetation. Browse density will be estimated at 12 locations along each transect, spaced 5 m apart, totalling 24 sample points per site. At each location all plants of the selected species rooted within 1 m^2, 2 m^2, and 4 m^2 circular plots will be counted by diameter class. Diameter classes will be in 10 mm increments. Circulatr plots will be delineated by rotating a rope, marked at the appropriate radius (56 cm, 80 cm, and 113 cm for 1 m^2, 2 m^2 and 4 m^2 plots, respectively), around a metal rod inserted into the ground at each location along a transect.

Analysis will consist of examining data variation in relation to plot size, time to read a plot of a certain size, and the estimated adequate sample size for each plot size. These parameters will be evaluated with regard to browse species and vegetation type. The plot size that results in the lowest data variability (e.g., smallest coefficient of variation), time to read, and smallest adequate sample size will be the optimum size selected.

To determine biomass, up to 30 plants of each of the 10 selected species present will be randomly selected for examination at each site. This should adequately represent the range of diameter classes within a stand. Search area in the randomization process for these plants will be confined to the homogeneous stand being sampled. The maximum height, maximum width, and width at a right angle to the maximum width will be measured to determine volume. The basal diameter of each plant will also be recorded. Each plant will be divided into height categories: ground level - 40 cm, 41 - 80 cm, and 81 - 250 cm. Plant materials > 250 cm in height will not be measured. All twigs and stems within a height strata that are less than or equal to a predetermined average (or maximum) diameter-at-point-of-browsing (DPB) will be counted. From each plant up to 30 twigs with leaves will be clipped at the mean (or maximum) DPB. All the leaves remaining on the plant will be harvested by height strata. The time it takes to sample each plant will be

recorded. The clipped twigs will be individually measured in the laboratory for length (fresh) and separated into old growth, current annual twig growth, and leaves. Samples will be oven dried at 60°C for 48 hours then weighed. Twig lengths and basal diameters will then be remeasured. Each twig and its associated components will be kept separate.

4.1.6.5 Data Management and Reports. To estimate time efficiency, transects will be run concurrently using the 3 plot sizes. The time it takes to establish each transect, to establish each plot-center, and to move from plot-center to plot-center will be constant for each plot size. Each plot size will have the same plot-center. The time needed to count the plants by diameter class within the plot will be recorded for each plot size.

Dry weight standing crop biomass will be determined for each twig component and leaves by species and vegetation type. An average biomass per height strata, per component, by plant species and vegetation type will be calculated. Basal stem diameter, height, width, and plant biomass relationships will be examined using regression models. Equations will be derived that predict plant biomass based on basal diameter, and for plant volume measurements. Equations will be derived to predict twig biomass based on twig basal diameter (DPB) and length relationships. Other relationships that will become apparent as the data is collected and analyzed will also be examined. Each equation can be tested for accuracy by extracting a subset of the data and checking predictions against actual values.

Using the equations derived from this pilot study and the data collected from the actual browse inventory study, kilograms of dry forage/ha can be estimated by incorporating plant density (#/ha) and mean biomass per plant for each species by vegetation type. The area of the middle Susitna River Basin occupied by a particular vegetation type will provide estimates of total forage biomass available to moose in the Basin. The effects of snowfall on forage availability can be evaluated through the estimates of browse biomass by height strata.

Deliverables will include the following:

1. A draft report of analyzed data, a discussion of results, and methodology recommendations for the 1984 browse inventory study will be available on January 20, 1984.

2. A final report will be available on February 10, 1984.

4.1.7 Moose Food Habits Study

4.1.7.1 Background. A nutritionally based carrying capacity model will be used to assess the impacts on moose of potential dam impoundments in the middle Susitna Basin. For the model to produce accurate simulation results, detailed information on forage quantity and quality, and on moose food habits on a seasonal basis is required.

Knowledge of moose food habits is necessary to determine what input data are needed for the carrying capacity model subroutines concerning vegetation quantity and quality. The plant species actually sampled to estimate biomass of forage will be based on the results of the moose food habits study.

4.1.7.2 Objectives/Hypotheses. The specific objectives of the moose food habits study are to:

1. Provide data on the seasonal foods of moose to be incorporated into the carrying capacity simulation model;
2. Determine specifically which plants will be sampled for the browse inventory study.

4.1.7.3 Study Area. To facilitate quantification of moose winter food habits the study area will be divided into nine sections. These sections correspond to areas occupied by moose subpopulations as defined by Ballard et al. (1982a). The nine areas also correspond to the locations of the 1983 phenology transects. All winter fecal samples will be categorized based on the area it came from and composited within each area.

4.1.7.4 Detailed Methodology. Microhistological examination of moose fecal samples will be used to estimate moose food habits (Sparks and Malecheck 1968, Dearden et al. 1975, Free et al. 1970). This procedure has many advantages applicable to this study as discussed by Holecheck et al. (1982).

About 49 moose defecations were collected by AAES during the 1982 season. Forty-six of the samples were collected during summer while three samples represent winter foods. Approximately 213 moose defecations were collected by AAES during the 1983 field season. About 194 defecations represent winter foods of moose. LGL collected an additional 12 late-winter samples. One spring and 18 summer samples were also collected by AAES during 1983.

Approximately 30-35 late-winter fecal samples are scheduled to be collected by W. Ballard (ADF&G) during adult moose radio-collaring operations in March 1984. Fifteen late-fall samples were collected by W. Ballard during October 1982. Approximately 15 spring fecal samples will be collected by W. Ballard during calf radio-collaring and mortality monitoring during May and June 1984.

Every effort will be made to identify individual shrub species within genera (i.e., Betula glandulosa, B. papyrifera, and species of Salix) if identifying characteristics can be established from the reference collections. Species of primary interest for winter moose diets are: Salix pulchra, S. glauca, S. lanata, S. alaxensis, Betula glandulosa, B. papyrifera, Alnus sinuata, and Vaccinium vitis-idaea. Summer diets will include the species for winter diets plus unidentified forb and graminoid categories. Efforts will be made to identify all plant fragments not included in the above species that may be found to make up a substantial portion of the diet within a given area.

Fecal samples will be composited by area and season, oven-dried at 60°C for 48 hours, then ground through a Wiley Mill. The dried and ground fecal material will be made into 10 microscope slides for each area and season. Twenty fields will be examined on each slide. A valid field has to contain at least two identifiable plant fragments. An identifiable plant fragment has to possess at least two histological identifying characteristics. The data recorded will be frequency of occurrence of plant fragments for each 10-slide set.

4.1.7.5 Data Management and Reports. Analysis of data on moose food habits resulting from this study will involve statistical comparisons among areas and seasons. Tables presenting means and standard errors will be provided. Results will also be related to other studies concerning moose ecology in the middle Susitna River Basin.

Deliverables will include the following:

1. A draft report documenting winter and summer diets based on microhistological analysis of moose fecal samples will be available on April 15, 1984.

2. A final report will be available on May 7, 1984.

4.1.8 Browse Inventory

The browse inventory is necessary to provide inputs to the vegetation submodel for the purpose of carrying capacity estimation (see section 4.1.9). With browse inventory inputs the vegetation submodel will produce estimates of the amount of forage available on the range to be surveyed. These estimates, combined with estimates of the daily moose forage requirements from the bioenergetics model will produce estimates of moose carrying capacity.

The FY 1984 efforts represent the planning and mobilizaiton for the browse inventory which is currently planned to be conducted in July and August 1984 (FY 1985). A draft report of results is scheduled for review by January 31, 1985, following field work, laboratory analysis of samples, data analysis, and report writing. Recent technical meetings following review of preliminary pilot browse study results suggest that modifications to this schedule may be forthcoming.

A detailed plan of study for this subtask will be available by March 31, 1984. This subtask is designed to address Issues T-20 and T-36 (Appendix A).

4.1.9 Bioenergetics Model Testing

The habitat-based approach to assessing impacts through changes in carrying capacity requires the use of at least two computer submodels; one to estimate the nutritional needs of the animals and the other to estimate the nutrients available in the range. The first is a bioenergetics model called the ruminant submodel. This model, which was developed at Colorado State University and modified for moose at the Kenai Moose Research Center (MRC), is undergoing field validation at the MRC during FY 1984 and 1985 (see pages B-20-22 of ADF&G's FY 1984 Plan of Study, provided as Appendix B). The second model, a vegetation submodel, estimates the total nutrients supplied by the vegetation available to moose. This model, which was developed by the Colorado Division of Wildlife, requires inputs specific for each range being evaluated. These inputs will be collected by the browse inventory program during summer 1984. If deemed necessary, a third model, which would be designed to represent vegetation succession, may be developed to allow consideration of the change in nutrient availability over time. A bioenergetics model testing annual report will be prepared by April 1, 1984.

4.1.10 Moose Population Model Refinement

Moose population modeling efforts for the Middle Susitna Basin were initiated in 1982 and refined in 1983. Refinements to the existing model will continue in FY 1984 primarily based on results of upstream moose field studies (Section 4.1.3). ADF&G Game Division will be responsible for moose model refinements.

A detailed plan of study for this subtask will be available by February 10, 1984. This subtask is designed to address Issues T-20 and T-34 (see Attachment A).

4.1.11 Habitat Enhancement Techniques Review

4.1.11.1 Background. The mitigation plan for moose, as described in the FERC license application, includes compensation for permanent habitat loss through enhancement of other lands (see description of this portion of the mitigation plan in Section 4.1.12.1). Much information has been collected relative to moose habitat enhancement in Alaska and many studies are currently underway. However, much of these data have not been published and to date no systematic review of the subject has been made. Therefore, there is a need to collect, review, and synthesize the information pertinent to the Susitna River Basin so that techniques may be compared in terms of their cost and effectiveness.

4.1.11.2 Objectives. The purpose of the Habitat Enhancement Techniques Review will be to prepare a report which provides information on the cost and effectiveness of habitat enhancement techniques for use in refining the moose mitigation plan. The specific objectives of the study are to:

1. Briefly describe moose winter habitat;

2. Describe the types and effects of habitat modification on winter moose forage;

3. Generally describe the types and effects of habitat modification on other resources; and,

4. Evaluate the effectiveness and cost efficiency of types of habitat modification for the Susitna River Basin.

4.1.11.3 Study Area. The report will be based on existing information, and will focus on information from Alaska and adjacent parts of Canada with similar environmental conditions. The data base will cover the range of Alces alces.

4.1.11.4 Detailed Methodology. The methodology for this review will include a thorough literature search and review of unpublished data, a synthesis of this information and a cost analysis. The literature review will include computerized literature searches, reviews of references collected by Alaska game researchers and managers, and review of the literature cited in publications on hand and to be acquired. Unpublished data and information will be acquired via interviews with Alaska resource managers and researchers, including but not limited to: the Alaska Department of Fish and Game (ADF&G), the U.S. Fish and Wildlife Service (USFWS), the U.S. Forest Service (USFS), and the U.S. Bureau of Land Management (BLM).

Data will be gathered for a cost analysis through interviews with personnel who have planned and performed prescribed burns, logging, forest regeneration, site preparation, and mechanical habitat alteration. This will include review of standard construction cost analysis references for heavy equipment and labor, and consultation with civil design and field personnel.

4.1.11.5 Reports. The Habitat Enhancement Techniques Report will consist of an annotated bibliography of all pertinent literature, a succinct review of unpublished information, and a synthesis of the information from the above that responds to the subtask objectives.

The following is a preliminary draft report outline:

I. Background
   - A. Brief Description of Susitna Project and its potential impact on moose
   - B. Report objectives
   - C. Brief description of data base

II. Moose Habitat

A. Characteristics of winter forage.

1. Preferred species

a. Age, height, etc.

2. Availability

a. Snow depth, etc.

b. Other factors

B. Other Habitat Characteristics (cover, etc.)

C. Brief description of Susitna River Basin factors controlling distribution and amount of forage

1. River erosion and depositon

2. Fire

3. Slope, aspect, elevation, climate, soils

III. Fire

A. Description of factors controlling fire

1. Wild fire

2. Prescribed burn

B. Factors controlling fire effects on moose browse

1. Pre-burn vegetation

2. Fire intensity

a. Fuel loading

b. Fuel moisture

c. Weather

3. Seed source

4. Location, shape and size of burn

C. Effects on resources other than moose

1. Other game animals

2. Non-game animals

3. Soil and water quality

4. Visual

5. Socioeconomic

IV. Logging

A. Factors controlling logging effects on moose forage

1. Prelogging vegetation
2. Logging methods
3. Past-logging forest regeneration site preparation
4. Past-logging site preparation for moose forage
5. Seed rain
6. Size and shape of logged area

B. Effects on resources other than moose

1. Other game animals
2. Non-game animals
3. Soil and water quality
4. Visual
5. Socioeconomic

V. Mechanical site alteration (MSA)

A. Brief description of techniques

1. Crushing
2. Chaining
3. Other

B. Factors controlling effects of each type of mechanical site alteration or moose forage

1. Pre-MSA vegetation
2. Seed rain
3. Specific technique

C. Effects on resources other than moose

1. Other game animals
2. Non-game animals
3. Soil and water quality
4. Visual
5. Socioeconomic

VI. Cost effectiveness

A. Comparison of effectiveness of various techniques in enhancing moose habitat

B. Comparison of costs of various techniques

VII. Recommendations

A draft report will be available for review by March 31, 1984. The final report will then be available on April 30, 1984.

4.1.12 Candidate Mitigation Lands Study

4.1.12.1 Background

Dams, reservoirs, spillways, and damsite borrow areas of the proposed Watana and Devil Canyon developments will permanently cover about 50,000 acres of vegetated land and water within the Middle Susitna Basin (License Aplication p. E-3-253). Habitat within the affected area will no longer be available to moose, and displaced moose will compete for food and space on surrounding lands, potentially reducing browse quality and thus the carrying capacity of these adjacent ranges.

At the time of License Application submittal, preliminary estimates by ADF&G (1982) indicated that some 2,400 moose might have home ranges within or overlapping an arbitrarily-established five-mile zone surrounding the impoundment areas. The License Application indicated that the fate of these estimated 2,400 moose following project construction was unknown, but that the reduced carrying capacity of the immediate project area would produce a long-term deceasing trend in the number of moose present.

The loss of moose carrying capacity likely to result from the project can be mitigated only through compensation: i.e., increasing the moose carrying capacity of other lands, or, retaining lands of high carrying capacity which would otherwise be lost through planned future development. The License Application indicated on a preliminary basis that compensation for permanent moose habitat loss would be provided through the controlled burning of roughly 6,400 acres of woodland conifer forest in the Middle Susitna Basin, and clearing or crushing of vegetation on about 16,000 acres in the Lower Basin (i.e., downstream from Gold Creek). These acreages were derived from an assumed three-fold increase in browse biomass during the peak years of browse production following the manipulation, based conceptually on studies such as Wolf and Zasada (1979), and Viereck and Schandelmeier (1980). To offset the effects of plant succession, the License Application further indicated that enhancement measures would be repeated every 15 to 20 years

during project life. Therefore, to implement the proposed mitigation, the Alaska Power Authority would require management jurisdication over at least 22,400 acres of land for at least 50 years. The goal of the study described here is to identify appropriate tracts of land which may be considered for this purpose.

4.1.12.2 Objectives

Specific objectives of the Candidate Mitigation Lands Study are:

- To identify and map tracts of land which, from a biological standpoint, will be suitable for habitat retention or manipulative enhancement for moose, emphasizing lands already under State of Alaska ownership;

- To assure that sufficient acreages are identified to allow for an increase in the estimated total required area which may result from ongoing refinement of impact assessment and mitigation planning beyond the level of development presented in the License Application;

- To assure that the acreages identified provide adequate flexibility for negotiation by the Power Authority with other Alaska state agencies, Federal agencies, or private entities;

- To discuss the options for land selection relative to (a) biological suitability, (b) cost-effectiveness, and (c) potential conflicts with other intended land uses, particularly those designated in the Susitna Area Plan.

4.1.12.3 Study Area

The study area for selection of candidate mitigation lands will be limited to the Susitna River Basin.

4.1.12.4 Detailed Methodology

LGL will prepare one or more annotated maps which will identify at least 100,000 acres of candidate lands for moose habitat enhancement or retention. This land area will be about five times greater than the approximately 22,400 acres called for in the License Application for moose habitat enhancement; will probably be adequate for selective habitat retention, if deemed appropriate; and will thus allow flexibility in final land selection.

Candidate lands will be identified by LGL through the systematic application of selection criteria to be approved in advance by Harza-Ebasco. The selection process will be documented in a concise report to accompany map submittal on January 15, 1983.

The specific methodology for the Candidate Mitigation Lands Study will include:

- development and confirmation of selection criteria, including agency concurrence;
- development and confirmation of an implementation procedure for the selection criteria, including agency concurrence;
- review of appropriate 1:500,000-scale mapping prepared by ADF&G and ADNR in support of the Susitna Area Plan, including draft maps of estimated existing moose carrying capacity, estimated potential moose carrying capacity, annual precipitation, land use designations, and proposed special wildlife management areas;

- meetings with representatives of ADF&G (including Area Biologists), ADNR, the Matanuska-Susitna Borough, and other appropriate agencies to obtain advice and assistance in applying the selection criteria;

- development of constraint maps through the application of selection criteria to specific geographic locations;

- meetings with Power Authority, Harza-Ebasco, and agency representatives to review the constraint maps and seek concurrence on provisionally identified candidate lands;

- following concurrence on identified lands, preparation of draft maps delineating specific tracts which optimally satisfy the selection criteria and which total approximately 100,000 acres, and

- preparation of a concise report (see below)

4.1.12.5 Data Management and Reports

A report entitled 'Recommended Candidate Lands for Moose Habitat Compensation" will be submitted to Harza-Ebasco no later than January 15, 1984. This report will document the selection process; describe the recommended land areas; and provide an overview of selection options, explaining potential pros and cons of each option relative to biological suitability, cost-effectiveness, and apparent conflicts with land-use designations within the Susitna Area Plan.

4.2 DOWNSTREAM MOOSE

4.2.1 Background

Prior to statehood, the Susitna Valley was ranked as the most productive moose habitat in the territory (Chatelain 1951). During this same time period, winter concentration greater than 22 moose/km^2 were observed. (Spencer and Chatelain 1953). More recent evidence indicates that concentrations and densities of moose in the Susitna Valley are greatest when deep snows in surrounding areas and at higher elevations persist into late winter and obscure browse species (Rausch 1959). Such dense aggregations are the probable result of immigration of moose seeking refuge and forage in lowland habitats. These moose come from numerous sub-populations, some from areas 30-40 km distant (LeResche 1974) and others from more than 110 km away (Van Ballenberghe 1977). It appears that many moose, from an extensive area and numerous sub-populations, utilize winter range in the Susitna River Valley.

If the hydrologic regime of the Susitna River is modified by the proposed project, riparian habitats downstream of the dam sites may be altered and winter moose movements may be inhibited. As a result, intensive studies of moose populations along the downstream floodplain were initiated in early 1980 and have continued through the present time (Modafferi 1982, 1983).

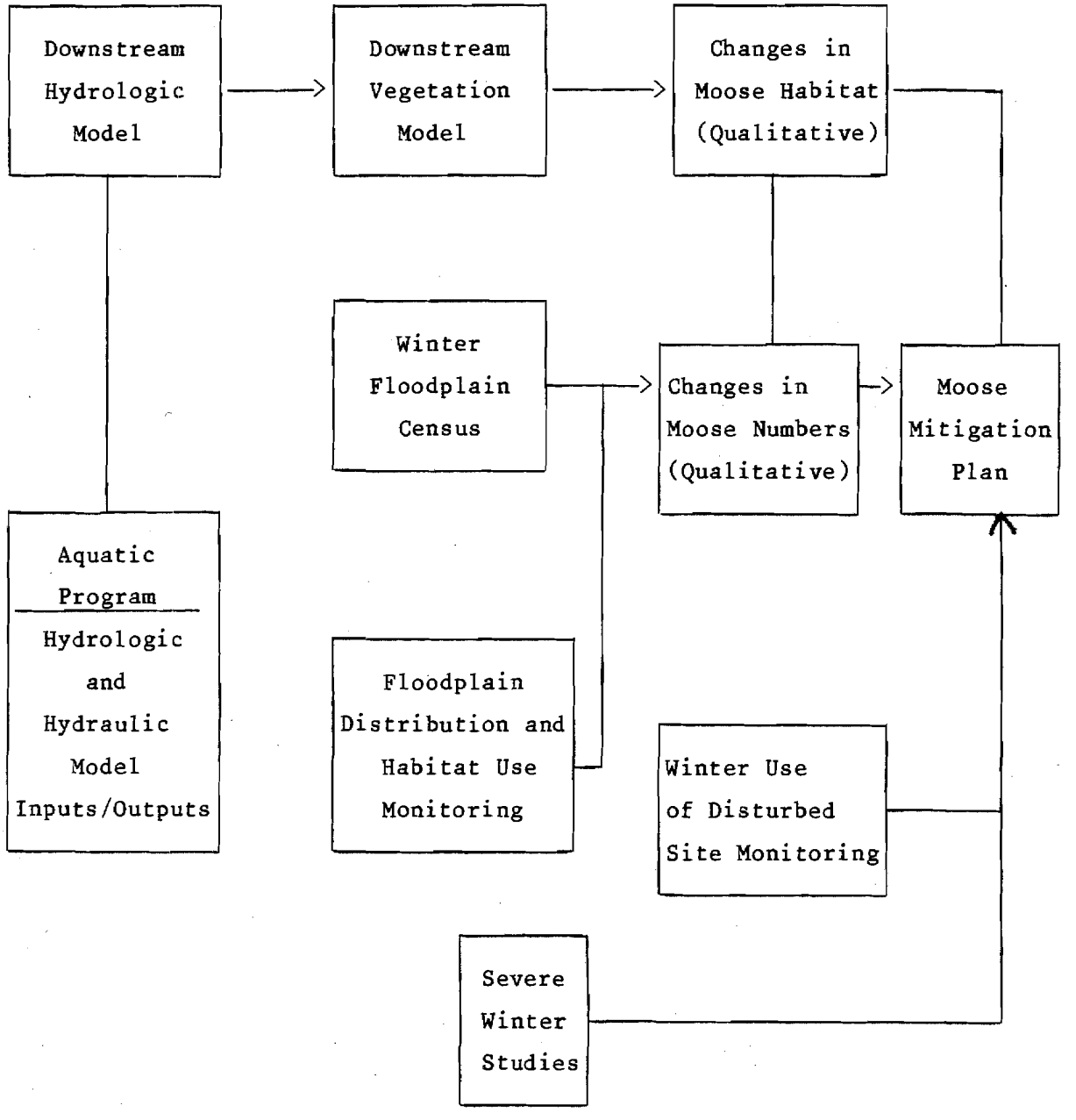
4.2.2 Approach

The impacts of the proposed project on moose downstream of Devil Canyon are being assessed by modeling the physical processes (e.g., flooding, ice scouring) affecting downstream moose habitat, modeling the changes in downstream moose habitat resulting from the modification of the hydrologic regime. Additionally, studies are underway to determine the magnitude, distribution, habitat selection, and timing of moose use of these floodplain habitats. Potential habitat enhancement measures are being studied by closely monitoring moose winter use of disturbed sites known to be heavily

used by moose in winter. Close coordination with the aquatic program will be maintained to assure consistency of inputs and outputs, where practical. Figure 4-2 portrays the linkages among the various work efforts involved in this approach.

All work efforts will be conducted at some level during FY 1984. A very weak link exists in the modeling efforts. This weakness is the lack of information on which to base the representation of the effects of physical processes on vegetation. This lack of information and the probable long-term nature of any studies that could be conducted to obtain the information, significantly limits the ability of the vegetation model to make quantitative predictions with a reasonable degree of accuracy. For this reason, the modeling efforts will be reevaluated to assess the value and role of the models and alternative assessment techniques in the overall effort.

Figure 4-2. Linkages Among Components of Downstream Moose Impact Assessment and Mitigation Plan Refinement Efforts



Work efforts to be conducted during FY 1984 along with the responsible organization include:

1. Floodplain Distribution & Habitat Use Monitoring - ADF&G
2. Winter Floodplain Censuses - ADF&G
3. Winter Use of Disturbed Site Monitoring - ADF&G
4. Severe Winter Studies (if severe winter occurs) - ADF&G
5. Downstream Hydrologic and Vegetation Model Refinement - LGL

Plans of study for these work efforts including deliverable due dates and the specific issues each work effort is designed to address are provided in the following sections.

4.2.3 Downstream Moose Field Studies

Downstream moose field studies are described on pages 4-6 and 23-24 of ADF&G's FY 1984 Plan of Study provided as Appendix B. The studies consist of four general work efforts: (1) floodplain distribution and habitat use monitoring; (2) winter floodplain censuses; (3) winter use of disturbed site monitoring; and (4) severe winter studies. The first three of these work efforts are designed to address Issues T-20, T-35, and T-40 (Appendix A) while the fourth work effort addresses Issues T-20, T-40, and T-41. The annual report for downstream moose field studies is due on April 1, 1984. This report will cover field studies conducted through fall 1983.

4.2.4 Downstream Hydrologic and Vegetation Model Refinement

Refinements to the downstream hydrologic and vegetation models will be made in coordination with the Aquatic and Hydrology Study Teams if a reassessment of the value of the models to the downstream assessment effort indicates it is justified. In addition, a reassessment of downstream impacts will be conducted based on a review of published and unpublished information and discussions with ice experts.

A detailed plan of study for this subtask will be available by February 28, 1984. This subtask is designed to address Issues T-1 and T-20.

4.3 CARIBOU

4.3.1 Background

The Nelchina caribou herd occupies a range of about 20,000 mi^2 in southcentral Alaska. This herd has been important to hunters because of its size and proximity to population centers. The herd has been studied continuously since about 1948 and records previous to that time are available. The U.S. Fish and Wildlife Service initiated research in 1948 which continued through 1959. ADF&G has been continually involved with the Nelchina herd since statehood and has conducted intensive research, population, harvest distribution, disease, and range monitoring studies (Skoog 1968; Lentfer 1965; McGowan 1966; Glenn 1967; Hemming and Glenn 1968, 1969; Pegau and Hemming 1972; Neiland 1972; Pegau and Bos 1972; Pegau et al. 1973; Bos 1973, 1974; ADF&G Survey and Inventory Reports 1970-1982). Skoog's (1968) doctoral dissertation, a major work on caribou biology, dealt largely with the Nelchina herd.

Intensive studies designed to evaluate the effects of the Susitna Project on the Nelchina herd were initiated in early 1980. These studies have continued through the present (Pitcher 1982, 1983).

4.3.2 Approach

The primary impacts of project development on caribou are likely to result from the partial barriers to movements potentially created by the access roads and the impoundments. The extent to which these features may affect movements is difficult to predict due to the variability exhibited by caribou in their reaction to other barriers reported in the literature and their unpredictable range use patterns relative to other large North American herbivores.

The best approach to evaluate project impacts appears to be through building up a large data base on pre-project movements and range use so that effec-

tive mitigation measures can be recommended and that the effects of the barriers after project development can be fully evaluated. Thus, the FY 1984 program includes monitoring the size productivity, and movement patterns of caribou in the main Nelchina herd and the upper Susitna Nenana subherd.

These field studies are described on pages 7-9 of ADF&G's FY 1984 plan of study (see Appendix B). This work effort addresses Issue T-20 (of Appendix A).

4.4 DALL SHEEP

4.4.1 Background

Dall sheep occur in three areas in the vicinity of the Susitna Project: near Mount Watana, the Watana Hills, and the Portage-Tsusena Creeks area. Besides the potential for disturbance from construction activities and from recreationists during operation, the major potential direct impact of the proposed project on Dall sheep may be disturbance of the Jay Creek mineral lick in the Watana Hills.

Aerial surveys of project area sheep were initiated in early 1981 along with frequent observations of the Jay Creek lick made in conjunction with other Susitna studies (Ballard et al. 1982). Further observations were made in 1982 (Tankersley 1983). More intensive studies were initiated in 1983 (described below).

4.4.2 Approach

The major potential direct impact of project development on Dall Sheep will be inundation of a portion of the Jay Creek Mineral lick and human disturbance at or near the lick. Therefore, additional studies are concentrating on quantifying sheep use of Jay Creek and other nearby licks, assessing and comparing the mineral content of these licks, and monitoring seasonal habitat use of sheep range in the project area. Issues T-20 and T-42 are addressed by these studies (see Appendix A). The field studies are described on pages 14-17 of ADF&G's FY 1984 Plan of Study (see Appendix B).

4.5 BLACK AND BROWN BEAR

4.5.1 Background

Prior to Susitna Project-funded studies, no black bear research had been conducted in the Susitna or Nelchina River Basins. Brown bear research, however, had been undertaken since 1978. This research concentrated on the magnitude and effects of brown bear predation on moose but considerable life history data were also collected (Ballard et al. 1980, Spraker et al. 1981). Intensive Susitna Project studies were initated in early 1980 and have continued through the present (Miller and McAllister 1982, Miller 1983).

4.5.2 Approach

Direct project impacts on bears will result primarily from loss of denning and foraging habitat. Bear habitat use, especially for foraging, exhibits considerable seasonal and annual variability. Therefore, a large data base on pre-project distribution, habitat use, numbers, and food habits is preferred for impact assessment. Also, because of the suspected importance of brown bear predation on moose calves in limiting moose populations, additional data on this phenomenon is required as input to moose modeling efforts. Studies designed to collect these data are currently underway. These studies along with the linkages among them are identified in Figure 4-3.

All studies are currently planned to be conducted in FY 1984. The responsible organizations for each work effort are listed below:

1. Impact Area Use Monitoring - ADF&G
2. Den Site Use Monitoring - ADF&G
3. Food Resource Identification - ADF&G
4. Spring Plant Phenology Study - U of A, Palmer

5. Moose Population Model Refinement - ADF&G/LGL
6. Bear Population Model Refinement - ADF&G/LGL

Plans of study for these work efforts including deliverable due dates and the specific issues each work effort is designed to address are provided in the following sections with the exceptions of work efforts 4 and 5. These are provided in Sections 4.1.4 and 4.1.10, respectively.

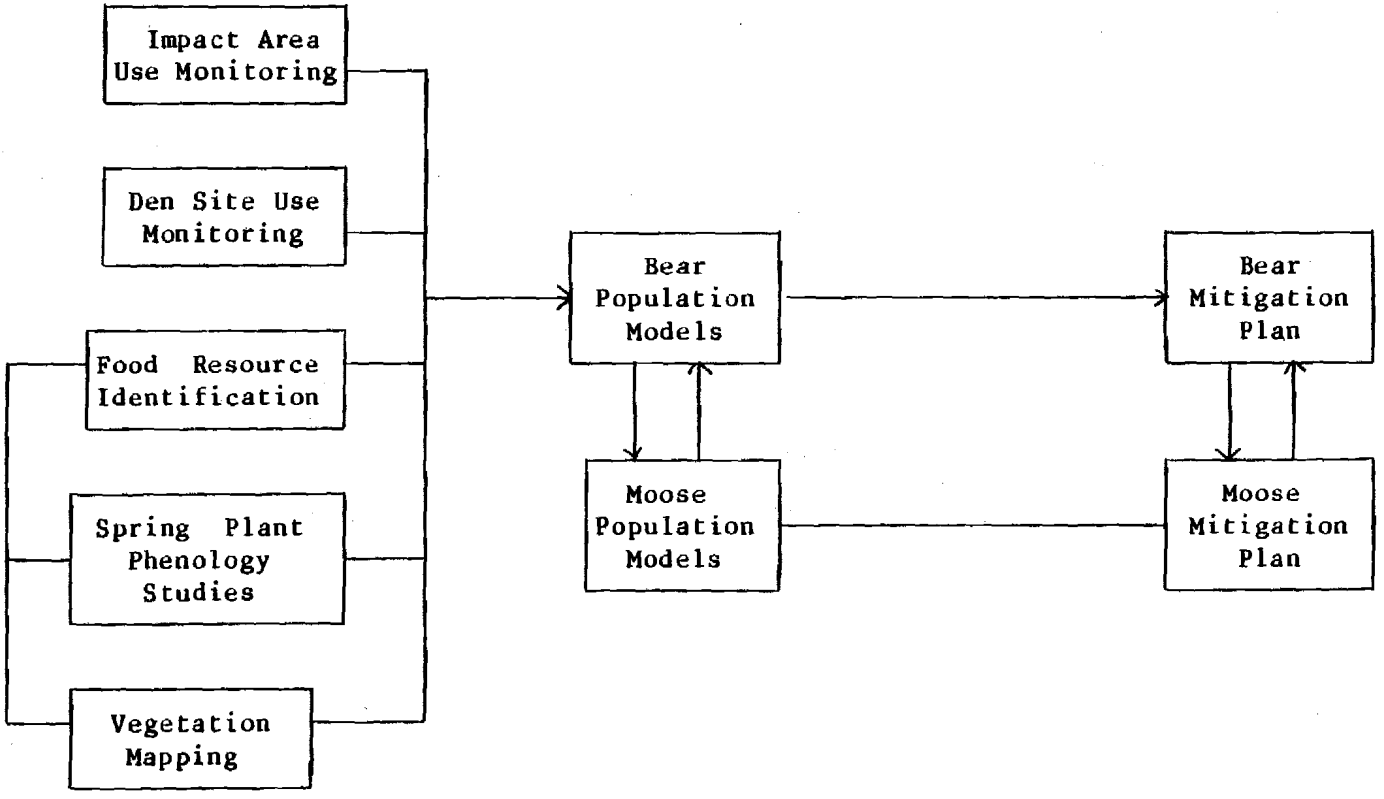
4.5.3 Bear Field Studies

Black and brown bear field studies are described on pages 12-13 of ADF&G's FY 1984 Plan of Study provided as Appendix B. The studies consist of three general work efforts: (1) impact area use monitoring; (2) den site use monitoring; and (3) food resource identification. These work efforts are designed to address Issues T-20 and T-44 (see Appendix A). The annual report for bear field studies is due on April 1, 1984. This report will cover field studies conducted through fall 1983.

4.5.4 Bear Population Model Refinement

Refinements to the bear population model will be made only if indicated following further review. Presently, further refinements do not appear warranted because the large number and questionable soundness of the model's assumptions limit its utility.

Figure 4-3. Linkages Among Components of Bear Impact Assessment and Mitigation Plan Refinement Efforts



4.6 WOLF AND WOLVERINE

4.6.1 Background

Wolves in Game Management Unit (GMU) 13, commonly referred to as the Nelchina Basin, have been the focus of interest and study for over 30 years (Ballard 1981). The history of GMU 13 wolves from 1957 through 1968 was summarized by Rausch (1969). From 1948 to 1953 poisoning and aerial shooting by the Federal Government reduced populations of predators to low levels. By 1953 only 12 wolves were estimated to remain in the basin. This small population quickly expanded and by 1965 was thought to have peaked at 400-450 (Rausch 1969). Although no systematic studies were conducted from 1969 through 1974, McIlroy (1976) suggested that a second population peak occurred in 1970.

During the period of wolf population growth, moose populations on GMU 13 declined, suggesting a cause-effect relationship. In 1975 a series of predator-prey relationships studies involving wolves were initiated. Results of these studies were provided by Stephenson (1978), Ballard and Spraker (1979), Ballard and Taylor (1980), Ballard et al. (1980) and Ballard et al. (1981b, 1981c). Portions of the aforementioned studies involved experimentally manipulating wolf densities in part of the area which could be impacted by Susitna hydroelectric development (Ballard et al. 1980). Wolf control activities were conducted from 1976 through July 1978. By 1980 wolf densities in the reduction area had returned to pre-control levels (Ballard 1980).

In contrast to the wolf, no previous studies of wolverine have been conducted in the project vicinity and few studies have been conducted in North America. Both wolf and wolverine studies funded by the Susitna project were initiated in early 1980 and continue through the present time (Ballard et al. 1982b, 1983a; Garner and Ballard 1982; Whitman and Ballard 1983).

4.6.2 Approach

Wolves are likely to be affected by a variety of project impact mechanisms, among which, reductions in prey populations sizes and changes in distribution may be the most severe. It is desireable to have a large data base on the number and distribution of wolf packs and the size of each wolf pack using the upstream moose zone of impact in order to assess the project impact on wolves, as well as the impact of wolves on moose. Studies to be conducted by ADF&G are planned for each of these areas in FY 1984. In addition, information on wolverine distribution, abundance, home range size, habitat selection, and food habits will be collected opportunistically by relocating wolverine during wolf tracking flights. These efforts are designed to address Issues T-20 and T-43 (see Appendix A). The studies are described on pages 10-11 of ADF&G's FY 1984 Plan of Study (see Appendix B).

4.7 BELUKHA WHALE

4.7.1 Background

Belukha whales range throughout Cook Inlet, concentrating in the upper Inlet near and in the Susitna River mouth in the spring and summer and moving to the lower Inlet during the winter. There is some evidence which suggests that during winters of heavy ice in Cook Inlet some of the belukhas may leave the Inlet entirely and move across the north Gulf of Alaska to as far away as Yakutat Bay (Calkins 1979). The Cook Inlet stock of belukha whales was estimated at 300 to 400 animals by Klinkhart (1966).

More recent surveys in the Inlet have shown that the population exceeds 400 animals (Calkins unpub. data). In response to concerns about the effects of the Susitna Project on this population, aerial surveys of upper Cook Inlet were flown in spring and summer 1982 (Calkins 1983) and again in 1983.

4.7.2 Approach

Because of the potential for project effects on belukha whales near the mouth of the Susitna River, aerial surveys were flown in spring and summer 1982 and 1983. FY 1984 work will be limited to data analysis and report writing (see pages 18-19 of ADF&G's Plan of Study in Appendix B). No additional field studies will be conducted unless new information on the impacts of fish populations believed to be important to belukhas indicates that additional studies are needed.

4.8 DOWNSTREAM BEAVER

4.8.1 Background

Beaver and other furbearer sign has been surveyed and inventoried along the lower Susitna River on several occasions. In August 1980 a riverboat was used to survey the Susitna River between Portage Creek and the Kashwitna River and a fixed-wing aircraft survey of the River between Devil Canyon and Cook Inlet was conducted in July 1981 (Gipson et al. 1982). Beaver sign and habitat associations were surveyed during spring and summer 1982 and a helicopter cache survey between Portage Creek and the Deshka River was conducted in September 1982 (Gipson and Durst 1982). Finally, a helicopter cache survey of the Susitna River between Portage Creek and Cook Inlet was conducted in October 1983.

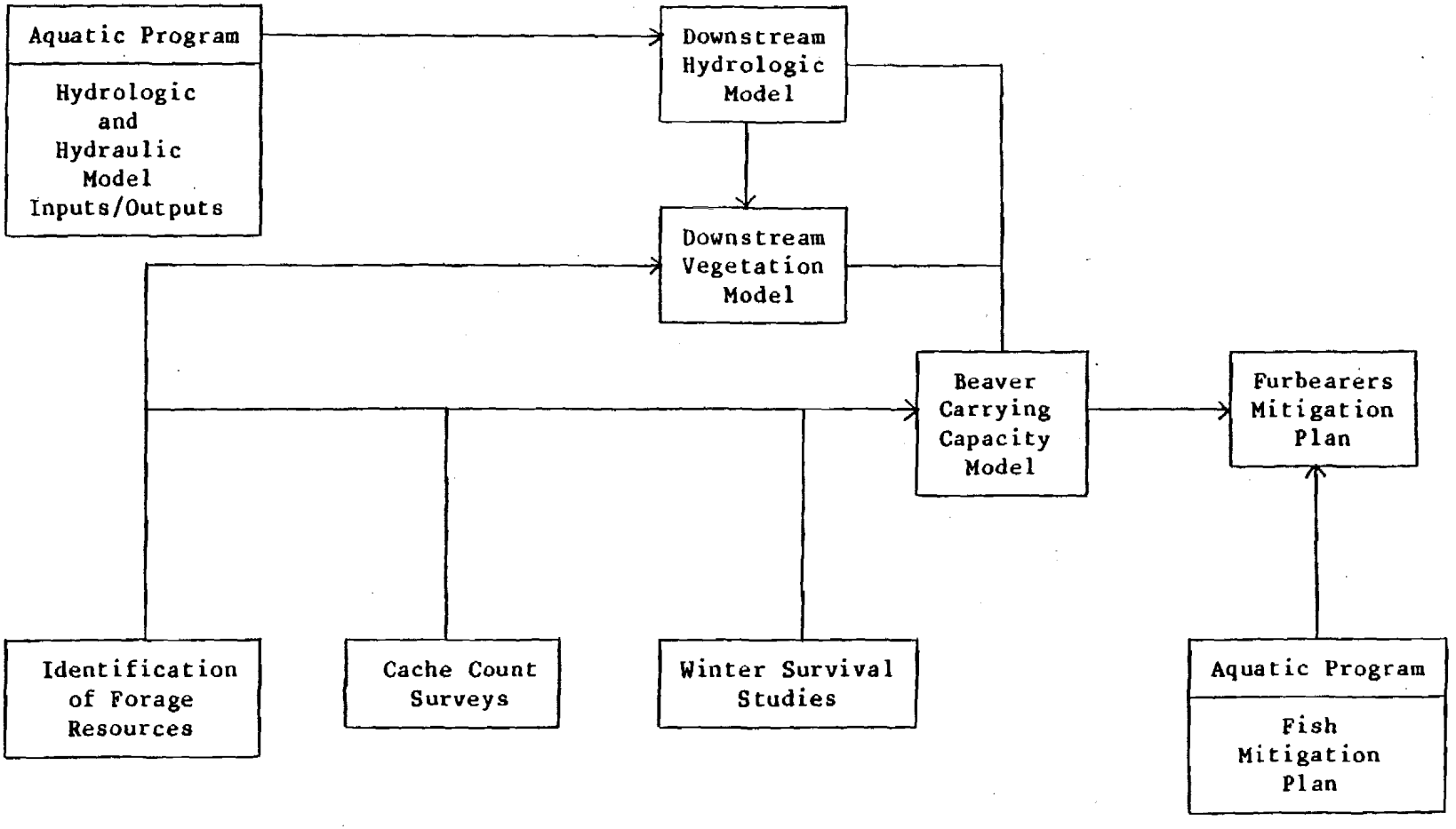
4.8.2 Approach

FY 1984 work included the October 1983 helicopter survey mentioned above and will include further refinement of the beaver carrying capacity model and limited overwinter survival studies. The linkages among these efforts and other related work efforts are shown in Figure 4-4.

4.8.3 Beaver Field Studies

An aerial survey of the number of beaver caches (representing colonies attempting to overwinter) will be conducted in fall 1983 along the Susitna River between Portage Creek and Cook Inlet. A complete count will be made between Portage Creek and Talkeetna and a representative area count will be made between Talkeetna and Cook Inlet. This information will allow assessment of annual variability in colony numbers between Portage Creek and Talkeetna and will allow a general estimate of beaver abundance downstream of Talkeetna.

Figure 4-4. Linkages Among Components of Downstream Beaver Impact Assessment and Mitigation Plan Refinement



Beaver overwinter survival studies will involve returning to beaver colony locations (marked during the cache survey) shortly before and after break-up for colony overwinter survival determinations, to sample the quality of cache food, to determine if lodges or bank dens were destroyed by break-up, and to measure certain environmental parameters. This information will be used directly in refining the beaver model.

A detailed plan of study for these efforts will be available by February 28, 1984. This subtask is designed to address Issues T-20 and T-46 (see Appendix A).

4.8.4 Beaver Model Refinement

Beaver modeling efforts for the Susitna River downstream of Portage Creek were initiated in 1982 and refined in 1983. Refinements to the existing model planned for FY 1984 primarily consist of integration of field study results into the model (Section 4.8.3) and the refinement of downstream hydrologic and vegetation models and reassessment of downstream impacts (Section 4.2.4).

A detailed plan of study for this subtask will be available by February 28, 1984. This subtask is designed to address Issues T-20 and T-45 (see Appendix B).

4.9 RAPTORS

4.9.1 Background

Little was known about the raptors of the middle Susitna Basin prior to initiation of baseline studies for the Susitna Project. Raptor baseline surveys were designed specifically for cliff-nesters (especially golden eagles, gyrfalcons and peregrine falcons) and large tree-nesters (especially bald eagles). Information on other species was obtained incidental to these surveys and during ground-based plot surveys and waterbody surveys.

Raptor surveys were conducted in the middle Susitna basin by helicopter on July 6, 1980 and May 16 and 17, 1981 (Kessel et al. 1982a). All cliff nesting habitat and stands of large white spruce and cottonwood within approximately 3 miles (5 km) of the Susitna River and its tributaries from Portage Creek (1980) and the Indian River (1981) to the mouth of the Tyone River were surveyed. The proposed project access routes were surveyed on July 3 and 5, 1981. In 1980 and 1981, active nests were visited from the ground between May 20 and July 13, 1981. In addition, all potential peregrine falcon nesting habitat (e.g., especially partially vegetated cliffs) was examined by helicopter and on foot in June 1981.

Raptor baseline data on the lower Susitna floodplain were collected using two methods. A ground survey of all bird species was conducted in early summer 1982 and aerial surveys for bald eagle nests were conducted in the spring or summer of 1980, 1981 and 1982.

The ground survey was conducted between Curry and the river mouth from June 10-21, 1982. Extensive, uniform patches of each of the major terrestrial habitats, as sighted from the river, were surveyed each morning on foot.

Surveys for nesting bald eagles were conducted in the lower Susitna River floodplain in April 1980 by the U.S. Fish and Wildlife Service, in late June

1981 by Terrestrial Environmental Services (TES), and on July 1, 1982 by the University of Alaska Museum (Kessel et al. 1982b).

4.9.2 Approach

Additional field efforts are necessary in two areas. First, elevations of many raptor nesting locations are estimates made from topographic maps with 100 foot contour intervals. In addition, a few discrepancies exist among survey results concerning the exact locations of nesting sites. Therefore, a survey to verify nesting locations with respect to impact locations is needed. A second field effort is needed to assess areas for nesting habitat enhancement so that the raptor mitigation plan can be refined.

4.9.3 Raptor Field Studies

Field studies will be conducted to obtain accurate measurements of nesting locations and nest site elevations relative to impact locations. Additional field efforts will be made to locate areas suitable for nesting habitat enhancement, for the purpose of refining the raptor mitigation plan. Supplemental data on raptor nesting will be obtained during these field efforts. Field efforts will be initiated in late FY 1984 but will not be completed until early FY 1985.

A detailed plan of study for these efforts will be prepared by February 28, 1984. This subtask is designed to address Issues T-50, T-51, T-52, T-53, and T-54 (see Appendix B).

4.10 OTHER WILDLIFE

4.10.1 Background

A considerable amount of data have been collected on other species of wildlife present in the Susitna Project area. Kessel et al. (1982a, 1982b) have collected and reported data on all birds and nongame mammals of the project vicinity and Gipson et al. (1982) have collected and reported data on all furbearers in the vicinity of the project. Studies on marten contributed to the preparation and completion of a doctoral dissertation (Buskirk 1983). These studies were conducted primarily in 1980 and 1981.

4.10.2 Approach

Additional field studies are not presently deemed necessary for birds, nongame mammals, or furbearers except in the case of raptors and beavers (See Section 4.8 and 4.9). However, further refinement and quantification of the impact assessment and mitigation plans for all birds and mammals will be conducted as described in Sections 3.1.3 and 3.1.4.

4.11 WETLANDS

4.11.1 Background

Vegetation maps of the project area have been prepared by McKendrick et al. (1982). Using the Viereck and Dyrness (1980) system of classification 1:24,000 scale maps of potential wetlands covering a corridor from the Oshetna River to Devil Canyon and 1:63,360 potential wetland maps of the access corridors were produced by first correlating the vegetation types from Vierick and Dyrness (1980) with the wetland types of Cowardin et al. (1979). The corresponding wetland categories were superimposed over the vegetation maps. The presence of steep slope and likely good drainage were interpreted to rule out classification as wetland. Lakes, ponds, rivers, and streams were not specifically classified.

4.11.2 Approach

Because the system of Cowardin et al. (1979) was not used directly to map wetlands, but was applied in a liberal sense to a general vegetation classification system, the existing wetland maps indicate areas which potentially qualify as wetlands rather than actual wetlands. Therefore, specific wetland mapping of the project area is currently planned to permit refinement of impact assessments and mitigation plans.

4.11.3 Wetland Mapping

A Cooperative Agreement between the U.S. Fish and Wildlife Service (Region 7) and the Power Authority has been drafted but has not yet been negotiated which calls for the U.S. Fish and Wildlife Service to map wetlands in the project area. The Cowardin et al. (1979) system is to be used and maps are to be prepared, at a scale of 1:63,360 as part of their National Wetlands Inventory (NWI). This effort will involve preparing 11 wetland maps of the main project area. Each map would overlay one of the following 15-minute U.S.G.S. Quad sheets: Talkeetna Mountains C-1, C-2, C-4, D-2, D-3, D-4, D-5, and D-6; Healy A-3, B-3, and B-4. In addition, wetland map coverage of Healy D-4 and D-5 would also be prepared. With the mapping of these two quads all areas traversed by the transmission line segments running from Willow to Anchorage and Healy to Fairbanks will also be included in the NWI.

Completion of field work and photointerpretation are presently scheduled for September 30, 1984, draft map production completion is scheduled for January 31, 1985, and final map production completion is scheduled for June 30, 1985.

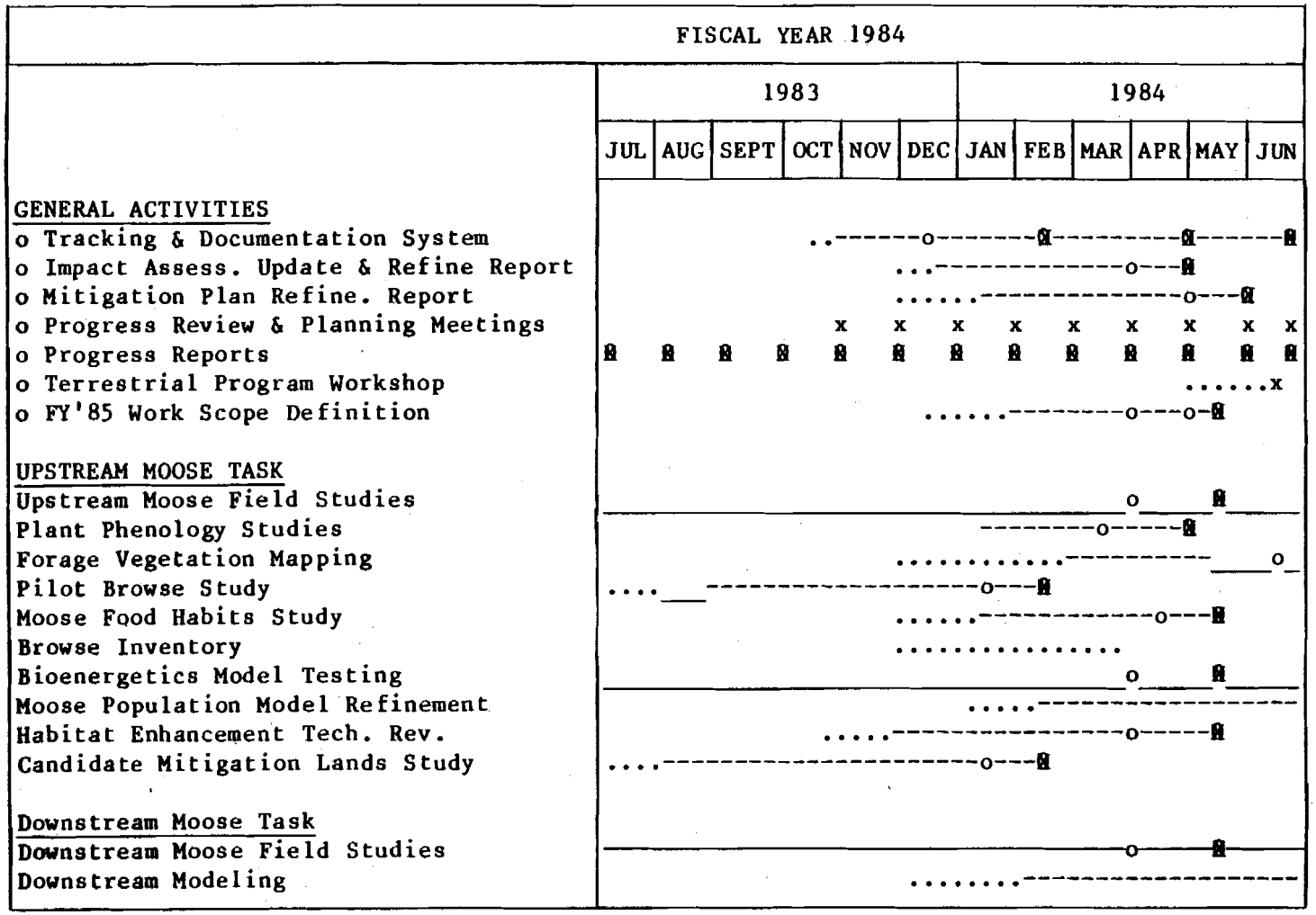
5.0 SCHEDULE AND DELIVERABLES

A list of FY1984 deliverables together with their due dates is provided in the following table. These dates have been extracted from the text of this plan of study. The schedule for Terrestrial Program impact assessment and mitigation plan refinement tasks is provided in Figure 5-1.

	DELIVERABLES*	DUE DATE
1.	Progress Reports	Monthly
2.	Draft Tracking and Documentation System (Rev. 0)	12/15/83
3.	Recommended Candidate Lands for Moose Habitat Compensation Draft Report	1/15/83
4.	Draft Pilot Browse Study Report	1/20/83
5.	Spring 1983 Terrestrial Modeling Workshop Final Report	1/31/84
6.	Moose Population Model Refinement Detailed Plan of Study	2/10/84
7.	Final Pilot Browse Study Report	2/10/84
8.	Final Tracking and Documentation System (Rev. 0)	2/15/84
9.	Recommended Candidate Lands for Moose Habitat Compensation Final Report	2/20/84
10.	Beaver Field Studies Detailed Plan of Study	2/28/84
11.	Beaver Model Refinement Detailed Plan of Study	2/28/84
12.	Downstream Hydrologic and Vegetation Model Refinement Detailed Plan of Study	2/28/84
13.	Forage Vegetation Mapping Detailed Plan of Study	2/28/84
14.	Raptor Field Studies Detailed Plan of Study	2/28/84
15.	Draft Plant Phenology Study Report	3/23/84
16.	Draft Impact Assessment Update and Refinement Report	3/31/84
17.	Browse Inventory Detailed Plan of Study	3/31/84
18.	Draft Habitat Enhancement Techniques Review	3/31/84
19.	Draft ADF&G Big Game Annual Reports	4/01/84

20.	Bioenergetics Model Testing Annual Report	4/01/84
21.	Draft Moose Food Habits Report	4/15/84
22	Draft Mitigation Plan Refinement Report	4/30/84
23.	Final Impact Assessment Update and Refinement Report	4/30/84
24.	Tracking amd Documentation System (Rev. 1)	4/30/84
25.	Plant Phenology Study Final Report	4/30/84
26.	Final Habitat Enhancement Techniques Review	4/30/84
27	Final Moose Food Habits Report	5/07/84
28.	Final FY 1985 Work Scopes	5/10/84
29.	Final ADF&G Big Game Annual Reports	5/15/84
30.	Final Mitigation Plan Refinement Report	5/30/84
31.	Terrestrial Program Workshop	6/15/84
32.	Preliminary Draft Forage Vegetation Maps	6/20/84
33.	Tracking and Documentation System (Rev. 2)	6/30/84

Figure 5-1. Schedule for FY1984 Terrestrial Program Impact Assessment and Mitigation Plan Refinement Tasks



* Draft refers to the first review draft produced. There will often be at least one additional draft prepared between the first review draft and the final report. Dates for these additional drafts are not indicated in table.

6.0 QUALITY ASSURANCE PROGRAM

6.1 PURPOSE

The purpose of the Harza-Ebasco Quality Assurance (QA) Program is to provide a measure of control over the quality of the Susitna Hydroelectric Project environmental studies and some assurance that resulting data and reports represent quality end-products which will withstand public and professional scrutiny. The QA Program comprises all planned and systematic actions, including quality analysis and corrective actions, necessary to provide adequate confidence in the results of the Aquatic, Terrestrial and Social Science Programs.

6.2 GENERAL APPLICATION

This QA Program will be applied specifically to all Harza-Ebasco management activities and subcontractor technical activities related to the Susitna Hydroelectric Project environmental studies. However, where these activities interface directly with other project tasks, such as hydrologic and hydraulic studies, elements of this QA Program may be applied. The general contents of the QA Program address four major aspects: organization and responsibilities; operating procedures; document control; and audits. Specific QA guidelines and actions will be implemented with each subcontractor to assure quality, reliability, redundancy and traceability of technical data, information, and project records.

The QA Program for the environmental studies is compatible with the Harza-Ebasco Quality Control Plan as defined in Exhibit 7 of the Harza-Ebasco Susitna Hydroelectric Project contract with the Alaska Power Authority. In addition, this QA Program complies with the "Ebasco Quality Manual for Hydroelectric Power Stations" which has been identified as a guidance document for this Project. Finally, the QA Program for environmental studies is in conformance with the General Investigation Memoranda for the Aquatic, Terrestrial and Social Science Programs.

6.3 ENVIRONMENTAL STUDIES QA PROGRAM

All subcontractors will be required to incorporate quality assurance in their studies. This will include quality assurance procedures for data collection, checking, and storage, analytical procedures, analyses performed on data, and processes for incorporating data into final reports.

Other items included in the QA Program will be organization charts, lines of authority and identification of the person(s) responsible for QA, methods for assuring competency and safety of files, audit programs and the identification of persons responsible for technical quality of the reports.

6.3.1 Organization and Responsibilities

The QA Program will address the organizational structure, functional responsibilities, levels of authority, and lines of internal and external communication for management, direction, and execution of the environmental studies. All key positions and their project relationships, one to another, will be clearly defined. These positions include, but are not limited to:

Harza-Ebasco	Subcontractors	Power Authority
Project Director	Project Managers	Project Manager
Project Manager	Technical Leaders	Deputy Project Managers
Operations Manager		Technical Leaders
Group Leaders		
Principal Staff		

6.3.2 Operating Procedures

The QA Program will define efforts to oversee the quality of the Harza-Ebasco management responsibilities as well as the technical studies being primarily conducted by subcontractors. Numerous procedures for adminis-

trative and technical operations are underway for the Susitna Hydroelectric Project which will receive attention through quality assurance activities. The QA Program requires each subcontractor to submit a QA Manual or "Statement of Compliance" with the Harza-Ebasco QA Program, depending upon the degree of activity and involvement of the subcontractor.

Operating procedures which are monitored by the QA Program include, but are not limited to:

1. Sample collection.
2. Packaging, shipping, and receipt of samples.
3. Sample preservation and analysis.
4. Maintenance of technical standards.
5. Calibration of equipment.
6. Recording, reduction, evaluation and reporting of data.

In short, all operating procedures dealing with field or other data collection, laboratory or office analysis, and the reporting of results are of concern to the QA Program.

6.3.3 Document Control

Criteria for document and data identification; logging of incoming and outgoing documents; document review, approval and release; and document checks, distribution, use, and revisions are addressed by the QA Program. This QA Program describes the system of control for all project documents which have an effect on quality-related environmental activities, and provides guidelines for the filing, collection, storage, disposition, and maintenance of records affecting the quality of the project including project data.

6.3.4 Audits

The QA Program provides for a variety of audit activities which may be applied to the Susitna Hydroelectric Project environmental studies. These

activities may include internal inspections of Harza-Ebasco project files, external audits of subcontractor files against their QA Manual and procedures, and surveillance of subcontractors field and laboratory data gathering and analysis activities to assure compliance with their QA Manual and procedures.

Internal inspections of Harza-Ebasco project files may be conducted by the Project Director, Licensing Manager, or Operations Managers at any time during the project. External audits and surveillance activities of subcontractors will be performed by Operations Managers or Group Leaders at least once per year and possibly more often at the discretion of the Project Director.

6.3.5 Harza-Ebasco QA

Harza-Ebasco will develop a generic QA Manual to encompass studies in which it directly participates and to include an overview of QA procedures by all environmental subconsultants. This QA Manual will be compatible with other project requirements and will serve as the umbrella over the Susitna Hydroelectric Project environmental studies. The contents of the Harza-Ebasco QA Manual will include at a minimum:

1. Copies of the subcontractor's procedures and QA Manuals.
2. QA responsibilities including levels of authority.
3. Safety, location, duplication of data files.
4. Applicable audit programs.
5. Procedures for maintenance of QA records.
6. Technical review procedures.

6.4 QA PROGRAM APPLICATION TO TERRESTRIAL PROGRAM

The Harza-Ebasco Environmental Studies QA Manual will serve as the controlling document for Terrestrial Program QA. However, in addition to the generic procedures described in this manual, QA for the Terrestrial

Program Impact Assessment and Mitigation Plan Refinement Efforts will be enhanced by the preparation and maintenance of the tracking and documentation system described in Section 3.1.2. This system will permit the tracking and documentation of impact assessment and mitigation plan status as these items are refined and, in doing so, will demonstrate the resolution of issues and the status of unresolved issues.

7.0 REFERENCES

Alaska Department of Fish and Game. 1970-1980. Annual Survey and Inventory Reports, Caribou. Juneau, Alaska.

Ballard, W.B. 1980. Wolf repopulation study. Alaska Department of Fish and Game. P-R Proj. Rep., W-21-2. 6 pp.

Ballard, W.B. 1981. Grey wolf-brown bear relationships in the Nelchina Basin of Southcentral Alaska. F.H. Harrington and P.C. Paquet, Co. Eds. Proc. Portland Wolf Symp. Portland, Oregon: In Press.

Ballard W.B., and K.P. Taylor. 1978. Upper Susitna River moose population study. Alaska Department of Fish and Game. Fed. Aid in Wildl. Rest. Proj. Final Rep W-17-9 and W-17-10, Job 1.2 or. 61 pp.

Ballard, W.B. and T. Spraker. 1979. Unit 13 wolf studies. Alaska Department of Fish and Game. P-R Proj. Rep., W-17-8, Jobs 14.8 R, 14.9 R and 14.10 R. 90 pp.

Ballard, W.B. and C.L. Gardner. 1980. Nelchina yearling moose mortality study. Alaska Department of Fish and Game. P-R Proj. Rep., W-17-11, W-21-1. 22 pp.

Ballard W.B., and K.P. Taylor. 1980. Upper Susitna Valley moose populatio study. Alaska Department of Fish and Game P-R Proj. Final Rep., W-17-9, W-17-10, and W-17-11. 102 pp.

Ballard, W.B., S.D. Miller, and T.H. Spraker. 1980. Moose calf mortality study. Alaska Department of Fish and Game. P-R Proj. Final Rep., W- n 17-9, W-17-10, W-17-11, and W-21-1. 123 pp.

Ballard, W.B., D.A. Cornelius and C.L. Gardner. 1981a. Moose-Upstream Studies, Susitna Hydroelectric Project Subtask 7.11. 91 pp.

Ballard W.B., T.H. Spraker, and K.P. Taylor. 1981b. Causes of neonatal moose calf mortality in Southcentral Alaska. J. Wildl. Manage, 45(2): 335-342.

Ballard, W.B., R.O. Stephenson and T.H. Spraker. 1981c. Nelchina Basin Wolf Studies. Alaska Department of Fish and Game. P-R Proj. Final Rept. W-17-8, W-17-9, W-17-10, and W-17-11. 201 pp.

Ballard, W.B., C.L. Gardner, J.H. Westlund, and J.R. Dau. 1982a. Big Game Studies, Volume III, Moose-Upstream. Susitna Hydroelectric Project, Phase I Final Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Ballard, W.B., C.L. Gardner, J.H. Westlund, and J.R. Dau. 1982b. Big Game Studies, Volume V, Wolf. Susitna Hydroelectric Project, Phase I Final Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Ballard, W.B., C.L. Gardner, and S.D. Miller. 1982c. Nelchina yearling moose mortality study. Alaska Department of Fish and Game. P-R Proj. Final Rep., W-21-1 and W-21-2. 37 pp.

Ballard, W.B., J.S. Whitman, L.D. Aumiller, and P. Hessing. 1983a. Big Game Studies, Volume V, Wolf. Susitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority, Alaska Department of Fish and Game.

Ballard, W.B., J.S. Whitman, N.G. Tankersley, L.D. Aumiller, and P. Hessing. 1983b. Big Game Studies, Volume III, Moose-Upstream. Susitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Ballard, W.B., R.O. Stephenson, S.D. Miller, K.B. Schneider and S.H. Eide. In Prep. Ecological studies of timber wolves and predator/prey relationships in Southcentral Alaska. Wildl. Monogr.

Bos, G.N. 1973. Nelchina Caribou Report, Alaska Dept. Fish and Game, Fed. Aid in Wildl. Rest., Proj. W-17-4 and W-17-5. Juneau, Alaska. 25 pp.

Bos, G.N. 1974. Nelchina and Mentasta caribou reports - Alaska Dept. Fish and Game, Fed. Aid. in Wildl. Rest., Proj. W-17-5 and W-17-6. Juneau, Alaska. 50 pp.

Buskirk, S.W. 1983. The ecology of marten in Southcentral Alaska. Ph.D. Thesis, University of Alaska, Fairbanks.

Calkins, D.G. 1979. Marine Mammals of Lower Cook Inlet and the Potential for Impact from Outer Continental Shelf Oil and Gas Exploration, Development and Transportation Special Report. Prepared for Alaskan Outer Continental Shelf Environmental Assessment Program. Juneau, Alaska.

Calkins, D.G. 1983. Big Game Studies, Volume IX, Belukha Whale. Susitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Chatelain, E.F. 1951. Winter range problems of moose in the Susitna Valley. Proc. Alaska Sci. conf. 2:343-347.

Cowardin, L.M., V. Carter, F.C. Golet and E.T. LaRoe. 1979. Classification of Wetlands and Deep Water Habitats of the United States. Publication FWS/BS-79-31. U.S. Fish and Wildlife Service.

Dearden, B.L., R.E. Pegau, and R.M. Hansen. 1975. Precision of microhistological estimates of ruminant food habits. J. Wldl. Mange. 39:402-407.

Free, J.C., R.M. Hansen, and P.L. Sims. 1970. Estimating dry weights of food plants in feces of herbivores. J. Range Mange. 23:300-302.

Gardner, C.L., and W.B. Ballard. 1982. Big Game Studies, Volume VII, Wolverine. Susitna Hydroelectric Project Phase I Final Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Gipson, P.S., and J.D. Durst. 1982. Susitna beaver population survey. Progress Report. Submitted to LGL. Prepared for Alaska Power Authority. Alaska Cooperative Wildlife Research Unit, University of Alaska, Fairbanks.

Gipson, P.S., S.W. Buskirk, and T.W. Hobgood. 1982. Furbearer studies, Phase I Report. Susitna Hydroelectric Project, Environmental Studies, Subtask 7.11. Submitted to Terrestrial Environmental Specialists, Inc. Prepared for Alaska Power Authority. Alaska Cooperative Wildlife Research Unit, University of Alaska, Fairbanks.

Glenn, L.P. 1967. Caribou report. Alaska Dept. Fish and Game, Fed. Aid in Wildl. Rest. Proj. W-15-T-1,2. Juneau, Alaska. 36 pp.

Hemming, J.E., and L.P. Glenn. 1968. Caribou report: Alaska Dept. Fish and Game, Fed. Aid. in Wildl. Rest., Proj. W-15-2. Juneau, Alaska. 41 pp.

Hemming, J.E., and L.P. Glenn. 1969. Caribou report. Alaska Dept. Fish and Game, Fed. Aid in Wildl. Rest., Proj. W-15-R-2. Juneau, Alaska 41 pp.

Holecheck, J.L., M. Vavra, and R.D. Pieper. 1982. Botanical composition determination of range herbivore diets: a review. J. Range Manage. 35:309-315.

Kessel, B., S.O. MacDonald, D.D. Gibson, B.A. Cooper, and B.A. Anderson. 1982a. Birds and non-game mammals, Phase I Report. Susitna Hydroelectric Project, Environmental Studies, Subtask 7.11. Submitted to Terrestrial Environmental Specialists, Inc. Prepared for Alaska Power Authority. University of Alaska Museum, Fairbanks.

Kessel, B., S.O. MacDonald, D.A. Gibson, B.A. Cooper and B.A. Anderson. 1982a. Susitna Hydroelectric Project Phase I Final Report. Birds and Non-game Mammals. University of Alaska Museum. Fairbanks, Alaska.

Kessel, B., D.D. Gibson, S.O. MacDonald, B.A. Cooper and K.C. Cooper. 1982b. Avifauna of the Lower Susitna River Floodplain, Alaska University of Alaska Museum.

Klinkhart, E.G. 1966. The Beluga Whale in Alaska. Alaska Dept. Fish and Game. Fed. Aid. in Wildl. Rest. Proj. Rept., Proj. W-6-R and W-14-R.

Lentfer, J. 1965. Caribou report. Alaska Dept. Fish and Game, Fed. Aid. in Wildl. Rest., Proj. W-6-5-5 and W-6-R-6. Juneau, Alaska 19 pp.

LeResche, R.E. 1974. Moose migrations in North America. Naturaliste can. 101:393-415.

McGowan, T.A. 1966. Caribou report. Alaska Dept. Fish and Game, Fed. Aid. in Wildl. Rest., Proj. W-6-R-6 and W-15-R-1. Juneau, Alaska. 19 pp.

McIlroy, C. 1976. Moose Survey - Inventory Progress Report 1974, Game Management Units 11 and 13. In: McKnight, D.E. (editor). Annual Report of Survey - Inventory Activities, Part II: Moose, Caribou, Marine Mammals and Goats. Fed. Aid in Wildl. Rest. Rept., Proj. W-17-7. Alaska Dept. Fish and Game.

McKendrick, J., W. Collins, D. Helm, J. McMuller, and J. Koranda. 1982. Plant ecology studies, Phase I Report. Susitna Hydroelectric Project, Environmental Studies, Subtask 7.12. Submitted to Terrestrial Environmental Specialists, Inc. Prepared for Alaska Power Authority. University of Alaska Agricultural Experiment Station, Palmer.

Miller, Sterling D. and Dennis C. McAllister. 1982. Susitna Hydroelectric Project, Phase I Final Report, Big Game Studies, Vol. VI, Black and Brown Bear, Alaska Dept. of Fish and Game. 233 pgs.

Miller, S.D. 1983. Big Game Studies, Volume VI, Black bears and brown bears. Susitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority. Alaska Dept. of Fish and Game.

Miller, S.D., J.S. Whitman, L.D. Aumiller, and P. Nessing. 1983. Big Game Studies, Volume V, Wolf. Susitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Modafferi, R.D. 1982. Big Game Studies, Volume II, Moose-Downstream. Susitna Hydroelectric Project, Phase I Final Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Modafferi, R.D. 1983. Big Game Studies, Volume II, Moose-Downstream. Susitna Hydroelectric Project, Phase I Final Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Neiland, K.A. 1972. Caribou disease studies. Alaska Department of Fish and Game, Fed. Aid. in Wildl. Rest. Proj. W-17-2 and W-17-3. Juneau, Alaska. 42 pp.

Pegau, R.E., and G.N. Bos. 1972. Caribou report. Alaska Department of Fish and Game, Fed. Aid in Wildl. Rest., Proj. W-17-3 and W-17-4. Juneau, Alaska. 32 pp.

Pegau, R.E., and J.E. Hemming. 1972. Caribou report. Alaska Department of Fish and Game, Fed. Aid. in Wildl. Rest., Proj. W-17-2 and W-17-3. Juneau, Alaska. 221 pp.

Pegau, R.E., G.N. Bos, and K.A. Neiland. 1973. Caribou report. Alaska Department of Fish and Game, Fed. Aid. in Wildl. Rest., Proj. 4-17-4 and W-17-5. Juneau, Alaska. 70 pp.

Pitcher, K.W. 1982. Big Game Studies, Volume IV, Caribou. Susitna Hydroelectric Project, Phase I Final Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Pitcher, K.W. 1983. Big Game Studies, Volume IV, Caribou. Susitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Rausch, R.A. 1959. Some aspects of population dynamics of the railbelt moose populations, Alaska. M.S. Thesis. University of Alaska, Fairbanks. 81 pp.

Rausch, R.A. 1969. A summary of wolf studies in southcentral Alaska, 1957-1968. Trans. N. Am. Wildl. and Nat. Resour. Conf., 34:117-131.

Skoog, R.O. 1968. Ecology of the caribou (Rangifer tarandus granti) in Alaska. Ph.D. Dissertation, University of California, Berkeley, CA. 699 pp.

Sparks, D.R., and J.C. Malecheck. 1968. Estimating percentage dry weights in diets using a microscope techniques. J. Range Manage. 21:264-265.

Spencer, D.L., and E.F. Chatelain. 1953. Progress in the management of the moose of southcentral Alaska. Trans. N. Am. Wildl. Conf. 8:539-552.

Spraker, T.H., W.B. Ballard and S.M. Miller. 1981. Brown bear studies, Game Management Unit 13. Alaska Department of Fish and Game P-R Proj. Final Rep., W-17-10 and W-17-11, Job 4.13R.

Steigers, W.D., D. Helm, J.G. MacCracken, J.D. McKendrick and P.V. Mayer. 1983. Environmental Studies-Subtask 7.12, 1982 Plant Ecology Studies, Final Report. Alaska Power Authority, Susitna Hydroelectric Project. Prepared for LGL Alaska Research Associates, Inc. University of Alaska Agriculture Experiment Station, Palmer.

Stephenson, R.O. 1978. Unit 13 Wolf studies. Alaska Department of Fish and Game. P-R Proj. Rept., W-17-8, Jobs 14.8R, 14.7R and 14.10R.

Tankersley, N.G. 1983. Big Game Studies, Volume VIII, Dall Sheep. Susitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Taylor, K.P., and W.B. Ballard. 1978. Moose movements and habitat use along the Upper Susitna River - a preliminary study of potential impacts of the Devils Canyon Hydroelectric Project. Prepared for U.S. Fish and Wildlife Service. Alaska Department of Fish and Game. 91 p.

Taylor, K.P., and W.B. Ballard. 1979. Moose movements and habitat use along the Susitna River near Devil Canyon, Alaska. Proc. N.Am. Moose Conf. Workshop, Kenai, Alaska. pp. 169-186.

Terrestrial Environmental Specialists, Inc. 1981. Environmental Studies Summary Annual Report - 1980. Submitted to Acres American, Inc. Prepared for Alaska Power Authority. Terrestrial Environmental Specialists, Inc., Pheonix, N.Y.

Toby, R.W. 1981. Big Game Studies, Part VIII, Sheep. Susitna Hydroelectric Project, Annual Progress Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

U.S. Fish and Wildlife Service. 1975. Southcentral railbelt area upper Susitna River Basin Hydroelectric Project two dam plan. U.S. Department of Interior, Anchorage, Alaska. 25 pp.

Van Ballenberghe, V. 1977. Migratory behavior of moose in Southcentral Alaska. Proc. Inter. Congr. Game. Biol. 13:103-109.

Viereck, L.A., and C.T. Dyrness. 1980. A preliminary classification system for vegetation of Alaska. U.S. Dept. Agric. Forest Service. Gen. Tech. Rept. DNW-106. 33 pp.

Viereck, L.A. and L.A. Schondelmeier. 1980. Effects of Fire in Alaska and adjacent Canada - A literature review. Bureau of Land Management Technical Report 6, BLM/AK/TR-80/06.

Whitman, J.S., and W.B. Ballard. 1983. Big Game Studies, Volume VII, Wolverine. SUsitna Hydroelectric Project, Phase II Progress Report. Submitted to Alaska Power Authority. Alaska Department of Fish and Game.

Wolff, J.O., and J.C. Zasada. 1979. Moose habitat and forest succession on the Tanana River Floodplain and Yukon-Tanana Upland. In: Proceedings of the North American Conference and Workshop No. 15. Kenai, Alaska.

8.0 APPENDICES

PRELIMINARY

4 Oct[illegible] 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-1 Downstream Effects The assessment of the extent and severity of downstream habitat alteration needs to be refined. Need to continue hydrologic and vegetation succession modelling and additional field studies where necessary, in order to refine impact assessment and mitigation planning for downstream effects. Should use geomorphological cross-sections information and possibly monitor these cross-sections.	FWS ADFG	1. Testimony before APA Board 4/16/82 p.1 (FWS) Draft Ex. E Comments p. 34, 35, 37, 58 68, 69, 98 (FWS) Feb/Mar '83 Workshop Recommendation p. 155, 162 (FWS) Draft Ex. E Comments p. B-6, B-7 (ADFG) Feb/Mar '83 Workshop Recommendation p. 155, 162 (ADFG)		
T-2 Downstream Vegetation Mapping Need to map floodplain vegetation in downstream areas including the Talkeetna to at least Delta Islands segment (10 year floodplain) in order to refine quantification of flow change impacts.	FWS	2. Draft Ex. E Comments p. 32, 34		
T-3 Matrix Approach to Summarize Impacts/Mitigation Measures Need to evaluate impacts and especially mitigation measures for each species relative to all others using a matrix format. Consider aquatic resources in this matrix analysis.	FWS ADFG	3. Draft Ex. E Comments p. 18-19 (FWS) Feb/Mar '83 Workshop Recommendation p. 163 (ADFG)		
T-4 Map of Permafrost Areas Need to map and evaluate permafrost areas to assess impacts due to erosion and vegetation removal.	FWS	4. Draft Ex. E Comments p. 37, 98		
T-5 Frost Impacts on Vegetation Need to study and quantify the effects of frost build-up on vegetation adjacent to the reservoir.	FWS	5. Draft Ex. E Comments p. 37		

PRELIMINARY

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-6 Reservoir Ice and Drawdown Zone Should evaluate information on the timing of formation, extent, thickness, and time of breakup of reservoir ice and the composition and physical characteristics of the reservoir shoreline and drawdown zones to assess wildlife impacts.	FWS	6. Letter 10/5/82-p.5		
T-7 Revegetation Study Need to initiate revegetation test plots as part of continuing project studies to provide information on which successful site restoration can be based. Wildlife food/cover plants should be considered in developing restoration plans.	FWS	7. Draft Ex. E Comments p. 78, Letter 10/5/82-p. 4		
T-8 Habitat Loss due to Various Dam Heights Should quantify the terrestrial habitat to be inundated due to the proposed dam height and an array of lower dam heights.	FWS	8. Letter 10/5/82-p.6		
T-9 Type and Siting of Construction Camp/Village Avoidance of adverse impacts was not given high enough priority in the siting and selection of type of construction camp and village.	FWS	9. Draft Ex. E Comments - p. 4 of letter		
T-10 Scheduling of Construction and Reservoir Filling Avoidance of adverse impacts was not given high enough priority in the scheduling of construction and reservoir filling.	FWS	10. Draft Ex. E Comments - p. 4 of letter Letter 10/5/82-p.6		
T-11 Estimates of Project Area Recreational Use Need better estimates of current and future recreational use of the project area.	ADFG	11. Feb/Mar '83 Workshop Recommendation p. 154		

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-12 Project Recreation Development Avoidance of adverse impacts was not given high enough priority in the design of project recreation development.	FWS	12. Draft Ex. E Comments - p. 4 of letter		
T-13 Mode, Timing, and Routing of Construction Access Avoidance of adverse impacts was not given high enough priority in selection of the mode, timing and routing of construction access.	FWS	13. Draft Ex. E Comments - p. 4 of letter, p. 41		
T-14 Identification of Construction Traffic Mode and Restrictions The specific mode of construction traffic and restrictions on worker use of access roads needs to be identified.	FWS	14. Draft Ex. E Comments - p. 41		
T-15 Identification of Restrictions on Public Use of Access Road The extent of restrictions on public use of access roads needs to be identified.	FWS	15. Draft Ex. E Comments - p. 41		
T-16 Traffic-related Impacts Extent of and effects of increased traffic on various road and railroad segments have not adequately been evaluated and related to big game disturbance and collision mortality.	ADFG	16. Draft Ex. E Comments - p. B-52		
T-17 Quantification of Moose Impacts Along Access Routes Need to quantify current and potential hunter demand and harvests, area moose populations, and habitat quality for access route areas in order to fully assess impacts.	FWS	17. Draft Ex. E Comments p. 66		

PRELIMINARY

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-18 Secondary Effects of Improved Access Effects of secondary development and increased recreational use resulting from improved access have not been fully evaluated.	ADFG FWS	18. Draft Ex. E Comments - p. B-6 (ADFG) Testimony before APA Board 4/16/82 p. 1 (FWS)		
T-19 Cumulative Impacts Effects of cumulative impacts have generally not been adequately addressed.	FWS ADFG	19. Draft Ex. E Comments - p. 19 (FWS) Draft Ex. E Comments - p. B-5, B-55 (ADFG)		
T-20 Quantification of Impacts In general, impacts have not been adequately quantified and determinations of significance have not been well-documented.	ADFG FWS	20. Draft Ex. E Comments - p. B-3 (ADFG) Draft Ex. E Comments - p. 17 (FWS) Testimony before APA Board 4/16/82 p. 1 (FWS)		
T-21 Impacts Based on Current Populations Impact evaluations should be based on the range of population levels that could reasonably be expected to occur during the life of the project rather than on current population levels as is generally done.	ADFG	21. Draft Ex. E Comments - p. B-3, B-4, B-5		
T-22 Resource Category Determination for Evaluation Species The habitat of caribou, brown bear, and wolf in the project area should be given a resource category determination of 2 for the purpose of defining mitigation goals.	FWS	22. Letter 1/24/83		
T-23 Habitat Based Approach A habitat based approach should be used as the primary means of assessing wildlife impacts.	FWS	23. Testimony before APA Board 4/16/82 p. 2 and 3		

PRELIMINARY

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-24 Access Road & T-Line Borrow Areas Should conduct a complete wildlife impact assessment of borrow areas for the access road and transmission line and access to these sites.	FWS	24. Letter 10/5/82-p.6		
T-25 T-Line Buffer Around Swan Nests Recommend minimum 150 m buffers between swan nests and any portions of the transmission corridor.	FWS	25. Draft Ex. E Comments p. 42		
T-26 T-Line Moose Calving and Bear Denning Describe the presence/absence of moose calving grounds and bear denning sites along the T-Line segment between Cook Inlet and Willow.	FWS	26. Draft Ex. E Comments p. 61		
T-27 Specific T-Line Erosion Control Plan An erosion control plan specific to T-Line project features and schedules should be developed.	FWS	27. Draft Ex. E Comments p. ?		
T-28 Snow Accumulation Data Need data on snow accumulation by elevation in the upper Susitna Basin.	ADFG	28. Feb/Mar '83 Workshop Recommendations p. 154		
T-29 Wetlands Mapping Need to delineate plant communities characteristic of wetlands (as defined by Cowardin et al, 1979) to a level of detail that will usefully support facility siting and design, quantification of wetland impacts, and preparation of permit applications required by Section 404 of the Clean Water Act.	FWS	29. Draft Ex. E Comments p. 17		

PRELIMINARY

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-30 Moose Browse Mapping Need to provide a quantifiable data base for precise type and areal extent of moose browse within the direct impact area to support carrying capacity modeling.	FWS ADFG	30. Draft Ex. E Comments p. 45 (FWS) Feb/Mar '83 Workshop Recommendations p. 160 (ADFG)		
T-31 General Vegetation Mapping Need to provide general mapping of vegetation types based on improved aerial imagery as a data base for refined impact assessment and mitigation planning. Include the three T-Line stubs in this new mapping.	FWS	31. Draft Ex E. Comments p. 17		
T-32 Assessment of Habitat Values Need to evaluate habitat values for species other than moose, furbearers, and birds rather than relying on analysis of populations only. The habitat assessment needs to be used in developing timely, comprehensive mitigation measures.	FWS	32. Draft Ex. E Comments p. 17-18 Letter 10/5/82 Letter 1/5/82 Letter 6/23/80 Letter 11/15/79 Testimony 4/16/82		
T-33 Integration of Moose & Vegetation Data Need to correlate moose relocation data with the revised vegetation mapping in order to understand habitat use and preferences. Also consider incorporating elevation, slope, and other habitat parameters into the analysis.	FWS	33. Draft Ex. E Comments p.45		

PRELIMINARY

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-34 Moose Carrying Capacity Model Need to conduct a habitat-based assessment of moose habitat loss/modification impacts as the basis for impact prediction and mitigation planning.	FWS ADFG	34. Draft Ex. E Comments p. 17, 18 52, 72 (FWS) Feb/Mar '83 Workshop Recommendation p. 161 (ADFG)		
T-35 Moose Habitat Enhancement Need to evaluate techniques for increasing moose carrying capacity through habitat enhancement and identify candidate areas for habitat enhancement in order to mitigate for project-induced carrying capacity reductions.	FWS ADFG	35. Draft Ex. E. Comments p. 40, 72 (FWS) Letter 10/5/82 p. 4 (FWS) Feb/Mar '83 Workshop Recommendations p. 161, 162, 177 (ADFG)		
T-36 Moose Browse Inventory Need to conduct a moose browse inventory in the impoundment areas to support the moose carrying capacity modeling efforts.	FWS ADFG	36. Draft Ex. E Comments p. 34 (FWS) Feb/Mar '83 Workshop Recommendation p. 160 (ADFG)		

PRELIMINARY

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-37 Moose Food Habits Need to conduct a limited moose food habits study to support the moose carrying capacity modeling efforts.	FWS ADFG	37. Draft Ex. E Comments p. 45 (FWS) Feb/Mar '83 Workshop Recommendation p. 160 (ADFG)		
T-38 Spring Plant Phenology Need to determine the temporal and spatial pattern of spring plant green-up in and adjacent to the impoundment zones in order to assess the significance of this seasonal forage resource to moose and bear reproduction and carrying capacity and to assess the portion of the resource to be lost due to impoundments. Also, need this information to refine the evaluation of microclimate changes, due to the reservoirs, on spring green-up.	FWS ADFG	38. Draft Ex. E Comments p. 36, 53 (FWS) Feb/Mar '83 Workshop Recommendation p. 159, 160 (ADFG)		
T-39 Upstream Moose Field Studies Need more data on moose numbers, herd composition, calf mortality and movements (especially during the critical winter and spring periods) relative to the impoundment areas to refine impact assessment and mitigation planning.	ADFG FWS	39. Feb/Mar '83 Workshop Recommendation p. 175, 176 (ADFG) Draft Ex. E Comments p. 47 (FWS)		
T-40 Downstream Moose Field Studies Need more data on moose use of downstream riparian areas during winter and spring to refine impact assessment and mitigation planning, especially because of the annual variability in this use. Also need more data on moose population, sex, and age composition on the downstream disturbed sites.	ADFG	40. Feb/Mar '83 Workshop Recommendation p. 177		

PRELIMINARY

4 October 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-41 Severe Winter Field Studies Need to gather intensive data on moose distribution, habitat selection and wolf predation during a severe winter.	ADFG	41. Feb/Mar '83 Workshop Recommendation p. 177		
T-42 Jay Creek Lick Enhancement A demonstration project should be conducted to verify that the lick can be enlarged by blasting or backup mitigation measures should be outlined.	FWS	42. Draft Ex. E Comments p. 19		
T-43 Wolf Field Studies Need to gather more information on movements, territory locations, predation rates, etc., of wolves in upstream zone of impact to refine assessment and mitigation planning.	ADFG	43. Feb/Mar '83 Workshop Recommendation p. 176		
T-44 Black and Brown Bear Field Studies Need to gather more information on habitat use (especially relative to the impoundments), denning habitats and availability of food habits to refine impact assessment and mitigation planning. Need to better evaluate importance of salmon to area bears. Overall, need to better quantify impacts and discuss cumulative impacts on brown bears.	ADFG FWS	44. Feb/Mar '83 Workshop Recommendation p. 171, 172, 179, 180, 181 (ADFG) Draft Ex. E Comments p. 57, 63 (FWS)		
T-45 Beaver Carrying Capacity Model Need to continue beaver carrying capacity model development as the basis for refining impact predictions and determining mitigation needs, if any.	FWS	45. Draft Ex. E Comments p. 74		

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-46 Beaver Field Studies Need additional beaver field studies to fill data gaps to support model development and to monitor beaver numbers for model testing.	FWS	46. Draft Ex. E Comments p. 48, 74 Feb/Mar '83 Workshop Recommendation p. 154, 165, 166, 167, 168		
T-47 Marten Habitat Model Need to continue marten habitat model development as the basis for refining impact predictions and determining mitigation needs. Need the assistance of a marten expert. Need better information on trapping intensity.	FWS	47. Draft Ex. E Comments p. 74 Feb/Mar '83 Workshop Recommendation p. 168, 169		
T-48 Marten Field Studies Need additional marten field studies to fill data gaps to support model development and to monitor marten numbers for model testing.	FWS	48. Draft Ex. E Comments p. 7		
T-49 Quantification of Lynx, Weasel, Mink, & Other Densities Need some quantification of the qualitative terms in Ex. E.	FWS	49. Draft Ex. E Comments p. 49, 64		
T-50 Peregrine Falcon Surveys Should conduct peregrine falcon surveys annually, in early July, throughout project studies and construction, or until there is sufficient evidence that peregrines do not inhabit the project area (i.e., no sightings over several years of helicopter surveys by a reputable observer during the proper time of year).	FWS	50. Draft Ex. E Comments p. 50		

PRELIMINARY

4 Oct. 1983

SUSITNA HYDROELECTRIC PROJECT: AGENCY-RAISED ISSUES

Subtask: Terrestrial Resources

ISSUE	AGENCY	SOURCE	STATUS	COMPLETION DATE
T-51 Bald Eagle Nest Surveys-Downstream Need to obtain accurate locations for bald eagle nest sites downstream of Gold Creek due to existing discrepancies in order to adequately assess project impacts.	FWS	51. Feb/Mar '83 Workshop Recommendation p. 170		
T-52 Artificial Raptor Nest Sites A demonstration project should be conducted to verify that artificial raptor nest sites can be created satisfactorily or backup mitigation measures should be outlined. A survey is necessary to locate trees, cliffs, etc. for nest site enhancement.	FWS	52. Draft Ex. E Comments p. 19		
T-53 Raptor Nest Surveys - Middle Basin Need to obtain accurate elevations of large raptor nests in the impoundment areas due to existing discrepancies.	FWS	53. Feb/Mar '83 Workshop Recommendation p. 169, 170		
T-54 Project Impacts on Bald Eagle Nests Project development may be in conflict with the Bald Eagle Protection Act due to impacts on bald eagle nests.	FWS	54. Letter 6/9/83		
T-55 Correlation of Bird Species & Habitat Changes Should correlate bird species and their relative abundance with postulated negative and positive effects of habitat alteration.	FWS	55. Draft Ex. E Comments p. 61		

SUSITNA HYDROELECTRIC PROJECT - BIG GAME STUDIES
FY 84 PLAN OF STUDY

UPSTREAM MOOSE

Title: Effects of the proposed Devil Canyon and Watana impoundments and associated facilities on moose populations upstream from Devil Canyon.

Investigators: Warren Ballard and Jackson Whitman

Objectives:

1. To determine the number of moose inhabiting the primary impact zone.

2. To determine habitat selectivity of moose inhabiting the upstream primary impact zone of the Susitna Hydroelectric project.

3. To determine the causes and rate of moose calf mortality.

Justification and Approach

Phase I moose studies were directed at determining how moose use the area in and around the proposed impoundments, determining the approximate number of moose using the area and identifying potential impact mechanisms. Emphasis was placed on those mechanisms which could measurably alter moose numbers, productivity or life expectancy. Impact mechanisms likely to be significant to upstream moose populations are numerous, varied, sometimes indirect and often cumulative. Some may be significant only at certain populations levels or under specific environmental conditions, such as severe winters. Consequently it is unrealistic to attempt to express impacts of the Susitna Hydroelectric Project on upstream moose as a simple number of moose lost.

A dual approach to estimating impacts of the project on moose upstream from Devil Canyon is being taken. ① The first is based on the existing population and attempts to predict how the population will respond to the project over time. ② The second is a habitat based approach which attempts to estimate the potential of habitat that will be altered or destroyed to support moose.

The population approach has the advantage of predicting actual changes in terms easily understood by users of moose populations. It also allows estimation of impacts that are not habitat based, such as accidents and human induced mortality. A habitat based approach is more useful for estimating changes in potential carrying capacity when existing populations are not fully utilizing their habitat and for direct comparison of specific acreages. Each approach will provide information necessary for evaluating the other and the integrated results of both are expected to provide a basis for mitigation planning.

The upstream moose study is designed to support two modeling efforts. It will provide direct input to a simulation modeling effort initiated by LGL, Alaska Research Associates in 1982 and will provide a basis for interpreting the results of a nutritionally based carrying capacity model which will be adapted to the Susitna Project in 1983 and 1984 (see page 21).

There are several deficiencies in the moose submodel. The population estimate being used for simulation modeling is based on a 1980 census that did not conform to the recently re-defined zone of impact. The "Zone of Impact" for moose is defined as all areas within one home range length of any area which will be altered by construction and operation of the project. While it is clear that some impacts may occur outside of this area and many moose within the area may not be impacted, we assume that most measurable changes in population size and productivity will be confined to the "zone of impact." Home ranges of radio-collared moose that use or come in close proximity to the two impoundments, the project construction zones, and areas where vegetation is likely to be altered through clearing and climatic changes were used to delineate the outer boundaries of the zone of impact. Areas rarely used by moose such as high elevations were excluded. A new census will provide a more reliable estimate and will test the accuracy of the current model. The model indicates that predation, particularly on newborn calves, is currently limiting the size of the population.

However, the predation rates in the model were derived from an adjacent area which has few black bears. Loss of habitat is likely to alter predator/prey ratios and could trigger a decline in moose numbers, negating any mitigation measures. Black bears are expected to be directly impacted more heavily than are brown bears. The significance of post construction predation will depend largely on the relative roles of black and brown bears in limiting the pre-construction moose population.

Information on habitat selection is necessary for both impact assessment and mitigation planning. Data from the first three years of study indicate that winter, spring and early summer are periods when the impoundment areas are most critical to moose. The number of moose using the impoundment area appears to vary annually, probably in response to snow conditions. For example, March censuses of the Watana impoundment area have shown 42, 260 and 500 moose in 1981, 1982 and 1983, respectively. While 1982-83 was more severe than the preceding two winters, it was not as severe as several other winters recorded in the last 20 years. Monitoring schedules for radio-collared moose will be altered to more carefully document habitat use in the immediate vicinity of the impoundments, project facilities and potential mitigation lands during those initial periods.

Procedures

Except where noted, procedures will follow these described in the Susitna Hydroelectric Project Phase I Final Report-Big Game Studies.

Objective 1

The zone of impact will be censused during November 1983 using techniques described by Gasaway et al. 1981 to provide estimates of the number and sex and age composition of moose that will be exposed to direct project impacts. The census area also will include all of composition count areas 7 and 14 to provide a comparison with the 1980 census and to check the accuracy of predictions of the moose submodel.

Objective 2

Thirty radio-collared moose known to inhabit the zone of impact will be relocated 2 to 4 times a month between September and February depending on moose movements and 6 to 8 times a month between March and June. Monitoring at other times of year and monitoring of other radio-collared moose will be limited to the level necessary to maintain contact and identify significant changes in movement patterns. If new vegetation maps are digitized, relocation data will be re-analyzed to determine habitat selectivity.

Objective 3

Forty newborn moose calves will be captured and fitted with mortality made radio collars in late May 1984. Signals will be monitored twice a day through June. (Monitoring will continue into FY85 at a rate of once a day through July and twice a month August through November.) When the radio signal indicates a calf is dead, the site will be visited on the ground as soon as possible and the causes of mortality will be assessed (Ballard et al. 1979). Mortality rates by cause will be calculated and used to correct the moose submodel. A sample of black bears will be intensively monitored to determine rates of predation (see Objective 3 of bear study).

Ballard, W. B., A. W. Franzmann, K. P. Taylor, T. Spraker, C. C. Schwartz, and R. O. Peterson. 1979. Comparison of techniques utilized to determine moose calf mortality in Alaska. Proc. N. Am. Moose Conf. Workshop, Kenai, Alaska. 15:362-287.

Gasaway, W. C., S. D. DuBois, and S. J. Harbo. 1981. Moose survey procedures development. Alaska Dep. Fish and Game, Fed. Aid Wildl. Restoration Proj. Final Rep. W-17-9 through W-17-11, W-21-1, and W-21-2, Juneau. 66pp.

DOWNSTREAM MOOSE

Title: Effects of Susitna River hydroelectric development on populations of moose downstream from the prospective Devil Canyon dam site.

Investigator: Ronald Modafferi

Objectives:

1. Determine annual variation in the seasonal timing, relative distribution, habitats selected and magnitude of use of riparian habitats in winter by moose along the Susitna River between Devil Canyon and Cook Inlet.

2. To determine seasonal and annual variations in distribution, numbers, sex and age of moose which use floodplain habitats and disturbance subclimax vegetative sites as winter ranges.

3. To determine the numbers, sex and age composition, origin and movement patterns of moose which use disturbed sites.

Justification and Approach

Knowledge about moose use of riparian habitats along the Susitna River between Devil Canyon and Cook Inlet is necessary to predict and evaluate potential impacts which may result from altered flow regimes associated with hydroelectric development and to assess suitability of the area for mitigation measures.

Phase I studies were designed: 1) to delineate populations of moose that are ecologically affiliated with the Susitna River downstream from Devil Canyon; 2) to determine how moose use riparian habitats located along that portion of the Susitna River; 3) to determine the relative distribution and approximate numbers of moose in Susitna River riparian habitats in winter, when conditions permit censusing moose and magnitude of use is greatest and 4) to identify potential hydroelectric project impacts that would ultimately affect size and viability of moose populations through decreased productivity, survival and/or life expectancy. It was realized that results obtained in these studies were subject to variation attributable in part to the relative population levels of moose and severity of winter conditions.

Studies to date indicate that a number of subpopulations of moose use riparian habitats within the floodplain of the river. Moose use is heaviest in winter and during calving. The number of moose on the river varies annually, apparently in response to snow depths. It appears that some subpopulations use the river annually while others use it only in more severe winters.

During severe winters, loss of riparian vegetation in the floodplain could impact large numbers of moose over a broad area of Game Management Units 14 and 16, two of the most heavily hunted areas in the state. The degree of impact would depend on the extent, timing and location of vegetation change. These changes have not been accurately predicted, in part because of the complexity of the mechanisms that set back plant succession and the lack of accurate predictions of changes in the mechanisms that would result from the project.

Use of artificially manipulated habitats near the river by moose suggests that many changes in riparian habitats can be mitigated through habitat enhancement procedures. However, the placement, size, age and method of manipulation will affect the value of such areas to moose. The presence of heavily used disturbed sites provides an opportunity to determine the area from which moose are attracted and the duration and timing of use by different individuals and different subpopulations. This information can be used along with knowledge of current subpopulation derived from movement studies and river censuses to formulate recommendations on the placement and size of artificially manipulated areas for mitigation purposes.

Procedures

Except where noted procedures will follow those described in the Susitna Hydroelectric Project Phase I Final Report-Big Game Studies.

Objective 1

Existing radio-collared moose will be relocated approximately twice a month from November to May and weekly between mid-May and mid-June. Monitoring during summer and monitoring of moose away from areas that are likely to be impacted by the project or serve as mitigation lands will be at a minimum level to maintain contact.

Objective 2

Aerial censuses for moose in Susitna River floodplain habitats and disturbance subclimax vegetative sites from Cook Inlet to Devil Canyon will be conducted six times, through winter as long as snow cover conditions permit.

Objective 3

Samples of 12 moose will be radio-collared from each of 3 (Montana west, Montana middle and Kashwitna Lake north) and 6 moose on one (Talkeetna west) of the previously studied "disturbed" sites (Modafferi, in prep.). To distributed sampling intensity over the winter period, 4 moose will be captured and radio-collared at each of the former 3 sites during each of 3

sampling periods (mid-November, mid-January and mid-March). Three moose will be captured and radio-collared during each of the later sampling periods at the Talkeetna west site.

There is evidence that some moose use such areas only during periods of greater snow accumulation. Consequently, tagging will be regulated by the changes in numbers of moose using the sites. If aerial censuses and observations made on radio tracking flights indicate that additional moose are no longer moving to the area, tagging will be suspended.

A sample of blood and an incisor tooth will be collected from each individual moose for determination of physiological condition and age.

Radio-collared moose will be relocated every two weeks, weather permitting, except during the mid-May to mid-June calving period when they will be relocated each week.

CARIBOU

Title: Population status and movement of caribou in the vicinity of the proposed Susitna Hydroelectric Project.

Investigator: Kenneth Pitcher

Objectives:

1. To determine movement patterns of the main Nelchina caribou herd in relation to proposed impoundments.

2. To determine the range and movement patterns of the upper Susitna-Nenana subherd.

3. To estimate the size of the upper Susitna-Nenana subherd.

4. To monitor size and productivity of the main Nelchina herd.

Justification and Approach

The most likely direct impact of the Susitna Hydroelectric Project on the Nelchina caribou herd appears to be the creation of barriers which may impede free movement of animals between various segments of their range. If caribou attempt to cross these barriers (impoundments and highways) increased mortality may result. Disturbance by construction and operational personnel and increased access to important habitats (particularly the calving grounds) are other potential important mechanisms.

The best approach to evaluate these potential impacts is to monitor movement routes and range use. It is particularly important to collect as much information as possible before construction in order to see where project construction and operation may impede movements. Recommendations can then be made for minimizing effects of construction and project facilities.

Results of the study to date indicate considerable movement across the upper Watana impoundment area by the female segment of the herd both during the spring migration to the calving grounds and during autumn dispersal. Crossings of the Susitna River in the middle portion of the proposed Watana impoundment have been at a relatively low level during the study. Historically (at least 21 of the past 32 years) major portions of the herd spend summers and winters north of the impoundment areas. This has not occurred to a major degree since about 1972. However it is likely that this area will again become important summer and winter range resulting in one or two major crossings per year of the impoundment area. These movements are probably more likely to occur at higher population levels.

Construction of the proposed Denali access road through the range of the recently identified upper Susitna-Nenana subherd may interfere with movements between calving areas, summer range and winter range for a portion of this herd. This road could also hinder movements of the main herd during years when they spent time north of the Susitna. It is unknown if this subherd is self-perpetuating or depends upon periodic influxes of animals from the main herd to sustain its numbers.

It appears that the Susitna Hydroelectric Project might tend to isolate the northwestern section of the Nelchina range (also the range of the upper Susitna-Nenana subherd). This could be detrimental to the main Nelchina herd by making important summer and winter range less accessible and harmful to the resident subherd by making it less likely that animals would be recruited from the main herd.

One identified scenario would have the spring migration of a portion of the main Nelchina herd deflected so that they would mix with the upper Susitna-Nenana subherd during calving. If this subherd is growing naturally, there would be an increase in calving in that area even without the project. The status of the subherd should be monitored so that project-induced changes can be separated from natural shifts.

Procedures

Except where noted procedures will follow those described in the Susitna Hydroelectric Project Phase I Final Report-Big Game Studies.

Objective 1

A pool of about 25 radio-collared caribou will be maintained in the main Nelchina herd. These caribou will be relocated throughout the year often enough to document movement routes (particularly in the vicinity of the proposed impoundments) and seasonal range use; 4 surveys in winter, 4 surveys during spring migration, 2 surveys during calving, 2 surveys during summer, 2 during autumn dispersal and 1 during the rut.

Objective 2

A sample of about 8 radio-collared caribou will be maintained in the upper Susitna-Nenana subherd. They will be relocated about 10 times per year to determine seasonal range use and movement patterns.

Objective 3

The dispersed nature of the upper Susitna-Nenana subherd make traditional census techniques impractical. A minimum population estimate will be made based on direct counts, during the rut. Observations of radio-collared caribou, tracks in snow and an analysis of seasonal habitat use will be used to ensure that major portions of the herd are not missed.

Objective 4

Estimates of population growth and herd productivity of the main Nelchina herd will be made through annual censuses and composition sampling.

WOLF AND WOLVERINE

Title: Effects of the proposed Devil Canyon and Watana impoundments and associated facilities on wolf and wolverine populations.

Investigators: Warren Ballard and Jackson Whitman

Objectives:

1. To map territories of wolf packs using the upstream moose zone of impact.

2. To monitor changes in size of each wolf pack.

3. To determine characteristics of wolverine use of the zone of impact.

Justification and Approach

Wolves are likely to be affected by a variety of impact mechanisms including habitat loss and disturbance. However, the most significant and farthest reaching is likely to be loss of prey. Food habits information indicates that moose and caribou are the most important prey in the study area. Availability of caribou in each pack's territory varies greatly depending on season and year. Changes in caribou numbers, distribution or movement patterns could influence the size and reproductive success of wolf packs throughout the Nelchina Basin. However, these impacts are impossible to quantify and few packs are likely to disappear unless a major reduction in caribou numbers occurs. Moose are a more reliable food source and are more likely to regulate wolf distribution and abundance over long periods of time. Therefore, impacts of the Susitna Hydroelectric Project on wolves are likely to be closely tied to the moose population occupying the moose zone of impact.

Key information needs are the number of packs using the moose zone of impact, the number of wolves at various seasons in each pack and the degree of dependence of each pack on that population of moose. During Phase I, it was estimated that 6 or 7 packs had territories that substantially overlapped the home ranges of moose that used proposed impoundment areas. Several other packs were known or suspected to have less overlap. Many of these packs were not radio-collared because of poor tagging conditions. These packs should be radio-collared, then territories mapped and their degree of dependence on moose in the moose zone of impact assessed.

Limited studies of wolverine were conducted during Phase I. Information on wolverine distribution, abundance, home range size habitat selection and food habits can be collected incidental to wolf studies at little extra cost.

Procedures

Except where noted procedures will follow these described in the Susitna Hydroelectric Project Phase I Final Report-Big Game Studies.

Objective 1

To the extent possible with a severely limited budget, a sample of wolves will be radio-collared in each pack that is believed to make substantial use of the upstream moose zone of impact. Territory boundaries and areas of seasonal importance such as den sites and rendezvous sites will be mapped by plotting of relocation. Food habits, with emphasis on prey species likely to be influenced by the hydroelectric project will be documented through observations of kills made on relocation flights and analysis of scats.

Relocation and food habits data will be used to assess the dependence of each pack on moose in the moose zone of impact.

Objective 2

Number of wolves in each pack will be monitored throughout the year through observation of radio-collared wolves and wolves accompanying them.

Objective 3

Wolverine radio-collared during FY 83 will be relocated opportunistically during wolf tracking flights. No specific expenditures of money will be directed at wolverine unless new information suggesting significant impacts arise.

BLACK BEAR AND BROWN BEAR

Title: Effects of the proposed Devils Canyon and Watana impoundments and associated facilities on populations of brown and black bears.

Investigator: Sterling Miller

Objectives

1. To document habitat use and determine the timing and magnitude of use of seasonal bear concentration areas.

2. To determine the location and characteristics of den sites.

3. To determine the food habits of bears using seasonal concentration areas.

Justification And Approach

Phase I bear studies were designed to reveal the kinds of impacts project construction might have on black and brown bear populations in the study area. Phase II bear studies will concentrate on verifying and quantifying the levels of impact of each species.

The biological impact of project construction on black bear populations will probably be relatively greater than on brown bear populations. However, humans tend to place a greater value on brown bears than on black bears. Also, relative to black bears, brown bear populations are more sensitive to disturbance, are less dense, have lower reproductive rates, and are a threatened species outside of Alaska and Canada. In terms of social impact, therefore, project-related reductions in brown bear populations may exceed in value the reductions in black bear populations.

Both species of bear spend about half the year in dens. Food requirements the rest of the year are likely to be substantial. Phase I studies suggest that both species of bear rely on seasonally available, often geographically concentrated food sources. Availability of many of these foods varies greatly from year to year. A food source little used one year might become critical the next year if the preferred food is not available. Some habitats, such as denning areas and escape cover for black bears, may be important for reasons other than food availability.

Habitat use and presumably degree of dependence on specific seasonally available foods has varied each of the three years of study. General hypotheses of how the availability of various foods impacts the population and how the Susitna project will affect the availability have been developed and incorporated into a bear model. It is unlikely that the full range of variability has been observed and these hypotheses may need modification and confirmation. In some cases particularly the identity of spring

foods and the role of salmon as alternatives to berries in late summer are highly speculative. Therefore there is a need to continue to monitor seasonal habitat selection on a broad scale and to key in on the importance of certain specific foods.

Procedures

Except where noted procedures will follow these described in the Susitna Hydroelectric Project Phase I Final Report-Big Game Studies.

Objective 1

Samples of approximately 20 brown bears and 20-25 black bears will be maintained. These bears will be relocated 6 times a month between late April and mid-June and 3-4 times a month the remainder of the active season.

Objective 2

Dens of radio-collared individuals will be marked and examined. Emphasis will be on black bear dens. This procedure will establish the proportion of available denning habitat that will be lost to the project. Examination of the dens will establish the characteristics of den sites in the impact zone, these data will permit evaluation of the degree of impact on bear populations when individuals are excluded from using current denning habitats.

Objective 3

In Phase II special emphasis will be placed on identification of the food resources utilized by bears during the periods of seasonal concentrations believed to be motivated by food availability. The most important area of these investigations will be on foods utilized by bears during spring and early summer in the impoundment inundation area and vicinity. Emphasis will also be placed on food habits of bears that congregate around salmon spawning areas in order to evaluate the significance of salmon the in diets of these bears.

Bear scats will be collected by extensive on-the-ground searching. Contents of scats will be determined through laboratory analysis. These data will be supplemented by direct observation of bear feeding activity when possible.

Observations of bears feeding on ungulates will be made during radio-tracking flights. A selected sample of bears will be relocated twice a day in conjunction with calf mortality studies to estimate the rates of predation on ungulates by both species of bear.

DALL SHEEP

Title: Habitat use by Dall sheep in the vicinity of the Susitna Hydroelectric Project

Investigator: Nancy Tankersley

Objectives:

1. Quantify sheep (and possibly moose) use of various elevations of the Jay Creek lick and monitor lick use by individual sheep.

2. Compare Dall sheep use of the Jay Creek mineral lick with that of other licks in the Watana Creek Hills.

3. Compare mineral content of the Jay Creek lick with that of other licks and non-lick areas within the range of the Watana Creek Hills sheep population.

4. Monitor seasonal habitat use of potential sheep range in the Watana Hills, Mt. Watana and Portage-Tsusena Creek areas that may be disturbed by project-related construction activities, and aircraft or vehicle traffic.

Background and Justification:

Dall sheep (*Ovis dalli*) occur in 3 areas in the vicinity of the Susitna Hydroelectric Project--near Mount Watana, the Watana Hills, and the Portage-Tsusena Creeks area. Besides disturbance from construction activities, aircraft traffic, and possibly access route ground traffic, probably the major direct impact of the project will be disturbance of the Jay Creek mineral lick in the Watana Hills. This lick is adjacent to the proposed Watana impoundment and is used by sheep and possibly moose (*Alces alces*) (Ballard *et al.* 1982) in early summer. This lick, discovered during Phase 1 studies, needs further study so that the impacts of the project on sheep can be assessed. Seasonal habitat use of the Watana Hills, Mt. Watana area, and Portage-Tsusena Creeks area by sheep also needs further documentation for impact assessment and mitigation planning.

Many North American ungulates seek out mineral elements from places known as mineral licks (Stockstad *et al.* 1953, Hebert and Cowan 1971, Weeks and Kirkpatrick 1976, Fraser and Reardon 1980). Mineral licks are heavily used by Dall sheep in Alaska and Canada (Dixon 1939, Palmer 1941, Gross 1963, Pitzman 1970, Nichols and Heimer 1972, Gill 1978). Some sheep have been documented to travel 12 miles out of their way to visit a lick before moving to summer range (Heimer 1973). Heimer (1973) has found that fidelity to the Dry Creek lick year after year is high, approximating

100% for ewes, and 80% for rams. Because of the apparent importance of mineral licks to Dall sheep in Alaska, Heimer (1974) recommended that licks be designated critical habitat areas.

Various elements have been suggested as the one sought by ungulates at mineral licks. Hanson and Jones (1976) hypothesized that sulfur may be a major lick attractant. However, as Weeks (1978) pointed out, sulfur is abundant in plant tissues and is not universally found in high levels in natural licks. Hebert and Cowan (1971), Weeks and Kirkpatrick (1976), Fraser and Reardon (1980) and others have presented convincing evidence that sodium is the desired element for mountain goats (*Oreamnos americanus*), deer (*Odocoileus virginianus*), and moose. At the Dall sheep lick at Dry Creek, Heimer (1973) found 7.3 times as much sodium, 3.0 times as much potassium, 3.6 times as much calcium and 14.9 times as much magnesium in the lick soil compared to soil from nearby areas not eaten by sheep. Because of the high phosphorus content of sheep forage in spring, Heimer (1973) suggested that calcium and magnesium may be the desired elements. However, Geist (1971) and Heimer (pers. commun.) have shown that bighorn and Dall sheep exhibit an appetite for sodium by using table salt (NaCl) to bait sheep. Denton and Sabine (1961) have shown that a sodium deficiency in domestic sheep leads to an increased appetite for that element.

Mineral lick use is highly seasonal, occurring mostly in spring and early summer (mid-May through mid-July in Alaska). The Dry Creek lick in the Alaska Range has received heaviest use during June with peak use occurring from 0400 to 1200 hours, and moderate use continuing until 2000 hours (Heimer 1973). The timing and intensity of use varies somewhat from year to year depending on weather patterns, which influence sheep movement to licks (Heimer 1973).

The Jay Creek lick will be subjected to flooding and erosion, and sheep attracted to the lick will be seasonally vulnerable to human disturbance. The lick area is a steep bluff on west bank of Jay Creek exposing some dry mineralized substrate interspersed with rock outcrops, steep slide areas, and trails to the creek and upper plateau. Sheep ingest the mineralized substrate, travel, and rest in various areas of the bluff from the creek bottom (2000 feet in elevation) up to the top (2450 feet) (Ballard *et al.* 1982). Portions of the lick area may be flooded, and the annual cycle of filling and draining in the impoundment will probably cause additional erosion of the bluff. The lick's close proximity to the impoundment makes the sheep seasonally vulnerable to disturbance from construction, transportation and recreational activities in this area. These impacts could reduce lick use or force abandonment of the area, with possible detrimental effects on this small sheep population.

Additional sheep licks occur in the Watana Hills. Along Jay Creek, secondary lick areas occur intermittently upstream from the main lick area for roughly 2 miles, and occur on a low ridge across the creek from the main lick. Another lick on the East Fork of Watana Creek (approximately 7 miles northwest of the Jay Creek lick) is used by Dall sheep. Tobey (1981) reports a lick in northeastern Watana Hills (Fig. 2); however, this has not been confirmed. The extent and overlap of use among these licks by the same sheep, as well as the similarity of lick elements, are unknown at this time. If only certain sheep traditionally use specific licks, different segments of the sheep population may not be aware of the existence of alternative areas (Geist 1971).

The goal of this study is to document the use and importance of the Jay Creek lick to the Watana Hills sheep population. This includes observing and quantifying use of the lick area, classifying the sexes and ages of lick users, determining the seasonal and daily timing of use, and various other pertinent parameters. Other areas of sheep habitat that may be disturbed by project-related construction activities, and aircraft and vehicle traffic will be monitored for sheep use.

Procedures:

The following procedures are for the summer of 1983 most work will be accomplished during FY83, however observations and mineral analyses will extend into early FY84.

Twenty-one sheep in the Watana Hills were color-marked by specially adapted firearms shot from a helicopter in early April 1983. Ten sheep marked in the northern Watana Hills were marked red; 11 sheep in the southern Watana Hills were marked blue.

An observation blind will be erected in early or mid-May to quantify use of various areas of the Jay Creek lick bluff and identify individual sheep (color-marked and others) using the main Jay Creek lick and the secondary lick area on the opposite ridge. Observations will be made by 1 or 2 observers with the aid of binoculars and spotting scopes. Most observations will be made during the most likely lick activity period (0400-2000 hours). The sex, age, dye-markings, individual identity (if known), length of lick use, zone of lick use, date, time, weather conditions and other pertinent information will be recorded. Observations will continue until late July or when a seasonal drop in use is evident. Similar observations will be made at the East Fork lick from late May to mid-June and at other Watana Hills' licks if possible.

Samples will be taken from various areas in the Jay Creek lick, nearby secondary licks (upstream and on opposite ridge), East Fork lick and any other licks found in the Watana Hills and nearby areas outside the licks for comparison. The samples will be taken with plastic utensils and placed in plastic containers to avoid contamination from metal. Sampling will occur after

lick observations have ascertained preferred licking zones. The samples will be analyzed for water soluble and total elemental levels of Na, K, Ca, Mg, and 29 other elements by the inductively coupled argon plasma (ICAP) method. Analyses of the Jay Creek lick will be completed by fall 1983.

One hundred foot elevation contours of various areas of the Jay Creek lick will be documented using a Wallace and Tiernan model FA181 altimeter, and visibly marked for use during sheep observations. Project engineers and soils geologists will be consulted to predict the physical effects of the impoundment on the Jay Creek lick.

BELUKHA WHALE

Title: **Timing and magnitude of use of the Susitna River by belukha whales.**

Investigator: **Donald Calkins**

Objectives:

1. To determine the timing and magnitude of use of the Susitna River by belukha whales.

2. To identify probably food sources attracting belukhas to the Susitna River.

Justification

An estimated population of 300 to 500 belukha whales inhabits Cook Inlet. This population appears to be isolated from the far larger population which occupies the Bering, Chukchi and Beaufort Seas. Belukhas are receiving increased international attention, particularly because of concerns about the effects of industrial development. The small size and isolated nature of the Cook Inlet population make it especially vulnerable to such effects.

The Cook Inlet population moves from one part of Cook Inlet to another through out the year often concentrating in the mouths of rivers. These concentrations are likely a response to the availability of anadromous fish moving in and out of the rivers. Eulachon and salmon, both outmigrating smolt and returning adults are the most likely attractants in Cook Inlet rivers.

Most of the Cook Inlet populations moves into upper Cook Inlet in spring and remains there through much of the summer. A high proportion of these concentrate at the mouth of the Susitna River, sometimes ascending the river for several miles. It is possible that all or most of the population calves in this area.

Reductions in eulachon or salmon populations by the Susitna Hydroelectric Project could adversely impact the Cook Inlet belukha population. In particular, reduced food availability or altered timing of availability could lead to poorer calving success or reduced calf survival.

Fisheries studies will be providing information on which anadromous stocks are likely to be reduced. By correlating the timing of migration of these stocks with the occurrences of belukha concentrations at the mouth of the river, we can gain insight into the degree of use of these stocks by belukhas. By comparing the proportion of the population using the Susitna River with the proportion using other rivers we can further assess the importance of these stocks to the population as a whole.

Scheduled field work will be completed in late FY 83. Unless new information on impacts on fish populations believed to important to belukhas becomes available, work will be limited to data analysis and report writing.

MOOSE CARRYING CAPACITY MODEL

Title: Application of a nutritionally based carrying capacity model to the Susitna Hydroelectric Project.

Investigator: Wayne Regelin

Objectives

To adapt a nutritionally based moose carrying capacity model to the Susitna Hydroelectric Project.

Justification and Approach

Carrying capacity, the number of individuals a unit of land can support for a unit of time, is a term commonly used by the wildlife biologist. However, quantification of carrying capacity has been elusive, and meaningful application of the concept generally nebulous. Early attempts to measure ungulate carrying capacity were based on range or browse transects, indicator plants, or browse utilization methods. Using these techniques, the biologist obtained a better understanding of the relationships between the animal population and its forage base. But because he could not relate these measurements to the nutritional requirements of the animal, he has seldom been able to quantify numbers of animals that the range could support.

A more recent approach to the problem of quantifying carrying capacity has been to integrate the nutritional needs of the animal with those supplied by the range. This concept of biological carrying capacity requires an understanding of ungulate nutrition, the nutrients the animal must obtain from the range, and the ability of the range to meet those nutritional needs.

This approach to quantifying carrying capacity required developing two computer submodels.① One to estimate the nutritional needs of the animals and the②other the nutrients available in the range.

The first, a ruminant submodel, was developed by D. Swift at Colorado State University and modified for moose at the Kenai Moose Research Center (MRC). This "paper moose" requires little change when applied to different moose populations.

The second, a vegetation submodel, estimates the total nutrients supplied by the vegetation available to moose. This submodel was developed by T. Hobbs, Colorado Division of Wildlife. Inputs for the vegetation submodel must be collected from each range being evaluated.

When the two submodels are integrated, the output is a quantification of the potential carrying capacity of the range being evaluated. The term potential carrying capacity is used rather than the actual or realized population level because the two may

be quite different. Any moose population has a number of decimating factors (predation, hunting, starvation, etc.) operating upon it at any time. These controlling factors generally determine the upper limits of population growth. Food is only one limiting factor and may not be the controlling factor at the time of measurement. Even when food is limiting, a surplus may occur within the population's range, but its spatial and temporal distribution may prevent full utilization. Consequently, the model should not be considered a panacea for all management problems. Its primary initial value is likely to be for comparing the ability of one area of habitat to meet the nutritional needs of moose with that of another or to measure changes in food production of the same area over time. This makes it an ideal tool for habitat management decisions. For precise application of the model for traditional population management decisions, additional information on moose movement patterns and the role of other potential limiting factors may be necessary to determine the relationship between the potential carrying capacity estimated by the model and the actual population size achievable.

Model Application

Probably the most useful application of the carrying capacity model is in the evaluation of a treatment response for habitat enhancement. Estimates of carrying capacity can be made in a particular vegetation type before and after treatment (i.e., burning or tree crushing) and the response evaluated on the basis of improved stocking rates (i.e., moose numbers before and after crushing). An enhancement project can then be evaluated on a cost to benefit ratio based on the quantification of improvement of potential carrying capacity.

A second equally valuable use of the carrying capacity model is estimating potential losses of habitat due to land use changes (i.e., hydroelectric projects, agriculture, strip mining). The Susitna Hydroelectric project is a prime example. A known area of moose winter range will be flooded by the proposed impoundment. Evaluation of these areas using the model can provide a quantified loss of the potential carrying capacity of the range based on moose nutrition and the vegetation. Estimates from the model coupled with population ecology studies can provide the basis for mitigation procedures. By including the model in this decision-making process, the possible biases of underestimating range losses are improved. This is true because by studying the moose population only, one cannot be sure the range is being utilized to its maximum potential. For example, the current population may be below the range carrying capacity due to excessive brown bear and wolf predation. By mitigating for current moose numbers only, we may be short changing the wildlife resource.

Current Status

Development of the moose carrying capacity model was undertaken in 1978 through a cooperative project by the U. S. Fish and Wildlife Service (F&WS) and the Alaska Department of Fish and Game (ADF&G). This effort resulted in adaptation of the general ruminant submodel to a model specific to moose. Data collected at the MRC on moose energy and nitrogen balance were incorporated into the model. Simulation runs in 1981 and 1982 indicate the submodel can accurately predict the energy and nitrogen requirements and generate daily forage intake values.

Procedures

Two phases of application of the model to the Susitna Project will be conducted simultaneously. The first phase will be a field validation of the model at the Kenai Moose Research Center in FY84 and FY 85. This phase will be conducted by ADF&G with partial support from USF&WS. ADF&G personnel partially funded by APA will participate in the design, direction and data analysis direction of this phase. However, all operating and most personnel costs will be borne by ADF&G and USF&WS.

The second phase is application of the model to the Susitna area. This phase will be carried out in cooperation with subcontractors of APA. FY84 field activities will be directed at experimenting with sampling design. Actual application of the vegetation submodel will occur in FY85.

SEVERE WINTER CONTINGENCY PLAN

Title: Effects of the Susitna Hydroelectric Project on moose during periods of severe snow accumulation.

Investigator: Warren Ballard and Ronald Modaferri

Objectives

1. To determine habitat selection of moose during periods of high snow accumulation.

2. To determine the number of moose using habitat that may be lost or altered by the Susitna Hydroelectric Project during periods of high snow accumulation.

3. To determine the numbers, sex and age composition, and cause of death of moose dying during a severe winter.

4. To determine that rate of wolf predation on moose during periods of high snow accumulation.

Background and Justification

Periodic deep snow accumulation has been shown to dramatically affect several moose populations in Alaska. During such periods moose frequently concentrate in riparian habitats at lower elevations. High mortality due to nutritional stress and increased predation by wolves may result in substantial population reductions. The extent of these reductions and the rate of recovery may be influenced by the amount and quality of winter range and predator abundance. Observations made during the early 1970's indicate that the number and sex and age composition of moose dying and the role of wolf predation varies in different areas.

The Susitna Hydroelectric Project is likely to destroy or alter winter range that might be critical during a severe winter in both the upstream and downstream study areas.

The impact of the project on moose will depend in part on the proportion of critical winter range that is lost or degraded. Critical winter range can not be accurately delineated except during severe winters. Similarly the response of the population to a severe winter can not necessarily be extrapolated from observations made in other areas.

Observations of moose distribution and habitat selection during a severe winter can greatly improve the assessment of the significance of habitat loss or alteration and provide useful information on the most effective size and placement of mitigation actions such as habitat enhancement. Knowledge of the patterns and causes of mortality during a severe winter is crucial to simulation modelling efforts.

Procedures

Spatial and temporal variation in snow accumulation patterns makes it difficult to define a "severe winter." Moose may respond differently to early accumulation of snow than they do to the same accumulation late in the winter. Therefore, a "severe winter" will be defined largely by the movements of moose. The winter of 1982-83 will be used as a standard. Severe winter procedures will be initiated when 1) radio-collared moose, whose movements were documented during 1982-83, move into areas subject to habitat loss or alteration in larger numbers than in 1982-83 or 2) when river censuses indicate larger numbers of moose in the downstream floodplain than were observed in 1982-83.

Upstream Study Area

Radio-collared moose relocation flights will be intensified. The sample of 30 regular inhabitants of the primary zone of impact will be located twice a week. Other radio-collared moose will be relocated weekly to determine if their use of the zone of impact increases and to aid in identification of critical winter range that will not be impacted.

Two aerial surveys will be conducted to map moose distribution in January and February.

In March, a census will be conducted to estimate the number of moose in and within 5 miles of the impoundments.

Location and numbers of dead moose will be recorded. A sample of dead moose will be visited on the ground and the sex, age and cause of death will be assessed.

Two wolf packs will be relocated daily for a period of 30 days. Wolves will be backtracked and kills recorded to determine rates of predation. As many kills as possible will be visited and sex, age and condition of each animal will be assessed.

Downstream Study Area

Four additional river censuses will be conducted. In conjunction with one river census, distribution of moose to either side of the river will be mapped to determine the availability, location and habitat type of critical winter range outside of the floodplain.

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Additional Information Required	(V) Proposed Mitigation Options (F.E.R.C. License Application)	(VI) Mitigation Plan Refinement
A) Moose	7) Habitat improvement will occur along the transmission line corridor due to maintenance of vegetation at early successional stages.	The transmission corridors would provide almost 78,100 acres (30,000 ha) of winter habitat of reasonable quality (p. E-3-528; Table E.3.145); representing a beneficial impact on moose.			
	8)Drifting snow from the impoundment surface may preclude use of a narrow band of winter browse along the impoundment shore.	Snow drifting is unlikely to extend far into wooded winter habitats. The drawdown zone and ice shelves will catch much windblown snow and further drifting will occur at the edge of open and wooded habitats (Table E.3.145).			
	9) Drifting snow in the transmission line corridor may preclude use of winter browse.	Impact not quantified but not expected to be significant (Table E.3.145).			
	10) Delayed melt-off of snow drifts in a narrow band along the impoundment shore and transmission corridor may reduce availability of spring forage.	Availability will be delayed in this zone but forage will eventually become usable as the spring thaw progresses. Actual area of early spring forage loss will be a narrow band along the impoundment shore and impacts are not expected to be significant (Table E.3.145).			
	11) Climatic changes due to the impoundments (increased summer rainfall, increased winds, and cooler summer temperatures) may reduce habitat carrying capacity; (p. E-3-406).	Available data from Williston Reservoir, B.C., indicate that these subtle climatic effects will likely be undetectable and of little impact on moose habitats (Table E.3.145).			
	12) Delayed plant phenology may occur immediately adjacent to the reservoir due to its cooling effect, reducing spring forage for moose; (p. E-3-400).	Impact not quantified and limited in extent to areas immediately adjacent to the impoundment. Effects on moose would be difficult to detect (Table E.3.145).			

(I) Affected Species or Group	(II) Impact Mechanism	(III) Impact Assessment Status	(IV) Additional Information Required	(V) Proposed Mitigation Options (F.E.R.C. License Application)	(VI) Mitigation Plan Refinement
H) Wolverine	5) Increase in carrying capacity of the transmission corridor for moose and ptarmigan may beneficially impact wolverines.	Impact represents a beneficial effect on wolverines (Table E.3.152).			
	6) Alteration of use patterns due to presence of the impoundments and changes in home range boundaries.	Conflicting data on home range boundaries of wolverines and terrain features make this impact difficult to predict; not expected to be significant (p. E-3-432).			
	7) Avoidance of all areas of human activity, at least initially, causing some changes in use patterns or preclusion of use in some areas.	Impact not quantified; not expected to be significant unless high levels of recreational disturbances occur (Table E.3.152).			
	8) Increase in mortality due to hunting, trapping, and poaching.	Impact not quantified but likely the most important impact on wolverines. Hunting and trapping can be regulated although poaching may represent an unavoidable adverse impact (Table E.3.152).			
I) Belukha	1) Water temperature changes at the mouth of the Susitna River due to the project may affect calving.	Water temperatures will not change significantly at the river's mouth; impact not expected to occur (p. E-3-422).			
	2) Food supplies of belukhas may be decreased due to alterations or blockage in the availability of spawning streams for salmon.	Salmon decreases would at most be 5-8% of Susitna river stocks; impact not expected to be significant (p. E-3-434).			
J) Beaver and Muskrat	1) Permanent loss of habitat for 5-10 muskrats due to impoundments and other permanent facilities.	Impact not considered significant to area populations due to the small numbers affected (Table E.3.153).		Some compensation will occur through improved habitat downstream from the dams (p. E-3-514).	
	2) Loss of some habitat for both species due to siltation of ponds, alteration of drainage patterns, and disturbance near access roads and borrow pits (primarily in the Deadman Creek area).	Impact not considered significant to area populations due to the small numbers affected (pp. E-3-434 to 436).		Partial avoidance is possible through realignment of the access route and design changes to reduce disturbance to beaver habitats (p. E-3-514).	

APPENDIX D

Terrestrial Program Principal Staff and Responsibilities

ORGANIZATION	NAME	TITLE/RESPONSIBILITY
Alaska Powr Authority	Dr. Richard Fleming	Deputy Manager-Environmental
Harza-Ebasco	Mr. Randy Fairbanks	Lead Terrestrial Biologist
	Dr. Roseann Densmore	Terrestrial Biologist
	Ms. April Rivkin	Terrestrial Biologist
LGL Alaska	Dr. Robin Sener	P.M.[1] - Imp. Assess. & Mit. Plan Refine.
	Mr. Dave Roseneau	P.I.[2] - Raptors
	Mr. Dale Heter	Wildlife Biologist
U of A Palmer	Dr. Bill Steigers	P.I. - Plant Ecology
	Dr. Dot Helm	Plnat Ecologist
U of A Fairbanks	Dr. Phil Gipson	P.I. - Furbearers
	Dr. Brina Kessel	P.I. - Birds & Small Mammals
R.A. Kreig & Associates	Mr. Ray Kreig	P.M. - Vegetation Mapping
	Mr. Ken Winterberger	Vegetation Mapping Consultant
	Ms. Deborah Heebner	Vegetation Mapper
	Mr. Ray Koleser	Vegetation Mapper
ADF&G - Game	Mr. Karl Schneider	Research Coordinator - Big Game
	Dr. Sterling Miller	P.I. - Bears
	Mr. Warren Ballard	P.I. - Upstream Moose, Wolf, and Wolverine

[1] P.M. = Project Manager
[2] P.I. = Project Investigator

ORGANIZATION	NAME	TITLE/RESPONSIBILITY
ADF&G Game (cont'd)	Dr. Ron Modafferi	P.I. - Downstream Moose
	Mr. Ken Pitcher	P.I. - Caribou
	Ms. Nancy Tankersley	P.I. - Dall Sheep
	Mr. Jack Whitman	Wildlife Biologist
	Ms. Suzanne Miller	Biometrician
	Dr. Wayne Regelin	P.I. - Carrying Capacity Model

1/ P.M. = Project Manager
2/ P.I. = Project Investigator

1190

ALASKA POWER AUTHORITY

334 WEST 5th AVENUE - ANCHORAGE, ALASKA 99501

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

June 28, 1984
Susitna File No. 1.8.1/1.17.4.2/4.3.3.1/4.3.2.1

Carl Yanagawa
Alaska Department of Fish & Game
333 Raspberry Road
Anchorage, Alaska 99502

Attention: Mr. Carl Yanagawa

Subject: Susitna Hydroelectric Project
Terrestrial Program
FY84 Detailed Plan of Study Revision

Reference: Document 1190 - Copy No. 018
Harza-Ebasco Letter dated April 25, 1984

Dear Mr. Yanagawa:

Enclosed are revisions to the Detailed Plan of Study for FY84 (Document 1190). This update reflects changes in the Terrestrial Program and provides additional clarification and detail for study task descriptions and organizations. Please revise your copy of the Plan of Study as indicated on Enclosure 1.

Sincerely,

for Jon S. Ferguson
Project Manager
Susitna Hydroelectric Project

ddp

Enc: as noted

cc w/o Enc:
L. Polivka, HE
J. Thrall, HE
R. Fairbanks, HE
D. Callesen, HE

42903

Please replace the original pages cited below with the revised pages.

Original Pages	--replace with--	Revised Pages
i - iv		i - iv
3-3 through 3-6		3-3 through 3-6
3-8		3-8
3-10 through 3-13		3-10 through 3-13
4-4		4-4
4-6, 4-7		4-6, 4-7
4-10, 4-11		4-10, 4-11, 4-11a through 4-11e
4-16		4-16
4-18 through 4-22		4-18 through 4-22
4-27		4-27
4-30, 4-31		4-30, 4-31
4-34		4-34
4-36		4-36
4-41, 4-42		4-41, 4-42
4-46 through 4-48		4-46 through 4-48
4-50 through 4-53		4-50 through 4-56
5-1 through 5-3		5-1 through 5-4
8-1		8-1
D-1, D-2		D-1, D-2

TABLE OF CONTENTS

Table of Contents (cont'd)

Table of Contents (cont'd)

LIST OF FIGURES & MAPS

3.1.2 Tracking and Documentation System

It is important that a "bookkeeping" system be developed and applied to the Terrestrial Program issue settlement process so that the current status of impact assessment and mitigation planning for each impact mechanism can be documented and tracked through the process. This is necessary even though there is a broader tracking system for the entire settlement process (being maintained by Task 6, Licensing and Permitting) because many agency-raised and other issues are general (i.e., impacts not adequately quantified--Issue T-20 Appendix A) and tracking and documentation of the resolution of these issues requires an examination of each impact mechanism.

The tracking and documentation system being implemented for the Terrestrial Program consists of a matrix organized to show for each type of impact the current studies, monitoring plans and mitigation plans that are relevant to that impact. The major column headings describe the steps in the planning process as follows:

I) Affected Species or Group: lists each species or groups of species of concern in the project area and surrounding region.

II) Impact Mechanism: briefly explains how various aspects of the project will affect each listed species or group.

III) Impact Assessment Status: provides an evaluation of the impact, including its perceived importance to the affected species or group, and any quantification of the impact that has been developed.

IV) Ongoing and Planned Studies: provides a summary of the investigations that are underway or planned for the near future and that are relevant to refining the particular impact assessment or mitigation planning.

V) Proposed Monitoring: summarizes research efforts that are proposed to be conducted during project construction and operation to document the impacts that are occurring and/or to assist in mitigating these impacts.

VI) Proposed Mitigation Measures: summarizes various mitigation measures that have been proposed to assist in mitigating the effects of the pertinent impact mechanism.

Two draft example pages of the Tracking and Documentation System are provided in Appendix C. A draft of the entire Tracking and Documentation System will be available in December 1983. The table will be updated periodically and will be used at the Terrestrial Program progress review and coordination meetings as a basis for reviewing progress and discussing planned activities. The table will provide a means for grasping the total scope of unresolved issues so that prioritization of work efforts can be clearly made.

3.1.3 Impact Assessment Update & Refinement Report

Central to the Terrestrial Program impact assessment and mitigation plan refinement process will be the preparation of an Impact Assessment Update and Refinement Report. This report will supplement the FERC License Application by providing an updated impact assessment which is based on all new information collected since the application was prepared and by refining the analyses conducted for the application where it is apparent that analyses need refinement.

The specific objectives of the Impact Assessment Update and Refinement Report (Assessment Report) are to:

(1) Provide an updated and more quantitative assessment of impacts upon which to base mitigation planning, making full utilization of data collected since the License Application was prepared, as well as previous data;

(2) Resolve as many items in the agency-raised issue list, the agency comments on the License Application, motions to intervene, and the FERC scoping issues list as possible.

(3) Provide FERC with an updated and more quantitative assessment of impacts upon which to base the preparation of their FEIS.

After the License Application was prepared, a complete set of big game studies annual reports was published (spring 1983). Data contained in these reports were only partially considered in the License Application. Another set of annual reports is currently under preparation for publication in the Spring of 1984. Also, additional data have been collected on plant phenology in and near the impoundment zones and on beaver colony abundance between Devil Canyon and Talkeetna and downstream of Talkeetna. In addition, refinements have been made to simulation models, which have been prepared to improve our understanding of the net or cumulative effects of

the project. These items represent the new information or refinements that will be considered in the preparation of the Impact Assessment Update and Refinement Report.

Updating the impact assessment with this new information will, in itself, allow resolution of many terrestrial issues. Additional analyses and refinements to existing analyses will be conducted as necessary, in order to resolve additional issues raised by the agencies and intervenors, or identified by FERC.

All updates and refinements will be documented by describing and referencing them in the Impact Assessment/Mitigation Plan Tracking & Documentation System. This system will also be used to indicate when an issue is addressed or resolved by an update or refinement.

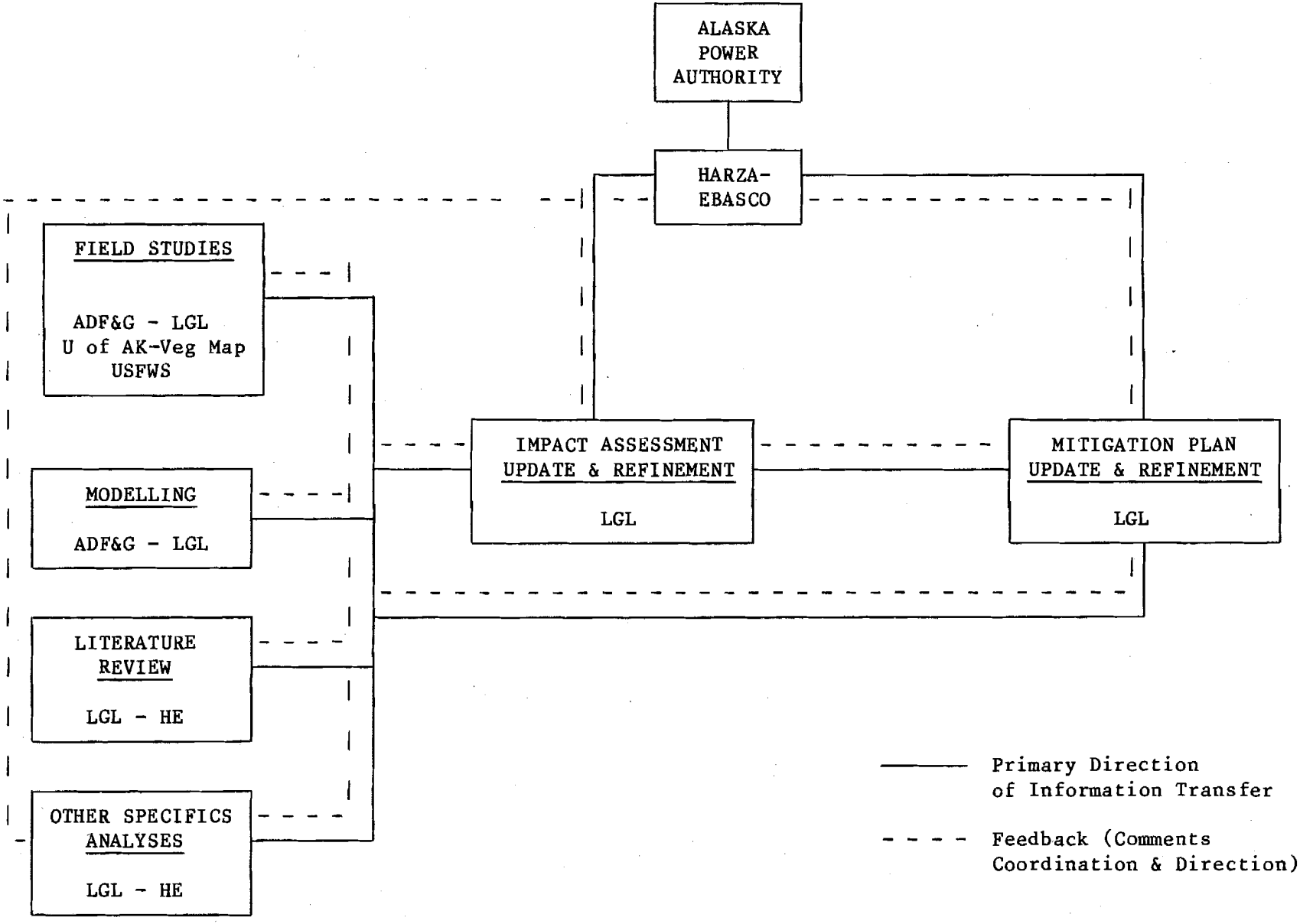
The Impact Assessment Update and Refinement Report will be prepared by a core team from LGL who will receive direction and technical review from Harza-Ebasco. The core team will coordinate directly and frequently with the principal investigators responsible for conducting the specific study tasks described below, in order to obtain the most up-to-date information available for the impact assessment. This coordination will ensure that the principal investigators are responsive to the outstanding terrestrial issues in preparing their reports and designing their studies. The relationships among the various impact assessment and mitigation plan refinement efforts, in terms of information transfer and responsibilities, are presented in Figure 3-1.

The schedule for preparation and completion of the Impact Assessment Update and Refinement Report is designed to ensure that the report will be available as input into the FERC Final Environmental Impact Statement (FEIS). Important milestone dates are presented below.

Initiation of Work	December 19, 1983
Preliminary Draft Completed	April 30, 1984
Final Draft Completed	May 15, 1984
Final Report Completed	May 30, 1984

Fig 3-1

Terrestrial Program: Impact Assessment/Mitigation
Plan Refinement Information Flow and Responsibilities



The Mitigation Plan Refinement Report will be prepared by a core team from LGL with direction and technical review from Harza-Ebasco. The work will be conducted simultaneously with work on the Impact Assessment Update and Refinement Report, but will be completed about one month after the latter report. It will be completed, however, in time to be used as input into the FERC FEIS. Important milestone dates are presented below:

Initiation of Work	December 19, 1983
Preliminary Draft Completed	May 31, 1984
Final Draft Completed	June 15, 1984
Final Report Completed	June 29, 1984

3.3. COORDINATION

3.3.1 Progress Review and Coordination Meetings

A systematic means of ensuring that good coordination occurs will be implemented through regular progress review and coordination meetings. These meetings will be attended by the Harza-Ebasco Terrestrial Group Leader, LGL Project Manager, ADF&G Research Coordinator, ADF&G Habitat Division reviewer, and a USFWS project reviewer. In addition, it is expected that Power Authority Staff will attend as time permits and additional staff members from Harza-Ebasco, LGL, ADF&G, USFWS, U of A Palmer Experiment Station, U of A Museum and U of A Cooperative Wildlife Research Unit, will attend as necessary. Members of the Aquatic, Hydrology and Social Science Study Teams will also attend as appropriate to ensure that activities are coordinated with these groups and to obtain their technical expertise as the need arises.

Progress review and coordination meetings will be conducted monthly, or more or less frequently as the need arises. These meetings will provide a forum for each major entity of the Terrestrial Study Team to report on their activities for the previous period, including preliminary results of field studies, and to discuss their planned activities. The meetings will also provide the opportunity for Terrestrial Study Team members to modify their activities so that they provide more useful input to other activities in a timely manner. These meetings provide an opportunity for regular input from ADF&G Habitat Division and USFWS project reviewers. Meeting summaries will be prepared and distributed to all Terrestrial Team members.

3.3.2. Workshops

Another form of information transfer and coordination is through workshops. A large workshop on terrestrial modeling efforts was held in spring 1983. A draft report was prepared presenting the status of terrestrial models, as refined at the workshop and associated technical meetings, and identifying information needs for further model refinement. This report will be finalized in the Spring of 1984, following receipt of review comments from Terrestrial Study Team members.

Terrestrial workshops are currently planned for April 10 and June 26, 1984. The first workshop represents a scoping workshop for FY85 terrestrial work efforts (see Section 3.4). The second workshop will cover impact assessment and mitigation plan refinements conducted in FY84.

3.4 FY85 PLAN OF STUDY DEVELOPMENT PROCESS

The plan of study development process for FY85 will be conducted in a manner that will ensure that all work efforts are designed to resolve or assist in resolving issues pertinent to the Settlement Process. The draft plan of study has been divided into tasks that address specific objectives for FY85, with some tasks more important than others because they are either critical to the licensing and settlement processes or are necessary to maintain baseline data collection. Based on the results of several intensive planning sessions attended by key terrestrial personnel, study plans have been prioritized by task description with decreasing priority asigned to increasing task number. The tasks have been divided into four general levels of importance. A scoping workshop was held to discuss these plans in detail with the agencies, and give the agencies an opportunity to provide their input and comment.

Prior to finalization of detailed task descriptions, agency comments will be incorporated and detailed methodologies will be developed. Developing budget estimates is an on-going process contingent upon the final budget allocation to the Susitna Project. Emphasis is on developing scopes further for the highest priority tasks. In anticipation of the study development process being delayed, detailed task descriptions are being developed for those tasks assigned to Levels 1-3. Detailed task descriptions will be developed for Level 4 tasks pending budget allocation decisions.

A detailed plan of study for FY85 will be developed after the Governor and legislature finalize the FY85 Susitna budget. This plan of study will be based on actual budget allocation, and will represent the actual scope of FY85 work.

The schedule for these activities is as follows:

Draft Plan of Study	March 31, 1984
FY85 Terrestrial Program Scoping Workshop	April 10, 1984
Agency Comments	April 30, 1984
Detailed Plan of Study	June 30, 1984

Final estimates will be available in late 1985 after completion of the bioenergetics model testing. Final population model predictions, which are partially based on the final carrying capacity estimates, will also be available in late 1985. These estimates will be incorporated into the Final Impact Assessment Update Report and will be used to make the final refinements to the Mitigation Plan, both of which will be completed in early 1986.

Work efforts to be conducted during FY 1984 along with the responsible organization include:

1. Zone of Impact Census - ADF&G
2. Impact Area Habitat Use Monitoring - ADF&G
3. Calf Predation Monitoring - ADF&G
4. Severe Winter Studies (if severe winter occurs) - ADF&G
5. Spring Plant Phenology Study - U of A, Palmer
6. Forage Vegetation Mapping - R.A. Kreig
7. Pilot Browse Sampling - U of A, Palmer
8. Moose Food Habits Study - U of A, Palmer
9. Browse Sampling - LGL, ADF&G
10. Wolf Studies - ADF&G
11. Bear Studies - ADF&G
12. Bioenergetics Model Testing - ADF&G/USFWS
13. Bear Population Model Refinement - ADF&G/LGL
14. Moose Population Model Refinement - ADF&G/LGL
15. Habitat Enhancement Studies (monitoring winter use of downstream disturbed sites) - ADF&G
16. Habitat Enhancement Studies (literature review of habitat enhancement techniques)-Harza-Ebasco
17. Mitigation plan refinement (identification of candidate lands for habitat enhancement) - LGL

4.1.3 Upstream Moose Field Studies

Upstream moose field studies are described on pages 1-3 and 23-24 of ADF&G's FY 1984 Plan of Study, provided as Attachment B. The studies consist of four general work efforts: (1) the zone of impact census (designed to address Issues T-17, T-20, and T-39 in Attachment A); (2) impact area habitat use monitoring (designed to address Issues T-17, T-20, T-33, and T-39); (3) calf predation monitoring (designed to address Issues T-17, T-20, T-39, and T-44); and, (4) severe winter studies (designed to address Issues T-17, T-20, T-39 and T-41). The annual report for upstream moose field studies is due in the Spring of 1984. This report will cover field studies conducted through the fall of 1983.

4.1.4 Plant Phenology Studies

4.1.4.1 Background. Studies on moose and bear subpopulations in the middle Susitna River Basin have documented general movement patterns of these animals into relatively low elevations within the proposed impoundment zones during late spring and early summer. It was suggested that this general movement pattern may be a response of the moose to earlier snow melt and the early development of vegetative growth at these lower elevations (Ballard et al. 1982;102). Ballard et al. (1982;102) suggested that the spring period was critical for moose. In a nutritionally stressed population, gestating cow moose may be the most deleteriously affected due to the demands placed upon them by the developing fetus. This trend is abruptly reversed when melting snow exposes previously unavailable forage and new plant growth becomes available. Ballard et al. (1982;102) suggested that the moose population may suffer significant mortality if prevented from moving to areas where early spring growth of vegetation, such as in the proposed impoundment zones, may occur.

Brown bear use of proposed impoundment zones was also most prevalent during early spring, soon after they emerge from their winter dens (Miller and McAllister 1982;55). They hypothesized that brown bear movements to the proposed impoundment zones during May were motivated by relatively earlier snow melt, especially on south-facing slopes, which made these the first areas where overwintering berries could be found and also the first areas where new vegetative growth was available. Some of the areas of overwintered berries and early spring growth of vegetation currently used by bears will be inundated by the impoundments.

4.1.4.2 Objectives/Hypothesis. The objectives of the 1983 early spring plant phenology studies are to:

early greenup sites. These results will provide ranges of topographical, elevational and vegetation types that are associated with early greenup sites or sites where foraging has been observed. Maps can then be elevated for the extent of these topographical or elevational features, as well as the extent of later developing areas that are in the potential impoundment zones. This will be used to assess potential losses of early greenup areas due to flooding.

Once areas are stratifed by time of vegetation development, means can be obtained for the relative abundance of overwintered berries for bears. Statistical analyses for phenological development of Equisetum can be developed similar to those for vegetation in general. Additionally, the area can be stratified by presence or absence of Equisetum.

The spatial distribution of snow-free areas and of phenological stages of forage vegetation will be graphically presented for each transect for each observation period.

Deliverables will include the following:

1. A draft report of analyzed data and a discussion of results will be available on April 30, 1984.
2. A final report of analyzed data and a discussion of results is expected to be available by June 15, 1984.

4.1.5 Forage Vegetation Mapping

4.1.5.1 Background. Detailed mapping of existing vegetation (emphasizing moose forage vegetation) which will be affected as a result of project construction and operation is an important requirement to support habitat-based impact assessment and mitigation planning currently in progress.

This effort is designed to provide more detailed vegetation mapping, to be used for quantification of habitat-based impacts in general and, more specifically, to provide a more accurate basis for stratification of the browse inventory. In addition, the mapping will allow more precise habitat use/availability analyses to be conducted for big game species, thus, refining our ability to assess impacts. This product will be of sufficient quality to allow for improved statistical efficiency in the browse inventory.

4.1.5.2 Objectives/Hypothesis. The specific objectives of the vegetation mapping are to:

1. Prepare a detailed and accurate 1:63,360 - scale map of vegetation for the Susitna Project area.

2. Prepare a concise and explicit user guide to accompany the map product.

4.1.5.3 Study Area. The study area to be mapped includes the entire project area, as illustrated in Figure 4-2 (Vegetation Mapping Areas).

4.1.5.4 Detailed Methodology. Maximum vegetation (especially forage) information will be acquired using stereoscopic photo interpretation and mapping techniques. A thorough review and collection of all available reference and ground plot data will provide a basis from which the 1984 field season and mapping can begin. Available color infrared and color

Figure 4-2: Vegetation Mapping Areas

photography will be reviewed to identify those areas requiring the most attention during field studies. This will include review of the following: 1) 1:60,000 CIR of the project area and other relevant research an ground data sites, 2) 1:24,000 color coverage of the Susitna River and Facility area, and 3) 1:3,000 CIR coverage of relevant Forestry Science Lab sampling plots. Additional detail not obtainable through photo interpretation but required for the forage maps will be added through supplemental field investigations. Field time will also be used to confirm and check mapping and interpretations made from photo interpretation. The vegetation legend will be designed, and sample test area mapping will be performed in areas where ground data already exists as a means of testing the forage legend.

Forage mapping will occur in two phases following the early April decisions made after the test area mapping. Phase 1 will be performed from early April to mid June, 1984 incorporating vegetation to Level III and IV, reference plot data, and vegetative photo interpretation. Field time has been scheduled into two main separate blocks of time to provide maximum time usage under the product delivery schedule. Therefore, the first main field season will occur in late June, 1984 to better utilize the growing season. It will concentrate on collecting representative forage cover percentages and checking the level 3 and 4 mapping performed during Phase 1. Percentage cover of Alder-Willow-Birch will be estimated on the ground for at least 80 sites. An accurate and efficient field sampling program that does not duplicate existing information will be conducted.

Phase 2 mapping will incorporate forage percentage birch-alder-willow modifiers developed after the first field season. A final two week field season during the best shrub fall colors in August and September will serve as a systematic aerial and ground check for both mapping products. Any additional forage detail needed to finalize the forage mapping product will also be obtained at this time.

The map user guide will be developed in several drafts as the mapping products incorporate successively more detail. Its vegetation descriptions will be improved as the field investigations and photo interpretation progress.

4.1.5.5 Data Management and Reports. The forage map will be provided on a 1:63,360 scale with clearly legible freehand ink labeling. All vegetation types will be mapped at least to 1/4" square (40 acre) minimums on 1:63,360 scale. Many types will be mapped to 20 acre minimums and certain types will be carried to 10 acre minimum. A minimum interpretation of Level III in the "1982 Revision of Preliminary Classification for Vegetation of Alaska" by Viereck et al. will be conducted. All forest, tall shrub, and low shrub types will be mapped to Level IV of the same classification scheme.

If complexing of vegetative types appears necessary, new legend units may be created to represent typical vegetation community associations. In this way, single labeling and cartographic clarity can be preserved. Forest, scrubland and herbaceous vegetative types will be determined using the Alaska Vegetation Classification by Viereck et al. 1982 rules of designation. If complex calls are required in areas where cartographic separation of two or more vegetative types is not possible, these calls will be determined and designated consistently. All minor vegetative type components will require >25 percent cover to be classified as such and legend units representing these complexes will be described in the map user guide and interim report.

Special feature mapping to be included in the vegetation map are percentage cover of alder, willow and shrub birch species occurring in all open and woodland forest types and all tall and low shrub types. It is anticipated that these cover percentages for alder, shrub birch and willow will be made in intervals adequate to incorporate the forage species detail obtainable from the aerial photography, existing data, and new field investigations. Initial field studies and map user consultation will reveal the most appropriate percentage grouping for the forage shrub understory species. All water bodies, barren areas and disturbed areas will also be included in this mapping product. In summary, a forage map label will include a mnemonic lettering symbology to include a Level IV (Viereck et al., 1982) classification plus a percentage cover for the understroy content of shrub species, alder (Alnus), Willow (Salix) and shrub birch (Betual) present in that type.

As an initial product, a draft map of several test areas, totalling about 20 square miles in size or larger, will allow for an early review of potential mapping accuracy and scale problems. The base map will be prepared using individual, unmosaiced 2x enlargemets of 1:120,000 CIR photography. Each would be prepared from a tip-tilt recertification to 1:63,360 U.S.G.S. mylars. Each of the approximately 21 sheets will have match lines and a title block.

In order that these mapping products be useful and their limitaton and accuracy limits understood by future users, a map user guide for the mapping product will be prepared. This document will appear as a concisely written typewritten report (8 1/2 x 11" paper). Its content will be prepared in such a way that a variety of users irrespective of their technical background will easily understand and be able to use the information available in these mapping products.

Specifically, the content of the map user guide will include basic and concise legend unit descriptions for both the forage and wetland mapping units to provide the user with specific floristic and natural feature data from which accurate and consistent distinction of mapping units can be made. The map user guide will also contain a summary of mapping techniques and procedures used in the production of the mapping products. In addition, a portion of the user guide will be dedicated to summarizing the map limitations and accuracy limits inherent in the mapping products. A summary of mapping limitations is an essential part of any map product so the user can better understand and implement the mapping information for his or her own use.

Deliverables will include the following:

1. A draft map of several test areas, totalling about 20 square miles will be available on March 31, 1984;

2. Draft maps for one-half of the study area will be available on May 15, 1984 and for the remaining one-half of the area on June 15, 1984;

3. An interim report summarizing vegetation type descriptions will be available on June 15, 1984;

4. A draft map incorporating ground truthing and field investigation refinements will be available on December 1, 1984;

5. A final map will be available on January 31, 1985;

6. A draft user guide will be available on Novermber 15, 1984;

7. A final user guide will be available on January 31, 1985.

Deliverables will include the following:

1. A draft report of analyzed data, a discussion of results, and methodology recommendations for the 1984 browse inventory study will be available on January 31, 1984.

2. A final report is expected to be available by May 31, 1984.

About 3 moose defecations were collected by AAES during the 1982 season. Forty-six of the samples were collected during summer while three samples represent winter foods. Approximately 196 moose defecations were collected by AAES during the 1983 field season which represent winter foods of moose.

Approximately 20 late-winter fecal samples are scheduled to be collected by W. Ballard (ADF&G) during adult moose radio-collaring operations in March 1984. Approximately 15 spring fecal samples will be collected by W. Ballard during calf radio-collaring and mortality monitoring during May and June 1984.

Every effort will be made to identify individual shrub species within genera (i.e., Betula glandulosa, B. papyrifera, and species of Salix) if identifying characteristics can be established from the reference collections. Species of primary interest for winter moose diets are: Salix pulchra, S. glauca, S. lanata, S. alaxensis, Betula glandulosa, B. papyrifera, Alnus sinuata, Vaccinium vitis-idaea, and Populus tremuloides. Summer diets will include the species for winter diets plus unidentified forb and graminoid categories. Efforts will be made to identify all plant fragments not included in the above species that may be found to make up a substantial portion of the diet within a given area.

Fecal samples will be composited by area and season, oven-dried at 60°C for 48 hours, then ground through a Wiley Mill. The dried and ground fecal material will be made into 10 microscope slides for each area. Twenty fields will be examined on each slide. A valid field has to contain at least two identifiable plant fragments. An identifiable plant fragment has to possess at least two histological identifying characteristics. The data recorded will be frequency of occurrence of plant fragments for each 10-slide set.

4.1.7.5 Data Management and Reports. Analysis of data on moose food habits resulting from this study will involve statistical comparisons among areas and seasons. Tables presenting means and standard errors will be provided. Results will also be related to other studies concerning moose ecology in the middle Susitna River Basin.

Deliverables will include the following:

1. A final report documenting winter diets based on microhistological analysis of moose fecal samples will be available by June 30, 1984.

4.1.8 Browse Inventory

The browse inventory is necessary to provide inputs to the vegetation submodel for the purpose of carrying capacity estimation (see section 4.1.9). With browse inventory inputs the vegetation submodel will produce estimates of the amount of forage available on the range to be surveyed. These estimates, combined with estimates of the daily moose forage requirements from the bioenergetics model will produce estimates of moose carrying capacity.

The FY 1984 efforts represent the planning and mobilizaiton for the browse inventory which is currently planned to be conducted in July and August 1984 (FY 1985). A draft report of results is scheduled for review by January 31, 1985, following field work, laboratory analysis of samples, data analysis, and report writing. Recent technical meetings following review of preliminary pilot browse study results suggest that modifications to this schedule may be forthcoming.

A detailed plan of study for this subtask will be available by June 15, 1984. This subtask is designed to address Issues T-20 and T-36 (Appendix A).

4.1.9 Bioenergetics Model Testing

The habitat-based approach to assessing impacts through changes in carrying capacity requires the use of at least two computer submodels; one to estimate the nutritional needs of the animals and the other to estimate the nutrients available in the range. The first is a bioenergetics model called the ruminant submodel. This model, which was developed at Colorado State University and modified for moose at the Kenai Moose Research Center (MRC), is undergoing field validation at the MRC during FY 1984 and 1985 (see pages B-20-22 of ADF&G's FY 1984 Plan of Study, provided as Appendix B). The second model, a vegetation submodel, estimates the total nutrients supplied by the vegetation available to moose. This model, which was developed by the Colorado Division of Wildlife, requires inputs specific for each range being evaluated. These inputs will be collected by the browse inventory program during summer 1984. If deemed necessary, a third model, which would be designed to represent vegetation succession, may be developed to allow consideration of the change in nutrient availability over time. A bioenergetics model testing annual report will be prepared in Spring 1984.

4.1.10 Moose Population Model Refinement

Moose population modeling efforts for the Middle Susitna Basin were initiated in 1982 and refined in 1983. Refinements to the existing model will continue in FY 1984 primarily based on results of upstream moose field studies (Section 4.1.3). ADF&G Game Division will be responsible for moose model refinements.

A detailed plan of study for this subtask will be available by June 15, 1984. This subtask is designed to address Issues T-20 and T-34 (see Attachment A).

VI. Cost effectiveness

A. Comparison of effectiveness of various techniques in enhancing moose habitat

B. Comparison of costs of various techniques

VII. Recommendations

A draft report will be available for review by June 15, 1984. The final report will then be available on July 15, 1984.

4.1.12.3 Study Area

The study area for selection of candidate mitigation lands will be limited to the Susitna River Basin.

4.1.12.4 Detailed Methodology

LGL will prepare one or more annotated maps which will identify at least 100,000 acres of candidate lands for moose habitat enhancement or retention. This land area will be about five times greater than the approximately 22,400 acres called for in the License Application for moose habitat enhancement; will probably be adequate for selective habitat retention, if deemed appropriate; and will thus allow flexibility in final land selection.

Candidate lands will be identified by LGL through the systematic application of selection criteria to be approved in advance by Harza-Ebasco. The selection process will be documented in a concise report to accompany map submittal.

The specific methodology for the Candidate Mitigation Lands Study will include:

- development and confirmation of selection criteria, including agency concurrence;
- development and confirmation of an implementation procedure for the selection criteria, including agency concurrence;
- review of appropriate 1:500,000-scale mapping prepared by ADF&G and ADNR in support of the Susitna Area Plan, including draft maps of estimated existing moose carrying capacity, estimated potential moose carrying capacity, annual precipitation, land use designations, and proposed special wildlife management areas;

- meetings with representatives of ADF&G (including Area Biologists), ADNR, the Matanuska-Susitna Borough, and other appropriate agencies to obtain advice and assistance in applying the selection criteria;

- development of constraint maps through the application of selection criteria to specific geographic locations;

- meetings with Power Authority, Harza-Ebasco, and agency representatives to review the constraint maps and seek concurrence on provisionally identified candidate lands;

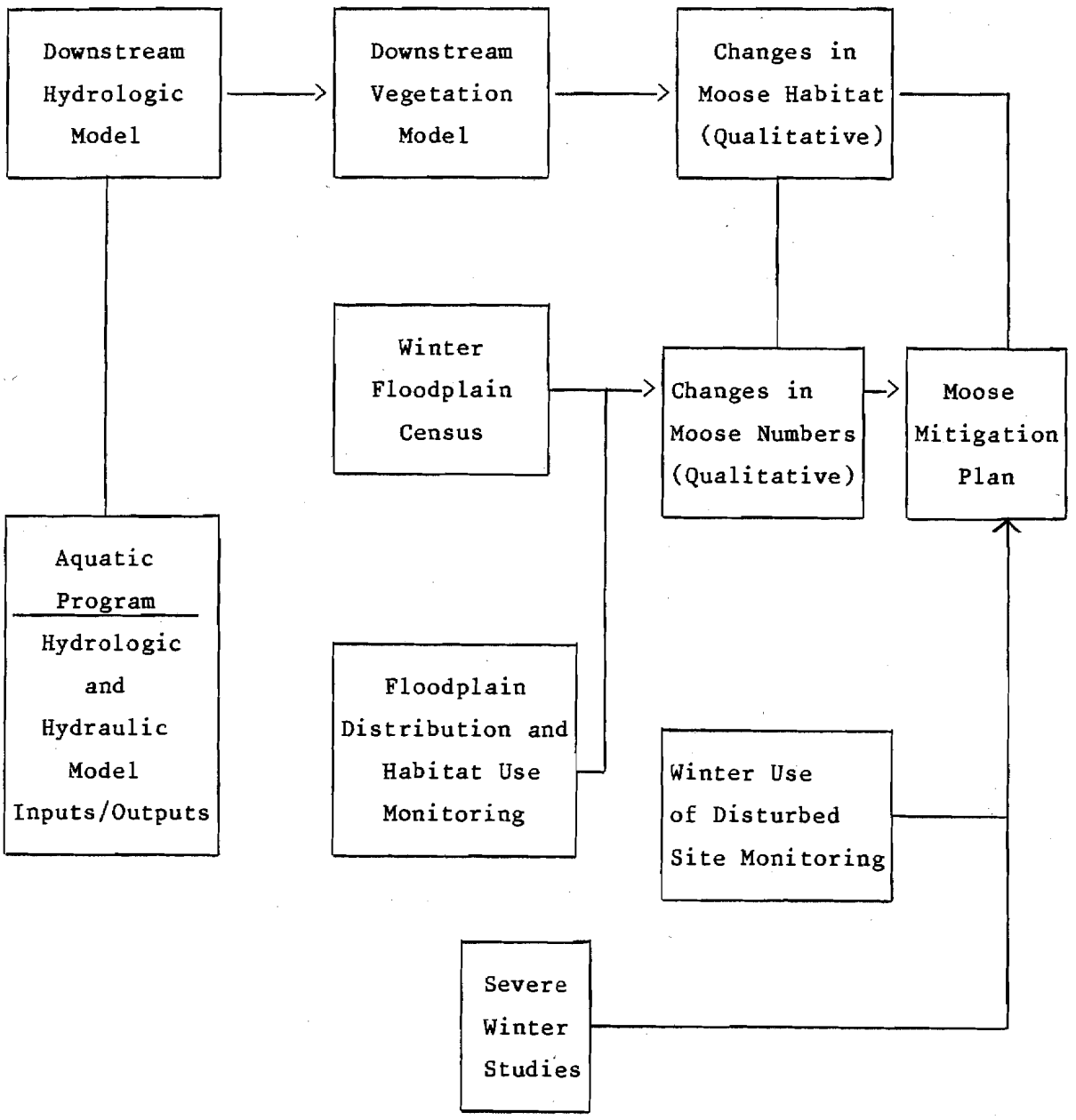
- following concurrence on identified lands, preparation of draft maps delineating specific tracts which optimally satisfy the selection criteria and which total approximately 100,000 acres, and

- preparation of a concise report (see below)

4.1.12.5 Data Management and Reports

A draft report entitled 'Recommended Candidate Lands for Moose Habitat Compensation" will be submitted to Harza-Ebasco no later than May 21, 1984, with a final report available on June 30, 1984. This report will document the selection process; describe the recommended land areas; and provide an overview of selection options, explaining potential pros and cons of each option relative to biological suitability, cost-effectiveness, and apparent conflicts with land-use designations within the Susitna Area Plan.

Figure 4-3. Linkages Among Components of Downstream Moose Impact Assessment and Mitigation Plan Refinement Efforts



4.2.3 Downstream Moose Field Studies

Downstream moose field studies are described on pages 4-6 and 23-24 of ADF&G's FY 1984 Plan of Study provided as Appendix B. The studies consist of four general work efforts: (1) floodplain distribution and habitat use monitoring; (2) winter floodplain censuses; (3) winter use of disturbed site monitoring; and (4) severe winter studies. The first three of these work efforts are designed to address Issues T-20, T-35, and T-40 (Appendix A) while the fourth work effort addresses Issues T-20, T-40, and T-41. The annual report for downstream moose field studies is due in the Spring 1984. This report will cover field studies conducted through fall 1983.

4.2.4 Wildlife Habitat/Instream Flow Relationships Report

The Wildlife Habitat/Instream Flow Relationships Report will contain an updated and expanded analysis of the potential effects of alternative with-project instream flow regimes, temperatures, ice conditions, and related physical processes on wildlife and wildlife habitats downstream from Devil Canyon. This report will document the coordination among project hydrologists, fishery biologists, and wildlife biologists necessary to develop this approach, and provide information on how alternative project flow regimes would affect wildlife utilizing the downstream floodplain Mitigation Opportunities Report to help ensure consistency between mitigation planning refinement for fisheries and wildlife. A draft Instream/Flow Wildlife Relationhips Report will be available on June 22, 1984. A final report will be available on July 27, 1984.

5. Moose Population Model Refinement - ADF&G/LGL
6. Bear Population Model Refinement - ADF&G/LGL

Plans of study for these work efforts including deliverable due dates and the specific issues each work effort is designed to address are provided in the following sections with the exceptions of work efforts 4 and 5. These are provided in Sections 4.1.4 and 4.1.10, respectively.

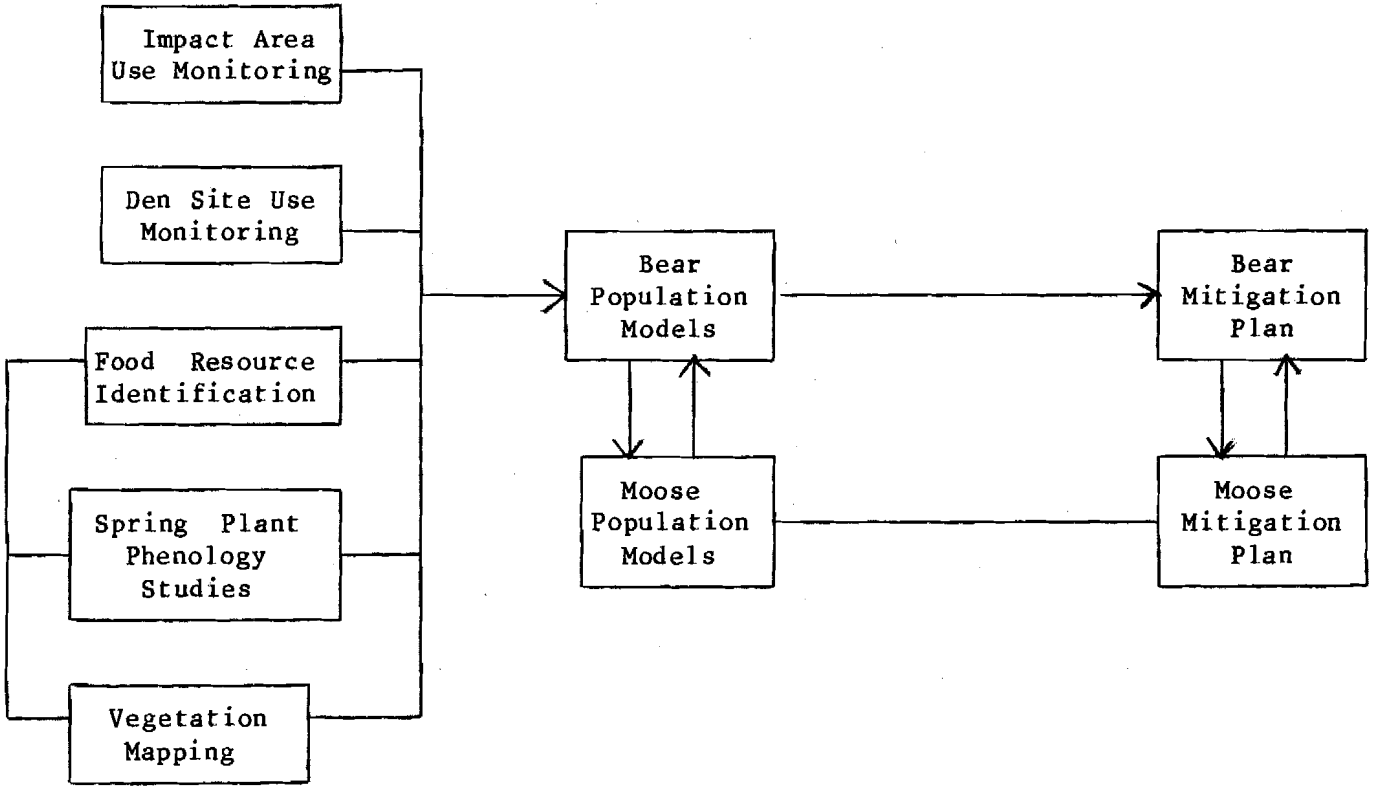
4.5.3 Bear Field Studies

Black and brown bear field studies are described on pages 12-13 of ADF&G's FY 1984 Plan of Study provided as Appendix B. The studies consist of three general work efforts: (1) impact area use monitoring; (2) den site use monitoring; and (3) food resource identification. These work efforts are designed to address Issues T-20 and T-44 (see Appendix A). The annual report for bear field studies is due in Spring of 1984. This report will cover field studies conducted through fall 1983.

4.5.4 Bear Population Model Refinement

Refinements to the bear population model will be made only if indicated following further review. Presently, further refinements do not appear warranted because the large number and questionable soundness of the model's assumptions limit its utility.

Figure 4-4. Linkages Among Components of Bear Impact Assessment and Mitigation Plan Refinement Efforts



4.8 DOWNSTREAM BEAVER

4.8.1 Background

Beaver and other furbearer sign has been surveyed and inventoried along the lower Susitna River on several occasions. In August 1980 a riverboat was used to survey the Susitna River between Portage Creek and the Kashwitna River and a fixed-wing aircraft survey of the River between Devil Canyon and Cook Inlet was conducted in July 1981 (Gipson et al. 1982). Beaver sign and habitat associations were surveyed during spring and summer 1982 and a helicopter cache survey between Portage Creek and the Deshka River was conducted in September 1982 (Gipson and Durst 1982). Finally, a helicopter cache survey of the Susitna River between Portage Creek and Cook Inlet was conducted in October 1983.

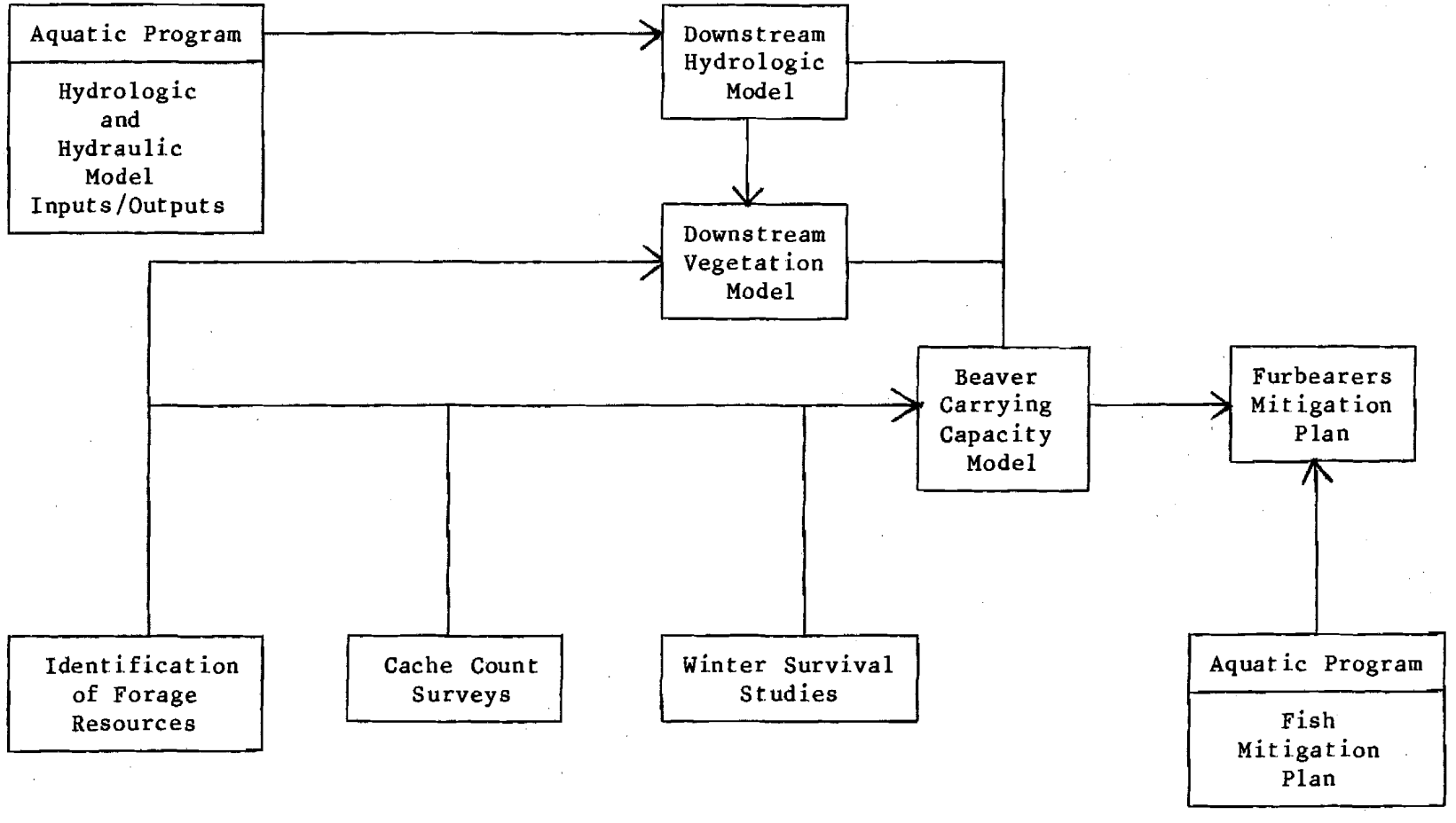
4.8.2 Approach

FY 1984 work included the October 1983 helicopter survey mentioned above and will include further refinement of the beaver carrying capacity model and limited overwinter survival studies. The linkages among these efforts and other related work efforts are shown in Figure 4-4.

4.8.3 Beaver Field Studies

An aerial survey of the number of beaver caches (representing colonies attempting to overwinter) will be conducted in fall 1983 along the Susitna River between Portage Creek and Cook Inlet. A complete count will be made between Portage Creek and Talkeetna and a representative area count will be made between Talkeetna and Cook Inlet. Two representative caches shall be marked for overwinter survival studies. This information will allow assessment of annual variability in colony numbers between Portage Creek and Talkeetna and will allow a general estimate of beaver abundance downstream of Talkeetna.

Figure 4-5. Linkages Among Components of Downstream Beaver Impact Assessment and Mitigation Plan Refinement



Beaver overwinter survival studies will increase our understanding of the relationships between ice thickness, depth of water below ice, open water areas, and other parameters with beaver overwinter and breakup survival. Beaver colony overwintering sites located between Talkeetna and Devil Canyon were previously marked with steel rods and colored flagging during autumn cache surveys in 1983. These and other known wintering sites will be visited shortly before and after breakup to check for evidence of recent beaver and trapper activity, for colony overwinter survival determinations, to sample the quality of cache food, and to determine if lodges or bank dens were destroyed by break-up. Measurements of ice thickness and depth of water below ice will be made at several locations around both successful and failed sites. Successful sites will be related to availability of open water areas during winter identified by hydrologists and fishery study teams. This information will be used directly in refining the beaver model. A draft report will be available on June 15, 1984, and a final report will be available on July 15, 1984.

4.8.4 Beaver Model Refinement

Beaver modeling efforts for the Susitna River downstream of Portage Creek were initiated in 1982 and refined in 1983. Refinements to the existing model planned for FY 1984 primarily consist of integration of field study results into the model (Section 4.8.3) and the refinement of downstream hydrologic and vegetation models and reassessment of downstream impacts (Section 4.2.4).

A detailed plan of study for this subtask will be available by June 15, 1984. This subtask is designed to address Issues T-20 and T-45 (see Appendix B).

1981 by Terrestrial Environmental Services (TES), and on July 1, 1982 by the University of Alaska Museum (Kessel et al. 1982b).

4.9.2 Approach

Additional field efforts are necessary in two areas. First, elevations of many raptor nesting locations are estimates made from topographic maps with 100 foot contour intervals. In addition, a few discrepancies exist among survey results concerning the exact locations of nesting sites. Therefore, a survey to verify nesting locations with respect to impact locations is needed. A second field effort is needed to assess areas for nesting habitat enhancement so that the raptor mitigation plan can be refined.

4.9.3 Raptor Field Studies

Field studies will be conducted to obtain accurate measurements of nesting locations (cliff and tree nests) and nesting site (cliff nests) elevations relative to impact locations. Additional field efforts will be made to locate areas suitable for nesting habitat enhancement, for the purpose of refining the raptor mitigation plan. Supplemental data on raptor nesting will be obtained during these field efforts. Field efforts will be initiated in late FY 1984 but will not be completed until early FY 1985.

A careful determination of nest elevations and horizontal positions is required, with a precise altimeter used to measure nest elevations, and with photography of each nest keyed to a detailed map of the project area. The survey will be conducted by an experienced raptor biologist familar with the nesting requirements of the key raptor species found in the project area. The raptor biologist will be assisted by a second, equally experienced raptor expert who is familiar with a veriety of raptor nesting situaitons and habitats. The assistant will help to evaluate the suitability of certain locations for potential enhancement. He will also facilitate instrumented measurements of nest elevations.

Nest sites within and adjacent to the impoundments zones will be visited by helicopter. Accurate elevations for existing nests and potential mitigation sites will be obtained using an American Paulin Precision Surveying Altimeter or equivalent.

Surveys of areas adjacent to the impoundment (including Portage and Prairie Creeks) will be conducted by helicopter to assess their potential as future mitigation sites. These assessments will take into consideration a variety of factors important to raptors, including slope, aspect, 'overlook', presence of suitable hunting habitat, and distances to other potential and existing raptor nesting locations. Trees and cliffs which may be suitably modified to improve their potential for use by nestig raptors will be described and photographed.

In addition, a one-day survey of known historical peregine falcon nest sites will be conducted on the Tanana River near Nanana because the proposed Healy-to-Fairbanks transmission corridor will pass within 1 mile of two of the nest sites, and within 2 miles of a third site. The exact locations and current active or inactive status of the nests will be determined to support impact assessment and transmission route design refinements.

Deliverables will include the following:

1. Two sets of 1:63,360 USGS topographic maps with all locations and elevations of raptor nesting locations and nesting sites in the impoundment zones shown on them will be available in draft on June 29, 1984, and in final version on September 28, 1984.

2. Two sets of 1:63,360 USGS topographic maps outlining areas sutable for enhancement of raptor nesting habitat will be available in draft on June 29, 1984, and in final version on September 28, 1984.

3. Labeled photographs of potential mitigation sites will be available on June 29, 1984.

4. A draft report will be available on June 29, 1984.

5. A final report will be available on September 28, 1984.

4.10 OTHER WILDLIFE

4.10.1 Background

A considerable amount of data have been collected on other species of wildlife present in the Susitna Project area. Kessel et al. (1982a, 1982b) have collected and reported data on all birds and nongame mammals of the project vicinity and Gipson et al. (1982) have collected and reported data on all furbearers in the vicinity of the project. Studies on marten contributed to the preparation and completion of a doctoral dissertation (Buskirk 1983). These studies were conducted primarily in 1980 and 1981.

4.10.2 Approach

Additional field studies are not presently deemed necessary for birds, nongame mammals, or furbearers except in the case of raptors and beavers (See Section 4.8 and 4.9). Additional project-related studies not included in the above mentioned Furbearer Report (Gupson et al. 1982) will be updated to include the following:

- Studies of beavers, including population estimates, habitat use studies and preliminary impact modeling assessments.
- Pine marten, focusing on field studies conducted in the Watana and Devil Canyon impoundment zones.
- Red fox investigations conducted primarily in the impoundment zones and adjacent alpine areas.
- Miscellanceous observations of furbearers including sightings of coyotes and reports form trappers operating in the Susitna drainage.

Further refinement and quantification of the impact assessment and mitigation plans for all birds and mammals will be conducted as described in Sections 3.1.3 and 3.1.4. A draft Furbearer Report update will be available on June 15, 1984. The final report will be available on July 15, 1984.

4.11 WETLANDS

4.11.1 Background

Vegetation maps of the project area have been prepared by McKendrick et al. (1982). Using the Viereck and Dyrness (1980) system of classification 1:24,000 scale maps of potential wetlands covering a corridor from the Oshetna River to Devil Canyon and 1:63,360 potential wetland maps of the access corridors were produced by first correlating the vegetation types from Vierick and Dyrness (1980) with the wetland types of Cowardin et al. (1979). The corresponding wetland categories were superimposed over the vegetation maps. The presence of steep slope and likely good drainage were interpreted to rule out classification as wetland. Lakes, ponds, rivers, and streams were not specifically classified.

4.11.2 Approach

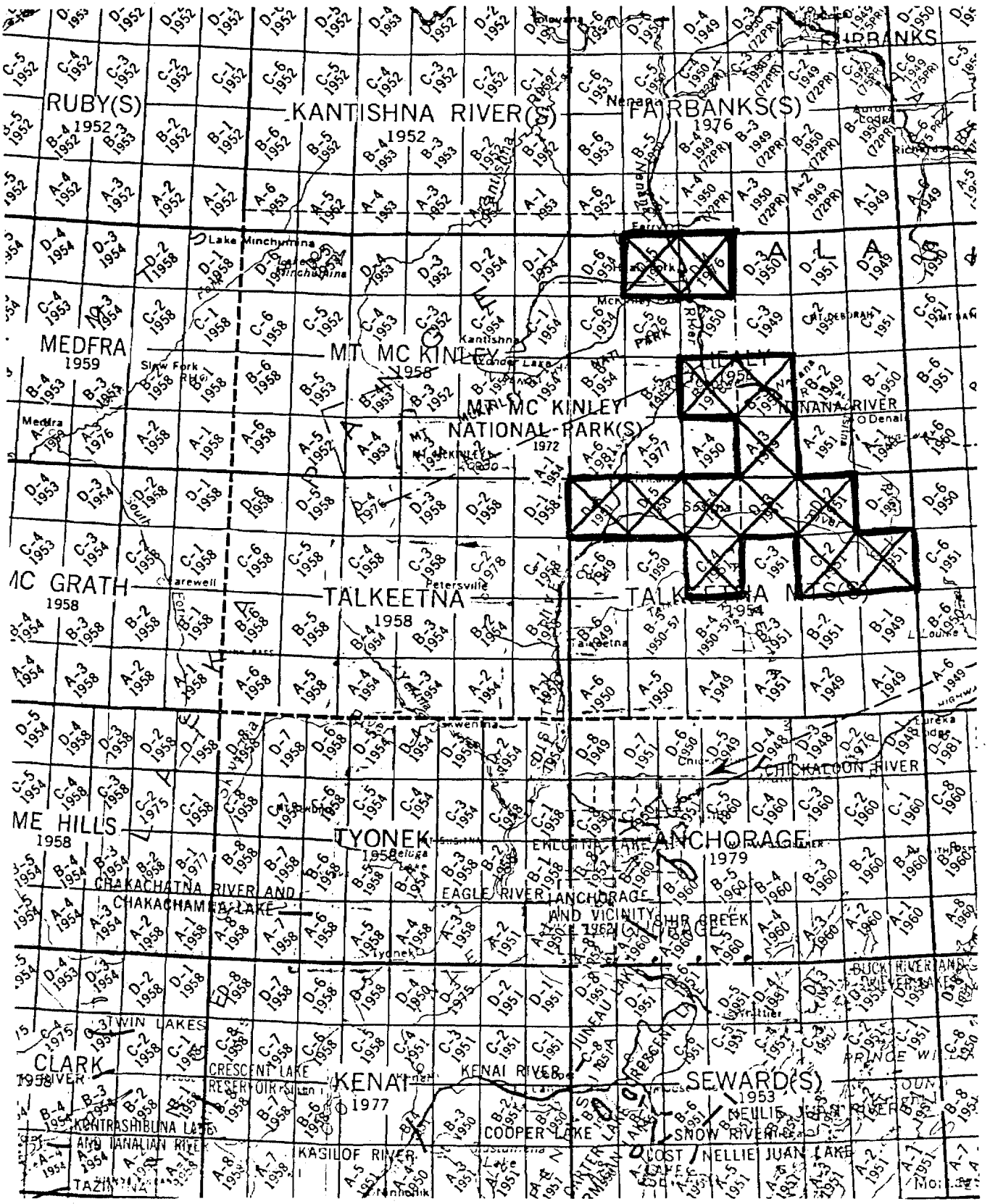
Because the system of Cowardin et al. (1979) was not used directly to map wetlands, but was applied in a liberal sense to a general vegetation classification system, the existing wetland maps indicate areas which potentially qualify as wetlands rather than actual wetlands. Therefore, specific wetland mapping of the project area is currently planned to permit refinement of impact assessments and mitigation plans.

4.11.3 Wetland Mapping

A Cooperative Agreement between the U.S. Fish and Wildlife Service (Region 7) and the Power Authority has been drafted but has not yet been negotiated which calls for the U.S. Fish and Wildlife Service to map wetlands in the project area. Mapping is to be performed through steroscopic interpretation of high altitude color infraced aerial photographs with detailed ground sampling. The Cowardin et al. (1979) system is to be used and maps are to be prepared, at a scale of 1:63,360 as part of their National Wetlands Inventory (NWI). A minimum mapping polygon size of 2 to 4 acres for wetlands will be utilized. This effort will involve preparing 13 wetland maps of the main project area. Each map would overlay one of the following 15-minute U.S.G.S. Quad sheets: Talkeetna Mountains C-1, C-2, C-4, D-2, D-3, D-4, D-5, and D-6; Healy A-3, B-3, and B-4. In addition, wetland map coverage of Healy D-4 and D-5 would also be prepared. With the mapping of these two quads all areas traversed by the transmission line segments running from Willow to Anchorage and Healy to Fairbanks will also be included in the NWI.

Completion of field work and photointerpretation are presently scheduled for September 30, 1984, draft map production completion is scheduled for January 31, 1985, and final map production completion is scheduled for June 30, 1985.

Figure 4-6: Wetlands Mapping Areas



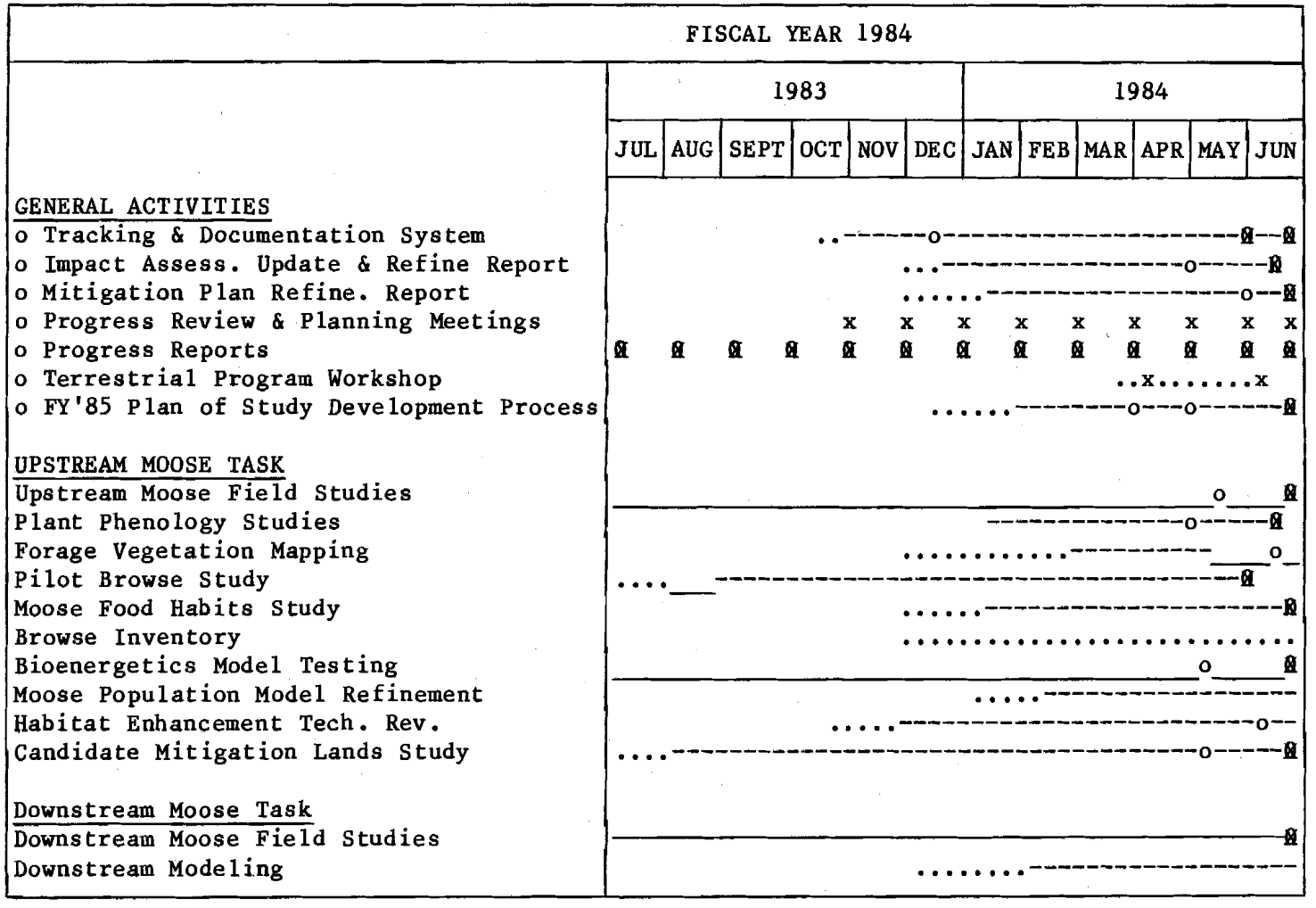
5.0 SCHEDULE AND DELIVERABLES

A list of FY1984 deliverables together with their due dates is provided in the following table. These dates have been extracted from the text of this plan of study. The schedule for Terrestrial Program impact assessment and mitigation plan refinement tasks is provided in Figure 5-1.

	DELIVERABLES*	DUE DATE
1.	Progress Reports	Monthly
2.	Draft Tracking and Documentation System (Rev.0)	12/15/83
3.	Draft Pilot Browse Study Report	1/31/84
4.	Final Tracking and Documentation System (Rev.0)	2/15/84
5.	Draft Terrestrial Plan of Study FY85	3/31/84
6.	Draft Test Forage Vegetation Map	3/31/84
7.	Terrestrial Program Scoping Workshop	4/10/84
8.	Tracking and Documentation System (Rev.1)	4/30/84
9.	Draft Plan Phenology Study Report	4/30/84
10.	Draft Impact Assessment Update and Refinement Report	5/15/84
11.	Recommended Candidate Lands for Moose Habitat Compensation Draft Report	5/21/84
12.	Final Impact Assessment Update and Refinement Report	5/30/84
13.	Final Pilot Browse Study Report	5/31/84
14.	Draft ADF&G Big Game Annual Reports	Spring '84
15.	Bioenergetic Model Testing Annual Report	Spring '84
16.	Spring 1983 Terrestrial Modeling Workshop Final Report	Spring '84
17.	Terrestrial Program Impact Assessment and Mitigation Plan Refinement Workshop	6/05/84
18.	Plant Phenology Study Final Report	6/15/84

19.	Beaver Model Refinement Detailed Plan of Study	6/15/84
20.	Moose Population Model Refinement Detailed Plan of Study	6/15/84
21.	Browse Inventory Detailed Plan of Study	6/15/84
22.	Draft Habitat Enhancement Techniques Report	6/15/84
23.	Draft Mitigation Plan Refinement Report	6/15/84
24	Preliminary Draft Forage Vegetation Map	6/15/84
25.	Interim Forage Vegetation Report	6/15/84
26.	Draft Furbearer Update Report	6/15/84
27.	Draft Beaver Overwinter and Breakup Survival Studies Report	6/15/84
28.	Draft Wildlife Habitat/Instream Flow Relationships Report	6/22/84
29.	Final Mitigation Plan Refinement Report	6/29/84
30.	Draft Raptor Nesting Locations and Elevations Map	6/29/84
31.	Draft Map Outlining Raptor Nesting Habitat Enhancement Locations	6/29/84
32.	Photographs of Potential Raptor Mitigation Sites	6/29/84
33.	Draft Raptor Studies Report	6/29/84
34.	Final Moose Food Habits Report	6/30/84
35.	Recommended Candidate Lands for Moose Habitat Compensation Final Report	6/30/84
36.	Tracking and Documentation System (Rev.2)	6/30/84
37.	Final ADF&G Big Game Annual Reports	6/30/84
38.	Detailed Plan of Study FY85	6/30/84

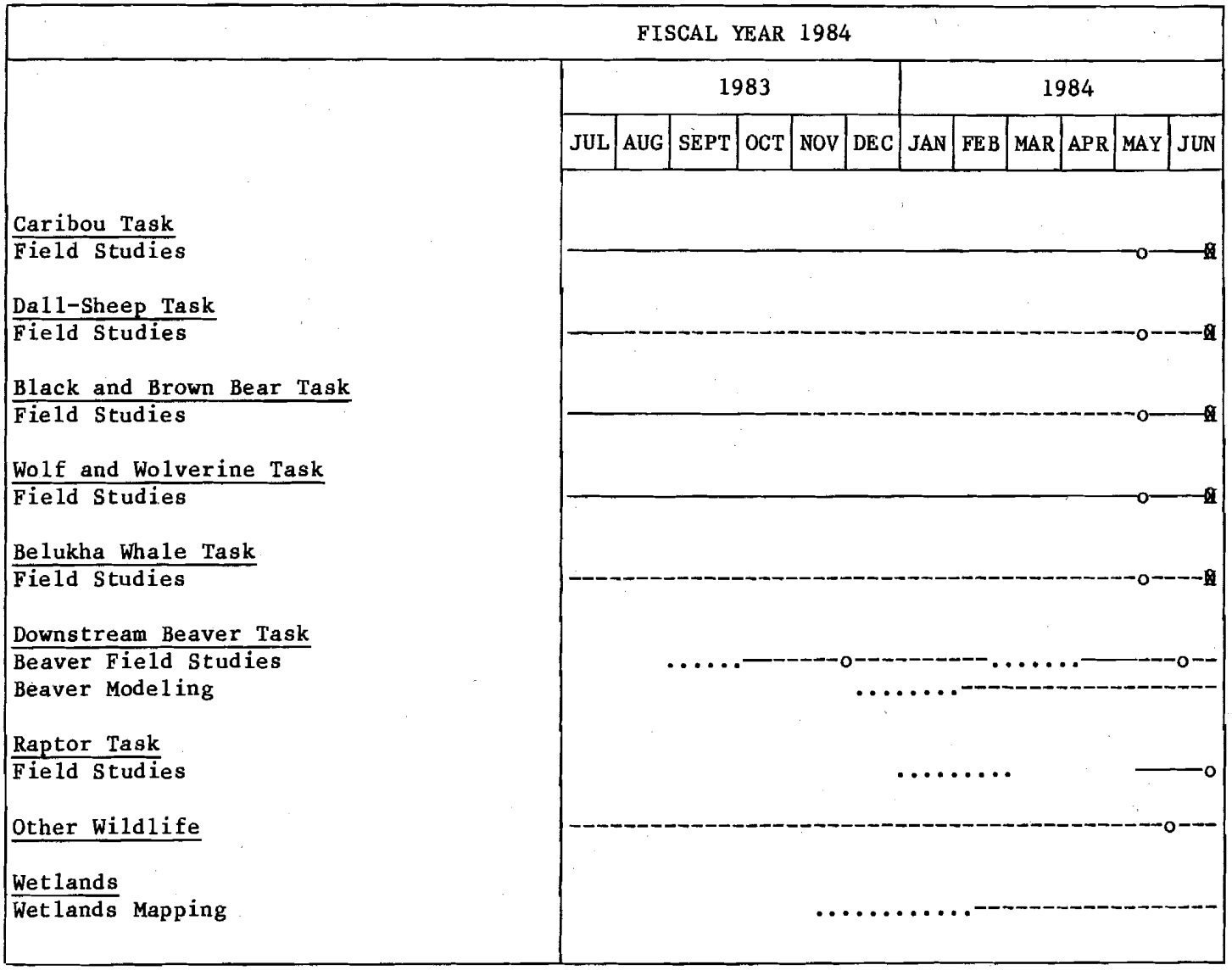
Figure 5-1. Schedule for FY1984 Terrestrial Program Impact Assessment and Mitigation Plan Refinement Tasks



Legend: .... Planning ___ Field Work --- Office/Lab Work x Meeting o Draft Report ▩ Final Report

* Draft refers to the first review draft produced. There will often be at least one additional draft prepared between the first review draft and the final report. Dates for these additional drafts are not indicated in table.

Figure 5-1. Schedule for FY1984 Terrestrial Program Impact Assessment and Mitigation Plan Refinement Tasks



8.0 APPENDICES

APPENDIX D

Terrestrial Program Principal Staff and Responsibilities

ORGANIZATION	NAME	TITLE/RESPONSIBILITY
Alaska Power Authority	Dr. Richard Fleming	Deputy Manager-Environmental
Harza-Ebasco	Mr. Randy Fairbanks	Lead Terrestrial Biologist
	Dr. Roseann Densmore	Terrestrial Biologist
	Ms. April Rivkin	Terrestrial Biologist
	Dr. Charles Elliott	Terrestrial Biologist
LGL Alaska	Dr. Robin Sener	P.M.[1/] - Imp. Assess. & Mit. Plan Refine.
	Mr. Dave Roseneau	P.I.[2/] - Raptors
	Mr. Dale Herter	Wildlife Biologist
	Mr. Bill Steigers	Wildlife Biologist
U of A Palmer	Dr. Dot Helm	P.I. - Plant Ecology
U of A Fairbanks	Dr. Phil Gipson	P.I. - Furbearers
	Dr. Brina Kessel	P.I. - Birds & Small Mammals
R.A. Kreig & Associates	Mr. Ray Kreig	P.M. - Vegetation Mapping
	Mr. Ken Winterberger	Vegetation Mapping Consultant
	Ms. Deborah Heebner	Vegetation Mapper
	Mr. Ray Koleser	Vegetation Mapper
ADF&G - Game	Mr. Karl Schneider	Research Coordinator - Big Game
	Dr. Sterling Miller	P.I. - Bears

1/ P.M. = Project Manager
2/ P.I. = Project Investigator

ORGANIZATION	NAME	TITLE/RESPONSIBILITY
ADF&G Game (cont'd)	Mr. Warren Ballard	P.I. - Upstream Moose, Wolf, and Wolverine
	Dr. Ron Modafferi	P.I. - Downstream Moose
	Mr. Ken Pitcher	P.I. - Caribou
	Ms. Nancy Tankersley	P.I. - Dall Sheep
	Mr. Jack Whitman	Wildlife Biologist
	Ms. Suzanne Miller	Biometrician
	Dr. Wayne Regelin	P.I. - Carrying Capacity Model

1/ P.M. = Project Manager
2/ P.I. = Project Investigator

ALASKA POWER AUTHORITY

334 WEST 5th AVENUE - ANCHORAGE, ALASKA 99501
Phone: (907) 277-7641
(907) 276-0001

April 25, 1984
Susitna File No. 1.8.1/1.17.4.2/4.3.2.1

Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99502

Attention: Mr. Carl Yanagawa
Regional Supervisor, Habitat Division

Subject: Susitna Hydroelectric Project
Terrestrial Program
FY84 Detailed Plan of Study

Dear Mr.Yanagawa:

Enclosed for your use is an individually numbered copy of the subject document (Document No. 1190). This copy has been assigned a number to insure that updates are distributed appropriately.

The Detailed Plan of Study is a working document intended to serve as a common reference for Terrestrial Study Team members in that it contains individual study task descriptions and an indication of how individual study tasks fit into the overall Program. In this respect, it also serves as a means of updating Aquatic Program, Social Sciences Program, and other personnel on Terrestrial Program status in order to maintain and improve coordination.

The Plan of Study will be updated as necessary to reflect changes in the Terrestrial Program and to provide additional clarification and detail for study task descriptions and organization. A set of instructions will be transmitted along with any updates.

Note that although minor revisions were made in March 1984, the document basically reflects the status of the Terrestrial Program as of January 1984. The dynamic nature of the Terrestrial Program, especially during the past six months, has made, and will make it difficult to keep the document completely up-to-date at all times. Some task descriptions are currently being updated and revised pages will be distributed as soon as they become available.

Sincerely,

Jon S. Ferguson
Project Manager
Susitna Hydroelectric Project

peb

Enc: as noted

cc: w/o Enc:
R. Fleming, Power Authority
W. Larson, HE
Honorable Don Collinsworth, Commissioner, ADF&G
D. McKay, ADF&G