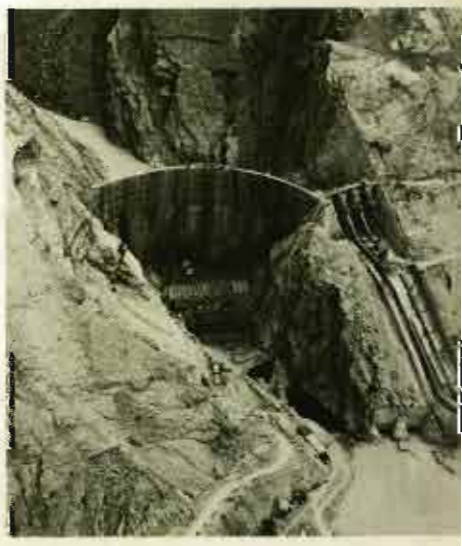
A KA POWER AUTHORITY
A ORAGE, ALASKA

PLAN OF STUDY

FOR
PROJECT FEASIBILITY AND
FERC LICENSE APPLICATION

VOLUME I - SUMMARY

SUSITNA HYDROELECTRIC PROJECT



RZA ENGINEERING COMPANY

MEBER 1979

HARZA ENGINEERING COMPANY CONSULTING ENGINEERS

September 10, 1979

Alaska Power Authority
333 West 4th Avenue
Suite 31
Anchorage, Alaska 99501

Attention: Mr. Eric Yould
Executive Director

Subject: Susitna Hydroelectric Project
Plan of Study

Gentlemen:

We are pleased to present our Plan of Study for the identification, feasibility and FERC License Application for the initial Susitna Hydroelectric Project. The Plan of Study (POS) was prepared in response to the invitation in your letter of June 28, 1979. This letter summarizes the POS and includes a discussion of the issues we believe are critical to the successful development of the project.

Investigations in Alaska

In order to properly assess the issues to be considered in the POS we sent a team of engineers, geologists and environmental scientists to Alaska to collect data and discuss the proposed study with individuals who are familiar with the area, previous studies, local concerns, and objectives. Our team spent nearly five man-months in Alaska gathering background information. A six-man team made an aerial reconnaissance of the Susitna basin including landings at the Devil's Canyon and Watana sites, and another three man team made a second reconnaissance of the lower basin. The team members met with State and Federal agencies, utility managers, public officials, local engineers and scientists, equipment and service suppliers and private citizens interested in and knowledgeable about the Susitna River development. We believe this background has given us excellent insight to the objectives to be met and problems to be dealt with.

Contacts with FERC and Others

In addition we have discussed the proposed study with a staff member of the FERC, representatives of a bond underwriting firm and a lawyer experienced in FERC License Applica-

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tions. These discussions helped us in formulating a Plan of Study that will lead to a license from the FERC in the most effective way and will assure funding the project without delay.

Issues Affecting the Plan of Study

The development of the Susitna River will require a comprehensive study program, addressing complex technical, environmental and economic issues.

Technical problems that are of major concern include the seismicity of the area, the effect of permafrost on the project structures and vice-versa, the effect of subarctic weather conditions on the construction and operation of the project, and the reliability of the construction cost estimate.

Significant environmental concerns relate to impact on the lower basin fisheries and wildlife by modification of the flow regime; and on the large and small game populations resident in the upper basin.

Economic issues will center on the impact of Susitna power on the Railbelt market and the ability of that market area to absorb it. Hence, it is important that the project be compatible with the financial capacity of the utilities and power purchasers. This is a critical factor if the project is to be funded by revenue bonds.

Several of the foregoing concerns, among others, were expressed to us by concerned citizens and group representatives at a meeting convened by APA on July 19, 1979.

The long history of Susitna proposals has acquainted the public with the project. They have developed a keen awareness of the issues and have expressed an interest in active participation in the planning and for input during the execution of the studies. That should be encouraged and provision made for the issues of concern to be recognized and addressed in the project planning.

Clearly, the Plan of Study should address the identified issues of concern plus other constraints imposed by regulations and the difficulties of operation in a remote wilderness.

Organization of Plan of Study

The Plan of Study we recommend will be accomplished in three phases, namely, 1) a Basin Planning Study to identify the initial project, 2) a Feasibility Study to evaluate the

initial project from the technical, environmental, economic, and financial viewpoints, and 3) a license application to the FERC to construct and operate a hydroelectric generating facility on the Susitna River.

The Basin Planning Study will determine the most favorable scheme for the ultimate development of the river and will identify the project to be developed first. Studies will be made comparing the Susitna with alternative energy sources to determine if a hydroelectric project on the Susitna River is the best way to meet the Railbelt power requirements beginning in the late 1980's. Alternative thermal power will be evaluated by an independent consultant to assure the objectivity of that evaluation.

The Feasibility Study will determine if the Project can be constructed and operated safely and economically, with acceptable environmental impact, and if it is financially viable.

The FERC License Application will be prepared and submitted if the feasibility of the Project is established. Engineering and legal services will be required while the license application is being processed, and the environmental data collection program will continue. If the Authority decides to implement the project as soon as possible after receiving a license, it will be necessary to arrange for funding and negotiate power sales contracts during the licensing period.

Logistics Support

A large number of study teams, furnished under subcontracts, will be required to accumulate the necessary data for technical and environmental evaluations. Rather than have each of these provide its own transportation, lodging and support facilities, and services, Harza will assume this responsibility. To minimize the difficulties of working in the remote wilderness of the Upper Susitna and to comply with existing state and federal regulations, we propose to provide logistic support on a unified basis.

Alaskan Participation

We believe as much as possible of the work should be done in Alaska by Alaskan entities in order to make maximum use of the knowledge of local conditions and to be most effective in responding to local concerns. Harza has associated with CH_2M Hill/Alaska who will participate in the engineering and environmental studies. During the visit to Alaska in July, we investigated the availability of Alaskans to furnish technical

support services such as surveying and drilling, and to perform environmental studies and logistic support. As a result we are planning extensive use of Alaskan entities including native village personnel.

We strongly believe that the Director of Information should be a resident Alaskan familiar and conversant with local conditions, customs and issues. We will seek out such a person and engage him for this position.

In terms of cost we estimate the direct participation of Alaskan residents will exceed 55% of the total cost of the studies, and an additional 20% is allocated for the services of others assigned to work in Alaska.

Organization - The Project Team

All of the work will be undertaken and accomplished through a single organizational structure headed by a Project Manager. The purpose of so organizing is to provide an effective means of mobilization of resources and to provide continuity of work and personnel. The team organization is designed to provide the engineering and environmental expertise in a coordinated work effort and to provide an effective means for direction and control. The lines of authority are simple and direct, eliminating layering between the management and those responsible for the work. Personnel experienced in receiving direction and passing results upward are assigned to key positions. Senior advisors will participate in the conceptual planning and solution of difficult technical problems, particularly those involving safety of structures.

The execution of the studies will require a full time office in Anchorage to interface with the Authority, to coordinate field investigations with office studies, interested government agencies, and the public. Office studies that require close contact with local conditions and data sources will be performed in Alaska. The Alaska office will also include an information center to keep the public informed of the work status and progress and to coordinate public participation throughout planning of the project.

Key Personnel

Reporting to the Project Manager are five key positions: the Project Engineer, three Task Leaders (Planning and FERC Licensing; Economics and Finance; and Environmental Sciences) and the Resident Manager. For these key positions we have selected senior personnel from our permanent staff.

Project Manager - Dwight L. Glasscock
Project Engineer - Richard L. Meagher
Planning and FERC Licensing - L. Dow Nichol
Economics and Finance - George V. Volland
Environmental Studies - James H. Thrall
Resident Manager - Herbert E. Schoeller

Their experience resumes are presented in Volume III of the Plan of Study.

Coordination Procedures

To execute the comprehensive studies required to plan the Susitna project and to manage supporting field investigations requires a major coordination effort. The preference of the Authority for "open planning" and the need for logistics support of the field operation in the remote area and cold weather conditions, add complexity to the problem. For the coordination effort to be successful we believe it should be a planned operation which recognizes the necessity for 1) assignment of coordination responsibility, 2) procedures for dissemination of information and securing essential feedback and 3) a method for reporting progress and events.

Assignment of coordination responsibilities closely parallels the operational responsibilities of key personnel as established under the project organization. The dissemination of information and securing feedback is a significant problem. A public information and participation program to be headed by an Alaskan resident is planned to handle this.

Work progress together with the status of budget and work schedule will be reported monthly; quarterly progress meetings are also recommended. Special meetings will be scheduled prior to significant decision points.

Cost and Schedule

The budget estimate is divided into two major categories of work and two distinct time periods. Included under the Authority Management and Administration are those items set forth in the invitation or by later direction. The summary below includes services of the Engineer during the licensing period related to continuing environmental studies and matters dealing with the license application; it does not provide for any engineering design in advance of receipt of the license.

	Initiation to License Application $ Million	License Application to Award of License $ Million
Engineering and Environmental Services	17.0	2.7
APA Management and Administration	0.8	1.6
TOTAL ($ Million)	17.8	4.3

The overall schedule for submission of the license application is 27 months and it is estimated about two years will be required by the FERC for processing the application. The three phases of the Plan of Study are scheduled in sequence:

Basin Planning Study	9 months
Feasibility Study	15 months
FERC License Application	3 months

Plan of Study

Our Plan of Study is presented in four volumes:

Volume I - Summary
Volume II - Detailed Program
Volume III - Supplementary Information
Volume IV - Supplementary Information

The material submitted relates directly to the Plan of Study and does not include qualifications of Harza Engineering Company to perform the work. That information was previously submitted in our Proposal to Prepare the Plan of Study. Should you wish any of that material resubmitted or supplemental information, we will be pleased to comply with any request.

Alaska Power Authority Advisors

Concern has been expressed regarding the reliability of estimated construction cost of the project and seismicity of the area including the potental for natural earthquakes and those induced by large reservoirs. Our studies will give special attention to both of these problems.

We concur with the Authority's suggestion of an independent review of the construction cost estimate and, further, suggest that consideration be given to an exploratory adit should an underground powerhouse be selected, as an additional means of improving the construction cost reliability.

A special study of the seismicity of the Upper Susitna basin is included in the proposal. It is suggested that the Authority retain a Board of Consultants who are recognized experts in the conditions that effect project safety and cost to review our findings.

The FERC will, upon granting a license, require the Authority to establish a Board of Consultants for review of design and construction of the project. The Authority may wish to consider establishing the Board at an earlier date for review of the feasibility study and to acquaint the Board with the proposed project.

During the latter stages of the feasibility study there will probably be a need for a financial advisor to assist in matters related to bonding and contracts for the sale of Susitna power, and during the preparation of the FERC license application there will be a need for legal counsel experienced in those matters.

Guidelines for a State Sponsored Project

The Authority has stated in the invitation that the decision will be made in late 1979 on whether to proceed on the basis that the state undertakes the Susitna development on its own or to seek federal assistance. The requirements and concepts influencing the formulation of the POS are materially different for these two alternatives, particularly, with respect to means of financing and selection of the size of the initial project.

In selecting guidelines which will provide the project most beneficial to the state, one should be mindful of the following:

1. The Upper Susitna is a remote wilderness and has already aroused considerable public concern about the environmental effects of the project.

2. Little factual information is known concerning the fisheries regime in the lower basin beyond the fact that anadromous fish upstream migration does not go beyond Portage Creek. Within the upper basin there is a paucity of factual knowledge on the habitats and migration routes of the resident large and small game.

3. To secure the baseline environmental information on which to make a realistic judgment of the impact of "world class" projects such as the high Watana and

high Devil's Canyon dams may require a long term effort, prior to obtaining a license to construct the project.

4. Other problems, such as, seismic effects, induced earthquake and construction difficulties encountered in the subarctic climate add complexity to the project execution.

5. The site selected for the first project should minimize the technical problems associated with the engineering design and construction of the project. For example, exposed rock foundations which exist in long reaches of the river should be preferable to those having considerable overburden where permafrost may exist.

6. The project selected should employ construction materials and procedures that maximize the work season each year and thereby reduce the overall construction period.

7. Project features such as dam, powerhouse, spillway and diversion scheme should be as simple and direct as possible to avoid complexities and risk; and thereby enhance safety.

8. Consideration must be given to the impact of Susitna power on existing generating facilities and the availability of abundant natural gas in the Kenai area.

9. The project should be sized so the power and energy production can be quickly absorbed by the market to avoid the need for financial subsidies.

10. A shorter construction period should reduce the construction investment and interest during construction as well as make project revenues available at an earlier date.

These guidelines suggest that the state must, in our opinion, consider in addition to the projects previously identified and recommended, smaller projects and/or stage developments of the projects selected so that the initial project is best suited to the conditions prevailing at the time of its completion.

It is imperative that the POS consider all reasonable alternative schemes for the hydroelectric development including those fulfilling the guidelines above, as well as alternative sources of generation.

The selection of Harza for the execution of the Plan of Studies will make available to the Susitna Project:

(1) Extensive background in planning river basin developments and hydroelectric projects.

(2) An appreciation of the environmental concerns and experience in resolving similar problems through a coordinated environmental and engineering approach to the study.

(3) Current experience in FERC licensing procedures plus a long successful history of working with FPC, its predecessor organization.

(4) An understanding of the unique problems involved in the Susitna Project.

We believe that we can make a major contribution to the selection of the right project for Alaska as well as assist in securing the FERC license in an expeditious manner. We look forward to being a member of the Susitna team. Should you wish any additional information or care to discuss any part of our Plan of Study, please call us.

Very truly yours,

Richard D. Harza

Richard D. Harza
President

Volume I

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SECTION 1. PROGRAM OBJECTIVES

Section 1

PROGRAM OBJECTIVES

The overall objective of the Alaska Power Authority in undertaking the Upper Susitna program is to benefit the people of Alaska by developing the hydroelectric potential of the Upper Susitna River with a minimum of uncertainty, environmental impact, and financial burden.

The adoption of this objective rests on certain working assumptions and conclusions based on previous studies. These are: the Upper Susitna projects are the most appropriate and economical hydroelectric projects now available to the south-central Alaska Railbelt area when considered in terms of location and scale in relation to realistic load projections; the development of this hydro resource will provide significant economic benefit to the area and the state; and the environmental impact will be both acceptable and less severe than alternative medium and long term sources of generation. The Plan of Study (POS) is designed to evaluate these assumptions in detail.

The major objectives of the POS are to:

1) Establish the technical feasibility of the initial hydroelectric project on the Susitna River that is compatible with full development of the hydroelectric resource,

2) Evaluate the environmental impact resulting from the construction and operation of the project,

3) Enlist public participation in formulating the Susitna River plan of development,

4) Determine the economic attractiveness of the project in relation to alternative sources of energy and develop a viable program for funding its construction and operation, and

5) Obtain a license from the Federal Energy Regulatory Commission (FERC) for the project.

Technical Feasibility

Preliminary studies will be performed to determine the optimum development for the Susitna River and to select the most favorable project for detailed study. Several alternative schemes for development of the hydroelectric resource have been identified and others are proposed by Harza to provide a spectrum of reasonable alternatives.

The scheme that is selected must be flexible enough to meet changing economic conditions and modified operating requirements during the life of the project. The projects should be designed so the capacity of the power installation can be increased in the future or modified for combined pumped-storage and down-river operation. Any project selected as the first step in the program must have flexibility for further expansion by stages and must not preclude the development of other future projects. These needs must be considered in the inital planning so future modifications can be made economically and with minimal environmental impact.

There are specific technical considerations peculiar to the Susitna region that will influence the selection of the initial project and that will be studied in detail to establish the feasibility of the project. These conditions relate to the seismicity of the area; the effect of permafrost on the safe construction and operation of the project; and the influence of severe sub-arctic weather on the construction procedures and schedule. The influence of ice formation and break-up on the operation of the project will be given special consideration in the studies.

The technical studies will be performed in sufficient detail to permit accurate cost estimates to be calculated for funding purposes and to assure that the project can operate safely and reliably. The studies will be done so the results can be presented conveniently in a license application to the FERC. The technical studies will be coordinated with the environmental studies to permit timely evaluation of the potential impacts resulting from the construction and operation of the project. Adverse impacts will be mitigated by appropriate modification in the design and proposed operation of the project.

Environmental Assessment

The environmental studies will characterize the existing environment of the Susitna Project area, compare future conditions with and without the project, and predict the magnitude and significance of project impacts. During the basin

planning phase, environmental investigations will identify factors that will differentiate the relative environmental acceptability of alternative developments to provide a basis for environmental comparison. Impacts that will occur regardless of the exact location of projects within the Upper Susitna Basin will also be evaluated.

Once an Initial Project is selected, the objective of the environmental studies will be to determine the nature and degree of environmental and social impact of the project, along with those mitigating measures that could be taken to minimize or offset adverse impacts.

The environmental investigations will include distinct, but interrelated studies in six areas of concern; requiring expertise in:

Human Ecology and Socio-economic Considerations
Aquatic Ecology (including water quality and water use)
Terrestrial Ecology
Historic and Archaeologic Resources
Recreation Resources
Land Management and Aesthetics

These investigations will be conducted in sufficient detail to identify and evaluate impacts and to prepare an environmental report on the project that will be in compliance with FERC and other NEPA-related guidelines. The environmental assessment will also include an analysis of alternatives to the proposed project, including the no action alternative.

Public Participation

Although public participation is built into the EIS process, we believe it is highly desirable that public involvement go considerably beyond the conduct of meetings to solicit comments and reactions to information and proposals that are in an advanced state of planning. To that end, the program will solicit public involvement at the earliest possible date, promote public awareness throughout the course of the studies, and provide channels for input and work-shops for participation by interested members of the public. We will also establish close working relationships with local, state, and federal agencies to provide specific lines of communication for resolving potential questions or conflicts at an early stage.

To obtain a license from the FERC in the most effective manner a program for public information and participation during the study period, and subsequent phases is very important. Some

projects have suffered unnecessary delays in the licensing process because lack of information or misinformation has contributed to undue public concern or alarm. We believe this situation can best be avoided by an active public information program and by providing a forum for public opinion and participation.

By inviting public participation throughout the study program the project can be designed to accommodate local concerns where possible and thereby facilitate the permitting and licensing process. Beyond this responsible groups should be kept abreast of the planning through periodic release of a "fact sheet" and participation in workshops.

There are two major decision points in the study program. At the end of the Phase I Basin Planning Studies, the site for detailed feasibility studies will be selected. At the end of the Phase II-Feasibility Studies, a decision must be made about submitting a license application to the FERC. As a part of the ongoing public involvement, public meetings will be scheduled before each major decision point to further enhance the public participation. These meetings will summarize the work to date, which will have been previously presented to the public, and present the results of the studies and seek feedback from interested citizens.

Economics and Financing

Economic studies will be made to illustrate the relationship of the Susitna Project with alternative sources of energy on the basis of cost and benefits. The studies will also indicate which site on the river is most favorable for development from an economic viewpoint.

The economic comparisons will include other hydroelectric alternatives that could serve the Railbelt power market as well as other sources of energy. Alternative energy sources to be considered include wind, solar, tidal, geothermal, and wood fueled thermal; in addition to the more commonly used energy sources for major electricity generation; coal, gas, oil and nuclear. A no-load-growth alternative will also be evaluated.

If the preliminary economic comparisons show a project on the Susitna River is economically favorable for early development, detailed studies will be made to optimize the Initial Project and to demonstrate the economic comparison with the most favorable alternative. For budgeting purposes, the POS has been formulated assuming a thermal generation plant using fossil fuel will be the most favorable alternative.

Hydro power and thermal power complement each other in a generation system because the hydro project can be used to displace thermal energy and save fuel when the hydro energy is available. When hydro energy is limited the hydro power can serve peak requirements with the base load served by thermal plants. The optimization studies will be directed toward minimizing the operating costs of the overall generation and transmission system.

The financing studies will provide the basis for determining the financial requirements for constructing and operating the Susitna Project and the financial capability of the Railbelt power users to support the project. A major factor in the selection of the initial project will be the ability to finance the power installation which is appropriate to serve all or a part of the Railbelt power market beginning in the late 1980's.

The size of the initial project is particularly critical because any project on the Susitna will require a major capital investment in relation to the financial capacity of the energy buyers. Should the project be given financial support in excess of that which will accrue from the sale of power and energy, that factor will permit more flexibility in selecting the initial project. The financial requirements and constraints must be evaluated early in the study program to provide a guide in selecting an initial project that can be funded. This task will be done in close liaison with the Alaska Power Authority.

We have met with representatives of John Nuveen Company, Bond Underwriters, to discuss the major concerns that would affect financing the project through the sale of revenue bonds. The major areas of concern would be the reliability of the construction cost estimates; the ability of power market to absorb power from the project at rates that would provide the revenue to repay the bonds; and assurance that the project would operate as designed during the life of the bonds.

The POS is designed to meet the needs of the bonding underwriters in order to assure that the project can be funded. Provision is made for independent review of the cost estimates and market forecasts. Specialists will be introduced to evaluate the most sensitive technical concerns such as the seismicity of the area and problems associated with cold weather construction and operation. The studies will be directed toward identifying ways to reduce the risks of construction time and cost overruns.

FERC License Application

The investigations and studies are formulated so the results can be incorporated in a license application to the FERC for construction of the Initial Project alone. However, with minor modifications a license application could be submitted for the entire reach of the Susitna River as the Susitna River Project, with the first site to be constructed as the first development in the Project. The advantages and disadvantages of these alternative approaches can be examined with the FERC during the study period, and a decision made after the studies are well advanced.

We have had preliminary discussions with the FERC concerning the possibility of submitting an application for the entire river reach. We judge from those conversations that the FERC would respond favorably to an application for licensing the development of a reach of the Susitna or for the Initial Project alone. Both approaches have been used in the past and licenses have been granted.

If a license application were submitted for the entire basin development, details of each project would have to be developed to a level to reasonably identify the project costs, and the environmental impact assessment would have to evaluate the effect of full development. It appears that the comprehensive environmental evaluation that is preferred by the State of Alaska, Department of Fish and Game would be appropriate for a license application covering the entire reach of the Susitna River that is to be studied.

An application to license the Initial Project only would demonstrate that the Initial Project would not preclude future development of the resource and, if pertinent, that the Initial Project could be developed in stages. The environmental assessment could be limited to the impacts associated with the Initial Project but should make provisions for gathering additional baseline data to expedite the assessment of the impact of future project(s).

In view of the complex environmental issues and the time and expense required to develop engineering details for multiple projects, an application for licensing an Initial Project having minimal environmental effects may substantially advance the date for granting a license. Should this course be selected, it must be borne in mind that the granting of an initial license makes no committment on future projects. Each of these would be judged on its own merits.

SECTION 2. STUDY APPROACH

Section 2

STUDY APPROACH

General Approach

The approach to the Plan of Study is designed to achieve the objectives stated in the preceeding section. It is planned to be fully responsive to environmental and public interest concerns and the basic questions of technical, economic, financial, and environmental feasibility. The Plan of Study will include a continuing program of public information and public participation. It will be sufficiently thorough to provide full support for the conclusions and recommendations. The significant basic data and results of analyses will be presented in a form which will permit knowledgeable individuals to verify the bases for the decisions reached. The study will be as economical as possible, consistent with the achievement of its objectives and under the working and access conditions of the Upper Susitna area. The study is planned to be completed in the minimum period of time consistent with study requirements and site conditions, to permit an early decision concerning the role of the Susitna projects in Alaska's future development.

Basic to Harza's approach to the planning of the hydroelectric project is our opinion that a viable state-sponsored initial project can be planned and placed in service on the Upper Susitna prior to 1990. The full potential of the river is larger than the immediate needs of its market area, but an initial project of suitable size can be selected and implemented without sacrificing the potential for full economic development. This is a basic part of Harza's general approach to river basin planning. During many years of service to electric utilities we have helped to select initial projects which were small in relation to the resource but which did not impair full development at a later time.

Planning and Engineering Studies

We will conduct a methodical identification of sites and development plans and successive evaluations of all practical combinations of dams, reservoirs, hydroelectric plants to select the optimum plan of development. Inventories of alternative hydro projects will be updated and put on a common basis for comparison with the Susitna, to confirm the previous selection of the Upper Susitna as the most attractive hydroelectric development to serve the

Railbelt area. We propose to conduct an in-depth evaluation of alternative thermal plants, and a separate study of the availability and cost of fuels for those plants. To reinforce the objectivity of these studies of thermal alternatives, we will engage specialized independent consultants to perform them. The comparisons of other sources of generation with the Susitna project will be based on complete alternatives in each case, with transmission and all other factors accounted for in supportable estimates of production and costs.

The power market studies will cover another essential element in the economic and financial justification of the project. The several existing projections will be reviewed in detail and methods with successful histories of application will be used to estimate the most probable load growth pattern and the high and low limits of expected load growth. The sensitivity of the projections to various conditions of economic development, population growth, energy and fuels policies, load management, and conservation measures will be estimated. The sensitivity of the economic and financial results to the use of low, most probable, and high load growth projections will be tested.

Financial analyses will be made from the point of view of the APA, the individual utilities, and their customers, taking into account financial requirements and criteria as established with the advice of prominent public agency and revenue bond financing specialists, to evaluate the relative financial burdens on institutions and customers between the Susitna project and the alternative plans.

Harza's approach to the technical studies of the projects in the Basin Plan, at the pre-feasibility level, and the Initial Project, at the feasibility level, will be thorough and largely conventional, as described in the detailed work program. The special climate and other conditions of the sites, however, present a number of significant potential problems, many of which can be grouped under the heading of cold regions engineering aspects. These include: 1) the hydrology of permafrost and glacier dominated basins; 2) the hydraulics of ice covered and ice-impacted reservoirs; 3) possible local climatic effects of plant discharges during severe cold weather; 4) stability of permafrost slopes under the effects of reservoir storage; 5) possible permafrost foundation conditions affecting project structures and transmission towers; and 6) the effects of severe cold weather and short construction seasons on construction of various types of structures. We will approach these cold regions design, construction and operations aspects through the experience of our personnel who have been involved with the design and operation of hydroelectric projects in Iceland and North America, through the operating experience of our clients in

those areas, by careful review of the literature and direct contacts, and by special studies as required. Studies of seismicity and design for seismic loads and related possible risks of public safety hazards will be made and taken into account in the selection of the types and sizes of dams. We will engage a firm with extensive experience in geologic seismology to investigate the area and evaluate potential seismic conditions that could affect the project.

The planning and engineering studies will be carried out by a multi-disciplinary team, including significant Alaskan participation as described in later sections, with adequate logistic support to achieve these results within the stated time frame. The work items selected for emphasis in this discussion of our general approach are those related to public safety, special cold regions engineering aspects, and the comparison of the Upper Susitna Basin Plan and Initial Project with alternative sources of generation.

Environmental Investigations

Harza's approach to the project environmental investigations is based on the requirements of the National Environmental Policy Act and the regulations of the Federal Energy Regulatory Commission which are, in effect, that all reasonable alternatives to the project be examined; the broader issues of public concern about the uses of natural resources, socio-economic development of the area, and public safety be considered; and public participation in the planning and project identification process be achieved.

Levels and Timing of Study

The studies will be performed at three general levels which correspond to the organization of the engineering studies. In Phase I-Basin Planning Study the environmental studies will parallel the engineering work with the objective of identification of the best potential alternatives in terms of environmental advantages and disadvantages. In Phase II-Feasibility Study the objective will be to demonstrate the environmental feasibility of the selected project in accordance with standardized procedures. Environmental assessment studies emphasize the characterization of the existing environmental or baseline conditions; the projection of future conditions with and without the proposed project; and analysis of possible alternatives to the project, including the "no action" alternative.

Phase III-FERC License Application consists of the preparation of the environmental exhibits, with emphasis on impact quantification, alternative analysis, and participation by the public and regulatory agencies. The approach here will be to prepare an assessment which complies fully with FERC guidelines, so as to facilitate and shorten the process of preparation of the Environmental Impact Statement by the FERC. The authorization of Phase III by APA would be based on the Phase II determination that the project would be environmentally acceptable.

Areas of Study

Five general geographic areas will be considered, with different emphasis at different points in the study. These are the Upper Susitna Basin, where the hydroelectric project sites and tributary drainage areas are located; the Lower Susitna River and flood plain, where flow regulation and other effects may be involved; the Upper Cook Inlet area; the transmission corridors; and sites related to alternative sources of generation, including their transmission corridors and fuel sources.

Resource Inventory and Data Management

An integrated program of resource and project data inventory and subsequent data management will be carried out to facilitate the comparison of baseline data and impacts of alternatives.

Analysis of Alternatives and Evaluation of Impacts

Harza uses an iterative approach to its environmental studies in which the basic evaluation processes are performed concurrently and repeatedly for various alternatives, as defined by the engineering studies, and at successively more detailed levels in accordance with the phase of study.

The principal tasks in the analysis and evaluation process are:

- baseline data collection,
- habitat and population evaluation,
- alternative evaluation,
- impact assessment, and

- development of mitigation and enhancement programs.

Principal Disciplines

The principal areas of study by disciplines for which the analysis and evaluation studies are performed are:

- Human Ecology and Socio-economic Considerations,
- Aquatic Ecology (including water use and water quality),
- Terrestrial Ecology,
- Historic and Archeologic Resources,
- Recreation Resources, and
- Land Management and Aesthetics.

Field Support

A large number of study teams, furnished under subcontracts, will be required to accumulate the necessary data for technical and environmental evaluations. Rather than have each of these provide their own transporation, lodging and support facilities and services, Harza will assume this responsibility. To minimize the difficulties of working in the remote wilderness of the Upper Susitna and to comply with existing state and federal regulations, we propose to provide logistic support on a unified basis.

Conceptual Plans of Development

During the preparation of this Plan of Study we have considered briefly the principal alternatives to be studied and, in a qualitative manner, some of their advantages and disadvantages, as summarized in this section. The general area of study, from Fairbanks to the Anchorage-Cook Inlet area, is shown on Exhibit 2-1. The Upper Susitna study area, showing the principal dam sites now identified, is shown on Exhibit 2-2.

Previous studies have identified dam sites known as Denali, Vee Canyon, Watana, the Kaiser site, Devil Canyon, and Olson, in downstream order. Harza proposes to give only cursory attention to the Denali site, where a combination of foundation problems and environmental impact, appear to preclude its inclusion in a practical

plan of development at this time. The other named sites, and additional sites we will seek to identify, will be considered at least through the preliminary screening process as described in the detailed work program. The Vee site, however, may be of doubtful economic value for early development in the absence of flow regulation by the Denali reservoir.

The following is a listing of some of the principal alternatives as we see them now. The purpose of introducing these very preliminary conceptual schemes at this time is to illustrate the reasons for our approach to the Basin Planning Study, which is described in the detailed work plan.

The "sites" referred to are in most cases extended reaches of canyon or narrow river valley which permit considerable freedom in the location of dams of moderate or even fairly great height. Only when the limits of development are approached, as in some of the previous plans, are the "sites" narrowly defined by topography. In this situation we see the possibility of a number of alternative plans in which the elevations of the downstream reservoirs are selected to provide convenient increments of capacity and investment.

Plan 1 - Corps 2 Dam Scheme

The scheme presented by the Corps of Engineers in their 1975 Feasibility Report and February 1979 Supplemental Feasibility Report consists of an initial dam at Watana, with normal reservoir elevation 2185, and another dam at Devil Canyon, with reservoir elevation 1450. The installed capacity of the completed 2-dam project would be 1568 MW, and the average generation 6900 GWh per year. The Watana dam would be a fill structure with a height of about 810 feet and a normal maximum head of about 705 feet. The Devil Canyon dam would be a concrete gravity structure with overflow spillway. The structural height of the main dam would be approximately 640 feet, and the height of the auxilliary fill dam on the left abutment would be approximately 170 feet. The normal maximum head is approximately 570 feet. Both powerstations would be underground.

This plan, which is shown on Exhibit 2-3, remains as the point of departure for the study and one of the general plans for consideration. The types, arrangements, and heights of structures would of course be reexamined. Both sites are at or near the limits of development in the Corps plan, and the alternative elevations to be considered would be lower. In this range of heights the Watana dam probably would be a fill dam while either fill or concrete dams could be considered at Devil Canyon. Among the comments on this scheme are that both projects

are large, with long construction periods prior to the realization of benefits, and part of the head between Watana and Devil Canyon remains undeveloped because of the topographic limitations of the Devil Canyon site.

Plan 2 - Kaiser and Vee Sites

This plan also includes 2 main dams, one at approximately mile 140, to Elevation 1750, and one at or downstream from Vee Canyon, to El. 2350, as shown on Exhibit 2-4. Nearly 200 feet of head downstream from Vee would remain undeveloped if the Vee site is used. The downstream site was suggested by Kaiser but was not specifically studied. Another 100 to 150 feet of head would remain & undeveloped between the Kaiser and Devil Canyon sites, but this ultimately could be developed by a Devil Canyon or Olson dam. The main storage dam would be at the High Devil Canyon or Kaiser site, some 5 miles upstream from the Devil Canyon site. The fill dam would be about 800 feet high and provide a maximum head of about 720 feet. A dam of about the same height as high Watana would provide about half the total storage of Watana and prevent the development of Watana. We consider the area near the Kaiser or High Devil Canyon site to be of interest primarily for a smaller dam as discussed below.

Plan 3 - Kaiser-Watana-Vee

This plan, shown schematically on Exhibit 2-5, combines the Kaiser, Watana, and Vee Sites, with the possible addition of an Olson or low Devil Canyon Project. The Kaiser and Watana dams each would develop approximately 450 feet of head, and encroachment or overlap storage could be provided if desired. The Kaiser site, at this height, would not be built to its limits nor overbuilt, as may be the case of Devil Canyon at El. 1450. The initial stages of construction here may be somewhat large in relation to the load, but could be more attractive if Watana were built in stages to an ultimate elevation somewhat lower then El. 2185.

Plan 4 - Kaiser-Watana

In this scheme, shown on Exhibit 2-6, the Vee dam is omitted and Watana is built to any selected elevation in either one or more stages. At Watana El. 2185, for example, this becomes similar to the Corps of Engineers Scheme 1 except

that the Kaiser site is substituted for Devil Canyon, with 450 ft. and 570 ft. of head, respectively. The remaining head could be developed by a lower Devil Canyon or Olson project after one of the upstream projects.

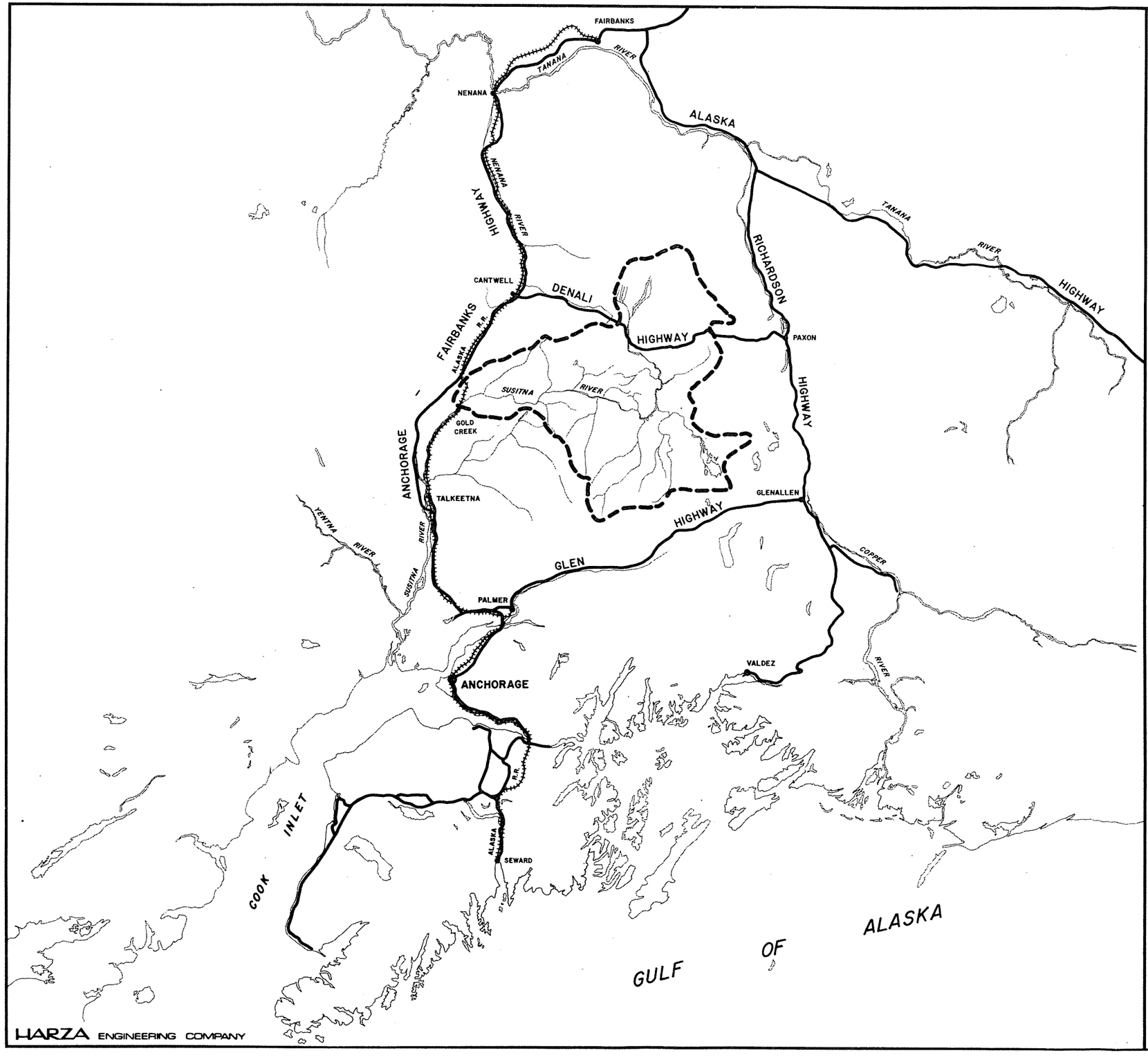
Plan 5 - Devil Canyon, Devil Creek, Watana

This scheme consists of a dam in the Devil Canyon area and one at approximately mile 145 to 150, upstream from Devil Creek and about midway between Devil Canyon and Watana; plus the Watana project, to an elevation to be selected. The schematic profile is shown on Exhibit 2-7. Each of the downstream dams would develop approximately 280 to 300 feet of head. The Devil Canyon dam could be at the Corps site or, with a reservoir elevation on the order of El. 1150 to 1200, it could be moved downstream, closer to Portage Creek, to develop more head. The Devil Creek project would be developed to the Watana tailwater level, approximately El. 1500, or to a slightly higher elevation if some encroachment is found to be advantageous. The planning would have considerable flexibility in this regard because the dams are relatively low structures and well within the topographic and structural limits of the sites. These three dams could be built in any order, but we consider one of the principal advantages of the scheme to be the availability of one of the smaller downstream dams for the initial project. The construction time would be less than the high Watana project, and the size of the project may be more appropriate for the system load in the period around 1990. The second project could be the second low dam or it could be the Watana project, designed for construction in one or two stages. Watana would provide significant regulation of the river and a large increase in the firm energy and dependable capacity of the system. The postponement of Watana until after the small dams, however, will make it easier to absorb Watana's output in a larger system. Selection of these elevations or the order of construction is of course not the purpose of the present effort, but will be the principal focus of planning in Phase I of the Plan of Study.

Plan 6 - Devil Canyon, Devil Creek, Watana, Vee

This scheme, shown on Exhibit 2-8, is similar to Scheme 5 except that the elevation of Watana reservoir is limited by the Vee site, which probably would be the last stage of development. In common with Scheme 3, the merits of this depend on the technical feasibility and cost of the Vee project in comparison with the alternative costs and staging of the Watana project.

EXHIBIT 2-1



NORTH

SCALE 0 10 50 MILES

LEGEND

UPPER SUSITNA RIVER BASIN BOUNDARY

SOURCE: U. S. DEFENSE MAPPING AGENCY.

BASEMAP DERIVED FROM THE LAMBERT CONFORMAL CONIC PROJECTION.

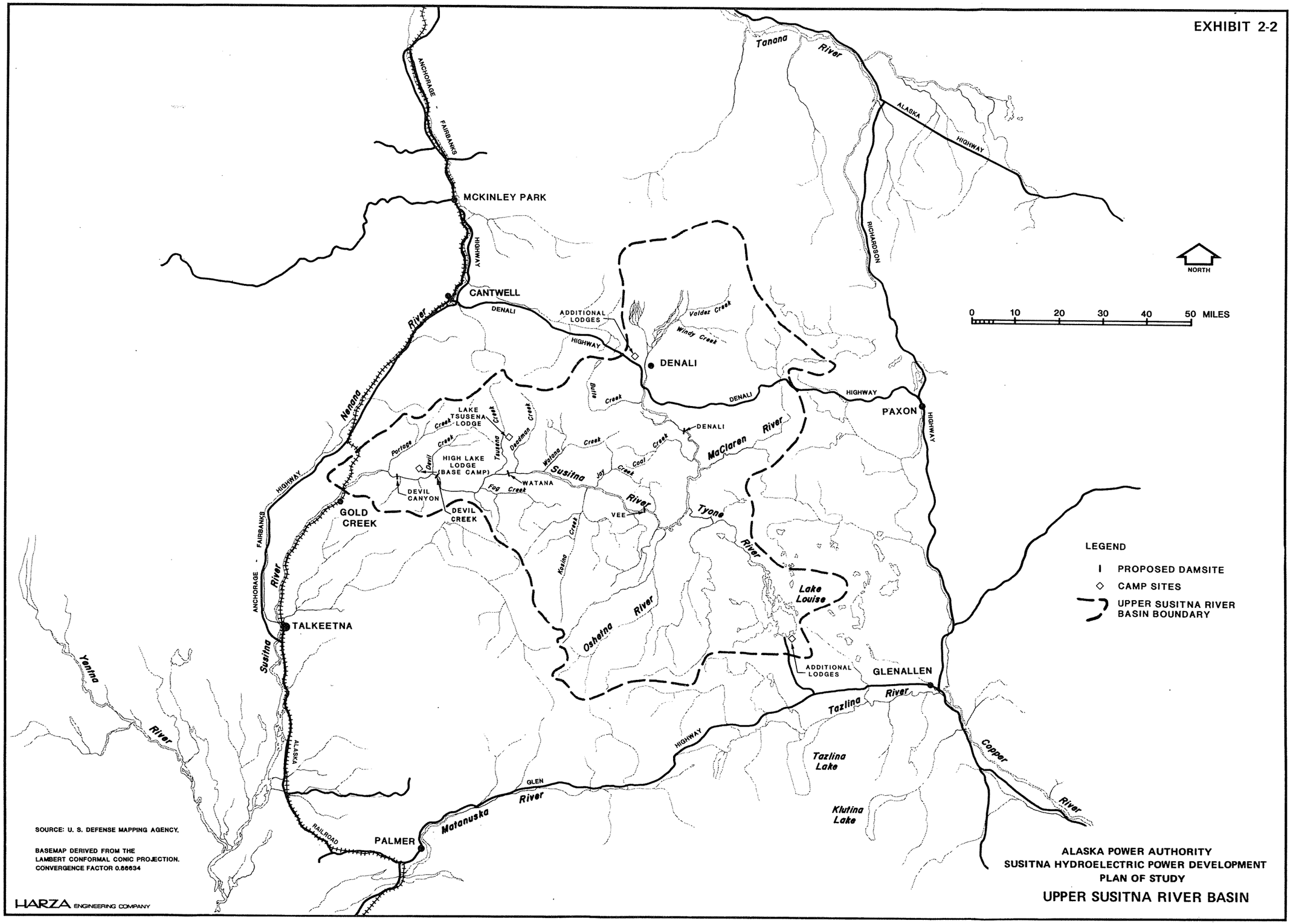
CONVERGENCE FACTOR 0.86634

HARZA ENGINEERING COMPANY

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

THE RAILBELT AREA

EXHIBIT 2-2



SOURCE: U. S. DEFENSE MAPPING AGENCY.

BASEMAP DERIVED FROM THE LAMBERT CONFORMAL CONIC PROJECTION. CONVERGENCE FACTOR 0.86634

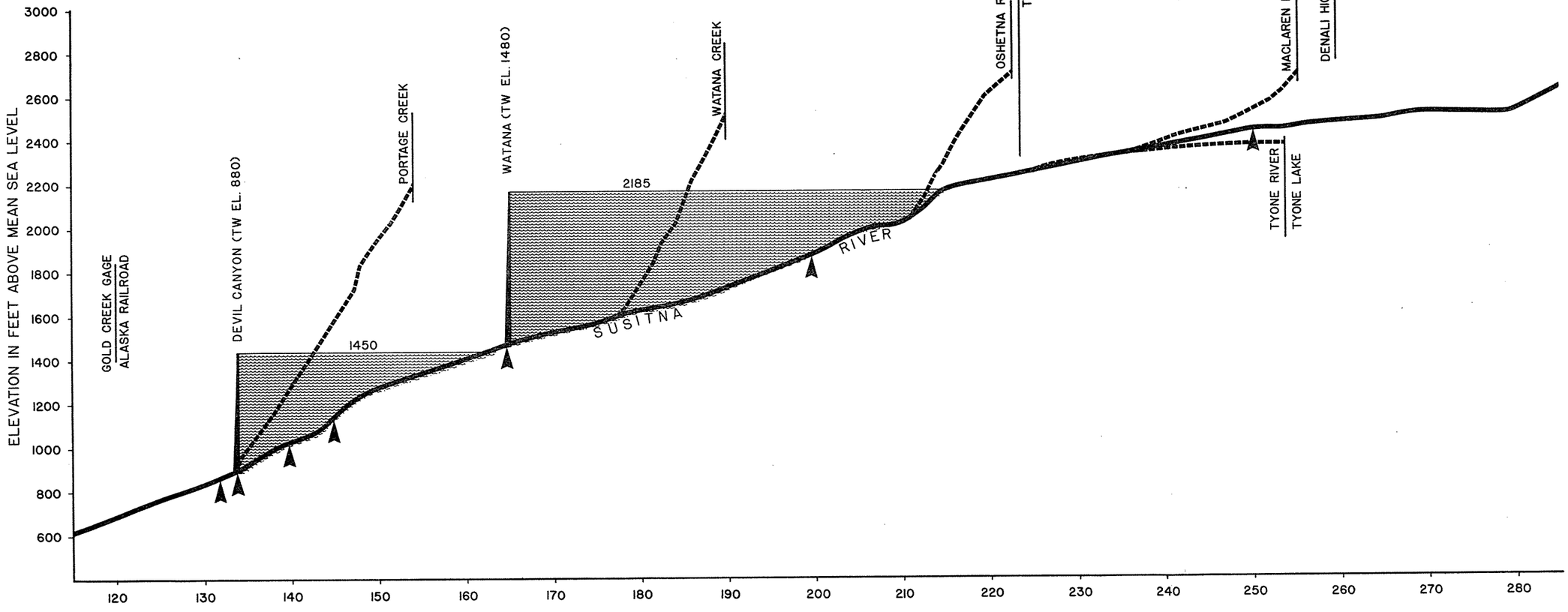
HARZA ENGINEERING COMPANY

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

UPPER SUSITNA RIVER BASIN

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
WATANA	2185	POSSIBLE ALTERNATIVES IN RESERVOIR ELEVATION OR STAGING
DEVIL CANYON	1450	



LEGEND

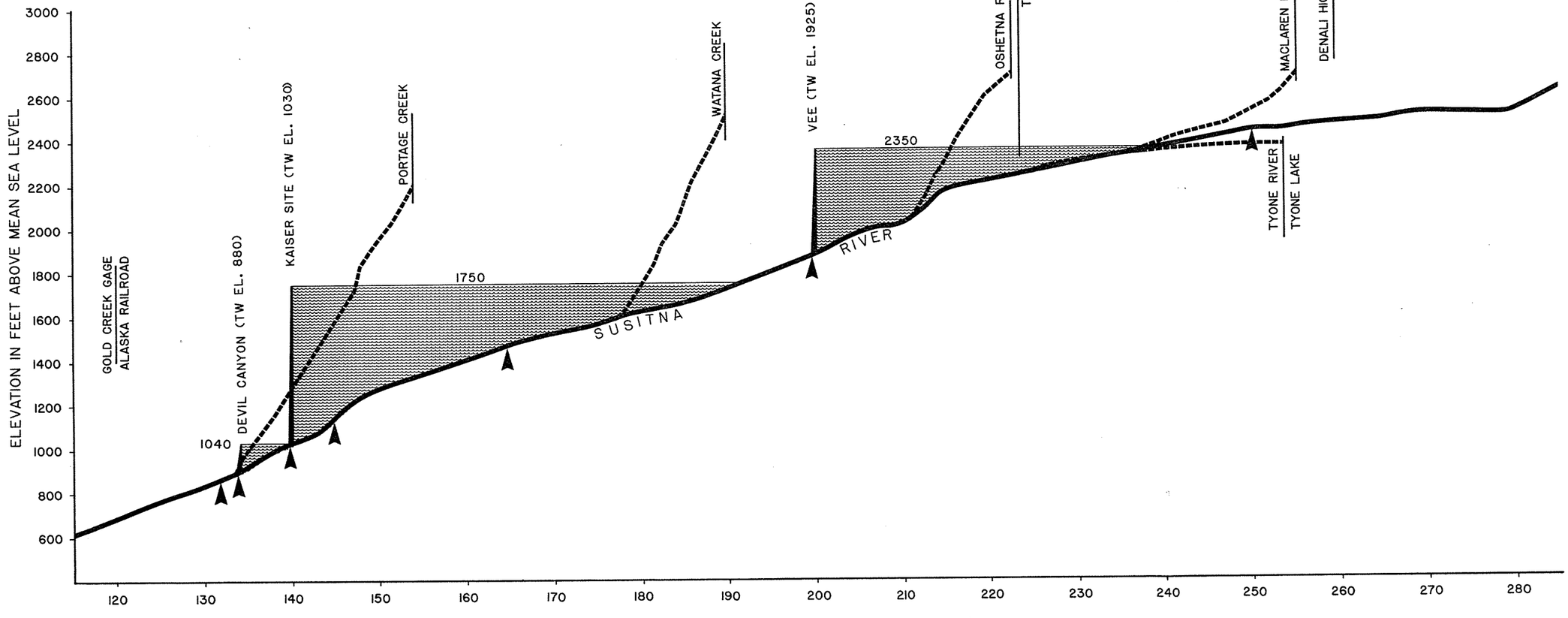
- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO. 1

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
VEE	2350	
KAISER	1750	
DEVIL CANYON	1040	



LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

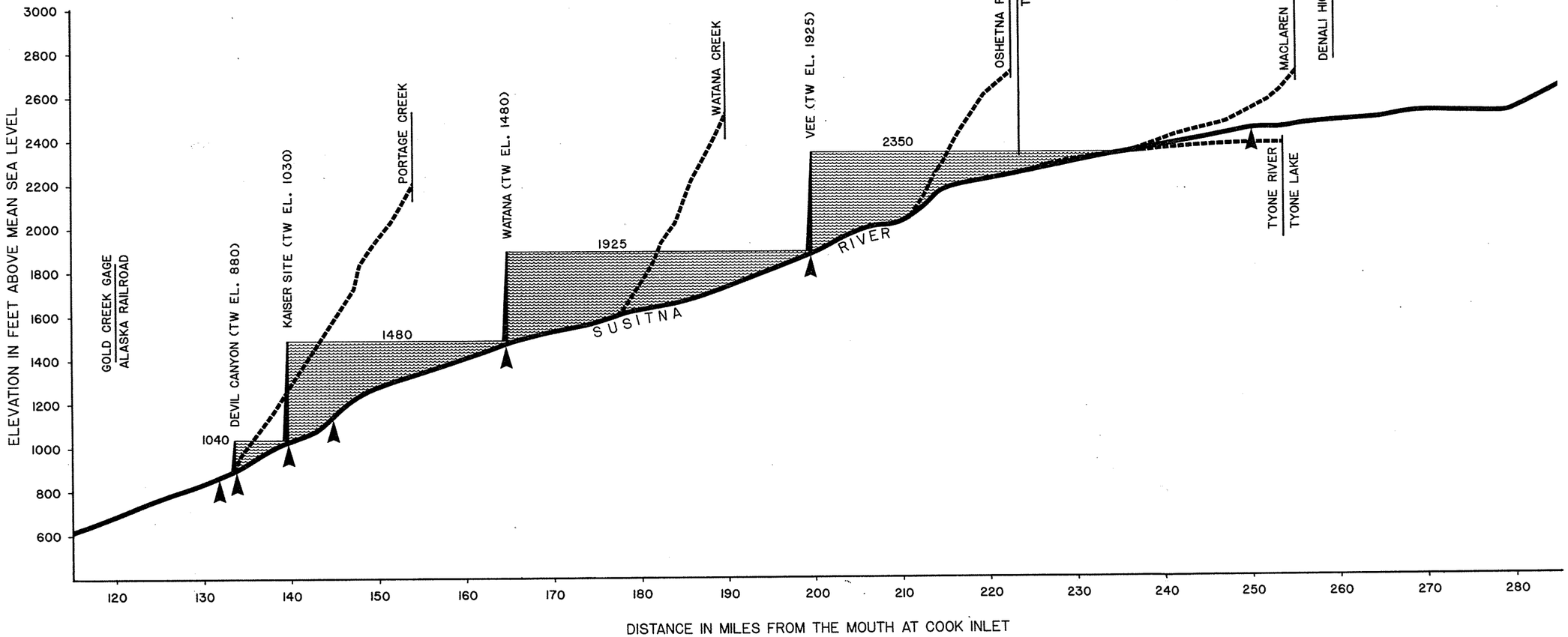
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO. 2

EXHIBIT 2-5

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
VEE	2350	
WATANA	1925	
KAISER	1480	
DEVIL CANYON	1040	



LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

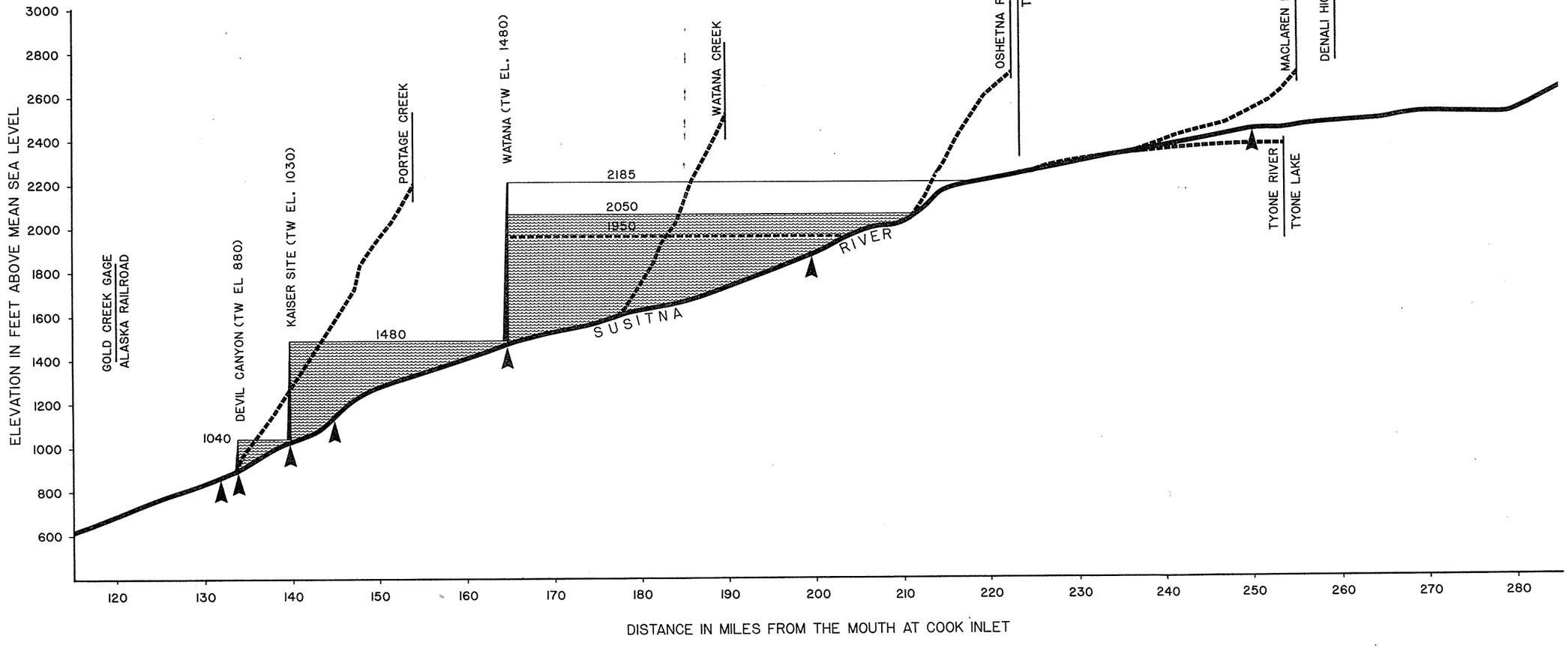
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO.3

EXHIBIT 2-6

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
WATANA	1950–2185	POSSIBLE ALTERNATIVES IN RESERVOIR ELEVATION OR STAGING
KAISER	1480	
DEVIL CANYON	1040	



LEGEND

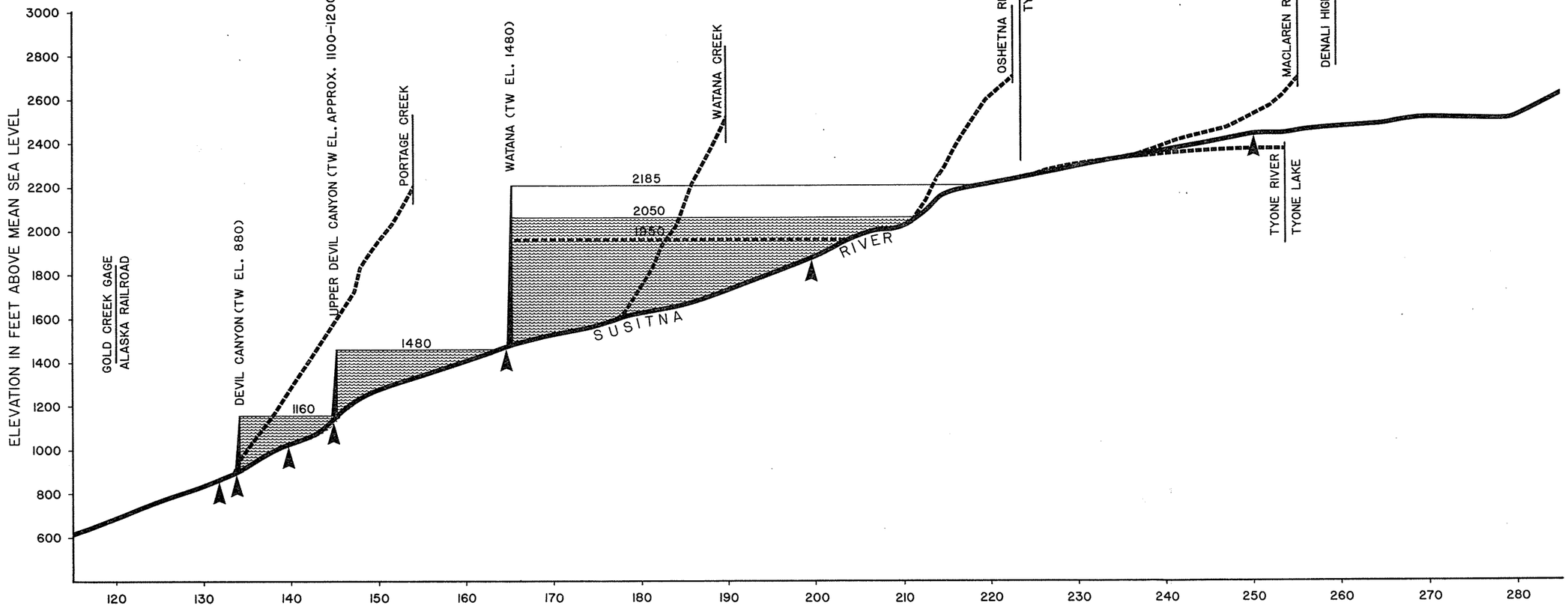
- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO.4

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
WATANA	1950–2185	POSSIBLE ALTERNATIVES IN RESERVOIR ELEVATION OR STAGING
UPPER DEVIL CANYON	1480	
DEVIL CANYON	1160	



LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

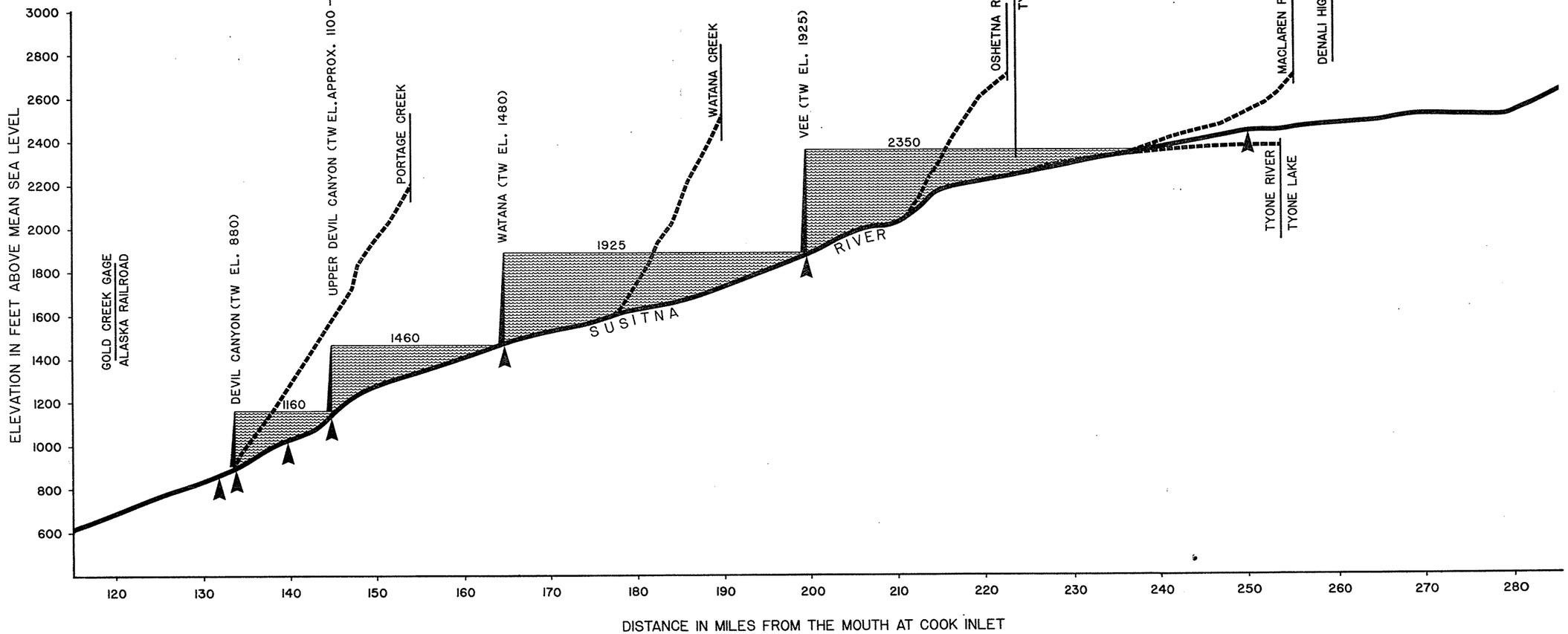
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO. 5

EXHIBIT 2-8

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
VEE	2350	
WATANA	1925	
UPPER DEVIL CANYON	1460	
DEVIL CANYON	1160	



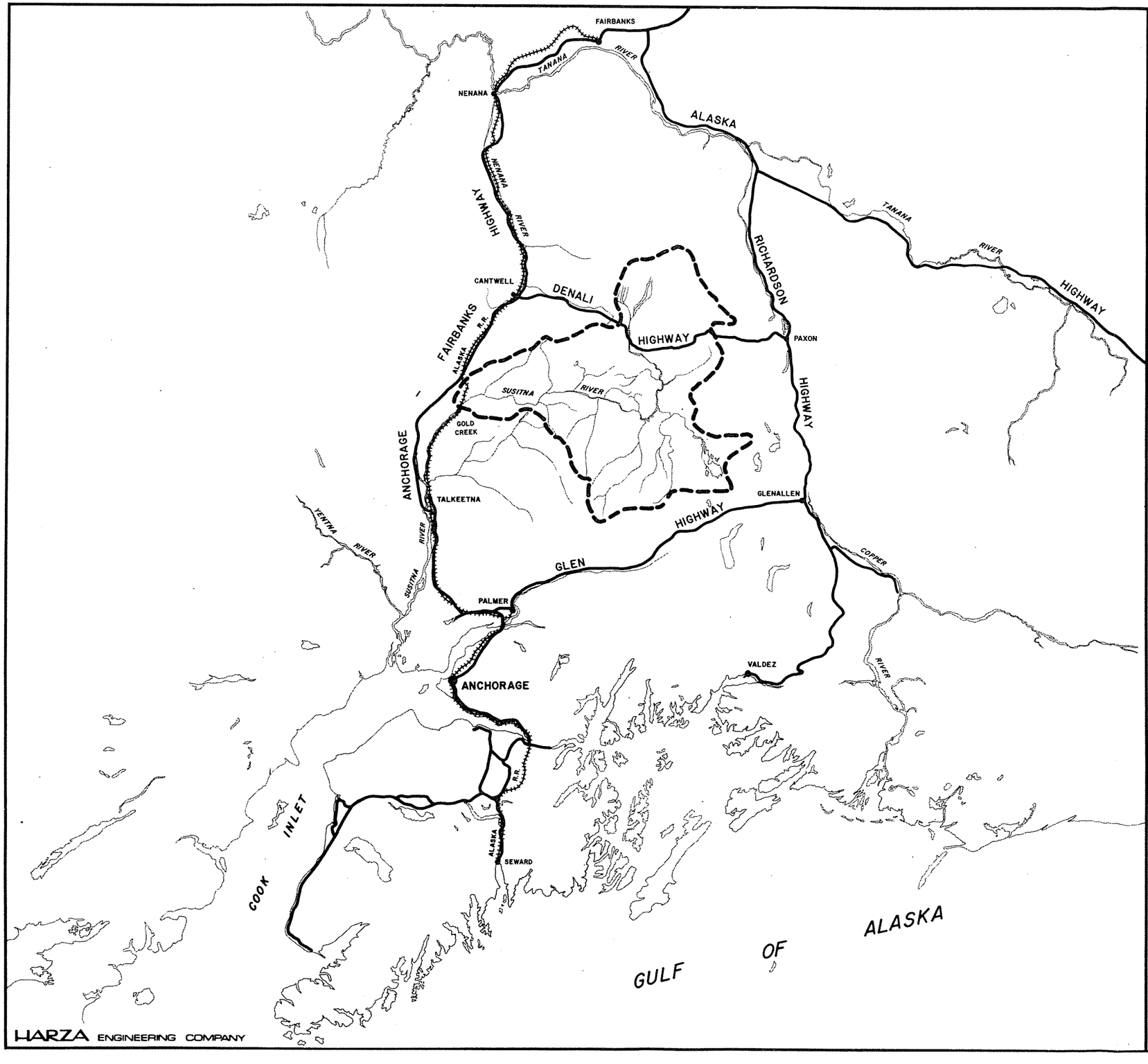
LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO.6

EXHIBIT 2-1



HARZA ENGINEERING COMPANY

NORTH

SCALE 0 10 50 MILES

LEGEND

UPPER SUSITNA RIVER BASIN BOUNDARY

SOURCE: U. S. DEFENSE MAPPING AGENCY.

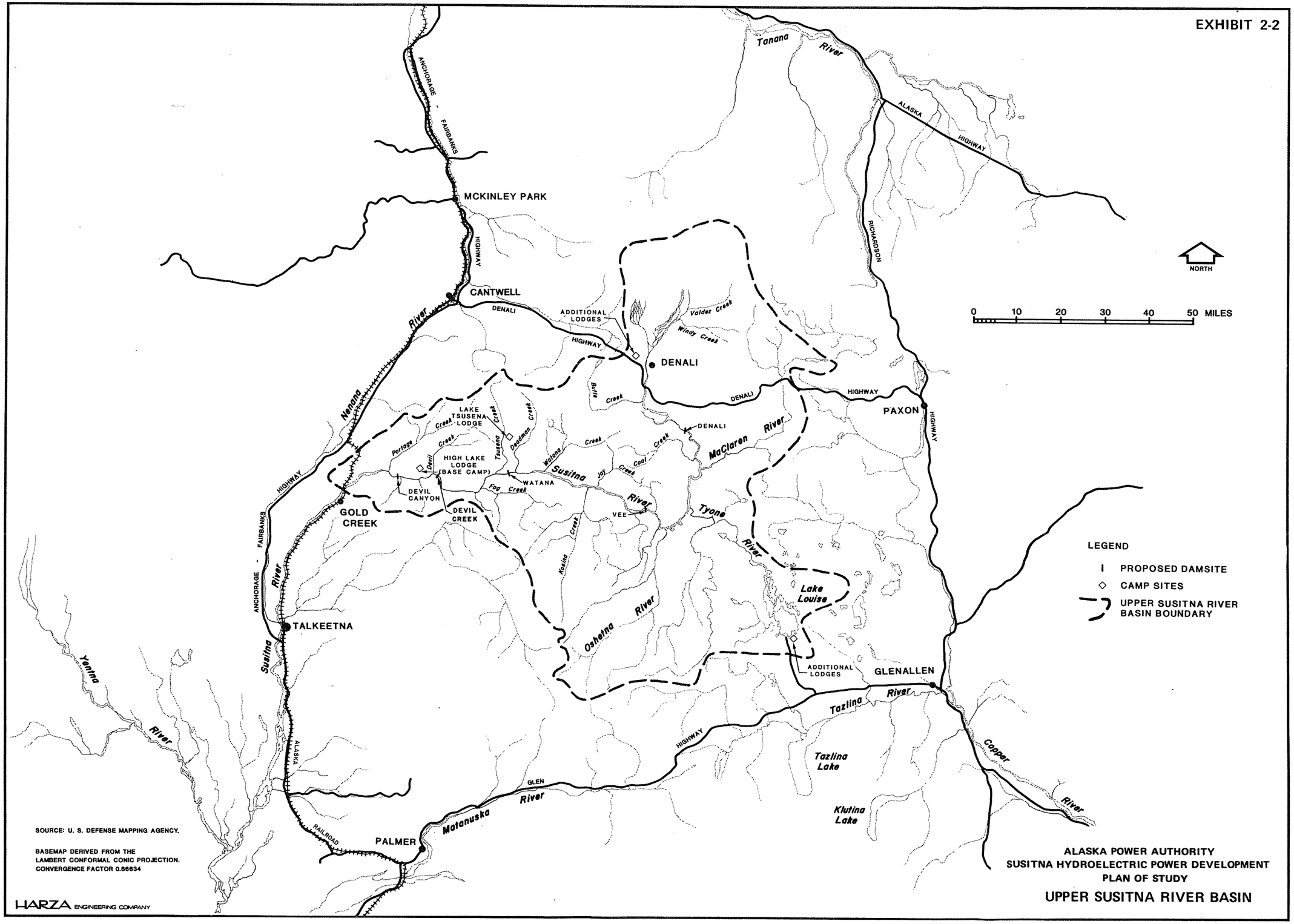
BASEMAP DERIVED FROM THE LAMBERT CONFORMAL CONIC PROJECTION.

CONVERGENCE FACTOR 0.86634

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

THE RAILBELT AREA

EXHIBIT 2-2



SOURCE: U. S. DEFENSE MAPPING AGENCY.

BASEMAP DERIVED FROM THE LAMBERT CONFORMAL CONIC PROJECTION. CONVERGENCE FACTOR 0.86634

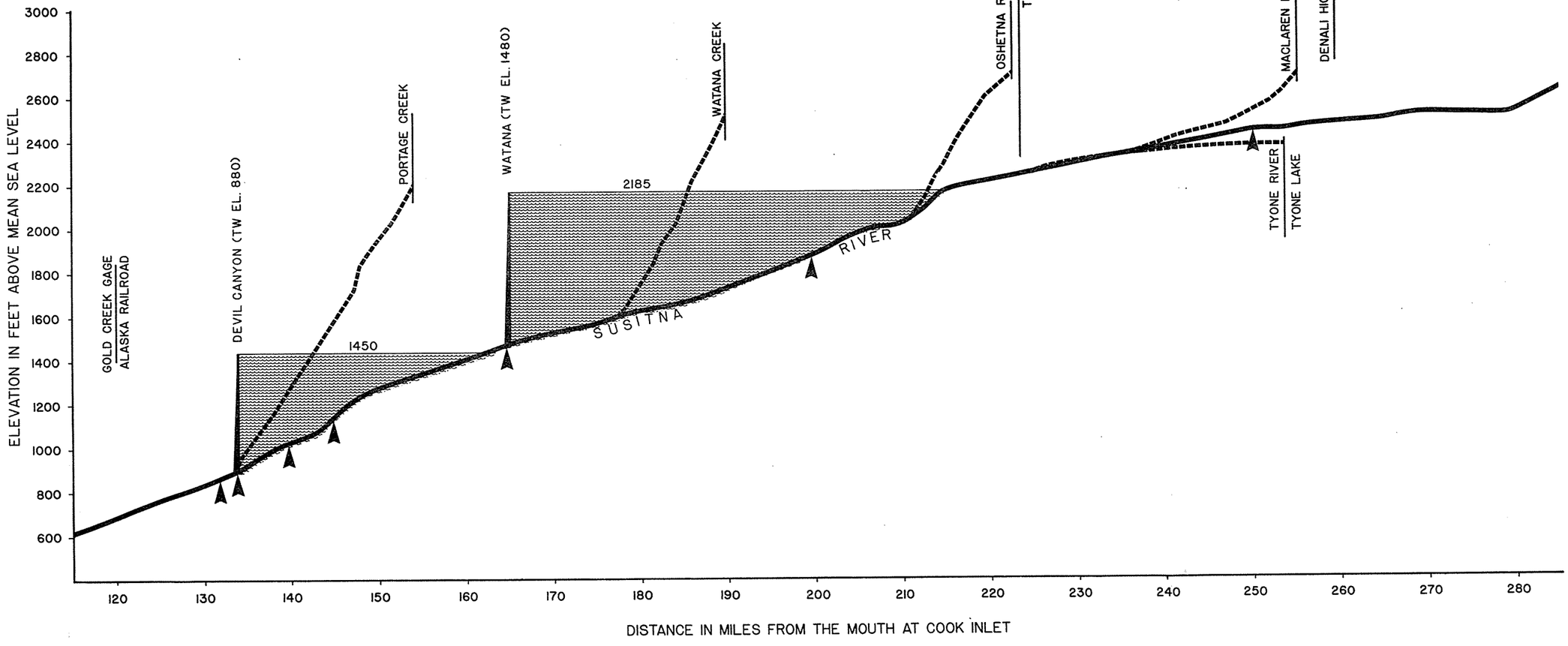
HARZA ENGINEERING COMPANY

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

UPPER SUSITNA RIVER BASIN

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
WATANA	2185	POSSIBLE ALTERNATIVES IN RESERVOIR ELEVATION OR STAGING
DEVIL CANYON	1450	



LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

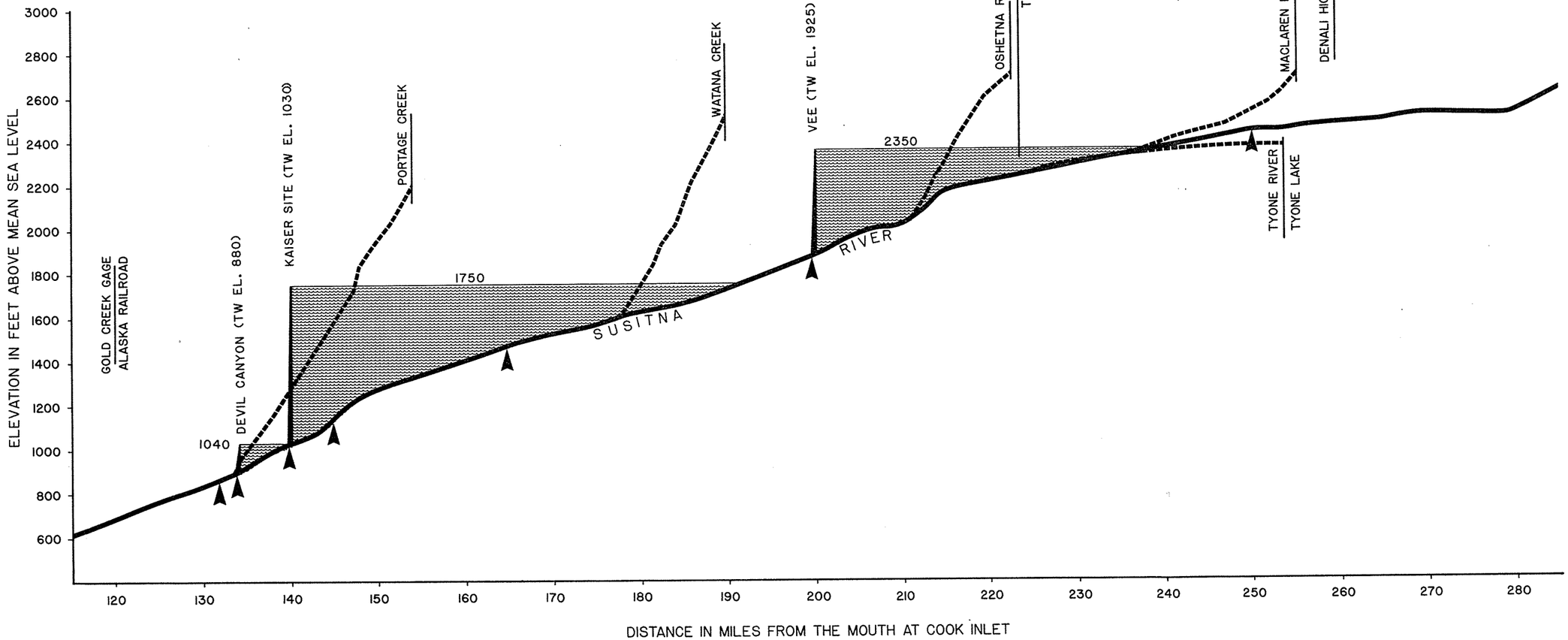
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT

PLAN OF STUDY

CONCEPTUAL PLAN NO. 1

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
VEE	2350	
KAISER	1750	
DEVIL CANYON	1040	



LEGEND

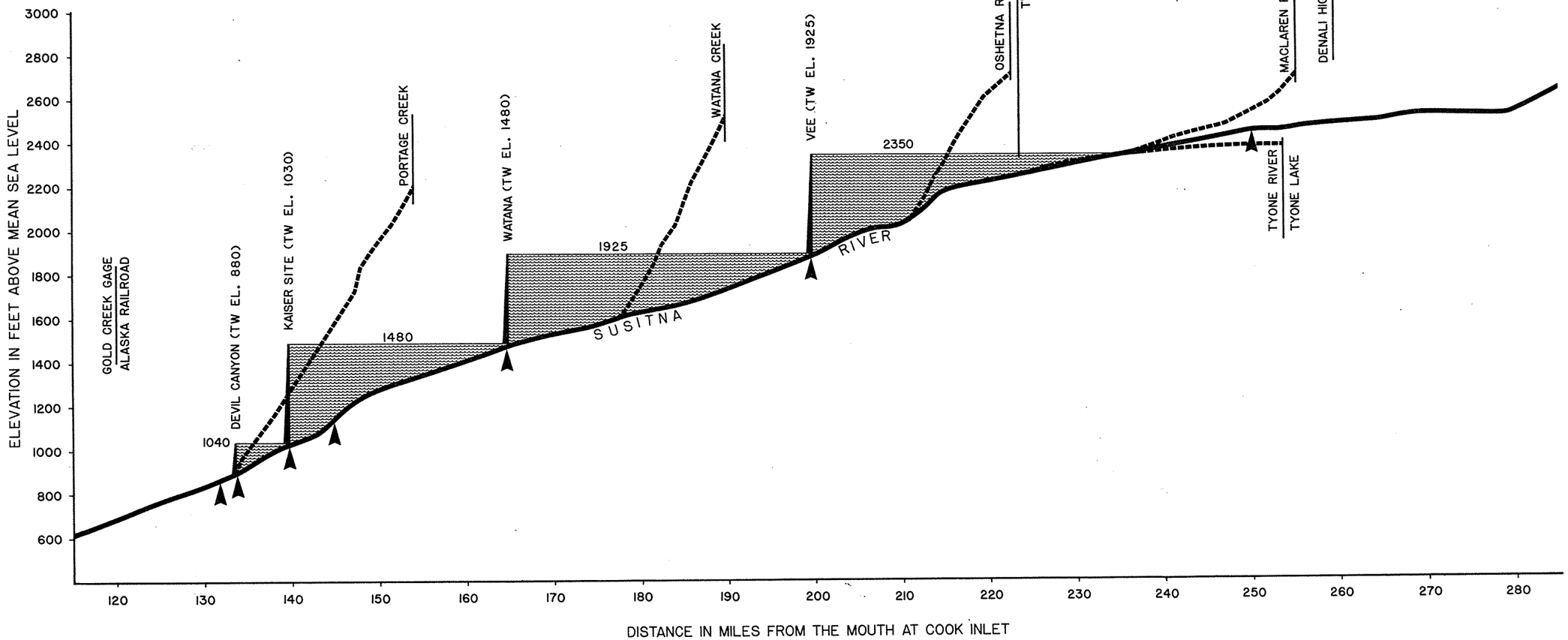
- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO. 2

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
VEE	2350	
WATANA	1925	
KAISER	1480	
DEVIL CANYON	1040	



LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

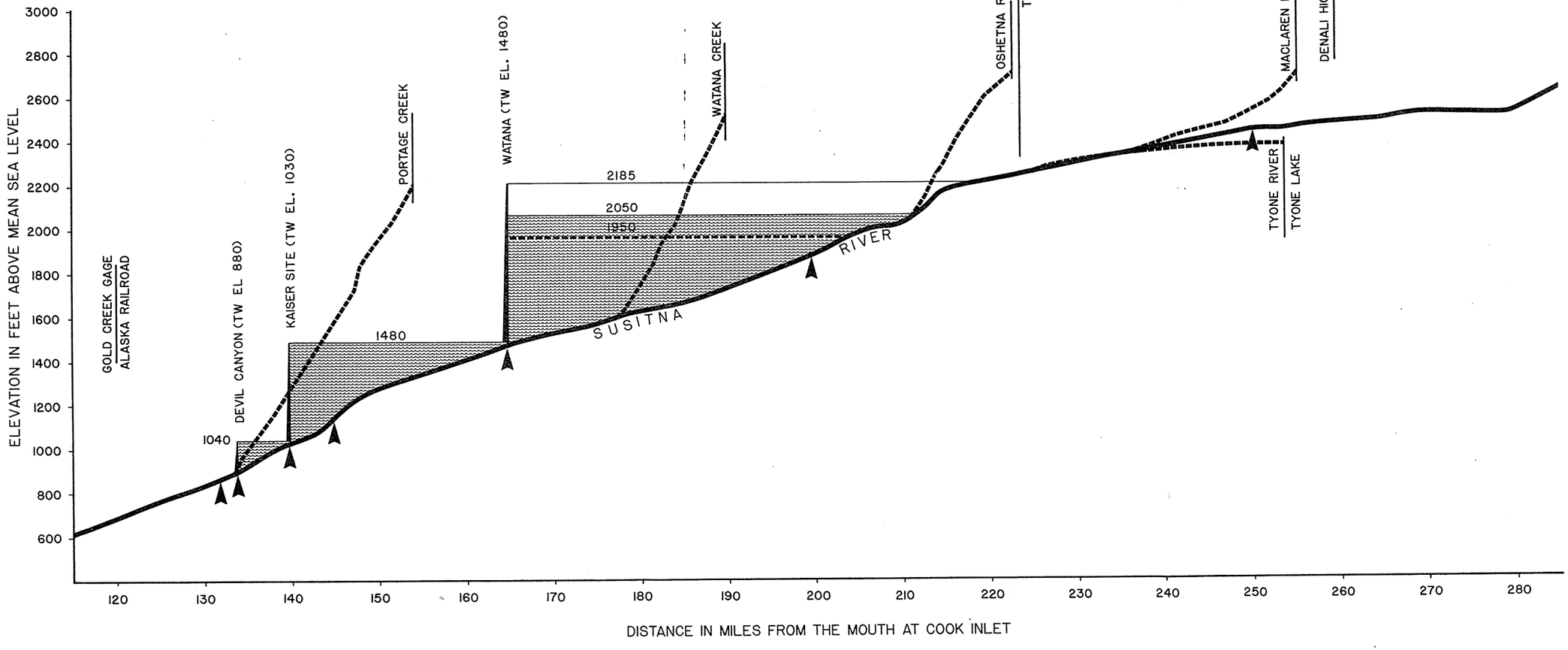
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO.3

EXHIBIT 2-6

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
WATANA	1950–2185	POSSIBLE ALTERNATIVES IN RESERVOIR ELEVATION OR STAGING
KAISER	1480	
DEVIL CANYON	1040	



LEGEND

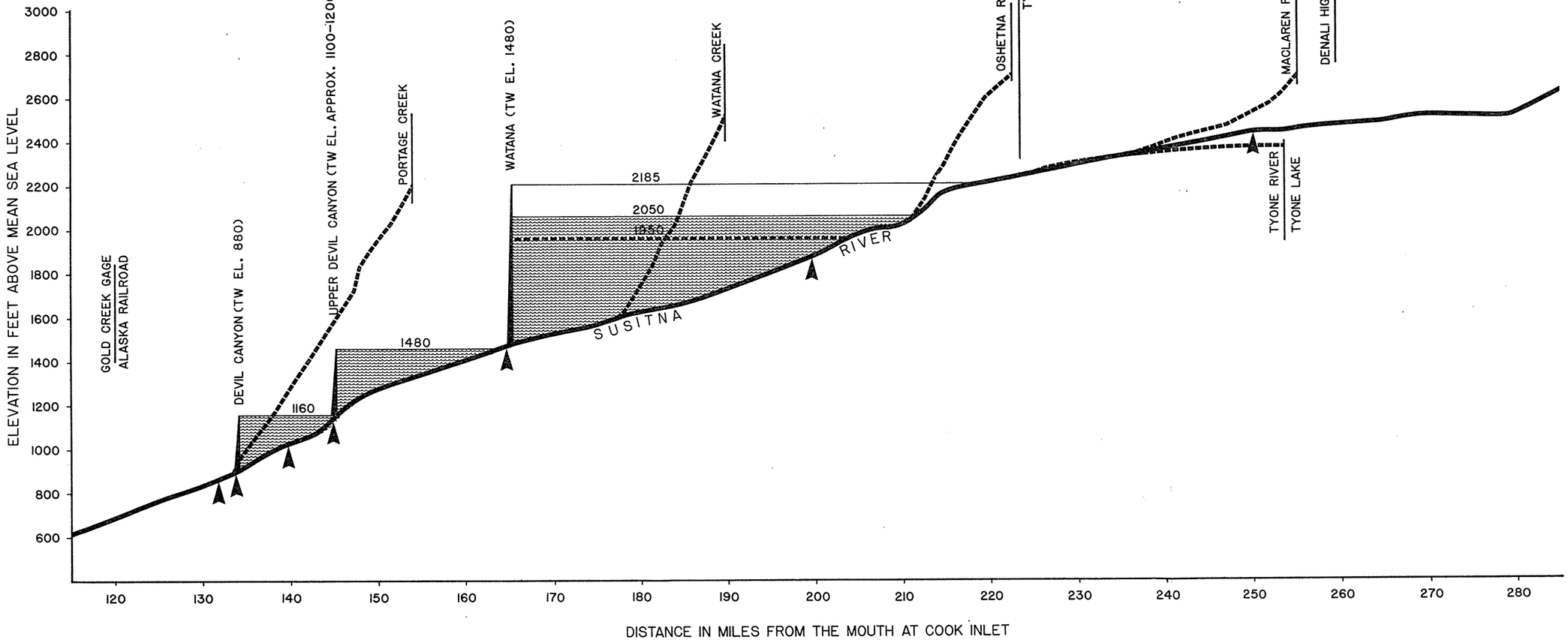
- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO.4

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
WATANA	1950–2185	POSSIBLE ALTERNATIVES IN RESERVOIR ELEVATION OR STAGING
UPPER DEVIL CANYON	1480	
DEVIL CANYON	1160	



LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

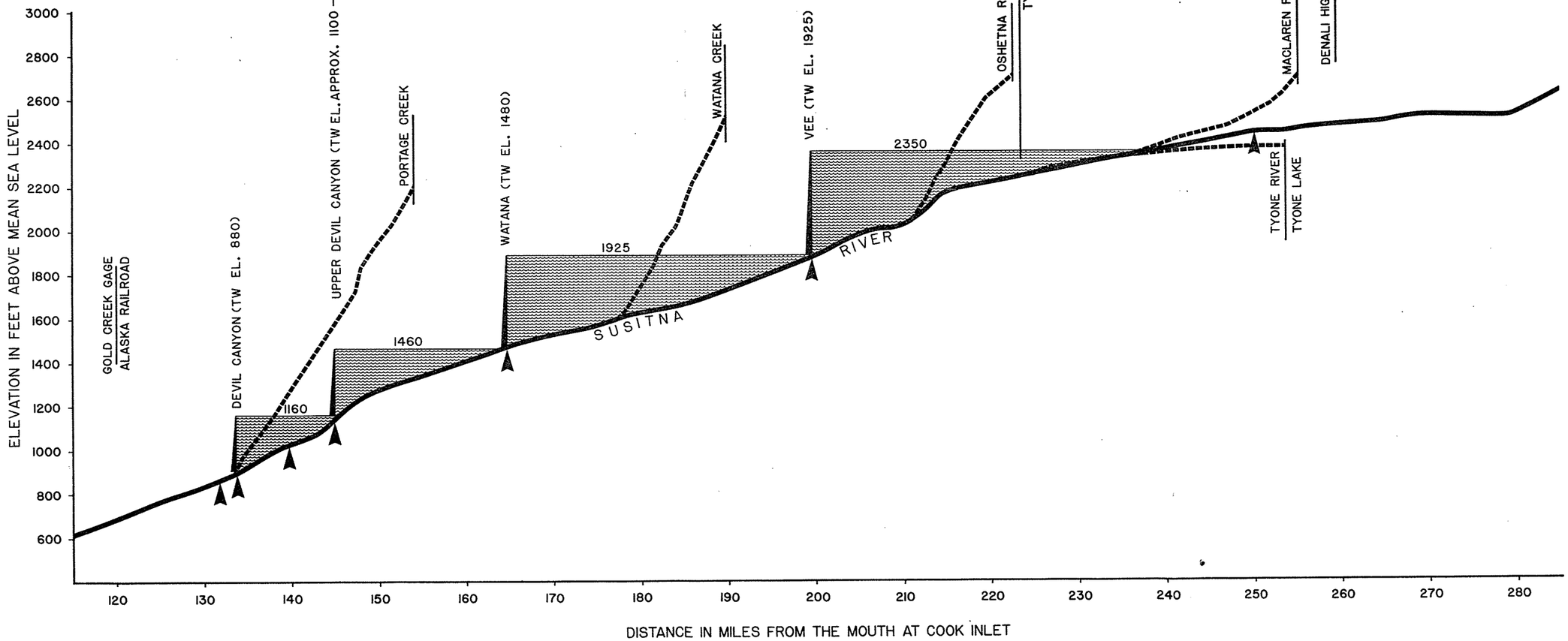
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO. 5

EXHIBIT 2-8

CONCEPTUAL PLAN COMPONENTS

DEVELOPMENT SITE	MAXIMUM RESERVOIR ELEVATION FT. MSL	REMARKS
VEE	2350	
WATANA	1925	
UPPER DEVIL CANYON	1460	
DEVIL CANYON	1160	



LEGEND

- DAM AND RESERVOIR
- POTENTIAL DAM SITE
- SUSITNA RIVER PROFILE
- TRIBUTARY PROFILE

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

CONCEPTUAL PLAN NO.6

SECTION 3. BUDGET SUMMARY

Section 3

BUDGET SUMMARY

This section presents a budget summary for undertaking the three phases of the Plan of Study, through the FERC licensing phase. A detailed budget breakdown by work activity through license submittal is given in Volume II, Detailed Program.

Summary Table

A budget summary for carrying Susitna studies through licensing is presented in Table 3-1. The table is divided into two parts: I) Engineering and Environmental Services; and II) APA Management and Administration. The budget is further subdivided into prior to and after License Application Submittal. The License Application is scheduled for submittal in March 1982.

The budget for the Plan of Study leading to the FERC License Application is $17,762,000. The estimate for the period from submitting the license application until the FERC grants the license is approximate because it depends on the length of the licensing period and possible action by intervenors. We have assumed the license would be granted by June 1984, and, on that basis, have estimated a budget of $4,342,000 to cover on-going activities.

Table 3-1

BUDGET SUMMARY

Item	Amount ($1000)
I Engineering and Environmental Services	
A. Prior to License Application Submittal (January 1980 - March 1982)	
1. Project Management	557
2. Logistics	5,300
3. Public Information Support	657
4. Photography, Surveying, and Mapping	420
5. Environmental Studies and Investigations	4,784
6. Engineering Studies and Investigations	5,273
Subtotal A	16,991
B. After License Submittal (April 1982 - June 1984)	
1. Technical Support	500
2. Continuing Environmental Baseline Data Collection	1,531
3. Continuing Logistic Support	600
4. Public Information and Participation	135
Subtotal B	2,766
Subtotal I	19,757
II APA Management and Administration	
A. Prior to Licence Submittal (January 1980 - March 1982)	
1. APA Review and Coordination	225
2. Alaska Department of Fish and Game Coordination	170
3. Payment to Native Corporations	162
4. Legal Services	215
Subtotal A	772
B. After License Submittal (April 1982 - June 1984)	
1. APA Coordination	225
2. Alaska Department of Fish and Game Coordination	169
3. Payment to Native Corporation	162
4. Legal Services	385
5. Land Management	135
6. Independent Cost Estimate Review	500
Subtotal B	1,576
Subtotal II	2,348
TOTAL I & II	22,105

Plan of Study Budget Estimate

The budget for the Plan of Study is summarized by major program and distributed by quarter on Table 3-2. The Engineering and Environmental Services and the APA Management and Coordination activities are tabulated so they can be identified. A detailed budget developed from the Engineering and Environmental work items is presented in Volume II.

Engineering and Environmental Services

The budget for Engineering and Environmental Services was prepared on the basis of man-time and direct costs for each work item. Budgets were obtained from service contractors, suppliers, and responsible government agencies for work that will be done under subcontract.

Man-time estimates for engineering, planning, and environmental studies are based on the detailed work program, using Harza's experience with other projects.

The cost of drilling and other major field activities was estimated based on contacts and preliminary quotations from qualified, subcontractors. Estimates for logistic support, including food, lodging and transportation, are based on information received from suppliers, outfitters, and lodge proprietors.

We have obtained a quotation for constructing and operating a field camp from Cook Inlet Region Inc./Homes and Narver (CIRI/H&N). Their cost estimate included $3,125,000 for construction of a field camp and $685,000 for demobilization of the camp if that is necessary. We have not included these cost items in the budget requirements because lodge facilities are available at High Lake Lodge, near Devil Canyon, and at Tsusena Lake Lodge, near Watana. Discussions and price quotations from the lodge operators indicate that the lodge facilities can be expanded for use by the field investigators. A major consideration in the decision to construct a field camp is that the initial site will not be selected until late in the first year of study. Therefore, the camp might require moving if it is constructed early.

The University of Alaska and Alaska Department of Fish and Game are major subcontractors in the environmental data collection program. The estimates of their services have been discussed in detail with them.

Budget estimates for environmental data collection and required logistic programs and public involvement were based on

Item No.	Discipline or Major Program	Discipline Total
	Engineering and Environment	
1.	Project Management	557
2.	Logistics	5300
3.	Public Information Supp	657
4.	Photography, Surveying, and Mapping	420
5.	Environmental Studies	
	a. Data Coordination & Management	384
	b. Terrestrial Ecology	1685
	c. Aquatic Ecology	1904
	d. Recreation & Aesthetics	95
	e. History & Archeology	544
	f. Human Ecology	120
	g. Quality Control & Technical Editing	52
6.	Engineering Studies	
	a. Hydrologic & River Hydraulics	321
	b. Power Market	68
	c. Alternative Sources of Generation	265
	d. Hydroelectric Projec	1104
	e. Power System Expansi and Operation	62
	f. Transmission & Syste	122
	g. Engineering Geology	666
	h. Drilling & Testing	979
	i. Soil Foundations and Construction Materi	400
	j. Seismic Geology & Seismology	984
	k. Economic and Financi Analyses	112
	l. Construction Costs & Programs	190
	APA Management and Administ	
1.	APA Review and Coordina	225
2.	ADF&G Coordination	169
3.	Payment to Native Corp.	162
4.	Legal Services	215
	Quarterly Subtotals	17,762

continuing the programs, as planned, during FERC License Application Proceedings. These items could be maintained directly under APA control.

APA Management and Administration

The budget for APA coordination and review ($100,000 per year) was based on information furnished by the APA. Payments to the Native Corporations and the the Department of Fish and Game ($72,000 per year and $75,000 per year respectively) for land use and coordination were specified by APA.

Legal costs, associated with presenting and supporting the FERC License Application, estimated to be $600,000 during the three study phases, are also included in the budget estimate. This budget allocation is based on information from Mr. Arnold Quint, who is with the law firm Hunton & Williams. Mr. Quint has several years experience in processing FERC (formerly FPC) License Applications.

We have not included provision for a Financial Consultant in the POS budget. If the APA intends to use this type of service an additional budget allowance will be needed.

The budget item for an independent review of cost estimates ($500.000) was provided to cover that requirement indicated in the instructions from the APA. We have allocated $984,000 in the Engineering budget for seismicity studies. These will include a seismic risk analysis.

Distribution of the Work

The work program has been made to maximize the use of Alaskan subcontractors and Alaskan-based personnel to carry out the program. About 50 percent of the Harza-CH2M Hill effort is scheduled to be done in Alaska. Environmental baseline data collection and studies and other major field efforts will be carried out by Alaskan subcontractors. It is anticipated that about 75 percent of the total POS Budget will be expended for work to be done in Alaska. The organization required to undertake this POS is described in detail in Part B of this volume.

Budget Estimate for Licensing Phase

The POS activities are described in detail in Volume II, and also included are quarterly budget estimates for major work items. A yearly budget distribution of activities "after FERC License Application submittal" (April 1982 to June 1984) is included in Table 3-3. The extent of this phase of the work is impossible to estimate accurately because it can vary greatly, depending on intervenors in the licensing process.

The schedule, for FERC licensing assumes that the opposition to the project will not be substantial. Harza, in its POS, has emphasized public participation and addressing environmental concerns and anticipates developing a project that is socially and environmentally acceptable, locally supported, and technically, economically and financially sound.

Table 3-3

BUDGET AFTER FERC SUBMITTAL
($1000)

	Item	1982 April-Dec	1983 Jan-Dec	1984 Jan-J
I	Engineering and Environmental Services			
	1. Technical Support	100	300	100
	2. Continuing Environmental Baseline Data Collection	686	570	275
	3. Continuing Logistic Support	200	250	150
	4. Public Information & Participation	45	60	30
II	APA Administration and Support Services			
	1. APA Review & Coordination	75	100	50
	2. Alaska Department of Fish & Game	56	75	38
	3. Payment to Native Corporations	54	72	36
	4. Legal Services	100	150	135
	5. Land Management	45	60	30
	6. Independent Cost Estimate Review		500	
	Subtotals	1,361	2,137	844
	TOTAL (Apr 1982 - June 1984)			4,342

SECTION 4. LOGISTICAL PLAN

Section 4

LOGISTIC ASPECTS OF CONDUCTING THE PROGRAM OF STUDY

Introduction

This section describes the logistical problems inherent in conducting the program of study and our current best judgement regarding means for dealing with these problems. We have reviewed the publication "Stipulations for Temporary Use Permit AK-017-9025, Susitna Hydropower Feasibility Study (March 1979)" and our logistical support program is designed to assure compliance with these stipulations as well as being sensitive to the desires of local residents. A detailed "Plan of Operations" will be prepared and submitted to the Bureau of Land Management for approval prior to initiation of field activities.

The major logistical support problems expected relate to the following factors:

1. Remoteness and inaccessible nature of the project area;
2. Compliance with land-use stipulations;
3. Lack of existing communications network; and
4. Potential severe weather conditions.

The following paragraphs describe proposed means for: (a) establishing a project area base camp; (b) developing a reliable communications network; (c) meeting the in-field requirements of project personnel; (d) providing transportation from Anchorage to the base camp and from the base camp to more remote areas within the basin; (e) transporting and maintaining drill rigs; (f) assuring emergency evacuation capability; (g) providing safe fuel handling; and (h) developing and maintaining an effective system for managing and administering logistic operations.

An overall cost estimate for logistic support has been developed based on our understanding of logistical problems and requirements, discussion with individuals experienced in field-support requirements in cold-weather environment, and preliminary contacts with suppliers.

Base Camp Sites

There is an existing facility known as High Lake Lodge located approximately seven miles north-east of the Devil Canyon Dam site, and two miles north of the Susitna River. The High Lake Lodge can immediately accommodate 20-25 persons and upon notice, expansions can be completed to house up to 50 persons.

There is another existing facility know as Tsusena Lake Lodge located approximately seven miles north of the Watana Dam site. This lodge can accommodate more than 40 persons with the main facility and ten cabins.

Both lodges would provide rooms, housekeeping, and catering service. Both of these lodges have a lake that can be used for landing pontoon-equipped planes. High Lake Lodge has more facilities and would make a more desirable base camp. These two camps could handle a total of 90 people assigned to field work.

A proposal has been offered by Cook Inlet Region Incorporated/Holmes and Narver (CIRI/H&N) to provide a new base camp and a variety of support items as follows:

1. Design, procurement, and construction of a base camp at the Watana site in the Fog Lake area to have a peak capacity of 75.

2. Design and construction of a 3,000 foot airstrip in the base camp area capable of accommodating a Twin Otter type aircraft, assuming that a strip can be bulldozed easily.

3. Design and construction of a helicopter pad in the base camp area.

4. Operation and maintenance of the base camp.

5. Overall logistic support for all field operations.

6. Permitting for all field activities.

The CIRI/H&N proposal assumes that the land for the camp and attendant facilities will have been conveyed to Alaskan Native

Organizations. The proposal provides for operation of the camp from April 1980 (contingent on lead time of 90-120 days for procurement) through February 1982.

The relative merits and economics of utilizing the above base camp possibilities - or combination thereof - will be discussed with APA to determine the optimium selection for the phases of our proposed Plan of Study plus possible future work.

The budget estimate assumes the use of existing facilities and does not include the cost of a new camp.

The Susitna River Basin covers an area approximately 125 miles long by 100 miles wide. Thus it might be expedient to have advanced camps at outlying areas. These could be tent camps that would be used for short periods of time but only during the summer months.

Communications

The only suitable means of communications in the study area is by radio. The communications setup will enable radio contact between the base camp with each field party, and to planes and helicopters. Any outlying camps also will require facilities for communicating to the base camp. Each field party must have radio communications, especially to cover any emergency situation that might arise.

On-site "Project" or long haul "to Anchorage" communications can be accomplished using either HF-SSB (high frequency single side band) or VHF-FM (very high frequency-frequency modulation).

Licensing

HF Communications. HF Communications can be readily licensed as an Alaska public fixed service. Application is made to the Federal Communications Commission on FCC Form 503 "Application for Land Radio Station License in the Maritime Services". Licensing takes approximately eight weeks to accomplish.

VHF Communications. This equipment can be licensed as a special industrial service. Application is made on FCC Form 400-10 "Public Safety, Industrial, and Land Transportation Radio Services and Class A Stations in the Citizens Radio Service". This action takes approximately 12-18 weeks.

Requirements of Field Personnel

Clothing

Because of topographic and climatic conditions, it will be necessary to outfit field personnel with high-quality outdoor clothing. Of primary concern is cold-weather clothing for winter field work, including down parkas and coveralls, mittens and gloves, and arctic boots to insure field personnel comfort and safety.

Training of Personnel

Base camp training will be provided to acquaint arriving personnel with the field study operations plan, first aid techniques and use of first-aid equipment, use of radio equipment, and winter survival techniques.

Personnel Protection -- Firearms.

Generally firearms are not required. Should marauding animals be noted or become a nuisance, assistance can be obtained from the lodges or from the Alaska Department of Public Safety, Fish and Game. If a continuing problem arises, firearm training and safety can be carried out at the base camp lodge.

Survival Gear

First aid kits, survival rations, emergency shelter, and arctic sleeping bags should be kept at each remote work site in the event weather conditions strand a crew.

Winter Care and Training

Films on winter dress and frostbite safety are available in Anchorage either from the University of Alaska film library or from Pictures, Inc. Four hours should be programmed for orientation and for personnel to be outfitted before they begin field activities in severe weather conditions.

Transportation

Transportation To And From Base Camp

Field personnel would be flown by small plan from Anchorage to the base camp. During the months of June through September, when a large number of people will be working in the field, a twin Otter airplane will be scheduled to fly as needed from Anchorage to the base camp to rotate personnel and for supplies and equipment to be flown to the base camp.

The base camp will have airplane landing facilities that could be used during all seasons of the year. In the summer, a landing strip could be used for wheel-equipped airplanes. In the winter ski-equipped planes could land on a frozen lake, or packed snow. High Lake Lodge has a 2000-foot long runway and a lake for pontoon-equipped airplanes.

A small warehouse will be provided in Anchorage where equipment and supplies can be assembled prior to moving them to the base camp. The control of moving items into and out of the warehouse to the airplane for the flight to the base camp would be administered through the Resident Manager in the Harza Anchorage office.

Transportation Within the Basin

Transportation within the basin will vary depending on season. During winter months, short-distance travel from the base camp can be made using snow mobiles which can be used safely without damage to tundra. For longer-distance travel during winter helicopters would be employed. During summer more care must be taken in ground transportation to avoid potential damage to tundra. In general, summertime travel would be via helicopter and on-foot.

Air Transportation

Both fixed-wing and rotary-wing air support are available from either Anchorage or through Talkeetna. Fuel is available in Talkeetna or can be carried to the base camp in 55 gallon drums. The field camp will include capacity for crew support and housing, whenever operation is away from their home base.

Fixed wing aircraft operate out of Anchorage or Talkeetna. Depending upon the base camp site selected, crew shuttle and resupply can be accomplished by fixed-wing aircraft. Wheeled, ski equipped, wheel/ski, float, wheel/float combinations are readily available. There are numerous operations with helicopter service out of Anchorage. Talkeetna also is able to support helicopter service. Heavy or awkward loads can be trucked to Talkeetna and taken into the project area as a sling load. Talkeetna is about 30 minutes flying time from the work area but is prone to be closed to project access during bad weather.

The charter helicopter pilots can fly a total of only 8 hours in any 14 hour period per FAA regulations. For each helicopter one ground crew member is normally needed. If three helicopters are working out of the same base camp, only two ground crew members will be required.

Sea Airmotive Inc. of Anchorage was contacted to obtain estimated costs for helicopter operations in the project area.

For budgeting purposes we have estimated that 4,600 hours of helicopter time and 2,300 hours of fixed wing aircraft time will be required to support the study and data collection programs.

Ground Transportation

Ground transportation will be difficult year-round until permanent roads are built. Most movements of field crews and equipment will be by helicopter unless the distance is very short.

Movement and Maintenance of Drill Rigs

Drilling equipment can be moved into the area by breaking it down into manageable pieces and moving it by helicopter. In winter the drilling equipment could be moved over the snow pack to locations where it would be used at a later date. Supplies for the drilling rigs would be moved in by helicopter.

The crews that would be working on the drilling rigs would need to be furnished with floodlights so that they could work during the months with a small number of daylight hours. This would require that the rigs be equipped with small generating plants. The men should have small portable shelter during winter drilling operations to provide protection from the wind and cold weather. Skid mounted units to be used for a bunk house, a kitchen and a dining facility will be provided at the drill site.

To maintain the drill rig equipment, a mobil maintenance shop will be established at the base camp. In cold weather operations equipment is prone to breakdown with greater frequency than during warm weather. Therefore, the maintenance shop will be a vital link in keeping drilling operations moving on schedule. Transporting items to be repaired and returning them to the drill rigs would be accomplished by means of helicopter or snowmobile.

Emergency Evacuation

Detailed plans will be developed to assure effective personnel performance during in-field emergency situations such as injuries, sickness, and fire. Training of personnel in first aid care, radio operations, and survival techniques will help to assure that injuries are minimized

To assure that the base camp has as much medical emergency support as can be provided on a realistic basis, a paramedic will be employed, who will also handle the radio communications and dispatch activities. Thus if any emergency is reported from the field he will be on hand to give immediate first aid. A backup radio operator will be provided for times when the regular operator is off duty. Evacuation of any injured person from the field would be done by helicopter directly to the hospital in Anchorage.

Precautions also must be taken in the event of a fire at the base camp. Both the High Lake Lodge and the Tsusena Lake Lodge have bulldozers with blades that can be used in case of fire. A

storage of survival supplies will be provided for use in the event of a serious fire or other emergency. This storage would consist of food, utensils, clothing, tents, sleeping bags, and medical supplies. The storage site would be located some distance from the immediate camp sites and would be used only for emergency situation.

Fuel Purchase, Storage, and Handling

Fuel is available in Anchorage or in Talkeetna from bulk distributors. Fuel for work and camp use can be flown (in 55 gallon drums) to the base camp or the work locations. Fuel can be stored at the base camp in bladder tanks. These tanks are fire-safe and sturdy enough to avoid potential leakage that could cause adverse environmental effects. In the winter fuel could be flown by a Hercules aircraft, landing on the frozen lake and off-loaded to bladder tanks. In this manner the fuel requirements for the summer's operation could be brought in when the demands on helicopter time is less.

Management and Administration of Logistical Support

The management and administration of logistical support will be performed by two key individuals: a field coordinator based in Anchorage and a camp coordinator/radio operator/dispatcher at the base camp. The coordinator in Anchorage will report directly to the Resident Manager and will be responsible for subcontract administration and all logistical support activities. The camp coordinator/radio operator/dispatcher will have responsibility for day-to-day field operations and for the well-being of the field personnel.

SECTION 5. DESCRIPTION OF ACTIVITIES

Section 5

DESCRIPTION OF ACTIVITIES

This section presents a brief description of the technical and environmental investigations and studies leading to an FERC license to construct and operate the Initial Susitna River Project. A detailed description of the activities is presented in Volume II of this Plan of Study.

Previous discussions have indicated a three-phase approach is proposed to obtain a license from the FERC. Phase I will be a Basin Planning Study to identify the optimum development plan for the Upper Susitna Basin and to select the most favorable Initial Project. Phase II will consist of the detailed Feasibility Study of the Initial Project. Phase III will be the preparation and submittal of the FERC License Application. The support of the license application during the FERC review and hearings until the license is granted is not included in the Plan of Study but budget allocations are made for these activities. The environmental studies closely parallel the engineering studies but they are more continuous because they must develop baseline data to provide a basis for evaluating the impact of the project on the existing conditions. Because they are more continuous they are described in one section. The following summary describes the proposed technical activities in three phases and then discusses the environmental activities.

PHASE I - BASIN PLANNING STUDY

A Basin Plan for hydropower development of the Upper Susitna Basin will be developed during this phase and compared with non-basin alternatives for meeting power system load requirements. In so far as possible, the planning studies will be based on available data that have been collected and used in previous reports, primarily by the Corp of Engineers. It will be necessary to review and evaluate the data to assure full development of the Upper Susitna River resource, while at the same time providing projects that are scaled to meet market requirements and are environmentally acceptable. Where necessary, additional information will be collected; particularly geotechnical data, aerial photos, and topographic maps relating to the project layouts that will be prepared for the potential sites along the Susitna River. It will also be necessary to update basic information that is available for power markets and

other aspects. Environmental data collection programs will be required to adequately address the issues raised by the Governor's Devil Canyon Task Force.

Several alternative basin plans will be formulated. The alternative plans will comprise a series of dams sized to develop the total resource. The plans will be formulated, within identified constraints including geotechnical, environmental, power market and financial. The alternative plans will comprise integrated developments at two or more sites with staged development. Connecting transmission facilities also will be a part of the plan.

Previous studies by Kaiser, the USBR and particularly the Corps of Engineers will be reviewed and compared with alternative schemes that appear reasonable. The data collected for the previous studies has been very useful in formulating this POS and will be used for the preliminary studies to the extent possible.

Preliminary Plan Layouts

Preliminary layouts of major features will be made to provide a basis for initial field investigations and for preliminary cost estimates. The layouts essentially will consist of a general design and sketches that define hydraulic dimensions, structural dimensions, foundation treatment, and electrical and mechanical equipment. Preliminary cost curves for dams (height vs. cost) and powerplants (installed capacity vs. cost) will be made for each site considered.

The preliminary layouts will be based on available data. The initial step in planning layouts will be to define general design and planning criteria necessary to bring all layouts to a consistent level for comparison and evaluation. Four main areas will be addressed: geotechnical; hydraulic and structural dimensions; transmission requirements; and mechanical and electrical equipment.

Geotechnical Investigations. The preliminary geotechnical investigations necessary for making plan layouts will cover four main areas: foundation conditions at each site; reservoir conditions; construction materials availability; and seismicity studies.

Site investigations will be made to determine the type of rock available for founding different types of structures. In

this regard, it will be necessary to determine the structural characteristics of the foundation, including the orientation of the bedding, joints, and faults with respect to proposed structures.

The reservoir investigations will evaluate the ability of the reservoir to hold water and the effect of submergence and draw-down, resulting from reservoir operation, on the stability of the slopes forming the reservoir.

The construction materials investigation will be performed to assess the availability of construction materials for the types of structures that are planned.

The geotechnical investigations will include a detailed seismicity study by Woodward-Clyde Consultants to evaluate seismic risk associated with each project and to provide preliminary design criteria.

Hydraulic and Structural Dimensioning

The hydraulic and structural (concrete and embankment) dimensions of the major project components (dams, spillways, low level outlets, penstocks, and power stations) will be determined. Structures will be sited to conform to topographic and geologic features. Configurations of components will be selected and major dimensions will be determined. The dimensioning will form the basis for quantity takeoffs and cost estimates for development of cost curves.

Transmission Connection

Preliminary transmission routes will be planned to connect power generated at the site to the transmission system. If the load centers at Anchorage and Fairbanks are not interconnected when the project is built, the project transmission lines will provide the interconnection between the two major load centers. Cost curves (transmission distances vs. cost) for varying line capacities will be developed from existing data and studies. Separate cost curves also will be developed for substation and switching structures and equipment.

Electrical and Mechanical Equipment

Required sizes of turbines and generators will be estimated to meet alternative plan requirements, based on the anticipated heads and flows. Other power plant equipment will be estimated based on existing data and previous reports. These will be used to help develop power plant cost curves. Other equipment such as gates and remote control equipment will be sized to meet project requirements based on experience with similar projects.

Hydrology and Operation Studies

To properly define and evaluate these alternatives, hydrologic and power operation studies must be undertaken as part of the plan formulation process. All the necessary hydrologic studies will be based on available data. These studies will include determination of the monthly flows at each proposed power site. This information will provide the basis for calculating the energy that can be generated to serve system requirements. Studies will be made to determine the magnitude of floods that must be discharged during the construction of the project, and during the operation of the project. Available data on sediment will be used to determine the effect on the long term operation of the projects that will result from reservoir sedimentation. The hydrologic studies will be scheduled early in the study program in order to provide the basic information for determining the reservoir volumes necessary for regulating the flow of the river and for establishing the installed capacity of the power facilities that relate to the energy generation and the power market requirements.

The power operation studies will be made using a mathematical model that has been prepared for analyzing multi-project schemes similar to the Susitna River development. The model calculates the power and energy generation capability of each project in response to system load requirements. The calculation is based on streamflow records, reservoir storage, and the hydraulic head on the powerplant. It accounts for headwater and tailwater variations, hydraulic losses, and equipment efficiency. The operation study results will give the firm and secondary energy generation and the dependable capacity of each powerplant.

Power Market Studies

Phase I will include the definitive studies of power market and alternative sources of generation. This scheduling will contribute to the evaluation of alternatives in Phase I but is intended primarily to assure the availability of these completed studies at the beginning of Phase II. Power market projections, alternative sources of generation, and alternative fuels are expected to be among the areas of interest and comment by the public. A related item to be included in Phase I is the development of the detailed methodology for the Phase II studies of power system expansion and operation, which will include the economic dispatch program and estimates of system generation cost.

Cost Estimates and Construction Scheduling

Preliminary cost estimates will be made for each alternative plan. The estimates will include costs of access roads, project elements at the dam site, transmission lines and substations, diversion during construction, and land. Costs of works to mitigate any adverse environmental affects will also be included, if appropriate. Allowances for contingencies and engineering will be included.

Cost of major project elements will be estimated primarily from preliminary designs, quantity estimates, and unit prices. Unit prices will be developed for the major construction items considering labor and equipment rates, rates of work, and other factors taking into account the construction conditions in severe weather. For example, embankment costs will be based on the time limits for placing earthwork, and concrete costs will include provision for maintaining required temperatures when the ambient temperature is low. Costs for minor construction items and equipment will be estimated from similar work that has been done with adjustments to reflect local costs and construction conditions.

A preliminary construction procedure and schedule for each alternative plan will be estimated. A major consideration in selection of the initial project will be the extent to which the project construction procedures and schedules can accomodate the severe weather conditions.

Preliminary Economic Analyses

Preliminary benefit estimates will be made for each alternative plan and will include capacity and energy benefits. Preliminary benefit values in $/kw, $/kw/yr, and $/kwh will be selected from available data and ongoing studies. The unit benefit values will be combined with power and energy output determined from the power operation studies.

An initial screening of alternative basin plans will be made utilizing all available engineering, economic, and environmental information, and a matrix of alternative plans will be developed. During this initial screening, economic factors will be used to identify and eliminate alternatives that are totally infeasible or significantly less feasible.

A preliminary estimate of economic viability of alternative plans will be determined using internal rate of return (IRR) analysis. The analysis consists of comparing the present worth of costs and the present worth of benefits. Annual O&M costs for the hydropower projects will be estimated using previous work. Computations for the IRR analyses will be performed using a computer program adapted from programs already in use at Harza. It is anticipated that the results of the IRR analysis will indicate two or three favorable sites and stagings.

The Susitna Projects will be compared to alternative sources of generation and to a load management alternative to determine if a Susitna Project is justified and if it is favorable enough to proceed with detailed studies. The cost of generation from a thermal alternative will be evaluated independently by a Consultant that specializes in thermal power design. This POS includes a program recommended by Fluor Power Services Inc. for evaluation of thermal alternatives.

Preliminary Financial Evaluation

The financial requirements of the alternative basin plans, and particularly for the Initial Project will be evaluated in relation to the financial capability of the power users. The evaluation will be a major consideration in selecting the Initial Project.

Report

The Phase I studies will culminate in the preparation of a Basin Plan Report which will identify the plan of development best adapted to make optimum use of the Susitna resource and select an initial project which is economically attractive, environmentally acceptable and financially feasible.

PHASE II - FEASIBILITY STUDIES

Introduction

Phase II engineering studies will be performed to establish the technical, economic, and financial feasibility of the Initial Project selected in Phase I to meet requirements of the FERC License Application. It is anticipated that the Initial Plan will comprise the first development at one of the sites. The major work items of Phase II will include:

Hydrology Studies

Geotechnical Investigations

Project Layouts

Transmission System

Construction Cost and Schedule

Power System Expansion Program

Economic Analyses

Financial Analyses

Hydrology Studies

The hydrologic analyses for the Phase II study will involve: (a) a detailed evaluation of long range water supply through stochastic analyses; (b) the determination of design and diversion floods through refined PMF and flood frequency analyses; (c) a refined estimation of reservoir sedimentation and an evaluation of potential downstream degradation; and (d) the development of the tailwater rating curve for the selected site or sites, development of water surface profiles for affected downstream areas, selected modeling of water quality parameters,

and preparation of pertinent exhibits for the license application.

Geotechnical Investigations

Feasibility stage investigations involve completion of detailed geologic surface mapping and preparation of geologic sections to demonstrate the subsurface site conditions inferred from appraisal studies. The subsurface exploratory work is laid out to satisfy geotechnical requirements, such as establishing stratigraphic correlation, presence of major faults or shear zones, continuity of surface features at depth, depth of weathering, sound rock horizon, and ground water conditions. The investigations will provide data to analyze the strength and stability of structure foundations and to determine the stability of the reservoir slopes. The availability of suitable construction materials are also an integral part of this study. A limited amount of geotechnical study will be required for access roads and transmission tower foundations.

It is known that the Susitna Basin is located within a highly seismic region. The seismicity and tectonics of the region are under study but are not yet well understood. Therefore, considering the importance of the Susitna Basin Development to the region and the large investments involved, this aspect of the project planning and design deserves special attention.

Project Layouts

The Phase II studies of the project structures and equipment will consist, in general, of the refinement and preliminary design, at the feasibility level, of the initial project selected in Phase I. The detailed content of the Phase II studies will of course depend on the type and size of structures and stages of construction of the selected project. We assume for present purposes that the initial project could be either a fill or concrete dam scheme. The principal areas of study and some of the detailed considerations will be as follows:

Access and Relocations

Access to the sites of the project structures for construction and operation purposes will be studied at the feasibility level, with the aid of additional topographic and geologic studies as required.

Dam and Reservoir

The selected project scheme will be developed in greater detail on the basis of the geotechnical, hydrologic, and topographic data as they become available. The selection of the type of dam and general project arrangement from the pre-feasibility studies in Phase I will be reviewed as necessary.

The normal reservoir elevation will be optimized, within a range of elevations defined by the Phase I studies, on the basis of the power economics of the initial project and its relation to upstream and downstream projects.

The spillway layout will be revised to accomodate the project design flood as developed in the Phase II hydrology studies and studied to provide safe operations under all operating conditions.

The scheme for diversion during construction will be developed to provide an economical but adequately safe solution, taking into account the degree of risk associated with the types of structures selected, as between concrete or fill dams and surface or underground powerstations, including the risk of delay in timely completion of the project.

Power Facilities

The power generating facilities, consisting primarily of intakes, water conductors, powerstation, and switchyard will be studied in detail for a range of plant capacities and initial project reservoir elevations. A preliminary design at the feasibility level will be prepared for the selected initial installation. The planning will include the possible later expansion of the plant when needed.

The intakes for the underground powerstation scheme may be in the concrete dam or in a separate intake structure with either type of dam. The latter arrangement may result in some increase in tunnel length but with some advantages in simplicity of design and construction. The intakes will be of the multi-level type, to permit plant discharges to be drawn from selected reservoir elevations in accordance with environmental requirements.

The permanent operating facilities for the project, including control facilities, maintenance and support facilities, and housing and community facilities for the permanent operating staff will be included in the overall plan of development from the beginning of the feasibility study.

Transmission System

The Phase II transmission studies will deal, at the feasibility level, with the transmission lines and substations associated with the initial Upper Susitna Project. This work will consist primarily of the refinement of the studies made in the basin planning study. The system is assumed, for desciptive purposes, to consist of a 230 kV line from the initial project to the substation on the line between Anchorage and Fairbanks and routes from the substation to these two load centers.

Construction Cost and Schedule

Cost estimates of selected features and alternative project schemes will be prepared during the feasibility study. These estimates will be used for the optimization of project features and the final selection of the project elevation,capacities, and stages of development.

Construction procedures and associated schedules needed for severe weather conditions will be studied in detail to identify areas that are susceptible to problems. CPM analyses will be made to determine the effects that schedule changes would have on construction costs.

The unit prices for all significant items of civil works will be estimated by the contractor's cost method. The required labor, equipment, supplies, and rates of production will be estimated on a basis consistent with the constructibility analysis and the adopted construction schedule. These items will be priced using the latest labor, equipment, and materials costs based on prevailing conditions in Alaska.

The construction schedule will be based on detailed analyses of the methods and procedures and required quantities for the major features of the project, taking into account the aspects of cold weather logistics, environmental constraints, materials supply and control, manpower and equipment requirements and availability, and the sequence of construction operations.

Power System Expansion Program

Two expansion plans will be developed to meet the future power requirements of the Railbelt area, one with the Susitna Project and the other without. The expansion plans will be developed taking into account projected power demands, construction lead times, possible interconnections between the three power market areas (Anchorage, Fairbanks, and Glennallen-Valdez), and FERC licensing requirements. The timing of the generation and transmission additions will be established so that there will be sufficient energy supply to meet the forecasted demand including reserve requirements at all times. The most probable load forecast will be used for the expansion programs, but the sensitivity of the programs to the high and lowload forecasts also will be studied. Energy generation studies for the entire system will be made to optimize the operation of the Initial Susitna Project. The operation studies will provide the basis for contracts to supply power and energy to the utility systems.

Economic Analysis

The alternative power system expansion plans will be evaluated on the basis of benefit-cost analysis.

In the analyses, "cost" will include all costs associated with the development and operation of the hydroelectric projects; "benefits" will be based on the alternative costs of producing power and energy with alternative generation sources. The benefit-cost ratios are computed using two methods:

(1) a normalized cost analysis based on the annual cost of producing power and energy from the hydroelectric projects and the other alternatives at fixed price levels.

(2) a life-cycle evaluation based on the actual worth of expenditures required for the initial construction of the projects and alternatives and for operation over their service lifes.

Financial Analysis

All financing plans available for the development of the Susitna Project or any other alternative will be reviewed. Contracts and meetings will be held with Alaska Power Authority, government agencies, local electric utilities, and private interest groups to obtain information on their financing abilities. Potential financing plans will be reviewed with a financial consultant to assure the project is designed in a way that will enhance its funding. An analysis of the various plans will be performed.

Feasibility Report

A feasibility report will be prepared to document the technical, and financial feasibility of the projects; its safety; and environmental and social acceptability. The feasibility report will consist of a summary report and several supporting appendices.

The appendices will include sufficient information to allow experts in the various disciplines to substantiate the soundness and accuracy of the conclusions and recommendations presented in the main report. There will be sufficient basic data included to establish project dimensions. The appendices will include descriptions of the methods of investigations and analyses used.

PHASE III - FERC LICENSE APPLICATION

The preparation of an application for the Federal Energy Regulatory Commission will constitute Phase III of the engineering and environmental studies. The basic studies required for the preparation of the license application will be done in Phase II, and those studies will be planned from the beginning to meet the requirements of the license application. The preparation of the license application is planned to overlap the final work on the feasibility report by about three months, and it will begin at such time as APA decides, on the basis of the feasibility study reaching completion, to authorize the preparation of the application.

The requirements for preparation of the technical exhibits have been considered in the preparation of the Plan of Study. Informal discussion with the FERC staff and other appropriate agencies will be initiated at the beginning of Phase I, and continuing contact with these officials will be maintained so the study team will bee aware of the deal with items of concern to the FERC and other agencies regarding the license application.

Harza will be responsible for preparation of the technical and environmental portions of the license application, subject to APA review, and for the assembly of the completed application. APA will be responsible for certain other exhibits, with assistance from Harza if requested.

The exhibits now required for an FERC License Application are listed in Volume II, with a brief indication and their content and the organization responsible. The environmental exhibits R, S, V, and W are listed in their present from, although we understand that the FERC plans to combine them into a unified environmental exhibit.

ENVIRONMENTAL STUDIES

The environmental investigations for the Susitna Project will include interrelated studies in six distinct areas and will be carried out continuously throughout Phase I, II and III.

Human Ecology and Socio-economic Considerations

Aquatic Ecology (including water use and water quality)

Terrestrial Ecology

Historic and Archeologic Resources

Recreation Resources

Land Management and Aesthetics

These areas closely parallel major sections of the environmental report that will have to be filed as part of the FERC License Application.

The following paragraphs briefly describe the purpose and scope of the tasks to be performed under each of these areas of expertise. Details regarding methodologies and the interrelatedness of specific tasks and sub-tasks are provided in Volume II.

Human Ecology

The Human Ecology Studies have been designed to provide information for project planning purposes on population and economic conditions in the Railbelt area and anticipated growth with and without the project. They will also provide information on present and future life-styles as they relate to the project and potential project impacts. This information will be utilized to assist in the development of reliable future electrical load projections for the potential market area for the project, for development of strategies for minimizing impacts during project construction, and for evaluating unavoidable residual impacts. Consideration will also be given to the timing of the project, in relation to other major construction work (e.g., the gas pipeline), so as to determine possible effects on Alaska's tendency towards "boom and bust" economic cycles.

Identified tasks include:

Electrical Consumption Patterns. Conduct a survey of significant social and economic sections which are broadly representative of larger consumer groups in the Anchorage, Fairbanks, and Glennallen-Valdez power market areas so as to identify present and anticipated future electrical consumption patterns with and without system expansion.

Population Projections. Develop independent population projections for the power market region on the basis of available secondary data and cohort-survival projection techniques. Expected increase in population of each consumer sector identified in Task S-1 will permit projection of high, most likely, and low load demand forecasts for the area. Results from these tasks will also provide valuable information for dissemination and discussion through the public participation program.

Socio-economic Characteristics. Assess social and cultural values, economic conditions, and life-style goals of the inhabitants of Talkeetna and other portions of the Matanuska-Susitna Borough that may be impacted by project construction. Results of this assessment will be utilized for identification and minimization of potential construction impacts and for making the public participation program responsive and relevant to Borough concerns and values.

Social Impacts. Calculate the magnitude, intensity, and duration of project impacts on the human ecology of the area. Special attention will be paid to unavoidable impacts, such as

any displacement of people, changes in health, safety, and social welfare conditions, and changes in cultural values and life-styles. Similarly, any irreversible or irretrievable commitment of human resources stemming from the project will be detailed.

Aquatic Ecology

Baseline aquatic ecology studies have been conducted in the Susitna Basin by ADF&G intermittently since 1974. The findings of these studies and recommendations for future investigations are contained in the ADF&G fishery report on the project dated March 1978. Continued collection of biological and physical data concerning the important aquatic resources to be affected by the project is essential to understanding and evaluating potential project impacts. The Aquatic Ecology Studies have been developed on the basis of the results of past investigations, the recommendations of ADF&G and the U.S. Fish and Wildlife Service, and extensive past experience of Harza's aquatic ecologists with comparable hydroelectric projects in the United States and throughout the world.

The Aquatic Ecology Studies are divided into additional baseline data gathering programs and an integrated assessment of the resource and potential project impacts on the resource. Geographically the studies are divided between riverine and estuarine ecosystems. In addition, aquatic impacts will be assessed for locations where transmission line right-of-way clearing and line construction will occur in the vicinity of rivers and streams.

The aquatic ecology investigation programs outlined in the following paragraphs will be undertaken prior to submittal of the license application for the project. Similar programs to study specific impacts and management measures will be continued following submittal of the application.

Water Quality. Determine baseline water quality characteristics of the Susitna River in and downstream from the project area. Long term water quality sampling stations will be established to provide information required for the evaluation of the aquatic habitat and for prediction of changes in water quality resulting from project construction and operation. In addition, intensive sampling programs will be carried out over shorter periods of time in conjunction with specific aspects of the fisheries, instream flow, ice formation, and aquatic modeling studies.

Physical Parameters. Identify and evaluate other physical parameters affecting aquatic habitat quality. In addition to water quality, physical parameters such as depth, current velocity, bedload movement and sedimentation are important determinants of aquatic habitat quality. Critical habitat areas and areas of high use or high productivity will be identified and their physical parameters measured in conjunction with studies on aquatic invertebrate and resident and anadromous fish populations.

Instream Flow Studies. Develop instream flow study methodologies suitable for use in the Susitna basin, including probability of use curves for resident and anadromous fish. This fisheries habitat evaluation technique, appropriately refined to reflect Susitna conditions, can play a major part in the assessment, comparison, and screening of potential project impacts on aquatic habitat quality and quantity and resultant effects on fish populations.

Aquatic Plants. Identify and describe distributions of principal aquatic plant species. Aquatic vegetation can be a major component of the aquatic habitat for invertebrates and fish. Quantitative data on aquatic vegetation will be developed for critical habitat areas, particularly backwater slough salmonid rearing habitat.

Invertebrates. Identify and characterize invertebrates that are important to fish populations with special attention to rearing success of juvenile salmonids. Qualitative and quantitative surveys of planktonic, nektonic, and benthic invertebrates will be carried out in the mainstem river and important tributaries and backwaters. Efforts will be concentrated in those areas identified as important to rearing of juvenile anadromous fish, although habitats important to resident fish populations will also be surveyed.

Anadromous Fish. Characterize anadromous fish movements and critical habitat areas that may be affected by the project. Adult and juvenile migrations will be characterized and critical habitats identified. Estimates of the numbers of fish using these areas at various stages of their life cycles will be made. Knowledge of the requirements for maintenance of these critical habitats will permit evaluation of project-induced impacts.

Resident Fish. Determine abundance, seasonal distribution, movement, significant life history requirements, and critical habitat areas of resident fish species. This work will be carried out in conjunction with similar studies of anadromous

fish, and will include areas both upstream and downstream of potential damsites.

Estuarine Studies. Characterize estuarine dynamics, and water quality, anadromous and resident fish populations and commercially important invertebrates in the Upper Cook Inlet and the influence of the Susitna River on the Inlet and on these resources. Once estuarine dynamics have been characterized, data derived from the riverine studies will be used to determine the extent of the river's influence on the estuarine system.

Fishery Economics. Develop a program to characterize the economic importance of commercial and sport fishing in Upper Cook Inlet and the contribution of Susitna stocks to these fisheries.

Limiting Factors. Integrate baseline information on the physical and chemical parameters and biological components of the various types of fish habitat, and analyze identified food chains, energy dynamics, and habitat/fish population relationships. This integration and analysis will identify the key habitat factors that limit fish population sizes. Limiting factors will be characterized for each important fish species for areas of the Susitna Basin and estuarine zone to be affected by the project.

Evaluation of Alternatives. Anticipated alterations in fish habitat related to each project alternative and component alternatives will be determined, as will the magnitude of resultant impacts and their economic effects. During this identification, assessment and comparison process, the initial concepts for some project components may be modified in order to reduce impacts, and alternatives or component concepts with unacceptably severe impacts will be excluded from further consideration. Following selection of the final, smallest-impact project system, recommendations will be made to reduce those residual adverse impacts that are unavoidable.

Reports. Draft reports summarizing aquatic studies, impact assessment, and mitigation recommendations will be prepared and submitted to APA, ADF&G and other fisheries agencies. These revised reports will then be incorporated into the FERC license application.

Terrestrial Ecology

Studies conducted to date by the Alaska Department of Fish & Game and the U.S. Fish and Wildlife Service have identified potential impacts on several wildlife species that reside in the project area, use the area for migration or other seasonal

purposes, or use habitat downstream which may be altered by changes in river flows. The following individual work tasks have been developed as an integrated program to supplement the available baseline information, undertake the detailed biological studies needed to fully assess project impacts on terrestrial resources, provide a basis for programs for minimizing or mitigating adverse impacts, and prepare a comprehensive report on the relationship between the project and existing and future terrestrial resources of the area.

Vegetation Mapping. Prepare vegetation/habitat maps of the project area. Vegetation maps of most of the requisite areas have been prepared as parts of broader, multidisciplinary studies cooperatively being conducted by State (DNR) and Federal (BLM, SCS, NASA) agencies and the Geophysical Institute of the University of Alaska. Data gaps and inconsistencies in mapping systems will be identified and resolved so as to provide habitat classifications and base maps that can be utilized for the other terrestrial ecology tasks.

Wetlands. Identify type, distribution, and major species composition of wetlands in the study area. Section 404 of the Clean Water Act and Executive Orders 11990 and 11990 require special consideration of wetlands and floodplains in assessing the impacts of proposed activities which may alter or destroy wetlands. Data on wetland identification and classification will be derived and field checked as one aspect of Task T-1, Habitat Mapping. Results of these investigations will be utilized in evaluation of relative environmental acceptability of alternative development schemes and of impacts of the selected inital project.

Riparian Habitat. Characterize interrelationships between maintenance of willow/moose habitat in downstream floodplain and seasonal flooding characteristics. Riparian willow vegetation provides critical winter moose habitat. Alterations in the flows released from the project could result in changes in riparian vegetation and thus in a reduction in moose habitat and moose populations. Flow requirements for maintenance of preferred habitat will be determined by identifying historic high flow distributions and frequencies and successional stages of vegetation in affected areas. Investigations during subsequent years will evaluate mitigation and management measures necessary to minimize any adverse effects resulting from project-related alterations in downstream flow regimes.

Non-game Animals. Determine distribution and abundance of non-game vertebrate species in the study area. Almost nothing specific is known of the birds and small or non-game mammals of

the area. For the license application and discussion of project impacts, this information will have to be obtained. Extensive studies of bird species in the area will provide data for comparisons with the avifauna of better known comparable areas of Alaska. Sample sites in different habitat types found in the basin will be utilized for intensive study to provide data on bird and small mammal species composition and density and a basis for predicting faunal changes resulting from habitat alteration caused by the project. Observations on habitat use by big game, fur bearers, waterfowl, and raptors will also be made during these studies.

Big Game. Identify big game abundance, habitat utilization, movements, and species composition. Impacts of the project on moose, caribou, bear, wolf, and wolverine are major concerns of ADF&G. Extensive programs utilizing aerial census surveys and radio-tracking of marked individuals will provide an understanding of the populations of these species using the project area and subject to project impacts. This information, combined with data on habitat conditions derived from Tasks T-1 and T-4, will provide a basis for predicting the magnitude of anticipated impacts and for developing appropriate mitigation programs. Although these programs will be initiated shortly after authorization to begin work on the Susitna Project, it will be necessary that they continue for an additional one to three years following submittal of the license application. Anticipated impacts will be identified prior to license submittal, but the subsequent time will be required to obtain sufficient information to form a reliable basis for management programs during and following project construction. One aspect of these management programs will likely include mitigation measures to minimize identified impacts and these measures will have to be identified and evaluated as part of the continuing big game studies.

History and Archeology

FERC regulations, as well as state and federal law, require that the applicant provide a report on the historical and archeological resources in the project area and the impact of the project on those resources. The report must be prepared in consultation with the State Historic Preservation Officer and the U.S. Heritage Conservation and Recreation Service.

Because of the minimal quantity of data available on the cultural resources within the study area, the reconnaissance and intensive surveys developed for this study are of paramount importance in identifying cultural resources and providing the appropriate recommendations as required by law. These tasks

include, at a minimum: (1) Identification and documentation of cultural resources within project areas, and (2) a description of any measures recommended for the purpose of locating, identifying, and salvaging historical or archeological resources that would be affected by the project, together with a statement of the applicant's position regarding the acceptability of the recommendations and proposed programs for their implementation.

The proposed historic preservation efforts should be conceptually divided into (1) the effort necessary to obtain the license, (2) effort necessary to mitigate possible adverse effects during the course of the study essential to obtain the license, and (3) effort necessary to mitigate damage to all historic and prehistoric sites that will be impacted by the construction phase. Specifically identified tasks are:

Office Preparation. Conduct literature reviews, develop a specific research design and sampling strategy, and secure necessary permits. These are basic tasks needed for implementation of the history and archeology program. If not done in a timely manner, other project investigation tasks (e.g, geologic exploration) may be delayed. The study area for this initial task is defined to include three related but geographically distinct locations: a) Susitna River from Gold Creek upstream to Tyone Creek, five miles either side of the river; b) Susitna River downstream from Gold Creek to Cook Inlet to an elevation 100 ft above the floodplain or five miles either side (whichever is less); and c) alternative transmission corridors.

Reconnaissance Surveys. Conduct a reconnaissance level archeological survey of portions of the area covered in Task H-1 based on priorities determined by project planning activities. Highest priorities for field archeological study will be given to those areas to be disturbed by activities essential to meet licensing requirements (e.g., camps, test holes, access facilities, etc.). Within the areas selected for field reconnaissance crews will implement surface and subsurface sampling procedures in order to locate, document, and inventory historic and prehistoric sites that may occur in the area to be affected by the project. Results from these surveys will be utilized in evaluation of alternative developments and in planning of the selected initial project so as to minimize impacts.

Detailed Field Surveys. Conduct more intensive surveys in construction zones of the identified initial project so as to provide information necessary to delineate mitigation measures. Each identified archeological or historic site will be evaluated

and recommendations made as to required mitigating measures. On the basis of this work, a final report will be prepared in accordance with State and Federal regulations documenting the sites identified and a mitigation comment or recommendation for each.

Recreation Resources

The objectives of the Recreation Resources Study are to inventory and evaluate the recreation resources within the Susitna Basin for the purpose of assessing the impacts that hydroelectric development might have on them, and to determine the need for, and the types of additional recreational facilities that could be associated with Susitna hydroelectric development. This work will be responsive to the FERC requirements for a report on recreation resources. The report will be developed in consultation with the Division of Parks of the Alaska Department of Natural Resources, the Matanuska-Susitna Borough Planning Department, the U.S. Heritage Conservation and Recreation Service, and other local, state, and federal agencies.

Existing Resources Identify and describe existing recreation resources and facilities in the Railbelt Area and evaluate recreation resource potential and demand within the Susitna Basin. Much of this work will be done through review of previous studies and close coordination with state and local agencies. Study of the basin's opportunities and constraints for recreation activities will be done on the basis of such factors as physical site qualities, access, and population pressure. Impacts resulting from various alternative development schemes on the existing and potential recreation resources will be assessed.

Impacts. Assess recreational impacts resulting from the selected initial project and develop a recreation plan for public utilization of project lands and waters. The projected beneficial and/or adverse impacts of the project will be expressed in terms of physical effects on recreation resources as well as on visitor use. A recreation plan will be developed in cooperation with APA, the State Division of Parks and the Matanuska-Susitna Borough to enhance beneficial and/or mitigate adverse impacts.

Land Management and Aesthetics.

The FERC requires that a report be prepared on the management of land within the proposed project boundary and the protection of the scenic values of the project area. The report will be prepared following consultation with local and state zoning and land management authorities and federal agencies with

managerial authority. At the present time the land is under the jurisdiction of BLM. It is anticipated, however, that in the near future title may be transferred to the native village corporations of the Cook Inlet Region, Inc. Throughout the course of all planning activities, we will maintain close contact with both organizations to ensure that all needs and requirements are met.

Existing Resources. Inventory and evaluate the natural and scenic resources of potentially impacted areas of the Susitna basin for the purpose of comparing alternative development programs. Specific resources which contribute to the wildland character of the area will be identified and mapped in cooperation with other ongoing resource inventory tasks. Landscape types and scenic viewpoints and views will be noted. Impacts of various alternative development schemes on these resources will be identified.

Impacts. Assess the potential impacts the selected project might have on aesthetic and visual resources and identify measures to ensure that project works blend, to the extent possible, with the surrounding environment. Two computer programs utilized on comparable Harza projects will be utilized to provide a set of versatile, rapid, low-cost and objective techniques for evaluating the visual impacts of land use proposals before they are implemented. One or two iterations of this process will permit the design of project facilities and transmission lines that have minimum impact on their natural setting.

SECTION 6. PROGRAM SCHEDULE

Section 6

PROGRAM SCHEDULE

Previous sections of this Plan of Study have described the three phases leading to a license application to the FERC to construct the Initial Susitna River Project. The entire program is scheduled for a 27-month period, as follows:

Phase I	- Basin Planning	January 1980 to September 1980
Phase II	- Feasibility	October 1980 to December 1981
Phase III	- FERC License Application	January 1982 to March 1982

The program is continuous with certain activities directed toward project feasibility beginning in Phase I and work on the preparation of exhibits for the FERC license application starting during Phase II. The overlapping of phases is done to reduce the overall time requirement. The phases are defined because the Basin Planning Studies and the Feasibility Studies lead to decisions to be made by the APA. The basin planning phase culminates in selection of the Initial Project and the feasibility phase will provide the basis for a decision to submit a license application to the FERC.

In each of the first two phases the study results will be summarized in a report that will provide the information needed by the APA for its decision, and can be used to inform the public about significant results. The studies are scheduled so there will be time to receive public comments and make appropriate adjustments in the program before major work items in the subsequent phase are committed.

As indicated above the Plan of Study is assumed to begin in January 1980. This is an important factor because the overall schedule is timed to make the most effective use of the seasonal weather conditions in the Susitna basin. The major mobilization and demobilization of the equipment is scheduled when there is snow cover. Office studies and field investigations are coordinated to make the best use of appropriate field conditions. Some of the geologic mapping in the canyons is scheduled in the early spring, before ice breakup, to facilitate access to certain areas. In order to accommodate this schedule it is important to have preliminary topographic maps along the river as early as possible. Based on discussions we have had with Mark Hurd Aerial Surveys about providing preliminary maps, we recommend the river

mapping be started by November 1979. The cost for this one work item should not exceed $50,000.

The work schedule is shown on Exhibit 6-1 attached. That schedule shows the major activities and the approximate time schedule for them to be done. Exhibit 6-1 also shows the FERC license application exhibits that will be prepared from the detailed studies. Harza will assist APA as necessary in preparing other exhibits relating to obtaining authority to construct the project.

The environmental portion of project investigations will reflect the three-phase effort, but will be more continuous because the data collection program continues after the POS is completed. All of the studies will initially consider a relatively extensive portion of the basin, but, as engineering programs focus on specific project formulations with identifable impacts, the environmental studies will become more restricted in area and more intensive in nature.

Throughout the basin planning study, information will be exchanged between the environmental scientists and the planning engineers. Toward the end of Phase I, interim reports will summarize available information in each of the environmental disciplines. Thus, essentially basinwide information will be available for use in the initial screening of alternative development sites, and more detailed information will be available for selection of the initial project(s).

The environmental studies will continue in Phase II, focusing on the initial project(s), in order to provide the data necessary to evaluate project impacts, to identify programs to mitigate these impacts, and to prepare the environmental report on the project for inclusion as one portion of the FERC license application.

Subsequent to submission of the license application, environmental efforts will continue in order to complete ongoing studies, to obtain data necessary to mitigate any identified impacts and to manage the resource during and following construction.

The studies outlined in this POS will require approximately 27 months (from the first of January 1980) for completion and submission of the environmental portion of the FERC license application. Since environmental studies will be continuing during FERC consideration of the application, we believe this program schedule will be compatible with the objectives and desires of the APA, ADF&G, and other interested agencies.

EXHIBIT 6-1

MAJOR DISCIPLINE OR PROGRAM	1980 JAN (1)	FEB (2)	MAR (3)	APR (4)	MAY (5)	JUN (6)	JUL (7)	AUG (8)	SEP (9)	OCT (10)	NOV (11)	DEC (12)	1981 JAN (13)	FEB (14)	MAR (15)	APR (16)	MAY (17)	JUN (18)	JUL (19)	AUG (20)	SEP (21)	OCT (22)	NOV (23)	DEC (24)	1982 JAN (25)	FEB (26)	MAR (27)
LOGISTICS	MOBILIZE FIELD CAMP, OBTAIN COMMUNICATION AND FIELD EQUIPMENT, CONTRACT FOR AIR TRANSPORT SERVICE.	FIELD CAMP AND AIR TRANSPORTATION WILL BE REQUIRED FROM APRIL,1980 TO NOVEMBER, 1981											MOBILIZE EQUIPMENT FOR FIELD INVESTIGATIONS									CLEAR EQUIPMENT FROM INVESTIGATION AREA DEMOBILIZE CAMP					
PHOTOGRAPHY, SURVEYING AND MAPPING	PREPARE 1:10,000 TOPO MAPS FROM EXISTING NASA PHOTOS			GROUND CONTROL	AERIAL PHOTOGRAPHY FOR RIVER MAPPING		PREPARATION OF RESERVOIR MAPS AND DAMSITE MAPS		CHANNEL SURVEYS								AERIAL PHOTOS AND CONROL FOR ACCESS ROAD AND TRANSMISSION		PREPARE MAPS FOR ACCESS ROAD AND TRANSMISSION LINE			PREPARE PROPERTY BOUNDRY MAPS			EXHIBITS F, J, K	
ENVIRONMENTAL DATA MANAGEMENT	FORMULATION OF DATA COLLECTION. COLLECTION PROGRAMS AND STANDARDIZATION OF FIELD DATA FORMS						ADAPT DATA FOR COMPUTER ANALYSIS AND DISPLAY						ASSIST WITH DATA ANALYSIS DISPLAY AND PREPARATION OF GRAPHICS														
TERRESTIAL ECOLOGY		INITIATE AERIAL CENSUS OF BIG GAME, ATTACH RADIO COLLARS, EVALUATE EXISTING VEGETATION MAPS		CONTINUE AERIAL CENSUS, CONDUCT VEGETATIVE AND SMALL VERTEBRATE STUDIES ALTERNATIVE					MAJOR EFFORT FOR RADIO COLLARING BIG GAME		AERIAL CENSUS AND RADIO TRACKING		WINTER VERTEBRATE STUDIES	COMPLETE RADIO COLLARING OF BIG GAME			CONTINUE VEGETATION AND VERTEBRATE STUDIES, AERIAL CENSUS AND RADIO TRACKING					CONTINUE RADIO TRACKING			EXHIBITS S, W	
AQUATIC ECOLOGY	OBTAIN EQUIPMENT, MOBILIZE FIELD TEAMS						ANALYSIS OF ALTERNATIVE PLANS																	PREPARE REPORTS				
		INITIATE FIELD STUDIES					RE-EVALUATE FIELD METHODOLOGY				MODIFY FIELD METHODOLOGY			DATA PROCESSING AND ANALYSIS													
RECREATION AND AESTHETICS					IDENTIFICATION OF PRESENT CONDITIONS AND EVALUATION OF PROJECT ALTERNATIVES													CONTINUE FIELD STUDIES					PREPARE DRAFT REPORT			EXHIBITS S, W	
HISTORY AND ARCHEOLOGY	PREPARE PRELIMINARY-OFFICE STUDY OF BASIN				INITIAL FIELD RECONNAISSANCE OF AREAS TO BE IMPACTED									IDENTIFICATION OF IMPACTS AND PREPARATION OF PLAN AND MITIGATION MEASURES												EXHIBITS R, V	
HUMAN ECOLOGY AND SOCIO-ECONOMICS		PREPARE SOCIAL ASPECTS OF LOAD PROJECTIONS		CHARACTERIZE SOCIO-ECONOMIC ASPECTS OF BASIN AND ADJACENT AREAS TO IDENTIFY IMPACTS AND EVALUATE ALTERNATIVES							ANALYSIS OF FIELD DATA					DETAILED ANALYSIS OF INITIAL PROJECT AREA AND PRELIMINARY ANALYSIS OF TRANSMISSION ROUTE					DATA ANALYSIS AND REPORT PREPARATION				EXHIBITS V, W	
HYDROLOGIC AND RIVER HYDRAULIC STUDIES		DATA COLLECTION AND REVIEW	PRELIMINARY MONTHLY FLOW AND FLOOD STUDIES		EVALUATE DATA COLLECTION SYSTEM AND SUPPLEMENT IF NEEDED				SEDIMENTATION AND EVAPORATION STUDIES							IDENTIFY IMPACTS OF SELECTED PROJECT, PREPARE SOCIAL IMPUTS TO REPORTS									EXHIBIT W	
									MONTHLY STREAMFLOW ANALYSES					RESERVOIR WATER QUALITY MODEL STUDIES												EXHIBITS H, L, W	
														FLOOD STUDIES		DEVELOP WATER SURFACE PROFILES FOR CRITICAL REACHES OF RIVER											
GEOTECHNICAL STUDIES							SEISMOLOGY MONITORING			SEISMOLOGY EVALUATION									MONITORING		EVALUATION						
								SEISMOLOGY RECONNAISSANCE																			
	MAP STUDY AND AIR PHOTO INTERPRETATION			GEOLOGIC RECONNAISSANCE MAPPING FOR BASIN STUDIES				RECONNAISSANCE OF ALTERNATIVE TRANSMISSION ROUTES	DEVELOP SUBSURFACE INVESTIGATION PROGRAM		BIDDING AND AWARD OF CONTRACT						SEISMOLOGY FIELD STUDIES				RESERVOIR INDUCED SEISMICITY					
		FOUNDATION CRITERIA FOR PRELIMINARY LAYOUTS					IDENTIFY SOURCES OF CONSTRUCTION MATERIALS										CORE DRILLING AND GEOPHYSICAL TESTING										EXHIBITS L, W	
																	DETAILED GEOLOGIC MAPPING		TRANSMISSION ROUTE INVESTIGATION		FOUNDATION AND DAM DESIGN						
																RESERVOIR SLOPE STABILITY ANALYSIS			CONSTRUCTION MATERIALS INVESTIGATION AND LABORATORY TESTING								
HYDROELECTRIC PROJECT STUDIES	DETAILED REVIEW OF PREVIOUS STUDIES	PREPARE LAYOUTS FOR IDENTIFIED SITES TO GUIDE FIELD INVESTIGATIONS		PRELIMINARY ESTIMATE OF INSTALLED CAPACITIES		REFINE LAYOUTS TO REFLECT RESULTS OF FIELD INVESTIGATIONS AND SELECT INSTALLED CAPACITIES					PREPARE ALTERNATIVE LAYOUTS FOR INITIAL PROJECT					EVALUATE ALTERNATIVE PROJECT ARRANGEMENTS		ESTABLISH PRELIMINARY DESIGNS OF MAJOR STRUCTURES		PREPARE FINAL FEASIBILITY LAYOUT					
		FORMULATE ALTERNATIVE BASIN PLANS			PRELIMINARY COMPARISON OF ALTERNATIVE BASIN PLANS	FORMULATE FAVORABLE BASIN PLANS		RECOMMEND BASIN PLAN AND INITIAL PROJECT						SELECT MOST FAVORABLE LAYOUT TO GUIDE FIELD INVESTIGATIONS				SELECT GENERATING EQUIPMENT	PREPARE ONE-LINE DIAGRAM						EXHIBITS K, L, M, V	
TRANSMISSION AND SYSTEM STUDIES					IDENTIFY ALTERNATIVE TRANSMISSION ROUTES		DETERMINE TRANSMISSION CAPACITY										IDENTIFY RECOMMENDED TRANSMISSION ROUTE		PERFORM LOAD FLOW AND SYSTEM STABILITY STUDIES						EXHIBITS J, K, M	
POWER SYSTEM EXPANSION AND OPERATION				PRELIMINARY OPERATION STUDIES TO DETERMINE ENERGY GENERATION FROM ALTERNATIVE PROJECTS			OPERATION STUDIES TO DETERMINE FIRM AND SECONDARY ENERGY FOR ALTERNATIVE BASIN PLANS											OPERATION STUDIES TO OPTIMIZE GENERATION SYSTEM WITH SUSITNA PROJECT								EXHIBITS H, I, U	
POWER MARKET STUDIES		INVENTORY EXISTING FACILITIES		REFINE LOAD FORECASTS		DEVELOP LOAD-DURATION CURVE											REVIEW AND UPDATE MARKET REQUIREMENTS									EXHIBITS I, U	
ALTERNATIVE SOURCES OF GENERATION		IDENTIFICATION AND EVALUATION OF ALTERNATIVE ENERGY SOURCES			PRELIMINARY EVALUATION OF THERMAL ALTERNATIVES TO IDENTIFY MOST FAVORABLE ALTERNATIVE								EVALUATE POSSIBLE LOAD MANAGEMENT IN RAILBELT AREA			ANALYZE FUEL COST FOR ALTERNATIVE THERMAL		PREPARE DETAILED COSTS OF ALTERNATIVE THERMAL PROJECT							EXHIBIT W	
CONSTRUCTION COSTS AND PROGRAMS		PREPARE COST INFORMATION FOR BASIN PLANNING			STUDY EFFECTS OF COLD WEATHER CONSTRUCTION ON ALTERNATIVE PROJECTS		PREPARE PRELIMINARY COST ESTIMATES										DETAILED STUDY OF COLD WEATHER CONSTRUCTION PROCEDURES		DEVELOP UNIT PRICES AND CONSTRUCTION SCHEDULE		PREPARE FEASIBILITY COST ESTIMATE				EXHIBITS N, O	
ECONOMIC AND FINANCIAL ANALYSES					MAKE PRELIMINARY EVALUATION OF POTENTIAL PROJECT FUNDING	COMPARISON OF SUSITNA PROJECTS WITH THERMAL ALTERNATIVES		ECONOMIC COMPARISON OF ALTERNATIVE SUSITNA BASIN PLANS												ECONOMIC COMPARISON WITH MOST FAVORABLE ALTERNATIVE				EXHIBIT G	
																				FUNDING REQUIREMENTS AND BOND REPAYMENT SCHEDULE						
PUBLIC INFORMATION SUPPORT	INITIAL PUBLIC MEETING					DISCUSSION OF ALTERNATIVES			PRESENT BASIN PLAN AT MEETING																PRESENT FEASIBILITY RESULTS AT MEETING		
REPORTS	PUBLIC MEETINGS, WORKSHOPS AND INFORMATION RELEASES												PUBLIC MEETINGS, WORKSHOPS AND INFORMATION RELEASES														
ALASKA POWER AUTHORITY DESCISION POINTS							BASIN PLANNING REPORT		APA DECISION ON INITIAL PROJECT ▲													FEASIBILITY REPORT			APA DECISION ON FERC LICENSE APPLICATION ▲	FERC LICENSE APPLICATION	

NOTE: IT IS EXPECTED THAT REVISED FERC GUIDELINES WILL REQUIRE PREPARATION OF ONE UNIFIED ENVIRONMENTAL EXHIBIT COVERING THE INFORMATION NOW REQUIRED IN EXHIBITS R, S, V, AND W BY THE TIME THE LICENSE APPLICATION IS PREPARED.

HARZA ENGINEERING COMPANY

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
PLAN OF STUDY
WORK SCHEDULE

SECTION 1. INTRODUCTION

PART B - IMPLEMENTATION OF THE PLAN OF STUDY

Section 1

INTRODUCTION

Stages and Objectives

To execute the tasks encompassed in the Plan of Study and to achieve its objectives, Harza proposes to undertake the study in three distinct stages, namely, 1) a basin planning study; 2) a feasibility study; and 3) an application for a FERC license to construct and operate a hydroelectric generating facility on the Susitna River.

The basin planning study will identify the project to be constructed as the first step in the Susitna Basin Development, as noted in the Study Approach (Part A.2).

The feasibility study will examine and evaluate the project so identified from both technical and environmental viewpoints. Economic benefits must be assessed and construction costs estimated and cost/benefits compared. Also, an assessment of expected project revenues must be made and compared with estimated project annual costs if revenue bonds are to be considered as a vehicle for financing the project.

The environmental assessment will characterize the existing environment, project future conditions both with and without the project, and predict project impacts both in terms of magnitude and significance. It will also include an analysis of alternatives to the proposed project, including the no action alternative, and an active interaction with regulatory agencies and the general public to solicit their views and comments throughout the planning studies.

The result of the feasibility study will be an objective presentation of the technical and engineering considerations and problems, a comparison of the estimated annual revenue with the estimated annual costs, and a full evaluation of the environmental impacts and environmental feasibility of the project.

Only, if the foregoing factors are favorable will the third stage be undertaken. On the assumption a favorable project has been identified, the findings of the feasibility and environmental studies will be arranged in the format of Exhibits required by the Federal Energy Regulatory Commission. The legal

and information Exhibits required in a complete license application submittal will be prepared with the APA.

In the post submittal period, additional environmental data will be gathered and evaluated. The updated findings will be submitted as supplements to the License Application Exhibits.

Study Team

A multi-disciplined team composed of Harza's in-house staff, subcontractors and consultants will be required to undertake the myriad of tasks identified by the Detailed Activities (Part A.5). The Harza staff will manage and coordinate the studies as well as be responsible for the logistic support for the field studies and investigations within the Susitna Basin.

Subcontractors will be used in the field investigations, the gathering of environmental baseline data, surveying and mapping and laboratory testing. Consultants, both firms and individuals, will be retained under subcontracts to undertake special studies in the environmental and technical areas.

Alaskan Participation

Recognizing the Authority's desires to maximize local participation we have arranged for the Alaska Office of CH2M Hill to participate as a part of the Harza team subject only to the Authority's concurrence. Alaskan firms will be invited to make proposals for mapping, surveying, drilling and other field investigations. Further participation by Alaskans including native village personnel will be encouraged and sought.

Cook Inlet Region Inc./Homes & Narver (CIRI/H&N) have expressed interest in supplying the logistic support of the field investigation. They propose to employ native village personnel in that operation. Harza will give full consideration to the CIRI/H&N partcipation, with with final arrangements for participation subject to APA review and approval.

The Alaska Department of Fish and Game has shown a keen interest in the environmental impacts on fisheries and game habitats. Specifically, they would like to be involved in the collection of baseline data and assessment of environmental impacts. Harza must make the assessment of the environmental impacts to fulfill its obligation to the Authority, but interposes no constraint on using ADF&G as a participant in the gathering of baseline data. An agreement on the extent of their participation together with an arrangement for reimbursement must

be worked out between ADF&G and Harza, subject to the approval of the APA.

Our preliminary survey indicated that services can be obtained under subcontract with Alaskan firms for drilling, surveying and mapping, most of the required laboratory testing, archeological studies, socio-economic interviews, fisheries and big game studies, vegetation mapping and non-game vertebrate studies. Where substantial programs are involved, Harza proposes to use competitive or incentive bidding procedures in obtaining subcontracts. For highly specialized services, subcontractors will be selected on the basis of qualifications and the negotiation of a satisfactory contractual agreement.

To assure that the director of the public information program has a thorough background of Alaskan attitudes, customs, viewpoints and is familiar with local issues and conditions, we propose to engage an Alaskan resident for this position.

SECTION 2. KEY PERSONNEL ASSIGNMENTS

Section 2

KEY PERSONNEL ASSIGNMENTS

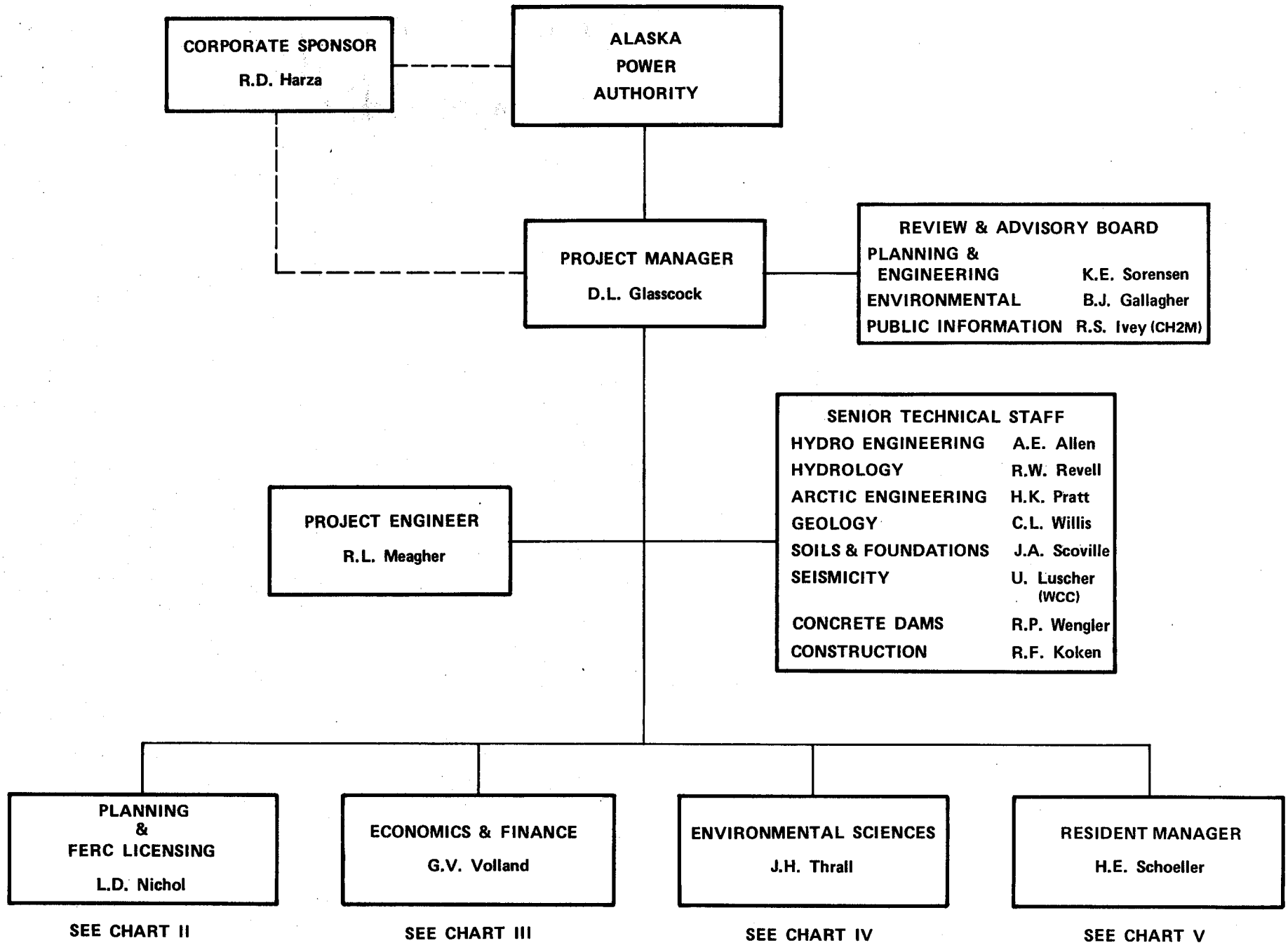
The scope of the work to be accomplished in the Susitna Studies has been detailed in Part A. Harza will organize a project team or task force and dedicate it to that purpose. Talent from our own staff, consultants and subcontractors will be integrated into the project team. Where key positions are to be filled from the consultants organizations they have been so identified; the remainder are all from Harza's current, permanent staff. Key personnel assigned to the Susitna Project will be dedicated to that effort for the term of the study or the duration of the task in which they are involved.

A project review and advisory board will be formed to provide input for the conceptual planning and design studies, and later for regular periodic reviews of the work as it progresses. This group will not be involved in the day to day operations of the studies so that its review function can be performed effectively. They will report to and advise the Project Manager.

The project team will be supported by the Senior Professional Staff who will provide expertise in the key disciplines as well as be involved in the solution of difficult or unusual problems. Their input to the studies will be coordinated by the Project Engineer.

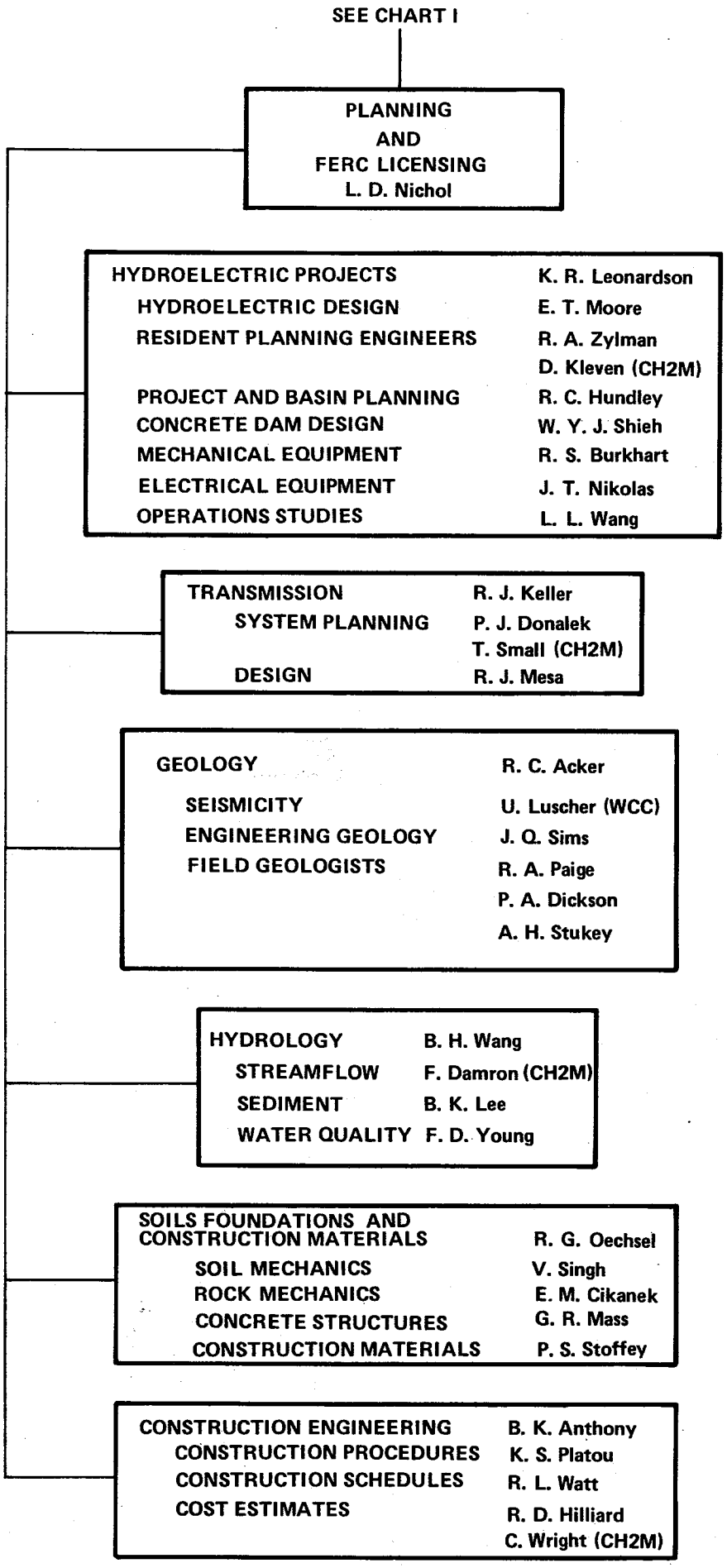
The key positions and corresponding proposed personnel are set forth on Chart I. Groups will be formed in each of the principal areas of study and their activities will be coordinated by the task group leader. Tasks within the group will be undertaken by personnel experienced in the respective technical disciplines. The breakdown of the study groups and proposed personnel assignments are shown on Charts II through V. A brief summary of qualifications of key study personnel who will be extensively involved is provided below. Resumes of all proposed personnel are presented in Volume III.

SUSTINA PROJECT
ORGANIZATION CHART I

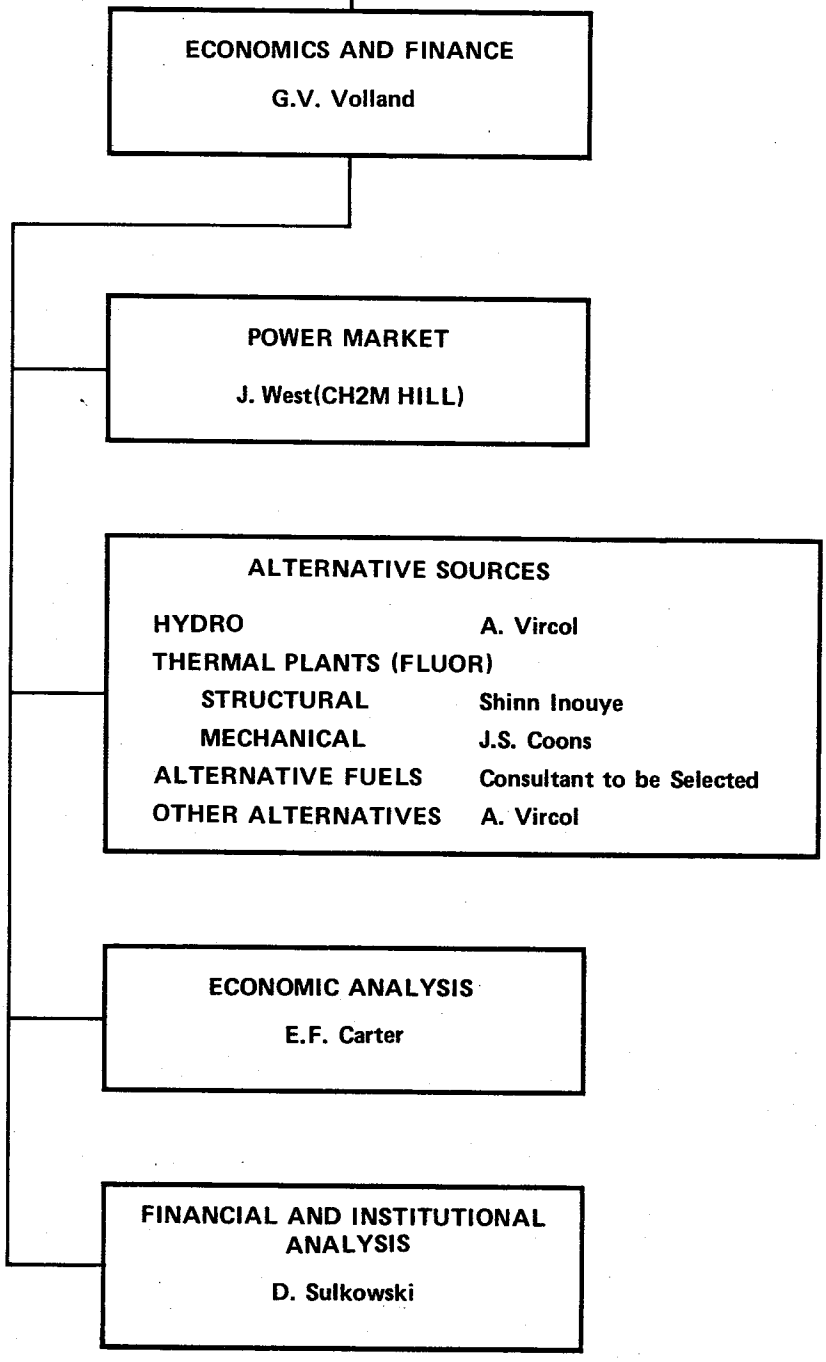


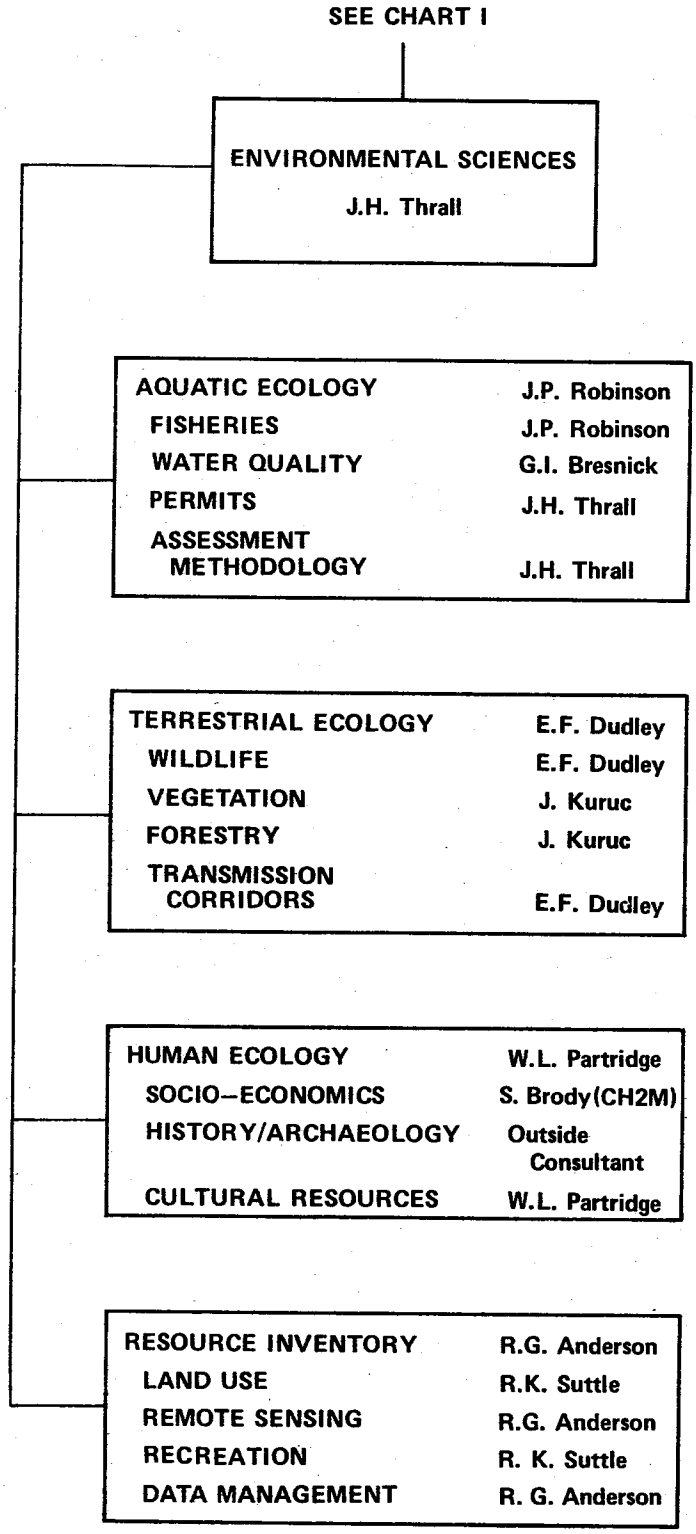
SEE CHART II
SEE CHART III
SEE CHART IV
SEE CHART V

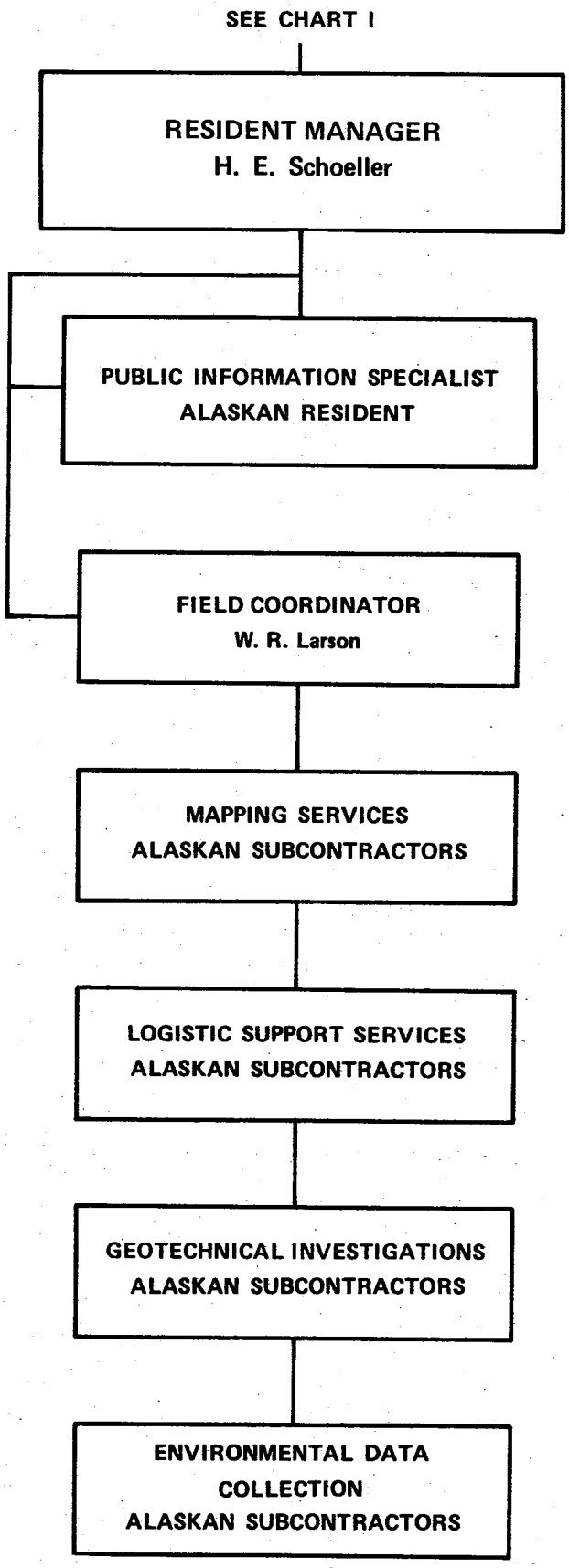
CHART I


SEE CHART I
PLANNING
AND
FERC LICENSING
L. D. Nichol
HYDROELECTRIC PROJECTS
K. R. Leonardson
HYDROELECTRIC DESIGN
E. T. Moore
RESIDENT PLANNING ENGINEERS
R. A. Zylman
D. Kleven (CH2M)
PROJECT AND BASIN PLANNING
R. C. Hundley
CONCRETE DAM DESIGN
W. Y. J. Shieh
MECHANICAL EQUIPMENT
R. S. Burkhart
ELECTRICAL EQUIPMENT
J. T. Nikolas
OPERATIONS STUDIES
L. L. Wang
TRANSMISSION
R. J. Keller
SYSTEM PLANNING
P. J. Donalek
T. Small (CH2M)
DESIGN
R. J. Mesa
GEOLOGY
R. C. Acker
SEISMICITY
U. Luscher (WCC)
ENGINEERING GEOLOGY
J. Q. Sims
FIELD GEOLOGISTS
R. A. Paige
P. A. Dickson
A. H. Stukey
HYDROLOGY
B. H. Wang
STREAMFLOW
F. Damron (CH2M)
SEDIMENT
B. K. Lee
WATER QUALITY
F. D. Young
SOILS FOUNDATIONS AND CONSTRUCTION MATERIALS
R. G. Oechsel
SOIL MECHANICS
V. Singh
ROCK MECHANICS
E. M. Cikanek
CONCRETE STRUCTURES
G. R. Mass
CONSTRUCTION MATERIALS
P. S. Stoffey
CONSTRUCTION ENGINEERING
B. K. Anthony
CONSTRUCTION PROCEDURES
K. S. Platou
CONSTRUCTION SCHEDULES
R. L. Watt
COST ESTIMATES
R. D. Hilliard
C. Wright (CH2M)

SEE CHART I


ECONOMICS AND FINANCE
G.V. Volland
POWER MARKET
J. West(CH2M HILL)
ALTERNATIVE SOURCES
HYDRO
A. Vircol
THERMAL PLANTS (FLUOR)
STRUCTURAL
Shinn Inouye
MECHANICAL
J.S. Coons
ALTERNATIVE FUELS
Consultant to be Selected
OTHER ALTERNATIVES
A. Vircol
ECONOMIC ANALYSIS
E.F. Carter
FINANCIAL AND INSTITUTIONAL ANALYSIS
D. Sulkowski


SEE CHART I
ENVIRONMENTAL SCIENCES
J.H. Thrall
AQUATIC ECOLOGY J.P. Robinson
FISHERIES J.P. Robinson
WATER QUALITY G.I. Bresnick
PERMITS J.H. Thrall
ASSESSMENT METHODOLOGY J.H. Thrall
TERRESTRIAL ECOLOGY E.F. Dudley
WILDLIFE E.F. Dudley
VEGETATION J. Kuruc
FORESTRY J. Kuruc
TRANSMISSION CORRIDORS E.F. Dudley
HUMAN ECOLOGY W.L. Partridge
SOCIO–ECONOMICS S. Brody(CH2M)
HISTORY/ARCHAEOLOGY Outside Consultant
CULTURAL RESOURCES W.L. Partridge
RESOURCE INVENTORY R.G. Anderson
LAND USE R.K. Suttle
REMOTE SENSING R.G. Anderson
RECREATION R. K. Suttle
DATA MANAGEMENT R. G. Anderson


SEE CHART I
RESIDENT MANAGER
H. E. Schoeller
PUBLIC INFORMATION SPECIALIST
ALASKAN RESIDENT
FIELD COORDINATOR
W. R. Larson
MAPPING SERVICES
ALASKAN SUBCONTRACTORS
LOGISTIC SUPPORT SERVICES
ALASKAN SUBCONTRACTORS
GEOTECHNICAL INVESTIGATIONS
ALASKAN SUBCONTRACTORS
ENVIRONMENTAL DATA
COLLECTION
ALASKAN SUBCONTRACTORS

Corporate Sponsor - Richard D. Harza

Mr. Harza, President of Harza Engineering Company, has 33 years of professional engineering experience and has been involved in many of Harza's major dam and hydroelectric projects. Mr. Harza directs all activities of the Company: Business Development Operations, Project Management Operations, Engineering Operations, as well as the administrative, financial, and corporate operations of the Company.

Project Manager - Dwight L. Glasscock

Mr. Glasscock has 32 years of experience and for the past eight years has been responsible for the direction of the engineering and construction management for a large number of pumped-storage and conventional hydroelectric projects in the United States and the international sector. Those responsibilities have generally included project staffing, work schedule, performance reviews, as well as broad technical surveillance of the work.

He directed the engineering activities for the complete detailed design of the 1,400 MW Marimbondo and the feasibility study for the 1,380 MW Agua Bermelha Hydroelectric Projects in Brazil. He supervised a study for the regulation of the outflow of Lake Ontario, reviewed the existing regulating scheme and investigated alternative regulation plans to determine the economic effect on the power generating facilities of the St. Lawrence Power Project, U.S. and Canada. He was responsible for the economic studies and analyses in conjunction with the comprehensive review and preparation of the engineering feasibility report for the California Water Plan.

Mr. Glasscock directed the engineering performance for the 600 MW Bear Swamp Pumped-Storage Project, the 1,000 MW Blenheim-Gilboa Pumped-Storage Project, and the 600 MW Jocasse Pumped Storage Project in the United States.

Project Review and Advisory Board

Planning and Engineering - Kenneth E. Sorensen

As Chief Planning Engineer, Mr. Sorensen has been responsible for most of the firm's major appraisal planning and financing reports. For the past 20 years these projects have included the 28,000 MW Inga Project on the Congo River (Africa); 10,000 MW development of the Caroni River (Venezuela), 4,000 MW Yacryreta-Apipe Project on the Parana River (Argentina), 2,500 MW

Priest Rapids-Wanapum Development on the Columbia River, and the 1,000 MW Reza Shah Kabir Project in Iran. Mr Sorensen has specialized in staged development of hydro projects leading up to total river development. He was involved throughout the planning phases for development of the Lempa River (El Salvador), the Caroni River (Venezuela), the Karun River (Iran), and numerous other Harza planning studies for which feasible first and second stage projects were identified during the planning phase and have been constructed.

Environmental Sciences - Brian J. Gallagher

At Harza, Dr. Gallagher supervises interdisciplinary teams of environmental scientists and engineers conducting ecological studies and investigations. He is responsible for the overall direction of ecosystem analysis and environmental impact assessment projects.

Prior to joining Harza, Dr. Gallagher was principal of his own firm providing environmental consulting services to industry and governmental agencies. He was the Principal Investigator on an applied research contract for U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, on the hydraulic design of dredged material sedimentation basins and discharge structures. He also directed EPA facility planning projects (201 studies) for major wastewater collection and treatment projects in Michigan. In 1976, he served as a special advisor on water quality modeling of the Morava River in Yugoslavia for a United Nations Development Program. This project involved the comprehensive planning of the Western Morava River Basin development using advanced computer systems models for flood control, hydropower, navigation, water supply and water quality purposes. During 1975 to 1976, Dr. Gallagher participated in interdisciplinary research on Sierra Mountain Alpine Lakes and Streams water quality for the National Forest Service, and studies assessing the environmental impacts of coal gasification residual waste disposal.

Previously, Dr. Gallagher was President of Limnetics, Inc. (1968 to 1974) conducting environmental services for electric utilities and fossil fuel development industries. At Limnetics, he designed and directed major ecological studies of municipal and industrial discharges, cultural eutrophication, recreational area development, thermal effects from power plant operations, artificial cooling lakes, and environmental impacts of oil shale development projects in Western Colorado. He has also presented

expert witness testimony at Atomic Energy Commission Hearings on the environmental effects of nuclear power plant operations.

Public Information - Richard S. Ivey (CH2M Hill)

Mr. Ivey is Director of Planning at CH2M Hill, and is responsible for comprehensive city and regional planning and environmental planning. He has been responsible for several community impact statements for the Kenai Borough and the Cities of Homer, Kenai, Soldotna and Seldovia in Alaska, relating to off-shore oil development. Responsibilities have also included the public involvement program in connection with the Corps of Engineers water quality study in Anchorage. Mr. Ivey served four years as the principal consultant to the Southeastern Washington Regional Planning Commission and the Clearwater Valley (Idaho) Regional Planning Commission, a bi-state program for the development of a comprehensive regional plan for growth anticipated from Lower Cronite Dam and slackwater navigation to the Port of Lewison. Mr. Ivey's consulting experience and research has included studies in local government organization and operations, municipal finance, personnel administration, law enforcement administration, municipal law, and city and regional planning.

Project Engineer - Richard L. Meagher

Mr. Meagher has 23 years experience planning and designing major hydroelectric projects throughout the U.S. and abroad. He has served as Project Manager for the Feasibility Study and FERC License Application for the Brumley Gap Pumped Storage Project in Virginia. He has directed engineering planning for the 450 MW Rio Chimbo Project in Ecuador, and the 210 MW Haruneyjafoss Project in Iceland. Mr. Meagher was Project Manager for the study of the Patia River Basin in southwest Columbia. The study involved the identification of all sites which have the potential for construction, preliminary evaluation to determine the most favorable sites, and selection of the initial site, and feasibility study of that site. The potential for total development of the Patia River is 3,000 MW and the initial project will have 1500 MW. He was the lead planning engineer for basin planning studies for the Karun River in Iran, and for the subsequent feasibility study of the Reza Shah Kabir Project, which has a 200-meter arch dam and 1000 MW installed capacity.

Resident Engineer - Herbert E. Schoeller

Mr. Schoeller has 16 years of engineering experience in water resources planning. He has been involved in project management activities and technical supervision of water resources planning studies both in the U.S. and overseas. He has managed and coordinated feasibility studies for the 350 MW Itapuera Project in Brazil; planning investigations for the 75-foot high Burlington Dam (Flood-Control) Project in North Dakota; and the preparation of water supply and control plans for the Caballo and Rawhide Mines in Wyoming. He has had extensive experience as a field and office hydrologist, including long term resident assignments in Indonesia and Thailand and shorter field assignments in Indonesia, Colombia, Venezuela, and West Africa.

Planning Studies and
FERC License Application

Team Leader - L. Dow Nichol

Mr. Nichol has over 20 years experience in hydroelectric planning. He participated in Feasibility and FERC (FPC) License Application Studies for the Stony Creek Pumped Storage Project (Pennsylvania). He has directed optimization studies to select the power and energy capacity of the Bath County Pumped Storage Project (Virginia). Mr. Nichol has directed many feasibility and prefeasibility level studies including field reconnaissance of a 380 kilometer undeveloped reach of river with preparation of a screening program for evaluation of various sites and levels of development for the Rio Grande Project, Bolivia. He has served as resident engineer in Colombia during the feasibility study of the Sogomoso Hydroelectric Project, and has recently directed the evaluation of alternative plans for storage and conveyance of water and development of hydroelectric power for the multiple-purpose Puyango-Tumbes Project in Equador and Peru.

Hydrolectric Projects - Ken R. Leonardson

Mr. Leonardson, Division Head for the Power Projects Division, has been with Harza for approximately 21 years. Mr. Leonardson recently was Project Manager in studies leading to a FERC License Application for the 140 MW hydroelectric plant on the Kootenai River in Montana. He has also been Project Manager for the 210 MW Hrauneyjafloss hydroelectric project in Iceland for preparation of contract documents. He has extensive

experience in the planning and design of fish passage and hatchery facilities.

Resident Planning Engineer-Robert A. Zylman. Mr. Zylman has 8 years of experience and has been with Harza since 1974. At Harza he has assumed major responsibilities for the 3000 MW Brumley Gap Pumped Storage Project in Virginia. Mr. Zylman also was involved in Feasibility studies for the 30 MW Puerto Cortes Diesel Project and the 22.5 MW El Nispero Hydro Project in Honduras, C.A. He performed inspection, documentation, and field engineering on the restoration of the Upper and Lower Dams of the Occoquan Project in Virginia. He currently is involved in preliminary planning studies for the Tlingit-Haida area in Alaska and recently returned from a one-month resident assignment in Alaska for that project.

Project and Basin Planning - Robert C. Hundley. Mr. Hundley was Project Manager for major pumped-storage hydroelectric projects including the 1,000 MW Mount Hope Project in New Jersey, 2,000 to 3,000 MW project in northern Illinois, 500-MW Montezuma Project in Arizona, and two site surveys for Illinois. He has participated in feasibility studies for several other hydroelectric projects including the 2,100 MW Bath County Project in Virginia, and the 380 MW Seneca Project, Pennsylvania. Mr. Hundley has participated in the preparation of License Applications to the FPC for Mount Hope, Bath County, Montezuma, and Seneca Pumped-Storage Projects, existing Deep Creek, Raystown and Warrior Ridge Projects of Pennsylvania Electric Company and Priest Rapids, and preparation of Form 6, Original Cost Statement for the Seneca Project.

Studies of conventional hydroelectric power projects include the 2067 MW Guri Plant in Venezuela, the 140 MW Pisayambo Project, Ecuador, the 788.5 MW Priest Rapids and 831.3 MW Wanapum Developments, Washington, and the 135 MW Cerron Grande Project, El Salvador.

Operation Studies - Leei-Luoh Wang. Mr. Wang has been with Harza since 1966 and has nearly 20 years of professional engineering experience. At Harza, Mr. Wang has been responsible for a number of hydroelectric planning projects and for supervising junior engineers in the planning investigations. He has assumed primary project management responsibilities for the 800 MW Cuffs Run Pumped-Storage Project (prefeasibility), the 230 MW Safe Harbor Project and 108 MW Holtwood Project on the

Susquehanna River (feasibility study of expansion potential), and the 1,800 MW Sogamoso Project in Colombia, S.A. (feasibility). He currently is involved with planning studies for hydroelectric development of the Lower Caroni River in Venezuela.

System Planning

Peter Donalek. Mr. Donalek has 18 years of electrical and transmission engineering experience, including 6 years with Harza. He holds two masters degrees, mathematics and electrical engineering, and has taught college level courses in electromechanics, electrical power systems, and mathematics. His position with Harza as Senior Electrical Engineer involves him in project management and report preparation for high voltage transmission system evaluation and design projects. Some of these projects include: a transient network analyzer study for a 500-kV transmission line in Pakistan; evaluation of transmission system expansion for the State of Montana; expansion of power transmission system in El Salvador; and preliminary cost estimates for the electrical portion of various pumped-storage and hydroelectric generating stations and high voltage substations.

Thomas S. Small. Mr. Small's primary experiennce with CH2M Hill has been related to transmission and electrical system design for Alaska communities. Recent projects with CH2M Hill include the design and installation of a standby duel-fuel generator system for Nome, Alaska and the design of distribution facilities destroyed during a 1974 storm. Mr. Small was also utility manager and city engineer for the City of Nome Joint Utility System where he was responsible for such activities as design and maintenance of new distribution and transmission facilities, purchasing and supervising installation and operation of diesel generators, and administering the utility's budget. He has traveled and worked with natives in more than 30 villages over the past 3 years as captain in the Alaska National Guard, with responsibility to support the communications needs of the 207th Arctic Recon Group.

Geology - Richard C. Acker

During his 17 years with Harza, Mr. Acker has been responsible for directing geological field and office studies for appraisal, feasibility and design of many important dam and reservoir projects within the U.S.A. and in many foreign countries. Most of these projects have involved hydroelectric power development both conventional and pumped-storage. These projects have included rockfill embankments ranging from 300 feet to 825 feet high and thin-arch dams to 660 feet high. Three of the projects now under construction include a 330 feet high earth-fill dam, a 400 feet high rockfill dam and a 265 feet high thin-arch dam. Mr. Acker has had extensive experience in engineering geologic investigations and studies for water conveyance tunnels and tunnel systems and for large underground chambers.

For six of his 12 years with the U.S. Corps of Engineers prior to his association with Harza, Mr. Acker was District Geologist working on foundation exploration, foundation design and construction for military installations in arctic and sub-arctic northeastern Canada and Greenland. Projects included roadways, airfield runways, large and small buildings, fuel storage tanks and communications towers, mostly on permafrost. Mr. Acker has rather broad experience in successful adaptation of foundation designs to a variety of permafrost conditions. His work also involved reconnaissance, exploration and testing of materials for non-frost-susceptible fill and concrete aggregate.

Field Geologists

Russel A. Paige. During his 7 years experience with Harza, Mr. Paige has gained wide experience in supervision of feasibility and design phase geologic studies for high earth and rockfill embankments and concrete arch dams. Most notable of these projects are the Patia 405, a 825-foot high rockfill dam in Colombia, the Chimbo hydroelectric project in Ecuador involving numerous embankment dams and long conveyance tunnels and canals, Bath County Pumped Storage Project, Virginia, with an upper and lower earthfill embankment of moderate height and numerous tunnels, the Brumley Gap Pumped Storage Project, also in Virginia, which includes two 300-foot high embankment dams, long tunnels and an underground powerhouse, and the Foothills project in Denver, Colorado with a 265-foot high thin concrete arch dam. He is presently Project Geologist on construction of the Foothills project on which foundation work is expected to be completed in early 1980.

Mr. Paige also has 12 years of prior professional geologic experience, largely with special engineering geology problems of snow, ice and frozen ground in the Antarctic and Alaska. Studies included selection of road routes, airfields, and ice foundations for building sites in Antarctica, and location of suitable construction materials and road routes in southcentral Alaska. He has authored several technical papers and articles concerning these cold climate studies, especially in the permafrost areas of Fairbanks and Barrow. He worked with Dr. Troy L. Pewe on the Barrow permafrost studies, and with a number of professors with the University of Alaska.

Peter A. Dickson. Mr. Dickson has gained valuable experience in solving problems of complex structural and stratigraphic correlation in Appalachian Plateau geology in Pennsylvania and Virginia for pumped storage project studies, where he was resident field geologist on the Brumley Gap Project, Virginia. This project includes two 300-foot high embankment dams, long tunnels, and an underground powerhouse.

He has worked extensively with aerial photo and LANDSAT imagery interpretation, with particular application to regional patterns of jointing and faults. He is presently performing geologic mapping, including study of potential landslides, of the 600-foot high rockfill Maqarin Dam project in northern Jordan. He also will conduct an investigation of the relationship of regional lineaments to faults and seismicity patterns for this project.

Arthur H. Stukey. Mr. Stukey serves as Project Geologist for Harza on the construction of a 660-foot high thin multiple-curved concrete arch (Reza Shah Kabir) dam in southwestern Iran. His responsibilities included geologic supervision, mapping and inspection of the tunnels, adits, dam and power house foundations and the treatment and drainage of the foundation rock. He also was responsible for rock slope stabilization in the steep narrow canyon, and for implementation of the geohydrologic monitoring and instrumentation program.

He is presently serving in the same capacity on the Tavera-Bao project for construction of a 330-foot high earth and rockfill embankment dam, and dikes which close deep depresions in the left bank. His project geology duties also include assistance to the project grouting engineer and evaluation of drainage requirements, and assisted in research and determination of the Maximum Credible Earthquake (MCE) and seismicity of the

project. He has also supervised geophysical downhole logging surveys with various petroleum companies.

Hydrology - Dr. Bi-Hui Wang

Dr. Wang has twenty-four years of experience, all as a surface water hydrologist. He holds a Doctorate of Philosophy in Hydrology from Utah State University. He has served at Harza as a Senior Hydrologist, Head of the Hydrology Department, and Assistant Head of the Hydrology Division. Dr. Wang directs, supervises, and performs hydrologic analyses of all types, such as spillway design floods, flood frequency, dependable yield, stochastic hydrology, sediment, steady and transient heat flow, and mathematical simulation of water resources systems. Assignments have included a full range of hydrometeorological analyses, including all hydrologic design parameters for the Bath County Pumped Storage Project, Virginia, and for hydroelectric projects in the United States and nine other nations.

Soil Foundations and Construction Materials - Roger G. Oechsel.

Mr. Oechsel has 19 years of experience in his field of expertise as a geotechnical engineer. He is registered in two states as a professional engineer and one state as a structural engineer. He has a Bachelor of Science in Civil Engineering from Northwestern University and is a registered professional and structural engineer. In his capacity at Harza he directs and supervises work on soil mechanics, foundations, and embankment engineering aspects of Projects within the United States. He has worked on many projects in various capacities including the Bath County Pumped Storage Project, Virginia, as project soils engineer; Seneca Pumped Storage Project, Pennsylvania; Rio Lindo Hydroelectric Project, Honduras; Finchaa Hydroelectric Project, Ethiopia; Lake Camelot Dams, Wisconsin; Huron River Dams, Michigan; Fling River Beautification Project, Michigan; and Fellows Lake Dam Restoration.

Soil Mechanics - Mr. V. Singh

Mr. V. Singh, a senior geotechnical engineer, will be responsible for soil mechanics and foundations aspects of the project. He has twelve years of varied experience and has a Master of Science in Civil Engineering from Illinois Institute of Technology. He is a registered professional engineer in the State of Illinois and California. He has been with Harza

since 1977 and has worked on the Guri Project, Venezuela, Maqarin Project, Jordan, San Lorenzo Project, El Salvador, Sula Valley Flood Control Project, Honduras and Bath County Pumped-Storage Project, Virginia. Previous to that he has five years of experience with Sargent & Lundy in Chicago, Illinois. There he had been responsible for geotechnical aspects of the work of various nuclear and fossil power plants including Byron Nuclear Station and Braidwood Nuclear Station in Illinois, Bailly Nuclear Station and Marble Hill Nuclear Station, Indiana, Kaiserhaust Nuclear Station, Switzerland and a nuclear station in Israel. His earlier experience included two and one half years with Chicago & Northwestern Railway Company.

Cost Estimates

Robert D. Hilliard. Mr. Hilliard has primary responsibility for preparing engineering construction cost estimates, contract documents, construction planning and scheduling, contract administration, and technical procurement. Mr. Hilliard has 31 years of experience in construction management. He was responsible for construction management services on the $500 million Mainstream Tunnel Project (Chicago) and for bid evaluation on the $1.2 billion Guri Dam (Final stage) Project in Venezuela, S.A. With TAMS, Mr. Hilliard supervised and inspected construction on the Tarbela Dam Project in Pakistan which included 1.7 million cubic yards of concrete work and 1.0 million cubic yards of underground excavation.

Charles R. Wright. Mr. Wright has been with CH2M Hill since 1971 and has performed construction management services for several large projects. He has served as a resident engineer on a large wastewater treatment plant in Alaska which included an earth dam, water treatment plant and a pumping station. Mr. Wright has participated in studies involving the design of water, wastewater and structural projects in Alaska, California, Idaho and Oregon. His construction management work has included construction coordination, procurement, scheduling, cash flow projections and construction record keeping.

Economics and Finance

Team Leader - George V. Volland

Mr. Volland has 14 years of engineering experience primarily in the field of hydroelectric power development. He has conducted planning, economic, and financial studies for the following major projects: 100 MW Tavera-Lopez Project in the Dominican Republic, 460 MW Chimbo River Basin Project in Ecuador, and the 270 MW Cerron Grande Project in El Salvador. He also directed planning and economic studies for the Santa Cruz System Expansion Project in Bolivia involving a 16 MW gas-turbine generating plant and 25 kM of 69 kV transmission line and substations.

Mr. Voland currently is leading a reconnaissance-level study of small (0.5-5.0 MW) hydroelectric power developments in the Tlingat-Haida Area of southeast Alaska for the Alaska Power Authority. These studies will assist APA in deciding on whether to proceed with FERC License Application.

Power Market - Jack West

Mr. West, a senior consultant practicing in Alaska for 16 years, has designed and construction-managed electric power and control projects of a wide variety. Included in these projects are diesel and gas turbine generation, transmission and distribution lines, substations, remote communications systems, and complex industrial control and instrumentation systems. Prior to Alaska, Mr. West participated in electrical and fluid mechanics design of hydrocarbon refineries and gas liquefaction plants for a construction engineering firm.

Mr. West has participated in numerous small hydroelectric feasibility studies and investigative field work for Alaskan municipal and REA electric utilities. He has provided extensive consulting services relating to control and instrumentation for the Alaska Pipeline.

Hydroelectric - A. Vircol

Mr. Vircol has approximatley 15 years of relevant hydroelectric design and planning experience with Harza and other companies. Most recent assignments have included economic evaluations of potential hydropower alternatives at various existing multi-purpose dams in the Kanawha River Basin in West Virginia. He has also performed economic evaluations for hydropower and alternative thermal plants in feasibility studies for a hydropower plant to be built at Itapeuara, Brazil. Mr. Vircol conducted an economic assessment and comparison of various current and future technologies to satisfy future peak demands in the American Electric Power System for the U.S. Army Corps of Engineers.

Environmental Sciences

Team Leader - James H. Thrall

Dr. Thrall has 15 years experience, and his credentials include a Ph.D. in Biological Sciences, an M.S. in Biological Sciences, and a B.S. in Biology. He has performed analyses of the fisheries resources and aquatic ecosystems for: the Tlingit-Haida area of southeast Alaska (small hydro development); the Garrison Diversion Project, North Dakota; the Lake Andes-Wagner Irrigation Development, South Dakota; the Puyango-Tumbes Irrigation Project, Peru and Ecuador; the Sogamoso Hydroelectric Project, Sogamoso River - Colombia; the San Lorenzo Hydroelectric Project, Lempa River, El Salvador; and the Upper Mazaruni Hydroelectric Project, Mazurini River, Guyana. He supervised the preparation of a report on the riverine ecosystems to be affected by the Garrison Division Unit Irrigation Project. Impacts of diversion water on terrestrial and aquatic biota, as well as on quality of the receiving streams were considered. In South Dakota, he assessed impacts on terrestrial, aquatic and recreation resources, and made recommendations for mitigating actions, impacts on migratory fish, effects of nutrient entrapment in reservoirs, and the integration of reservoir fisheries development and aquaculture. He performed a feasibility level analysis of fishery resources and fish production potentials.

Aquatic Biology - James P. Robinson

Mr. Robinson has extensive experience in fisheries biology. His experience with Pacific salmon species includes biotelemetry field studies in northern British Columbia coastal waters and on Lake Michigan, and investigations of potential impacts on salmon of several hydropower projects in southeast Alaska and the southern Lake Michigan drainage basin. Mr. Robinson prepared the aquatic ecology sections of FERC License Exhibits S and W for a major hydroproject, and participated in subsequent interagency and public meetings. Also, his recent work in Alaska involved analysis of state and federal environmental review and permitting requirements and procedures. Other areas of expertise pertinent to Susitna studies include assessment and mitigation of impingement and entrainment impacts, and instream flow assessment methodologies.

Terrestrial - Eugene F. Dudley

Dr. Dudley has 24 years of experience in conducting environmental assessments relating primarily to terrestrial ecology and wild life biology. He has been environmental task leader for more than twenty major Harza projects with overall responsibility for environmental inventories, assessments, and impact evaluations. Prior to joining Harza nine years ago, he was staff biologist with the U.S. Fish and Wildlife Services, responsible for review of applications for license for hydroelectric and nuclear generating facilities and preparation of draft comments for incorporation into Department of Interior's report on project suitability. He is thoroughly familiar with agencies policies and procedures for determining environmental feasibility of hydroelectric projects.

Human Ecology

William L. Partridge. Dr. Partridge, as Harza's Sociologist/Anthropologist has responsibility for planning and reviewing resettlement programs, evaluation of social and cultural impacts of projects, and the planning and execution of socio-economic surveys and treatment of resultant data. He is responsible for the revision of the human ecology and socio-economic impacts chapters of the new AID (U.S. Department of State) Environmental Design Guidelines Manual, covering small-scale irrigation systems, rural road construction, water supply and sanitation systems, and rural industry. Dr. Partridge has designed the resettlement program for the Nam Mun Project

(Thailand) affecting over 6,000 people and designed and implemented a preliminary human ecology program including mitigation through resettlement planning in Brazil's Amazon River Basin. He has also carried out human ecology impact studies of resettlement for the National Science Foundation and Pan American Health Organization. Dr. Partridge has designed and implemented socio-economic impact studies for hydropower development in West Virginia and underground coal mining in Illinois. His wide field experience over a 13-year career includes administration of a team of 20 human ecology impacts field investigators.

Susan Brody. Ms. Brody is a member of the planning and economics department at CH2M Hill where she specializes in the areas of socio-economic impacts, policy analysis and land use planning. Ms. Brody participated in an MIT research project to develop policy options for state governments dealing with the social and economic impacts of energy facility siting in the Western United States. Her recent experience with CH2M Hill includes social and economic impact analysis for off-shore oil development in Alaska's Lower Cook Inlet and the formulation of strategies to meet impact related needs. Ms. Brody has also participated in the design of a procedures manual to help guide developers through the permit regulatory processes within Alaska.

Resource Inventory - Rodger G. Anderson

Mr. Anderson has extensive experience at Harza in management of resource inventory data, mapping subcontracts, surveying subcontracts, and remote sensing applications. He also has been responsible for assessment of effects of alternative reservoir surface levels on recreation facilities, visitor use, and visual impact for project siting studies and has developed alternative conceptual plans and preliminary design for recreational development for projects licensed by the Federal Energy Regulatory Commission and the Nuclear Regulatory Commission.

SECTION 3. ORGANIZATIONAL STRUCTURE OF THE STUDY TEAM

Section 3

ORGANIZATIONAL STRUCTURE OF THE STUDY TEAM

All of the work to be performed in the three phases of the Plan of Study (POS) will be undertaken by and accomplished under a single project organization. The fundamental purpose for so organizing is twofold: 1) to provide an effective means of mobilization of the resources required under a single project manager, and 2) to provide continuity of work and personnel throughout the three stages. The three stages will progress in sequence with an overlap between phases.

To effectively manage the multiplicity of tasks comprised in the POS requires that clear, definite lines of responsibility and authority be established at the onset of the work.

A Project Manager will be assigned who will be responsible and held accountable for the overall execution of the work, while the technical quality and adequacy of the engineering work will remain the responsibility of the engineering organization. The Project Manager will be assigned from the Operations Organization and the remainder of the staff will be assigned from the Engineering Organization.

The principal participants of the project team are the Project Manager, Project Engineer, Lead Engineers for the three groups of studies, and a Resident Manager to coordinate the work and field activities in Alaska.

The basic project organization through the several task leaders is shown on Chart I. The expansion of the responsibility of each task group is shown in Charts II through V, in Section 2.

In addition the project will be supported by Senior In-house advisors in areas vital to the project success. A review and advisory board will be set up to address global problems and advise the project manager, and from the Engineering Organization the project engineer will have available the Senior Professional Staff for technical advice and review.

The Project Manager will be directly responsible for carrying out the tasks encompassed in the approved Plan of Study as well as receive additional direction form the Authority's Project Manager. He will be responsible for the activities of the entire project team and in direct charge of the lead engineers with regard to work planning, scheduling, budgeting and reporting. He will monitor the work progress in these respects and be held accountable for the overall performance including "on

time" completion within the budget limits. This accountability will extend to all of the tasks whether performed by Harza Staff, Consultants or Subcontractors.

All work effort required to complete the studies, whether they are supplied from in-house staff, consultants or subcontractors, will function within the framework of the proposed organization. Consequently, the Project Manager should have an experience background in large projects of similar complexity. We believe the Susitna POS warrants an officer of the firm as a Project Manager. We will assign Dwight L. Glasscock, a Vice President of the firm, to this position.

The Project Sponsor will be a Senior Officer of the firm. His principle function will be to maintain periodic liaison with the client and to provide a communications channel to the Harza Management for the evaluation of the performance of the project team as a whole, and of its individual members. Because of the importance of the Susitna Project, Mr. Richard D. Harza, President of our Firm has elected to assume this responsibility.

The Project Engineer will perform a key role in the success of the studies. He will be responsible for coordination of the entire engineering effort including consultants and field investigation. Familiarity with investigations and planning of major projects and basin developments together with an understanding of the economic factors and environmental implications is essential. For this position we propose Mr. Richard L. Meagher who is a Senior Associate and Head of our Water and Energy Planning and Design Department.

Reporting to the Project Manager are the following key positions:

The Project Engineer will be responsible for the coordination of all technical aspects of the studies and the FERC License Application. In this capacity he will coordinate the activities of outside consultants and subcontractors with the activities being supervised by the task leaders.

Task Leaders will be responsible to the Project Manager for work planning, budgeting, scheduling and reporting and will be held accountable to him for the performance within those constraints. The task leaders will initiate and undertake the work on specific tasks within their assigned responsibilities and be accountable to the Project Manager for their completion. The Task Leaders will be responsible to their Department Heads within the Engineering Organization for the technical quality of their work.

The Resident Manager will be responsible for the coordination of the activities in Alaska. These include coordination with APA; the field studies and investigations; and supervision of the office studies to be done in Alaska with CH2M Hill. The Resident Manager will also be responsible for successful performance of the public information program.

The Project Review and Advisory Board will assist the Project Manager in the overall conceptual planning studies and will review periodically the progress of the work. In addition they will advise the Project Manager on the Public Participation Program.

The highest level of technical expertise will be made available to the project by participation of the Harza Senior Professional Staff. They will be available as individuals or collectively for consultation and review of engineering concepts and plans. They will assist in the solution of difficult and unusual problems and assure the safety of the designs. Their participation will be coordinated by the Project Engineer.

The proposed organization will be effective for the following reasons.

1. It provides an integrated, multidisciplined approach to each task as identified in the POS.

2. It provides direct liaison by the task leader with all participants providing input to that task and other task leaders for interfacing tasks.

3. It provides prompt response to change and new developments.

4. It makes effective use of the Senior Professional Staff.

5. It provides control and is efficient because the management level has direct access to the task leaders. Directions are passed down and results passed up through experienced personnel skilled in handling and interpreting them.

SECTION 4. COORDINATION PROCEDURES

Section 4

COORDINATION PROCEDURES

The size and complexity of the studies proposed for the Susitna River development demand a major coordination effort. The Authority's preference for "open planning" to secure participation of the public as well as federal, state and local agencies further expands the coordination effort. A second factor of complexity is the need for logistics support to transport, and maintain the large and diverse work force in the remote wilderness area of the upper basin. Even though special programs are proposed to cope with dissemination of information for planning and for logistics support, these require integration into the overall program planning and its execution.

The coordination effort is viewed as a major management task, and is given special attention in the formulation and budgeting of the Plan of Study. For the coordination procedures and techniques to be effective for all aspects of the project operation, we recommend that these be a separately planned operation which recognizes the need for a.) assignments of coordination responsibility, b.) identifying a set of procedures for reporting progress and events, and c.) securing essential feedback.

The technique we propose establishes coordination in two major sectors; one, for relations external to the engineering organization and the other, for the internal direction, control and flow of data and information. The external group will embrace the Authority, their consultants and advisors, interested agencies, utilities and the public at large. The internal effort addresses the engineers own study groups, his consultants and subcontractors, the local engineer (CH2M Hill) and Harza's Anchorage Office. Items and tasks on which data and information should flow have been identified, together with the individual responsible for their coordination. The matrix shown on Exhibit 4-1 defines the primary coodination responsibilities for the key personnel of the project team. It should be noted that the assignment of coordination responsibility closely parallels that of other responsibilities for key personnel as set forth under the project organization.

The Project Manager must retain overall responsibility for coordination. His primary effort will be largely external to the Home Office, including his consultants, subcontractors and the Anchorage Office.

The Project Engineer has overall responsibility for coordination of the technical effort internally and for the flow of technical data and information to external organizations. He may require assistance from Task Leaders or he may require their participation in discharging this responsibility.

The Resident Manager of the Anchorage Office will maintain coordination with external agencies in Alaska on behalf of the Project Manager. He will function as Harza's representative in Alaska and will be empowered to receive direction from the Authority and respond to their requests. He is responsible for coordination of the Alaska office studies and field activities, and administration of the subcontracts for field exploration, environmental baseline data, logistics support, and special studies. In addition he will coordinate with federal, state and local government agencies and act as the Project Manager's representative in interfacing with other interested groups. The Resident Manager will be responsible for securing permits (if not previously arranged by APA, such as the BLM Agreement) necessary for the studies, and unless specifically delegated to others, he will contact the appropriate agencies.

Coordination by Task Leaders is internal except for their participation at the request of the Project Engineer. They will be responsible for receiving direction from the Project Manager and the Project Engineer in their respective areas of responsibility as shown under Section 2 - Part B above, and for the coordination of the studies within their assignment.

The Director of Information will be privy to the studies in progress. He will be responsible for assembling the information from the internal sources and disseminating it to the Authority and with its approval, to other organizations, agencies or the general public.

The Public Information and Participation program is designed to handle the dissemination of information and feedback. This program establishes channels of communication for those purposes. Exhibit 4-2 and 4-3 show respectively the primary channels for the dissemination of information and for feedback together with the persons responsible. The Resident Manager is responsible for this effort.

The Director of Information will coordinate many of the tasks discussed under the Public Information and Participation Program. He will serve as the agent for the distribution of information and act as a focal point for receiving feedback.

The Project Manager and the Project Engineer as well as the Resident Manager will be available to assist or participate in

meetings, discussion or specific presentations. In general they will be advised of that need by the Director of Information.

Internal coordination within the study team will follow the lines of responsibility established in the organization chart. The Director of Information, however, shall be at liberty to request or inquire about the status of the work from the project team. Responses to these inquiries will be along the normal lines of responsibility.

Progress Reporting

Immediately after the authorization to proceed, a budget and schedule for the POS will be developed and agreed upon. These should be formally approved by the Authority as they will form the basis for monitoring work progress and costs. A monthly progress report will show the current status of the tasks completed or in progress, and the status with respect to work schedule. It would also indicate those tasks which would be undertaken in the next month. A summary of the costs expended in the period and those incurred to date would be included together with a projection of those for the ensuing month. Actual expenditures would be compared with the budgeted amounts to allow spotting any deviation at an early date.

The schedule of subcontractors would be monitored and progress plotted against schedule completion dates. Any deviation in their performance both with respect to schedule and cost will be noted and potential delays identified.

In addition we propose that progress meetings be held at least quarterly. For these an agenda identifying the points for discussion would be prepared and forwarded to parties at least one week prior to that scheduled meeting.

Project Reports

The result of the studies will be summarized in reports and submitted to the Authority. At the conclusion of the Basin Planning phase a draft report will be prepared and submitted to the Authority or distributed as they may direct. After receiving comments the report will be finalized and formally transmitted. At the conclusion of the feasibility studies a similar report will be prepared and handled in the same manner.

For the FERC License Application the information contained in the feasibility report will be arranged into the necessary technical and environmental exhibits and submitted to Alaska

Power Authority for review. Other exhibits required for the application will be added prior to the submission to FERC.

Overall Program Coordination

For the FERC License Application it will be necessary for the Authority to have legal assistance and to demonstrate the financial soundness of the proposed method of financing the project construction. As a part of the financial considerations the Authority may consider negotiating contracts for the sale of power with the Utilities in the Railbelt Area.

After the feasibility study is completed, consideration should be given to acquiring title to or easements for the real estate involved within the project boundaries and reservoir areas.

The foregoing services will be required in addition to the engineering and environmental studies. The environmental studies are scheduled to continue through the period while the FERC license application is pending. Presumably, The Authority will also wish to continue the Public Information and Participation program. Presently, these are being proposed as a part of the engineering work and a budget to carry them through the licensing period is included.

Special legal counsel is recommended for assistance in preparing and filing the FERC License Application. A financial advisor may also be useful during the feasibility studies to assure that the project is formulated and presented in a manner that will facilitate funding.

In considering the long term requirements, the Authority must decide the manner in which it wishes to handle the organizational and coordination problems. The areas required for the execution of the program needing coordination are listed below.

1. Engineering
2. Environmental
3. Legal
4. Financial
5. Real Estate

EXHIBIT 4-1

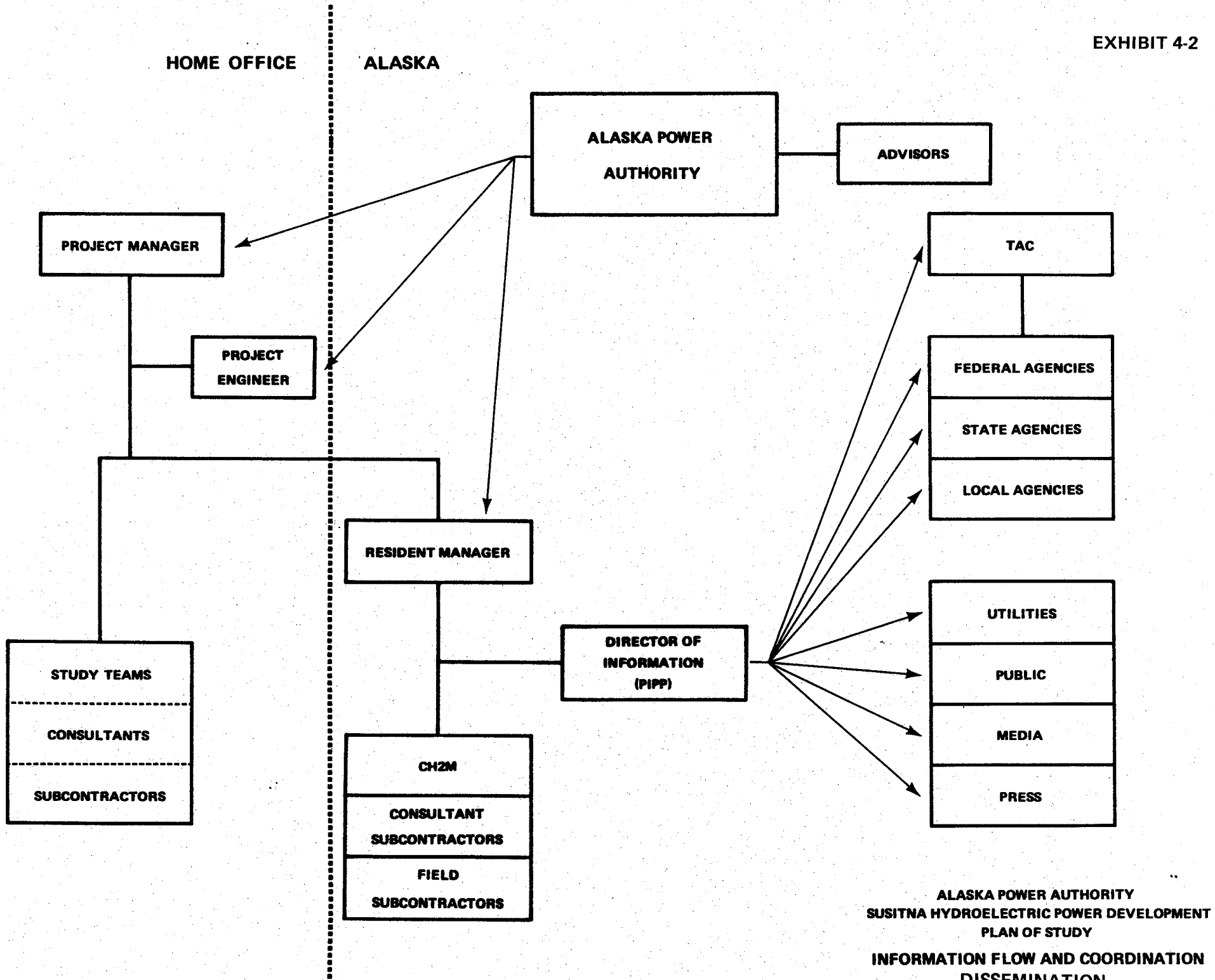
COORDINATION / ITEM	EXTERNAL: BETWEEN ENGINEER AND						INTERNAL: ENGINEER'S PROJECT TEAM				
	APA	APA Advisors	Alaska Utilities	Federal Agencies	State and Local Agencies	General Public	Harza Internal Task Groups	Harza Consultants	Harza Subcontractors	Harza Alaska Office	CH2M – Hill
Team Performance	S	–	–	–	–	–	–	M	M	M	M
Key Individual Performance	S	–	–	–	–	–	–	M	M	M	M
Contractual Matters	M	–	–	–	–	–	–	M	M	–	M
Liaison	M	M	M	M	R	R	E	E	E	E	E
Progress Reports	M	–	–	–	–	–	E	E	E	E	E
Progress Meetings	M	M	M	M	R	R	E	E	E	E	E
Planning Studies	M	M	E	E	R	R	T	T	T	T	T
Economic Studies	M	M	E	E	R	R	T	T	T	T	T
Environmental Studies	M	M	E	E	R	R	T	T	T	T	T
Engineering Field Investigations	E	E	E	E	R	R	T	T	T	T	T
Environmental Field Investigations	E	E	E	E	R	R	T	T	T	T	T
Harza Advisory Board	M	–	–	–	–	–	–	–	–	–	–
Harza Senior Professional Staff	E	E	–	E	E	E	E	E	E	E	E
Public Information	I	I	I	I	I	I	I	I	I	I	I

S – Corporate Sponsor
M – Project Manager
E – Project Engineer
T – Team Leader
R – Resident Manager
I – Information Director

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

SUSITNA PROJECT
COORDINATION RESPONSIBILITY

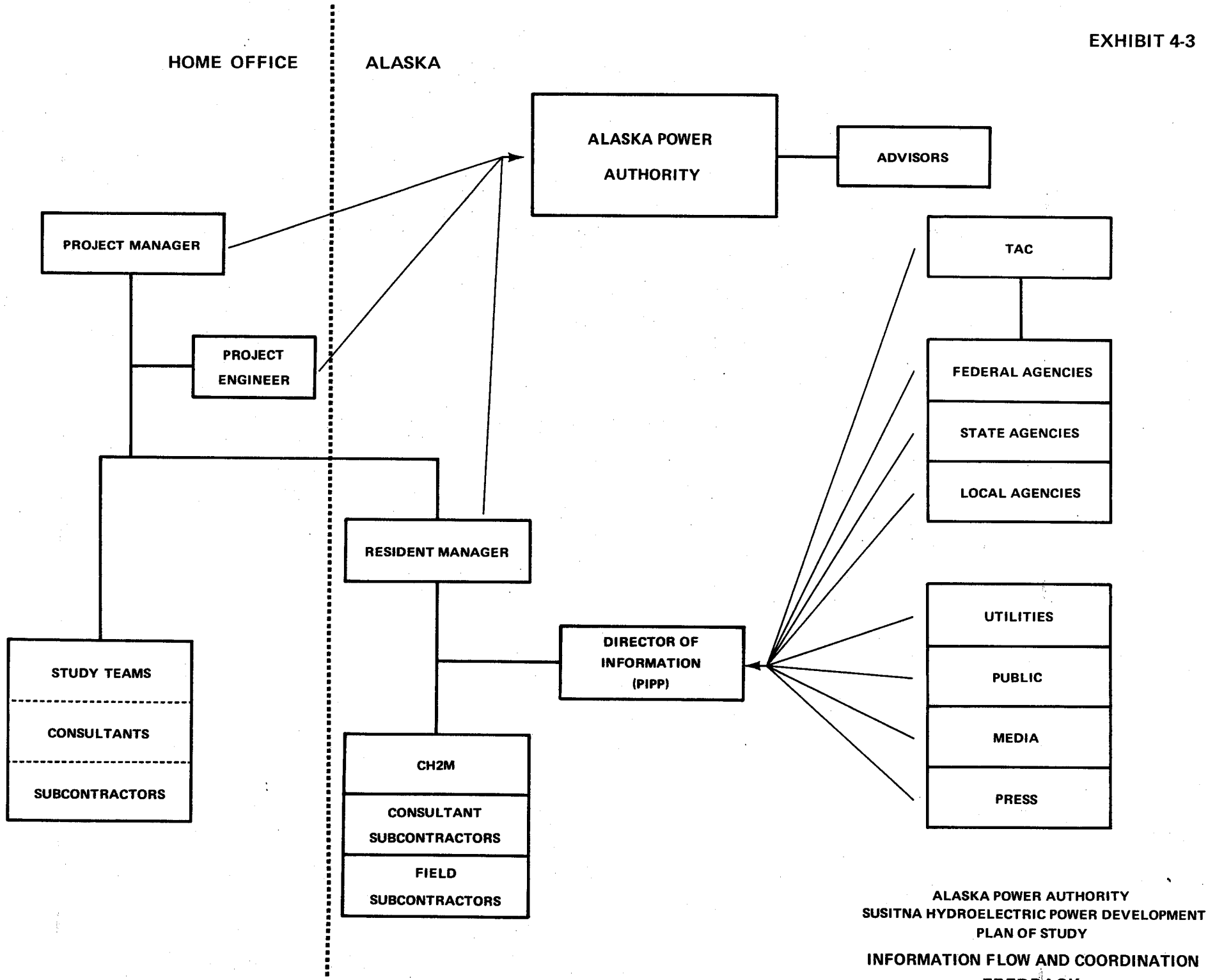
EXHIBIT 4-2



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

INFORMATION FLOW AND COORDINATION
DISSEMINATION

EXHIBIT 4-3



ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC POWER DEVELOPMENT
PLAN OF STUDY

INFORMATION FLOW AND COORDINATION
FEEDBACK