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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

FEASIBILITY STUDY

SUMMER 1982 SEISMIC SURVEYS PROGRAM
RELICT CHANNELS AND DAMSITE

AGREEMENT NO. P5700.10.13

JULY 1982

ACRES AMERICAN INCORPORATED
1577 C Street, Suite 305
Anchorage, Alaska 99501
(907) 276-4888

DCNO 61

ACRES AMERICAN INCORPORATED
AGREEMENT NO. P5700.10.13

FOR

SUMMER 1982 SEISMIC SURVEYS PROGRAM
RELICT CHANNELS AND DAMSITE

TO BE PROVIDED BY

IN CONNECTION WITH

SUSITNA HYDROELECTRIC PROJECT
ENGINEERING AND TECHNICAL SERVICES

JULY 1982

Acres American Incorporated
Consulting Engineers
1577 C Street
Anchorage, Alaska 99501

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THIS AGREEMENT made and entered into this 19 day of AUGUST in the year Nineteen Hundred and Eighty Two by and between:

Acres American Incorporated
Buffalo, New York 14202

OF THE FIRST PART

hereinafter referred to as the "Acres"

and

Woodward-Clyde Consultants Incorporated
701 Seasame Street
Anchorage, Alaska 99503
hereinafter referred to as the "Contractor"

OF THE SECOND PART

WHEREAS, Acres has entered into an agreement with the Alaska Power Authority to study the feasibility of development of a hydroelectric project known as the Susitna Hydroelectric Project located in the Upper Susitna River Basin;

AND WHEREAS, Acres may require certain seismic survey and interpretation operations and work incidental thereto to be carried out from time to time by the Contractor;

AND WHEREAS, Acres and the Contractor have agreed that the following general conditions consisting of Section one (1) through Section four (4) including Attachments, shall apply in respect to such seismic survey operations;

NOW THEREFORE THIS AGREEMENT, IN WITNESS WHEREOF the parties have caused this Agreement to be signed by their respective officers thereunto duly authorized as of this 19 day of AUGUST 1982.

Acres American Incorporated

By: John W Mayden
Title: Deputy Project Manager

Contractor

By:
Title: Vice President

SECTION 1

GENERAL PROVISIONS

INDEX TO SECTIONS OF THIS AGREEMENT

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SECTION 3: SCOPE OF WORK (Cont'd) Page

SECTION 4: PAYMENT CONDITIONS

SECTION 1 - GENERAL PROVISIONS

1.1 - Definitions

(a) The word "Contractor" shall mean the person, persons, firm, company, or corporation awarded work as hereinafter provided.

(b) The word "Acres" shall mean Acres American Incorporated, as prime consultant on the Susitna Hydroelectric Project for the Alaska Power Authority.

(c) The acronym "APA" shall mean the Alaska Power Authority.

(d) "Seismic Surveys" means an investigation of subsurface conditions being carried out by the Contractor under contract to Acres and includes all work required in connection thereto.

(e) "Engineer" means the Acres field engineer or appointed representative assigned to the Seismic Surveys.

(f) "Schedule" means the schedule of contract prices attached hereto as Attachment C and forming part of this agreement.

(g) "Site" means the area around and adjacent to the Watana Damsite of the Susitna Hydroelectric Project, together with the identified reservoir, relict channels, and related proposed borrow sites, as indicated in Attachment A.

(h) "Crew" means those personnel and equipment necessary and adequate to independently perform seismic survey operations subject to the restrictions of Secton 2.12.

1.2 - Communications and Notices

All communications between Acres and the Contractor about this Agreement shall be addressed to the following personnel at Acres and Contractor, respectively.

ACRES:

Vern Smith
Deputy Resident Manager
Acres American Incorporated
1577 C Street, Suite 305
Anchorage, Alaska 99501
(907) 276-4888
Telex: 09025450

CONTRACTOR:

Rupert G. Tart
Vice President
Woodward-Clyde Consultants Incorporated
701 Sesame Street
Anchorage, Alaska 99503
(907) 276-2335

All notices required by this Agreement to be given by either party shall be deemed to be properly given and received if made in writing to the other party by certified mail, telegram, telecopy or telex addressed, directed or hand delivered as provided in this Article, save that telex and telecopy transmittal must be confirmed as received in complete and readable copy to constitute fulfillment of contract requirements.

1.3 - Contractor's Undertakings

(a) The Constractor shall do all work and furnish all labor, tools, and equipment required for performing and completing the work awarded to him as hereinabove set forth, and as that work may be modified pursuant to the provisions of this agreement.

(b) In performing any of the work awarded under this Agreement, the Contractor shall adopt his own methods, ways, and work and select the equipment and labor subject to Acres approval and, as hereinafter provided for. Acres may, at the discretion of the Engineer, require the Contractor to utilize such equipment and means as may be deemed necessary to correct deficiencies in data collection or clarity.

1.4 - Prosecution of Work by Contractor

(a) All work shall be prosecuted with diligence and shall be done in a good, substantial, and workmanlike manner in accordance with all applicable codes and standards.

(b) The Contractor shall employ only competent men in the performance of the work herein; and the Engineer shall be notified in advance of the Contractor's intention to use, in performance of the field work, any technical personnel not previously listed in the Qualification Statement. (Attachment C-2).

1.5 - Unemployment and Social Security Payments and Workmen's Compensation

The Contractor shall be responsible for and shall pay all dues and assessments payable under the Federal Insurance Contributions Act and Unemployment Tax Act and the State Unemployment Insurance Act applicable thereto and the applicable Workmen's Compensation Insurance; and the Contractor agrees to duly report and pay over in the manner provided by law the moneys required thereby to be deducted and withheld, and to make such payments required of it by said Acts; and any such subcontractor shall be required to agree to make such reports and payment in respect to his employees or operations and shall, upon request, furnish Acres with satisfactory evidence that he has complied with the provisions of any such Act.

1.6 - Indemnity by the Contractor

The Contractor shall indemnify and save harmless Acres, APA, and its employees from and against all claims, demands, losses, costs, expenses, actions, suits, proceedings, or damages, whatsoever (including consequential damages), injury(s) including death sustained or suffered by any employee or workman of the Contractor or his agents while engaged on or in connection with any or all work performed under this Agreement, but excluding any claims or demands arising out of a negligent act or omission of Acres.

1.7 - Injuries and Infringements of Rights

The Contractor shall further insure that he, his agents, and all workmen and persons employed by him or under his supervision and/or control shall use due care and diligence that no persons or property is injured and that no rights are infringed in the prosecution of any seismic surveys. Contractor shall notify

the Engineer at the earliest opportunity of all injuries or illness occuring on the job, and assist the Engineer in completing and filing all required injury reports and forms.

1.8 - Confidentiality

The Contractor shall insure that all findings, results, determinations, and information resulting from the seismic surveys are held confidential and for the sole use of Acres and APA. All drawings, reports, and documents prepared by the Contractor in connection with services furnished hereunder shall be the property of Acres, and shall be delivered to Acres on completion of the work under this Agreement.

The Contractor shall insure that all workmen and persons employed by him regard information resulting from the seismic surveys as confidential.

1.9 - Patent Rights

The Contractor shall insure that any method of work performed or material furnished by him hereunder shall not infringe upon any patent issued or pending, covering any such method or material and claimed by the patentee or owner of the patent as an infringement, and in event of any such claim, the Contractor agrees to defend, indemnify, and hold Acres and APA harmless from any and all cost or expense arising out of the Contractor's use of any such method or material.

1.10 - Nondiscrimination Agreement, Certification and Affirmative Action Compliance

During the performance of this Agreement, Contractor agrees as follows:

(a) Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, or national origin. Such action will include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising;

layoff or termination; rates of any or other forms of compensation; and selection for training, including apprenticeship. Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

(b) Contractor will, in all solicitations or advertisements for employees placed by or on behalf of Contractor, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, or national origin.

(c) Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by Acres advising the labor union or workers' representative of contractor's commitments, under Section 202 of Executive Order Number 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(d) Contractor will comply with all provisions of Executive Order Number 11246 of September 24, 1965, and the rules, regulations, and relevant orders of the Secretary of Labor.

(e) Contractor will furnish all information and reports, required by Executive Order Number 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by Acres and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(f) Contractor and all associates performing Services must comply with the provisions of (a) the agreement between the Alaska Power Authority and the Individual Cook Inlet Native Village Corporations and the Cook Inlet Region, Inc., (b) the Bureau of Land Management Stipulations, and (c) the Alaska Department of Fish and Game Regulations applicable to the Susitna Hydroelectric Project which this Agreement supports as defined in Attachments G, E, and F, respectively.

(g) In the event of Contractor's noncomplicance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this Agreement may be cancelled, terminated, or suspended in whole or in part, and the contractor may be declared ineligible for further contracts, in accordance with procedures authorized in Executive Order Number 11246 of September 24, 1965, and other such sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rules, regulations or order of the Secretary of Labor, or as otherwise provided by law.

(h) Contractor will include the provisions of Paragraphs (a) through (g) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor, issued pursuant to Section 204 of Executive Order Number 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor.

1.11 - Insurance

(a) The Contractor shall take out, maintain, and keep in full force and effect during the currency of this Agreement, a policy of public liability and property damage insurance, in an amount that is acceptable to Acres.

(b) Prior to commencement of work, evidence shall be furnished to Acres that policies have been issued to the Vendor for the aforementioned insurance. These policies of insurance are subject to the approval of Acres.

(c) The Contractor undertakes to assume and abide by the requirements for Workmen's Compensation in the state of Alaska and covenants to provide Acres with proof of such compliance.

Insurance requirements are indicated in Attachment D.

1.12 - Time Sheets and Invoices

(a) The Contractor shall submit a daily field report to the Engineer containing the particulars of all chargeable items in accordance with the Schedule. This record is to be signed by both the Engineer and the Contractor's representative and will constitute the basis for invoice quantities.

(b) the Contractor shall submit to Acres, within two weeks of the end of each month for each monthly billing period, an invoice in triplicate giving a detailed breakdown of all charges in accordance with the annexed Schedule and showing the job title and job number and all receipts where applicable. Invoices submitted late or incompletely will be deferred to the following month for payment.

(c) Upon receipt of the invoice required by Clause 1.12(b), Acres will acknowledge receipt thereof and advise the Contractor whether or not the same has been approved for payment, and in the event that any item is not approved, will give particulars as to why it was rejected.

(d) No payment will be made by Acres for services performed under this Agreement until such time as the APA has approved individual invoices, as necessary, and has paid Acres therefore. In no case, however, will payment of approved invoiced items be delayed more than 45 days from receipt of invoice.

(e) Invoicing shall be made in accordance with the Schedule of Pay Items, with each item referenced to the applicable pay item. Man-hour breakdowns, receipts, and itemized invoices need be shown only for those items being paid as a reimbursable or hourly rate (Pay Items 3, 4 and 5). Per foot unit rate and lump sum items should be invoiced by quantity performed under the Schedule of Pay Items, without cost details.

1.13 - Termination of Agreement

(a) This Agreement shall apply to every Seismic Surveys Operation within the scope of this agreement unless this Agreement has been terminated in accordance with Clause 1.13(b), or an alternative agreement has been negotiated.

(b) The performance of the work under this Agreement may be terminated by Acres in whole, or in part:

(i) Whenever the Contractor shall default in performance of this Agreement (including in the term "default" any such failure by the Contractor to make progress in the prosecution of the work hereunder as

endangers such performance) and shall fail to cure such default within a period of ten (10) working days after receipt from Acres of notice specifying the default; and

(ii) Whenever Acres shall terminate for its convenience.

Acres may terminate this Agreement by delivery to the Contractor (by personal service or by registered mail) of a Notice of Termination specifying the extent to which performance of work under the Agreement is terminated and the date upon which such termination becomes effective.

(c) This Agreement may terminate by notice from Acres as specified in Section 1.13(b), but in any event shall terminate on December 30, 1982, without further notice, unless a modification extending the terms and pay items of this Agreement shall have been executed prior to that date.

1.14 - Applicable Regulations, Permits, and Access Requirements

Contractor represents and warrants that (1) Contractor is in compliance with and shall continue to comply with and secure compliance by its subcontractors with all applicable federal, state and local laws, rules, regulations, decisions, ordinances, stipulations and with the particular environmental and access permits and agreements contained in Attachments E, F, and G hereto (collectively "Law"), including but not limited to the provisions of Alaska Statutes 36.05 and 36.10 and regulations thereunder to the extent the same are applicable to the award and performance of this Agreement, and (2) the award of this Agreement to Contractor shall not contravene any of the foregoing Law. Contractor or its subcontractors shall bear any additional costs and defend, indemnify, and hold Acres harmless from any expense resulting from violation and correction thereof.

Contractor shall defend, indemnify, and hold Acres harmless from any liability or penalty which may be imposed on Acres by reason of any alleged violation or violation of Law by Contractor or its subcontractors and also from all claims, suits or proceedings that may be brought against Acres arising under, growing out of, or occurring by reason of work performed under this Agreement with

respect to such alleged violation or violation of Law whether brought by employees of Contractor or its subcontractors, by third parties, or by any governmental authority.

Contractor shall not, under any circumstances, enter into negotiations with any governmental authority or agency to develop acceptance of variations or revisions of law without Acres' prior approval. Acres will act as prime contact with governmental agencies on all such matters relating to this Agreement.

1.15 - Arbitration

(a) All claims, disputes, and other matters in question between the parties to this Agreement, arising out of or relating to this Agreement or the breach thereof, shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then prevailing unless the parties mutually agree otherwise. No arbitration, arising out of or relating to this Agreement, shall include, by consolidation, joinder or in any other manner, any additional person not a part to this Agreement except by written consent containing a specific reference to this Agreement and signed by Acres, the Contractor, and any other person sought to be joined. Any consent to arbitration involving an additional person or persons shall not constitute consent to arbitration of any dispute not described therein or with any person not named or described therein. This Agreement to arbitrate and any agreement to arbitrate with an additional person or persons duly consented to by the parties to this Agreement shall be specifically enforceable under the prevailing arbitration law.

(b) Notice of the demand for arbitration shall be filed in writing with the other party to this Agreement and with the American Arbitration Association. The demand shall be made within a reasonable time after the claim, dispute, or other matter in question has arisen. In no event shall the demand for arbitration be made after the date when institution of legal or equitable proceedings based on such claim, dispute, or other matter in question would be barred by the applicable statute of limitations.

(c) The award rendered by the arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

1.16 - Excusable Delays

Except with respect to defaults of subcontractors, Contractor shall not be in default by reason of any failure in performance of this Agreement in accordance with its terms (including any failure by Contractor to make progress in the prosecution of the work hereunder which endangers such performance) if such failure arises out of causes beyond the control and without the fault or negligence of Contractor. Such causes may include, but are not restricted to, acts of God or the public enemy; expropriation or confiscation of facilities; was, rebellion, sabotage or riots; and floods, that could not reasonably have been anticipated; fires, explosions, or other catastrophes; strikes or any other concerted acts of workmen; or other occurrences which are not within the control of the party affected and which by the exercise of reasonable diligence said party is unable to prevent or provide against. If the failure to perform is caused by the failure of a subcontractor to perform or make progress, and if such failure arises out of causes beyond the control of both Contractor and subcontractor and without the fault or negligence of either of them, Contractor shall not be deemed to be in default, unless (a) the supplies or services to be furnished by the subcontractor were reasonably obtainable from other sources, and (b) Acres shall have ordered Contractor, in writing, to procure such supplies or services from such other sources, and (c) Contractor shall have failed to comply with such order. Upon request of Contractor, Acres shall ascertain the facts and extent of such failure and, if any failure to perform was occasioned by any one or more of the said causes, the schedule of Work shall be revised accordingly, subject to the rights of Acres under Section 1.13 hereof, and subject to the rights of both parties under Section 1.15 hereof.

1.17 - Assignment

This Agreement is not assignable without prior written authorization from Acres, nor is any subcontract issued by Contractor for work to be performed under this Agreement assignable without prior written authorization from Acres provided

that such authorization shall not be unreasonably withheld. This Agreement is assignable by Acres without change of conditions at the direction of APA, and may be assigned to such party as APA my direct.

1.18 - Changes

(a) Contractor shall not make changes to the Scope of Work or undertake work for Acres additional to the Scope of Work without prior written authorization from Acres.

(b) Acres may, at any time, by a written order delivered to Contractor, make change to, or authorize additional work outside the Scope of Work contained herein.

(c) If any such change or addition causes an increase or decrease in the estimated cost of or time required for the performance of any part of the work under this Agreement, whether changed or not by any such order, or if such change otherwise affects any other provisions of this Agreement, and equitable adjustment shall be made by Acres:

- In the estimated cost of completion or schedule, or both; and
- In such other provisions of the Agreement as may be affected, and the Agreement shall be modified in writing accordingly.

Any claim by Contractor for adjustment under this Section must be asserted within thirty (30) days from the date of receipt by Contractor of the notification of change; provided, however, that Acres, after deciding that the facts justify such action, may receive and act upon any such claim asserted at any time prior to final payment under this Agreement. Failure to agree to any adjustment shall be a dispute within the meaning of Section 1.15 of this Agreement.

1.19 - Examination of Costs

ACRES shall have the right to examine Contractor's books, records, documents, and other evidence; and Contractor shall employ accounting procedures and practices, sufficient to reflect properly all invoice costs, including overtime and all direct costs of whatever nature claimed to have been incurred and

anticipated to be incurred for the performance of the Seismic Surveys. Such right of examination shall include inspection at all reasonable times during normal business hours at Contractor's offices, plants, or such parts thereof as may be engaged in the performance of this Agreement.

The materials described above shall be made available at the offices of Contractor at all reasonable times during normal business hours for inspection, audit, or reproduction, until the expiration of three (3) years from the date of final payment under this Agreement and for such longer period, if any, as is required by applicable statute, or by other Sections of this Agreement, or by (a) and (b) below:

(a) If this Agreement is completely or partially terminated, the records related to the work terminated shall be made available for a period of three (3) years from the date of any resulting final settlement therefor.

(b) Records which relate to disputes under Section 1.16 of this Agreement or litigation or the settlement of claims arising out of the performance of this Agreement, shall be made available until such disputes, litigation, or claims have been disposed of, and for a period of three (3) years after settlement of claims.

1.20 - Alaska Preference

Contractor agrees to comply with all applicable provisions of A.S. 36.05 and 36.10 and of any regulation thereunder with respect to employment preferences to Alaskan residents and firms in the performance of this Agreement or of any subcontract hereunder.

1.21 Subcontractor Approval

Acres reserves the right to review and approve in advance any subcontractor or subcontract proposed to perform services covered by this Agreement. Such approval shall not be unreasonably withheld.

1.22 - Governing Law

This Agreement shall be governed by and construed in accordance with the laws of the State of Alaska.

1.23 - Waiver of Contract Breach

The waiver by Acres of any breach of this Agreement or the failure of Acres to enforce at any time, or for any period of time, any of the provisions hereof, shall be limited to the particular instance; shall not operate or be deemed to waive any future breaches of this Agreement; and shall not be construed to be a waiver of any provision, except for the particular instance.

1.24 - Severability of Invalid Provisions

If any provisions of this Agreement shall be held to contravene or be invalid under the laws of any particular state, county, or jurisdiction where used, such contravention shall not invalidate the entire Agreement, but shall be construed as if not containing the particular provisions or provisions held to be invalid in the particular state, county, or jurisdiction; and the rights or obligations of the parties hereto shall be construed and enforced accordingly.

1.25 - Additional Provisions

The agreement between APA and the Alaska Native Corporations, and applicable Bureau of Land Management and Alaska Department of Fish and Game stipulations and regulations as attached to this Agreement (Attachments E, F, and G) are considered part of this Agreement, and are to be adhered to by the Contractor and incorporated as part of all sub-tier contracts as necessary to insure compliance with the said agreement and stipulations.

SECTION 2

SPECIAL PROVISIONS

SECTION 2 - SPECIAL PROVISIONS

2.1 - Work Under This Agreement

The contractor shall provide the necessary and appropriate equipment, materials, and skilled manpower to perform the subsurface investigation program and shall undertake the Seismic Surveys in accordance with this Specification.

2.2 - General

The purpose of the Seismic Surveys is to secure subsurface information regarding the geologic and geotechnical properties of the material and ground water underlying the Site, with particular emphasis on the depth to bedrock and rock quality variations. Information will be gathered by interpretation of seismic refraction velocity data generated by explosives or other suitable Contractor-furnished energy source, approved for use by the engineer.

2.3 - Location and Site Description

The site of the Seismic Surveys to be carried out under this Agreement is located near the Susitna River approximately 90 miles upstream from Talkeetna between Tsusena and Deadman Creeks (Attachment A). Work will be conducted in the abutment areas of the proposed Watana damsite and in the upper flatland areas surrounding the damsite for a distance of 10 miles upstream.

Overburden at the Site consists primarily of glacial tills, outwash, and alluvium with boulder and gravel zones, although significant rock talus exists on the valley slopes in the damsite area. Previous investigations have determined the following general stratigraphy from the surface downward in the relict channel areas. These general conditions may not prevail over the entire area of investigations, and variations will not be basis for claims or "change-of-conditions" claims, and indeed one of the objectives of this work is clarification of existing overburden and bedrock conditions.

Surficial Deposits

Organic silts and sands with cobbles and boulders.

Outwash

Silty sand with gravel and cobbles.

Alluvium and Fluvial Deposits

Sand, silt with occasional gravel to 160 feet or more.

Till/Water Lain Till

Clayey silty sand with gravel and cobbles, often plastic; up to or exceeding 65 feet thick.

Till

Silt, sand, gravel, cobbles, poorly sorted; to 60 feet thick or more.

Interglacial

Sand, gravel, with occasional silt, sorted; to 45 feet thick or more.

A typical cross section is given in attachment A, figure 4.5

Alternating sequences of alluvium, outwash, and till have been detected in the area. Scattered frozen ground is found and depth to bedrock varies from zero to greater than 500 feet. Copies of drill logs and seismic surveys from all previous investigations are available for inspection at Acres upon request of the Contractor. An extracted set of documents from the seismic surveys reports for the 1980 and 1981 field seasons, which included work in all the areas covered under this contract, have been included as Attachment B to indicate previous work. These attachments are intended as an indication of the previous seismic interpretation work and do not necessarily represent actual or anticipated conditions under this contract. Previous geotechnical reports and boring logs are available for inspection at Acres offices in Anchorage and Buffalo, New York during normal business hours.

The Fog Lakes Relict Channel has not been drilled, but is expected to be similar in materials to the Watana Relict Channel. The photos and sketch in Attachment A (labeled Figure 6.30) indicates the general conditions in the Watana Relict Channel

area. An indication of present inferred geologic conditions are shown in the figures in Attachment B.

The Damsite area constitutes a significant portion of the work. Typical conditions are shown in Attachment A by the photos labled Figure 6.18. Overburden is not expected to exceed 100 feet at any point. Heavy talus accumulations and scattered rock outcrops may occur on many of the lines.

2.4 - Scope

The work to be performed under this Agreement shall comprise all activities necessary to perform seismic refraction surveys and interpretation, as detailed below. Performance shall include all work performed by the Contractor's forces, assisted by brushing, laborer and survey support provided by Acres as specified in Section 2.9.

The actual footage of seismic survey under this contract is indeterminate, but is estimated as follows:

- Damsite: 26,600 LF
- Watana Relict Channel: 27,000 LF
- Fog Lakes Relict Channel: 37,400 LF

Tentative line locations and lengths are shown in Appendix A. The exact line locations, sequences, and length will be determined in the field by the Engineer. Alternative or secondary lines are shown for the relict channel areas, and are noted on the Tables and/or Figures as such. These represent additional or alternative locations which may be run in addition to or in lieu of the primary lines which form the basis for the estimated footages above.

The purpose of the work specified shall be to determine; within the limits and accuracy of modern equipment, knowledge and methods; the thickness and general nature of the overburden underlying each line, and seismic velocities and variations in the upper 50-100 feet of bedrock.

Final report preparation and presentation of data shall be in accordance with Section 3.6.

2.5 - Commencement and Completion

(a) Commencement

Contractor shall begin performance under this Agreement on or about August 11, 1982 (anticipated award date) and proceed such that all equipment and personnel are on-site prepared to commence work by August 20, 1982. The contractor shall diligently proceed with the Seismic Surveys until directed to cease by Acres or its Engineer, or until termination of this agreement as defined in Section 1.13. Estimated duration of the field program will be approximately 6 weeks, and normal operating conditions will be one 12-hour, daytime shift per day. The Contractor shall complete field work on or before September 30, 1982, and report submittal shall be as stated in Section 3.6.

(b) Completion

The work under this Agreement will be considered complete when either of the following take place:

(i) Final acceptance as defined in Section 2.13(b); or
(ii) Termination as defined in Section 1.13.

2.6 - Contractor-Furnished Material and Equipment

The materials and equipment to be provided by the Contractor at the Site shall include all equipment, materials, supplies and associated adjuncts required for the effective conduct of the Seismic Surveys, including but not limited to the following specific items:

All Contractor-furnished material below applies separately to each seismic crew unless otherwise specified, and shall be in sufficient quantity to perform the specified work, and shall be in good working order. Adequate spare parts shall be onsite to repair and/or replace normal or expected wear and tear, damage, and malfunctions, including all electrical and electronic components which could be expected to fail or have a significant risk of failure during the contract duration. Payment for all items under this section is implicity included entirely in the Contract Pay items set forth in the Schedule of Pay Items, Items 1 through 4.

(a) Seismic refraction electronic and electrical equipment to trigger and monitor seismic shock waves with a minimum capacity of 12 channels of input from the geophone layout.

(b) Cables, wires, and geophones to run line lengths of not less than 500 feet in a single shot, with not less than 12 geophones operating simultaneously.

(c) Swamp phones (or approved equivalent), cables and other materials necessary to run lines up to 1,000 feet through swampy or marshy terrain with standing water up to 2 feet deep.

(d) All safety and operational materials for producing the necessary seismic energy. To be specifically included are transport and storage containers which meet all FAA, ICC, BATF, Matanuska - Susitna Borough, OSHA and State of Alaska regulations for handling, transport, and storage of any explosives brought onsite.

(e) Adequate equipment and material to run the seismic surveys and obtain adequate results in overburden depths to 800 feet through all types of overburden which may be loose or dense, dry or wet, frozen or partially frozen or covered with organic material.

(f) Distinctive and readily visible stakes or hubs to mark shotline points requiring survey, including at a minimum all start, end, and turning points. Markers shall be readily recoverable by the survey crews. Contractor shall keep in mind necessary stickup and durability for markings to be visible after wind, rain, normal animal activity, seasonal vegetative color changes, and through up to 2 feet of snow.

2.7 - Field Engineering

The Engineer at the Site will determine the exact location of the Seismic Surveys and will direct the Contractor with respect to sequence of lines shot and adequacy of results.

2.8 - Interpretation and Report Standards

Interpretation in the field, as required under Sections 2.4, 3.5 and 3.6, shall be conducted to the best ability of the qualified person performing the work, considering the uncontrolloed nature of the data. Final report format and presentation shall be in accordance with Section 3.6

All interpretation shall be performed in accordance with the current standards and methods of practice in the industry. The draft and final report presentations shall represent the best interpretation of the results obtained, and shall discuss in the text as appropriate alternative interpretations considered, if any, and the quantitative confidence in the report interpretation.

2.9 - Facilities Provided to Contractor

The following will be provided for the reasonable use of the Contractor:

(a) Fuel for equipment onsite: leaded regular gas and diesel No. 1; to be provided at the camp. Contractor shall provide appropriate DOT-approved containers for transport to any equipment requiring fuel.

(b) Camp: housing and food for contractors personnel at the Site while performing activities specified in the Scope of Work.

(c) Indoor repair and storage space of approximately 200 square feet, with 120 V electrical power in reasonable quantity. Since camp power is provided by onsite generator, occasional power fluctuations, surges and outages occur. Therefore, adequate reserve battery packs should be provided to allow for at least two continuous days of field operation without access to camp power. Contractor shall also provide any necessary filtering or protection devices necessary to protect equipment being charged from damage by power fluctuations. Charging systems which charge batteries external to the instruments are encouraged.

(d) Helicopter transport of personnel to and from work sites and to and from camp and staging area. For purposes of mobilization and demoblization of personnel and equipment specifically required under this Contract, the staging point will be from an air field in the Anchorage area, or at the Contractor's request, a point within easy access of the Parks Highway near Talkeetua or Hurricane (Vicinity of Broad Pass, Alaska), at the Engineer's discretion. For purposes of transport of personnel and material throughout the operational phases of the Contract, the following transportation will prevail and be provided at no cost to the Contractor.

(i) Personnel changes/turnarounds will be staged from an airfield in the Anchorage area. The Contractor must provide at least 48 hours notice of transportation requirements to Acres, and flight departure time shall be as scheduled by Acres on the designated day. Payment for standby will be made for normal time in transit. Excessive personnel trips will be backcharged against Contractor's earnings at the direct cost to Acres.

(ii) Equipment and materials weighing less than 2000 pounds and able to be safely carried in the 9 passenger aircraft provided by Acres will be transported under the same 48 hours notification requirement, free of charge to the Contractor, from Anchorage to the Site or return. Contractor shall be responsible for loading and unloading aircraft unless specifically released from that responsibility by Acres or the aircraft operator. Contractor shall be responsible for timely delivery or parts and materials to meet scheduled departure time. Downtime will be charged against crews awaiting parts or materials which were not provided under the 48-hour notification requirement. Contractor is responsible for safe packaging of all materials and equipment to avoid damage in transit. Explosives/hazardous substance transport shall be in accordance with all applicable regulations, shall meet the aircraft operator's requirement, and may require up to 72 hours advance notice of transport requirements. Blasting caps and explosives will usually not be carried to the site on the same day, so scheduling of shipments should take

this into account. Transport of explosives to the work site from the on-site storage area will require separate flights from personnel transfers but should not present problems in schedule.

(iii) In the event the Contractor desires more expedient supply of materials, crews, or parts to reduce his downtime cost, or in the event the supplies or materials are too bulky or heavy for transport on the aircraft provided by Acres, the Contractor will provide Acres not less than four hours notice of Contractor's requirement for transportation. Pickup will be available only during normal field operations hours at either Hurricane on the Parks Highway, or Gold Creek on the Alaska Railroad, or such other pickup point as may be mutually agreed upon at the discretion of Acres. Weights and rigging must be acceptable to the pilot and must be in safe condition for flying. Each load must be under 3,000 pounds in total weight. Contractor shall be responsible for rigging and loading of any items exceeding 60 pounds per piece or exceeding the interior cargo capacity of the helicopter performing the pickup.

(e) Helicopter for transport of equipment to and between work sites with a maximum lift capacity of 3,000 pounds.

(f) Communications between work site and camp and reasonable business use of camp phone to call Anchorage area for parts, recording time worked, etc.

(g) Two laborers, for each Seismic Surveys crew, up to a maximun of two crews, for use by the Contractor in brushing, staking, and manual labor tasks related to the work under this contract. Supervisory control will be through the Engineer, but operational control will be under the Contractor's crew chief.

(h) Control surveys of line locations and elevations following completion of the line. Survey data will be provided to the contractor as the data becomes available for use in his interpretation. Contractor's personnel shall assist the survey crews as necessary to locate any points which cannot be readily found by the survey crew.

2.10 - Access

Since helicopter support is necessary for access to the sites, support of Seismic Survey operations, crew changes, equipment moves and maintenance, Acres will provide the required helicopters for access and support at no cost to the Contractor. The helicopters will be operated by crews and/or pilots experienced in external load operations. The largest helicopter for external load operations will have a maximum hook-load capacity of 3,000 pounds. Use of helicopter support by the Contractor will be subject to the terms of Section 2.9.

2.11 - Explosives Handling

The Contractor shall be responsible for securing, handling, and storing all explosive materials used, in accordance with all applicable regulations. Storage and transport containers in accordance with these regulations shall be provided by the Contractor, utilizing his own materials or rented items.

2.12 - Contractor-Supplied Workmen and Personnel

The Contractor shall provide adequate crew and technical personnel to execute the scope of work stated herein. The field technical crew member, or the Geologist (if provided), performing the interpretation, shall be experienced in seismic refraction surveys in glacial overburden, permafrost, and rugged mountainous terrain, in Alaska. The Contractor shall include in the crew a full-time technician thoroughly familiar with the repair and operation of the equipment and performance of the required line shooting and interpretation, and one individual must be designated as the Contractor's authorized field representative. A full-time geologist or geophysicist experienced and qualified in field interpretation and alternative line shooting and layout procedure shall be on the crew to facilitate field interpretation decisions and efforts to successfully obtain adequate seismic records.

Contractor must provide, as part of this proposal and Agreement, the names, qualifications, and experience of the technical personnel proposed for this job, and the position each individual would fill on the crew. Qualifications should be submitted in the format shown on Attachment C-2.

Contractor shall determine the necessary crew requirements, but Contractor personnel onsite may not exceed six persons without prior approval of the Engineer. Staggered crew mobilization or demobilization will be allowed, and due to camp space constraints, delayed arrival (to early September) of a second crew, if needed, is preferred.

At the request of the Engineer, the Contractor shall remove immediately from the Site any workmen who, in the opinion of the Engineer, misconduct themselves or are incompetent or negligent in the performance of their duties or violate camp rules; and such persons shall not be employed again on operations for Acres without written permission from Acres. Replacement personnel must be onsite within five calendar days, and nonavailability resulting from lack of personnel will be considered downtime. Copies of the camp rules are available on request from bidders, and will be provided to the successful bidder prior to start of work.

2.13 - Project Closeout

(a) Cleanup

The Contractor shall at all times keep the premises free from accumulation of waste material or rubbish caused by his employees or work. Contractor shall maintain work sites in a clean and workmanlike manner and shall comply with all state and federal regulations regarding environmental disturbance, and shall comply with the attached environmental restrictions and permits. Engineer and Contractor shall use their best efforts to minimize any damages to the environment. Shotholes need not be backfilled.

In addition, at the completion of the work and prior to final inspection, the Contractor shall remove all temporary structures and all rubbish and

waste specifically including his tools, containers, wrappers, cables, shot wires and surplus materials, and shall leave his work area "CLEAN", ready for immediate use. No burning of rubbish and/or waste materials shall be permitted on the Site. If the Contractor fails to clean up the work area

as specified, the Engineer shall clean up the sites and the Contractor shall be backcharged for the expense.

(b) Final Acceptance

Upon completion of the work, the Contractor shall so notify the Engineer in writing. Upon receipt of written notice, the Contractor and the Engineer shall conduct a final inspection of the work sites which will result in either a written final acceptance or a written punch list of deficiencies. If the final inspection results in a written punch list, the Contractor shall perform all necessary corrective work which, when work is completed, will require another final inspection of the Site.

(c) Upon completion of all work covered by this Agreement, all property produced or purchased under this Agreement shall be transferred and delivered to Acres.

SECTION 3

SITE WORK

SECTION 3 - SITE WORK

3.1 - Mobilization and Demobilization

Mobilization and demobilization shall include preparation of equipment and transportation of personnel and equipment to the project site and return upon contract completion of all of the Contrator's personnel and equipment to his base. Equipment, supplies, and crew will be transported to and from the site in accordance with the provisions of Section 2.9 at no cost to the Contractor.

(a) Mobilization

Mobilization will be considered complete when all personnel and all associated equipment and materials necessary to commence operations are on the Site and are set up at a work site ready to work.

(b) Demobilization

Demobilization will begin when seismic operations and field interpretation at the last line site has been completed and Contractor has been notified to remove his equipment. Demobilization will be considered complete when all personnel, equipment, and surplus material is removed from the Site and cleanup is complete as defined under Section 2.13.

3.2 - Fog Lakes Relict Channel

Work to be performed in the Fog Lakes Relict Channel area is estimated to total 37,400 linear feet of line, (Attachment A) in segments of about 1,100 feet each. The intent of these lines is to define the subsurface profiles of the suspected relict channels and to ascertain the probable highest point of the bedrock profile on the channel thalwegs, therefore, shifting of the lines from the locations shown may be necessary to follow the channel. At any point, a line trend may be abandoned in favor of alternative locations if it is felt to be necessary to obtain the required information. All lines shot in this area are expected to exceed 1,000 feet each. The primary objective is to determine

depth to bedrock, however, general intermediate and rock velocity data is also required. Accuracy as a percentage of overburder depth is critical, particularly in the deepest areas. All points along the line shall be staked as necessary to obtain accurate locations within one foot horizontally and vertically at start, end and turning points, and within 10 feet along the lines. All markers shall be clearly labelled with the line and point numbers.

3.3 - Watana Relict Channel

The work to be performed in the Watana Relict Channel area is predominately fill-in lines to tie into or supplement the 1980-81 lines. Total estimated footage in this area is 27,000 linear feet, (Attachment A) in straight line segments of 1,100 feet typically, and estimated line lengths of 1,100 - 6,600 feet. The primary intent of these lines is to obtain detailed top-of-rock profiles. All points along the line shall be staked as necessary to obtain accurate locations, within one foot horizontally and vertically at start, end, and turning pints, and within 10 feet along the lines. Lines are expected to be predominantly straight, with not more than one or two turning points per line.

3.4 - Damsite

An estimated 26,600 linear feet of line are to be conducted in the damsite area (Attachment A). The accurate determination of depth to bedrock and bedrock velocity variations are the primary concerns in these lines. All lines shall be staked for accuracy within one foot vertically and horizontally at critical points, and within 10 feet along the lines. Individual line segments are expected to be straight lines (in plan) at least 550 feet in length. Line segment locations will be laid out in the field by Acres prior to shooting. Minor shifts in location will be allowed to avoid excessively difficult work areas, subject to approval by the engineer.

Overburden within the damsite is shallow in mort areas, with an estimated maximum depth of 100 feet. Contractor shall have capability of geophone spacings suitable for determining depths to bedrock from 0-100 feet. Variations in bedrock velocity across the site, which may indicate fractured, sheared and

faulted areas, shall be specifically noted and investigated in detail, as approved by the Engineer.

All points along the line shall be staked as necessary to obtain accurate locations within one foot horizontally and vertically at start, end and turning points, and within 10 feet along the lines.

3.5 - Interpretation

Field interpretation shall define; within the limits imposed by field conditions, lack of survey, and the unadjusted seismic records; the approximate overburden velocity, top of bedrock location, and approximate bedrock velocity variations. Significant detail is expected with respect to bedrock conditions in the damsite area, whereas a more general conditions interpretation similar to that of Appendix B is acceptable in the relict channel areas.

Computer refinement and interpretation similar to that performed in the 1980-81 surveys shall be used under this contract, with refinement and application of experience and judgement being performed by the chief interpreters for the draft and final reports. These reports shall be prepared under the direction of, and be signed by, and experienced registered geophysicist.

3.6 - Reporting

(a) A daily field progress report shall be provided to the Engineer, listing work accomplished for that day's shift, with quantities claimed under each pay item. This report, which may be on simple fill-in form, shall be signed by the Engineer and the Contractor's Field Representative, and will constitute the record of field contract services when signed by both parties.

(b) Field interpretation shall be performed as specified in sections 2.4, 2.8, and 3.5 and provided to the Engineer in rough field format understandable to a geologist or engineer.

(c) The Contractor shall provide three copies of a draft report, complete in

all essentials but without completion of editing, proofreading, or final minor interpretation changes, to Acres by November 1, 1982. Format shall generally be as described in section 3.6 (e) below.

(d) The Contractor shall provide ten copies of the final report, in the format specified in 3.6 (e) below, to A res by November 24, 1982. This final report shall adequately address all questions, suggestions and corrections to the draft report, review of which will be completed by Acres and returned to the Contractor not later than November 12.

(e) Acres will provide to the Contractor by September 15, 1982 a sample format for report preparation and figure format, and will specify the view direction to be shown on all figures. In general, report format will be similar to that shown in Attachment B.

The text shall contain at a minimum a description of work performed, conditions encountered, line lengths, designations, shooting details, and the interpreted results giving inferred material types and conditions underlying each line. One blank Mylar copy of each necessary base map will be provided by Acres to the Contractor for use in preparing the report. Drafted ink profiles (on mylar) of each line shall be prepared in the general format shown in Attachment B with horizontal scale of one inch equals 200 feet, and vertical scale of one inch equals 100 feet unless prior approval for deviation is obtained. All figures shall be clear and readily understandable, shall clearly define top of bedrock and material velocities, shall indicate interpreted break-in-velocity locations, and indicate variations and discontinuities as detected. All orig nals shall be capable of high quality reproduction by xerox, photographic, and offset types of reproductions.

(f) Time - distance diagrams shall be provided for each line on neat drafted reproducible pencil or ink format in the "original" report only, without duplication on the extra copies. Time - distance plots need not be at the same scale as profiles, but must be clear and complete.

(g) All original field notes, plots, seismic travel records, drawings, report

original and related original contract document shall be provided to Acres upon completion of the contract.

(h) Sequential line number designations shall be assigned and utilized for all field and report work as follows, as approved by the Engineer.

- Fog Lakes lines - SL82-FL-1 and up as neccessary
- Watana Relict Channel and damsite lines - SL82-1 and up as necessary

3.7 - Standby Time

Standby time refers to that time when Seismic Surveys equipment, material, and crew are ready to begin work at the direction of the Engineer but work is not possible because of weather, lack of Engineer-provided transportation to or at the site, or other reasons beyond the control of the Contractor. However, delays in moving crews to or from the work site up to 1/2 hour total per day shall be considered normal in the operation, and will not be chargeable. Standby time shall be chargeable up to a maximum of 8 hours per shift. Standby time will be considered in accordance with the following items:

(i) When crew is detained in camp for entire shift, 8 hours of Standby will be chargeable;

(ii) When 8 or more hours of work are performed during a shift, subsequent Standby will be chargeable only for time the crew is detained at the drill site; and

(iii) When less than 8 hours of work is performed during a shift, Standby will be chargeable to make a maximum combined total of 8 hours of pay; unless crew is detained at work site.

3.8 - Special Equipment Requirements

Due to the special and varied nature of the seismic exploration activities, the Engineer may direct the Contractor to acquire and use, under the provision of

Item 5 of the Schedule, those items of special equipment that the Engineer may deem necessary to properly perform the exploration tasks. Alternatively, at the Engineer's discretion, the Engineer may acquire supplies or equipment and provide them to the Contractor for the Contractor's use in performing the Seismic Survey operations. All items acquired under this provision shall remain in the ownership of the project at all times, and the Contractor shall incur no interest or right of ownership by the use thereof.

To allow utilization of Engineer-specified equipment, modification of Contractor-owned equipment may be necessary. It is expected that such modifications would be limited to standard options, or similar items. All modifications shall be agreed to in writing by Engineer and Contractor prior to making any modifications. Any Contractor-owned equipment modified under this section will be returned to its original condition on completion of the job at the Contractor's request.

Should the Contractor have, in his ownership or available to him, items which are required under this section but not required by any other conditions in this Agreement, the Engineer may, at his discretion, negotiate with the Contractor a rental or usage rate for such Contractor material and equipment.

SECTION 4

PAYMENT CONDITIONS

SECTION 4 - PAYMENT CONDITIONS

4.1 - Mobilization and Demobilization

For all activities associated with mobilization and demobilization as described in Section 3.1 Acres will pay the Contractor the lump sum prices stated in Item 1 of the Schedule. Mobilization will be paid at completion of the mobilization, and demobilization will be paid only at completion of demobilization and sucessful acceptance of cleanup conditions. Failure to adequately perform demobilization and cleanup as specified in Section 2.13 to the satisfaction of the Engineer will be cause for nonpayment for demobilization. Payment for mobilization and demobilization shall be deemed to fully cover all expenses of transporting men, materials and equipment to and from the pickup point designated under section 2.9.

If more than one crew is utilized on a staggered field arrival schedule, Acres will pay the Contractor one-half of the lump sum price stated in Item 1 of the Schedule following completion of mobilization of the first crew to the site. Acres will pay the Contractor the other one-half of the lump sum price stated in Item 1 of the Schedule following completion of mobilization of the last crew to the site.

4.2 - Relict Channels - Unit Price

This rate shall apply to all Seismic Survey Operations conducted in the Fog Lakes and Watana Relict Channels areas, as shown in Attachment A and as specified in Sections 3.2 and 3.3.

Acres will pay the Contractor at the rate stated in Item 2 of the Schedule for each linear foot (as measured in horizontal projection) of seismic line run and accepted. This payment shall be deemed to include all interpretation and report preparation as specified in Sections 3.5 and 3.6 and all associated costs of performing the work.

4.3 - Equipment and Personnel Operating Rate

This rate shall apply to all Seismic Survey Operations in the damsite area where the crew and equipment are operational and working. The equipment and personnel operating rate shall include all operations associated with conducting Seismic Surveys and shall include all personnel, equipment and materials as specified in Section 3.4.

Acres will pay the Contractor at the rate stated in Item 3 of the Schedule for Contractor's operating and working equipment and personnel, up to a maximum of 12 hours per shift for each crew, unless specifically authorized by the Engineer to exceed this period of work. This payment shall be deemed to include all interpretation and report preparation as specified in Sections 3.5 and 3.6 and all associated costs of performing the work.

For purposes of payment regular hourly rates will apply to the first 8 hours per day to a total of 40 hours per week. Overtime hourly rates will apply to all hours over 8 hours per day or a total of 40 hours per week.

4.4 - Equipment and Personnel Available Rate

This rate shall apply to all Seismic Survey Operations where the crew and equipment are available for work but not working due to causes beyond the Contractor's control, after mobilization is complete and prior to completion of field work.

Acres will pay the Contractor at the rate per crew stated in Item 4 of the Schedule for Contractor's equipment and personnel available, up to a maximum of 12 hours per shift for each crew except as noted in Section 3.7.

For purposes of payment regular hourly rates will apply to the first 8 hours per day to a total of 40 hours per week. Overtime hourly rates will apply to all hours over 8 hours per day or a total of 40 hours per week.

4.5 - Downtime

Downtime refers to that time when the seismic instruments or associated equipment is not operating because of mechanical or electrical failure, lack of repair parts or equipment, or lack of crew. For downtime Acres will pay the Contractor at the equipment and personnel Available Rate stated in Item 4 of the Schedule as approved by the Engineer up to a cumulative total of 24 crew-hours total. No payment will be made for downtime in excess of 24 total crew-hours. Maximum downtime chargeable per shift for any crew will be 12 hours.

4.6 - Other Contractor-Supplied Equipment and Materials

Acres will pay the Contractor under Item 5 of the Schedule, the invoice cost plus 10 percent handling charge, plus actual transportation invoice costs for those items of special equipment or materials as defined in Section 3.8 supplied by the Contractor at the written request of the Engineer. No payment will be made for Contractor supplied equipment unless specifically requested by the Engineer in writing. Transportation costs shall not include Contractor transportation of materials to or form the project staging areas.

Should addition to or modification of Contractor-owned equipment be necessary to allow utilization of Engineer-specified equipment as defined in Section 3.8, the Contractor will be paid actual invoice costs on materials plus his direct labor at the "available" rate specified in Item 4 of the Schedule for all directed modification of the equipment to meet the project requirements, plus reimbursement on the same basis for returning the Contractor-owned equipment to its original condition.

No payment will be made for equipment, materials, or supplies which become lost, stuck, damaged, worn, or broken as the result of lack of maintenance, normal wear and tear, natural environmental or wildlife incidents, or negligence of the Contractor. No payment will be made for tools, cables or seismic survey supplies that, in the opinion of the Engineer, are lost, stuck, or damaged because of poor work practices or negligence of the part of the

Contractor. No payment will be made for consumables unless approved by signature of the Engineer at the Site.

4.7 - Special Payment Provisions

(a) Acres will pay the Contractor in accordance with the Schedule, and except as otherwise provided herein or by memorandum in writing signed by the Engineer, payment in accordance with the Schedule will be deemed to constitute full payment to the Contractor for all labor, equipment, material, and services supplies in respect of the Seismic Surveys.

(b) Payment as defined under Sections 4.3, 4.4, and 4.5 will be made only up to a maximum combined total of 12 hours per shift per crew. In no case will payment be made for cumulative total charges for the sum of Items 3 and 4 of the Schedule in excess of 12 hours per shift for each crew, unless approved in writing by the Engineer.

(c) For each crew, if any payment conditions defined in Sections 4.1, 4.2, 4.3, 4.4 and 4.5 occur on the same day, payment will be made according to the following priority only for the period of time said payment conditions occur simultaneously:

(i) First, for conditions defined under Section 4.1;
(ii) Second, for conditions defined under Section 4.2;
(iii) Third, for conditions defined under Section 4.3;
(iv) Fourth, for conditions defined under Section 4.4; and
(v) Fifth, for conditions defined under Section 4.5.

For each crew, no payment shall be made under more than one of the payment conditions even though more than one of these payment conditions may occur simultaneously.

(d) Statements with copies of signed shift reports and all applicable invoices for expenses must be submitted monthly, in accordance with Section 1.12 of this Agreement.

(e) If this contract is terminated Acres will pay the Contractor at the rates stated in the Schedule for work completed. Acceptable partially completed work will be paid at direct cost to the Contractor, based on audited invoices, pay and overhead costs. Unacceptable incomplete work will not be paid for.

(f) When performing under Section 4.3 or 4.4, and subject to approval of the Engineer, crews may be combined for joint operations to increase efficiency. Payment for combined crews will be made as if the crews were working independently.

(g) Upon successful completion of the field work required for the seismic lines and acceptance of the contractor's preliminary field interpretation by the engineer, Acres will pay the contractor 65 percent of the applicable rates stated in schedule C-1. Acres will pay the contractor the remaining 35 percent upon acceptance by Acres of the final interpretation and report preparation. Acceptance of the contractor's preliminary field interpretation by the engineer does not guarantee acceptance of or payment for the final interpretation or report.

(h) For purposes of initial payment following the completion of field work, the length of seismic lines run in the Watana and Fog Lakes relict channels will be based on the measured distance (either taped or taken from maps) along the completed lines as approved by the engineer. Upon completion of survey work the exact length of all lines (as measured in horizontal projection) will be calculated and the payment quantities adjusted accordingly.

ATTACHMENT A

SITE AND PROPOSED WORK LOCATION PLAN

ATTACHMENT A

SITE AND PROPOSED WORK LOCATION PLAN

The following documents are provided in this attachment, showing the location and extent of proposed work. As these figures are extracted from a previous report, references to tables or figures not included herein should be neglected. It should be noted that line numbers shown herein are planning designations only, and permanent numbers will be assigned in accordance with Section 3.6 of the Agreement.

CONTENTS	COVERAGE
Site Location	
Plate 1	Location Plan
Fog Lakes Relict Channel	
Figure 3.1	Site Location map indicating location of: Fog Lakes Relict Channel, Watana Relict Channel, Watana Dam Site.
Table 4.1	Estimated Fog Lakes Relict Channel scope under this contract is first two lines listed, or alternates at similar estimated footage.
Figure 4.1	Fog Lakes Relict Channel exploration map - showing primary and alternate proposed line location under this contract. See Table 4.1.
Watana Relict Channel	
Table 4.2	Estimated Watana Relict Channel scope under this contract, all items. Note "OR" condition on 4th and 5th items.

CONTENTS	COVERAGE
Figure 4.2	Watana Relict Channel exploration plan - showing proposed line locations under this contract. See Table 4.2.
Figure 6.30	Schematic and photos - showing Watana Relict Channel area. Topography at Fog Lakes Relict Channel area is generally similar.
Figure 4.3	Watana Relict Channel profiles - showing interpreted bedrock along two selected profiles and location of several proposed seismic lines. Actual field conditions may vary significantly from that shown.
Figure 4.5	Watana Relict Channel expanded thalweg section - illustrating an interpreted cross section and the bedrock variation interpretation, the further definition of which is the primary objective of the lines in this area under this contract.
Watana Dam Site	
Table 2.1	Estimated Dam Site scope under this contract, all items.
Figure 2.1	Dam Site exploration plan showing proposed line locations under this contract. Phase II lines shown on this plan are not included in this primary contract.
Figure 6.18	Photo showing steeper portion of dam site area downstream of proposed dam centerline (Ref. Figure 2.1).

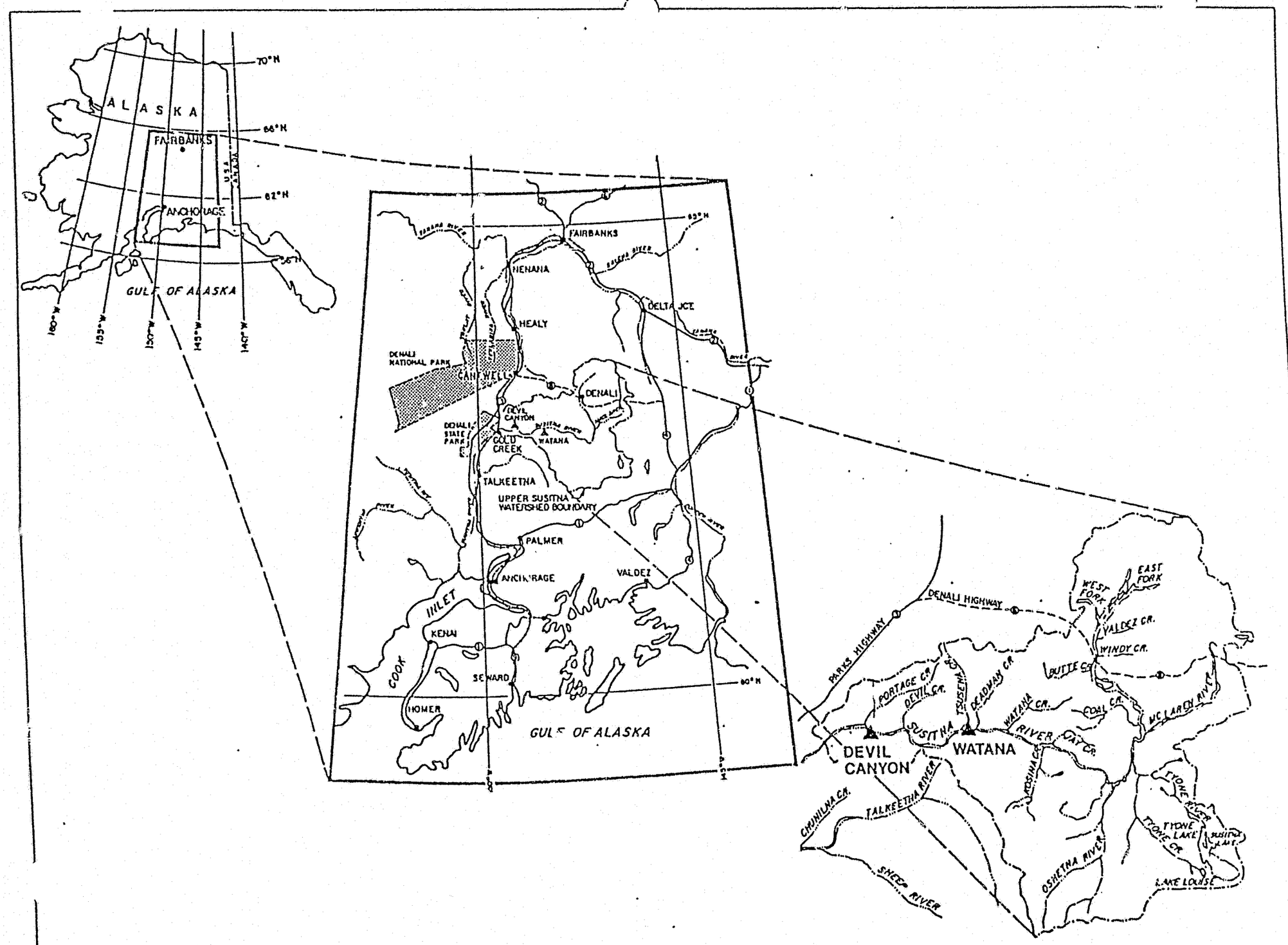
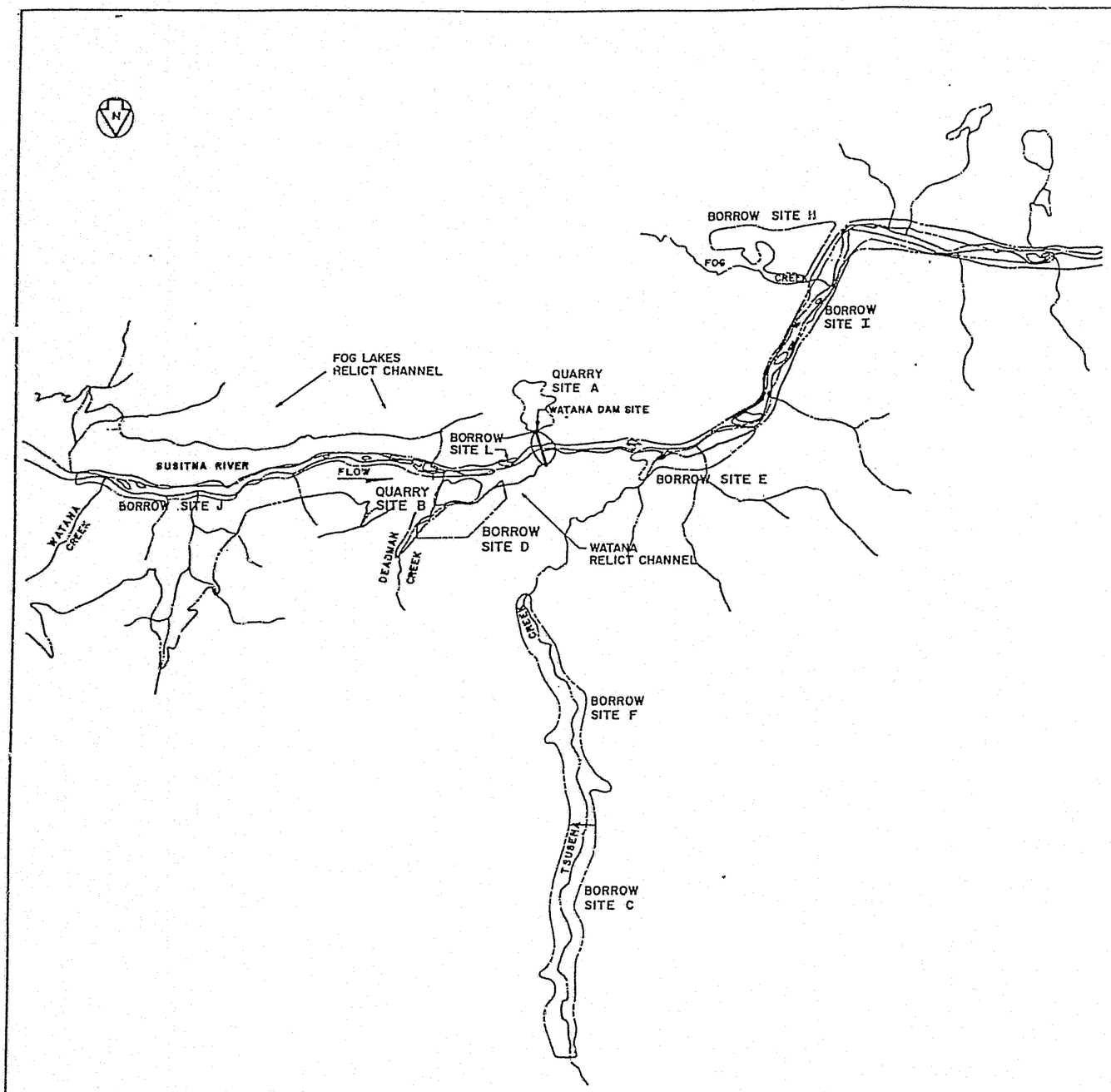
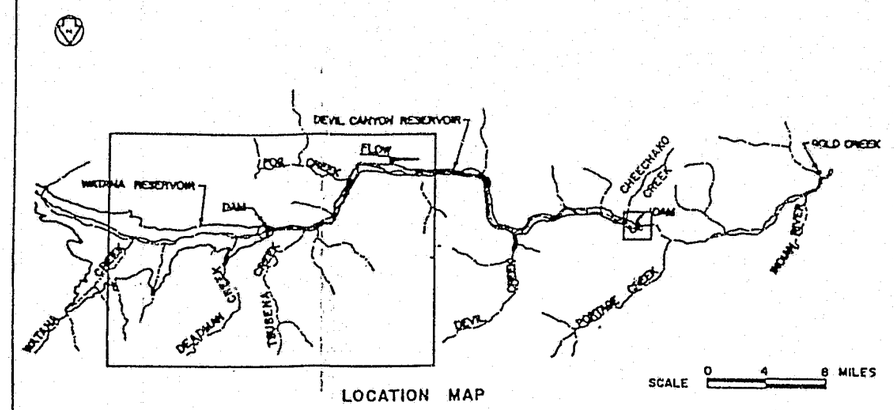


PLATE 1 | LOCATION PLAN





LEGEND

BORROW / QUARRY LIMITS

SCALE 0 1 2 MILES

WATANA
BORROW SITE MAP

FIGURE 3.1

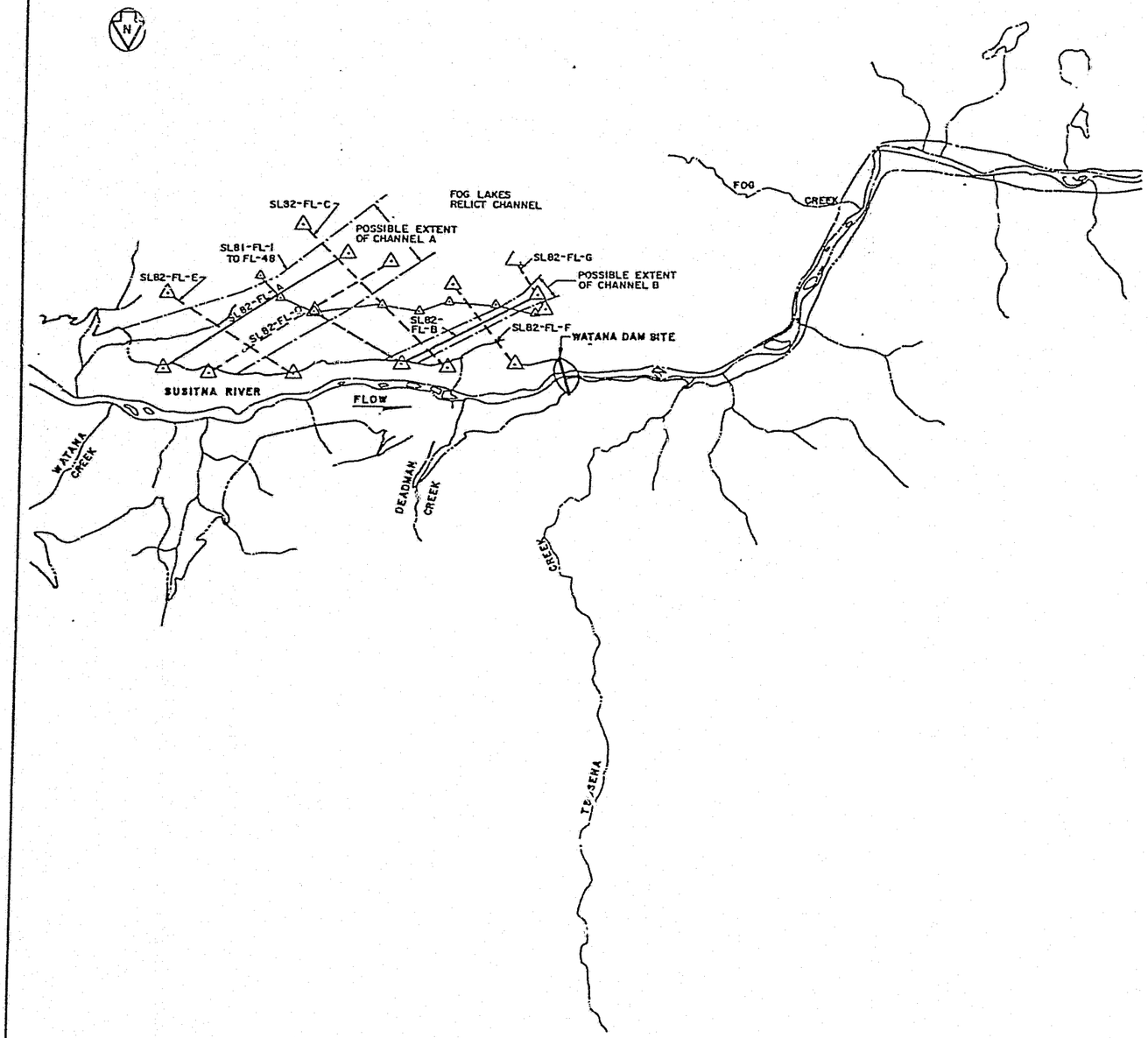
ACRES

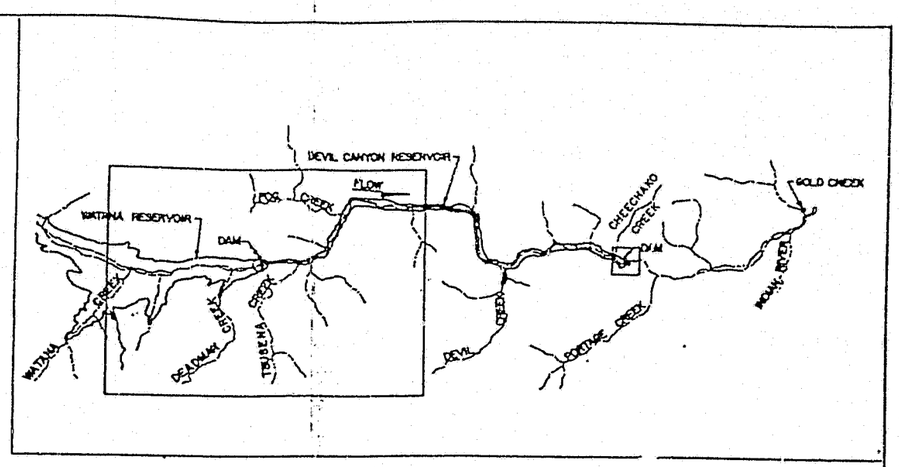
TABLE 4.1: FY83 EXPLORATORY PROGRAM
FOG LAKES RELICT CHANNEL
GEOPHYSICAL SURVEY

Seismic Refraction Line No.	Location**	Approximate Length (ft)	Purpose
SL82-FL-A	Channel A	22,000	Determine gradient of channel.
SL82-FL-B	Channel B	15,400	Determine bedrock gradient of channel.
SL82-FL-C	Channel A and B	22,000	Width of Channel A and B.
SL82-FL-D	Channel A	22,000	Determine bedrock gradient of possible additional channels.
SL82-FL-E	Channel A	15,400	Upstream width of channel.
SL82-FL-F	Channel B	9,900	Width of channel.
SL82-FL-G	Channel B	5,500	Width of channel.

*The seismic lines shown here are based on limited geologic data suggested for more complete definition of the channels. The number and orientations of seismic lines will be based on additional geologic mapping and interim field results obtained during the program.

**See Figure 4.1





LEGEND

GEOPHYSICAL SURVEYS:

SL82-FL-1 TO FL-48 — SEISMIC REFRACTION SURVEY LINE

PROPOSED GEOPHYSICAL SURVEYS:

SL82-FL-A — SEISMIC REFRACTION SURVEY - PHASE I. DASHED LINES ARE ALTERNATIVE ALIGNMENTS, DEPENDING ON FIELD GEOLOGY INTERPRETATION.

SCALE 0 1 2 MILES

FOG LAKES RELICT CHANNEL
PROPOSED FY83 EXPLORATION PLAN

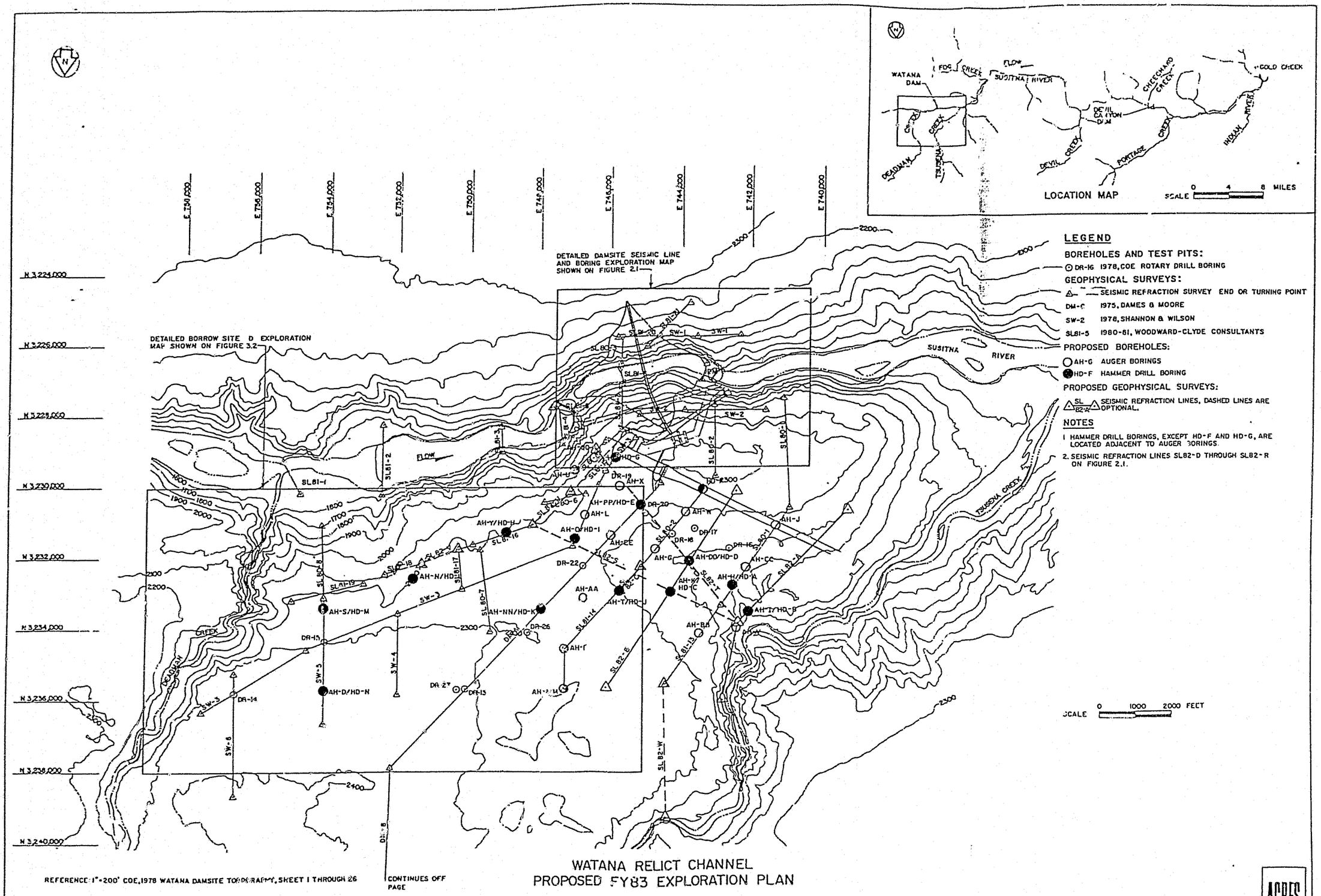
FIGURE 4.1

ACRES

TABLE 4.2: FY83 EXPLORATORY PROGRAM - PHASE 1
WATANA RELICT CHANNEL GEOPHYSICAL SURVEY

Seismic Refraction Line No.*	Location**	Approximate Length (ft)	Purpose
SL82-A	Relict channel	6,600	Bedrock depth, overburden conditions.
SL82-B	Relict channel	6,600	Bedrock depth, overburden conditions.
SL82-C	Relict channel	1,100	Tie in lines SL81-14 and SL80-2 to complete coverage.
SL82-S Or	Relict channel	6,600	Detail of main relict channel thalweg.
SL82-T	Relict channel	6,600	Same as above.
SL82-U	Relict channel	1,500	Tie in lines SL81-16 and SL81-15X to complete coverage.
SL82-V	Borrow Site D and relict channel	1,100	Tie in lines SL81-16 and SL81-18 to complete coverage.
SL82-W	Relict channel	3,500	From SL81-13 to Tsusena Creek to complete coverage.

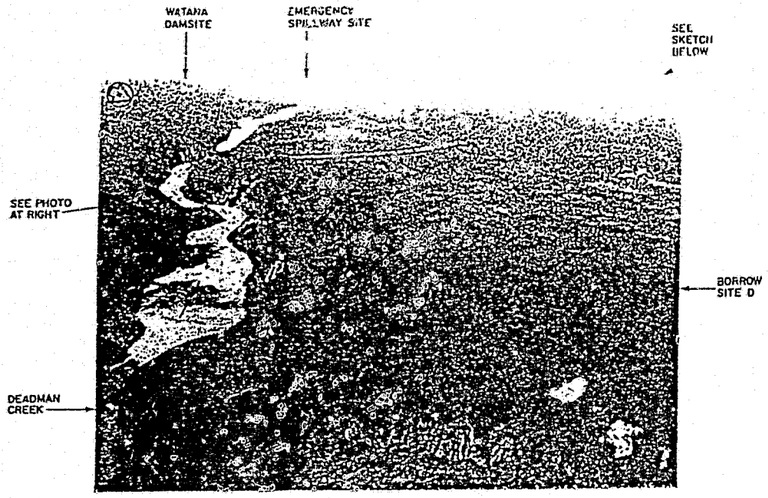
*Seismic lines listed in order of priority, SL82-D through SL82-R on Table 2.1.
**See Figure 4.2.



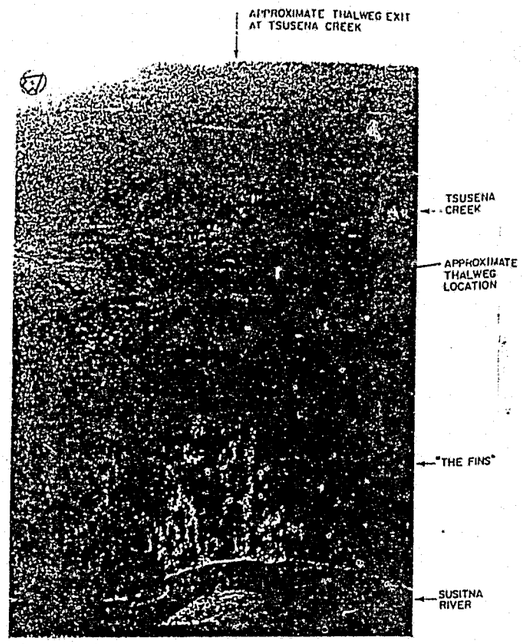
WATANA RELICT CHANNEL
PROPOSED FY83 EXPLORATION PLAN

ACRES

FIGURE 4.2



GENERAL VIEW OF INLET AREA
& WESTERN HALF OF OUTLET ZONE



SHORTEST FLOW PATH

LEGEND

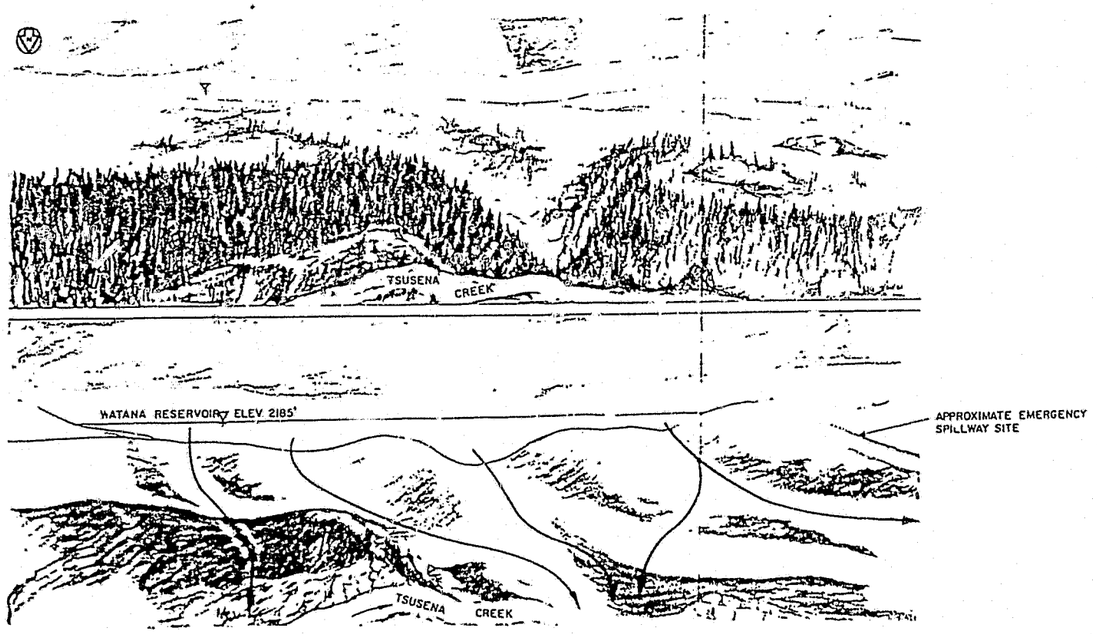
CONTACTS

APPROXIMATE NORMAL MAXIMUM OPERATING LEVEL, EL. 2185'

POSSIBLE FLOW PATH IF SEDIMENTS ARE PERMEABLE.

NOTES

1. RELICT CHANNEL PROFILES SHOWN ON FIGURES 6.31 AND 6.33
2. PHOTO LOCATIONS & RELICT CHANNEL TOP OF ROCK SHOWN ON FIGURES 6.30 AND 6.35
3. PHOTOS TAKEN SUMMER 1980 (LEFT) & SUMMER 1981 (RIGHT).
4. RIGHT PHOTO LOOKS DOWN SHORTEST POTENTIAL FLOW PATH. CLEARED SPOT NEAR CENTER OF PHOTO IS TOPOGRAPHIC LOW, EL., 2200 FEET. PHOTO LOCATION SHOWN ON LEFT PHOTO.
5. ARTISTS SKETCH LOOKS OPPOSITE DIRECTION OF RIGHT PHOTO.

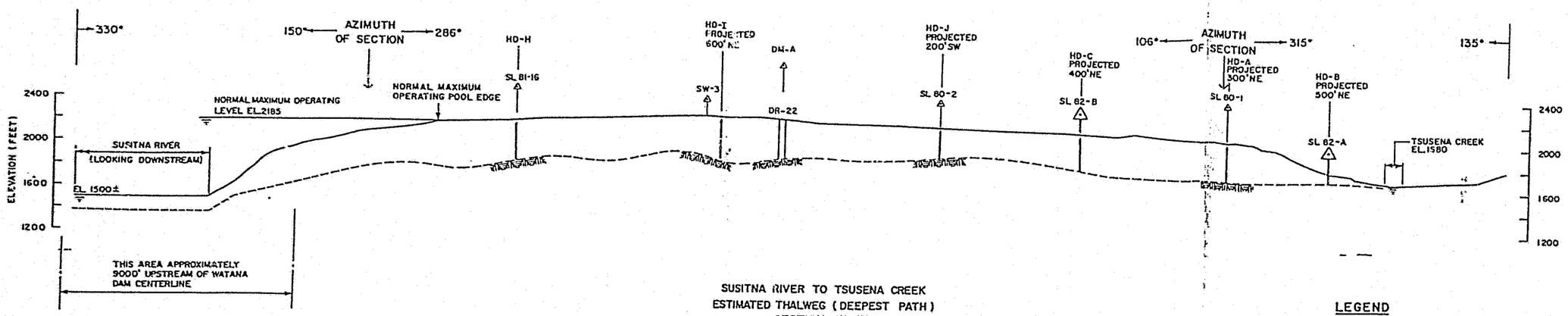


ARTIST'S SKETCH

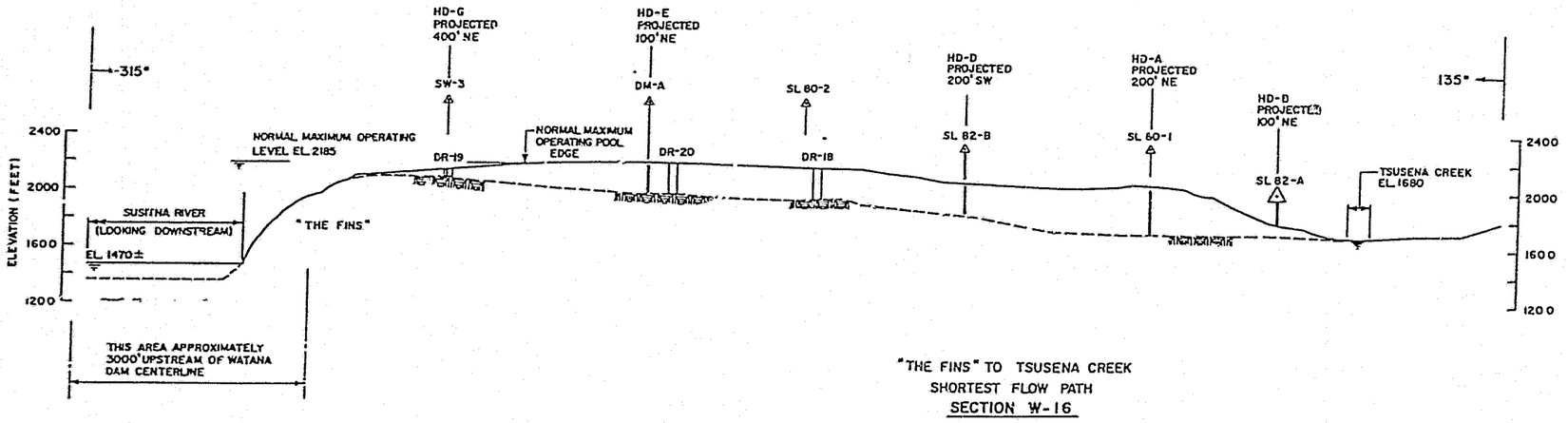
WATANA
RELICT CHANNEL PHOTOS

FIGURE 6.30

ACRES



SUSITNA RIVER TO TSUSENA CREEK
ESTIMATED THALWEG (DEEPEST PATH)
SECTION W-17



"THE FINS" TO TSUSENA CREEK
SHORTEST FLOW PATH
SECTION W-16

SCALE 0 400 800 FEET

LEGEND

CONTACTS:

----- APPROXIMATE TOP OF ROCK

GEOPHYSICAL SURVEYS:

SW-1 INTERSECTION WITH SEISMIC REFRACTION LINE

DM-C 1975, DAMES & MOORE

SW-1 1978, SHANNON & WILSON

SL 80-1 1980, WOODWARD-CLYDE CONSULTANTS

SL 81-2 1981, WOODWARD-CLYDE CONSULTANTS

BOREHOLES:

DR-19 COE ROTARY DRILL BORING

PROPOSED BOREHOLES:

HD-A HAMMER DRILL BORING

PROPOSED GEOPHYSICAL SURVEY:

SL 82-A SEISMIC REFRACTION LINE

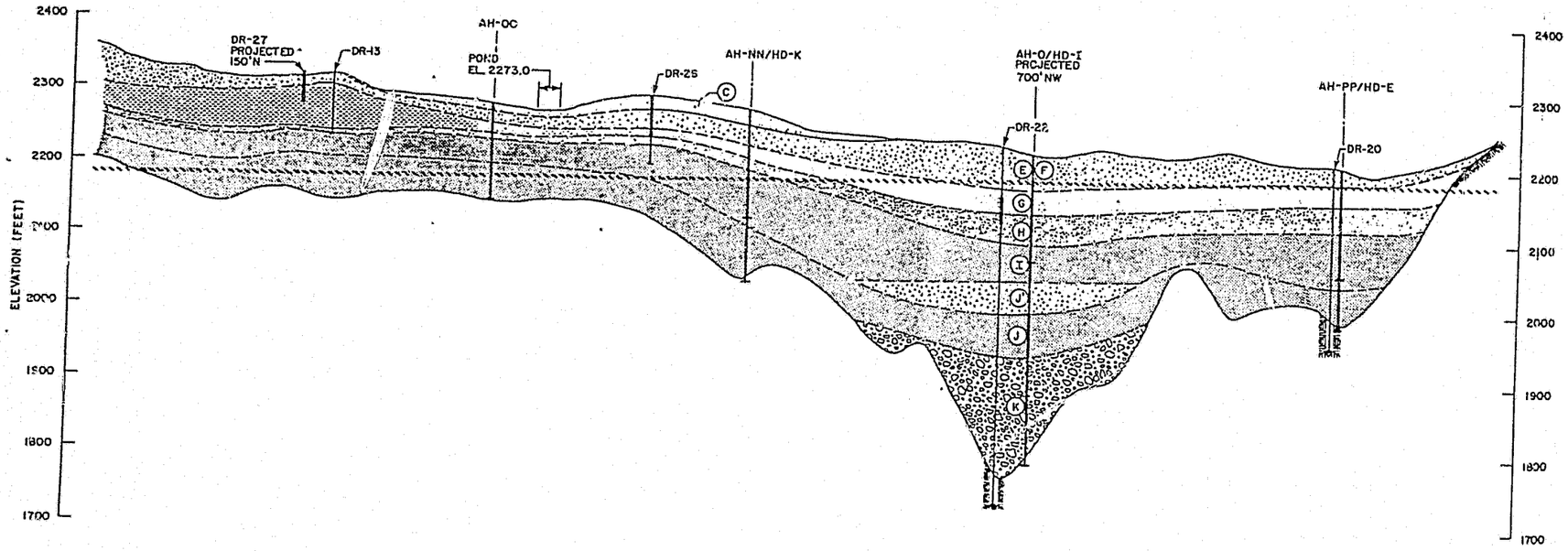
NOTES

1. PROFILE AND SEISMIC LINE LOCATIONS SHOWN ON FIGURE 4.4.
2. SECTION ALONG DM-A SHOWN ON FIGURE 4.5.
3. VERTICAL AND HORIZONTAL SCALE EQUAL.
4. SURFACE PROFILE FROM 1"= 200' TOPOGRAPHY, COE 1978 TOPOGRAPHY GENERALIZED TO 425 FEET.
5. TOP OF ROCK NORTHWEST OF SL 80-1 IS PROJECTED UP TO 300 FEET TO PORTRAY ACTUAL THALWEG PROFILE.
6. AUGER BORINGS IN RELICT CHANNEL ARE SHOWN ON FIGURE 4.2.

WATANA RELICT CHANNEL PROFILES

ACRES

~045° ← AZIMUTH OF SECTION → ~225°



LEGEND

LITHOLOGY:

C		I	
E,F		J'	
G		J	
H		K	

CONTACTS:

——— KNOWN UNIT CONTACT

– – – INFERRED UNIT BOUNDARY

BEDROCK SURFACE WHERE DRILLED.

NORMAL MAXIMUM OPERATING LEVEL EL. 2185

BOREHOLES:

DR-26 COE ROTARY CORE BORINGS

NOTED AS FROZEN DURING DRILLING

PROPOSED BOREHOLES:

HD-E HAMMER DRILL BORING

AH-B AUGER BORING

NOTE

1. LOCATION OF SECTION ALONG SEISMIC LINE DH-8, ON FIGURE 4.4.

SCALE 0 80 160 FEET VERTICAL

SCALE 0 400 800 FEET HORIZONTAL

WATANA RELICT CHANNEL-EXPANDED THALWEG SECTION

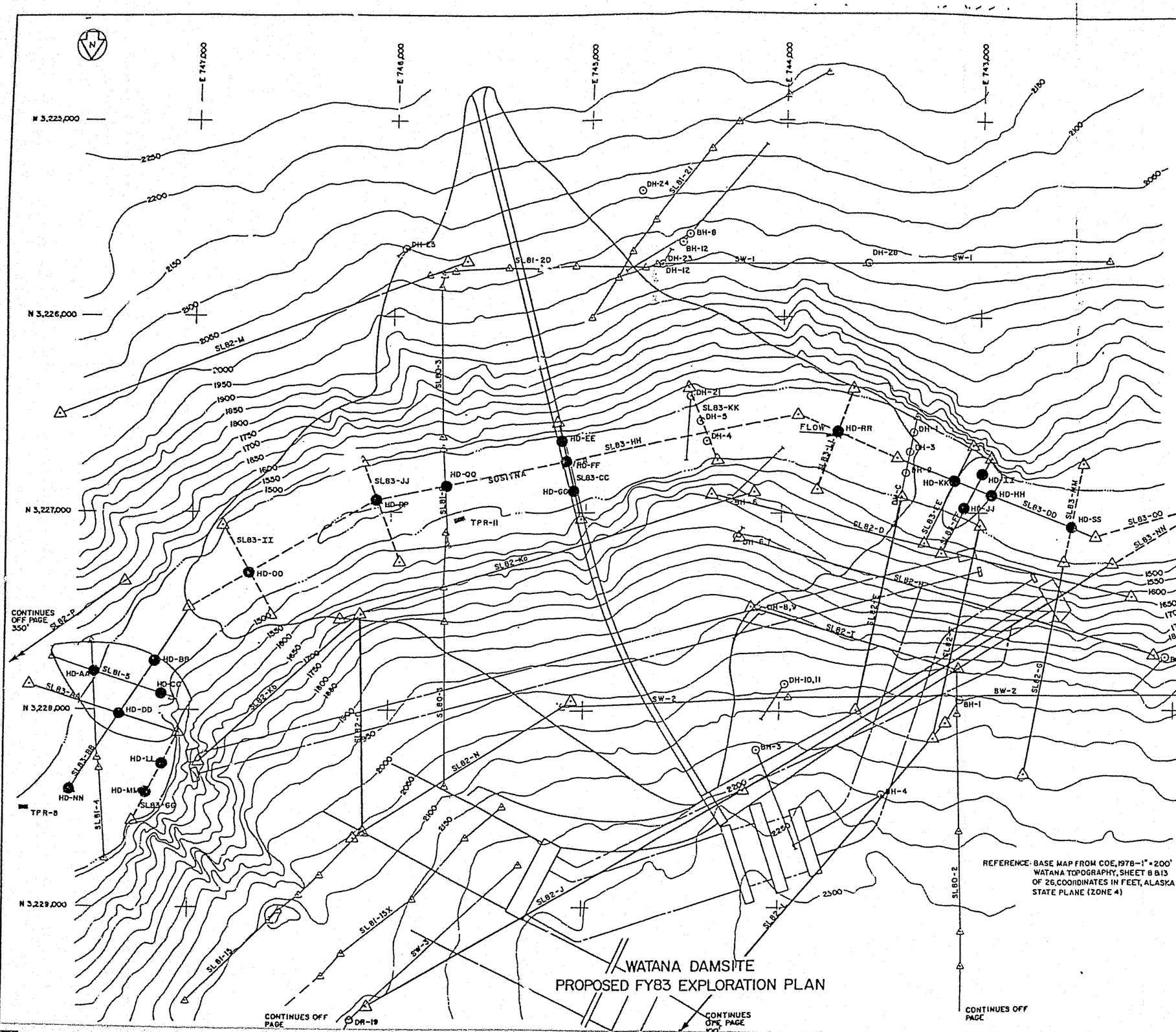
AGRES

FIGURE 4.5

TABLE 2.1: FY83 EXPLORATORY PROGRAM - PHASE I
WATANA DAMSITE GEOPHYSICAL SURVEYS

Seismic Refraction Line No.*	Location**	Approximate Length (ft)	Purpose
SL82-D***	Downstream Portals, BH-6 towards BH-2	2,200	Depth to bedrock, overburden thickness.
SL82-E	Downstream Portals, DM-C to SW2	1,100	Overburden thickness, bedrock conditions.
SL82-F	Downstream Portals, SW-2 to river	1,100	Overburden thickness, bedrock conditions.
SL82-G	Flip Bucket, Spillway Area Rock Stability	1,100	Overburden thickness, bedrock conditions in "Fingerbuster".
SL82-H	Downstream Portals, mid slope	2,200	Overburden thickness, bedrock conditions, NW and N shears.
SL82-I	DH-9 to SL80-2	1,100	Overburden thickness, bedrock conditions, NW and N shears, overall slope stability.
SL82-J	Spillway	4,400	Overburden thickness, bedrock conditions, NW and N shears.
SL82-Ka	North Abutment	2,200	Overburden thickness, bedrock conditions, NW and N shears.
SL82-Kb	Upstream North Abutment	1,100	"The Fins," NW and N shears.
SL82-L	Powerhouse Area	2,200	"The Fins," NW and N shears.
SL82-M	Upstream South Abutment	2,200	NW and N shears.
SL82-N	North Abutment, SL81-15 to SW-2	1,300	NW and N shears.
SL82-O	North Abutment	1,100	"The Fins," and possible east-trending structures.
SL82-P	Upstream South Abutment	1,100	"The Fins".
SL82-Q	Downstream Portal Area, Right Bank	1,100	"Fingerbuster".
SL82-R	Downstream Portal Area, Right Bank		
	TOTAL	26,600	

*Seismic lines listed in order of priority, seismic lines SL82-A through C are listed on Table 4.2.
**See Figure 2.1.
***Upon execution of work, temporary line letters will be replaced with a permanent chronologically sequential line number.



LEGEND

BOREHOLES AND TEST PITS:

- DH-1 1978, COE } DIAMOND CORE BORING, HORIZONTAL PROJECTIONS AS SHOWN
- BH-8 1980-81, AAI }
- TPR-11 1981, AAI BACKHOE TEST PIT

GEOPHYSICAL SURVEYS:

- SW-1 SEISMIC REFRACTION SURVEY END OR TURNING POINT
- DM-C 1975, DAMES & MOORE
- SW-1 1978, SHANNON & WILSON
- SL 80-1 1980-81, WOODWARD-CLYDE CONSULTANTS

PROPOSED BOREHOLES:

- HD-AA HAMMER DRILL BORING

PROPOSED GEOPHYSICAL SURVEY:

- SL82-A SEISMIC REFRACTION LINE - PHASE I
- SL83-AA SEISMIC REFRACTION LINE - PHASE II (DASHED LINES ARE OPTIONAL)

NOTE

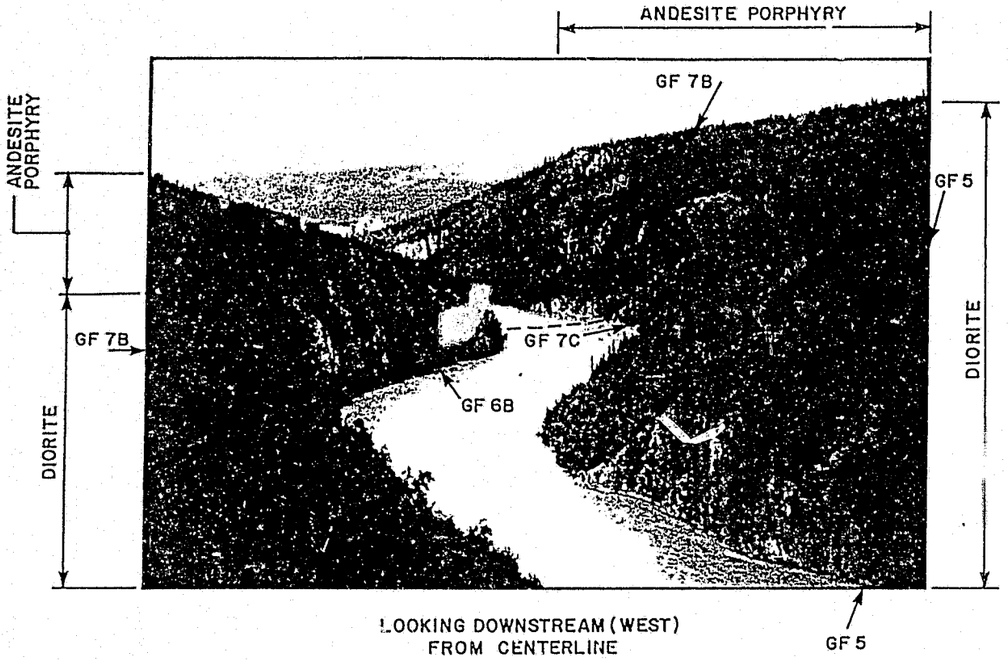
1. SEISMIC REFRACTION LINES SL82-A THROUGH SL82-C ARE SHOWN ON FIGURE 4.2.

SCALE 0 200 400 FEET

REFERENCE: BASE MAP FROM COE, 1978 - 1" = 200' WATANA TOPOGRAPHY, SHEET 8 B13 OF 26, COORDINATES IN FEET, ALASKA STATE PLANE (ZONE 4)

WATANA DAMSITE
PROPOSED FY83 EXPLORATION PLAN

FIGURE 2.1



NOTES:
1. GEOLOGIC FEATURES GF5, GF 6B, GF 7B, AND GF 7C DESCRIBED IN SECTION 6.1.
2. DASHED LINE IS ANDESITE PORPHYRY & DIORITE CONTACT.

WATANA
GEOLOGIC FEATURES DOWNSTREAM OF CENTERLINE

FIGURE 6.18

ACRES

ATTACHMENT B

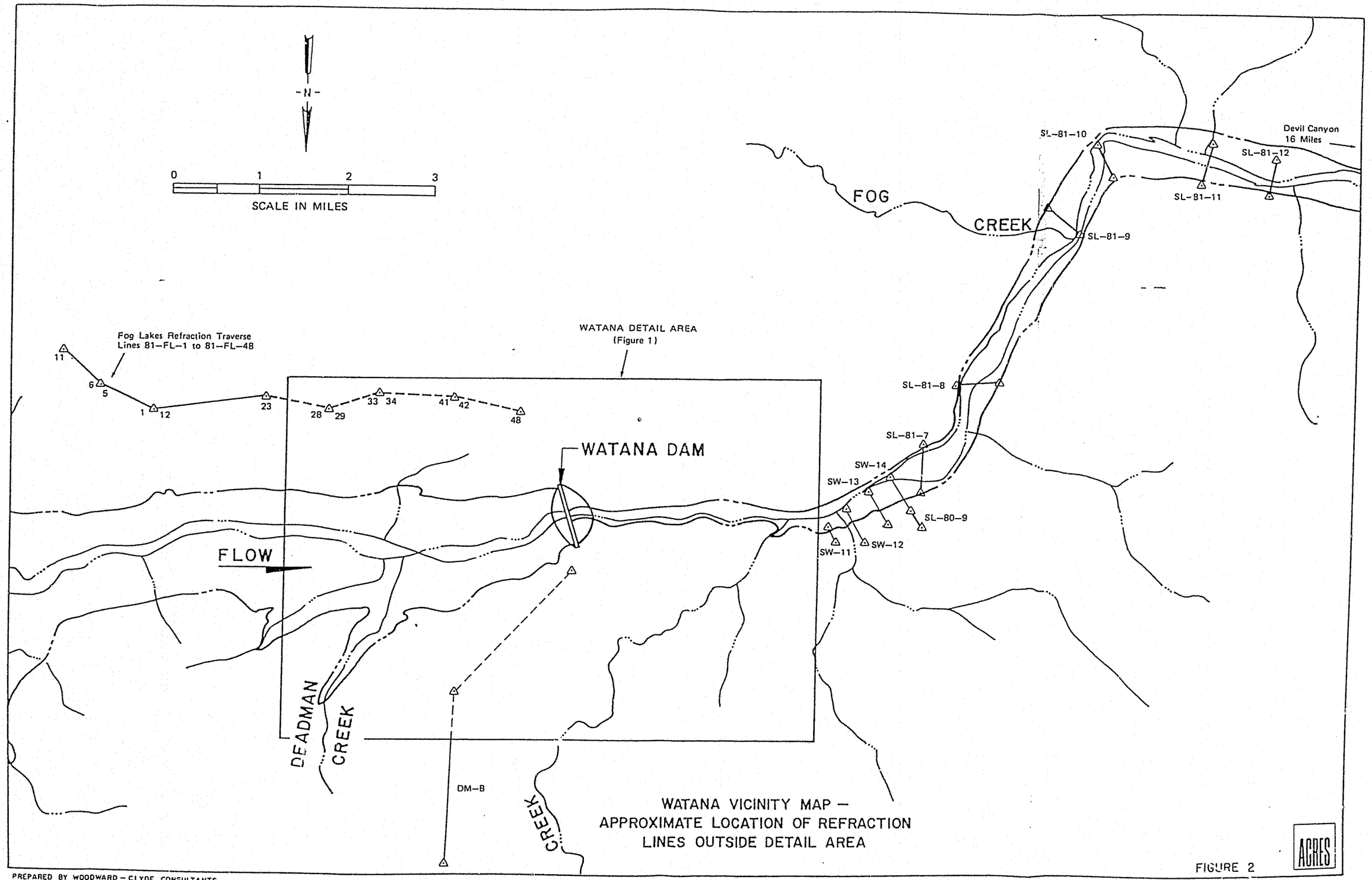
SITE INFORMATION PACKAGE - PREVIOUS WORK
SUSITNA HYDROELECTRIC PROJECT
1980-81 GEOTECHNICAL REPORT, EXTRACTS

ATTACHMENT B

SITE INFORMATION PACKAGE - PREVIOUS WORK
SUSITNA HYDROELECTRIC PROJECT
1980-81 GEOTECHNICAL REPORT, EXTRACTS

The attached extracts from the Geotechnical Report are provided as examples of the report format required (subject to minor modifications to meet current report standards) and of the conditions encountered in recent explorations.

CONTENTS	COVERAGE
Previous Explorations	
Figure 2	Fog Lakes seismic line locations
Figure 5.1a	Watana dam site and relict channel seismic line locations
Figure 5.1b	Watana dam site seismic line locations
Appendix I	
Extracts from Seismic Refraction Surveys, 1981 report	



WATANA VICINITY MAP –
APPROXIMATE LOCATION OF REFRACTION
LINES OUTSIDE DETAIL AREA

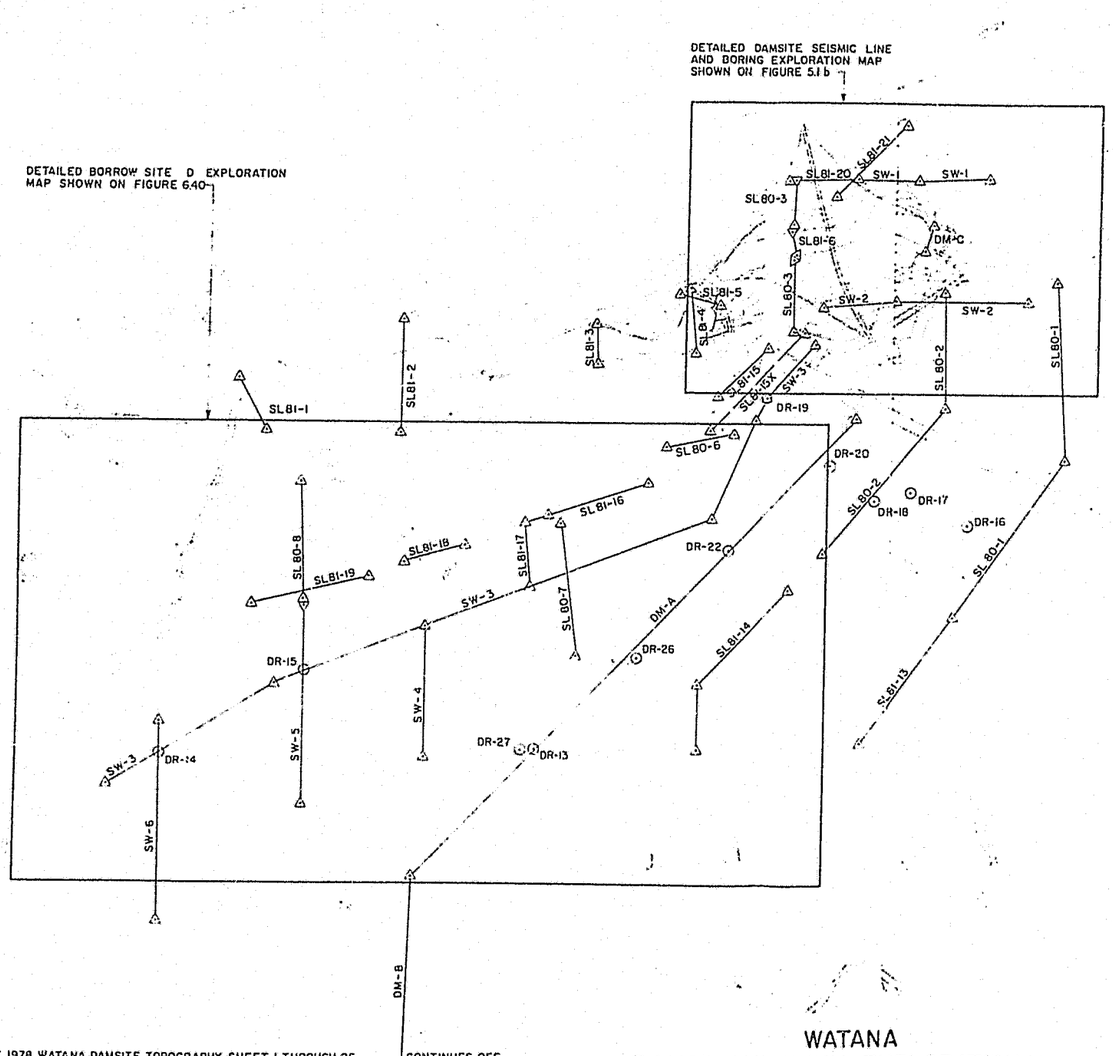
PREPARED BY WOODWARD – CLYDE CONSULTANTS

ACRES

FIGURE 2

DETAILED BORROW SITE D EXPLORATION MAP SHOWN ON FIGURE 6.40

DETAILED DAMSITE SEISMIC LINE AND BORING EXPLORATION MAP SHOWN ON FIGURE 5.1 b



REFERENCE 1"=200' COE, 1978 WATANA DAMSITE TOPOGRAPHY, SHEET 1 THROUGH 26

CONTINUES OFF PAGE SEE NOTE 9

LOCATION MAP

SCALE 0 4 8 MILES

LEGEND

BOREHOLES AND TEST PITS:

DR-16 1978, COE ROTARY DRILL BORING

GEOPHYSICAL SURVEYS:

SEISMIC REFRACTION SURVEY END OR TURNING POINT

DM-C 1975, DAMES & MOORE

SW-2 1978, SHANNON & WILSON

SL81-5 1980-81, WOODWARD-CLYDE CONSULTANTS

NOTES

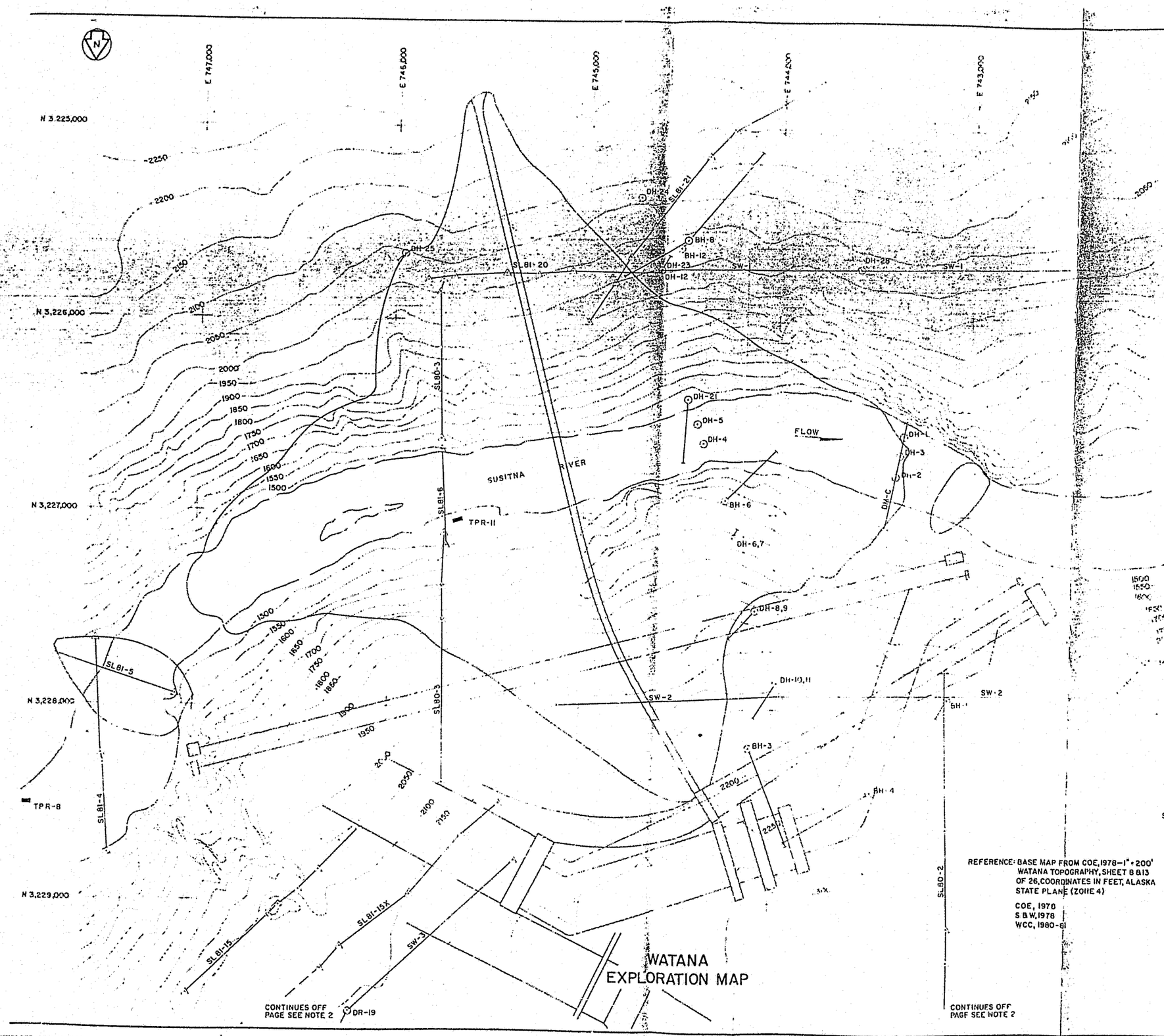
1. DETAILED EXPLORATION MAP OF DAMSITE ON FIGURE 5.1b
2. BORROW SITE D TEST PITS AND AUGER HOLES, AS WELL AS SEISMIC LINES, SHOWN ON FIGURE 6.40.
3. DETAILED SECTION ON DM-A & B ON FIGURE 6.31.
4. RIVER ALLUVIUM TEST PITS SHOWN ON FIGURES 6.51 AND 6.52.
5. RELICT CHANNEL AREA MAP SHOWN ON FIGURE 6.35.
6. CONTOUR INTERVAL 100', ENLARGED AND TRACED FROM REFERENCED BASE MAP.
7. D & M SEISMIC LINE LOCATIONS CORRECTED PER COE SURVEY AND REFERENCED BASE MAPS.
8. S & W SEISMIC LINE LOCATIONS CORRECTED FROM ORIGINAL FIELD BOOKS AND S & W, 1978.
9. LINE DM-B CONTINUED 11,000 FEET NORTH OF TURNING POINT SHOWN
10. COE EXPLORATION LOGS AND S & W SEISMIC PROFILES AS REFERENCED
11. WCC SEISMIC REFRACTION DATA SHOWN IN APPENDICES H AND I
12. NORTHING GRID LINES ARE IN ERROR BY APPROXIMATELY 50 FEET, NORTH, FROM STATION N 3,232,000 TO N 3,234,000

SCALE 0 1000 2000 FEET

WATANA
DAMSITE VICINITY-EXPLORATION MAP

ACRES

FIGURE 5.1a



LEGEND

BOREHOLES AND TEST PITS:

- 1978, COE } DIAMOND CORE BORING, HORIZONTAL PROJECTIONS AS SHOWN
- 1980-81, AAI }
- 1981, AAI BACKHOE TEST PIT

GEOPHYSICAL SURVEYS:

- SW SEISMIC REFRACTION SURVEY END OR TURNING POINT
- DH 1975, DAMES & MOORE
- SW 1978, SHANNON & WILSON
- SL 80 1980-81, WOODWARD-CLYDE CONSULTANTS

NOTES

1. GEOLOGIC SECTIONS SHOWING EXPLORATION DETAILS ON FIGURES 6.4 THROUGH 6.8.
2. EXTENSIONS OF EXPLORATIONS TO NORTH AND OVERALL SITE EXPLORATION PLAN SHOWN ON FIGURE 5.1a.
3. CONTOUR INTERVAL 50', TRACED FROM REFERENCED BASE MAP.
4. S & W SEISMIC LINE LOCATIONS CORRECTED FROM ORIGINAL FIELD BOOKS AND S & W, 1978.
5. FOG LAKES SEISMIC LINE (SL81-FL1 THRU 4B) LIES JUST OFF TOP OF PAGE (SEE APPENDIX I).
6. COE EXPLORATION LOGS AND S & W SEISMIC PROFILES AS REFERENCED.
7. AAI DRILL LOGS AND SELECTED COE BORING RELOGS SHOWN IN APPENDIX B.
8. WCC SEISMIC REFRACTION LINES SHOWN IN APPENDICES H AND I.

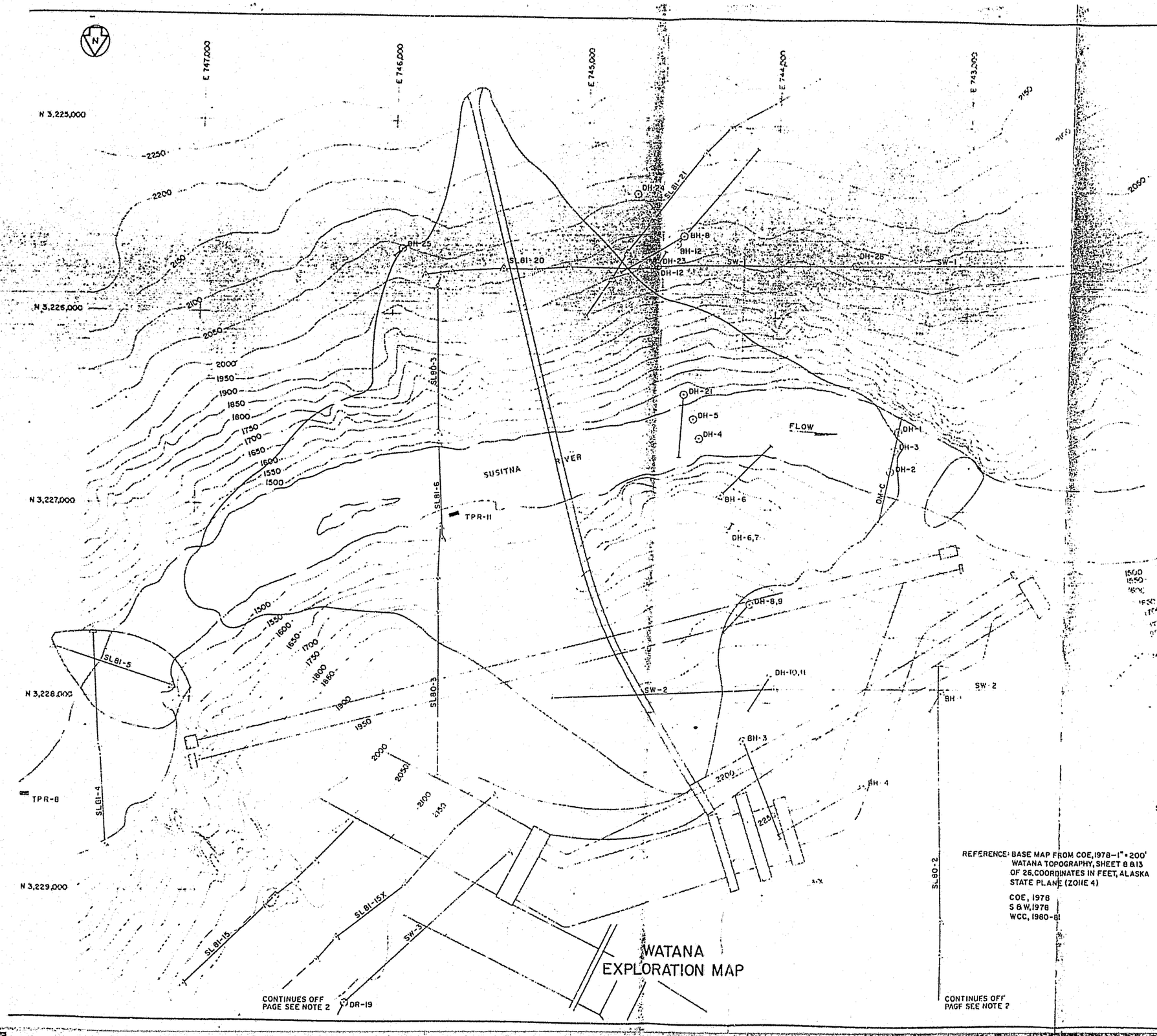
REFERENCE: BASE MAP FROM COE, 1978—1" = 200'
WATANA TOPOGRAPHY, SHEET 8 813
OF 26, COORDINATES IN FEET, ALASKA
STATE PLANE (ZONE 4)

COE, 1978
S & W, 1978
WCC, 1980-81

WATANA EXPLORATION MAP

FIGURE 5.1 b

ACRES



LEGEND

BOREHOLES AND TEST PITS:

- 1976, COE — DIAMOND CORE BORING, HORIZONTAL PROJECTIONS AS SHOWN
- 1980-81, AAI — DIAMOND CORE BORING, HORIZONTAL PROJECTIONS AS SHOWN
- 1981, AAI — BACKHOE TEST PIT

GEOPHYSICAL SURVEYS:

- SW — SEISMIC REFRACTION SURVEY END OR TURNING POINT
- DM — 1975, DAMES & MOORE
- SW — 1978, SHANNON & WILSON
- SL 80 — 1980-81, WOODWARD-CLYDE CONSULTANTS

NOTES

1. GEOLOGIC SECTIONS SHOWING EXPLORATION DETAILS ON FIGURES 6.4 THROUGH 6.8.
2. EXTENSIONS OF EXPLORATIONS TO NORTH AND OVERALL SITE EXPLORATION PLAN SHOWN ON FIGURE 5.1a.
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6. COE EXPLORATION LOGS AND S & W SEISMIC PROFILES AS REFERENCED.
7. AAI DRILL LOGS AND SELECTED COE BORING RELOGS SHOWN IN APPENDIX B.
8. WCC SEISMIC REFRACTION LINES SHOWN IN APPENDICES H AND I.

SCALE 0 200 400 FEET

REFERENCE: BASE MAP FROM COE, 1978—1" = 200' WATANA TOPOGRAPHY, SHEET 8 &13 OF 26, COORDINATES IN FEET, ALASKA STATE PLANE (ZONE 4)

COE, 1978
S & W, 1978
WCC, 1980-81

WATANA EXPLORATION MAP

FIGURE 5.1 b

ACRES

SUSITNA HYDROELECTRIC PROJECT
SEISMIC REFRACTION SURVEYS
1981

Submitted to

R & M Consultants
5024 Cordova
Anchorage, Alaska 99502

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

This report presents the results of geophysical surveys performed during the spring, summer, and fall of 1981 on the Upper Susitna River, Alaska, approximately 125 miles north of Anchorage. These surveys were performed under contract with R & M Consultants (R & M) as part of their subcontract with Acres American Incorporated (AAI).

The 1981 geophysical program was essentially a continuation of surveys performed during 1980 under the same contract. Results of the 1980 surveys were submitted to R & M in a report dated 19 December 1980. Interpretations included in this report are based in part on the 1980 work, on previous seismic refraction surveys (Dames and Moore, 1975; Shannon and Wilson, 1978), and on limited boring and surface mapping information.

Locations of all refraction traverses from 1975 through 1981 are shown in Figures 1, 2, and 3. Figure 1 covers the immediate area of the proposed Watana Dam site and Figure 2 shows line locations outside of the immediate site area but in the same vicinity. Figure 3 shows line locations near the proposed Devil Canyon Dam site.

1.1 Purpose

Geophysical surveys from 1981 and from past years were accomplished as part of feasibility studies for the Susitna Hydroelectric Project proposed by the Alaska Power Authority. Seismic refraction and limited magnetometer surveys were intended to investigate the nature and distribution of bedrock and overburden materials and to supplement data from other sources such as borings and geologic mapping.

For all surveys run during 1980 and 1981, line locations were specified by AAI. Some of the 1981 locations were recommended by Woodward-Clyde Consultants at the close of the 1980 season, and incorporated in the 1981 program.

1.2 Scope

A total of 72,900 ft of refraction line was run in 1981 during three separate field efforts (spring, summer, and fall) to bring the two-year total to approximately 100,000 linear feet. In addition, approximately 3,000 ft of magnetometer line was run near Devil Canyon in an unsuccessful attempt to detect buried mafic dikes.

The spring seismic refraction survey consisted of 21,900 ft of line at 12 locations (Lines 81-1 through 81-12) across the river and adjacent low-lying areas near the Watana site (Figures 1 & 2). Field work was accomplished between 1 April and 14 April 1981 when the river was frozen. The low water level and low water velocity plus access afforded by ice allowed refraction surveys to be run in areas where they would be infeasible later in the year. A draft report of the results of the spring work was submitted to R & M dated 18 June 1981.

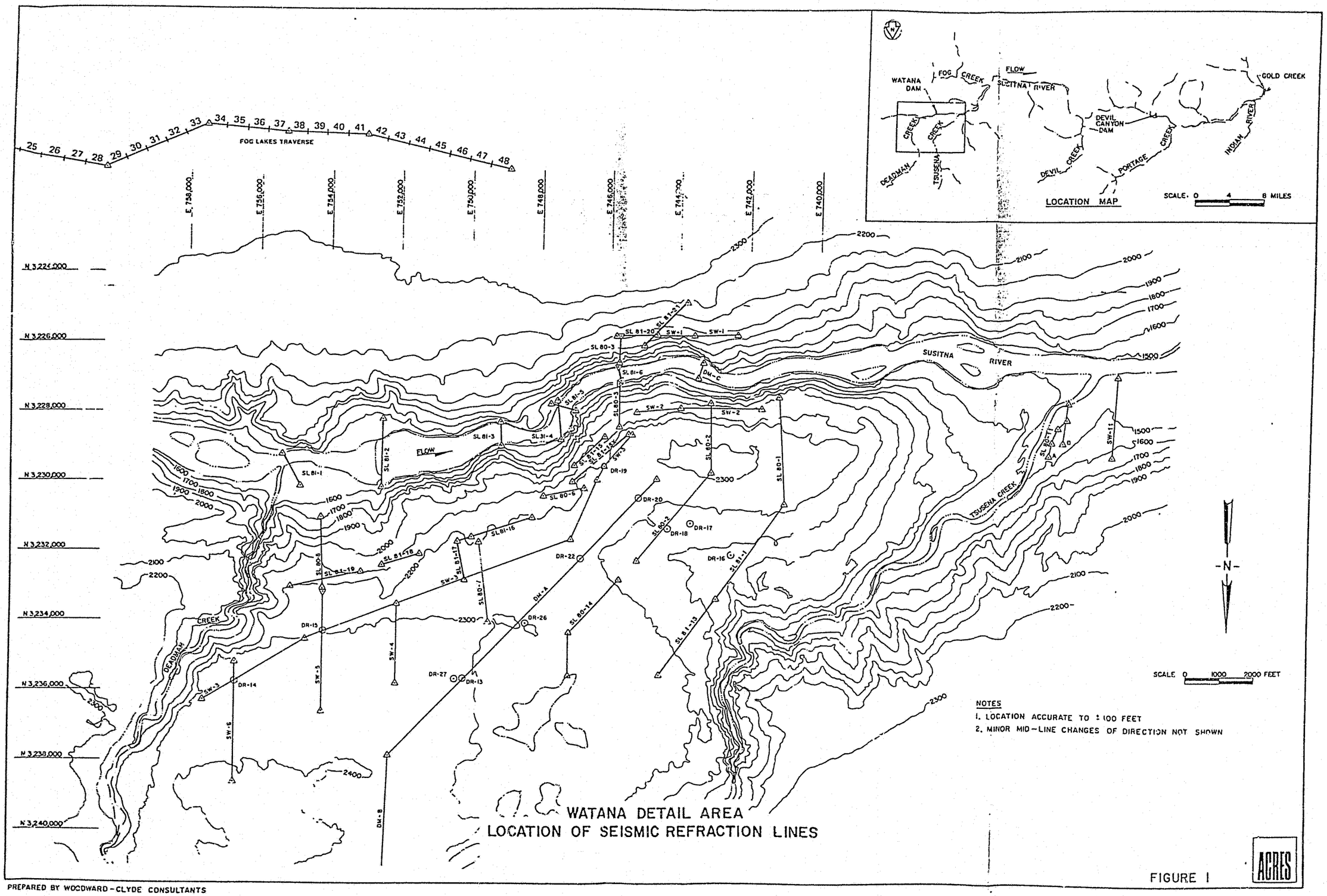
A total of 22,200 ft of refraction line was run during the month of July as 10 separate traverses (Lines 81-13 through 81-22). Nine of these were run at the Watana site (Figure 1), some as continuations of existing lines. One traverse was run on the proposed south abutment at Devil Canyon (Figure 3).

From 26 October to 15 November, 1981, a 28,800 ft traverse was run from rock outcrops near the proposed Watana south abutment to a point approximately 5 miles to the east. The

locations of lines 81-FL-1 through 81-FL-48 are shown on Figures 1 & 2. This traverse crossed an area of suspected buried channels in the Fog Lakes area.

The alignments of all traverses were flagged by R & M or AAI personnel prior to refraction surveying. During refraction work, the location of all shot points and geophones were flagged. The coordinates and elevations of each of the shot and geophone points for spring and summer traverses were subsequently surveyed by R & M. For the fall work (Fog Lakes) R & M provided coordinates and elevations at all turning points and breaks in slope.

Data for all seismic refraction traverses accomplished during 1980 and 1981 are summarized in Table 1. The table includes line numbers used in this report, line numbers used by R & M for coordinate and elevation surveys, presentation data, line configuration data, and comments. This report discusses the interpretation of 1981 traverses in detail and references 1980 lines where they are in proximity to the 1981 survey lines.



WATANA DETAIL AREA
LOCATION OF SEISMIC REFRACTION LINES

PREPARED BY WOODWARD-CLYDE CONSULTANTS

FIGURE 1

ACRES

TABLE 1 (Continued)

WCC Line No.	R & M Survey No.	Location Figure	Profile Figure	Time-Distance Plot Figure	Line Length (ft)	Number of Segments/Shots	Comments
81-5	81-5	2	5	A-1	450	1/3	Run Over River Ice, 0.5 Miles Upstream from Proposed Watana Dam Centerline.
81-6	81-6	2	6	A-1	450	1/2	Run Over River Ice, 0.1 Miles Upstream from Proposed Watana Dam Centerline.
81-7	81-7	1	6	A-2	3,200	3/9	Run Over River Ice, 4.0 Miles Downstream from Proposed Watana Dam Centerline.
81-8	81-8	1	7	A-2	2,500	3/6	Run Over River Ice, 5.2 Miles Downstream from Proposed Watana Dam Centerline.
81-9	81-9	1	7	A-2	2,000	2/6	Run Over River Ice, 7.3 Miles Downstream from Proposed Watana Dam Centerline.
81-10	81-10	1	8	A-3	2,100	2/6	Run Over River Ice, 8.2 Miles Downstream from Proposed Watana Dam Centerline.
81-11	81-11	1	8	A-3	2,800	3/9	Run Over River Ice, 9.3 Miles Downstream from Proposed Watana Dam Centerline.
81-12	81-12	1	9	A-3	2,000	2/7	Run Over River Ice, 10.1 Miles Downstream from Proposed Watana Dam Centerline.
81-13	80-1X	2	10	B-1	3,200	3/10	Watana Relict Channel Area--Extends 80-1 to NE
81-14	80-2X	2	11	B-2	3,300	3/5	Watana Relict Channel Area--Extends 80-2 to NE--North Extension Not Surveyed
81-15 & 15X	BH-11	2	12	B-3	2,100	4/11	Watana Rt Abutment--Fins Area
81-16	16-81	2	12	B-3	2,200	2/8	Watana Relict Channel Area
81-17	---	2	13	B-4	1,100	1/5	Watana Relict Channel Area--Not Surveyed
81-18	QSB	2	13	B-4	2,200	2/10	Watana Relict Channel Area--N of Quarry Source B
81-19	QSB	2	14	B-5	1,100	1/6	Watana Relict Channel Area--N of Quarry Source B
81-20	SW-1X	2	15	B-6	1,600	5/11	Watana Left Abutment--Extends SW-1 East
81-21	BH-12	2	15	B-6	1,850	5/19	Watana Left Abutment--Crosses 81-20
81-22	17	3	16	B-6	1,500	3/6	Devil Canyon Left Abutment--Crosses 80-12 and 80-13
81-FL-1 to 81-FL-48	Fog Lakes	1 & 2	17 - 23	C1 - C7	28,800	48/138	Watana Fog Lakes Area--Continuous Profile

2.0 DATA ACQUISITION AND REDUCTION

Field procedures used during the 1981 season were similar to those of the 1980 survey (Woodward-Clyde Consultants, 1980). A Geometrics/Nimbus model ES-1210F twelve-channel stacking seismograph and an explosive energy source was used for all lines. Line lengths and geophone spacing varied as discussed later in separate sections.

Data reduction for the 1981 surveys was accomplished in a similar manner as for the 1980 lines, essentially following the procedures of Redpath (1973). Rigorous delay time methods were used for only a few lines for which data was sufficient and too complex for adequate interpretation by approximation methods.

Time-distance plots of the data are included in Appendix A (spring surveys), Appendix B (summer surveys), and Appendix C (fall-Fog Lakes surveys). Interpretation of these lines are shown as Figures 4 through 23 and are discussed in Sections 4.0, 5.0, and 6.0. These sections discuss the setting of each traverse, our interpretation, and anomalous or ambiguous conditions which became apparent during data reduction and subsequent review of all available data.

Our confidence in the contacts between layers of differing velocities on the figures is variable. Solid lines represent well controlled contacts with the depths shown probably within 20 percent of the true total depth. Dots on a line represent depths calculated by the delay time method or by approximation techniques. Dashed lines are less well controlled with an estimated possible deviation from true depths on the order of 30%. Queried dashed lines are

assumed contacts that are based on assumed velocities and information other than that resulting directly from data reduction, or that are inferred by the data but are not mathematically explicit.

3.0 LIMITATIONS

Seismic refraction is a widely used and well suited exploration tool for engineering projects but is subject to certain limitations which should be kept in mind when evaluating the interpretations presented in the following sections. The effects of inhomogeneities, irregular contacts, "blind zones" and hard-over-soft conditions are discussed below. Other limitations which result from the site environment and from the specified scope of these surveys apply particularly to seismic work performed at the Susitna sites.

The seismic refraction technique depends upon measuring the first arrival of a seismic wave at geophones placed on the ground surface progressively further from an explosive charge or other seismic source. Arrivals at nearest phones generally indicate travel directly through low-density surface materials. At points further from the source, the seismic wave arrives sooner than would be expected from travel through surface materials, having traveled in part through deeper, more dense, and therefore higher velocity layers. If subsurface layers are uniform, horizontal and the seismic velocities progressively increase with depth, a mathematical model can be developed from the arrival time data that approximates actual conditions. Several conditions exist in nature, however, which make interpretation of the data less precise and introduce ambiquity into the model.

In ideal situations, plots of arrival times versus distance (see Appendices A, B, and C) produce straight lines, the inverse slopes of which represent the seismic velocity of the subsurface material. Deviations of the data from straight lines indicate inhomogeneity within layers,

irregular layer contacts, or inaccuracy in identification of first arrival time. Sufficient data is seldom available to distinguish amoung these possibilities. It is also difficult to determine if irregularities occur in near-surface layers or at depth. In many cases, the data resulting from local or lateral velocity changes can also be interpreted as contact irregularities.

Thin layers at depth also present a problem. Ideally each layer is represented on a time-distance plot as a separate straight line. Thin layers may produce no indication of their existance in the data regardless of the detail of the survey. Such "blind zone" cases can affect the calculated depth to deeper layers, such as bedrock, by a theoretical maximum of 30 percent.

Layers with seismic velocities less than overlying layers are not detectable by refraction. This situation is suspected to exist in several areas, at the Watana site in particular, where less dense sediments may underlie frozen, more dense ground. Non-seismic information, such as boring data, is required to resolve hard-over-soft conditions, enabling correction of the refraction model, which is otherwise likely to be in error by as much as 30 percent for the depth of deeper layers.

Several conditions occur which preclude collection of the optimum quantity and quality of data. These include weather, ground conditions and, of course, the time available to resolve operational problems which may arise. For the Susitna work, field data reduction was performed to assure the sufficiency of results from each line. In some cases, however, time and budget constraints precluded running additional lines which may have resolved some uncertainties.

In interpreting data which is less than straight forward, the tendency is to produce as simple a model as possible without violating the restraints of the data. In these cases, the experience and judgement of the interpreter is important in producing a geologically reasonable picture. The presence of an experienced geologist during shooting of the lines and during interpretation, combined with the results of previous investigations, increased the likelihood that profiles presented herein reflect a fairly accurate model of existing conditions suitable for evaluation of the feasibility of the project. Further exploration is required to resolve the uncertainties identified during these surveys.

5.0 SUMMER 1981 SURVEYS

Traverses 81-13 through 81-19 were located on the north side of the river, upstream from the proposed Watana Dam. This area is underlain by a buried or "relict" channel. Velocities of channel fill material vary considerably as discussed in relation to the individual traverses below. From borings discussed in the 1980 report (Woodward-Clyde Consultants, 1980), these materials are known to include well consolidated glacial tills and outwash deposits, younger alluvial deposits, and some lacustrine sediments, all possibly frozen in part or entirely. Although the seismic velocities of the channel fill referenced with each traverse are a reflection of material properties, no subsurface boring data was available in the vicinity of the 1981 traverses to identify the type of material that might be represented by a particular velocity range.

Traverses 81-20 through 81-22 were run in areas of shallow bedrock on the south abutment at Watana and on the south abutment at Devil Canyon. For these as well as for the other lines, higher velocity bedrock (ie 15,000 to 20,000 fps) is presumably more competent than lower velocity bedrock (ie 10,000 to 14,000 fps). Specific rock types or degrees of weathering, however, cannot generally be distinguished by velocity alone. Correlation of the seismic velocities reported herein with the most recent surface mapping and boring information may provide a better idea of the extent of particular mapped units and structural features away from their locations known from outcrops or cores.

5.1 Traverse 81-13

Three 1,100 ft geophone spreads overlapped line 80-1 by 500 ft and continued that traverse an additional 2,800 ft to

the northeast as shown in Figure 1. The traverse crosses undulating topography which rises gently to the northeast. The interpreted profile of traverse 81-13 (Figure 10) shows a continuation of the relict channel with a relatively uniform depth toward the northeast end of the line where it shallows. Bedrock, with seismic velocities ranging from 13,000 to 15,000 fps is from 200 to 250 ft deep beneath most of the traverse. Channel fill material ranges from 6,000 to 8,000 fps and surficial sediments, which are thicker toward the southwest end of the line where it overlaps 80-1, average 2,200 fps. Several irregularities in the time-distance plot (Figure B-1) appear to be due to topographic effects.

5.2 Traverse 81-14

The southwest end of traverse 81-14 is located about 600 ft from the northeast end of traverse 80-2. Three 1,100 ft lines were used to extend traverse 80-2 to the northeast. The northern end of the line turns north tc the edge of a small lake as shown in Figure 1. Relatively smooth topography rises gently to the northeast to within 1,000 ft of the small lake, then drops gently toward the lake. The tcpography along the northern 1,000 ft was not surveyed; the profile shown in Figure 11 for that area was approximated from small scale maps and field notes.

The interpretation of traverse 81-14 (Figure 11) shows 18,000 fps bedrock to be 500 ft deep beneath the southwest end of the line. This requires a drop of about 200 ft from the northeast end of line 80-2 which is not inconsistent with the 1980 interpretation. The 500 ft depth places the thalweg of the channel at an elevation of about 1,700 ft, which is similar to that found on line 80-1 to the west and somewhat deeper than on lines to the southeast. This

east side of the traverse to produce more detailed data in that area. Gently rolling topography along the traverse rises slightly toward the east.

Figure 15 shows that bedrock, interpreted to be about 18,000 fps, underlies the entire traverse at shallow depth, generally less than 10 ft. A small wedge, up to 50 ft thick, of intermediate velocity material, averaging 7,000 fps overlies bedrock near the east end of the line. This material was identified as varved silts and clays in boring DH-25 (U.S. Army Corps of Engineers, 1979).

5.9 Traverse 81-21

Four overlapping 550 ft geophone spreads and several 225 ft detail spreads were run across the suspected projection of the Fingerbuster structural feature on the south abutment of the proposed Watana Dam. The total length of the line was about 1900 ft. It crosses line 81-20 near its northeastern end. The topography rises steeply to the southwest along the traverse.

The purpose of traverse 81-21 was to delineate, if possible, the Fingerbuster zone in order to locate a drill site for further exploration of the zone. As shown on the interpretive profile of the traverse (Figure 15), the structural zone appears to occur as an area of 12,000 fps bedrock flanked by more competent 18,000 fps bedrock. This is overlain by 1,500 to 3,500 fps surficial materials which range in thickness from zero to 40 feet.

The location of the zone was thought to be known more precisely from apparent anomalies on field time distance plots. Several anomalies apparent on the time-distance plot (Figure B-6), can be attributed for the most part to topographic irregularities and to changes in thickness of

the near surface layer. The zone appears to be delineated by a prominent slope break to the west and a rapid thinning of surficial deposits to the east. It appears that a topographic low exists over the central portion of the zone. The depression appears to be due to erosion by a crossing stream.

5.10 Traverse 81-22

This traverse was run as three overlapping 550 ft geophone spreads along the ridge on the south abutment of the proposed Devil Canyon Dam. The eastern portion of the traverse crosses the southern ends of lines 80-12 and 80-13. The somewhat irregular ground surface along the traverse slopes downward toward the east end.

The interpretive profile of traverse 81-22, shown in Figure 16, shows very shallow bedrock ranging from 11,000 to 15,000 fps overlain by surficial materials of 1,800 to 2,000 fps. The surficial material appears to average about 10 ft thick but thickens to as much as 30 ft at one location near the east end. Intermediate layers of 5,000 and 10,000 fps interpreted for the south ends of 80-12 and 80-13 were not apparent from the data for 81-22.

6.0 FALL TRAVERSES-FOG LAKES AREA

The Fog Lakes traverse consisted of 48-500 ft geophone spreads with common end shot points. The location of the traverse was selected to cross areas of possible buried channels which could contribute to seepage from the reservoir. Topography along the line is gently rolling and relatively flat locally. Elevations range from less than 2,300 ft across the Fog Lakes valley, approximately five miles east of the proposed Watana Dam, to about 2,400 ft near the proposed south abutment.

The interpretation of the data for the traverse, shown in Figures 17 through 23, indicates that apparent bedrock velocities vary substantially along the traverse, from 20,000 fps to as low as 10,000 fps.

Two types of intermediate material are apparent. The first ranges from 4,500 to 7,000 fps and is interpreted to consist of poorly consolidated, saturated glacial deposits. The second ranges from 8,000 fps to as much as 10,500 fps. This is suspected to be well consolidated glacial sediments in part or entirely frozen. Surficial deposits range from 1,000 to 3,000 fps, are as thick as 50 ft in some areas, and are absent in others.

Several areas along the traverse appear to be underlain by buried channels which extend below the proposed reservoir level. The two most prominent of these are near the west end of the traverse (Figure 17) and beneath the Fog Lakes Valley (Figures 22 and 23). Near the west end, a channel which may be as deep as 300 ft (to elevation 2,030) is filled mainly with low velocity (4300 to 6000 fps) deposits. Higher velocity channel fill (9000 fps) is indicated near the east side of the channel but the contact

between the two types of channel fill is uncertain. It is possible that the higher velocity material is permafrost, in which case unfrozen sediments (with lower velocities) could be present below it and the total depth of the channel could be somewhat less than shown on the profile. The width of the deepest part of the channel appears to be about 1,000 feet.

The apparent channel in the Fog Lakes Valley is more than a mile wide. The deepest part appears to underlie the lowest part of the valley at an elevation of about 1,940, 350 ft below ground surface. Much of the rest of the channel, which extends below the topographic high northwest of the valley, is below an elevation of 2,100 feet.

The shape of the channel shown on the profile is based on marginal arrival-time data from distant offsets and from minimum depth calculations where distant offsets did not penetrate sufficiently to detect rock. The shape, therefore, could be significantly different, especially on the west side where depths could be greater. The interpretation shown, however, is considered to be a reasonable estimate of the maximum depth within the limits of the uncertainties of the data.

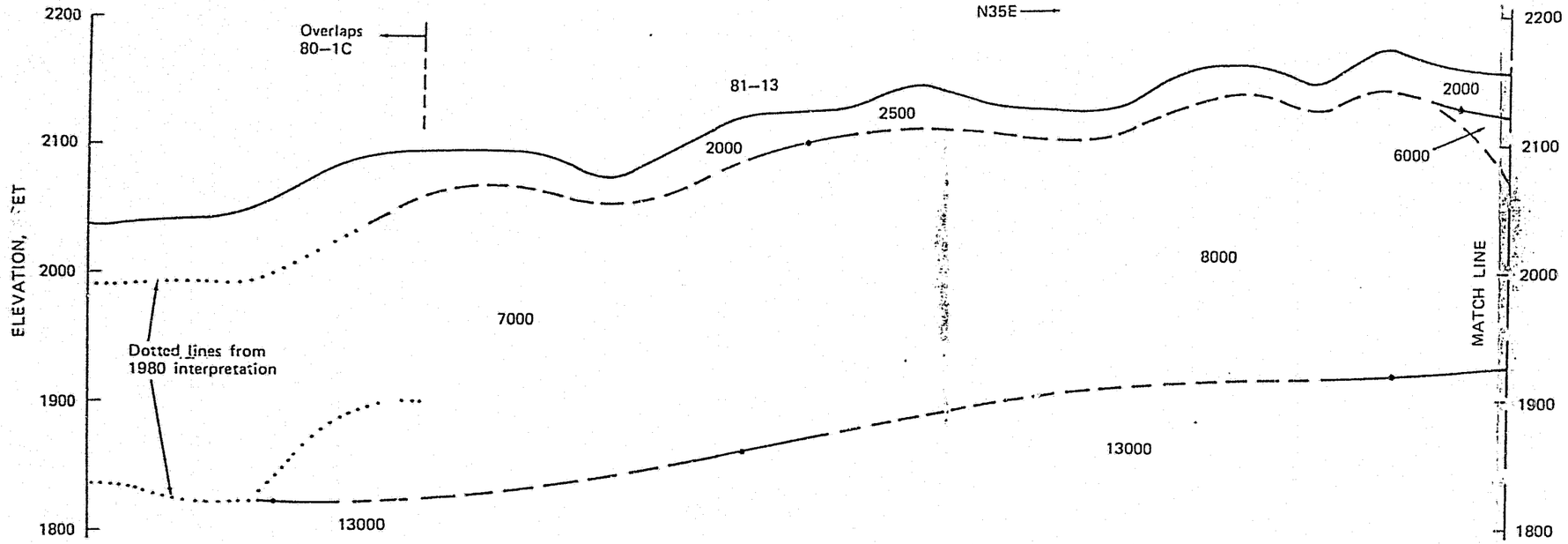
The most critical uncertainty is the nature of the 8,000 to 11,000 fps apparent channel fill material. If this material is interpreted to be well consolidated glacial deposits then the interpreted profile as shown in Figures 22 and 23 is appropriate. However, if the material is frozen, then lower velocity material could underlie the permafrost and depths to bedrock could be shallower than shown on the Figures.

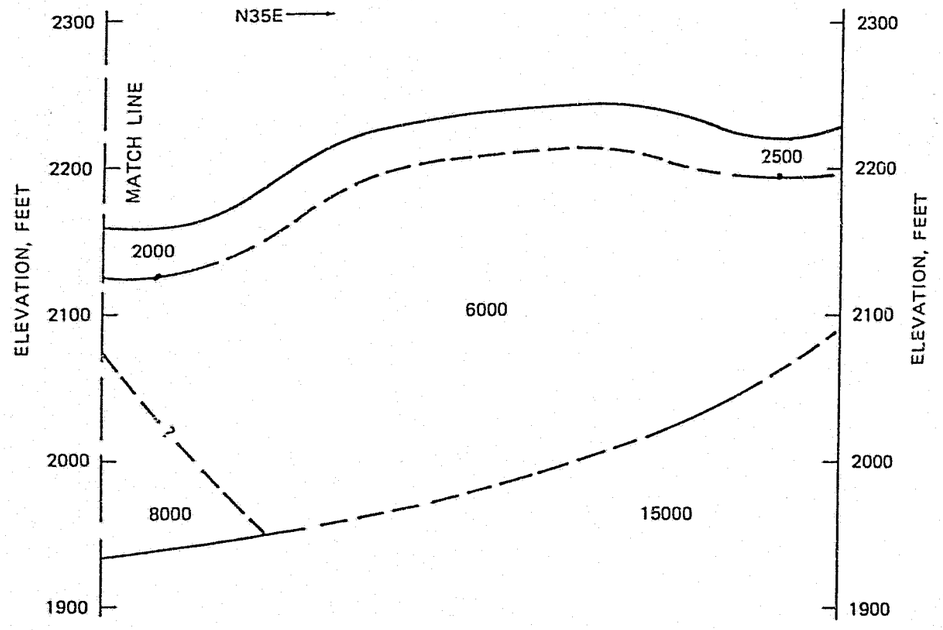
A third possibility, which is not likely, is that the apparent channel fill could instead be weathered bedrock, at least in part. If this were true the bedrock velocity would be so close to that expected for frozen or well consolidated sediments that the contact between them could not be distinguished. It is remotely possible that the apparent indications of high velocity bedrock at depth are the result of irregularities in shallower, very low velocity weathered rock or from steeply dipping contacts between weathered bedrock and high velocity channel fill.

An attempt was made to resolve the nature of high velocity apparent channel fill material using shallow reflection at the location of refraction line 81-FL-3. Results were not definitive but the most likely reflection appears to place the bedrock contact at a depth of 170 ft below ground surface which is similar to the depth indicated by refraction in that area. This depth, however, indicates an anomalous high near the middle of the broad channel which makes the interpretation even more tenuous.

Other areas of apparent channeling are present along the central portion of the traverse. These channels, although broad in some cases, are all above elevation 2,150 and generally shallower than elevation 2,200.

At several locations along the Fog Lakes Traverse, bedrock lows appear to coincide with higher seismic velocities which is contrary to conditions elsewhere in the vicinity. No explanation for this is evident from the present data.





Compressional velocities in feet per second

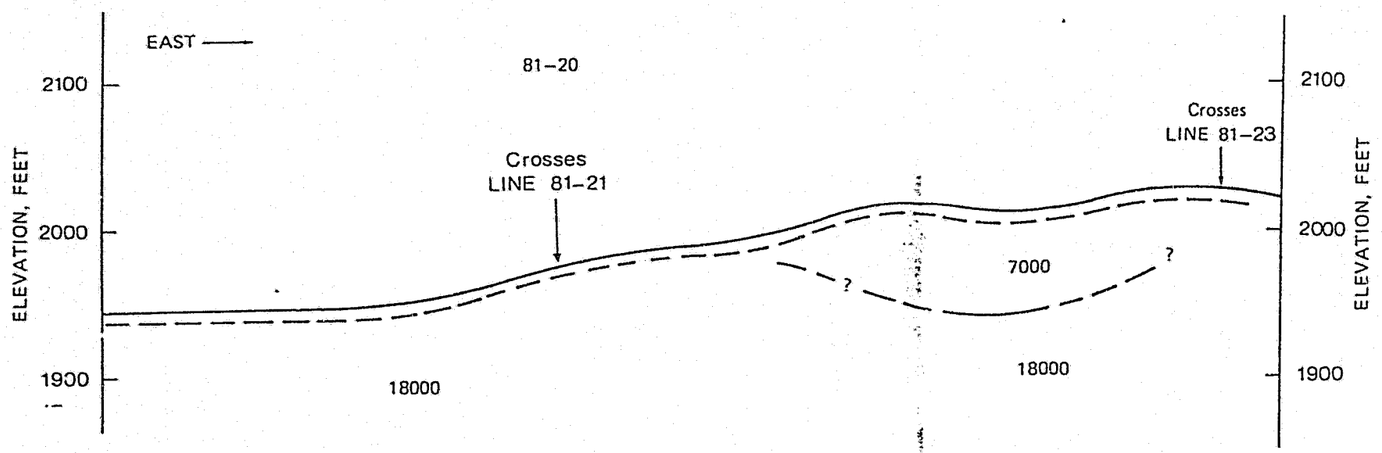
0 100 200

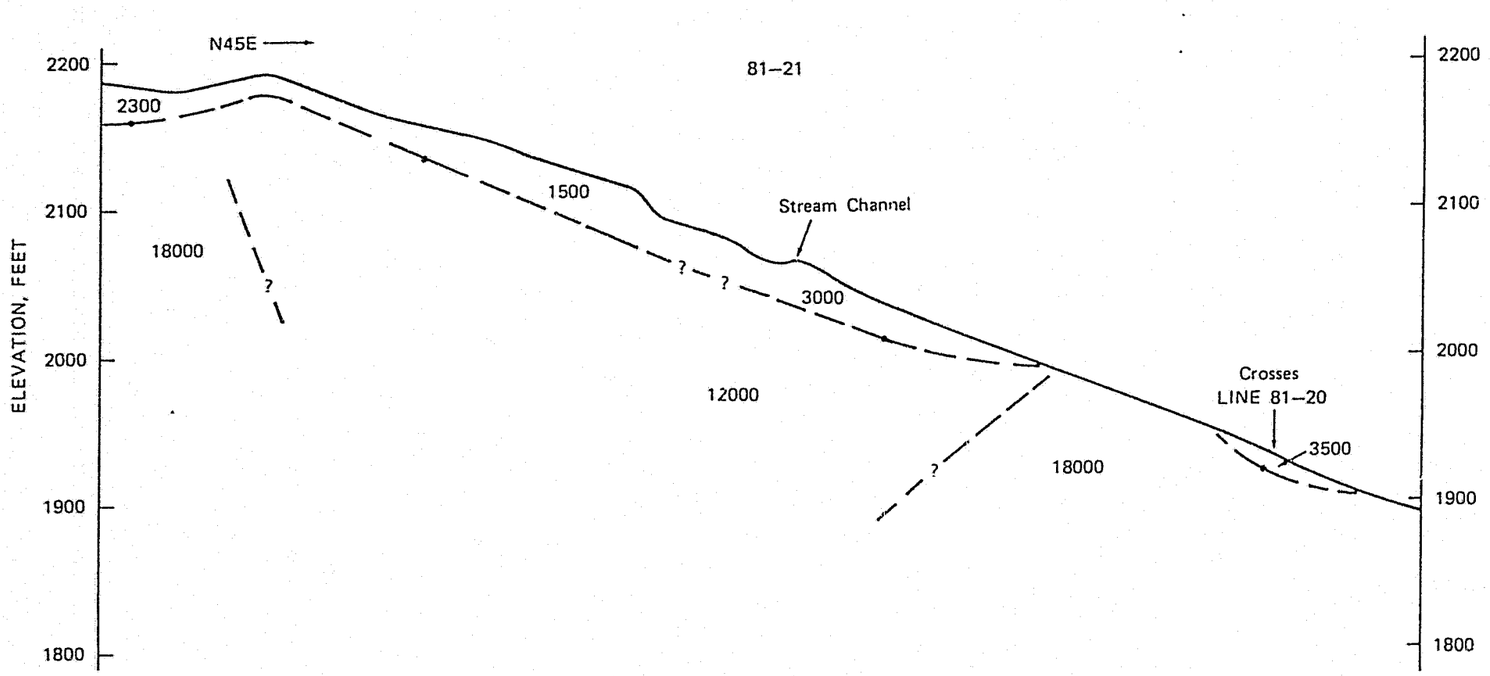
HORIZONTAL SCALE
IN FEET

SEISMIC REFRACTION PROFILE
LINE 81-13 (80-IX)

FIGURE 10

PREPARED BY WOODWARD—CLYDE CONSULTANTS





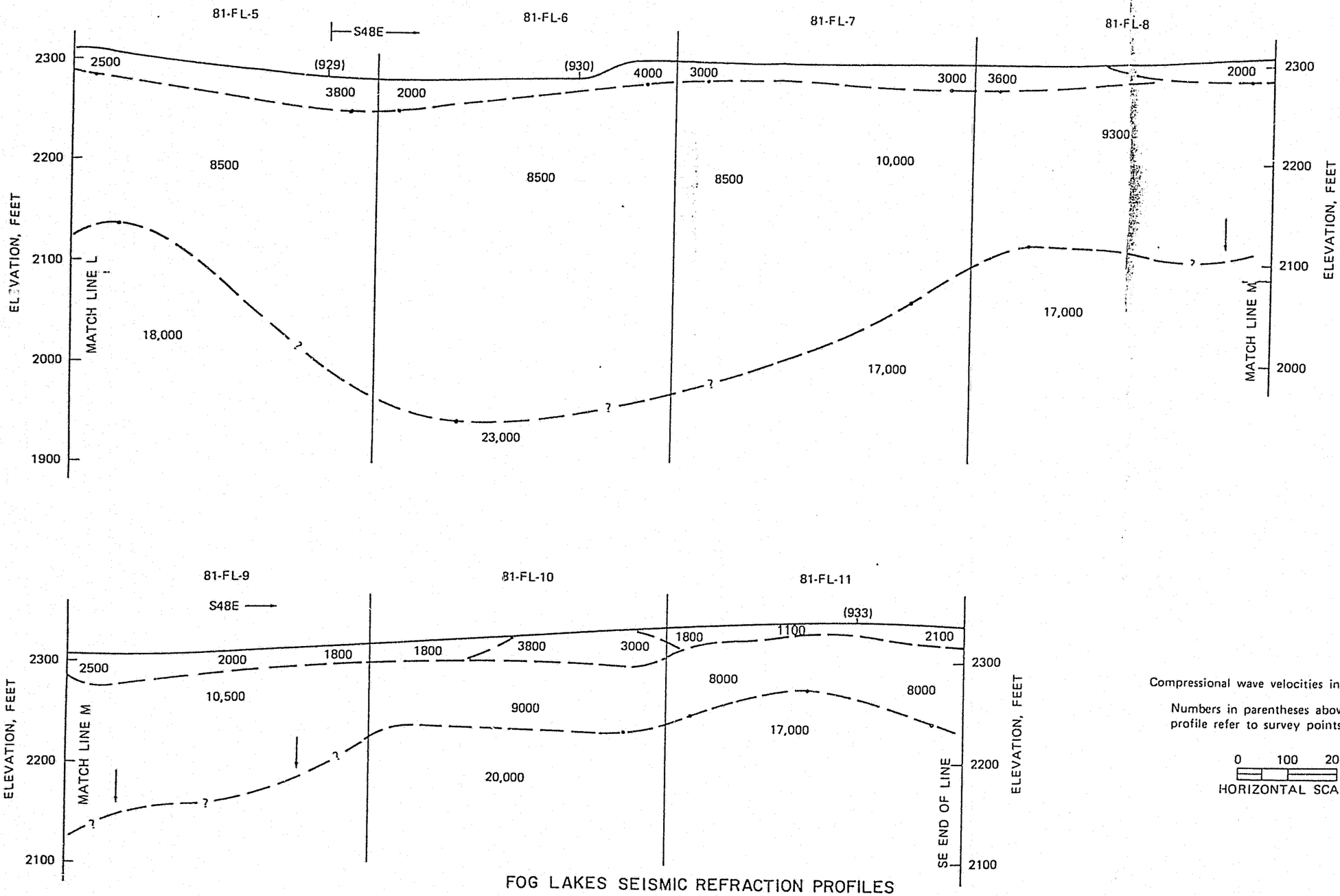
Compressional velocities in feet per second

0 100 200

HORIZONTAL SCALE IN FEET

SEISMIC REFRACTION PROFILES
LINES 81-20 (SW-IX) AND
81-21 (BH-12)

FIGURE 15



FOG LAKES SEISMIC REFRACTION PROFILES
SHEET 7 OF 7

FIGURE 23

PREPARED BY WOODWARD—CLYDE CONSULTANTS

ATTACHMENT C

SCHEDULE OF PAY ITEMS

ATTACHMENT C-1
SCHEDULE OF PAY ITEMS

ITEM	Description	Estimated* Quantity	Unit	Amount	
1	a) Mobilization	1	Lump Sum	$1000	
	b) Demobilization	1	Lump Sum	$1000	
2	Seismic Survey Operations, Relict Channel Areas	64,400	Linear Foot	$0.52	
				Regular	Overtime
3	Equipment and Personnel Operating Rate per Crew and all materials	160 reg 176 OT	Crew Hour	$150	$150
4	Equipment and Personnel Available Rate per crew (may not exceed rates shown in Item 3)	36 reg 12 OT	Crew Hour	$ 90	$ 90
5	Other Contractor-Supplied Equipment and Material Approved by the Engineer		Per Item	(Invoice + 10%) + Transportation	

Estimated Total $ Amount of Contract &90,208.00

* For the purposes of bid evaluation, a total price based on the estimated quantities shown in Items 1 through 4 will be the basis for determination of the lowest bidder, subject to the qualifications requirement of Section 1.4 and 2.12, and Attachment C-2 and the terms of Section 1.15. Estimated hours shown are total crew-hours, determined by totaling payable hours for each individual crew.

ATTACHMENT C-2

QUALIFICATIONS STATEMENT - PERSONNEL EXPERIENCE

This Personnel Experience Statement shall briefly list recent experience in the type of operations specified in Section 2.4 and 2.12 as a minimum, and will include all direct interpretation and technical field personnel being proposed for work under this contract. Designation of personnal shall include position title and whether the individual will be the primary field interpretations. Indicate intended crew size and which individual(s) will be the Contractor's field representative. Use additional pages in same format as shown, as necessary.

Name, Position Title Experience (Years): - Total Seismic - Alaskan/Permafrost - In Position Shown	Work Experience in Type of Work Specified		
	Project Description (Brief description of types of work performed by Personnel, as relates to conditions specified in Section 2.12, para. 1)	- Project Geographic Location - Approx. Total Footage of Seismic Lines	Years in which Experience Occurred

(SEE ATTACHED SHEETS)

Name, Position Title Experience (Years): - Total Seismic - Alaskan/Permafrost - In Position Shown	Work Experience in Type of Work Specified Project Description (Brief description of types of work performed by Personnel, as relates to conditions specified in Section 2.12, para. 1)	- Project Geographic Location - Approx. Total Footage of Seismic Lines	Years in which Experience Occurred
R.G. Tart Project Manager 4-Seismic 8-Alaskan 8-In position shown	<u>Experience as Lead or Assistant Field Lead for Refraction Seismic Crew</u>		
	1) Air Force Hard Rock Silo-Bedrock depth and property assessments for missile silos.	Wyoming, Utah, New (50,000 ft)	1967-69
	2) Ranch to California-Depth of overburden studies for roadway.	California (5,000 ft)	1972
	3) Birchwood Interchange-Rippability study for contractors bid estimate.	Alaska (1,000 ft)	1977
	<u>Experience as Project Manager of Refraction Seismic Surveys</u> Mr. Tart serves as Geotechnical Manager of the Anchorage WCC office and has managed numerous projects both in Alaska and outside. The following projects had major geophysical programs:		
	1) Bradley Lake-Rock property, overburden, and geologic interpretations for various aspects of dam design.	Alaska (10,000 ft)	1979
	2) VLA-Soil properties, water table, and seismic properties of materials underlying rail transported radio telescopes.	Magdalena, New Mexico (40,000 ft)	1973

Jan D. Rietman, Ph.D. Registered Geophysicist Registered Geologist Project Technical Director 7 Years Alaska 7 Years as Deputy Director of Geophysics for WCC, 10 Years other Companies	Experience as Technical Director Dr. Rietman has served as technical director and report author on over 200 seismic projects. The following projects reflect his Alaskan experience.		
	1) Point Thomson Development	North Slope, AK (10,000 ft.)	1982
	2) Susitna Hydroelectric Project	Susitna River, AK (10,000 ft.)	1981 & 1980
	3) Bradley Lake Hydroelectric Project	Homer, AK (9,000 ft.)	1981 & 1980
	4) ANGTS Pipeline	Fairbanks Vicinity (10,000+ ft)	1981
	5) Yakutat LNG Facility	Yakutat, AK (15,000 ft)	1979
	6) Alyeska Pipeline	Delta Junction, AK (20,000 ft,)	1976
Dennis E. Jensen, M.S. Project Geophysicist Project Geologist Registered Engineer- ing Geologist Field Representative and Primary Interpreter 15 Years Experience 10 Years Seismic Refraction 5 Years Alaskan 5 Years as Seismic Refraction Crew Supervisor	Experience in Alaska 1) Alyeska Pipeline Crew Supervisor Clear Water Lake Study	Delta Junction, AK (20,000 ft.)	1976
	2) Susitna Hydroelectric Project Assessment of overburden and bedrock conditions at borrow areas, dam sites, and at Fog Lakes.	Susitna River, AK (55,000 ft.)	1980 & 1981
	3) ANGTS Pipeline Project Geophysicist	Fairbanks, AK (10,000+ ft.)	1981
	Non-Alaska Experience Crew member to project geologist/ geophysicist on seismic refraction investigations for dams and nuclear power plants.	California, Nevada Utah, Arizona (10,000+ ft.)	1972-1982

Ronald L. Mees
Asst. Project Geophysicist
Registered Geophysicist
Years of experience:

Seismic: 5
Alaskan: 3
Current Position: 2

Experience in Alaska		
1) Bradley Lake Damsite Evaluate damsite, tunnel, and powerhouse rockmass conditions and overburden using seismic refraction.	NE of Homer, AK (6,000 ft.)	1979
2) Bradley Lake Access Road Seismic refraction evaluation of road alignment overburden and rock conditions.	Homer, AK (3,000 ft.)	1980
3) ANGTS Pipeline Delineate possible faults having project impact using seismic and other geophysical methods.	Fa banks to Canada (3,000 ft.)	1980
4) Susitna Hydroelectric Project Assessment of overburden and bedrock conditions under the ice-covered Susitna River.	Susitna River, AK (22,000 ft.)	1981
5) Exxon Point Thomson Seismic refraction and other geophysical surveys for geotechnical and permafrost investigations.	North Slope of AK (10,000 ft.)	1982
Recent Non-Alaskan Experience:		
1) Confidential Oil Project Supervision of 6-man refraction crew and collecting digital data for velocity analysis.	Blanding, Utah 50 miles of continuous coverage.	1982
2) Seismic Evaluations of Dams Field and interpretation supervisor of seismic refraction studies.	California, Utah, New Mexico, 20 sites	1978-1982
3) Jordan Valley Pipeline Field and interpretation supervisor.	Jordan 30 miles of pipeline route coverage.	1979

R.G. Dugan Assistant Field Manager	Experience as Field Manager And/Or Logistics Coordinator 1) Over-the-Ice Drilling Set-up enclosed rig for geotechnical borings.	Beaufort Sea, AK	1980
	2) Pilgrim Hot Springs Thermal Well-Manager logistics of moving rig and equipment to remote site.	Seward Peninsula, AK	1982
R.F. Black Geophysical Assistant	Experience on Seismic Crew 1) Location of suspected fault zone. for geologic study of subdivision site (Ditz-Crane Homes).	Richmond, CA (500 ft)	1978
Staff Engineer Soils Foundation Systems, Inc. 1976-1979	2) Rock Rippability Study.	Santa Clara, CA (300 ft)	1979
	3) Location of suspected fault zone.	Antioch, CA (300 ft)	1979
	Alaskan Field Experience 1) Atka Soil Investigation (Aleutian) technical and soil sampling.	Atka, AK	1980-81
	2) Akutan Soil Investigation (Aleutian).	Akutan, AK	1981
	3) Bethel Waste Heat Recovery System Soil Drilling Program.	Bethel, AK	1980
	4) Trail Lake Fish Hatchery, Well draw-down tests.	Moose Pass, AK	1979
	5) Mega-structure parking (construction assistance).	Anchorage, AK	1979
A. Dale Berry Geophysical Assistant	Alaska Field Experience 1) Exxon Gravel Island Instrumentation-Installed and monitored Thermistors, Sondex, and Slope Indicators, and reduced and analyzed data.	Beaufort Sea, AK	1981

	2) Shell Over-the-Ice Drilling - Logged borings and analyzed data.	Beaufort Sea, AK	1980
Stanton L. Clarke Geophysical Assistant	Alaska Field Experience 1) Northwest Pipeline Blast Testing-Monitored tests with seismographs, reduced and analyzed data.	Fairbanks, AK Prudhoe Bay, AK	1980
	2) Exxon Gravel Island Design and Construction Verification - Performed design analyses and monitored construction including field and laboratory soil testing.	Beaufort Sea, AK	
Keith F. Mobley Geophysical Assistant	Alaska Field Experience 1) Shell Gravel Island Construction Monitoring-Set up field laboratory, conducted tests as necessary, and monitored construction.	Beaufort Sea, AK	1982
	2) Alyeska Pipeline Monitoring - Installing and monitoring thermistors and slope indicators.	Atigun Pass, AK	1981
Richard J. Upton Geophysical Assistant	Alaska Field Experience 1) Alyeska Pipeline Drilling-Logged and analyzed results of drilling done to investigate pipe settlement.	Gulkana, AK	1981
	2) State Office Building Drilling Program-Assisted in coordination of 26 hole drilling program.	Anchorage, AK	

ATTACHMENT D

INSURANCE REQUIREMENTS

ATTACHMENT D

INSURANCE REQUIREMENTS

The Contractor has procured and maintains the following insurance coverage. Such insurances are subject to the approval of Acres and shall remain in force until termination of this Agreement. The Contractor shall provide complete copies of all policies if requested by Acres.

(1) Workmen's Compensation Insurance in compliance with statutory obligations imposed by law. Employer's Liability Insurance with a limit of $500,000 per accident.

(2) Comprehensive Automobile Liability Insurance for all owned vehicles, non-owned vehicles, and hired vehicles used in the performance of the work with the following limits of liability.

$1,000,000 combined single limit per occurrence.

(3) General Liability Insurance covering premises operation, independent contractors, products/completed operations, blanket contractual, broad form property damage, and personal injury with the following minimum limit of liability:

$1,000,000 combined single limit per occurrence.

This insurance shall be provided throughout the Contract term and shall continue in force, for any and all claims resulting from occurences during the Contract term, for a period equal to the legal limit or statute of limitations for filing a claim against the Contractor, Acres, or APA. Acres and APA (The Alaska Power Authority) shall be listed on the policy or policy endorsement as additional insureds.

Under no circumstances will any of the policies above be cancelled or modified without at least 30 days prior notification to Acres.

Before any work is started under this Agreement, current certificates of insurance must be furnished to Acres and must contain the following information:

- Name of insurance company, type of insurance, policy number, and expiration date;

- Limits of insurance and amount deductible; and

- Name insured.