HARZA-EBASCO

SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER 6, 1982 - JUNE 30, 1983

Enclosed is a compilation and summary of the tasks and activities required for the timely performance of the Task 5, Winter 1983 Geotechnical Investigation Program.

Information pertaining to the scope of service descriptions, contract data, costs and schedules are presented as follows:

A. Executive Summary
   1) Cost Summary - Geotechnical Program
   2) Cost Summary - Support Logistics
   3) Site - Camp Loading Requirements

B. Activity Schedules - Manpower and Cost Loaded
   1) Geotechnical Programs
   2) Support Logistics

C. Information Appendices
   1) HARZA/EBASCO Joint Venture
   2) Denali Drilling, Inc.
   3) R & M Consultants, Inc.
   4) Harding-Lawson Associates
   5) Cook Inlet Region, Inc.
   6) Air Logistics of Alaska, Inc.

The above stated compilations and summaries are based upon the basic assumptions which follow:

400 112th Avenue, NE Bellevue, Washington 98004 206 451-4500

DCNO 3264

HARZA-EBASCO

Basic Project Assumptions

The logistical parameters of this study are based on optimizing the Harza-Ebasco Joint Venture Winter Geotechnical Proposal Program, plus giving consideration to interfacing and sequencing commencement of the pre-summer auger program which will be initiated by HLA, coupled with support activities from Harza-Ebasco, R&M, CIRI, and Air Logistics, Inc. and scheduled to commence on May 1, 1983.

Due to seasonal changes, interfacing and scheduling, it is necessary to make the following basic assumptions in order to optimize the Harza-Ebasco Watana geotechnical program.

1. Harza-Ebasco

   (a) Fifteen professional people working in the field on a rotating shift schedule. Ten days at the site and 4 days off, working 12 hours/work day.

   (b) Four professional people coordinating full time from the Anchorage office.

   (c) It is assumed that transferees from the Lower 48 will be given a clothing allowance.

2. FMAA

   FMAA will control site logistics as part of the Harza-Ebasco team in accordance with the Moolin estimate. These costs are in the attached appendices.

3. Denali

   Denali will provide drilling services in accordance with the contract and Denali cost estimates specified in the appendices.

4. R&M

   Surveying and instrumentation will be accomplished in accordance with estimates provided in the appendices.

5. HLA

   Site laboratory geotechnical testing, geophysics, and Becker Drilling support activities will be done per HLA estimates attached in the appendices.

6. Air Logistics

   As shown in the attached appendices, it is assumed that at the onset a minimum of two aircraft will be required for transporting work crews and for safety. These aircraft will be contracted in 3 month time periods. As shown in the appendices, other aircraft will be contracted for the projects with commitments made on a month-to-month basis. Part-time budget cost estimates have been projected to provide for the auger drilling and environmental programs. Other contract negotiations include a 15% cost reduction below standard tariff rates on any aircraft owned by Air Logistics, Inc. It is envisioned that fixed-wing aircraft will be required for transportation from Anchorage.

7. CIRI

   CIRI will be responsible for the Watana Camp operations, including but not limited to, maintenance, catering and warehouse-laboratory modifications in accordance with the Acres/CIRI Agreement.

LEGEND:
4 Staff/Crew
Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

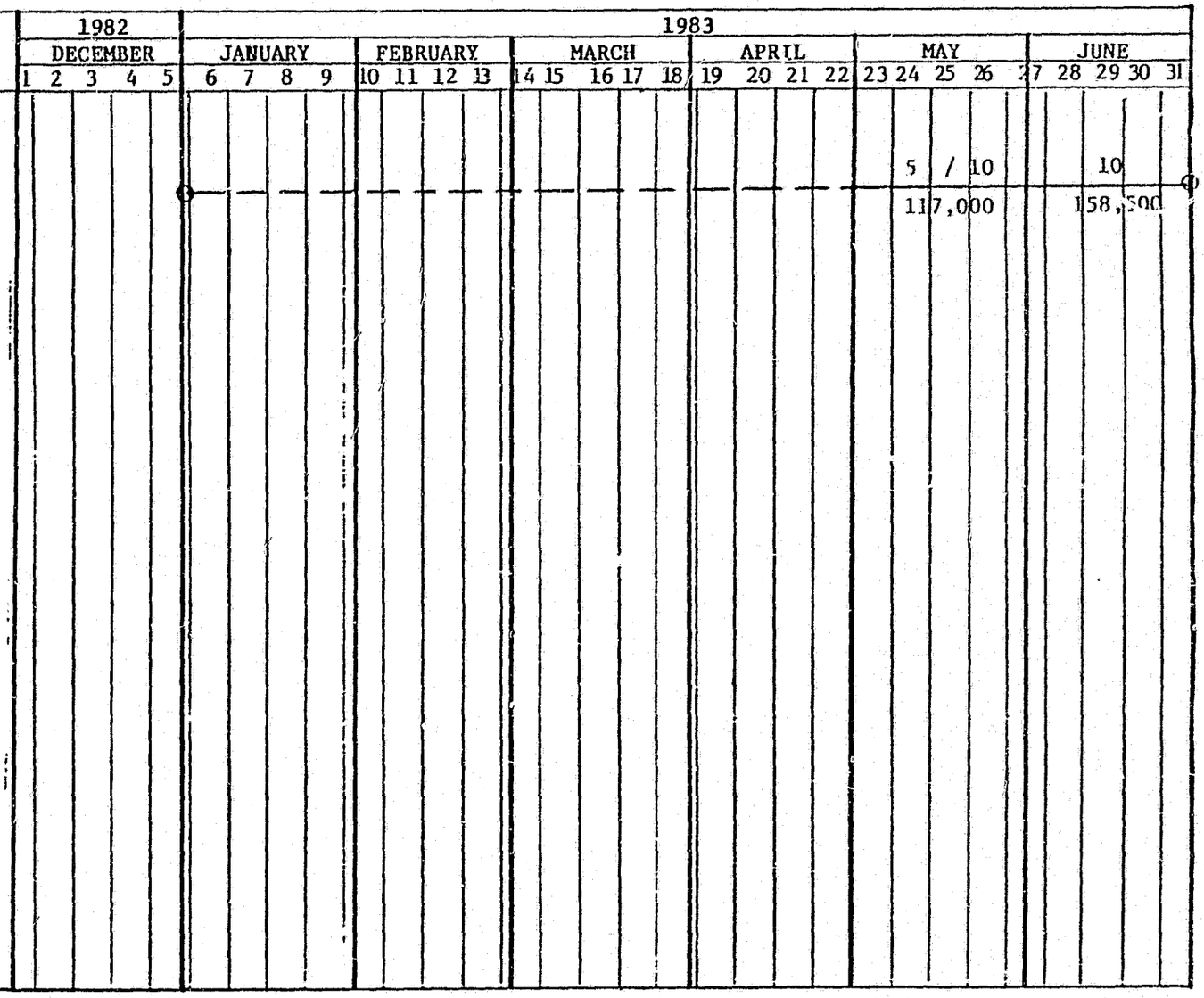
SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER	1983 JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
		1 2 3 4 5	6 7 8 9	10 11 12 13	14 15 16 17 18	19 20 21 22	23 24 25 26 27	28 29 30 31
5A	HARZA/EBASCO							
	1) Mobilize and Execute Geotechnical Programs							
	a) Site Investigations		10	10	10	10 / 5		
			80,000	158,500	158,500	158,500	117,000	
	1) Technical Supervision							
	2) Interpretation & Evaluation							
	3) Documentation & Reporting							
	4) Hammer Drilling-Logging, Sampling & Testing							
	5) Instrumentation							
	6) Seismic Refraction Surveys							
	7) Down Hole Geophysical Surveys							
	8) Ground Penetrating Radar							
	b) Technical Support Staff-Anchorage	5	5	5	5	5	5	5
		99,300	65,400	72,300	72,300	72,300	72,300	72,300
	1) Project Administration-Cost & Schedule Control							
	2) Interpretation & Evaluation (Preparation of the Geologic Model)							
	3) Documentation & Reporting							
	2) Contract Administration	1	2	1	1	1	1	1
	a) Technical Contractors-HARZA/EBASCO	6,000	12,000	8,100	8,100	9,700	9,700	8,100
	1) Denali Drilling							
	2) R&M Consultants							
	3) Harding Lawson Associates							

LEGEND:
4 Staff/Crew
Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

SUB-TASK NO.	SUBTASK DESCRIPTION
5A	HARZA/EBASCO (cont)
	3) Preliminary Underground Exploration
	a) Summer Program Logistics
	b) Core Drilling & Auger Drilling
	c) Trenching
	d) Portalling & Tunneling

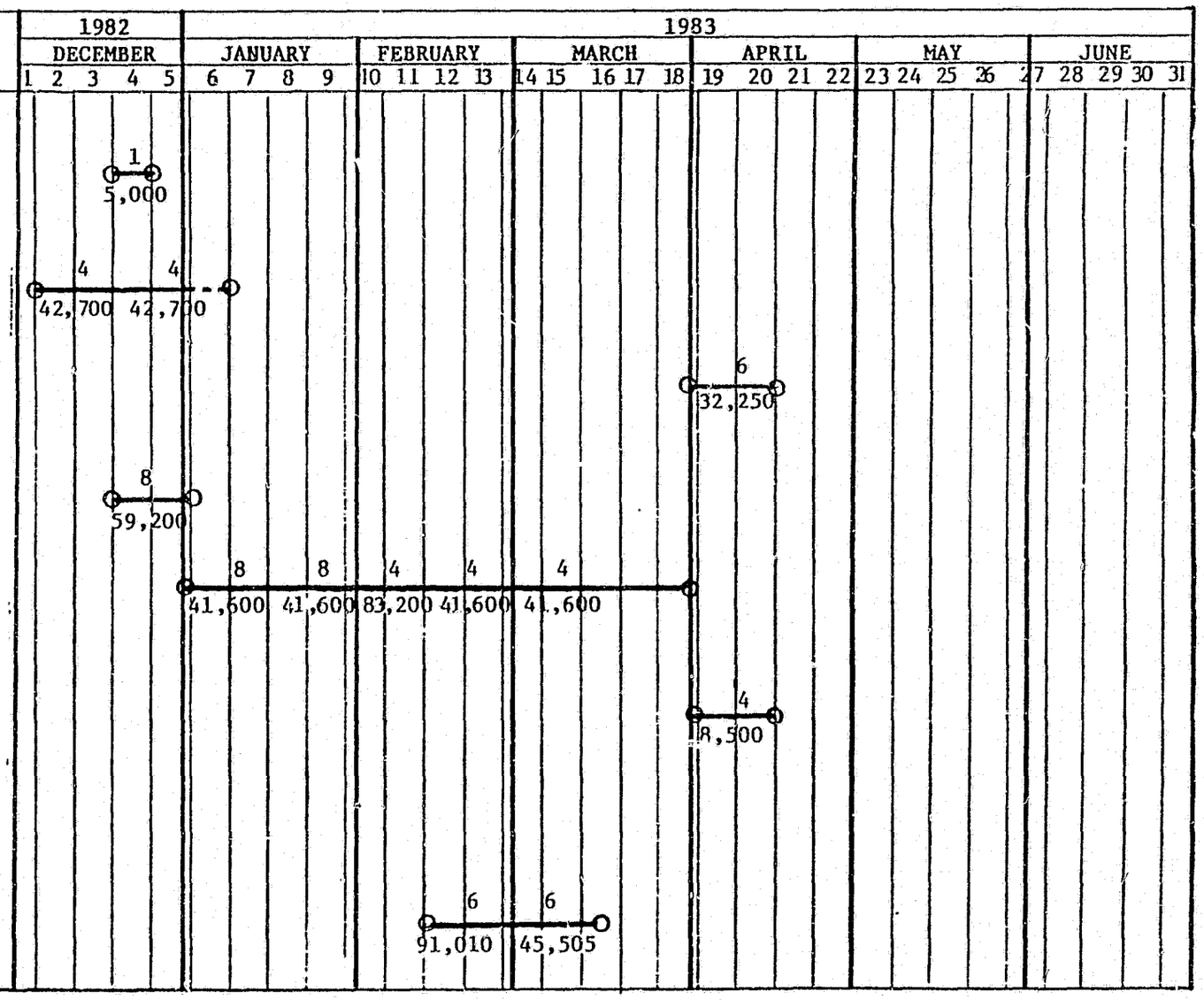


LEGEND:
4 Staff/Crew
●——● Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

SUB-TASK NO.	SUBTASK DESCRIPTION
5B	DENALI DRILLING, INC.
	1) Recon of Access Route
	2) a) Mob-Drill & Crew
	b) Demob-Drill & Crew
	c) Mob-Winter Support
	d) Winter Operation
	e) Demob-Winter Support
	3) Drilling
	a) Hammer/Rotary Drilling
	1) Dam & Cofferdam



LEGEND:
4 — Staff/Crew
●——● Activity Duration
42,250 — Cost in $.

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

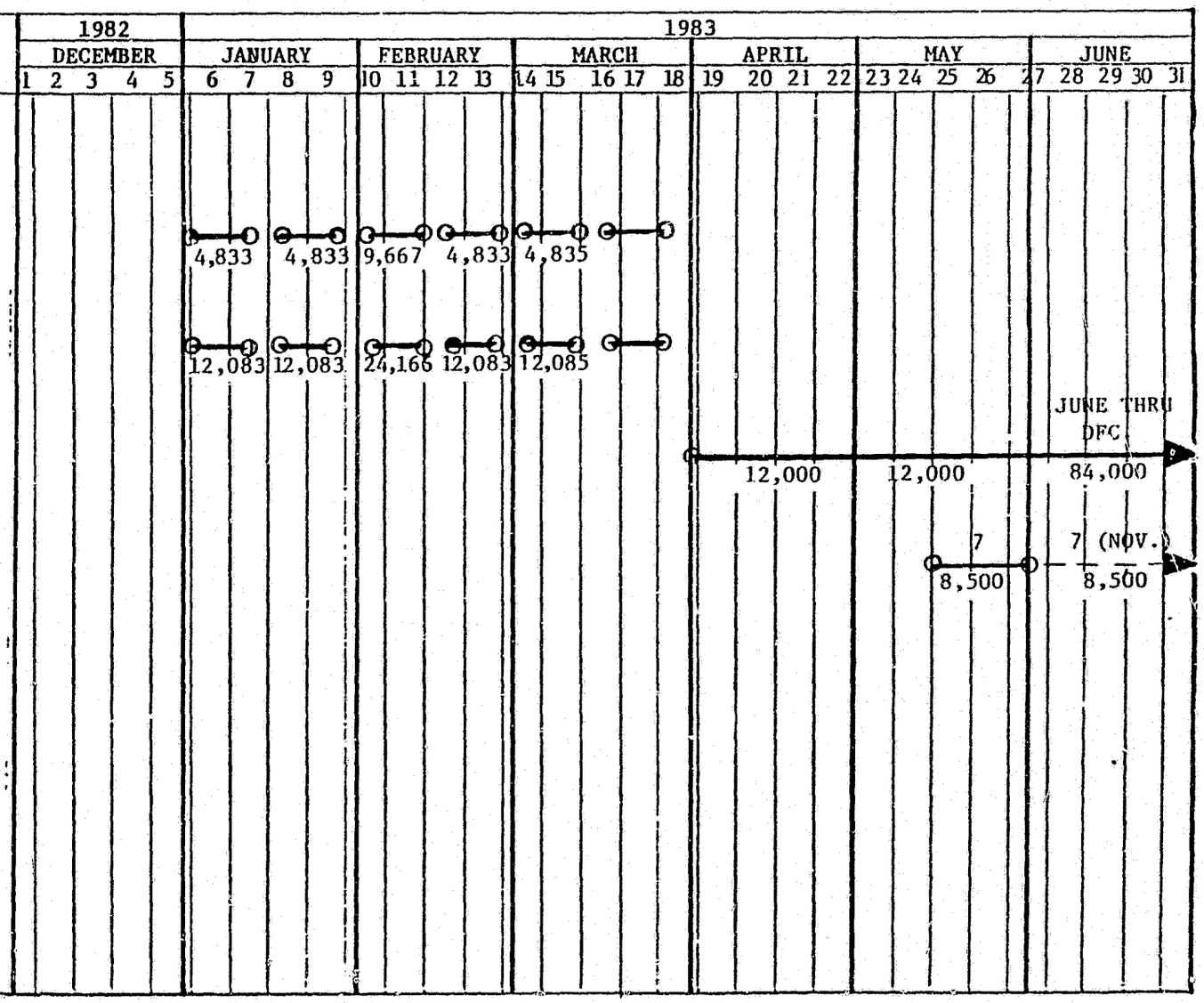
SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER 1 2 3 4 5	1983 JANUARY 6 7 8 9	FEBRUARY 10 11 12 13	MARCH 14 15 16 17 18	APRIL 19 20 21 22	MAY 23 24 25 26 27	JUNE 28 29 30 31
5B	DENALI DRILLING, INC. (cont)							
	2) Relict Channel		6 — 91,010					
	3) Borrow Site D			6 — 182,020				
	4) Borrow Site E & I				6 — 45,505			
	5) Water Well-Camp		6 — 91,010					
	b) Core Drilling		4,655	4,655	9,310	4,655	4,655	
	4) Hourly Operating Rates		18,040	18,040	18,040	18,040	18,040	18,040
	5) Hourly Stand-By Rates		16,500	16,500	16,500	16,500	16,500	16,500

LEGEND:
4 — Staff/Crew
●——● Activity Duration
42,250 — Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

SUB-TASK NO.	SUBTASK DESCRIPTION
5B	DENALI DRILLING, INC. (cont)
	6) Testing & Sampling
	a) Permeabilities Testing
	b) Spoon or Drive Sample
	7) Secured Stand-By
	8) Crew Time



LEGEND:
- 4 — Staff/Crew (MH)
- ●——● — Activity Duration
- 42,250 — Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER (1 2 3 4 5)	1983 JANUARY (6 7 8 9)	1983 FEBRUARY (10 11 12 13)	1983 MARCH (14 15 16 17 18)	1983 APRIL (19 20 21 22)	1983 MAY (23 24 25 26 27)	1983 JUNE (28 29 30 31)
5C	R & M CONSULTANTS							
	1) Instrumentation Monitoring		120 MH 5,300	120 MH 5,300	240 MH 10,600	240 MH 10,600	240 MH 10,600	360 MH 15,900
	2) Instrumentation Data Reduction	40 MH 1,800	40 MH 1,800	40 MH 1,800	40 MH 1,800	40 MH 1,800	40 MH 1,800	60 MH 1,800
	3) Field Coordinator	50MH 2,350	320 MH 15,000	320 MH 15,000	320 MH 15,000	160 MH 7,500	320 MH 15,000	320 MH 15,000
	4) Location & Brushing Crew	70MH 3,100	900 MH 39,800	300 MH 13,300				
	5) Survey Crew	24MH 1,020	900 MH 48,600	900 MH 48,600	900 MH 48,600	450 MH 24,300	900 MH 48,600	900 MH 48,600
	6) Survey Support & Data Reduction		160 MH 7,000	160 MH 7,000	160 MH 7,000	80 MH 3,500	160 MH 7,000	160 MH 7,000
	7) Project Management	40MH 2,500	40 MH 2,500	40 MH 2,500	40 MH 2,500	20 MH 1,250	40 MH 2,500	40 MH 2,500

LEGEND:
4 — Staff/Crew
● — ● Activity Duration
42,250 — Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

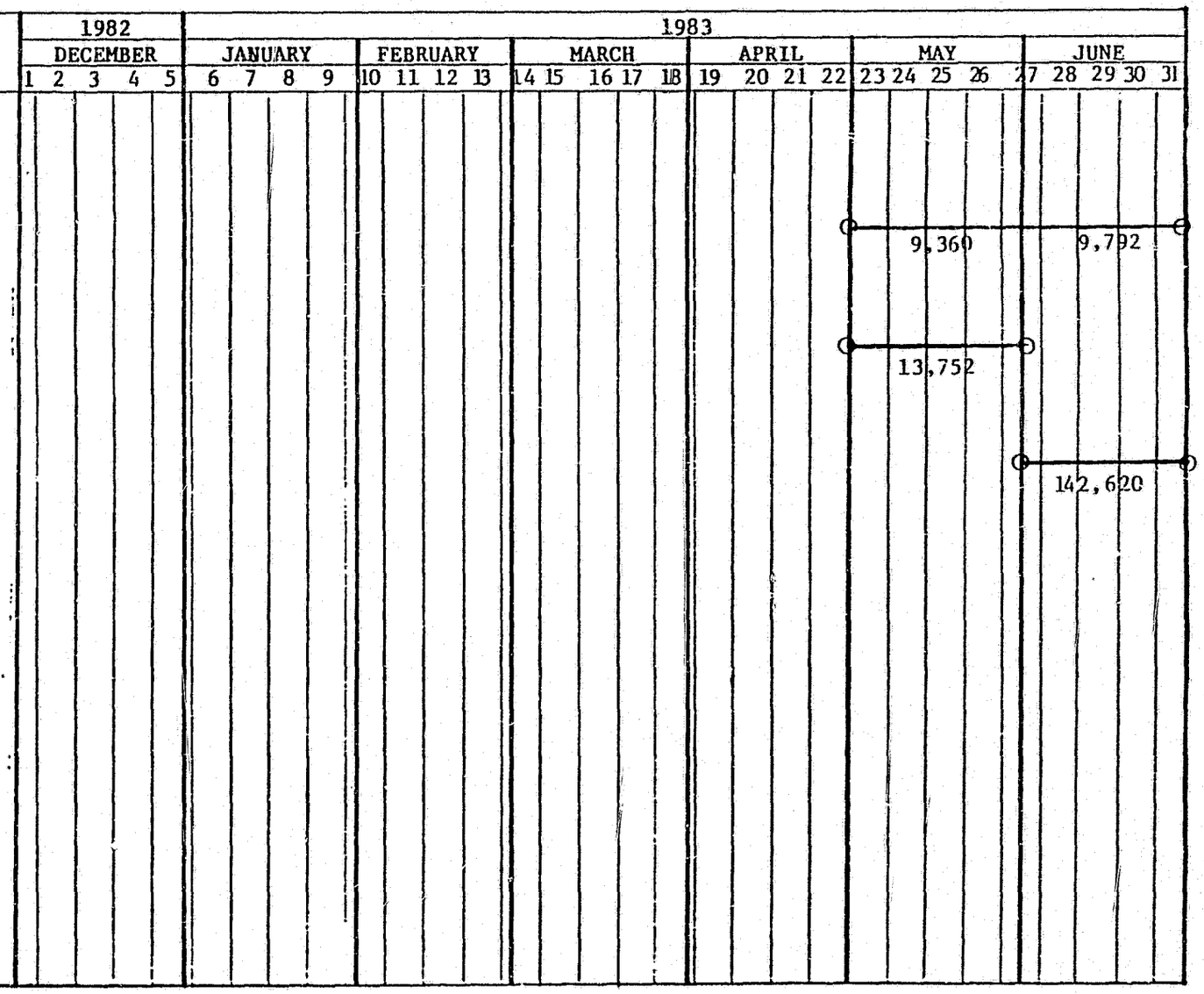
SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER	1983 JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
		1 2 3 4 5	6 7 8 9	10 11 12 13	14 15 16 17 18	19 20 21 22	23 24 25 26 27	28 29 30 31
5D	HARDING LAWSON ASSOCIATES							
	1) Planning & Project Management	16,640	9,792	9,792	9,792	9,792	9,792	7,168
	2) Order & Purchase Equipment	64,762						
	3) Equipment Shipment							
	4) Set Up Field Lab	3,200						
	5) Technical Services							
	a) Site Testing Services		95,592	84,395	93,150	90,232		
	1) Supervisor & 9 Technicians							
	b) Anchorage Testing						15,000	
	c) Geophysical Surveys (3 Men)		68,302	61,846	67,030	65,302		
	d) Geologist/Engineer Support (2 Men)		33,120	30,240	34,560	12,960		

LEGEND:
4 Staff/Crew
●——● Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

GEOTECHNICAL PROGRAM - TASK 5

SUB-TASK NO.	SUBTASK DESCRIPTION
5D	HARDING LAWSON ASSOCIATES (cont)
	e) Auger Drilling
	1) Planning & Project Management
	2) Mobilization
	3) Drilling (100 Day Program)
	4) Demobilization (September 1983)



LEGEND:
4 Staff/Crew
Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

SUPPORT LOGISTICS - TASK 39

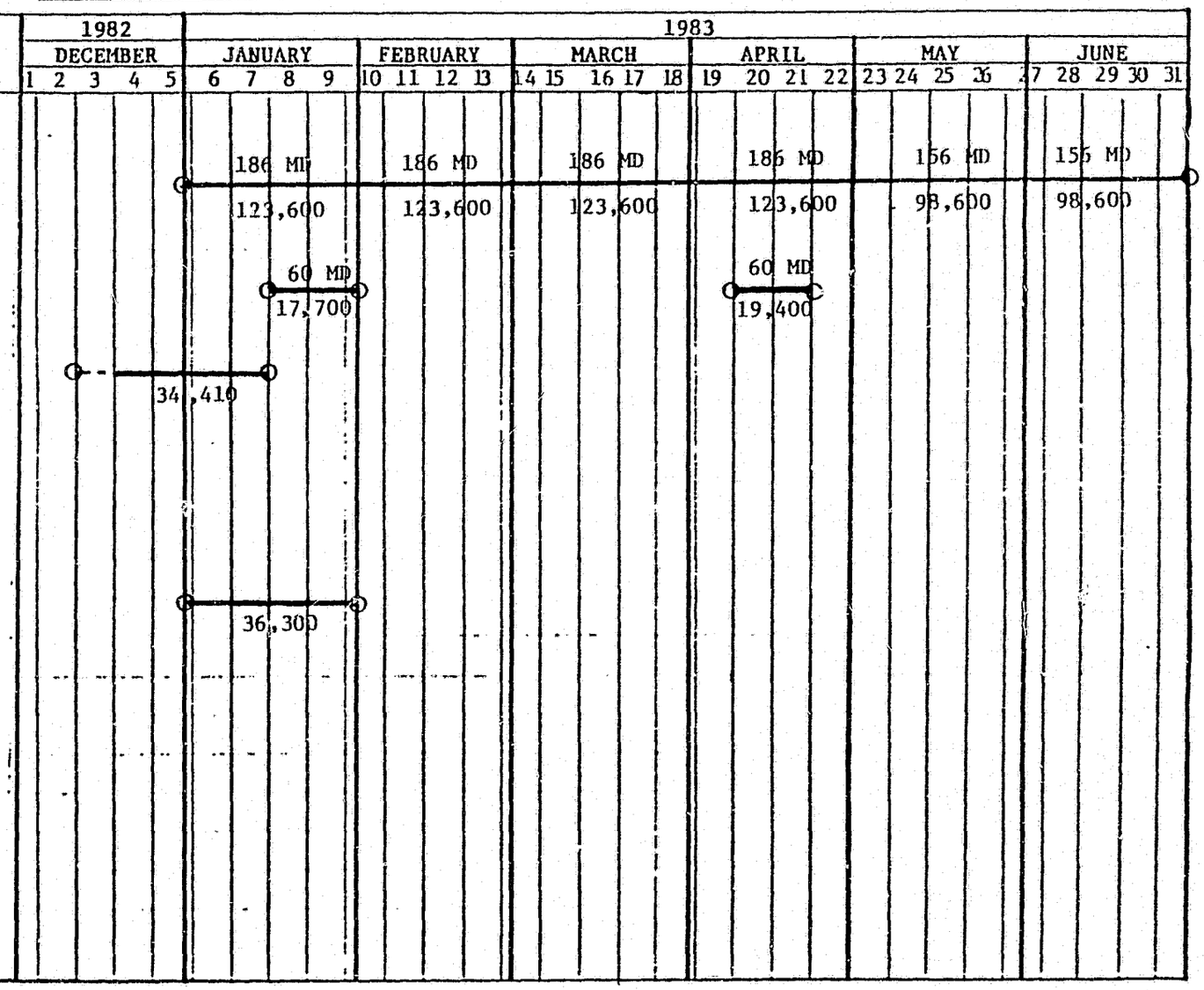
SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER 1 2 3 4 5	1983 JANUARY 6 7 8 9	FEBRUARY 10 11 12 13	MARCH 14 15 16 17 18	APRIL 19 20 21 22	MAY 23 24 25 26	JUNE 27 28 29 30 31
39A	HARZA/EBASCO-SITE LOGISTICS							
	Non-Technical Contractors- Frank Moolin and Associates	31,100	51,300	41,700	41,700	51,300	41,500	41,500
	a) Cook Inlet Region, Inc.							
	b) Air Logistics of Alaska							
	c) Matanuska Telephone Associations							

LEGEND:
4 Staff/Crew (MD)
●——● Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

SUPPORT LOGISTICS - TASK 39

SUB-TASK NO.	SUBTASK DESCRIPTION
39B	COOK INLET REGION, INC.
	1) Camp Operation & Maintenance at Watana
	2) Major Fuel Lift
	3) Camp Modification & Upgrade
	a) Lab
	b) Water Well
	4) Special Projects
	a) Warehouse Door
	b) Snow Strip
	c) Water Saver; Washer/Dryer
	d) Warehouse Demobilization of Cores, Etc.
	e) Camp Leveling
	f) RF Patch



LEGEND:
4 Staff/Crew
●——→ Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

SUPPORT LOGISTICS - TASK 39

SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER 1 2 3 4 5	1983 JANUARY 6 7 8 9	FEBRUARY 10 11 12 13	MARCH 14 15 16 17 18	APRIL 19 20 21 22	MAY 23 24 25 26 27	JUNE 28 29 30 31
39C	AIR LOGISTICS OF ALASKA, INC.							
	1) Helicopter 206 Series							
	a) B-Aircraft #1 (3 mo.)	11,630	46,525	46,525	46,525	46,525	46,525	46,525
	b) B-Aircraft #2 (3 mo.)	11,630	46,525	46,525	46,525	46,525	46,525	46,525
	c) B-Aircraft #3 (m/m)	10,300	41,250	41,250	41,250	41,250	41,250	41,250
	d) B-Aircraft #4 (m/m)	10,300	41,250	41,250	41,250	41,250	41,250	41,250
	e) B-Aircraft #5 (m/m)	5,150	20,625	20,625	20,625	20,625	41,250	41,250
	f) L-Aircraft #6 (m/m)	5,800	23,175	23,175	23,175	23,175	46,350	46,350
	g) L-Aircraft #7						46,350	46,350
	h) L-Aircraft #8						46,350	46,350

LEGEND:
4 — Staff/Crew
● — ● — Activity Duration
42,250 — Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

SUPPORT LOGISTICS - TASK 39

SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER 1 2 3 4 5	1983 JANUARY 6 7 8 9	FEBRUARY 10 11 12 13	MARCH 14 15 16 17 18	APRIL 19 20 21 22	MAY 23 24 25 26	JUNE 27 28 29 30 31
39C	AIR LOGISTICS OF ALASKA, INC. (cont.)							
	i) L-1-Aircraft #9						48,150	48,150
	j) L-1-Aircraft #10						48,150	48,150
	k) L-1-Aircraft #11						48,150	48,150
	2) Helicopter 205 Series							
	a) Aircraft #1	26,850	107,400	53,700	53,700	107,400	107,400	107,400
	b) Aircraft #2		26,850	26,850	26,850	26,850	26,850	26,850
	3) Fixed Wing Aircraft							
	a) CASA-212-100 (alt. to 205)							
	b) CASA-212-200 (alt. to 205)							
	c) CESSNA 206		6,000	6,000	6,000	6,000	12,000	12,000

LEGEND:
4 Staff/Crew
●——● Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

COST SUMMARY - GEOTECHNICAL PROGRAM - TASK 5

SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER 1 2 3 4 5	1983 JANUARY 6 7 8 9	FEBRUARY 10 11 12 13	MARCH 14 15 16 17 18	APRIL 19 20 21 22	MAY 23 24 25 26 27	JUNE 27 28 29 30 31
5A	HARZA-EBASCO	185,300	235,900	238,900	238,900	199,000	199,000	238,900
5B	Denali Drilling, Inc.	149,600	377,442	531,624	223,265	52,750	20,500	92,500
5C	R & M Consultants, Inc.	10,770	120,000	93,500	85,500	48,950	85,500	90,800
5D	Harding Lawson Associates	84,602	206,806	186,273	204,532	178,286	47,904	159,580
	MONTHLY SUBTOTAL	$ 430,272	$ 940,148	$1,050,297	$ 752,197	$ 478,986	$352,904	$ 581,780
							TOTAL TO THE END OF THE 1983 FISCAL YEAR:	$4,586,584

LEGEND:
4 Staff/Crew
Activity Duration
42,250 Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

COST SUMMARY - SUPPORT LOGISTICS - TASK 39

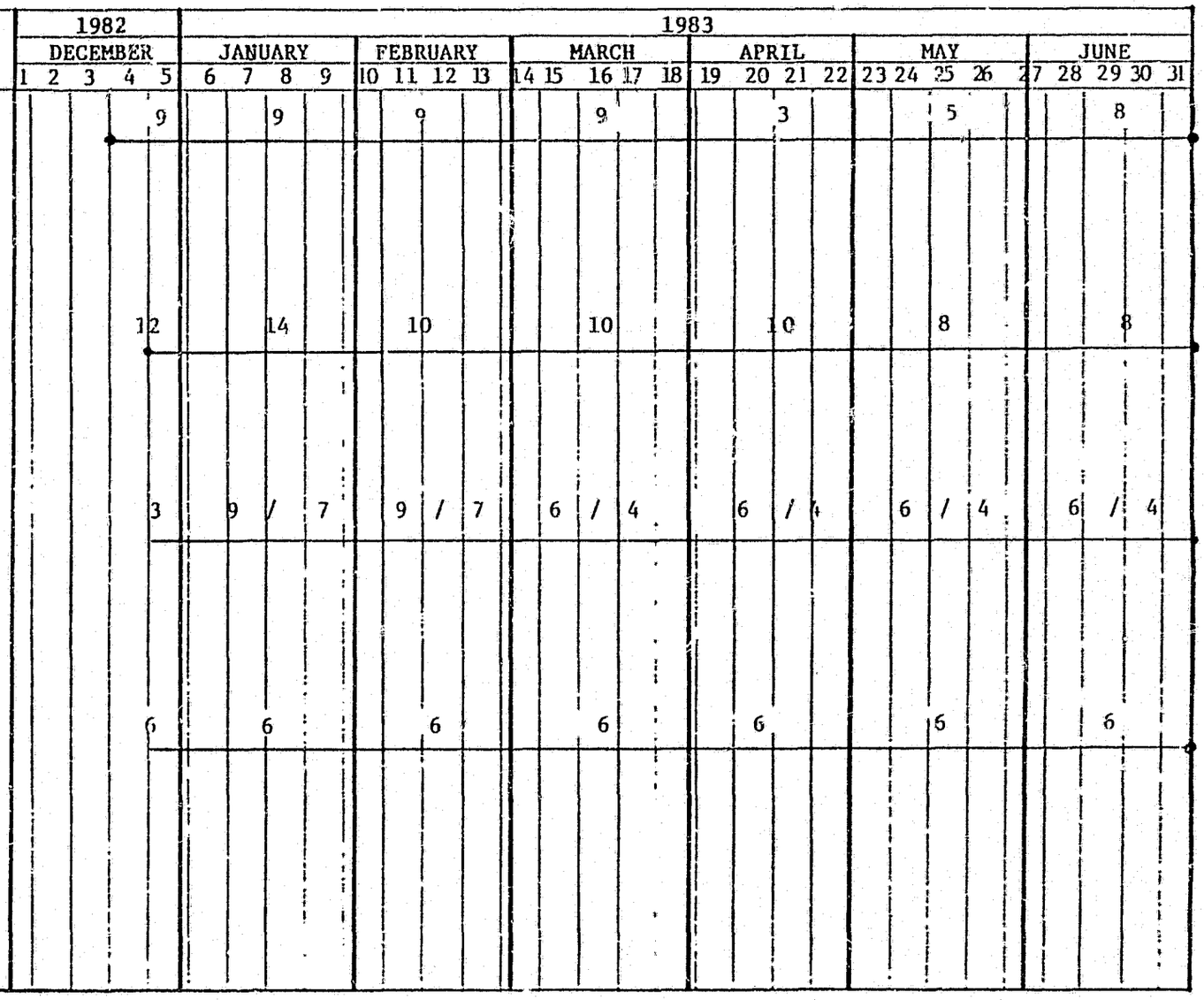
SUB-TASK NO.	SUBTASK DESCRIPTION	1982 DECEMBER 1 2 3 4 5	1983 JANUARY 6 7 8 9	FEBRUARY 10 11 12 13	MARCH 14 15 16 17 18	APRIL 19 20 21 22	MAY 23 24 25 26 27	JUNE 28 29 30 31
39 A	HARZA-EBASCO-Frank Moolin	31,100	51,300	41,700	41,700	51,300	41,500	41,500
39 B	Cook Inlet Region, Inc.	17,205	194,805	123,600	123,600	143,000	98,600	98,600
39 C	Air Logistics of Alaska, Inc.	81,660	359,600	305,900	305,900	305,900	646,550	646,550
	MONTHLY SUBTOTALS	$ 129,965	$ 605,705	$471,200	$ 471,200	$ 553,900	$786,650	$ 786,650
							TOTAL TO THE END OF THE 1983 FISCAL YEAR:	$ 3,805,270

LEGEND:
4 — Staff/Crew
●——● — Activity Duration
42,250 — Cost in $

TASK-5 SUMMARY
SUSITNA HYDROELECTRIC PROJECT
TASK 5 - GEOTECHNICAL STUDIES
DECEMBER, 1982 - JUNE 30, 1983

WATANA CAMP LOADING

SUB-TASK NO.	SUBTASK DESCRIPTION
5-A	HARZA-EBASCO/ACRES Technical 1) Rig (4) 2) Geophysics (2) 3) Tech Mgr. (1) 4) Lab (1) 5) Camp Manager
5-B	Denali Drilling 1) Mob (12) 2) Set Up (14) 3) Drill (10)
5-C	R & M Consultants 1) Instrumentation (2) 2) Brushing (3) 3) Survey (3) 4) Coordinator (1)
5-D	Harding Lawson Associates 1) Lab Superintendent (Anchorage) (1) 2) Tech (2) 3) Tech Superintendent (1) 3 x 2 = 6 (2-12 hrs/7 days; 21 on, 7 off)



SUBTASK 5A - GEOTECHNICAL WINTER EXPLORATION PROGRAM

Mobilize and execute Phase II (Winter) of the FY-83 Proposed Geotechnical Program through January 31, 1983. Mobilization is to meet start of field work for the Hammer Drilling Program on January 2, 1983.

This task consists of technical and management activities by HARZA/EBASCO and technical activities by three subcontractors as follows:

Denali Drilling, Inc. - Hammer Drilling Services

Harding-Lawson Associates - Site Laboratory Testing and Geophysical Survey Services

R & M Consultants - Instrumentation Monitoring and Surveying Services

Item A: HARZA/EBASCO Technical and Management Activities

HARZA/EBASCO will provide direct management of the geotechnical Winter exploration program to direct activities, coordinate subcontractors, and assure the program is being executed to meet program objectives. Technical management of the program will be accomplished by HARZA/EBASCO personnel monitoring subcontractor subtasks, and performing various technical activities to execute the acquisition and interpretation of the field data.

HARZA/EBASCO will perform geophysical surveys at the Watana Damsite with support of Harding-Lawson in Subtask C.

Seismic refraction, ground penetrating radar, and downhole geophysical surveys will be initiated in early January.

Seismic refraction surveys will be conducted to determine the overburden and competency of bedrock within the river channel and along embankments. Both onland and marine refraction methods will be used. Along the embankments, field procedures will consist of laying out linear spreads of 12 geophone over distances of up to 600 feet. Mark Products 4 hertz geophones will be at 10 to 50 foot intervals at each spread. Seismic P-waves will be generated with one-third to one-half pound dynamite charges. Shot points will be located at both ends of individual spreads to obtain fully-reversed subsurface profiles. All seismic data will be recorded using a Nimbus 12-channel seismograph (ES-12 F). Within the river channel, marine refraction methods will be used. The marine method differs from onland technique in that a 40-cubic-inch mudgun is used for the energy source and P-44 hydrophone replaced the geophones. The airgun and hydrophone will be suspended through holes drilled in the river ice canopy. The hydrophone will be placed at 25 to 50 foot intervals over a distance of between 400 to 500 feet. These data will also be recorded on a Nimbus 12-channel seismograph.

Ground Penetrating Radar (GPR) surveys will be conducted within the river channel to determine under-ice configurations in the channel and to map shallow subsurface stratigraphy. GPR will also be utilized to locate ice/gravel contacts in the river which will assist in the location of the Susitna River drillholes.

Downhole compressional and shear wave surveys will be conducted to define engineering properties such as elastic moduli and P-wave velocities of the overburden and bedrock. A downhole shear wave hammer will be used to generate S-waves which will be recorded on a Nimbus 1210-S. Suitable instrumentation, i.e. downhole geophones, for crosshole surveys will also be available during the survey.

Items For Task #5 (Partial)
(Geotechnical and Geological Field Studies)

Period - November 16 thru December 31, 1982

FMAA Scope of Work

- Provide subcontract assistance to change existing Acres America contract to Harza/EBASCO contracts effective 1/1/83 and extend to 6/30/83:
  - + CIRI
  - + Air Logistics - Helicopter
    - Fixed Wing
  - + R&M Consultants
  - + Denali Drilling - Becker Drilling
    - Core Drilling
- Provide subcontract assistance for new contracts with Harza/EBASCO for work to commence 1/1/83.
  - + Harding and Lawson - Drilling
  - + Matanuska Telephone Assoc. - Communication Modifications
- Provide logistical support and management of CIRI's design of on-site materials lab and water well and construction of materials lab.
- Provide logistical support for mobilization of winter drilling program to commence 1/1/83
- Provide logistical support and management for CIRI to maximize camp capacity by 1/1/83.

FMAA Budget

- 290 Manhours - $19,768 (See attached)

Deliverable Work Products

- Harza/EBASCO interim contracts with subcontractors
- P.S.& E. for materials lab
- P.S.& E. for water well modification
- Maximum utilization or Watana Camp space

Items for Task #5 (Partial)

Period - January 1 thru June 30, 1983

FMAA Scope of Work

- Provide management for subcontracts furnishing services and support for field drilling programs.
- Provide logistical coordination of aircraft subcontractors with other subcontractor requirements.
- Provide logistical support and management of camp operations, maintenance and catering subcontractor.
- Provide management of water well modification and construction by subcontractor.

FMAA Budget

- 4572 Manhours - $171,208 (See attached)

Deliverable Work Products

- Provide information to Project Control to assist in cost and scheduling monitoring of contracts.
- Provide monthly progress reports.
- Provide management of work status.

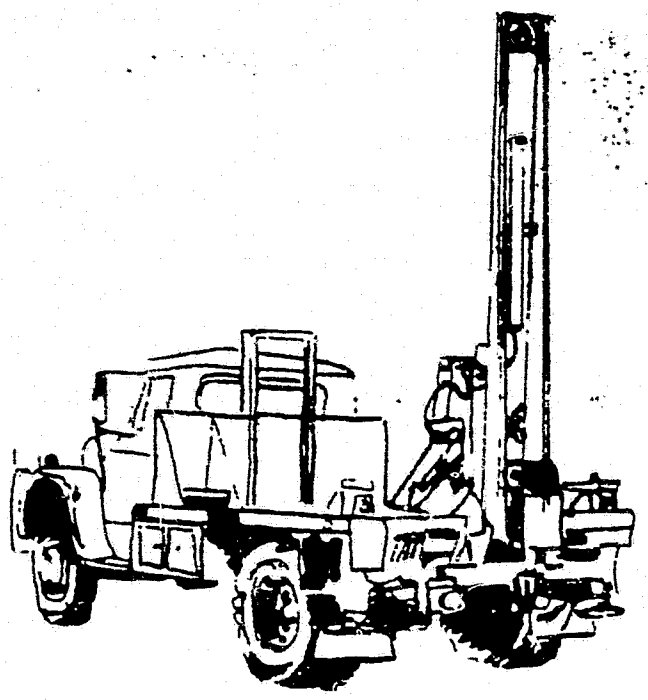
FMAA

BUDGET

DATE	MANHOURS	$
11/20/82	13	1,074
11/27/82	19	1,568
12/04/82	50	3,084
12/11/82	60	4,196
12/18/82	50	3,368
12/25/82	58	3,792
01/01/83	40	2,686
01/01/83-02/01/83	876	32,594
02/01/83-03/01/83	705	26,505
03/01/83-04/01/83	705	26,505
04/01/83-05/01/83	876	32,594
05/01/83-06/01/83	705	26,505
05/01/83-06/30/83	705	26,505
TOTALS	4,862	190,976

SUBTASK 5B - HAMMER DRILLING SERVICES - DENALI DRILLING, INC.

Denali Drilling, Inc. will mobilize and begin hammer drilling services in accordance with provisions of Agreement No. P5700.10.15 for the Hammer Drilling Program, dated October, 1982. Services will consist of drill and winter support mobilization, and of hammer drilling services for the camp water well and for the exploration program at the damsite, cofferdams, relict channels and borrowfits. Drilling services on borrow areas are anticipated to begin in February.



Denali Drilling inc.

6000 A STREET ANCHORAGE, ALASKA 99502
(907) 279-4568

December 2, 1982

Acres American Incorporated
1577 "C" Street, Suite 305
Anchorage, Alaska 99501

Attn: Mr. Bob Henschel

Ref: Susitna Hydroelectric Project
1982-83 Winter Drilling Program
Hammer Drill Project

Dear Bob,

Enclosed for your review and transmitted herewith are the following documents to assist your administration of this contract:

1) Bar Chart - reflecting activity scheduling, manpower, Helicopter utilization and cash flow per contract.
2) Bar Chart - reflecting the early start time schedule with Denali actual.
3) Materials price estimate.
4) Mobilization letter of expenses
5) Daily reports for drilling activities, equipment and manpower.
6) Memo comments of 11/26/82 & 11/29/82 meetings.
7) Hydraulics print of hydraulic splitter.
8) Copy of Susitna Dam Summer Drilling Program 1982.

If there are any questions, please contact this office.

Sincerely,

Harry A. Hartung
Engineer

HAH:kb

Encl.

FORM 14-29

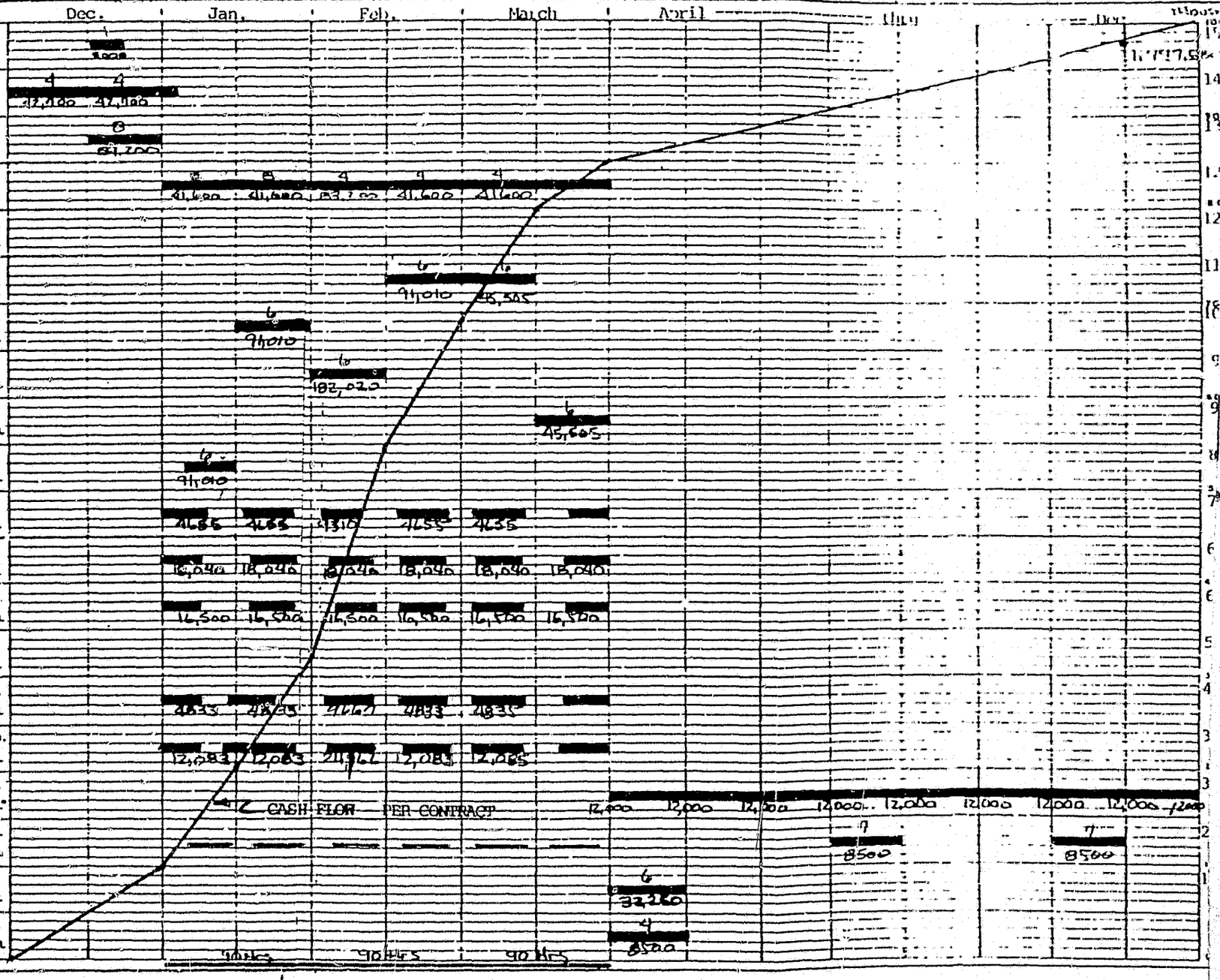
DENALI DRILLING INC.

CONSTRUCTION PROGRESS SCHEDULE

1. CONTRACTOR: DENALI DRILLING INC.	3. CONTRACT AMOUNT: $ 1,447,680.00	5. CONTRACT DESCRIPTION: Drill 50 holes to a maximum depth of 600' with Becker Drill	6. Submitted (Contractor) Peter Tester 7. Receipt Acknowledged (District)
2. PROJECT: Susitna Hydroelectric Hammer Drilling Services	4. CONTRACT TIME: Jan. 1, 1983 - March 31, 1983 Winter 1984	LENGTH: MILES	DATE: 11/29/82

LEGEND: NAME; SCHEDULE; ACTUAL (RED); ACTUAL (RED)

ITEM NO.	ITEM NAME	%	EST. COST	
1.	Recon of Access Route			SCHED. / ACTUAL
2. a)	Mob - Drill & Crew		$ 90,400.	SCHED. / ACTUAL
c)	" - Winter Support		59,200.	SCHED. / ACTUAL
d)	Winter Operation		249,600.	SCHED. / ACTUAL
3.	Drilling a) Hammer/Rotary Drilling		546,060.	SCHED. / ACTUAL
	1) Dam & Cofferdam			SCHED. / ACTUAL
	2) Relict Channel			SCHED. / ACTUAL
	3) Borrow Site D			SCHED. / ACTUAL
	4) Borrow Site E & I			SCHED. / ACTUAL
	5) Water Well - Camp			SCHED. / ACTUAL
	b) Core Drilling			SCHED. / ACTUAL
4.	Hourly Operating Rates		108,240.	SCHED. / ACTUAL
5.	Hourly Stand-by Rates		99,000.	SCHED. / ACTUAL
6.	Testing & Sampling			SCHED. / ACTUAL
	a) Permeabilities Testing		29,000.	SCHED. / ACTUAL
	b) Spoon or Drive Sample		72,500.	SCHED. / ACTUAL
7.	Secured Stand-By		108,000.	SCHED. / ACTUAL
8.	Crew Time		17,000.	SCHED. / ACTUAL
2. b)	Demob - Drill & Crew		32,250.	SCHED. / ACTUAL
e)	" Winter Support		8,500.	SCHED. / ACTUAL
	HELICOPTER			
			$ 1,447,680.	



ENG 14-29

DENALI DRILLING INC.

CONSTRUCTION PROGRESS SCHEDULE

1. CONTRACTOR: DENALI DRILLING INC.	3. CONTRACT AMOUNT: $ 1,447,680.00	5. CONTRACT DESCRIPTION: Drill 50 holes to a maximum depth of 600' with Becker Drill	6. Submitted (Contractor) Peter Tester — DATE 11/29/82
2. PROJECT: Susitna Hydroelectric Hammer Drilling Services	4. CONTRACT TIME: Jan. 1, 1983 - March 31, 1983 Winter 1984	LENGTH: MILES	7. Receipt Acknowledged (District) — DATE
			DATE

LEGEND

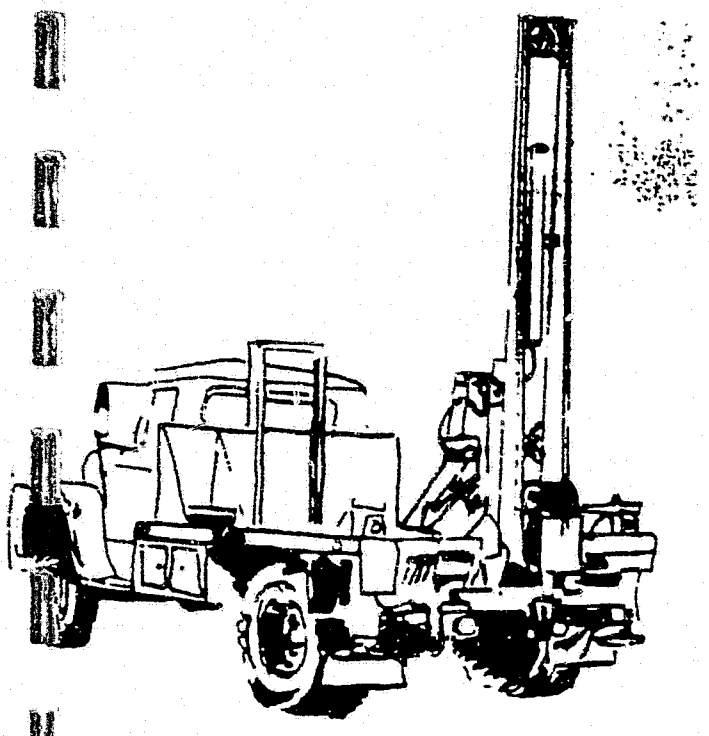
BASIS:
SCHEDULE
ACTUAL (RED)
CURVES: SCHEDULE ACTUAL (RED)

ITEM NO.	ITEM NAME	%	EST. COST	SCHED. / ACTUAL
	MOBILIZATION			
	Recon to Watana			
	Prepare Drill & Carrier			
	Prepare Ancilliary Tools			
	Mob equipment & tools to Anchorage			
	Preparation in shop			
	Mob equipment to Cantwell			
	Travel to Watana Camp			
	WINTER SUPPORT			
	Prepare D-7 Cats & Pumps			
	Mob Cats to Cantwell			
	Clearing roads			
	Building ice bridges			
	Winter Operation			
	Well Drilling			
	Hammer Rotary Drilling			

DEC. 5 10 15 20 25 30 — JANUARY 5 10 15 20 25 30 — THOUSAND

$541,500
~~DENALI DIRECT EQUIPMENT CASH FLOW FOR DRILL, CARRIER, PIPE & PARTS TO BE AMORTIZED~~

% COMPLETE: 100 90 80 70 60 50 40 30 20 10 0



Denali Drilling inc.

6000 A STREET ANCHORAGE, ALASKA 99502
(907) 279-4568

Information Requested by Harza/Ebasco

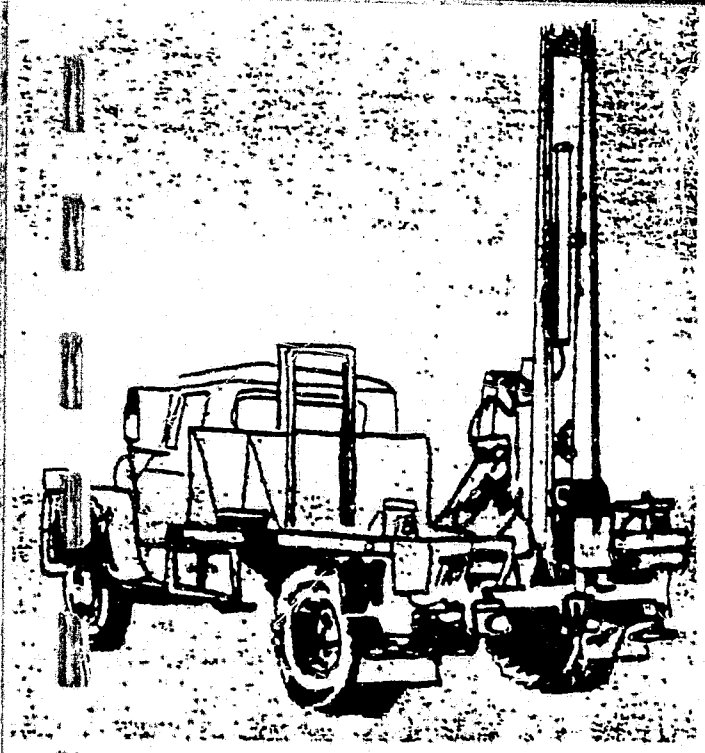
1) Fuel consumption - Approximately 50,000 gallons for 110 days. This is based on maximum utilization of winter support equipment.

2) Propane consumption - Approximately 1,500 lbs. for 110 days.

3) Operating rate for D-7 if used for work not covered in contract, (air strip maintenance), will be $85.00 per hour straight time with operator, $105.00 per hour over time with operator.

4) Operating rate for Nodwell used for work not covered in contract will be $25.00 per hour dry or $56.00 per hour with operator.

5) Welding rate for running well casing is $220.00 per hour straight time and $310.00 per hour over time.



Denali Drilling inc.

6000 A STREET ANCHORAGE, ALASKA 99502
272-9518

December 2, 1982

MATERIALS/PRICES

DIRECTS W/O FREIGHT

A. PRICES

	10' Sections	Shoes
6" SW 3000'	$287.65/Lf	$180.50
3" ZW 1950'	$351.50/Lf	$373.50
10" 500'	$425.00/Lf	$281.00

PIPE AVAILABILITY

250 Assorted Pieces by 5 January 83
150 Remaining pieces by 26 January 83

(If ordered Friday, 26 November 82)

B. SCREENS

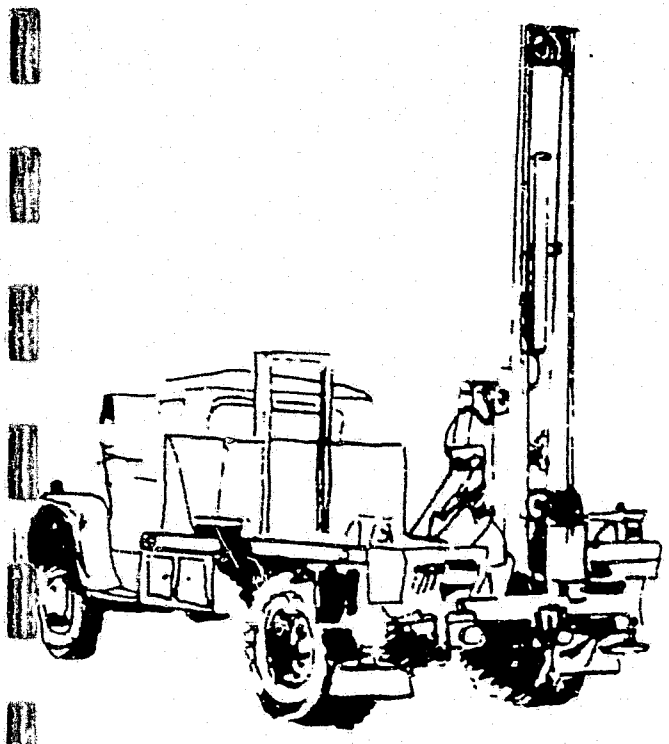
4" Well Screen @ #39.10/ft

(No plastic quoted yet)

C. PUMP

Enter 4" or 6" Casing
5HP - 18 gal/min @ 600'

Pump with control box	$1975
Pump wire $1/Lf	600
	$2575



Denali Drilling inc.

6000 A STREET
(907) 279-4568

ANCHORAGE, ALASKA 99502

December 2, 1982

Acres American Incorporated
1577 "C" Street, Suite 305
Anchorage, Alaska 99501

Attn: Mr. Bob Henschel

Ref: Susitna Hydroelectric Project
1982-83 Winter Drilling Program
Hammer Drill Project

Dear Bob,

It has become apparent that the three weeks delay in award of the contract, and subsequent delay in material orders and deliveries, that Denali shall be unable to meet the January 1st mobilization date with a normal sequence of operations.

There is a possibility we could be mobilized within a respectable time after the first to keep on schedule, if all activities of the mobilization process are accelerated.

We expect to expend approximately 500 hours in premium overtime to accomplish this (12 men X 4 hours per night X 10 days = 480 hours). Additional cost to the project is estimated at:

Labor - 500 hours @ $20.00/hr	$10,000.00
Special freight of critical parts	6,000.00
	$16,000.00

If you wish to proceed on fast track program to minimize the delay, please consider these additional costs.

Sincerely,
DENALI DRILLING INC.

Harry A. Hartung
Engineer

HAH:kb

cc: Ebasco

DENALI DRILLING, INC.
DAILY DRILL REPORT

W.O._____ Date_____

Client_____ Project_____ Location_____ Hole No._____ Angle_____ Shift _____

Drill No._____ Carrier No._____ Feet to water_____ Depth to water _____

FOOTAGE DRILLED	NO. OF HOLES	FROM FT.	TO FT.	CORE RECOVERED	BIT SIZE/TYPE	MATERIAL DRILLED	ROD & CASING IN HOLE SIZE	ROD & CASING IN HOLE FEET
AUGERED								
ROTARY								
CORED								
REAMED								

CODE	WORK DESCRIPTION	S.T.	O.T.
1	Mob / Demob		
2	Drilling		
3	Travel		
4	Standby		
5	Maintenance		
6	Down-time		
7	Cementing		
8	Logging / Angle test		
9	Fishing		
10	Reducing		
11	Moving		
12	Hole Conditioning		
13	Other		
14	TOTAL HOURS		

A.M.												P.M.												A.M.					
6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6					

EXPENDABLES			
Lifter Shoes		Drill Bolts	
Lifter Springs/Catches		Cement	
Drive Shoes		Mud	
Bits		Auger	
Fuel		Brass Liners	
Lab		Other	

BITS, CASING SHOES, ETC.				
SIZE	NUMBER	ON	OFF	FEET

SAMPLING		
ATTEMPTED	RECOVERED	TYPE OF SAMPLING

TOTAL HOURS	DRILLER / HELPER / GEOLOGIST	REMARKS:	WEATHER:	TEMP:

APPROVED BY: _____ SIGNED _____

FOREMAN

DENALI DRILLING, INC.
DAILY DRILL REPORT

W.O._____ Date_____

Client_____ Project_____ Location_____ Hole No._____ Angle_____ Shift _____

Drill No._____ Carrier No._____ Feet to water_____ Depth to water _____

FOOTAGE DRILLED	NO. OF HOLES	FROM FT.	TO FT.	CORE RECOVERED	BIT SIZE/TYPE	MATERIAL DRILLED	ROD & CASING IN HOLE SIZE	ROD & CASING IN HOLE FEET
AUGERED								
ROTARY								
CORED								
REAMED								

CODE	WORK DESCRIPTION	S.T.	O.T.
1	Mob / Demob		
2	Drilling		
3	Travel		
4	Standby		
5	Maintenance		
6	Down-time		
7	Cementing		
8	Logging / Angle test		
9	Fishing		
10	Reducing		
11	Moving		
12	Hole Conditioning		
13	Other		
14	TOTAL HOURS		

A.M. 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 P.M. A.M.

EXPENDABLES			
Lifter Shoes		Drill Bolts	
Lifter Springs/Catches		Cement	
Drive Shoes		Mud	
Bits		Auger	
Fuel		Brass Liners	
Lab		Other	

BITS, CASING SHOES, ETC.				
SIZE	NUMBER	ON	OFF	FEET

SAMPLING		
ATTEMPTED	RECOVERED	TYPE OF SAMPLING

TOTAL HOURS	DRILLER / HELPER / GEOLOGIST	REMARKS:	WEATHER:	TEMP:

APPROVED BY: _____ SIGNED _____
FOREMAN

DENALI DRILLING, INC.
Daily Equip/Manpower Report

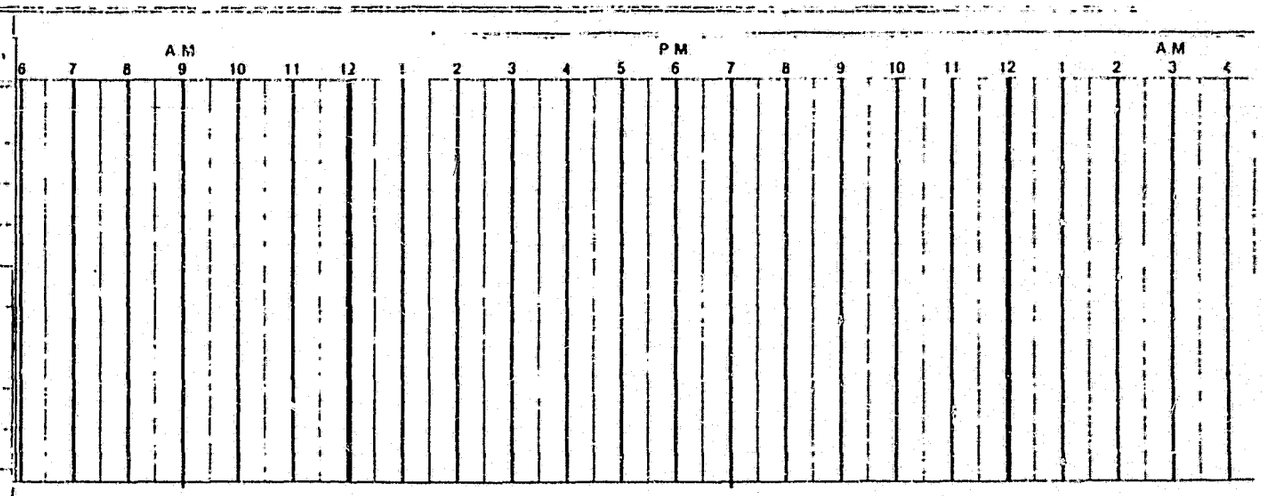
W.O.# _____ Date _____

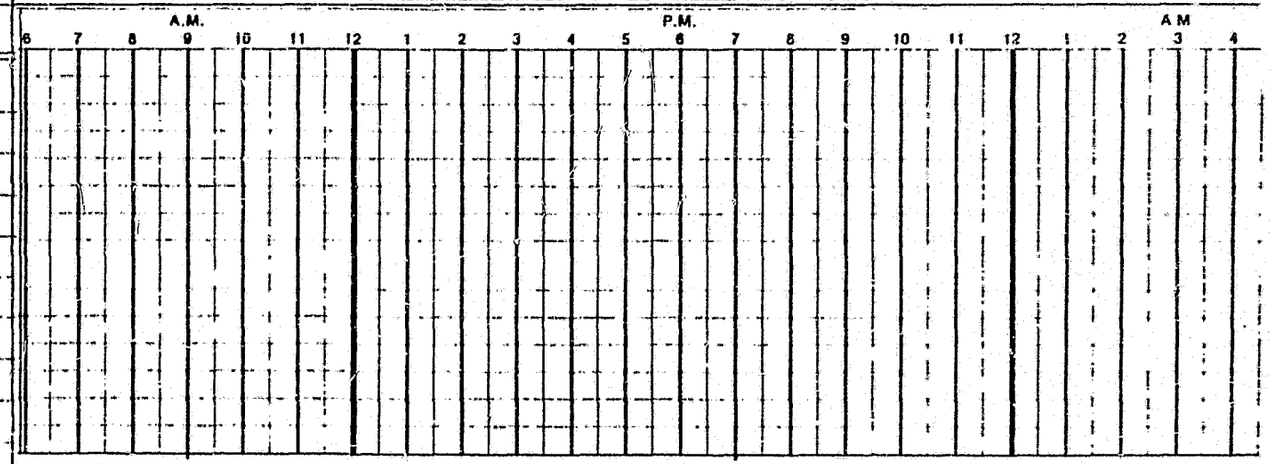
Client _____ Project _____ Location _____ Work Area _____ Shift _____

Site No. _____ Carrier No. _____ Feet to Water _____

EQUIP. DESCRIPTION	DRILL	WINTER SUPPORT
1. AP 1000		
2. Flex Track 360		
3. D7 Dozer		
4.		
5. FN 240 Pipe Carrier w/Boom		
6. FN 60 Vehicle Emerg. Supply Carrier		
7. FN 60 Personnel Carrier		
8. FN 160 Shop Carrier		
9. 2 ea. Nodwell Trailers		
10. Light Plant		
11. Welders		
12.		
13.		

PERSONNEL	S.T.	O.T.
1. Foreman		
2. Driller		
3. Helper		
4. 2nd Helper		
5. Mechanic		
6. Laborer		
7. 2nd Laborer		
8. Operator		
9. Others		
10. Crew Time: Drill Crew only		





TOTAL HOURS	DRILLER/HELPER/GEOLOGIST	REMARKS	WEATHER	TEMP

APPPOVED BY: _____ SIGNED _____
Foreman

SUSITNA HYDROELECTRIC PROJECT

November 8, 1982
P5701.10.15
T974

KNIKATNA Incorporated
Box 2130
Wasilla, Alaska 99645

Attention: Mr. Paul Theodore, President

Dear Paul:

Access Trail to River For Winter Exploration Program

This letter is written in regards to the access trail at the Watana site which is to be used this winter to allow the drilling equipment to travel from the Watana camp down to the Susitna River near the mouth of Tsusena Creek.

Based on our earlier discussions and visual examination of the general route location, the trail was located and brushed during the summer geotechnical program in preparation for the winter drilling. Following mobilization of the winter drilling and support equipment in mid to late December, a D7 dozer will be used to trim and regrade a few of the steeper sections of the trail to allow easier passage of the equipment.

To confirm our earlier discussions and your statement of non-objection to the location of the brushed trail, we request that KNIKATNA give us a letter of non-objection for the Alaska Power Authority and/or its Engineer, to construct the access trail as indicated above, and to use the trail for transporting drilling and support equipment to and from the Susitna River during the winter '82-83 Geotechnical Program.

If you have any questions or require any additional information, please do not hesitate to call me.

Sincerely,

Robert R. Henschel

RRH/ja

Robert R. Henschel
Geotechnical Coordinator

cc: C. Debelius
D. Wozniak
J. Shen

ACRES AMERICAN INCORPORATED

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF LAND & WATER MANAGEMENT

LAND USE APPLICATION AND PERMIT

2. APPLICANT

Alaska Power Authority
Name (Last) (First) (MI)

1. PERMIT - For Office Use Only			
Received by	District	Year	Number

334 West 5th Avenue, Anchorage, Alaska 99501 276-0001
Street/P.O. Box City State Zip Phone

3. LAND LOCATION:
Township_____, Range_____,_____Meridian,Section___Portion_____
Other Description Entry point - T22S R3W Sect. 18 Fairbanks meridian
Exit point - T32N R5W Sect. 2 Seward meridian
(see attached map)

4. PROPOSED ACTIVITY: Transportation of drilling and support equipment by tracked carriers for the Susitna Hydroelectric Project design study. The route proposed will follow the 1978 Corps of Engineers winter trail depicted on the attached map. The number of roundtrips will be approximately four, as described in the attached overland transportation plan.
(Use extra sheets if necessary)

5. SPECIAL STIPULATIONS: (in addition to conditions on reverse side)

6. DATE OF APPLICATION: November 10, 19 82
7. DATE OF INTENDED USE (not to exceed one year) From 12/15/82 to 5/15/83
8. CONTACT PERSON, if other than applicant: Acres American Inc., Attn: Robert Henschel
Name
1577 "C" Street, Suite 305 276-4888
Address Anchorage, AK 99501 Phone Position/Title

9. _____ Executive Director 11/10/82
SIGNATURE OF APPLICANT OR AUTHORIZED REPRESENTATIVE Title Date

10. APPLICATION IS Granted Denied Granted as modified
By_____
Division of Land and Water Management
11. BOND IS REQUIRED (See attached bond)
12. SUPPLEMENTAL INFORMATION_____

084 12/81 (rev.)

SUSITNA HYDROELECTRIC PROJECT

November 8, 1982
P5700.10.15
T976

Alaska Department of Fish & Game
Habitat Protection Section
333 Raspberry Road
Anchorage, Alaska 99502

Attention: Mr. Phil Brna

Dear Phil:

Susitna Hydroelectric Project
Winter 1982-83 Geotechnical Investigations

Further to our phone conversation earlier today, please find enclosed for your information and review a summary of the proposed geotechnical investigations to be carried out this winter (December 15, 1982 - May 15, 1983) at the Watana site in conjunction with the Susitna Hydroelectric Project design studies. These investigations consist primarily of reverse circulation drilling using a Becker Hammer Drill and geophysical surveys across the Susitna River channel.

Based on our previous discussions, it is our understanding that no Title 16 review is required since all geotechnical activities will be carried out upriver of the Portage Creek confluence, and this area is not classified as anadromous fish habitat. However, we would request that you review the proposed exploration program, and formally advise us and the Alaska Power Authority, in writing, that no Title 16 permit is required for the winter geotechnical program.

If you have any questions or require any additional information, please do not hesitate to call me at 276-4888.

Sincerely,

Robert R. Henschel
Geotechnical Coordinator

RRH/kt

Enclosure: as

cc: Jim Shen - CIRI
Dave Wozniak - APA
C. Debelius - Acres

SUSITNA HYDROELECTRIC PROJECT

Geotechnical Exploration Plan
Period: December 15, 1982 - May 15, 1983

INTRODUCTION

As a part of the ongoing Susitna Hydroelectric Project design study, additional geotechnical investigations are to be carried out at the proposed Watana damsite (Figure 1). The studies will include exploration of the dam foundations, relict channel area, and construction material sources. The present schedule calls for mobilization of equipment to the site starting December 15, 1982 with expected completion of work and demobilization by May 15, 1983.

OBJECTIVE OF GEOTECHNICAL INVESTIGATION

The winter geotechnical program is designed to provide additional information regarding the alluvial materials in the river channel underlying the proposed dam foundations, geology and extent of the relict channel on the north abutment, and geotechnical properties and quantities of construction materials.

SCOPE OF FIELD INVESTIGATIONS

Exploratory field investigations will comprise reverse circulation drilling utilizing a Becker Hammer Drill and geophysical surveys. The four principal areas that will be investigated during the winter geotechnical program are:

- relict channel on the north abutment
- borrow site D
- borrow sites E and I; and
- damsite (river channel)

A description of the activities is given below. The location of the exploratory activities are shown in plan on Figures 2 through 6.

Hammer Drilling will be conducted in borrow areas D, E and I, in the relict channel area and in the river channel under the proposed dam (Figure 2). A Becker AP1000 Hammer Drill mounted on a tracked carrier will be used to perform the drilling. With this drill a double wall drill pipe is driven into the soil with a diesel hammer. Compressed air is forced down through the annulus between the inner and outer drill pipes to the bit and then passes upwards through the center pipe lifting the drill cuttings to the surface. At the surface the cuttings and compressed air are passed through a "cyclone" which separates out the drilled material so that it can be collected for logging and testing.

SCOPE OF FIELD INVESTIGATIONS - cont.

Geophysical Surveys will be conducted in the river channel from the ice surface to determine the thickness of fluvial deposits overlying bedrock. The type of methods to be used has not been decided yet but may include seismic refraction and/or reflection, sub-bottom profiling, resistivity or some combination of these.

DAMSITE INVESTIGATION

The damsite investigations will consist of hammer drilling and geophysical surveys to determine riverbed foundation conditions for the cofferdams and main dam. Data from this task will be used in developing the general arrangement and design of the cofferdams, and represents a significant and critical factor in determination of design parameters and criteria for cofferdam diversion and main dam planning.

The alluvial deposits of the Susitna River, as determined to date, consist of gravel, cobbles, and boulders with a sand matrix. The thickness and type of material, as well as bedrock conditions, are known at only a few locations. Development of the general arrangement and design of cofferdams and the main dam will require detailed data on the following: thickness and types of alluvial material, frozen layers (if any), top of bedrock surface, bedrock lithology and structure, and depth to sound rock.

During the winter, when ice conditions on the river are suitable, approximately 11,000 feet of geophysical survey lines will be run along the axis of the river and an additional 4,100 linear feet in the cofferdam areas (Table 1). The surveys will run from "The Fins" to downstream of the "Fingerbuster" (upstream to downstream damsite limits) to define the top of bedrock surface and alluvial thickness. The survey lines will be arranged in a grid pattern both parallel to the dam axis and along the center of the river (Figure 3). The results of this survey will be the basis for selecting river borehole locations and for refinement of the top-of-rock maps. Boreholes will be drilled from the surface of the frozen river to confirm the geophysical line data and to sample alluvium and bedrock. A Becker AP1000 hammer drill capable of drilling 400-600 feet deep in alluvial material will be used for the drilling and sampling. Drilling will consist of both plug holes and sampled holes (Table 2 and Figure 3). Plug holes (holes without systematic, deliberate sampling or coring, although sampling of the disturbed material will be conducted for hole-logging purposes) will be drilled to confirm fluvial thickness and depth to sound bedrock as a calibration check on the geophysical lines. Sampled holes will continuously sample the alluvium and bedrock. Rock drilling, for both plug and sampled holes, will continue until a minimum of 10 feet of sound bedrock is encountered to ensure that large boulders are not mistaken as bedrock. A minimum of two of the holes beneath the core of the proposed dam will be core-drilled to a depth of 50-100 feet and pressure-tested to determine rock permeability and to assess the quality of rock at various depths.

DAMSITE INVESTIGATION - cont.

Drilling of the river alluvium will commence after completion of at least the initial seismic lines. A total of four drill holes are planned for each cofferdam site: two sample holes and two plug holes. Total drill footage for the cofferdam sites is estimated to be 800 feet. An additional seven drill holes will be drilled beneath the proposed main dam, and two holes are planned to verify the geophysical data in the plunge pool area. While Table 2 details the assigned priority of these holes, the actual order of drilling and number of holes will be controlled by the effectiveness of the geophysical surveys and drilling rate. Since the river drilling program requires a thick, stable ice cover, the drilling in the damsite area will be performed according to available climatic and snow and ice cover conditions rather than a fixed number of holes.

BORROW SITE D

Borrow Site D has been identified as a zone ranging from 2,000-6,000 feet in north-south dimension, stretching over 12,000 feet from a point on Deadman Creek to the approximate thalweg of the relict channel, including approximately 7,000 feet of exposure as bluffs overlooking the Susitna River, for a total area of about 1,075 acres (Figures 2 and 4). The area has been identified as the most favorable source for impervious core material for a total estimated site requirement of approximately 8.25 mcy. The information to date on the borrow site comprises seismic refraction surveys, auger holes, several deep rotary drill holes, and shallow test pits.

The winter program is designed to obtain additional details to confirm the stratigraphy developed during feasibility, and to develop a clear understanding of material properties, ground water, and permafrost conditions. Results of the winter program will form the basis for the subsequent detailed design level investigations. The long-range objective of the Borrow Site D investigations will be to determine:

(a) Borrow site stratigraphy and extent of each of the various identified units of interest to a level adequate to develop volume-distance relationships, stripping parameters, and producible volumes.

(b) Define site and adjoining areas, ground water, and permafrost conditions in order to allow optimization of production methodology, mining method, and water/frost handling.

(c) Limits of desired excavation based on geologic conditions and desired material properties and determination of mining methods.

(d) Continuity of material properties and their influence on production, processing, and placement requirements.

BORROW SITE D - cont.

(e) Engineering properties of the material as required for placement in the fill, including placement water content, gradation, plasticity, and compaction characteristics. Explorations will place emphasis on detailing volumes of reserve with various properties to allow for selectivity in production, if necessary.

Winter drilling in borrow area D will be carried out in conjunction with the relict channel exploration program. The Becker hammer drill will allow continuous sampling of the blown out cuttings and will provide large samples of the various stratigraphic units for use in geologic interpretation of the stratigraphy and in materials laboratory testing. In addition, drive and core type samples will be taken at selected intervals (Table 3 and Figure 4).

Due to the primary need for stratigraphic information and the fact that systematic pattern explorations of the borrow reserves will be conducted in the subsequent stage of design investigations, the emphasis of the winter program will be put on stratigraphic data collection. The sampling and instrumentation activities carried out in this program will be directed at maximizing the level of information obtained from each boring. Instrumentation will be installed to provide baseline thermal and geohydrologic data. The various methods that will be utilized are described individually below:

(a) Full depth sampling to provide material for geologic examination of the larger particle sizes and for laboratory testing.

(b) Drive and core type sampling as is appropriate using 2- and 3-inch standard split spoon with standard penetration blow counts. Denison sampling, and dry-blocked and conventional fluid circulation core barrel sampling will be conducted.

(c) Casing drive tests (open casing drive tests) for general correlation of stratigraphy and density.

(d) "Undisturbed" samples, using such samplers as fixed piston, "Osterberg", "Shelby", and other special split and tube type barrel samples.

(e) Water level detection and monitoring both during and after drilling to detect various aquifers, perched water zones, and "dry" zones. Due to the preliminary indications that the area has a complex system of ground water levels, most borings will have a minimum of a standpipe type piezometer, and those which penetrate a definite zone of interest may have pneumatic or electric piezometers installed. This system of observation points will be correlated with the relict channel installations.

(f) Limited aquifer permeability testing such as falling head and/or constant head tests will be performed where possible to obtain

order-of-magnitude information on the ranges of permeabilities of the materials in the borrow site.

(g) Permafrost detection will be limited to observation of both seasonal and permanent frost during drilling and installation of thermistors in most of the holes. The probes will enable detection of permafrost in the following year after the frost has stabilized, and of the depth of annual frost penetration during the winter. This information will be utilized to evaluate the frost conditions likely to be encountered in excavation and, at a later stage of design, will be used with the results of all thermal investigations data to develop the borrow site production method to minimize the adverse effects of the frost in excavation and fill placement.

(h) Depending on the variability of the stratigraphic units and material properties across the area, and the confidence in the geologic interpretation from recovered samples, downhole geophysical logging may be conducted. PVC plastic pipe will be installed in the boreholes to allow logging during later phases if it is deemed necessary at that time.

(i) Depending on the nature of the materials encountered, special vane, core, or downhole insite density measurement testing may be performed in the boreholes. Standard penetration and tube sample density will be performed as a routine form of testing.

RELICT CHANNEL

Two areas have been identified on the banks of the proposed Watana reservoir where bedrock falls below the proposed reservoir elevation and, hence, provides a potential for reservoir leakage. The preliminary explorations and geologic mapping indicate that both of these areas may be abandoned Susitna River channels or "relict channels", one between Deadman and Tsusena Creeks, designated the Watana relict channel, and the second in the Fog Lakes area, designated the Fog Lakes relict channel (Figure 2).

The potential conderns regarding these areas are:

(a) Potential for excessive reservoir leakage of such magnitude as to affect project economics.

(b) Potential for excessive local gradients under reservoir head which might cause piping of material and, hence, induce progressive failure of the rim material with ultimate breaching of the reservoir.

(c) Overburden instability or seismic liquefaction potential which could result in breaching of the reservoir confinement.

RELICT CHANNEL - cont.

(d) Crest settlement due to saturation and permafrost thawing.

Preliminary assessment of the Fog Lakes Channel shows the freeboard at Fog Lakes is significantly higher than the Watana Relict Channel, and the local and overall gradient is much flatter and the flow path much longer than the Watana Relict Channel, which minimizes any hazard. Access to the Fog Lakes channel is also extremely difficult due to its location on the south side of the Susitna River. The winter program will be restricted to the Watana relict channel. Detailed investigations in the Fog Lakes channel will be performed during later programs, if required.

The winter explorations will be jointly conducted with the Borrow Site D program since the borrow site lies within the confines of the relict channel areas. The principal objectives of the winter program are to: confirm the geometry of the relict channel; obtain representative samples for stratigraphic identification; define material properties distribution; determine geohydrologic conditions in the relict channel; and install instrumentation for monitoring ground water and permafrost.

The Becker hammer drill will be used to drill approximately 14 holes to bedrock in the relict channel (Table 3 and Figure 5). It is anticipated that these holes may attain maximum depths of 600 feet. As in Borrow Site D, emphasis in the sampling program will be placed on obtaining maximum size samples for stratigraphic information and materials investigations. The various sampling methods that may be available are listed below:

(a) Full depth sampling and logging of drill cutting, which will provide limited supplemental material and stratigraphic information.

(b) Drive and coring sampling, using 2- and 3-inch standard split spoon samples, as well as special samplers such as the Denison.

(c) "Undisturbed" sampling, using special "floating tube" or piston type samples such as the "Gus" and "Osterberg" and various diameters of "Shelby" and similar split or solid thin wall tube sampling.

(d) Casing drive testing, using the hammer drill to ascertain relative variations in density.

(e) Water level detection and monitoring, both during and after drilling operations.

(f) Installation of well casing screens and piezometers for subsequent observations and aquifer testing.

(g) Permafrost monitoring through drill cuttings temperature measurement, observation of ice in the samples taken, and installation of frost probe PVC pipe for continued observation. If significant frost is detected at depth, full thermistor strings may be installed if thought to be appropriate.

RELICT CHANNEL - cont.

(h) Downhole geophysical logging, as appropriate, to provide correlation of geologic interpretation between borings. Logging will be conducted in both the hammer drill holes and the summer rotary borings through 2-inch PVC pipe, which will be installed during drilling.

BORROW SITES E AND I

Borrow Sites E and I include the Tsusena Creek outwash plain and Susitna River floodplain from a point approximately 2-1/2 miles downstream from the Watana dam site to a maximum distance of approximately 12 miles downstream (Figure 2). This material has been indentified as the most favorable source for concrete aggregate, filter sand and gravel, and dam shell gravel requirements totaling approximately 40 million cubic yards. The information in these areas, to date, has been compiled from seismic refraction surveys, air photo interpretation, and various test pits and shallow auger holes.

The winter investigations in Borrow Site E and I are designed to obtain additional information needed for refinement of construction processing and costs and material properties. This information includes:

(a) Borrow site configuration to include lateral and vertical extent of suitable materials and ground water conditions. This information is needed to define type and method of excavation and placement.

(b) Limits of reasonable excavation depth based on geologic constraints, stratification of deposit, and inherent stability of the materials. These limitations will have significant impact on the actual economically recoverable reserves which, in turn, can be expected to influence maximum excavation depth, net excavation losses, and, consequently, equipment selection and overall land requirements for adequate development.

(c) Material gradations, including both typical and local variations in the material quality, which will influence production methods and requirements and possible processing.

(d) Suitability of the material for use in concrete, filters, and dam shells. This information will be used in selection of the type of processing requirements and optimization of placement utilization as determined by cost.

The Becker hammer drill, which is planned for use in the relict channel and river areas will be utilized to drill several confirmatory borings to maximum practical excavation depth below river level (estimated to be 125 feet) in the primary source area of Borrow Site E with the intent of verifying the seismic data and obtaining samples for gradations and laboratory testing.

The drilling will be distributed over the length of Borrow Site E (Table 4 and Figure 6) to provide a general overall view of the borrow materials. Due to the wide spacing of these borings, stratigraphic correlation is not expected to result from this drilling. The borings will be concentrated along the margins of the site to meet the criteria below:

(a) Ready access and relatively level drill setup to minimize setup time and, thereby, maximize the number of holes drilled.

(b) Placement of at least ten of the holes on previous seismic lines to verify the seismic data interpretation.

(c) Placement of several holes along the active river margin to verify the off-end-of-line seismic interpretation of alluvial depth and composition.

(d) Placement of a line of holes near the north limit of the flood-plain to confirm the average depth of alluvium and to assure that bedrock level does not rise rapidly in the north and east portions of the borrow site.

(e) Spacing of the borings so as to maximize the information concerning the variability of stratigraphic conditions within the borrow site.

Borehole sampling will be conducted as listed below:

(a) Primary sampling will be continuous cuttings sampling up to 4-inch size particles.

(b) Split spoon or Denison/Core Barrel sampling, as necessary, to sample fine sand, silt, or clay layers which may be encountered.

(c) Casing drive tests (open casing drive tests) for general correlation of stratigraphy versus density for use in estimating excavation requirements. Since the borrow site is planned for dragline excavation, detailed density testing is not considered necessary at this time.

(d) Water table detection and monitoring to provide information on potential dry versus wet excavation. Because the water table is expected to range from 10-30 feet below ground surface, simple standpipe piezometric monitoring will be utilized to allow continued monitoring of seasonal variations of the water table.

(e) Frost detection will be limited to direct observation of drilling rate and temperature measurements of cuttings. No permafrost is expected in the borrow site; however, the depth of seasonal frost will be measured and checks will be made throughout drilling operations to record any indications of possible permafrost. If

any permafrost is detected, thermal probe standpipes will be installed in the appropriate zones to detect the extent of the affected zone. In the remaining holes, standpipes will be installed to approximately 30 feet deep for detection of annual frost penetration and thermal probe readings.

The winter drilling program should: verify the general overall suitability of the source; ascertain the approximate upper size limits and range of the gradation; provide adequate samples for physical and durability suitability; and give an indication of variability of the deposit with depth.

Several borings will also be made in Borrow Site I if available time and ice conditions permit. The number of borings and the exact locations will be determined during the winter program.

Subsequent studies for final design investigations will determine the actual mineable limits, extent of variation in materials, ground water elevation, and the processing that will be required for each of the major gradation variations.

LABORATORY TESTING

The material testing program for the winter program will be designed for providing ready assistance in data interpretation. To expedite the testing program, a field laboratory will be established for performing routine soil tests to include:

- gradation;
- hydrometer;
- moisture;
- atterberg limits; and
- proctor

The more sophisticated tests will be performed by outside laboratories as required.

November 8, 1982
P5700.10.15
T975

Mr. Wayne Boden
District Manager
Bureau of Land Management
4700 East 72nd Avenue
Anchorage, Alaska 99507/2899

Attention: Mr. John Rego

Dear John: Hammer Drilling Program

Further to our letter of August 20, 1982, please be advised that the Hammer Drilling Contract for the Susitna Hydroelectric Project has been awarded to Denali Drilling, Inc.

The present schedule calls for mobilization of their drilling and support equipment to the Watana site between December 15, and December 31, 1982, with commencement of drilling on or about January 1, 1983. The program will last approximately three months with demobilization of equipment in April. As you are aware, these dates and activities will be controlled to a large extent by drilling progress, weather and access conditions.

Attached for your review and approval is a temporary land use permit application to allow transportation of Denali Drilling's equipment to and from the Watana site. As discussed previously the planned route will follow the winter trail used by the Corps of Engineers in 1978 and the Alaska Power Authority in 1980. Also included is a listing of equipment to be transported, a mobilization plan and a proposed schedule.

To help familiarize Denali Drilling with the proposed route and to allow the BLM to assess trail conditions prior to actual mobilization of the equipment, we plan on traveling the route during late November or the first week in December. We would fly the route first in a helicopter and then drive the entire route from Cantwell into the Watana site using a TF60 tracked personnel carrier and snow machines. The personnel carrier would be left at the Watana site to await the start of the drilling program. It is anticipated that representatives of Denali Drilling, BLM, Acres and Harza-Ebasco (new engineer for APA as of January 1, 1983) would be involved in this preliminary

route inspection.

We appreciate your prompt consideration of these matters. If you have any questions, or if we can provide you with any additional information, please call Bob Henschel at 276-4888.

Regards,

RRH/BJB/ja

Boyd J. Brownfield
Administrative Manager

Enclosure: as

cc: Jim Shen - CIRI
Dave Wozniak - APA
C. Debelius - Acres

Form 2920–1
(November 1977)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FORM APPROVED
OMB NO. 42–R0996

Serial Number

TEMPORARY USE APPLICATION AND PERMIT

Title I, Sec. 28(e) of the Mineral Leasing Act of 1920, 30 U.S.C. 185, as amended; Secs. 302(b) and 504(a) of P.L. 94–579, October 21, 1976, 43 U.S.C. 1732, 1764.

APPLICATION

INSTRUCTIONS ON REVERSE

1. Name *(first, middle initial, and last)*
Alaska Power Authority

Address *(include zip code)*
334 West 5th Avenue
Anchorage, Alaska 99501

2. Give legal description of public lands for which you are applying

TOWNSHIP	RANGE	SECTION	SUBDIVISION
19 South	1 West	29	(Staging area and entry point) Fairbanks Meridian, Alaska
32 North	5 East	27	(Exit point) Seward Meridian, Alaska

Meridian	State	County	Acres *(number)*

3. Proposed date(s) of use: From December 15, 1982 to May 15, 1983

4a. Are you 21 years of age or over? [X] Yes [ ] No

b. Are you a citizen of the United States or have you declared your intention? [X] Yes [ ] No

c. As applicant, are you a [ ] Partnership [ ] Association [ ] Corporation; [ ] Individual(s); or an agency of [ ] Federal Government [X] State Government [ ] Political subdivision of any state?

d. Are the statements required by Instruction Number 2 attached? [X] Yes [ ] No [ ] Not applicable

5. Are you making this application for your own use and benefit? [X] Yes [ ] No *(If "no," explain)*

6. Are the lands now improved, occupied, or used? [ ] Yes [X] No *(If "yes," describe improvements and purposes, identify users and occupants)*

SUSITNA HYDROELECTRIC PROJECT

November 22, 1982
P5700.10.15
T1001

Mr. Wayne Boden
District Manager
Bureau of Land Management
Anchorage District Office
4700 E. 72d Avenue
Anchorage, Alaska 99507/2899

Attention: Mr. Mike Kasterin/Mr. John Rego

Dear Mike:

Per our recent conversation concerning the temporary use permit application for overland transportation of equipment for the Susitna Hydroelectric Project, please find attached an amended legal description of the public lands which the proposed route traverses (see location plan).

If you have any further questions or if we can provide you any additional information, please call Mr. R. Henschel at 276-4888.

Regards,

Boyd J. Brownfield
Administrative Manager

RRH/BJB/kt

Encl: as

cc: Tom Arminski, APA
Chuck Debelius, Acres

ACRES AMERICAN INCORPORATED
Consulting Engineers
Suite 305
1577 C Street
Anchorage, Alaska 99501

Telephone (907) 279-9631 Telex: 025450 (ACRES AHG)
Other Offices Buffalo, NY: Columbia, MD: Pittsburgh, PA: Washington, DC

AMENDED ITEM 2

Township	Range	Section
19 South	1 West	29 (Staging area)
19 South	1 West	30
19 South	1 West	31
19 South	1 West	32
20 South	1 West	6
20 South	2 West	1
20 South	2 West	12
20 South	1 West	7
20 South	1 West	18
20 South	2 West	13
20 South	2 West	24
20 South	2 West	23
20 South	2 West	27
20 South	2 West	34
20 South	2 West	33
21 South	2 West	4
21 South	2 West	5
21 South	2 West	8
21 South	2 West	7
21 South	3 West	12
21 South	3 West	13
21 South	3 West	14
21 South	3 West	15
21 South	3 West	22
21 South	3 West	21
21 South	3 West	28
21 South	3 West	32

FAIRBANKS MERIDIAN

DNR pat'd or TA'd

Township	Range	Section
21 South	3 West	33
22 South	3 West	4
22 South	3 West	5
22 South	3 West	8
22 South	3 West	7
22 South	3 West	18
22 South	4 West	13
22 South	4 West	24
22 South	4 West	23
22 South	4 West	22
22 South	4 West	27
22 South	4 West	28
22 South	4 West	33
22 South	4 West	32
33 North	6 East	17
33 North	6 East	20
33 North	6 East	30
33 North	5 East	25
33 North	5 East	36
33 North	5 East	35
32 North	5 East	2
32 North	5 East	11
32 North	5 East	14
32 North	5 East	15
32 North	5 East	22
32 North	5 East	27 (Exit at Watana Camp)

FAIRBANKS MERIDIAN

SEWARD MERIDIAN

EBASCO SERVICES
INCORPORATED

December 1, 1982

TO: T. Clary/M. Temchin

FROM: N. Tilford/G. Bain 9213

FROM: Materials List - Relict Channel Aquifer Tests; and Additional Refraction Lines

Attached are (1) the requested modified Materials List and (2) the proposed location of an additional 7000 ln. ft. of refraction seismic line in the Relict Channel area. The additional seismic work is designed to answer uncertainties as to the location, geometry, depth, and stratigraphy of channels in the northeast section of the Watana Relict Channel area. Note also that I have exchanged the priority of Well G. for Well J. to provide a better opportunity to get stratigraphic control in the above northeast section.

GLB/bs

Enclosures

cc: J. L. Ehasz
File

MODIFICATION OF MATERIALS LIST - AQUIFER TESTS FOR RELICT CHANNEL

Following is a materials and equipment list for the winter drilling program in the Relict Channel Area. This list assumes that there will be no interchange of materials with other programs. It also includes materials and equipment for the summer aquifer testing program.

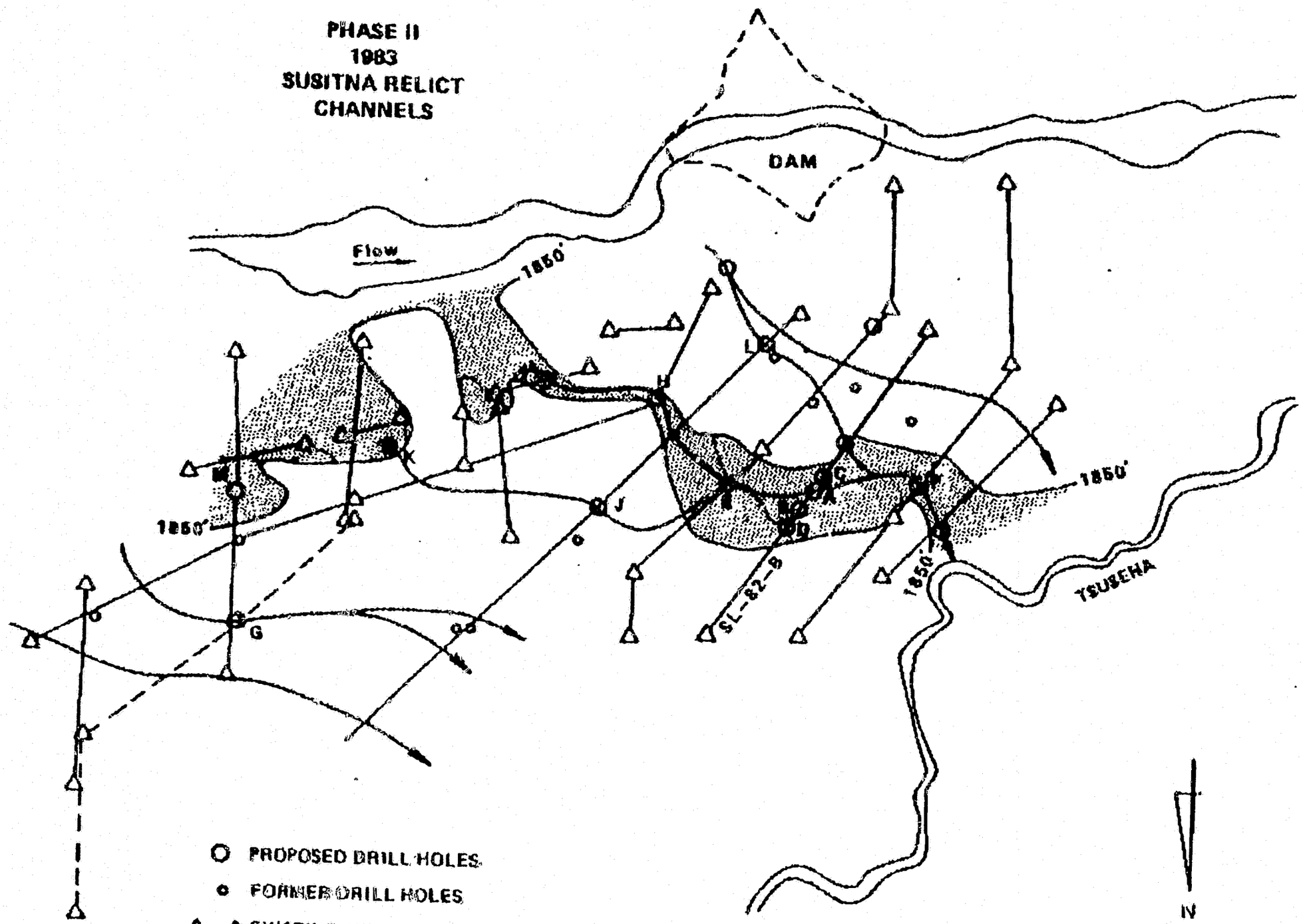
This list assumes that the test wells and/or piezometers will be constructed inside the 6 inch and 3 inch Becker drill stem or through ± 6 inch holes adjacent to and drilled immediately subsequent to construction of the primary exploratory hole. Each unit to be tested will be screened with a twenty foot section of #40 screen at a diameter that will allow pump-out and pump-in tests to be conducted on Units K, J', and H.

Materials list:

ITEM DESCRIPTION	MINIMUM 5 WELLS	MAXIMUM 9 WELLS
Workover rig or winch	1	1
Well Casing (minimums)		
Water well, galv. steel, 5 1/2" I.D.	2500 ft	3600 ft
Water well, galv. steel, 8" I.D.	175 ft	300 ft
Water well, Sch 80 PVC or Galv. steel, 2 1/2" I.D.	2000 ft	3000 ft
Well caps	7	12
Screens		
Stainless steel #40, 20 ft long for 5 1/2" I.D. Casing	16	29
Stainless steel/Or Schedule 80 PVC, #40, 20 ft long screens for 2 1/2" I.D. Casing	16	29
Filter sand	135 cu ft	245 cu ft
Bentonite	850 cu ft	1550 cu ft
Cement	500 lb.	900 lb.
Tremie pipe	550 ft.	550 ft.
Surge block	2	3
Suitcase geophysical logger (gamma, sp, & resistivity)	1	1
Straddle Packers		
"2 1/2 to 5 1/2 inch capability (Layne or equivalent equipped with automatic chart pressure recorder)	2	2
Downhole packer pipe	800 ft.	800 ft.
Water meters	2	3
Gate valves	2	2
Pressure meters	3	4
Air compressor for packers	2	2
Water Supply - pump-in tests provide capability of supplying water at the well head at 500 gpm for 10 hours during summer conditions.		

Submersible turbine pump, 4" dia. (50–100 gpm @ 100 to 200 ft head)	2	2
Generator to run turbine	2	2
Discharge pipe, 4" dia., PVC	1000 ft.	1000 ft.
Pressure transducers	15	15
Meter capable of reading 10 transducers	1	1
Hand sieve set	2	2
Water level hand tapes	3	4
Water level chart recorders	2	4
Hand pumps	2	2
G.I. pipe for hand pumps, 2"	150 ft.	270 ft.

PHASE II
1983
SUSITNA RELICT
CHANNELS



PROPOSED DRILL HOLES
FORMER DRILL HOLES
EXISTING SEISMIC LINES
PROPOSED SEISMIC LINES (7000 ft)

SUBTASK 5C - INSTRUMENTATION MONITORING AND SURVEYING SERVICES-R&M CONSULTANTS, INC.

R & M Consultants will collect raw data from existing and new piezometer and thermistor installations by means of a two-man field party on at least a monthly basis. Raw data will be reduced and formatted utilizing an R & M computer system and transmitted to HARZA/EBASCO on a monthly basis.

A three-person survey crew will provide horizontal and vertical surveys of seismic lines and drill holes. Surveys will be conducted to exceed Third-Order Class II survey accuracy. Survey work will be coordinated based on the previously established Susitna data base. Computered generated plots of the work oriented to ASPCS grid dimensions will be provided to HARZA/EBASCO.

A three-person crew will layout and clear seismic lines required for Subtask A geophysical surveys.

SUSITNA FY83 SURVEYS

Subtask 2.07.01 - R&M Field Coordinator

(a) Objective: Insure coordination and orderly movement of R&M personnel and data between Watana, R&M Anchorage and HARZA/EBASCO. Also responsible for coordination of interdependent activities in the field.

(b) Approach: Place one field coordinator personnel at Watana to insure objectives are completed.

(c) Schedule: December 27, 1982 to April 15, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.01 - R&M Field Coordinator

(a) Objective: Insure coordination and orderly movement of R&M personnel and data between Watana, R&M Anchorage and HARZA/EBASCO. Also responsible for coordination of interdependent activities in the field.

(b) Approach: Place one field coordinator personnel at Watana to insure objectives are completed.

(c) Schedule: April 16 to June 30, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.02 - Location & Brushing Crew

(a) Objective: To provide seismic line layout and brush removal prior to commencement of seismic or survey activities.

(b) Approach: Provide a 3-person crew at Watana to layout and clear seismic lines. Crew will be directed by the R&M field coordinator and will include one geotechnical person familiar with seismic logistics. All clearing will be performed with gas powered chainsaws or hand tools.

(c) Schedule: December 27, 1982 to February 28, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.03 - Survey Field Crew

(a) Objective: To provide horizontal and vertical surveys in order to position all seismic lines and drill holes investigated during the FY83 winter program.

(b) Approach: Provide a 3-person survey crew at Watana available for horizontal and vertical surveys of seismic lines and drill holes investigated during the winter program. All surveys will be directed by the R&M field coordinator and will exceed Third-order Class II survey accuracies.

(c) Schedule: December 27, 1982 to April 15, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.03 - Survey Field Crew

(a) Objective: To provide horizontal and vertical surveys in order to position all seismic lines and drill holes investigated during the spring FY83 program prior to June 30, 1983.

(b) Approach: Provide a 3-person survey crew at Watana available for horizontal and vertical surveys of seismic lines, test holes and other geological points as requested. All surveys will be directed by the R&M field coordinator and will exceed Third-order Class II survey accuracies.

(c) Schedule: April 16 to June 30, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.04 - Survey Support & Data Reduction

(a) Objective: To provide logistical support in Anchorage for the Watana survey crew and to reduce and compute the survey work executed.

(b) Approach: Provide survey technicians in the R&M Anchorage office to provide logistical support and data reductions. All survey work will be coordinated based on the previously established Susitna data base and will be referenced to the Alaska State Plane Coordinate System (ASPCS). Final computer generated plots showing all surveyed points locations, identifications, orientations with ASPCS grid dimensions will be prepared.

(c) Schedule: January 1 to April 15, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.04 - Survey Support & Data Reduction

(a) Objective: To provide logistical support in Anchorage for the Watana survey crew and to reduce and compute the survey work executed.

(b) Approach: Provide survey technicians in the R&M Anchorage office to provide logistical support and data reductions. All survey work will be coordinated based on the previously established Susitna data base and will be referenced to the Alaska State Plane Coordinate System (ASPCS). Final computer generated plots showing all surveyed points locations, identifications, orientations with ASPCS grid dimensions will be prepared.

(c) Schedule: April 16 to June 30, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.05 - Project Management

(a) Objective: To provide supervision, management and coordination of all R&M activities.

(b) Approach: Review, supervise and manage project on a regular basis by the project manager located in the R&M Anchorage office.

(c) Schedule: December 27 to April 15, 1983.

SUSITNA FY83 SURVEYS

Subtask 2.07.05 - Project Management

(a) Objective: To provide supervision, management and coordination of all R&M activities.

(b) Approach: Review, supervise and manage project on a regular basis by the project manager located in the R&M Anchorage office.

(c) Schedule: April 16 to June 30, 1983.

SUSITNA FY83 GEOTECHNICAL STUDIES

Subtask 5.06.01 - Instrumentation Monitoring (Data Collection)

(a) Objective: To collect raw data from existing and new Susitna piezometer and thermistor installations.

(b) Approach: The raw data will be collected by a snow cat and helicopter supported, two man field party, at least once each month from January 1983 to June 1983. The field work is expected to involve approximately one to two weeks field effort per month (Data reduction will be accomplished in Anchorage following the field collection effort).

(c) Schedule: December 27, 1982 through June 30, 1983.

SUSITNA FY83 GEOTECHNICAL STUDIES

Subtask 5.06.02 - Thermister and Piezometer Data Reduction

(a) Objective: To reduce and format the thermistor and piezometer data for use in the geologic and geotechnical design efforts.

(b) Approach: Data reduction and formatting will be accomplished by geologist utilizing an in-house computer system and software programs developed by R&M. The finalized data will be transmitted to HARZA-EBASCO on a monthly basis.

(c) Schedule: December 27, 1982 through June 30, 1983.

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 5.06.01
December 27, 1982 through June 30, 1983

Services		Cost
Manhours (Estimated) = 1,320		
	Salary	$19,695.00
	Fringe (33.4%)	6,580.00
	PCOS	$26,275.00
	Overhead (92.8%)	24,380.00
	Subtotal	$50,655.00
Fee on Services		7,645.00
	Subtotal	$58,300.00
	TOTAL CONTRACT	$58,300.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 5.06.02
December 27, 1982 through June 30, 1983

Services		Cost
Manhours (Estimated) = 300		
Salary		$4,255.00
Fringe (33.4%)		1,420.00
PCOS		$5,675.00
Overhead (92.8%)		5,265.00
	Subtotal	$10,940.00
Fee on Services		1,660.00
	Subtotal	$12,600.00
Direct Cost		
Disbursements		2,640.00
	TOTAL CONTRACT	$15,240.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2,07.01
December 27, 1982 to April 15, 1983

Services		Cost
Manhours (Estimated) = 1,170		
Salary		$18,530.00
Fringe (33.4%)		6,170.00
PCOS		$24,700.00
Overhead (92.8%)		22,920.00
	Subtotal	$47,620.00
Fee on Services		7,230.00
	Subtotal	$54,850.00
	TOTAL CONTRACT	$54,850.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.01
April 16 through June 30, 1983

Services		Cost
Manhours (Estimated) = 640		
Salary		$10,135.00
Fringe (33.4%)		3,385.00
PCOS		$13,520.00
Overhead (92.8%)		12,545.00
	Subtotal	$26,065.00
Fee on Services		3,935.00
	Subtotal	$30,000.00
	TOTAL CONTRACT	$30,000.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.02
December 27, 1982 through February 28, 1983

Services		Cost
Manhours (Estimated) = 1,270		
Salary		$18,990.00
Fringe (33.4%)		6,340.00
PCOS		$25,330.00
Overhead (92.8%)		23,505.00
	Subtotal	$48,835.00
Fee on Services		7,365.00
	Subtotal	$56,200.00
Direct Cost		
Disbursements		700.00
	TOTAL CONTRACT	$56,900.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.03
December 27, 1982 through April 15, 1983

Services		Cost
Manhours (Estimated) = 2,724		
Salary		$57,810.00
Fringe (33.4%)		19,310.00
PCOS		$77,120.00
Overhead (92.8%)		71,570.00
	Subtotal	$148,690.00
Fee on Services		22,430.00
	Subtotal	$171,120.00
Direct Cost		
Disbursements		5,100.00
	TOTAL CONTRACT	$176,220.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.03
April 16 through June 30, 1983

Services		Cost
Manhours (Estimated) = 1,800		
Salary		$32,840.00
Fringe (33.4%)		10,970.00
PCOS		$43,810.00
Overhead (92.8%)		40,655.00
	Subtotal	$84,465.00
Fee on Services		12,735.00
	Subtotal	$97,200.00
Direct Cost		
Disbursements		2,800.00
	TOTAL CONTRACT	$100,000.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.04
December 27, 1982 through April 15, 1983

Services		Cost
Manhours (Estimated) = 560		
Salary		$ 8,280.00
Fringe (33.4%)		2,765.00
PCOS		$11,045.00
Overhead (92.8%)		10,250.00
	Subtotal	$21,295.00
Fee on Services		3,205.00
	Subtotal	$24,500.00
Direct Cost		
Disbursements		12,320.00
	TOTAL CONTRACT	$36,820.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.04
April 16 through June 30, 1983

Services		Cost
Manhours (Estimated) = 320		
Salary		$4,730.00
Fringe (33.4%)		1,580.00
PCOS		$6,310.00
Overhead (92.8%)		5,855.00
	Subtotal	$12,165.00
Fee on Services		1,835.00
	Subtotal	$14,000.00
Direct Cost		
Disbursements		7,050.00
	TOTAL CONTRACT	$21,050.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.05
December 27, 1982 through April 15, 1983

Services		Cost
Manhours (Estimated) = 180		
Salary		$3,800.00
Fringe (33.4%)		1,270.00
PCOS		$5,070.00
Overhead (92.8%)		4,705.00
	Subtotal	$9,775.00
Fee on Services		1,475.00
	Subtotal	$11,250.00
	TOTAL CONTRACT	$11,250.00

PRICING PROPOSAL
R&M CONSULTANTS, INC.
SUBTASK 2.07.05
April 16 through June 30, 1983

Services		Cost
Manhours (Estimated) = 80		
Salary		$1,690.00
Fringe (33.4%)		565.00
PCOS		$2,255.00
Overhead (92.8%)		2,095.00
	Subtotal	$4,350.00
Fee on Services		650.00
	Subtotal	$5,000.00
	TOTAL CONTRACT	$5,000.00

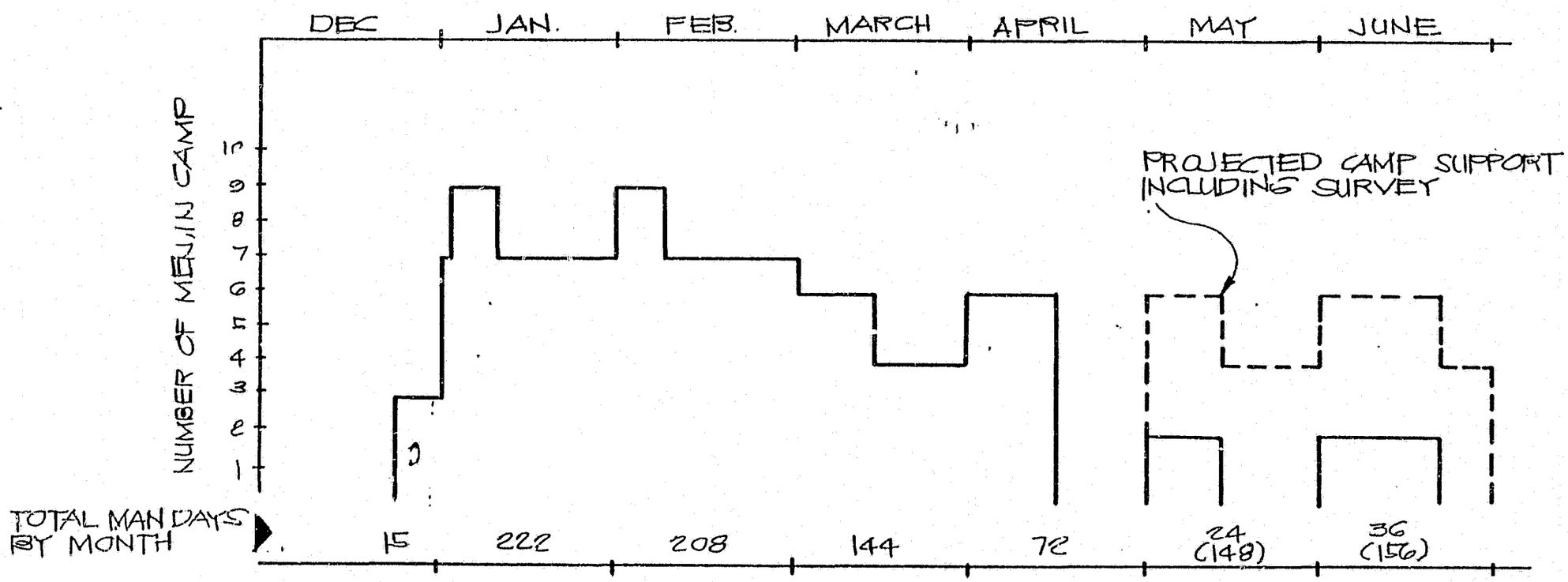
FY 83 WATANA GEOTECHNICAL SUPPORT PROGRAM

A = INSTRUMENTATION 12/27/82 - 6/30/83 & SURVEYS 12/27/82 - 4/15/83
B = SURVEYS 4/16/83 - 6/30/83

SUBTASK	# MEN	DEC.	JAN	FEB	MARCH	APRIL	MAY	JUNE	DISBURSEMENTS A	SUB TOTAL A	DISBURSEMENTS B	SUB TOTAL B	TOTAL
5.05.01 INSTRUMENTATION MONITORING	2		120 MH $ 5,300	120 MH $5,300	240 MH $10,600	240 MH $10,600	240 MH $10,600	360 MH $15,900					1320 MH $58,300
5.06.02 INSTRUMENTATION DATA REDUCTION	1	40 MH $1,800	40 MH $1,800	40 MH $1,800	40 MH $1,800	40 MH $1,800	40 MH $1,800	60 MH $1,800	$2640				300 MH $15,240
2.07.01 FIELD COORDINATOR	1	50 MH $2,350	320 MH $15,000	320 MH $15,000	320 MH $15,000	A&B 160 MH $7,500	320 MH $15,000	320 MH $15,000		1170 MH $54,850		640 MH $30,000	1810 MH $84,850
2.07.02 LOCATION & BRUSHING CREW	3	70 MH $3,100	900 MH $39,800	300 MH $13,300					$700	1270 MH $56,900			1270 MH $56,900
2.07.03 SURVEY CREW	3	24 MH $1,020	900 MH $48,600	900 MH $48,600	900 MH $48,600	450 MH $24,300	900 MH $48,600	900 MH $48,600	$5,100	2724 MH $176,220	$2,800	1800 MH $100,000	4524 MH $279,220
2.07.04 SURVEY SUPPORT & DATA REDUCTION	1		160 MH $7,000	160 MH $7,000	160 MH $7,000	80 MH $3,500	160 MH $7,000	160 MH $7,000	$12,320	560 MH $36,820	$7,050	320 MH $21,050	880 MH $57,870
2.07.05 PROJECT MANAGEMENT	1	40 MH $2,500	40 MH $2,500	40 MH $2,500	40 MH $2,500	20 MH $1,250	40 MH $2,500	40 MH $2,500		180 MH $11,250		80 MH $5,000	260 MH $16,250
MAN HOUR SUBTOTALS / COST SUBTOTALS		224 MH $10,770	2480 MH $120,000	1880 MH $93,500	1700 MH $85,500	990 MH $48,950	1700 MH $85,500	1840 MH $90,800	$20,760	7524 MH $409,580	$12,490	2810 MH $156,050	10364 MH $665,620

PROJECTED CAMP SUPPORT REQUIREMENTS

	DEC.	JAN		FEB		MARCH		APRIL	MAY		JUNE	
CAMP LODGING	3 MEN 5 DAYS	9 MEN 6 DAYS	7 MEN 24 DAYS	9 MEN 6 DAYS	7 MEN 22 DAYS	6 MEN 12 DAYS	4 MEN 18 DAYS	6 MEN 12 DAYS	(6) PROJ, 2 MEN 12 DAYS	(4) PROJ. 9 DAYS	(6) PROJ, 2 MEN 18 DAYS	(4) PROJ. 12 DAYS
HELICOPTER FLT. HOURS	10	160		80		90		55	20 (≥5) PROJ		20 (≥5) PROJ.	



SUBTASK 5D - SITE LABORATORY TESTING & HARZA/EBASCO FIELD SUPPORT-HARDING LAWSON ASSOC.

Harding Lawson Associates (HLA) will establish and operate a field soil classification laboratory at the Watana Dam camp to support the Winter 1983 field drilling program. The primary purpose of the field laboratory is to test soil samples from the Becker drilling program scheduled to operate January through March, 1983.

The field laboratory will be equipped to perform most primary soil tests, including moisture content, dry density, particle size analysis, Atterberg limits determination, specific gravity, organic content and compaction curves. The laboratory will require at least 700 square feet of space at the camp which will be provided in Task 2.

The field laboratory will be staffed by six full-time HLA technicians. The laboratory will operate on a 24-hour basis, seven days per week, utilizing two 12-hour shifts comprised of two technicians and one senior technician (foreman) per shift. Operation and quality control checks of the field laboratory operation will be performed by an Anchorage supervisor who will travel to the field lab every three to four weeks throughout the program.

HARZA/EBASCO personnel will schedule all laboratory testing. The technicians will perform individual tests as scheduled by HARZA/EBASCO. The senior technician will supervise the other technicians on his shift, be responsible for the day-to-day management of the lab, travel to the Becker drill rig during shift changes to pick up samples, and report all laboratory test results to HARZA/EBASCO field personnel.

HLA will provide geologist/engineer/geophysicist services to HARZA/EBASCO as needed to assist HARZA/EBASCO in field and office operations during the Winter 1983 program. Two geologists will be provided to support the Becker Winter 1983 program. Geophysical equipment and personnel will be provided to support HARZA/EBASCO geophysical surveys in Subtask A.

Harding Lawson Associates

Transmittal/Memorandum

To: Harza Ebasco, J.V.
1227 West Ninth
Anchorage, AK 99501

From: Donald E. Bruggers DEB
Date: December 3, 1982
Subject: The Susitna Hydroelectric Project - Watana Dam Site
Job No.: PW82-335.08

Remarks:

Enclosed please find two copies of our Agreement for Consulting Services for the Susitna Hydroelectric Project - Watana Dam Site and two copies of the Certificate of Insurance.

DEB/sr

cc:

SET TABSTOPS AT ARROWS

Certificate of Insurance

acord

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES LISTED BELOW.

NAME AND ADDRESS OF AGENCY

Calender-Robinson Co.,Inc.
P.O. Box 2836
San Francisco, CA. 94126

NAME AND ADDRESS OF INSURED

Harding Lawson Associates
P.O. Box 578
Novato, CA. 94947

COMPANIES AFFORDING COVERAGES

COMPANY LETTER **A** Aetna Insurance Co.

COMPANY LETTER **B** Lloyds of London

COMPANY LETTER **C** Great American Ins. Co.

COMPANY LETTER **D** Granite State Ins. Co.

COMPANY LETTER **E**

This is to certify that policies of insurance listed below have been issued to the insured named above and are in force at this time. Notwithstanding any requirement, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions and conditions of such policies.

COMPANY LETTER	TYPE OF INSURANCE	POLICY NUMBER	POLICY EXPIRATION DATE	Limits of Liability in Thousands (000)	EACH OCCURRENCE	AGGREGATE
A	**GENERAL LIABILITY** ☒ COMPREHENSIVE FORM ☒ PREMISES—OPERATIONS ☒ EXPLOSION AND COLLAPSE HAZARD ☒ UNDERGROUND HAZARD ☒ PRODUCTS-COMPLETED OPERATIONS HAZARD ☒ CONTRACTUAL INSURANCE ☒ BROAD FORM PROPERTY DAMAGE ☒ INDEPENDENT CONTRACTORS ☒ PERSONAL INJURY	CG 248651	4-1-85	BODILY INJURY	$ 500	$ 500
				PROPERTY DAMAGE	$ ---	$ ---
				BODILY INJURY AND PROPERTY DAMAGE COMBINED	$	$
				PERSONAL INJURY		$ 500
A	**AUTOMOBILE LIABILITY** ☒ COMPREHENSIVE FORM ☒ OWNED ☒ HIRED ☒ NON-OWNED	BAP 848267	6-28-84	BODILY INJURY (EACH PERSON)	$	
				BODILY INJURY (EACH ACCIDENT)	$	
				PROPERTY DAMAGE	$	
				BODILY INJURY AND PROPERTY DAMAGE COMBINED	$ 500	
D	**EXCESS LIABILITY** ☒ UMBRELLA FORM ☐ OTHER THAN UMBRELLA FORM	6182-9406	4-1-83	BODILY INJURY AND PROPERTY DAMAGE COMBINED	$ 5,000	$5,000
C	**WORKERS' COMPENSATION and EMPLOYERS' LIABILITY**	PC 309-7454	7-1-83	STATUTORY		
					$ 100	EACH ACCIDENT
B	**OTHER** Third Party Property Damage Liability	12-0295	4-1-83	$500,000/occurrence $500,000/aggregate		

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES

Cancellation: Should any of the above described policies be cancelled before the expiration date thereof, the issuing company will endeavor to mail 30 days written notice to the below named certificate holder, but failure to mail such notice shall impose no obligation or liability of any kind upon the company.

NAME AND ADDRESS OF CERTIFICATE HOLDER

DATE ISSUED _____

_____
AUTHORIZED REPRESENTATIVE

ACORD 25 (1-79)

BLUE MARK
AS PER DON BRUGGERS
12/3/82 5:05PM

AGREEMENT FOR CONSULTING SERVICES FOR THE SUSITNA HYDROELECTRIC PROJECT WATANA DAM SITE - FY '83

Engineer: Harza Ebasco, J.V.
1227 West Ninth Avenue
Anchorage, Alaska 99501

Consultant: Harding Lawson Associates
624 W. International Airport Road
Anchorage, Alaska 99502

December 3, 1982

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AGREEMENT FOR CONSULTING SERVICES FOR SUSITNA HYDROELECTRIC PROJECT

I GENERAL.

Engineer: Harza Ebasco, J.V.

Consultant: Harding Lawson Associates

Contact: Mr. Jay M. England, Vice President

Telephone: (907) 276-8102

Owner: Alaska Power Authority (Authority)

Study Area: Watana Dam Site and Vicinity

Harza Ebasco, J.V. (Engineer) and Harding Lawson Associates (Consultant) hereby agree that the services specified below shall be performed by Consultant in accordance with all provisions stated herein. Consultant agrees to perform this Contract as an independent contractor and not as an agent or employee of the Engineer or the Authority.

II STATEMENT OF SERVICE.

Consultant agrees to perform consulting services as defined in Appendix I, attached and hereby made a part of this Agreement.

III COMPENSATION.

Consultant shall be paid in accordance with Appendix II, attached and hereby made a part of this Agreement.

IV PERIOD OF PERFORMANCE.

The start date of this subcontract begins December 1, 1982, and it will terminate _____, 19__. The services described in Appendix I of this Agreement shall be performed to meet the completion schedule of the Engineer's agreement with the Authority. Work within Tasks A through E of the Engineer's agreement with the Authority will be authorized to begin upon execution of the Engineer's agreement with the Authority. Milestone schedule dates for the Engineer are provided in _____ of _____ of this Agreement. Completion of the Consultant's services for the various tasks will be negotiated with the Engineer during the work to meet these milestone schedule dates.

V GENERAL TERMS AND CONDITIONS.

A. INVOICES.

Invoices shall be submitted in triplicate each month directly to _____, marked for, Attention: Mr. _____, who will review and approve invoices for payment.

B. INSURANCE.

During the life of this Contract, the Consultant shall purchase and maintain insurance with a carrier or carriers satisfactory to Department of Administration, Division of Risk Management, covering injury to persons or property suffered by the State of Alaska or a third party, as a result of errors or omissions or negligent operations which arise both out of and during the course of this Contract by the Consultant or by any Subcontractor or anyone employed by them. The coverage will also provide protection against injuries by all employees of the Consultant and the employees of any Subcontract engaged in work under this Contract. A Certificate of Insurance will be furnished to the Project Manager prior to beginning work under this Contract. This certificate will show evidence of coverage and provide a written cancellation, non-renewal or material change and include a waiver of subrogation endorsement except for workers compensation and E & O insurance for the waiver of subrogation endorsement. Failure to furnish satisfactory evidence of insurance or lapse of the policy is a material breach and grounds for temination of the Consultant's services.

Before performing under this Contract, evidence of the following coverages will be provided:

1. Workers' Compensation Insurance. The Consultant shall provide and maintain, for all employees of the Consultant engaged in work under this Contract, workers' compensation insurance as required by AS 23.30.045. The Consultant shall be responsible for workers' compensation insurance for any subcontractor who provides services under this Contract.

   To include:

   a. Statutory coverage for states in which employees are engaging in work.

   b. Employer's Liability Protection in the amount of $100,000 each accident.

   c. Broad Form All State's Endorsement.

d. All State and Federal Acts where applicable.

e. Voluntary compensation endorsement.

2. General Liability with coverage limits of $500,000 each occurrence and $500,000 aggregate.

To include:

a. Premises Operations.

b. Independent Contractors.

c. Products/Completed Operations. (Maintained for two years after completion of contract.)

d. Blanket Contractural.

e. Owner's/Contractor's Protective Liability.

f. Broad Form Comprehensive General Liability Endorsement (ISOG-222 or equivalent).

3. Comprehensive Automobile Liability with coverage limits of $500,000 each occurrence.

a. All Owned Vehicles.

b. All Hired Vehicles.

c. All Non-owned Vehicles.

d. Uninsured Motorists.

4. Professional Liablity.

a. Coverage for all errors or omissions which the Consultant employees, may make which result in financial loss to the State of Alaska. Protection against financial loss which results from reliance on specifications, design or reports produced by the Consultant.

Limits required $1,000,000 each claim and $1,000,000 in the annual aggregate.

b. Indemnity.

Consultant shall hold and save the Engineer and/or Authority, their officers, agents and other employees, harmless from liability of any nature or kind imposed by law upon the Engineer and/or Authority, including costs and expenses, for or on account of any or all suits or damages of any character what-so-ever resulting from injuries or damages sustained by any person or persons or property by virtue of negligent performance of Consultant services under this Contract.

c. Compliance with Laws.

Consultant shall assure compliance with all applicable United States, state, territorial, and commonwealth laws, including rules, regulations, decisions, and ordinances or any political subdivisions and/or agencies of the United States, any state, territory, or commonwealth thereof.

d. Equal Employment Opportunity.

1) Consultant will not discriminate against any employee or applicant for employment because of race, color, religion, national origin, ancestry, age or sex. Consultant wil take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, national origin, ancestry, age, or sex. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination, rates of pay or other forms of compensation; and selection for training, including apprenticeship. Consultant agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

2) Consultant shall state, in all solicitations or advertisements for employees to work on Authority contract jobs, that all qualified applicants will receive consideration for employment without regard to race, color, religion, national origin, ancestry, age, or sex.

3) Consultant will send to each labor union or representative of workers with which Consultant has a collective bargaining agreement or other contract or understanding, a notice advising the said labor union or workers' representative of Consultant's commitments under this section, and shall post copies of the notice in conspicuous places available to all employees and applicants for employment.

4) Consultant will include the provisions of Paragraphs (1) through (3) of this Section in every contract, and will require the inclusion of these provisions in every subcontract entered into by any of its subcontractors, so that such provisions will be binding upon each subcontractor, as the case may be. For the purpose of including such provisions in any construction, maintenance, or service contract or subcontract as required hereby, the term "Contractor" and the term "Subconsultant" may be changed to reflect appropriately the name or designation of the parties of such contract or subcontract.

5) Consultant agrees that they will fully cooperate with the office or agency of the State of Alaska which seeks to deal with the problem of unlawful or invidious discrimination, and will all other state efforts of guaranteed fair employment practices under this Contract, and said Consultant will comply promptly with all requests and directions from the State Commission for Human Rights or any of its officers or agents relating to preventions of discriminatory employment practice.

6) Full cooperation as expressed in clause (5) foregoing shall include, but not be limited to, being a witness in any proceeding involving questions of unlawful or invidious discrimination if such is deemed necessary by any official or agency of the State of Alaska, permitting employees of said Consultant to be witnesses or complainants in any proceedings involving questions of unlawful or invidious discrimination, if such is deemed necessary by any official or agency of the State of Alaska, participating in meetings, submitting periodic reports on the equal employment aspects of present and future employment, assisting in inspection of the construction site, and promptly complying with all State directives deemed essential by any office or agency of the State of Alaska to insure compliance with all Federal and State laws, regulations and policies pertaining to the prevention of discriminatory employment practices.

7) Failure to perform any of the above agreements pertaining to equal employment opportunities shall be deemed a material breach of the contract.

The responsible officer overseeing compliance with such fair practice and nondiscriminatory provision shall be the Executive Director of the Alaska Power Authority. Such responsible officer shall report to the State Commission for Human Rights whenever discriminatory practices are brought to his attention.

e. Subcontracts.

Consultants shall not enter into any subcontracts for any services subject of this Agreement without prior written approval of the Engineer and the Authority.

f. Personnel.

Consultant shall not substitue professional personnel to perform services subject of this Agreement for the following functions without prior approval of the Engineer. Reasonable advance notice and justification that the impact of the substitution will be adequately compensated for by the Consultant shall be provided in writing. No substitution shall be made without the consent of the Engineer's Project Manager, whom shall not unreasonably withhold consent. A list of engineers, geologist and geophysicists that are available to perform services during the project are presented on Attachment 1. The organization of HLA personnel is shown on Attachment 2. Resumes of key personnel are presented in Appendix A.

g. Release and Waiver of Liens.

Consultant agrees that upon the completion of the services rendered hereunder the Project or premises shall be free and clear of any mechanic's and other liens of Consultant and any and all of its successors, assigns, materialmen, laborers, vendors, and/or subcontractors who may furnish any labor, material, services, fixtures, apparatus, machinery, improvements, repairs, or alterations in connection with, or to, the Project or premises, in connection with the services rendered hereunder.

Consultant shall deliver a waiver of liens, in an acceptable form, to the Engineer at that time of completion of the services.

h. Assignment.

Consultant shall not assign this Agreement in whole or in part or any monies due hereunder without written approval of the Engineer.

i. Royalties, Patents, and Licenses.

Consultant shall pay all royalties and license fees in connections with its services under this Agreement. It shall defend all suits or claims for infringement of any patents, letters patent, copyrights, or trademarks, and shall save the Authority and/or the Engineer harmless from loss on account thereof except that Consultant shll not be responsible for any such loss when a particular process or product of a particular manufacturer or manufacturers is specificed by the Engineer, unless Consultant has been notified prior to the signing of the Agreement that the particular process or product is patented or is believed to be patented.

j. Changes.

The Engineer reserves the right by written change order or amendment to make changes in requirements, amount of work, or schedule. If these changes require a price or schedule adjustment, Consultant and the Engineer shall negotiate and include such changes in this Agreement by amendment.

k. Reports and Records.

Consultant shall provide reports in the format, at the times, and submitted in the manner as negotiated with the Engineer. Reports shall be of the type and technical scope designated under Scope of Services in Appendix I. Consultant shall maintain on file and have available to the Engineer its engineering calculations and/or technical documentation in legible form for a period of three years following termination of this Services Agreement. Drawings, specifications, reports, and any other documents prepared by Consultant in connection with any or all of the services furnished hereunder shall be the property of the Engineer.

l. Choice of Law.

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

m. Relationship.

By entering into this Services Agreement, the relationship between the Engineer and Consultant is that of buyer and seller and neither has entered into any joint venture or partnership with the other.

n. Waiver.

The waiver by one party of any breach of this Services Agreement or the failure of one party 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 Services Agreement, and shall not be construed to be a waiver of any provision, except for the particular instance.

o. Entire Agreement.

This Services Agreement represents and incorporates the entire understanding of the parties hereto, and each party acknowledges that there are no warranties, representations, covenants, or understandings of any kind, matter or description whatsoever, written by either party to the other except as expressly set forth and hereinabove written. The Engineer and Consultant hereby agree that any purchase orders, invoices, confirmations, acknowledgments or other similar documents executed or delivered with respect to the subject matter hereof shall be null, void, and without effect. This Services Agreement shall not be subject to change or modification unless by the execution of another instrument in writing subscribed to by a duly authorized officer of each of the parties hereto and entitled "Amendment to Services Agreement."

p. Severability.

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

q. Notices.

Any notice required to be given by either party hereto shall be reduced to writing and, unless receipt of such notice is expressly required by the terms hereof, shall be deemed effectively served when deposited in the mails in a sealed envelope with sufficient first class postage affixed, and addressed to the party to whom such notice is directed at such party's place of business, which in the case of the Engineer shall be:

Harza Ebasco, J.V.
1227 West Ninth
Anchorage, Alaska 99501

Attention: Mr.

and in the case of the Consultant shall be:

Harding Lawson Associates
624 West International Airport Road
Anchorage, Alaska 99502

Attention: Mr. Jay M. England

or such other address as neither party shall hereafter furnish to the other party by written notice as herein provided.

VI EXECUTION.

IN WITNESS WHEREOF, Harza Ebasco, J.V. and Harding Lawson Associates have caused this Services Agreement to be executed this ___ day of _____, 1982.

HARZA EBASCO, J. V.

BY _____

ITS _____
Title

HARDING LAWSON ASSOCIATES

BY _____

ITS _____
Title

APPROVED: ALASKA POWER AUTHORITY

BY _____

ITS _____
Title

APPENDIX I

SCOPE OF SERVICES

The services to be performed under this agreement are a portion of the services described in ____ of the _____ contract between Alaska Power Authority (Authority) and Harza Ebasco J.V.

The portion of the work to be performed by Harding Lawson Associates (HLA), will be accomplished within the following tasks:

* Task A - Site Testing Services
* Task B - Anchorage Laboratory Testing
* Task C - Geophysical Surveys
* Task D - Geologist/Engineer/Geophysicist Services
* Task E - Auger Drilling

The Schedule of Activities and estimated costs for the above tasks are shown on Plates 1 and 2. These costs were developed as discussed in the description of the tasks using HLA's 1983 Schedule of Charges for Labor, Geophysical Equipment, Equipment and Expenses and Unit Unit Prices for the Anchorage Laboratory as shown on Attachments 3 through 6.

All laboratory test methods will be standard ASTM methods where appropriate or methods recognized as state-of-the-art by HLA and government agencies in Alaska. HLA's Anchorage office will provide quality control assurance of all laboratory test procedures. All laboratory and field equipment furnished by HLA will be calibrated on a regular basis in accordance with accepted industry standards. The procedure used to calibrate laboratory equipment is presented in Appendix C along with the appropriate forms.

TASK A - SITE TESTING SERVICES

Harding Lawson Associates (HLA) will establish and operate a field soil classification laboratory at the Watana Dam camp to support the winter 1983 field drilling program. The primary purpose of the field laboratory is to perform routine classification tests on soil samples from the Becker drilling program scheduled to operate January through March, 1983.

The field laboratory will be equipped to perform most primary soil tests, including moisture content, dry density, particle size analysis, Atterberg limits determination, specific gravity, organic content and compaction curves. The laboratory will require at least 700 square feet of space at the camp and will be located inside an existing heated warehouse. A sketch of the proposed laboratory floor plan is shown on Plate 3. Harza Ebasco will be responsible for construction of the laboratory. HLA will provide consultation during laboratory setup and startup. A list of laboratory equipment along with cost is presented in Table 1.

The field laboratory will be staffed by six HLA technicians full time for a period of four months, January through April, 1983. The laboratory will operate on a 24-hour basis, seven days per week, utilizing two 12-hour shifts comprised of two techinicians and one senior technician (foreman) per shift. The rotation schedule for the technicians is shown on Plate 1. Harza Ebasco will provide round-trip transportation from Anchorage to the camp site and room and board while at the camp. Operation and quality control checks of the field laboratory operation will be performed by our Anchorage supervisor who will travel to the field lab every three to four weeks throughout the program.

Harza Ebasco personnel will schedule all laboratory testing. The estimated fiscal year 1983 field laboratory testing program is shown on Table 2. The technicians will perform individual tests as scheduled by Harza Ebasco. The senior technician will supervise the other technicians on his shift, be responsible for the day-to-day management of the lab, travel to the Becker drill rig during shift changes to pick up samples, and report all laboratory test results to Harza Ebasco field personnel. Harza Ebasco will provide office space at the camp for the shift foreman.

All laboratory tests performed at the field lab will be reduced and reported at the field lab using the forms shown in Appendix B. HLA will provide progress reports of field lab work to Harza Ebasco by weekly memorandums. These memorandums will include all HLA field laboratory labor costs, summary of tests scheduled and completed for the week, and individual test results.

TASK B - ANCHORAGE LABORATORY TESTING

HLA will perform soil testing at their Anchorage laboratory during the winter 1983 field program. HLA's Anchorage laboratory will be equipped to perform most primary soil tests including moisture content, dry density, particle size analysis, Atterberg limits determinations, specific gravity, organic content, compaction curves and relative density selected samples as specified by Harza Ebasco. The Anchorage laboratory will receive both frozen and unfrozen samples and store them as appropriate to prevent thermal degradation. In addition to classification tests, the Anchorage laboratory will be responsible for permeability tests (falling head or constant head), unfrozen secondary testing such as triaxial and direct shear tests and conventional consolidation tests, and frozen testing such as thaw consolidation and thermal conductivity tests.

While the type and number of tests to be performed in the Anchorage laboratory has not been defined at this time, an estimate ofthe number of soil samples to be tested in HLA's Anchorage laboratory is shown on Table 2. All testing performed in HLA's Anchorage laboratory will be billed on a unit price basis per test. A listing of tests along with unit price per test are shown on the attached 1983 Schedule of Charges for laboratory testing, Attachment 6.

The cost figure shown on the Schedule of Activities, Plate 1, is an estimate for a moderate testing program consisting of classification tests as well as permeability tests and triaxial and consolidation tests. It does not include specialized testing which will be performed in HLA's headquarter

laboratory facilities in Marin County, California. These specialized capabilities include dynamic testing such as resonant column and cyclic triaxial, and high pressure/large scale testing in triaxial equipment which accommodates 12-inch-diameter specimens under confining pressures up to 1200 pounds per square inch.

TASK C - GEOPHYSICAL SURVEYS

Seismic refraction, ground penetrating radar, and downhole geophysical surveys are planned for winter 1983 program at the Watana Dam Site. The detailed scope of work and the size and number of crews is undetermined at this time. It is likely that crews will consist of geophysicists from both Harza Ebasco and HLA.

Seismic refraction surveys will be conducted to measure the overburden thickness and evaluate the competency of bedrock within the river channel and along embankments. Both land and marine refraction methods will be used. Along the embankments, field procedures will consist of laying out linear spreads of 12 geophones over distances of up to 600 feet. Mark Products 4 hertz geophones will be at 10- to 50-foot intervals at each spread. Seismic P-waves will be generated with one-third to one-half pound dynamite charges. Shot points will be located at both ends of individual spreads to obtain fully reversed subsurface profiles. All seismic data will be recorded using a Nimbus 12-channel seismograph (ES-12 F). Spreads will be located in the field using survey markers. Confirmation of the spread of locations are to be obtained the by Harza Ebasco representative. Within the river channel, marine refraction methods will be used. The marine method differs from land techniques in that a 40-cubic-inch mudgun is used for the energy source and P-44 hydrophones replaced the geophones. The airgun and hydrophones will be suspended through holes drilled in the river ice canopy. The hydrophones will

be placed at 25- to 50-foot intervals over a distance of between 400 to 500 feet. The airgun will be detonated several times at each end of the spread in order to obtain fully reversed data. These data will also be recorded on a Nimbus 12-channel seismograph.

Refraction surveys within the river channel will require all-terrain vehicles similar to a Tucker Sno-Cat or equivalent. Survey vehicles are to be supplied by Harza Ebasco. Table 3 outlines the proposed locations of the refraction surveys to be performed at the dam site.

Ground Penetrating Radar (GPR) surveys will be conducted within the river channel to determine under-ice configurations in the channel and to map shallow subsurface stratigraphy. The GPR system is an electrical analogue to the acoustic seismic reflection method. A short pulse of electromagnetic energy is radiated through the ice and the time required for echos or reflections from the river bottom and subsurface units to arrive at the antenna one recorded. Times are converted to depth when the velocity of propagation of the radar signal is known. The reflections of interest for this project include water-sediment interface, and subsurface soil boundaries. The radar unit to be used is limited to water depths of 25 feet or less. Survey procedures require a Tucker Sno-Cat or equivalent vehicle to house transmitting and recording units and to tow 80 megahertz transceiver along the ice surface at a speed of between 0.5 to 1 mile per hour.

Downhole compressional and shear wave surveys will be conducted to define engineering properties such as elastic moduli and P-wave velocities of the overburden and bedrock. This information is used in the dynamic analysis of

the dam and foundation, tunnel alignment and reservoir slopes. A downhole shear wave hammer will be used to generate S-waves which will be recorded on a Nimbus 1210-S. Suitable instrumentation, i.e. downhole geophones, for cross-hole surveys will also be available during the survey.

The cost estimate shown on Plate 1 is based on Harding Lawson Associates providing an experienced geophysical team consisting of three members lead by a registered geologist/ geophysicist (5 to 10 years of experience) and all geophysical equipment necessary to perform the above described programs. The program will run from January through April, 1983 with crews rotating as shown on Plate 1. All labor and equipment will be billed in accordance with the 1983 Schedule of Charges, Attachments 3 and 4.

In estimating the equipment cost shown on Plate 1, we have assumed the following operational/standby relationships:

Item	Operational	Standby
Seismic Refraction Survey	60%	40%
Ground Penetrating Radar	30%	80%
Downhole Compessional and Shear Wave Surveys	10%	90%

We have assumed Harza Ebasco will provide the geophysical survey vehicles, round-trip transportation from Anchorage to the camp site and room and board while at the camp and all navigation and positioning. All field and office activities performed by HLA personnel will be documented by letter during the work on a schedule determined by Harza Ebasco.

TASK D - GEOLOGIST/GEOTECHNICAL ENGINEER/GEOPHYSICIST SERVICES

HLA will provide geologist/geotechnical/engineer/geophysicist services to Harza Ebasco as needed to assist Harza Ebasco in field and office operations during the winter 1983 program. The cost estimate shown on the Schedule of Activities Plate 1, is based on HLA providing two geologists to support the Becker Winter 1983 drilling program for the period January through March, 1983. The rotation schedule of the geologists is shown on Plate 1. In our cost estimate, we have assumed Harza Ebasco will provide round-trip transportation from Anchorage to the camp site and room and board while at the camp.

Additional geologists, geotechnical engineers and geophysicists support can be provided by HLA as requested by Harza Ebasco. All labor will be billed in accordance with the 1983 Schedule of Charges for Labor, Attachment 3. A list of HLA personnel available for this project is presented on Attachment 1. All field and office activities performed by HLA personnel will be documented by letter during the work on a schedule as negotiated to meet the Harza Ebasco schedule with the Alaska Power Authority.

TASK D - GEOLOGIST/GEOTECHNICAL ENGINEER/GEOPHYSICIST SERVICES

HLA will provide geologist/geotechnical/engineer/geophysicist services to Harza Ebasco as needed to assist Harza Ebasco in field and office operations during the winter 1983 program. The cost estimate shown on the Schedule of Activities Plate 1, is based on HLA providing two geologists to support the Becker Winter 1983 drilling program for the period January through March, 1983. The rotation schedule of the geologists is shown on Plate 1. In our cost estimate, we have assumed Harza Ebasco will provide round-trip transportation from Anchorage to the camp site and room and board while at the camp.

Additional geologists, geotechnical engineers and geophysicists support can be provided by HLA as requested by Harza Ebasco. All labor will be billed in accordance with the 1983 Schedule of Charges for Labor, Attachment 3. A list of HLA personnel available for this project is presented on Attachment 1. All field and office activities performed by HLA personnel will be documented by letter during the work on a schedule as negotiated to meet the Harza Ebasco schedule with the Alaska Power Authority.

TASK E - ROTARY WASH/AUGER DRILLING PROGRAM

Soils exploration to be conducted during the summer of 1983 will include soil borings drilled in the Fog Lakes and Watana Relict Channel and in Borrow Sites. Approximately 15,500 feet of drilling is anticipated as shown on Table 4. Test borings will range in depth from 50 to over 150 feet. The bulk of the drilling will be performed in the Relict Channel areas. Monthly costs for the FY '83-'84 rotary wash/auger program are summarized on Plate 2.

Equipment and Personnel

One Mobile B-61 and one CME 55 hydraulic rotary drill rig both modified for transportation by Bell 205 class helicopters will be used for rotary wash/auger drilling. Drilling tools will include 8-inch O.D. hollow-flight and 6-inch O.D. solid-flight augers, 2-5/8 inch O.D. mobloc flush jointed drill rod, drag and tricone bits and 4.0-inch I.D. (HW) casing necessary for rotary wash drilling. Water for rotary wash drilling will be pumped whenever possible from surface water sources in the vicinity of the drill rig. A skid-mounted 500-gallon helicopter transportable water tank will be provided for use in areas where drill water is not readily available. All drilling fluid will be collected in a sump and recirculated to the drilling operation. In frozen soils where depths are not excessive, borings will be advanced using hollow-stem flight augers to reduce thermal disturbance.

The B-61 is capable of drilling to depths of 100 feet using eight-inch O.D. hollow-flight auger and to depths in excess of 400 feet using rotary wash techniques. CME 55 is capable of drilling to depths of 70 feet and 250 feet using hollow-flight auger and rotary wash techniques respectively. The CME 55

will be used primarily to drill the 50-foot borings in Borrow Sites E and I which will be advanced using hollow-stem flight augers and to drill the 100-foot borings anticipated in Borrow Site D which will be advanced using rotary wash techniques. The Mobile B-61 will be used to drill the deeper borings in the Relict Channel areas. Although CME 55 does not have the depth capability of the Mobile B-61 it can be moved in three picks with the Bell 205 helicopter versus five picks for the Mobile B-61. Therefore, the savings in helicopter flight time over the course of the summer drilling season would be considerable.

Both drill rigs will be operated by a crew consisting of a driller and drill helper. The drill rigs will be operated on a single shift 12-hour per day basis in order to complete the proposed drilling program in 100 days. Drill crews will work on a two-weeks on, one week off schedule. In addition to the drill crews, HLA will provide a drilling superintendent/mechanic who will be responsible for supervision of the crews, maintenance of the drilling equipment and rebuilding drill bits and augers.

Sampling

The drill rigs will be equipped with a full range of soil sampling equipment. Soils will be sampled using thin-walled samplers and standard penetration 1.4-inch I.D. split-spoon samplers and 2.5-inch I.D. split-spoon samplers driven with 140-pound safety drop hammers. Sampling will generally be performed on five-foot intervals and at changes in strata. Samples will be transported from the drill rig to the field lab each day. Those samples selected for secondary testing will be shipped to the laboratory in Anchorage.

Mobilization/Demobilization

The drilling equipment will be mobilized by truck to the staging area at Talkeetna. Helicopter transport for the drill rigs from Talkeetna to the job site will be provided by Harza Ebasco. We estimate that mobilization/demobilization of the drill rigs exclusive of air support will be ~~$22,000.~~ $24,100. Approximately 15 round-trips by a Bell 205 class helicopter will be required to transport both drill rigs and the drilling tools from Talkeetna to the job site. An additional 15 round-trip flights would be required to return the equipment to Talkeetna from the job site at the end of the field season. The mobilization/demobilization and helicopter transport costs would be accrued again during the FY '84-'85 field season. In an effort to reduce total project costs, we are prepared to leave the rigs at the job site at the completion of the FY '83-'84 field program. A standby charge of $1,900 per month per rig would be accrued while the rigs were not being used.

APPENDIX II

COMPENSATION AND PAYMENT

II 1. COMPENSATION.

The Engineer shall pay Consultant for services performed for this project to cover the following items as hereinafter defined:

II 1.1 PAYROLL COSTS.

Shall comprise the salaries paid to personnel for time worked directly on the project plus all statutory payroll taxes and insurance as well as vacation, holiday, sick leave, and retirement benefits. 1983 payroll costs are 0.30 percent of actual direct salaries for all permanent personnel.

Salaries shall be subject to adjustment in accordance with normal salary review practice. On the first of each calendar year all salaries are adjusted for merit and cost-of-living. In years of particularly high inflation, mid-year cost-of-living increases are sometimes authorized.

II 1.2 OVERHEAD COSTS.

Overhead costs for 1983 are 155 percent of payroll costs. Overhead costs cover those items of doing business which must be paid out of project revenue, but cannot be directly assigned to the project, such as office space and equipment, insurance and taxes other than income taxes and those taxes associated with salary costs, executive and administrative expenses, plus other necessary costs for conducting business. For temporary subprofessional laboratory and field personnel overhead costs for 1983 are 0.90 percent of payroll costs.

II 1.3 DIRECT NON-SALARY COST.

Payment for direct costs shall be made to Consultant for those costs which are directly attributable to the work, including:

a. The cost of all materials and supplies used in the performance of the project.

b. Costs for reproduction of plans, specifications, reports and other data, and for computer services.

c. Long distance communication costs.

d. All costs associated with Engineer personnel, outside consultants, subcontracts, and other outside services and facilities.

e. Costs incurred for travel and subsistence of personnel engaged in the performance of the project.

f. Rental of special equipment and special field office.

g. Any other costs not described above which are proper charges to the project and approved by the Engineer's representative.

II 1.4 Laboratory testing in HLA's Anchorage laboratory will be done at unit prices per test in accordance with HLA 1983 Schedule of Laboratory Unit Prices, Attachment 6.

II 1.5 FEE COSTS.

The fee paid to cover interest on invested capital, readiness to serve, and profit shall be 15 percent of the payroll costs plus overhead costs plus 15 percent of the direct non-salary costs.

II 2. ESTIMATED COSTS.

The costs estimated for performing the services subject of this Agreement are shown on Plates 1 and 2.

II 3. SUBMISSION OF INVOICES AND PAYMENTS.

II 3.1 Consultant shall submit monthly invoices to the Engineer within 30 working days of each month-end and in accordance with Appendix II, §§1.1, 2, 3, and 3.2. The monthly billing shall be based on costs incurred and fee earned for services performed and will be fully supported with appropriate documentation.

II 3.2 PAYMENT OF INVOICES.

The Engineer shall pay Consultant invoices within 10 calendar days of receipt by the Engineer of payment of the corresponding invoices by the Authority, or within 60 calendar days of invoice date, whichever occurs first. Should any invoiced item require substantiation or adjustment, the Engineer shall pay the invoice and shall provide Consultant a clear statement regarding the error or the deficiency to be corrected, and the Consultant shall provide the supporting documentation or effect the necessary corrective action within the next 30 days for the deficiencies and/or items in question. If supporting documentation is not received within 30 days, the Engineer will reduce the next invoice accordingly. Invoices not paid within 40 days of invoice date will be subjected to a finance charge of 1-1/2 percent per month.

II 3.3 LIMITATION OF FUNDS.

At no time will the Engineer or the Authority be liable for payment for performance of work under this Agreement in excess of the amounts allocated to this Agreement.

Consultant will not incur any expenses exceeding the allotted amount unless and until the Engineer has notified the Consultant in writing that such allotted amount has been increased and has approved an increased amount allotted to this Agreement.

In the event that Consultant expects the allotted amount will be exceeded by the costs and fees that are incurred in accomplishing the work that is a part of this Agreement, Consultant will notify the Engineer in writing as soon as such exceedance is identified.

JME/DEB/sr/1930A

ACTIVITY	NOV 22 28	DECEMBER 82 5 12 19 26	JANUARY 83 2 9 16 23 30	FEBRUARY 83 6 13 20 27	MARCH 83 6 13 20 27	APRIL 83 3 10 17 24	MAY 83 1 8 15 22 29	JUNE 83 5 12 19 26	TOTAL COSTS
PLANNING & PROJECT MGMT		$16,640	$9,792	$9,792	$9,792	$9,792	$9,792	$7,168	$ 72,768
ORDER & PURCHASE EQUIPMENT		$64,762							64,762
EQUIPMENT SHIPMENT									
SET UP FIELD LAB		$3,200							3,200
SITE TESTING SERVICES			$95,592	$84,395	$93,150	$90,232			363,369
SUPERVISOR-ANCHORAGE									
FIELD TECH 1* (DAY)									
FIELD TECH 2 (DAY)									
FIELD TECH 3* (NIGHT)									
FIELD TECH 4 (NIGHT)									
FIELD TECH 5 (NIGHT)									
FIELD TECH 6* (NIGHT)									
FIELD TECH 7* (DAY)									
FIELD TECH 8 (DAY)									
FIELD TECH 9 (DAY)									
ANCHORAGE TESTING							$15,000	?	15,000
GEOPHYSICAL SURVEYS			$68,302	$61,846	$67,030	$65,302			262,480
FIELD GEOPH. 1									
FIELD GEOPH. 2									
FIELD GEOPH. 3			$33,120	$30,240	$34,560	$12,960			110,880
GEOLOGIST/ENGINEER SUPPORT									
FIELD GEOLOGIST 1									
FIELD GEOLOGIST 2									
AUGER DRILLING(seeplate 2)							See Plate 2 for Cost		
MONTHLY COSTS		$84,602	$206,806	$186,273	$204,532	$178,286	$24,792	$7,168	$892,459

Notes:

1. * denotes shift supervisors.

2. Field Technicians will work 12 hours/day, 7 days/week and a three weeks on, one week off schedule. Field Geophysicists will work 12 hours/day, 7 days/week and two weeks on, one week off schedule with HARZA-EBASCO field geophysicists. Field Geologists will work 12 hours/day, 7 days/week and two weeks on, one week off schedule with HARZA-EBASCO field geologist. Auger drilling start-up date is dependent upon winter breakup.

Harding Lawson Associates
Engineers Geologists
& Geophysicists

Schedule of Activities-FY83
November 1982 through June 1983
Susitna Hydroelectric Project

PLATE 1

DRAWN | JOB NUMBER PW82-271.08 | APPROVED | DATE 12/1/82

ACTIVITY	MAY-FY83 1 8 15 22 29	JUNE-FY83 5 12 19 26	JULY-FY84 3 10 17 24 31	AUGUST-FY84 7 14 21 28	SEPTEMBER-FY84 4 11 18 25	TOTAL COSTS
AUG[illegible] DRILLING						
PLANNING & PROJECT MGMT	$9,360	$16,320	$16,864	$16,864	$4,352	$ 63,760
MOBILIZATION	$13,752					13,752
DRILLING (100 DAY PROGRAM)		$142,620	$147,374	$147,374	$38,032	475,400
B-61 DRILLER						
HELPER						
CME 55 DRILLER						
HELPER						
ALT. DRILLER						
ALT. HELPER						
SUPERINTENDENT/MECH 1						
SUPERINTENDENT/MECH 2						
DEMOBILIZATION					$7,792	7,792
MONTHLY COSTS	$23,112	$158,940	$164,238	$164,238	$50,176	$560,704

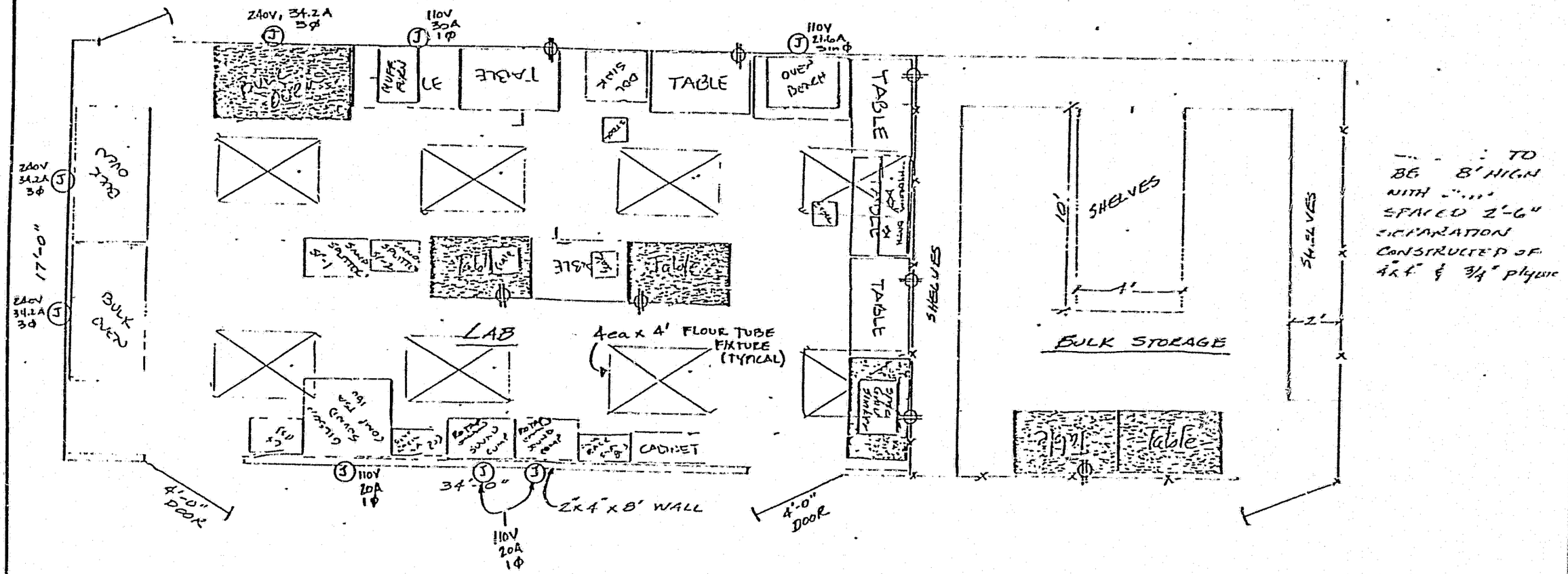
Notes:

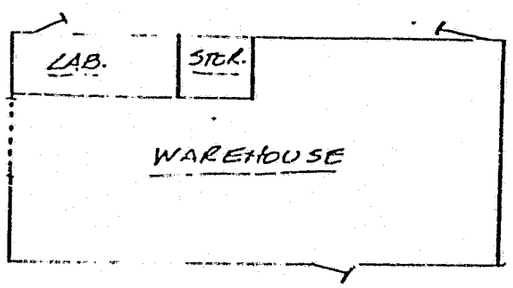
1. Drill rigs will operate on a single 12-hour shift per day basis. Fuel and helicopter support to be provided by HARZA-EBASCO.
2. Drillers and helpers will work 12 hours per day, 7 days per week and two weeks on, one weekoff schedule.
3. Crews will be quartered at the Watana Dam Camp Site.
4. In lieu of demobilization, rigs can be left at the camp site for future work. Standby rate for the rigs will be $1900/month per drill rig.
5. Monthly costs include labor and equipment charges for drilling superintendent/mechanic.

Harding Lawson Associates
Engineers Geologists
& Geophysicists

Summer Auger Drilling FY83-FY84

PLATE 2





NOTE: COVER FLOOR (4x12 PLANKS) WITH 3/4" PLYWOOD IN LAB, STORAGE AND 8' WIDE RECEIVING ADJACENT TO LAB & STORAGE.

SCALE 1/4" = 1'

Harding Lawson Associates
Engineers, Geologists & Geophysicists

LABORATORY LAYOUT
WATANA DAM SITE
ALASKA

3

DRAWN JRC | JOB NUMBER | APPROVED | DATE 11/82 | REVISED | DATE

ATTACHMENT I

AVAILABLE STAFF - HARDING LAWSON ASSOCIATES

TITLE

Geologist

Peter Ondra
Albert Friedman
Charles Masson
Richard Prescott
Gary Russey
Bruce Murphy

Senior Geologist

Steven Johnson
Robert Perry

Engineer

Mark Musial
Scott Crowther
Dennis Roe
Stuart Dykins
Kent Hansen
George Armstrong
Mohammad Joolazadeh
Sam Rambaoa

Geophysicist

William Henrich
Edward Ticken
Craig Rodeick
Thomas Casebier

Senior Geotechnical Engineer

Donald Bruggers
Bernard Nidowicz
John Chambers
Randolph Ross
Marvin Davis
George Howe
Edgar Johnson
James Bowers

Associate Geotechnical Engineer

Thomas Stimac
Hugo Hanson
Donald Quigley
Lyle Lewis

Principal Geotechnical Engineer

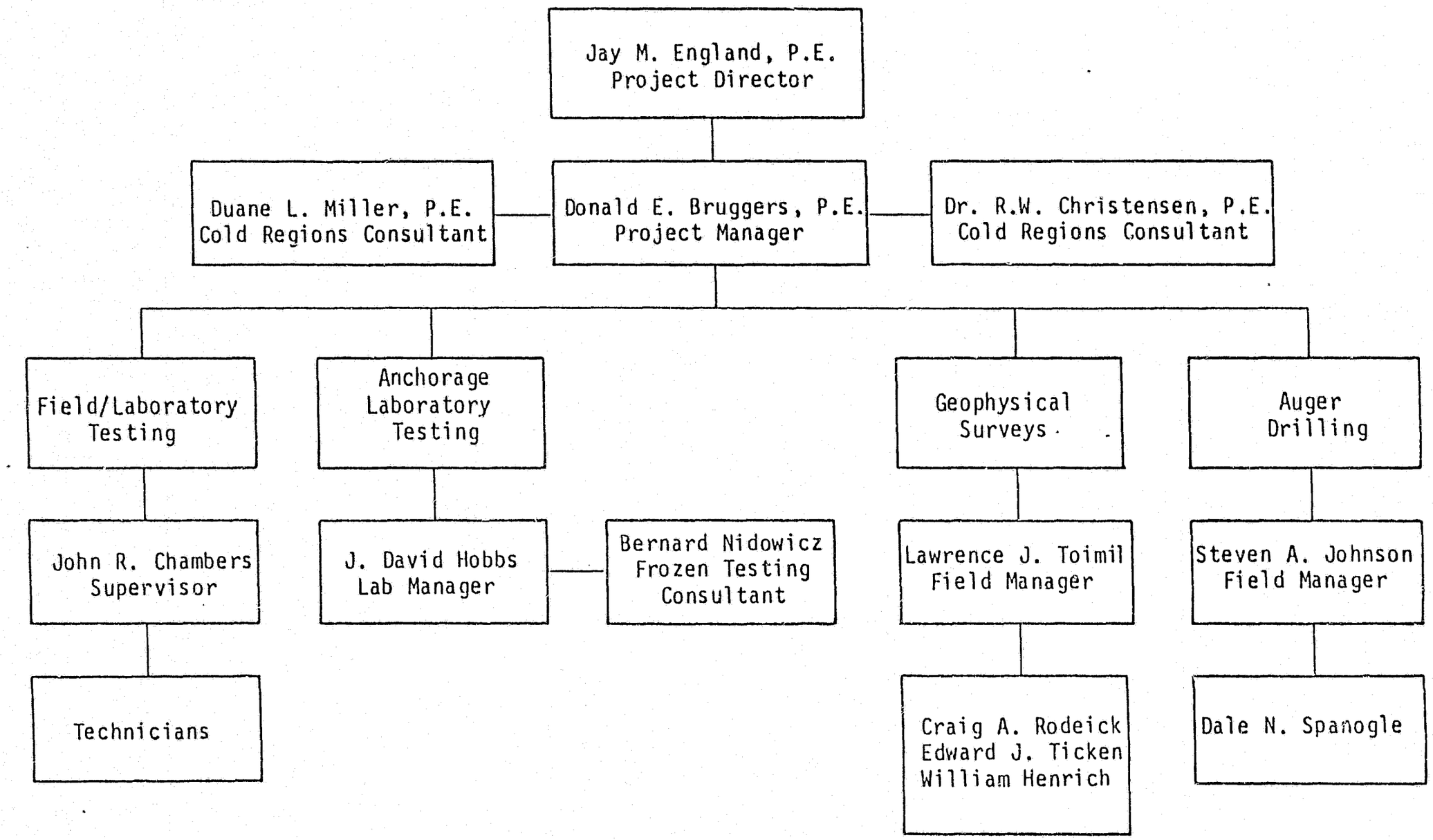
Jay England
Keith Bergman
Al Buchignani
Henry Taylor
Richard Christensen
Duane Miller

Senior Geophysicist

Kenneth Blom

Principal Geophysicist

Jerome Nelson



Harding Lawson Associates
Organization Chart
Watana Dam
Attachment II

ATTACHMENT 3
1983 SCHEDULE OF CHARGES
HLA - Anchorage, Alaska
(Page 1 of 1)

L A B O R

PROFESSIONAL SERVICES	Hourly Wages
Principal Engineers, Geologists & Geophysicists	$ 31.00 - 37.00
Associate Engineers, Geologists & Geophysicists	26.00 - 31.00
Senior Engineers, Geologists & Geophysicists	19.00 - 26.00
Engineers, Geologists & Geophysicists	14.00 - 19.00
TECHNICAL SERVICES	
Superintendent, Foreman, Mechanic	20.00*
Drill Rig Operator II	18.50*
Drill Rig Helper II	15.00*
Drill Rig Helper I	12.00*
Senior Engineering Technician, Field & Laboratory	12.00 - 18.00
Engineering Technician, Field & Laboratory	7.50 - 12.00
Technical Typist with Word Processor	10.00 - 14.00
Draftsperson	10.00 - 14.00
Typist/Clerk/Expeditor	6.00 - 12.00

O T H E R

IN-HOUSE EQUIPMENT	
HP 3000 Computer	$20.00 per connect hour
	0.06 per CPU second
Printing	0.25 per square foot

TERMS:

1. Hourly billing rate including wages, payroll taxes, insurance, and other related payroll burdens, overhead, and profit, will be determined by multiplying employee's straight time wages by 3.2 and will apply to all hours worked. Hourly billing rate for part-time employees such as drill rig labor marked by (*) above will be determined by multiplying employee's straight time wages by 2.4 and will apply to all hours worked.

2. For field work outside the Anchorage area, standby time for labor up to a maximum of 10 hours per day will be incurred when field work or travel is prevented because of weather, equipment breakdown or other conditions beyond HLA's control. Weather standby may be implemented when ambient temperatures are colder than minus 30°F, or wind chill conditions are colder than minus 50°F, or reduced visibility makes travel hazardous.

3. Outside costs such as rental vehicles, leased equipment, air fares, freight, subsistence, special printing, etc. will be invoiced at cost plus fifteen percent (15%).

4. Harding Lawson Associates makes no Warranty, either expressed or implied, as to its findings, recommendations, specifications, or professional advice except that they are prepared and issued in accordance with generally accepted professional practices.

5. Billings are payable upon presentation and are past due 30 days from invoice date. A finance charge of 1-1/2 percent per month will be charged on past due accounts.

ATTACHMENT 4
1983 SCHEDULE OF CHARGES
HLA - Anchorage, Alaska
(Page 1 of 2)

G E O P H Y S I C A L E Q U I P M E N T

	RATES		
	Per Day	Per Week (7 days)	Per Month (30 days)
Nimbus Seismograph, 12-channel, ES-1210F	$ 200	$ 1,260	$ 4,500
Nimbus Seismograph, 12-channel, ES-1200	180	1,134	4,050
SIE Seismograph, 12-channel, RS-4	150	945	3,375
Nimbus Seismograph, 1-channel, ES-125	50	315	1,125
Nimbus Pocket Timer	50	315	1,125
Spregnether Seismograph, MEQ-800	50	315	1,125
Downhole Shear Wave Hammer	100	630	2,250
Bison Shallow Resistivity Meter, Model 2350	50	315	1,125
Bison Signal Averaging Resistivity Meter, Model 2390	90	567	2,025
Geotronics Deep Resistivity System including generator	400	2,520	9,000
Self-potential Equipment	50	315	1,125
Johnson-Keck Borehole Logging System, SR-3000	150	945	3,375
GSSI Ground Penetrating Radar System with tape recorder	225	1,417	5,062
EG&G Uniboom Marine Subbottom Profiling System	400	2,520	9,000
Raytheon Shallow Marine Profiling System, RTT-1000	150	945	3,375
Raytheon Fathometer, DE-719	50	315	1,125

1983 SCHEDULE OF CHARGES
HLA - Anchorage, Alaska
(Page 2 of 2)

G E O P H Y S I C A L E Q U I P M E N T

	RATES		
	Per Day	Per Week (7 days)	Per Month (30 days)
Del Norte Trisponder Positioning System with printer	225	1,417	5,062
Geometrics Land Magnetometer	50	315	1,125
Oyo Sonic Viewer	70	441	1,575

NOTES:

1. Standby time for geophysical equipment will be incurred when field work or travel is prevented because of weather or other conditions beyond HLA's control. Equipment standby time will be invoiced at fifty percent (50%) of the daily working rate.

2. Leased or rented equipment such as side scan sonar, tide recorders, air guns, boats, generators, etc. and expenses such as fuel, chart paper and magnetic tapes will be invoiced at cost plus fifteen percent (15%).

ATTACHMENT 5
1983 SCHEDULE OF CHARGES
HLA - Anchorage, Alaska
(Page 1 of 2)

E Q U I P M E N T & E X P E N S E S

DRILLING EQUIPMENT including all standard tools and soil sampling equipment, less expendables

Mobile Drill B-61 or Failing 750 mounted on a Nodwell-tracked carrier:	
Working rate, per shift or any part thereof up to 12 hrs.	$ 460.00
Working rate, double shift	790.00
Weather or Mechanical Standby Rate, per day (see Note #1)	345.00
Mobile Drill B-61 or Failing 750 subbase mounted for use on sled or barge:	
Working rate, per shift or any part thereof up to 12 hrs.	400.00
Working rate, double shift	730.00
Weather or Mechanical Standby Rate, per day (see Note #1)	300.00
Mobile Drill B-61 Truck-mounted; Mobile Drill B-38 Truck-mounted or with helicopter base:	
Working rate, per shift or any part thereof up to 12 hrs.	430.00
Working rate, double shift	740.00
Weather or Mechanical Standby Rate, per day (see Note #1)	300.00
Mobile Drill B-61 Truck or Nodwell carrier, casual use Anchorage area	60.00 per hour
Mobile Drill Minuteman, 9 h.p. portable flight auger	150.00 per day
Three leg adjustable aluminum tripod with motorized cathead	50.00 per day
General Power Auger for soil or ice, hand-held	25.00 per day
Pneumatic Casing Hammer/Extractor (less compressor)	125.00 per day
Bean 535 Pump	70.00 per day
E5501 Dutch Cone Penetrometer, 20 ton, with mechanical cones, skid or trailer mounted	negotiate

DRILLING EXPENSES

Drilling and sampling, expendables and fuel, excluding casing lost, per foot drilled except permafrost	4.00
Drilling and sampling expendables and fuel, excluding casing lost, per foot drilled in permafrost	8.00
Casing lost or abandoned	cost + 15%

E Q U I P M E N T & E X P E N S E S
(Page 2 of 2)

OTHER EQUIPMENT

Zodiak Inflatable Boat	
Mark III GR	$ 75.00 per day
Mark II GR	50.00 per day
Outboard Motors, 5-25 HP	20.00 per day
Kohler Lister 4.0 kw Generator/Light Plant	48.00 per day
Honda 1.5 kw Generator	15.00 per day
Miller Welder	30.00 per day
Homelite two inch, 140 gpm Fire Pump	10.00 per day
Homelite XL12 Chainsaw	15.00 per day
Survival Gear, per Drum	15.00 per day
Pickup Trucks	
Anchorage Area	7.00 per hour
Prudhoe Bay Area, excluding fuel	105.00 per day
Two or Three-inch O.D. Split-Spoon Soil Sampler Kits	20.00 per day
Frozen Sample Field Storage (Mechanical Freezer)	10.00 per day
Troxler Model 2401 Nuclear Moisture-Density Gauge	10.00 per test
Sand Cone or Balloon Field Moisture	5.00 per hour
Density Test Kit	30.00 per day
Data Precision Model 248 multi-meter (including thermistor string)	10.00 per day

NOTES:

1. For work outside the Anchorage area, standby time for drilling equipment will be incurred when field work or travel is prevented because of weather, mechanical breakdown or other conditions beyond HLA's control. Standby for mechanical breakdown will not exceed one day for any one occurrence.

2. Rental of drilling equipment not included above and special equipment not ordinarily furnished by HLA and all other outside costs such as trucking, freight, non-drilling expendables, fuel and fuel handling costs, etc. will be invoiced at cost plus fifteen percent (15%). Trucking will be prorated if more than one client or project is involved.

ATTACHMENT 6
1983 SCHEDULE OF UNIT PRICES
HLA - Anchorage, Alaska

L A B O R A T O R Y T E S T S

Aggregate and Soil Laboratory Tests - Unit Price Schedule 1983

		UNIT PRICE
I.	**AGGREGATE TESTS**	
1.	Sieve Analysis, Coarse or Fine Aggregate (up to six sieves)	$ 40.00
2.	Sieve Analysis, Combined Coarse and Fine Aggregate with Wash Test for Finer than #200 Sieve Size, ASTM C136	52.00
3.	Material Finer than #200 Sieve Size by Washing, ASTM C117	28.00
4.	Clay Lumps and Friable Particles, ASTM C142	60.00
5.	Organic Impurities in Sands, ASTM C40	42.00
6.	Sulfate Soundness of Aggregates, per Sieve Size, ASTM C88	40.00
7.	Specific Gravity and Absorption of Coarse Aggregate, ASTM C127	35.00
8.	Specific Gravity and Absorption of Fine Aggregate, ASTM C128	65.00
9.	Unit Weight of Aggregates, ASTM C29	26.00
10.	Abrasion of Aggregates by Los Angeles Machine, ASTM C131	75.00
II.	**AGGREGATE AND SOIL TESTS - BULK SAMPLES**	
11.	Moisture-Density Relations (compaction curve) using 10-pound rammer and 18" drop, ASTM D1557	
	a. 4" diameter mold, 4 points minimum	140.00
	Check point	35.00
	b. 6" diameter mold, 4 points minimum	165.00
	Check point	45.00
12.	Relative Density of Cohesionless Soils, ASTM D2049 (1/10 ft^3)	145.00

	UNIT PRICE
13. Resistance (R-value), ASTM D2844	
a. Untreated Compacted Soil or Aggregate (3 points)	$ 175.00
b. Lime or Cement Treated Soil or Aggregate	200.00
14. California Bearing Ratio Study Soil or Aggregate	
a. Coarse-grained 3 points	See Note 3
b. Fine-grained 15 points	See Note 3
III. SOIL INDEX AND CLASSIFICATION TESTS	
15. Liquid Limit, Plastic Limit and Plasticity Index, ASTM D423 and D424	60.00
Specimen Non-plastic	30.00
16. Specific Gravity of Soils, ASTM D854	42.50
17. Moisture Content by Oven Drying, ASTM D2216	8.00
18. Organic Content Loss by Ignition ASTM D2974	35.00
19. Hydrogen Ion Concentration (P_h)	15.00
20. Wet and Dry Density	
a. Split-spoon Liner	14.00
b. Shelby Tube	22.00
21. Wet and Dry Density - Chunk or Frozen Sample (Immersion Method)	28.50
22. Classification of Soils (Visual-Manual Procedure), ASTM D2488	15.00
23. Sieve Analysis (Including Wash Test for Finer than #200 Sieve Size)	52.00
24. Particle Size Analysis (Combined Sieve and Hydrometer), ASTM D422	
a. With Assumed Specific Gravity	75.00
b. With Measured Specific Gravity	115.00
c. Measured to 0.02mm with Assumed Specific Gravity	60.00

		UNIT PRICE
25.	Amount of Material Finer than the #200 Sieve Size by Washing, ASTM D1140	$ 28.00
26.	Pore Water Chemistry including Freezing Point Depression	150.00
27.	Conductivity (Pore Water Leachate)	26.50
IV.	SOIL TESTS ON UNDISTURBED (Extruded Tube) OR REMOLDED SPECIMENS UP TO FOUR-INCH DIAMETER (*)	
28.	Unconfined Compressive Strength, ASTM D2166	45.00
29.	Unconsolidated Undrained Strength in Triaxial Compression, ASTM D2850	
	a. Back Pressure Saturated	130.00
	b. Field Moisture	60.00
30.	Consolidated Undrained Strength in Triaxial Compression, Back Pressure Saturated	160.00
31.	Consolidated Undrained Strength in Triaxial Compression, Back Pressure Saturated with Pore Pressure Measurements	220.00
32.	Consolidated Drained Strength in Triaxial Compression, Back Pressure Satruated, t-100 less than 20 minutes	170.00
33.	Consolidated Drained Strength in Direct Shear (Cohesionless Soils)	120.00
34.	One-Dimensional Consolidation, ASTM D2435, including Void Ratio vs Log P Plot and Two Time-Deformation Curves	225.00
	a. Additional Time Deformation Curves, per load	20.00
35.	Permeability of Granular Soils Constant or Falling Head	150.00

(*) Unit Price includes moisture density

		UNIT PRICE
36.	Dynamic (Cyclic) Triaxial Compression	See Note 3
37.	Resonant Column	See Note 3
V.	TESTS ON UNDISTURBED OR REMOLDED FROZEN SOIL SPECIMENS (See Note 5)	
38.	Unconfined Compression Test (Quick Test)	$ 125.00
39.	Unconfined or Triaxial Compression Tests on Undisturbed or Remolded Frozen Sample at a Specified Test Temperature (Long-term Tests)	See Note 4
40.	a. Thaw-Strain or Thaw-Consolidation, Single Load	75.00
	b. Multiple Loading	250.00
41.	Thermal Conductivity - Thermal Needle Method	
	a. Frozen Fine-grain Sample	175.00
	b. Thawed Fine-grain Sample	150.00

NOTES:

(1) Unit prices include normal handling, sample preparation, testing and presentation of data on standard laboratory report forms.

(2) Material handling to reduce sample size, crushing, drying and similar work not normally included in the standard laboratory test procedures will be charged on a time expended basis at $38 per hour.

(3) The unit prices of CBR and dynamic tests depend on soil type, number of tests to be performed and other variables and will be quoted on a specific job basis.

(4) The cost of performing tests on frozen samples depends on several factors including specimen preparation requirements, test temperatures, and test duration. Moreover, test procedures, data interpretation, and presentation methods are not standardized. Consequently, long-term testing of frozen soil is performed on a time and materials or negotiated basis.

(5) Frozen soil test temperature range -10 to 0°C; Sensitivity ±0.1°C.

(6) Large diameter (up to 12 inch) and high pressure triaxial and permeability test prices available on request.

(1/83)/1925A

TABLE 1
LABORATORY EQUIPMENT
WATANA DAM

Harding Lawson Associates

Item No.	Description	Unit Cost	Quantity	Total Cost	Weight (lbs.)
1	Oven Bulk DOD 240	$ 5,050.00	3	$15,150.00	1525
2	Oven Bench DOL 69	984.90	2	1,969.80	180
3	Muffle Furnace 306	428.00	1	428.00	75
4	Scale, Elec. Mettler PC 4400 DR	1,921.50	1	1,922.00	10
5	Scale, Elec. Mettler PC 24	1,615.50	1	1,616.00	15
6	Scale, Digital Bench Sar. 60 K	4,495.50	1	4,495.00	25
7	Scale, Triple Beam 311gm	84.50	1	106.50	5
8	Scale, Ohaus 2610gm	113.10	1	113.10	5
9	Platform Scale HS 300P	509.00	1	509.00	45
10	Gilson Screen Apparatus TS-1	1,795.00	1	1,795.00	466
11	Gilson Elec. Timer	94.00	1	94.00	1
12	Gilson, Extra Screens 3/4", 1/2", 3/8", No. 4	78.00	1	312.00	80
12A	4", 3", 2", 1-1/2", 1", 3/4"	78.00	1 ea.	468.00	120
12B	1/2", 3/8", No. 4, Pan	78.00	1 ea.	312.00	80
13	Door Enclosure Assembly TSA 157/180	88.00	1	88.00	12
14	Gilson Sound Compartment	430.00	1	430.00	115
15	Gilson Sound Compartment SSA 805	382.00	1	382.00	70
16	Exhaust Unit TSA 181	164.00	2	328.00	15
17	8" Tyler Rotap, 115V 60Hz Sieve Shaker SS30 w/timer	1,098.00	2	2,196.00	400
	Page Total			$32,714.40	3244
	Cumulative Total			$32,714.40	3244

LABORATORY EQUIPMENT
WATANA DAM

Item No.	Description	Unit Cost	Quantity	Total Cost	Weight (lbs.)
18	8" Brass Sieves includes:	409.35	4 sets	1,637.40	100
18A	3", 2", 1-1/2", 1", 3/4", 1/2"				
18B	3/8", 1/2", No. 4, 10, 20, 30				
18C	40, 100, 200, Pan, Lid				
19	Sieve Storage Rack SSA 803	105.00	4	420.00	50
20	#200 Wash Screen WT-2 12"	361.00	3	1,083.00	15
21	Repl #200 for WT-2 (WT-2A)	45.80	6	274.80	1
22	Water Spray Head WT-7	13.60	2	27.20	1
23	Spray Dispenser WT-5	5.25	4	21.00	1
24	Mech Anal Stirrer CL 272A	243.90	1	243.90	17
25	Hydrometer Impr CL 277A	21.06	4	84.24	1
26	Hydrometer Jar CL 271-6	11.50	6	69.00	15
27	Dispersion Cup CL 274	50.40	1	50.40	1
28	Mixing Paddle CL 275	3.18	1	3.18	1
29	Spec. Mixing Paddle CL 289A	18.60	1	18.60	1
30	Hydr. Jar Bath 110V 1060W CL 278E	1,130.00	1	1,130.00	130
31	Sod. Silicate Sol. CL 276	6.60	1	6.60	3
32	Jars 1 pt w/Lids LT 26	137.75	144	137.75	2
33	Amyl Alcohol	14.12	1 pt.	14.12	1
34	Thermometer 0-150°C	3.90	6 ea.	23.40	2
35	Wash Bottle, Guth G10	38.46	2	76.92	2
36	Brushes CL 315	11.94	4	47.78	1
	Page Total			$ 5,507.29	345
	Cumulative Total			$38,221.69	3589

LABORATORY EQUIPMENT
WATANA DAM

Harding Lawson Associates

Item No.	Description	Unit Cost	Quantity	Total Cost	Weight (lbs.)
37	Brushes CL 316	3.48	4	13.92	1
38	Bottle Merc Stor CL 255F	46.00	2	92.00	1
39	Laboratory Muller C 35	1,580.00	1	1,585.00	120
40	Mortar & Pestle Porcelain CL 73	13.70	2	27.40	8
41	Spatula 6" P 86	9.75	1/pkg.	9.75	1
42	Spatula 4" P 85	7.50	1/pkg.	9.75	1
43	Liquid Limit Device CL 205	425.00	1	425.00	9
44	Liquid Limit Device CL 204	195.00	2	390.00	9
45	Spare Cup and Holder CL 228	29.45	2	58.90	1
46	Groving Tool CL 218	25.00	2	50.00	1
47	Plastic Limit Plate CL 250	6.30	3	18.90	2
48	Moisture Cans LT 16	26.30	48	105.20	1
49	Dowel, 1/8"	0.50	2 ft.	1.00	1
50	Lab Tongs 20" length	15.00	2 ea.	30.00	1
51	Gloves Asbestos LT 116	14.28	2 pr.	28.56	1
52	Petre Dishes 25ml		24		1
53	Hot Plate 2 Burner 110V L 265	75.00	1	75.00	13
54	Density Basket G 340	42.25	2	90.50	8
55	Pycnometer Top & Jar G 335	9.80	2	19.60	2
56	Gasket G 366-20	0.45	4	1.80	1
57	Flasks Volumeteric 500 G 27	15.85	12	190.20	3
58	Vacuum Pump LT 420	595.00	1	595.00	25
	Page Total			$ 3,817.48	211
	Cumulative Total			$42,039.17	3800

Item No.	Description	Unit Cost	Quantity	Total Cost	Weight (lbs.)
59	Mercury Gage	300.00	1	300.00	15
60	Stop Watch LT 475	39.85	3	119.55	1
61	Comp Mold 6" CN 404	88.60	2	177.60	15
62	Comp Mold 4" CN 405	69.60	2	139.20	15
63	Comp Hammer 10# CN 416	62.70	2	125.40	18
64	Comp Hammer 5.5# CN 415	48.00	1	48.00	12
65	Stainless Steel Mixing Pans LT 622 21 x 12 x 2-1/2	21.80	48	1,046.40	75
66	Stainless Steel Mixing Pans LT 600 8 x 4 x 3	26.05	48	1,250.40	50
67	Spoon CN 995	3.95	6	23.70	1/2
68	Density Pick CN 503	18.60	2	37.20	3
69	Chisel CN 998	7.35	2	14.70	3
70	Rubber Mallet CN 999	7.75	2	15.50	3
71	Scoop 5 x 8 x 3 CN 502A	8.50	2	17.00	5
72	Scoop CN 502	5.58	2	11.16	3
73	Large Sample Splitter SP-1	382.00	1	382.00	136
74	Medium Sample Splitter SP-2	233.00	1	233.00	64
75	Mini Splitter SP-3	233.00	2	466.00	15
76	Quartering Canvas 5 x 5 LT 98	31.74	2	63.48	8
77	Shovel, square end	15.00	2	30.00	5
78	Shovel, round end	15.00	2	30.00	5
79	Trowel, 2-1/2 x 4-1/2 CN 840	4.00	3	12.00	1
	Page Total			$ 4,542.29	453
	Cumulative Total			$46,581.46	4253

Item No.	Description	Unit Cost	Quantity	Total Cost	Weight (lbs.)
80	Straight Edge CN 833	12.00	2	24.00	2
81	Sample Tags (weatherproof) 2-1/2 x 5-1/2	300.00	5000	300.00	
82	Polyethylene markers A0920/A0921	1.50	24	36.00	
83	Bosch Stapler, plier type	15.75	3	47.25	
84	Staples	6.27	4 bx.	25.08	
85	Soil Color Chart A-27	62.00	2	124.00	1
86	Pocket Penet CL 700 w/CL 701	46.50	2	93.00	1
87	Torvane CL 600 w/602 & 604	222.30	2	444.60	2
88	Lab Stools	62.42	3	187.26	
89	Double Sink w/drain & faucets	190.00	1	190.00	
90	Tables 3'x 6', 30 x 72	99.00	2	198.00	
91	Storage Cabinet 36 x 78	301.00	2	602.00	
92	1/4" Plastic Tubing w/fittings	0.25	50'	12.50	
93	Engineer Scale	12.50	2	25.00	
94	Engineer Ruler Folding 0.1'	6.50	2	13.00	
95	Plastic Tubs 12" x 18 x 18	3.80	12	45.60	
96	Tool Kit, includes sockets	161.37	1 kit	161.37	
96A	Screwdrivers, wrenches				
96B	Flaring Tool, box				
97	Electric Drill 1/2"	79.95	1	79.95	
98	Drill Bits	30.67	1 set	30.67	
99	Skill Saw	46.99	1	46.99	
	Page Total			$ 2,686.27	6
	Cumulative Total			$49,267.73	4259

Item No.	Description	Unit Cost	Quantity	Total Cost	Weight (lbs.)
100	Saw Blades	4.39	4	51.38	
101	Hammer, Claw	12.32	2	24.64	
102	Assorted screws, bolts & nuts	10.00		10.00	
103	Concrete Bit 3/4"	6.76	3	26.01	
104	Concrete Bit 3/8"	1.91	3	5.73	
105	Concrete Bolts (Gilson)	2.00	8	16.00	
106	Hand Trucks	98.58	2	197.16	
107	Wheel Carts Pallet Jack	513.45	1	513.45	
108	Filing Cabinets 4 dwr ltr	205.00	2	410.00	
109	Laboratory Forms			500.00	
110	Calculator HP 41c w/peripherals	750.00	1	750.00	
111	Xerox Copier 3450	9,995.00	1	9,995.00(1)	
112	ASTM Parts 14, 15 & 19		1 ea.	100.00	
113	Calibration Weights WS 124	70.25	2 sets	140.50	10
114	Shop Vacuum Milw. 9 gal.	407.05	1 ea.	407.05	
	Page Total			$13,146.92	10
	Cumulative Total			$62,414.65	4269
	Cumulative Total w/o Freight			$62,414.65	
	Laboratory Equipment Prices FOB Factory Air Freight @ $0.55 x $4269			$ 2,347.95	
	TOTAL			$64,762.60	

(1) Monthly Rental $800 per month

TABLE 2 ESTIMATED FY83 FIELD LABORATORY TESTING

Source	No. of Holes	Grab Sample Gradation	Sample Type		Testing					Retain for Future Testing
			Drive/Core	Cyclone	Gradation	Hydrometer	Moisture	Atterberg	Proctor Series (Modified & Standard)	
Summer 1982:										
Fog Lakes Relict Channel	0	15	0	0	15	15	5	5	0	15
Watana Relict Channel & Borrow Site	24	10	800	0	200	50	50	50	0	100
	26	20	850	0	200	100	100	100	5	100
Winter 1982-83:										
Damsite River Alluvium	20	-	100	220	200	20	0	20	5	50
Watana Relict Channel & Borrow Site D	9	0	200	300	150	25	50	50	5	100
	5	0	150	300	150	25	150	150	20	100
Borrow Site C and I	16	0	300	200	20	0	20	20	20	150
TOTAL (13,850 LF of drilling)	100	45	2,200	1,120	1,015	255	355	395	55	615

TABLE 3 FY83 EXPLORATORY PROGRAM - PHASE II
WATANA DAMSITE GEOPHYSICAL SURVEY

Seismic Refraction Line No.	Location	Approximate Length (ft)	Purpose
SL83-AA*	Upstream Cofferdam Centerline	800	Depth of overburden and bedrock conditions.
SL83-BB	Upstream Cofferdam, River Centerline	1,100	Depth of overburden, bedrock conditions, and "The Fins".
SL83-CC	Main Dam Centerline	500	Depth of overburden and bedrock conditions.
SL83-DD	Downstream Cofferdam, River Centerline	1,100	Depth of overburden, bedrock conditions, and "Fingerbuster".
SL83-EE	Downstream Cofferdam	550	Depth of overburden, bedrock conditions,
SL83-FF	Downstream Cofferdam Centerline	550	Depth of overburden, bedrock conditions, and "Fingerbuster".
SL83-GG	Upstream Portal	550	Depth of overburden, bedrock conditions, and "The Fins".
SL83-HH	Main Dam River Centerline	3,850	Depth of overburden, bedrock conditions, and NW and N shears.
SL82-II	Main Dam Upstream Toe	550	Depth of overburden and bedrock conditions.
SL83-JJ	Main Dam Upstream of Centerline	550	Depth of overburden and bedrock conditions.
SL83-KK	Main Dam Downstream of Centerline	400	Depth of overburden and bedrock conditions.
SL83-LL	Main Dam Downstream Toe	550	Depth of overburden, bedrock conditions, and "Fingerbuster".
SL83-MM	Plunge Pool	500	Depth of overburden, bedrock conditions, and "Fingerbuster".
SL83-NN	Plunge Pool	1,100	Depth of overburden, bedrock conditions, and "Fingerbuster".
SL83-OO	Plunge Pool	2,200	Depth of overburden, bedrock conditions, and "Fingerbuster".
	TOTAL	14,850	

*Upon execution of work, temporary line letter designation will be replced with a permanent chronologically sequential line number.

Table 4

Harding Lawson Associates

ESTIMATED PRE-CONSTRUCTION EXPLORATION AND MATERIALS TESTING

Task:	Geophysical Profiling	Rock Core Drilling	Hammer Drilling	Soil Auger/ Core Drilling	Trenches Test Pits	Adit Excavation	Watana Site Soils Lab	Anchorage Soils Lab	"Lower 48" Soils Lab
Contractor:	JV/Harding-Lawson	Subcontract To Be Let	Becker Drill	Harding-Lawson	Subcontract To Be Let	Subcontract To Be Let	Harding-Lawson	Harding-Lawson	Harding-Lawson
Units:	Feet	Feet	Feet (no. of holes)	Feet (no. of holes)	No. of Excatvations	Feet	No. of Tests	No. of Samples	No. of Samples
Geologic Structures	3,000	2,000							
Main Dam & Cutoff	3,000	5,000							
Diversion Tunnels	2,000	2,800				3,500			
Underground Power Structures		5,000							
Power Intake & Tunnels		2,000							
Outlet Facilities		500							
Main & Emergency Spillways	5,000	4,700							
Cofferdams	4,000	1,200	1,000 (10)						
River Channel	10,000		1,000 (10)				100	5	
Watana Relict Channel	11,000		3,500 (12)	7,500 (45)			600	20	10
Fog Lakes Relict Channel	12,000		3,500 (10)	6,000 (40)			450	20	
Borrow D	3,000		1,500 (3)	1,000 (10)	20		400	20	10
Borrow C	2,500		2,000 (20)	500 (10)	10		100	10	10
Borrow I	2,500		1,500 (15)	500 (10)	10		100	5	
Rock Quarry	3,000	500							
Auxiliary Facilities	8,000								

APPENDIX A

LIST OF RESUMES

JAY M. ENGLAND

Job Title: Project Director

Location: Anchorage

Education: Graduate Study, Engineering Management, University of Alaska
B.S., Civil Engineering, Pennsylvania State University - 1959
B.A., Business Administration, Pennsylvania State University - 1953

Special Qualifications: As a Prinicipal Engineer for HLA, Mr. England has been responsible for senior project management and has authored or co-authored comprehensive geotechnical reports for hundreds of Alaska projects ranging from complex industrial facilities to remote village schools. During the Watana Dam project, Mr. England will serve as Project Director, responsible for contract review, budgetary control, and public hearings. Mr. England has 20 years of experience as a supervisor and manager of engineering projects, planning studies and construction projects. He established the Anchorage office of HLA in 1969, is a Vice President of the firm and serves as a director of the corporation.

Professional Registration: Civil Engineer - Alaska, Oregon
Land Surveyor - Alaska, Oregon

Parent Company: Harding Lawson Associates

Experience: Mr. England provides technical review and direction on most of the projects conducted by the Anchorage office and laboratory. Representative projects include:

Upper Mahoney Lake Hydroelectric Project, near Ketchikan, 1981 - Soil and geologic reconnaissance for lake tap, tunnel and power plant for U.S. Army Corps of Engineers, Alaska District.[1]

Oil and Gas Exploration Drilling Sites, 1977-Present, Various permafrost and non-permafrost locations in central and western Alaska, Brooks Range, Alaska Peninsula, Bering Sea and Beaufort Sea islands - Soil investigations, material site exploration, earthwork and foundation designs for well pads, Hercules airstrips, docks, water supply, camp sites, access roads for Chevron, Union, Amoco, Sohio and Exxon.[2]

Experience Continued:

Near Island Bridge and Connecting Roadways, Kodiak, 1982 - Feasibility study, geologic reconnaissance, investigation and foundation design for piers and abutments for a 1200-foot-long bridge for the State of Alaska, Department of Transportation and Public Facilities.[3]

Natural Gas Conditioning Facility, Prudhoe Bay, 1981 - Soil and foundation investigation and design for a major industrial complex including a plant site, flare area, camp, reservoir and water intake for Ralph M. Parsons Company.[4]

Material Site Investigations, North Slope Area between the Colville and Canning Rivers, 1977-Present - Airphoto interpretation, geologic reconnaissance, delineation drilling and sampling, laboratory testing, mining plan preparation for ARCO, Sohio, Exxon, Conoco and the North Slope Borough.

Monashka Creek Cam and Reservoir, Kodiak, Alaska, 1975 - Soil and geophysical investigation for proposed earthdam and borrow area for the City of Kodiak.[5]

References:

1 Mr. Harlan E. Moore, U.S. Army Corps of Engineers, Alaska District, P. O. Box 7002 Anchorage, Alaska 99510, (907) 276-4817.

2 Mr. Robert Potter, Sohio Construction Company, 100 Pine Street, San Francisco, California 94111, (415) 433-7971.

3 c/o Mr. Steven Kautz, EMPS-Sverdrup, 4111 Minnesota, Suite 3, Anchorage, Alaska 99503, (907) 274-4541.

4 Mr. Maurice S. Greenberg, The Ralph M. Parsons Company, 100 West Walnut, Pasadena, California 91124, (213) 440-3474.

5 c/o Mr. Pablo Chavez, International Engineering Company, 220 Montgomery Street, San Francisco, California 94105, (415) 544-1200.

DONALD E. BRUGGERS

Senior Engineer

Mr. Bruggers has six years experience in geotechnical engineering in Alaska. He has performed soil investigations with written geotechnical reports for various structures throughout the state. Mr. Bruggers is an experienced arctic engineer and has completed investigations on and offshore throughout Alaska. He is experienced in pile, slope, thermal, and structural computer analysis.

EDUCATION

M.S., Civil Engineering, Michigan State University - 1976
B.S., Civil Engineering, Michigan State University - 1974 (graduated with honors)

EXPERIENCE

1978 - present: Harding Lawson Associates
1976 - 1978: R & M Consultants, Inc.

REGISTRATION

Civil Engineer - Alaska

REPRESENTATIVE PROJECTS

Offshore Development Unit, Point Thomson, Beaufort Sea, Alaska - Project manager responsible for detailed geotechnical data gathering and analysis. Data used to develop preliminary design criteria for offshore island, pipelines and causeway for Exxon Company, U.S.A.

Five Island Sites, Beaufort Sea, Alaska - Field engineer during over-ice drilling investigation of five well pad sites. For Exxon Company U.S.A.

Waterflood Project, Prudhoe Bay, Alaska - Project Manager responsible for laboratory testing and engineering analysis of thermal regime, ice load resistance, sheet pile, and slope stability for ARCO.

USGS Geotechnical Investigation, Beaufort Sea, Alaska - Field engineer and office project manager responsible for laboratory testing program on both thawed and frozen soils, field data and laboratory test result compilation and report preparation for U.S. Geological Survey, Conservation Division.

Barrow Utility System, Barrow - Project Manager responsible for field investigations, engineering analysis, and review of laboratory test data of permafrost ice-rich soil for a buried utility system for the North Slope Borough.

Retained Fill Island - Project manager responsible for literature study of geologic and soil conditions in the Prudhoe Bay and Harrison Bay areas and development of recommendations for the conceptual design of retained gravel islands in deep water for members of the Alaska Oil and Gas Association.

Barrow High School, Barrow, Alaska - Directed field investigation and developed recommendations for a pile support structure in ice-rich permafrost soil interbedded with thawed zones for North Slope Borough.

Yukon River Bridge - Performed computer structural analysis using SAP 4 for a pier founded on both bedrock and piles for Alyeska Pipeline Company.

Richardson Highway Reconstruction and Realignment, Miles 35 to 40 - Project manager; soil and geologic reconnaissance, pavement design and laboratory testing for 5 miles of highway reconstruction for State of Alaska, Department of Transportation and Public Facilities.

Seward Highway Reconstruction, Ingram to Bertha Creek, near Girdwood - Project manager; required geologic reconnaissance, drilling and sampling, seismic refraction survey, and development of recommendations for road design and reconstruction for State of Alaska, Department of Transportation and Public Facilities.

Circle Hot Springs to Eagle Road Reconnaissance Study - Project manager responsible for terrain unit mapping, geologic reconnaissance for route selection and preliminary feasibility recommendations for State of Alaska, Department of Transporation and Public Facilities.

Latouche Island, Prince William Sound - Project manager; directed geophysical field investigation and developed recommendations for the conceptual design of a harbor facility for State of Alaska, Department of Transportation and Public Facilites.

Lake Otis Medical Center, Anchorage - Directed field investigation and assisted with report preparation for foundation analysis and recommendations. Investigation involved ground response analysis and pile foundation system. For a private source.

Kaktovik High School, Barter Island, Alaska - Performed field quality control of pile installation for high school and generator building in ice-rich permafrost soil for North Slope Borough.

Anchorage Telephone Utility Wire Center, Anchorage and Girdwood - Project manager, directed soil investigation and developed recommendations for three structures at each facility for Municipality of Anchorage.

Bragaw Street Extension, Anchorage - Project manager responsible for soil investigation and pavement design for State of Alaska, Department of Transportation and Public Facilities.

MEMBERSHIPS

American Society of Civil Engineers

PUBLICATIONS

"Design Variables Influencing Piles Driven in Permafrost," ASCE Cold Regions Specialty Conference, Anchorage, May 1978 (co-authored with B.E. Davison, and J. W. Rooney)

"Design and Permafrost Conditions in the Alaskan Beaufort Sea", OTC 3887, 1980 (co-authored with D. L. Miller)

"Underground Utilities in Barrow, Alaska," Third International Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May, 1982

DUANE L. MILLER

Job Title: Cold Regions Consultant

Location: Anchorage

Education: Graduate Study, Engineering Management, University of Alaska
M.S., Geological Engineering, University of California, Berkeley - 1968
B.S., Civil Engineering, University of California, Berkeley - 1967

Special Qualifications: Mr. Miller has gained the majority of his professional experience as a project geotechnical engineer in Alaska. He has special training and experience in arctic and marine engineering, seismology and soil-structure interaction under earthquake loading. Mr. Miller has several years' experience as a geotechnical engineer during design of high-rise structures in seismically active areas.

Professional Registration: Civil Engineer - Alaska, California, Hawaii, Guam

Parent Company: Harding Lawson Associates

Experience: Duck Island Development Unit, Beaufort Sea, Alaska, 1981 - Technical project manager responsible for direction of 40-man team conducting on and offshore geotechnical investigation and geophysical surveys. Data used to develop design criteria for offshore and onshore pipeline corridors, island and causeway construction and marine permafrost foundations for Exxon.[1]

Trans-Alaska Oil Pipeline, 1977 - Provided consultation during field design changes and review of design criteria for vertical support members for Department of Interior.[2]

West Dock, Prudhoe Bay, 1979 - Project manager during investigation for 5000-foot-long causeway. First major causeway and dock in the Alaskan Beaufort Sea for ARCO.

Kandik Basin Oil Exploration, Alaska, 1977 - Project manager responsible for remote site investigations and foundation design and construction for well pads on warm permafrost for Louisiana Land and Exploration Company.[3]

Experience Continued:

On-ice Drilling Program, Beaufort Sea, Alaska, 1979 - Project manager supervising 32-man crew gathering geotechnical data used to evaluate oil lease sale areas previous to the 1979 sale for U.S. Geological Survey.[4]

Modules and Flare Pad of Flow Station III, Prudhoe Bay, 1977 - Project manager for investigation and analysis for heavily loaded adfreeze pile design and thermal study for ARCO.

Federal Office Building, Anchorage, 1979 - Project manager conducting foundation investigation, seismicity evaluation and dynamic response analysis for the General Services Administration.

Public Health Service Hospital, Bethel, 1976 - Project engineer, supervision and analysis of sustained load tests of driven H piles in warm permafrost for U.S. Public Health Service.

Publications:

Miller, D.L. and Shearer, G.B., "Geotechnical Investigation, Beaufort Sea - 1979", ASME Energy Technology Conference, New Orleans, Louisiana, February, 1980.

Miller, D.L. and Bruggers, D.E., "Soil and Permafrost Conditions in the Alaskan Beaufort Sea", Offshore Technology Conference, Houston, Texas, May, 1980.

References:

1 Mr. R. R. Bowen, Exxon Company, U.S.A., Western Division, 1800 Avenue of the Stars, Los Angeles, California 90067, (213) 552-5400.

2 Mr. Ralph Isaccs, Northwest Alaska Pipeline Company, c/o Fluor, 3333 Michelson Drive, Irvine, California, (213) 975-3553.

3 Mr. Lawrence Davis, Louisiana Land and Exploration Company, 1500 Denver Club, Denver, Colorado 80202 (303) 623-5759.

4 Mr. Jerry Shearer, U.S. Geological Survey, Minerals Management Services, 800 "A" Street, Anchorage, Alaska 99501, (907) 271-4582.

RICHARD W. CHRISTENSEN

Job Title: Cold Regions Consultant

Location: Anchorage

Education: Ph.D., Civil Engineering, Michigan State University - 1964
M.S., Civil Engineering, Michigan State University - 1960
B.S., Civil Engineering, San Diego State College - 1958

Special Qualifications: Dr. Christensen has over 20 years of experience as a geotechnical engineer in the United States and abroad. He has performed and directed geotechnical investigations for commerical/industrial facilities and power plants. In addition, he has served as a technical expert on a variety of special problems including vibrating machine foundations, liquefaction analyses and investigation of failures.

Professional Registration: Civil Engineer - Minnesota, Wisconsin, North Dakota, Illinois

Parent Company: Harding Lawson Associates

Experience: Underground Utilidor System, Barrow, 1979-Present - Arctic soils investigation of problems installing steam, water, and sewere lines in permafrost for the North Slope Borough c/o Frank Moolin & Associates.[1]

Rehabilitation of Matanuska Levee, Palmer, 1981 - Project manager providing consultation and engineering analysis including flow nets, estimation of permeability coefficients and expected seepage quantities.[2]

Petrochemical Plant Sites, Missouri, 1975 - Provided engineering analysis of dynamic response spectra and liquefaction studies.

Excavation Project, Illinois, 1978 - Design and construction monitoring of excavation using an innovative shoring technique consisting of shotcrete facing and grouted tendons; design of grouted anchors in soil and rock; specifications for foundation grouting; design of foundations on swelling soils.

Experience Continued:

Studies for Nuclear Power Plants, Iran, Illinois, and Michigan, 1974-1975 - Project manager and/or technical consultant on nine power stations. Responsible for deep foundation analyses dynamic evaluation of soil parameters; liquefaction analysis; and site feasibility studies.

Several Large Scale Steel Facilities, indiana, 1974-1978 - Foundation analysis for multi-sotry blast furnace and bag house structures for U.S. Steel.

Hydro Investigation, Akutan, 1980 - Investigations for dam sites, penstock, and power plant.

Publications:

"Measurement of Surface Strain-RAte on Taku Glacier, Alaska," Journal of Glaciology, Vol. 5, No. 39, October 1964. (Co-authored with T. H. Wu).

"Analysis of Clay Deformation as a Rate Process," Journal of the Soil Mechanics and Foundation Engineering Division, ASCE, November, 1964. (Co-authored with T. H. Wu).

"Rheological Model Studies in Clay," Clays and Clay Minerals, Vol. 17, 1969. (Co-authored with J. S. Kim).

"Swelling Characteristics of Compacted, Expansive Soils," Clays and Clay Minerals, Vol. 19, 1979. (Co-authored with N. V. Nayak).

"Hydraulic Erosion of Remolded Cohesive Soils," Special Report 135, Highway Research Board, 1973. (co-authored with B. M. Das).

"Soil Mechanics and Foundation Engineering," Section III, Handbook of Environmental Civil Engineering, Van Nostrand Reinhold Co., 1975.

"Application of Decision Theory to Engineering Practice: A Case Study," Preprint 3785, ASCE Convention & Eposition, Atlanta, Ga., 1979.

"Siting, Design and Licensing Considerations for a Long-Term Dredged Spoil Disposal Facility - A Case History," Proceedings, Third Annual Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, September, 1980 (Co-authored with K. T. Dunn and J. C. Davies).

References:

1 Mr. Winston Zirjacks, Frank Moolin & Associates, 3300 "C" Street, Anchorage, Alaska 99503, (907) 276-7484.

2 Mr. David Black, Ott Water Engineers, 4790 Business Park Boulevard, Anchorage, Alaska 99503, (907) 277-8255.

LAWRENCE J. TOIMIL

Senior Geophysicist

Mr. Toimil is a specialist in marine geophysics and bottom sampling, primarily in Alaskan waters. He has managed large marine geophysical operations for HLA and for the U.S. Geological Survey. While with the USGS, he participated in numerous field geologic and geophysical investigations in the Beaufort and Chukchi Seas, Alaska and others off California and Mexico. He has peformed over-ice geological sampling and under-ice diving in Alaskan waters and has directed heavy equipment operations on the fast ice. He has extensive experience with seismic reflection and seismic refraction techniques, as well as with remote sensing and oceanographic methods.

EDUCATION

M.A., Natural Science (Marine Geology), California State University, San Jose - 1978
B.S., Oceanography, California State University, Humboldt - 1973

EXPERIENCE

1978 - present:	Harding-Lawson Associates
1972 - 1978:	U.S. Geological Survey, Pacific-Arctic Branch, Menlo Park, California (resigned as Co-investigator Geologist, Beaufort-Chukchi Sea Environmental Geologic Studies Program)

REPRESENTATIVE PROJECTS

Interpretation of Geological and Geophysical Data from Beaufort Sea, Alaska - Senior project geophysicist performing engineering analysis of data collected by HLA during U.S.G.S. prelease-sale investigations for Members of Alaska Oil and Gas Association.

Rock Habitat Investigation, Beaufort Sea, Alaska - Project manager during underwater investigation using a combination of engineering geophysical techniques and biological monitoring to assess the impact on biologic communities of island construction performed for Exxon Company, U.S.A.

Observation of Sediment Transport, Beaufort Sea, Alaska - Performed a diving program at BF-37 assess impact to biological communities following gravel placement for Exxon Company, U.S.A.

Duck Island Development, Beaufort Sea, Alaska - Manager of extensive geophysical survey program onshore and offshore for preliminary design criteria for Exxon Company, U.S.A.

Geotechnical Investigation, Harrison Bay, Alaska - Manager of geophysical studies and review for Lease Sale Area 71 study conducted for Members of Alaska Oil and Gas Association.

Over-ice Drilling Program, Beaufort Sea, Alaska - Project geologist on exploration program involving 20 borings 100 and 300 feet deep, up to 18 miles offshore, using the sea ice as a drilling platform. Purpose was to gather subsurface information for the preliminary design of petroleum-related offshore facilities for U.S. Geological Survey.

Waterflood Project, Prudhoe Bay - Senior project geophysicist responsible for offshore seismic refraction surveys and engineering analysis to determine depth to bonded permafrost along alternative alignments. Presented preliminary recommendations on dredging gravel island construction, thermal effects and pipe burial for ARCO.

Offshore Seismic Refraction Surveys, Prudhoe Bay Waterflood Project, Alaska for ARCO.

Geophysical Investigation for Sewage Disposal Facility near Barrow, Alaska for North Slope Borough.

Seismic Refraction Survey to Determine Depth to Permafrost in a Freshwater Lake near Prudhoe Bay for Ralph M. Parsons and ARCO.

Buried Gas Pipeline at Five River Crossings, East and Northcentral Alaska - Project manager for geophysical investigation, using seismic refraction and resistivity, and data interpretation to determine extent of permafrost and material types for Fluor and Northwest Alaska Pipeline Company.

PUBLICATIONS

Mr. Toimil has authored 18 publications since 1973.

CRAIG A. RODEICK

Senior Geophysicist

Mr. Rodeick has extensive experience in marine geology and geophysics in Alaskan waters. He spent six years with the U.S. Geological Survey participating in invesigative cruises in the Bering Sea, the Beaufort Sea, other areas of offshore Alaska, and off the Northern California continental shelf.

EDUCATION

M.S., Geology, California State University - 1975
B.A., Geology, California State University - 1971

EXPERIENCE

1979 - present:	Harding-Lawson Associates
1977 - 1979:	John Sharrah and Associates, California (geologist-/surveyor)
1974 - 1977:	Gulf Research and Development Company, Pennsylvania (geologist, performing onboard interpretation of geophysical data acquired by R/V Hollis Hedberg from western gulf of Alaska, Bering Sea, and offshore Oregon and Washington. Integrated seismic, gravity, magnetic and geochemical data into a preliminary report at the termination of each cruise.)
1974:	U.S. Geological Survey, Pacific-Arctic Branch of Marine Geology, California
1969 - 1974:	U.S. Geological Survey (advanced from physical science technician to geologist performing petrographic analyses of rocks dredged from eastern Beaufort Sea continental margin to characterize as possible petroleum source.)
1969:	Moss Landing Marine Laboratory (laboratory technician)
1966 - 1968:	U.S. Marine Corps, infantry corporal in Vietnam (Honorable Discharge)

REPRESENTATIVE PROJECTS

Duck Island gravel studies, Beaufort Sea, Alaska - Project geophysicist responsible for radar investigation and interpretation of data for island studies. Client: Exxon Company, U.S.A.

Reinterpretation of geotechnical data collected in Beaufort Sea and Norton Basin, Alaska - As principal geophysical investigator performed analysis of data. Client: Members of Alaska Oil & Gas Association.

Alaska gas conditioning facility, Prudhoe Bay - Project geophysicist; conducted subsurface investigation using ground penetrating radar in

permafrost for location of processing facility that will prepare gas for shipment through proposed pipeline. Client: Northwest Alaska Gas Company.

Kuparuk River crossing, Prudhoe Bay - Performed ground penetrating radar survey as project geophysicist.

Responsible for analysis and interpretation of data for location of vehicular bridges and pipeline crossings. Clients: Sohio Petroleum Company and Atlantic Richfield Company.

PUBLICATIONS

Preliminary interpretation of seismic profiles from the Prudhoe Bay area, Alaska, U.S. Geological Survey Open File Report 548, 1972 (co-author with E. Reimnitz and S. Wolf)

Influence of grounding ice on the arctic shelf of Alaska, Marine Geology, Vol. 13, pp. 323-334, 1972 (co-author with E. Reimnitz, P. Barnes and T. Forgatsch)

River overflow, strudel drainage and the effects on the arctic sea floor, (abstract), Trans. American Geophysical Union, Vol. 54, No. 11, p. 1122, 1973 (co-author with E. Reimnitz)

Strudel scour: A unique arctic marine geologic phenomenon, Journal Sed. Pet., Vol. 44, No. 2, pp. 409-420, 1974 (co-author with E. Reimnitz and S. C. Wolf)

Marine gravel deposits of the Beaufort Sea Shelf, in the Coast and Shelf of the Beaufort Sea, J. Reed and J. Sater (eds.), p. 511, 1974.

Blake Plateau Program Summary, Technical Memorandum 4277TF067, 147 pp., 1975, company restricted.

Central America Program Summary, Technical Memorandum 4277TF069, 137 pp., 1976, company restricted.

EDWARD J. TICKEN

Geophysicist

Mr. Ticken's work experience involves the geophysical interpretation of sparker, uniboom and high resolution seismic profiles and side-scan sonar records. In addition, he has operated laboratory equipment (including LECO, "Gibbs" settling tube and radiograph) and collected and analyzed beach profile data. He has also acted as party chief for bottom sampling and seismic profiling cruises.

EDUCATION

M.S., Marine Geology, California State University, Northridge, California - 1980
B.S., Geology, University of Pittsburgh, Pittsburgh, Pennsylvania - 1972

EXPERIENCE

1980 - present: Harding-Lawson Associates

1977 - 1979: Marine Geologist, California State University, Northridge Research Foundation (duties included geophysical interpretation and party chief of data collection cruises)

Contracts: Shell Oil Company - Site evaluation for offshore drilling platform, San Pedro Basin Margin, California; Dames and Moore - Evaluation of the offshore extension of the Santa Ynez fault, south branch; California State Department of Boating and Waterways (formerly Navigation and Ocean Development) - Offshore sand and gravel inventory, Pt. Conception to the Mexican border.

1976 - 1977: Field technician - Coastal Engineering Research Center Field Office, Port Hueneme, California, collect littoral environmental data

1972 - 1976: Oceanographic Research Division Officer - U.S. Navy. Responsible for collection and analysis of data, preparation of reports and the coordination of a division of 25 Oceanographic Technicians

REPRESENTATIVE PROJECTS

Seismic refraction survey to determine depth to rock, St. Helena, California. Client: Associated Geotechnical Engineers

Marine and land seismic refraction study to determine depth to rock for the proposed expansion of Priest Rapids and Wanapum Dams, Washington. Client: Bechtel Corporation

Marine subbottom acoustical profiling, side-scan sonar and magnetometer survey for sewer outfall study, City of Sausalito. Client: Geotechnical Consultants, Inc.

Marine subbotom acoustical profile interpretation study for Alpetco Tanker Terminal, Port Valdez, Alaska. Client: Santa Fe Technical Services Company

Marine subbottom acoustical profiling, feasibility study for oil pipeline, Admiralty Inlet, Puget Sound, Washington. Client: D. Russell Associates

Marine subbottom acoustical profiling and side-scan sonar survey for dock construction at Selby, California. Client: Robert Brown Engineers

MEMBERSHIPS

American Association of Petroleum Geologists

AWARDS

The Martin Van Couvering Award, 1979 (AAPG-SEPM-SEG Pacific Section)

PUBLICATIONS

Recognition of Active (Holocene) Faulting, Southern California Borderland (abs): GSA Abstracts with Programs, V. 11, No. 3, p. 78 (co-author with Peter J. Fischer and John Rudat)

Beta Platform Site Evaluation - Geophysical and Geotechnical Evaluations of Platform Site Areas on OCS Tracts 35-261 and 35-262 (for Shell Oil Company)

Deep Water Beta Platform Site Evaluation - Geophysical and Geotechnical Evaluations of Platform Site Areas on OCS Tracts 35-261 and 35-262 (for Shell Oil Company)

Beta Pipeline Route Evaluation - Geophysical and Geotechnical Evaluations of Platform Site Areas on OCS Tracts 35-261 and 35-262 (for Shell Oil Company)

A Geophysical and Geologic Evaluation of the Offshore Extension of the Santa Ynez fault, south branch (for Dames and Moore)

The Inner Margin of the Southern California Borderland: Quaternary Tectonics, Seismic Stratigraphy and Evolution (abs.): AAPG/SEPM Pacific Section, April 1980 (co-author with Peter J. Fischer and others)

STEVEN A. JOHNSON

Job Title: Field Manager

Location: Watana

Education: M.S., Engineering Geology, Purdue University - 1974
B.S., Geological Engineering, University of Alaska - 1973

Special Qualifications: Mr. Johnson brings eight years of Alaskan field experience to the Watana Dam project. For the past three years he has managed field operations for major on-ice, onland and over-water geotechnical and geophysical investigations. He has developed particular expertise in coordinating logistics for remote site locations, including surveyors, barge operators, helicopter and fixed wing support. Mr. Johnson is skilled at conducting complex investigations under extreme conditions using large crews.

Parent Company: Harding Lawson Associates

Experience: Over-Ice Drilling Investigations, Lease Sale Area 71, Harrison Bay, Alaska, 1982 - Field project manager during pre-lease sale studies responsible for coordinating, planning and logistics for two concurrent operations including 36-man crew and two Rolligon-mounted, enclosed drill rigs that collected over 90 core samples to depths of 150 feet below mud line, using the ice as a drill platform. Responsible for ice safety reconnaissance. One investigation performed for a major oil company and one for Members of Alaska Oil and Gas Association.[1]

Duck Island Development Area, Beaufort Sea, Alaska, 1981 - Field project manager of drilling operations onshore and offshore. Responsible for complete rigging of drill barge. Supervised 15-man crew during investigation for first major offshore production wells in Beaufort Sea. Data used to develop preliminary foundation design criteria for offshore islands, buried pipelines, causeway and onshore facilities for Exxon[2].

Port of Nome Over-Ice Investigation, Nome, Alaska, 1981 - Field project manager supervising helicopter-supported, over-ice drilling operations. Drilled over 20 test holes on and offshore to bedrock and conducted rock core sampling for the City of Nome.[3]

Experience Continued:

Bethel Area Feasibility Study, Alaska, 1982 - As a geologic consultant, provided field reconnaissance support during field review of five potential hydroelectric sites on the Kisaralik and Kipchuck rivers for Alaska Power Authority[4].

Waterflood Project, Prudhoe Bay, Alaska, 1981 - Field project manager during offshore soil investigation to provide data for construction of offshore island, pipelines and dredged channels for Prudhoe Bay Joint Operating Group.

Bethel to Napakiak Road, Bethel, 1981 - Project manager responsible for library search, air photo interpretation and field analysis for preliminary design of west terminus of road for State of Alaska Department of Transportation and Public Facilities.

Soil Boring Programs, Trans-Alaskan Pipeline Route, 1976 - Supervised numerous construction mode confirmation soil boring programs. Responsibilities included coordinating field phases of programs and insuring proper sampling techniques were observed in a wide range of frozen and thawed soils for Alyeska Pipeline Service Company.

Coal Exploration Study, Beluga Basin, Alaska, 1975 - Performed preliminary field survey (coordinating helicopter support) for large scale exploratory program. Wrote geological hydrology sections of environmental impact statement for Shell Oil Company.

Offshore Drilling, Beaufort Sea, Alaska, 1974 - Participated in conception and design of artifical ice island for offshore drilling program. Duties included obtaining and analyzing subsea soil strength data and working with project engineer to develop design parameters for Mobil Oil Corporation.

Generating Facility, Beluga Area, Alaska, 1974 - Geotechnical investigation and design of foundation for new generating facility in Beluga area. Supervised analysis of soil borings and final report preparation for Chugach Electric.

References:

1 Mr. Grant Thompson, Mobil Oil Corporation, Research and Development, P. O. box 900 (FRL), Dallas, Texas 75221, (214) 333-6335.

2 Mr. R. R. Bowen, Exxon Company, U.S.A., Western Division, 1800 Avenue of the Stars, Los Angeles, California 90067, (213) 552-5685.

3 City of Nome, c/o Mr. Michael G. Horton, TAMS Engineers, 1305 Fifth Avenue, Suite 3320, Seattle, Washington 98101, (206) 624-3532.

4 Alaska Power Authority, c/o Mr. Paul Ford, Harza Engineering Company, 203 West 15th Avenue, Suite 204, Anchorage, Alaska 99501, (907) 278-4415.

DALE N. SPANOGLE

Job Title: Drilling Superintendent

Location: Watana

Special Qualifications: Mr. Spanogle has nearly 30 years of experience as a driller and superintendent in Alaska. He is responsible for the supervision of drilling crews and maintenance of drilling equipment for Harding Lawson Associates' Alaskan operations. Mr. Spanogle is experienced with permafrost drilling, refrigerated coring, soil sampling, hard rock mineral exploration, dam foundation drilling and testing, offshore operations and helicopter drilling operations at remote sites. Mr. Spanogle first performed coring on the Susitna River project in 1957 for the U.S. Bureau of Reclamation. Between 1962-1969 Mr. Spanogle was employed by the State of Alaska, Department of Highways and performed drilling operations throughout the State.

Parent Company: Harding Lawson Associates

Experience: Drilling Operations for Hydroelectric Development, Susitna River, Alaska, 1957-1960 - Performed core drilling, soil sampling and water testing in overburden to bedrock at the Devil's Canyon and Denali Dam sites in the summer months and at Vee Canyon over-ice in the winter while employed by the U.S. Bureau of Reclamation.

Duck Island Development, Beaufort Sea, Alaska, 1981 - Superintendent of barge-mounted drilling operations. Drilling program lasted 30 days over water; supervised two crews on 24-hour basis. Duties included trouble-shooting drill problems and maintaining equipment. Equipment reliability was 100 percent throughout drilling operations for Exxon Company, U.S.A.[1]

Kandik Basin Exploration, Brooks Range, Alaska, 1979 - Geologic coring investigations for mineral and oil exploration for Lousiana Land Exploration.[2]

Kenai Products Dock, 1977 - Used a Failing 1500 to drill five holes to over 100 feet below mudline in 80 to 100 feet of water with severe tidal conditions for Phillips Petroleum.

Port of Anchorage, 1975-1977 - Used B-61 equipment under severe tidal conditions (32 feet). In 1975 drilled four holes and in 1977 drilled three holes, some of which were 250 feet deep. The 250-foot boring was completed in 18-1/2 hours drilling time for Municipality of Anchorage.

References:

1 Mr. R. R. Bowen, Exxon Company, U.S.A., Western Division, 1800 Avenue of the Stars, Los Angeles, California 90067, (213) 552-5685.

2 Mr. Lawrence Davis, Louisiana Land and Exploration, 1675 Broadway, Suite 2100, Denver, Colorado 80202, (303) 623-5759.

JOHN R. CHAMBERS

Job Title: Operations Coordinator

Location: Anchorage

Education: Graduate Study, Engineering/Science Management, Univ. of Alaska
B.T., Civil Engineering, Oregon Institute of Technology - 1975
A.E., Highway Engineering Technology, Oregon Tech. Institute - 1967
U.S. Army Topographic Survey School, distinguished graduate - 1969

Special Qualifications: Mr. Chambers manages logistics support preparations in the Anchorage office and laboratory. He has supervised many field investigations and performs office engineering relative to Alaska geotechnical studies.

Parent Company: Harding Lawson Associates

Experience: Housing Projects, Kotzebue, Bethel, and Dillingham, 1977-Present - Project manager; foundation investigations and designs in marginal and sporadic permafrost conditions; performed for various regional housing authorities.[1]

Foundation Investigations and Design, McGrath and Aniak, 1977-Present - Project manager for studies in permafrost and unfrozen soil conditions for variety of school districts.[2]

Reconnaissance Investigations, National Petroleum Reserve, Alaska, 1970 - Project manager of study providing consulting services and laboratory testing for Husky Oil Company.

Foundation Systems, Barrow, Nome and Unalaska, Alaska, 1977-1980 - Inspection and instrumentation for foundation systems for Barrow High School, Northwest Community College buildings, and Dutch Harbor Dock Facility.

Native Village Land Selection Surveys, Mid Yukon Area, Alaska, 1977 - Used airborne control method with auto-tape systems. Party chief responsible for project planning, logistics, survey techniques, equipment and personnel needs. Supervised three professionals and seven to ten technicians and aides, and coordinated efforts of 16-man survey party, conducted final review of required computations and field note preparation.

References:

1 Mr. Hernan Amaya, Design Lab, Inc., 625 West Fifth Avenue, Anchorage, Alaska 99501, (907) 276-5254.

2 Mr. Marlin Knight, Kodiak Island Housing Authority, P. O. Box 197, Kodiak, Alaska 99615, (907) 486-5721.

J. DAVID HOBBS

Job Title: Laboratory Manager

Location: Anchorage

Education: University of Florida, 1977 - 1980

Special Qualifications: Mr. Hobbs has eight years of laboratory testing experience and is responsible for the day-to-day management of testing activities in Harding Lawson Associates' Anchorage laboratory. Under the direction of senior engineers at HLA, Mr. Hobbs supervises the laboratory technicians performing classification testing (moisture, density, compaction, grain size analysis, Atterberg limits), and performs triaxial shear strength and consolidation tests on frozen and unfrozen soils. He performs quality control review of data obtained from the technicians under his supervision and coordinates testing programs with staff engineers and geologists.

Parent Company: Harding Lawson Associates

Experience: Mr. Hobbs has provided laboratory support for most of HLAs' projects since he joined the firm, with particular emphasis on frozen soil testing of onshore and offshore samples.

Duck Island Development Unit, Beaufort Sea, Alaska, 1981 - Testing of frozen soil samples for triaxial compression, strength testing, and classification testing. Data were used to establish preliminary design criteria for offshore gravel islands, pipelines and causeways for Exxon Company, U.S.A.[1]

Gas Conditioning Facility, Prudhoe Bay, 1981 - Laboratory testing included shear strength in triaxial compression for both quick and long-term creep for design of facility which will condition gas for shipment through the proposed gas pipeline for Northwest Alaskan Pipeline Company and four major petroleum companies.[2]

Waterflood Project, Prudhoe Bay, 1980 - Extensive laboratory program included frozen strength, thaw consolidation, thermal conductivity, triaxial compression and classification testing for major water injection development. Performed for Prudhoe Bay Joint Operating Unit.[3]

References:

1 Mr. R. R. Bowen, Exxon Company, U.S.A., Western Division, 1800 Avenue of the Stars, Los Angeles, California 90067, (213) 552-5685.

2 Mr. Maurice S. Greenberg, c/o The Ralph M. Parsons Company, 100 West Walnut Street, Pasadena, California 91124, (213) 440-3474.

3 Mr. John K. Deavenport, Arco Oil and Gas Company, Prudhoe Waterflood Project, P. O. Box 7232, San Francisco, California 94120, (415) 768-5194.

WILLIAM J. HENRICH

Geophysicist

Mr. Henrich is experienced in geophysical exploration and engineering technology. He has worked on hydrologic, geothermal, and engineering projects and is particularly capable in performing seismic refraction, cross-hole, uphole, and downhole surveys. He is experienced in FORTRAN and BASIC computer languages and computer graphics packages.

EDUCATION

M.S. Geology - Idaho State University, Pocatello, Idaho, 1979
B.A. Economics - LaSalle College, Philadelphia, Pennsylvania, 1976

EXPERIENCE

1979 - present:	Harding Lawson Associates
1979:	Idaho State University, Pocatello, Computer Center, Computer Programmer and Consultant
1978: (4 months)	Bechtel, Inc., San Francisco, California Engineering Geologist
1977: (3 months)	Bechtel, Inc., San Francisco, California Student Engineer

REPRESENTATIVE PROJECTS

Conducted electric and gamma logging program to define suitable aquifer zones for hot water storage as part of a hydrologic resource project, Bethel, Alaska. Client: TRW

Performed field survey over geothermal site in Beowawe, Nevada and, as part of self-potential survey, investigated changes in the potential field resulting from varying steam production rates. Client: Chevron Resources

Determined bedrock depths and rock velocities along a proposed tunnel alignment for seismic refraction and uphole survey, Sultan, Washington. Client: Bechtel, Inc.

Determined elastic moduli over a low-level radiation disposal site as part of a downhole/cross-hole survey at Browns Ferry Nuclear Reactor, Huntsville, Alabama. Client: Tennessee Valley Authority

PUBLICATIONS

1979. Gravity survey of northern Marsh Valley. M.S. thesis, Idaho State University.

APPENDIX B

LABORATORY FORMS

Harding Lawson Associates

Transmittal/Memorandum

To:

From:
Date:
Subject:
Job No.:

Remarks:

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cc:

HARDING—LAWSON ASSOCIATES

EMPLOYEE NO.: (1 2 3 4 5) | NAME | WEEK ENDING: (55 56 57 58 59 60)

C. C.	JOB NUMBER (7 8 9 10 11 12 13 14 15 16)	HOURS S	S	M	T	W	T	F	TOTAL	CODE	JOB NAME	VEN.	AUTH. COMP. TIME	ACCOUNTING USE ONLY: W C (17)	AC C (18 19)	HOURS (20 21 22 23)	NON STD RATE (24 25 26 27 28)
											← TOTAL CHARGEABLE TIME — TOTAL →						

1. CHARGEABLE
2. P.W.
3. HOLIDAY
4. VACATION
5. SICK
6. COMP TIME
7. MARKETING
8. OTHER

01 ENGINEERS
02 GEOPHYSIC
03 GEOLOGY
04 LAB
05 DRAFTING
06 VEHICLES
07 OTHER EQUIP.
08 DRILLING
09 CONT'T LABOR
10 P.W. POSTED
19 OTHER
20 RECOVS.

NOTES:

REGULAR HOURS:__________

OVERTIME HOURS:__________

TOTAL HOURS:__________

PROSPECTIVE WORK AND MARKETING (DESCRIBE) — VEN.

PW	–	
PW	–	
PW	–	
PW	–	
		← TOTAL PROSPECTIVE WORK TIME
M	–	
M	–	
M	–	
M	–	
		← TOTAL MARKETING TIME

NON-CHARGEABLE TIME (EXPLAIN)

APPROVED: __________

← TOTAL NON-CHARGEABLE TIME

← TOTAL HOURS — TOTAL COMP. →

ACCOUNTING USE ONLY

HOURS WORKED (29 30 31 32)	HOURS PAID (33 34 35 36)	TIME + ½ (37 38 39 40)	TIME × 2 (41 42 43 44)

CODES: C = CONSULTATION CT = COMPENSATING TIME OFF D = DRAFTING FC = FIELD CONTROL FI = FIELD INVESTIGATION GL = GEOLOGY M = MARKETING GP = GEOPHYSICS H = HOLIDAY L = LABORATORY
P = PROJECT MANAGEMENT & OFFICE ENGINEERING R = CLERICAL SK = SICK V = VACATION DF = DRILL FOREMAN DR = DRILLER DH = DRILLER HELPER T = TECHNICIAN LP = LABORATORY POST

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SHIFT REPORT

SHIFT ___ PROJECT DAY _____

DATE _____ FOREMAN _____

SHIFT PERSONNEL: _____ _____ _____

WORK PERFORMED: _____

_____

SAMPLES SHIPPED: _____

VISITORS: _____

REMARKS & FOLLOWUP FOR NEXT SHIFT: _____

Sheet ____ of ____

Project: ____ Job No: ____

Subject: **LABORATORY TEST REQUEST** Date: ____

Description of Project: ____ By: ____

Approved: ____

Water Level: ____ Need Results By: ____ Received: ____

BOR.	DEPTH	TEST NAME	DATE EXTRUDED	SET UP IN PROGRESS	TEST COMPLETED	CALCU-LATED	INVOICE DATE	INSTRUCTIONS REMARKS

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SH PF
RECEI\

FROM: Location ____________________

Project Name ____________________ Project No. ______

Date Shipped ____________________ Date Received ______

Shipped by ____________________

TEST HOLE SAMPLE NUMBER	DATE SAMPLED	SAMPLE INTERVAL	SHIPPING CONTAINER NUMBER OF TOTAL	SAMPLE METHOD	FROZEN	THAWED	POLY WRAPPED CORE	SMALL SAMPLE BAG	BRASS LINER	MOISTURE TIN	LARGE SAMPLE BAG	SHELBY TUBE	INADEQUATE FOR CLASSIFICATION	BEDROCK SAMPLE				
			/															
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Remarks: (carrier, shipping route, etc.) ____________________

Party Number ______

ORIGINAL
(TO BE PACKED w/ SAMPLES FOR SHIPMENT)

Sample Designation	Soil Class		Classification Tests													Secondary Tests								Geologic and Other Tests
BORING NO. and DEPTH(ft)	USCS		SOIL GRADATION (%)			ORGANIC CONTENT (%)	ATTERBERG LIMITS			γ_d (pcf)	w_o (%)	G_s	ELEC COND	FP (°C)	PORE WATER CHEM	THERM COND	LAB VANE (psf)	SENSI-TIVITY	TXUU (psf)	TXCU	TXCD	DSCD	CONSOL	THAW-CONSOL (%)	
				#40 to 200	-200		LL	PL	PI																

NOTE: Refer to Plate for definition of symbols and abbreviations.

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Laboratory Test Summary

PLATE

DRAWN | JOB NUMBER | APPROVED | DATE | REVISED | DATE

SIEVE SIZE	Cum. Weight	% Retained	GRADATION	% PASS. TOTAL	Specs.
4"					
3"					
2"					
1 1/2"					
1"					
3/4"					
1/2"					
3/8"					
#4			A X		
Pan					
Total					

	B % Pass.	A x B
4		
8		
10		
16		
20		
30		
40		
50		
60		
80		
100		
200		
Total		

OVERSIZE		
Wt.-		
Wt.+		
Total		
%+		

X x Y PLUS A x B

	Y % PASS.	X x Y
4		
8		
10		
16		
20		
30		
40		
50		
60		
80		
100		
200		
Total		

0.02 mm | 0.005mm

Project Name:

Project No:

Date In: Out:

Field No:

Boring No:

Sample No:

Depth:

Material:

SPECIFIC GRAVITY

	Fine T-84		LeChatelier	
A	Oven Dry Weight		Flask Reading	
V	Volume of Flask	500	Apparent Sp. Gr.	
	Total Weight			
	Weight of Flask		Coarse T-85	
	Wt. of Soil (S.S.D.)	500	A Oven Dry Wt.	
	Wt. of Soil & Flask		B S.S.D. Weight	
W	Wt. or Vol. H_2O		C Weight in H_2O	
	Bulk $\frac{A}{V-W}$		Bulk $\frac{A}{B-C}$	
	S.S.D. $\frac{500}{V-W}$		S.S.D. $\frac{B}{B-C}$	
	App. $\frac{(V-W)-(500-A)}{A}$		App. $\frac{A}{A-C}$	

ABSORPTION

S.S.D. Weight	500	S.S.D. Weight	
Oven Dry Weight		Oven Dry Weight	
Weight of H_2O		Weight of H_2O	
% of H_2O		% of H_2O	

SAMPLE TYPE:

- Preconstruction
- Information
- Quality
- Field Control
- Check
- Progress Record
- Final Record
- Other

CLASSIFICATIO

AASHO	
Unified	
FSV	

DELETERIOUS MATERIAL

	Weight Before	Weight After	Diff.	% Del.	Specs.
Organic Content					
Soft Particals					
Sticks & Roots					
Coal & Lignite					
Clay Lumps					
-# 200					
Total Deleterious					
% Elongation					
Organic Impurities Parts Per Million					
Fineness Modulus					

FRACTURE COL

Total Weight	
Fractured Weight	
% Fractured	
Specification	

ATTERBERG LIMITS

				M.C.
Can Number				
Number of Blows				
Wt. of Wet Soil & Tare				
Wt. of Dry Soil & Tare				
Weight of H_2O				
Weight of Tare				
Weight of Dry Soil				
% Moisture				

P.I. L.L. P.L.

DENSITY TEST

Wet Wt. Soil & Ring	
Wt. of Ring	
Wet Wt. of Soil	
Vol. of Ring & Soil	
Vol. of Ring	
Vol. of Soil	
Natural Wet Density	
Natural H_2O Content	
Natural Dry Density	

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SOIL INDEX PROPERTY DETERMINATION

(1)

Party No.	Boring No.	Sample No.	Top Depth	Bottom Depth

Lab. No.:

✓		Date	By
	Jar Sample		
	Pocket Pen't.		
	Sieve		
	Hydrometer		
	Sp. GR.		
	LL, PI.		
	Density		
	Water Content		
	Organic		
	Classification		
	Thaw Consol.		
	Permeability		
	Triaxial		

(2) GRADATION:

Total Wt.

Sieve size	cum. weight	% Retained	% Pass.
1"			
3/4".			
1/2"			
3/8"			
4			
10			
40			
200			

(3) HYDROMETERS:

Hydrom. No.	Time	Temperature	Reading

(4) HYDROMETER SAMPLE WT.

(5) SPECIFIC GRAVITY

(6) LIQUID LIMIT:

Wet. Wt.	Dry Wt.	No. Blow	Tare Wt.

(7) PLASTIC LIMIT:

Wet. Wt.	Dry Wt.	Tare Wt.

(8) NATURAL DENSITY:

Wt. in air	gm	
Wt. w/paraffin	gm	
Wt. in water	gm	
Wet density	pcf	
Water content	%	
Dry density	pcf	

(9) NATURAL WATER CONTENT

Wet soil & tare	gm	
Dry soil & tare	gm	
Wt. of tare	gm	
Wt. of H_2O	gm	
Wt. of dry soil	gm	
% Moisture		

(10) ORGANIC CONTENT:

Wt. unburned	
Wt. burned	
Tare	

(11) CODE FOR ICE CLASSIF.

(12) CODE FOR ORGANIC PEAT

(13) LIQUID LIMIT IND.

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HARDING ASSOCIATES

WORK SHEET — CONSOLIDATION TEST

Project:		Job No.	Date / /
Hole No.	Sample No.	Depth	Apparatus No.

Diameter	Area	Initial Height	Volume	Specific Gravity
D=2.43in=6.17cm	A= 29.92 cm2	2H= 0.80 in.	V = cm3	G =

WEIGHTS and MOISTURE CONTENTS

ITEM	BEFORE TEST		AFTER TEST			
	Specimen	Moisture Sample	Specimen Portion	Washed Portion	Total	
Container No.						
Moist Soil & Container, gms.						
Dry Soil & Container, gms.						
Loss of Water, gms.						
Container Weight, gms.						
Weight of Dry Soil, gms.						=W_s
Weight of Moist Soil, gms.						
Moisture Content, % = w						

Height of Solids: $2H_o = \frac{W_s}{G \times A} \times \frac{1}{2.54} = \frac{\quad}{\times 29.92} \times \frac{1}{2.54} =$ in., $\frac{1}{2H_o} =$

Initial Unit Weight: $\gamma_o = \frac{W_s \times 62.4}{(\text{Volume} =)} = \frac{(W_s = \quad)}{} \times 1.027 =$ lbs./cu.ft.

Maximum Density, lbs./cu.ft. — | Initial Density, % Maximum Density:

COMPUTATIONS and RESULTS

Starting Date	Starting Hour	Load lb/sq.ft	Corrected Dial in.x10-4	Loading Final 2H inches	Loading Final e		Corrected Dial in.x10-4	Rebound Final 2H inches	Rebound Final e
		0	.1000	.8000					
		100							
		200							
		400							
		800							
		1600							
		3200							
		6400							
		12800							
		25600							

Degree of Saturation $\frac{G \times w}{e}$ | Before Test ——— = % | After Test ——— = %

Description of Sample:

Formula: Final $e = \frac{2H - 2H_o}{2H_o} = \left(2H \times \frac{1}{2H_o}\right) - 1$

Tested by:
Computed by:
Checked by:

LF-24

TIME-CONSOLIDATION DATA

Sheet ____ of ____

JOB _____ JOB NO. _____ BY _____ DATE _____

BOR. _____ DEPTH _____ UNIT NO. _____ TIME RATES _____

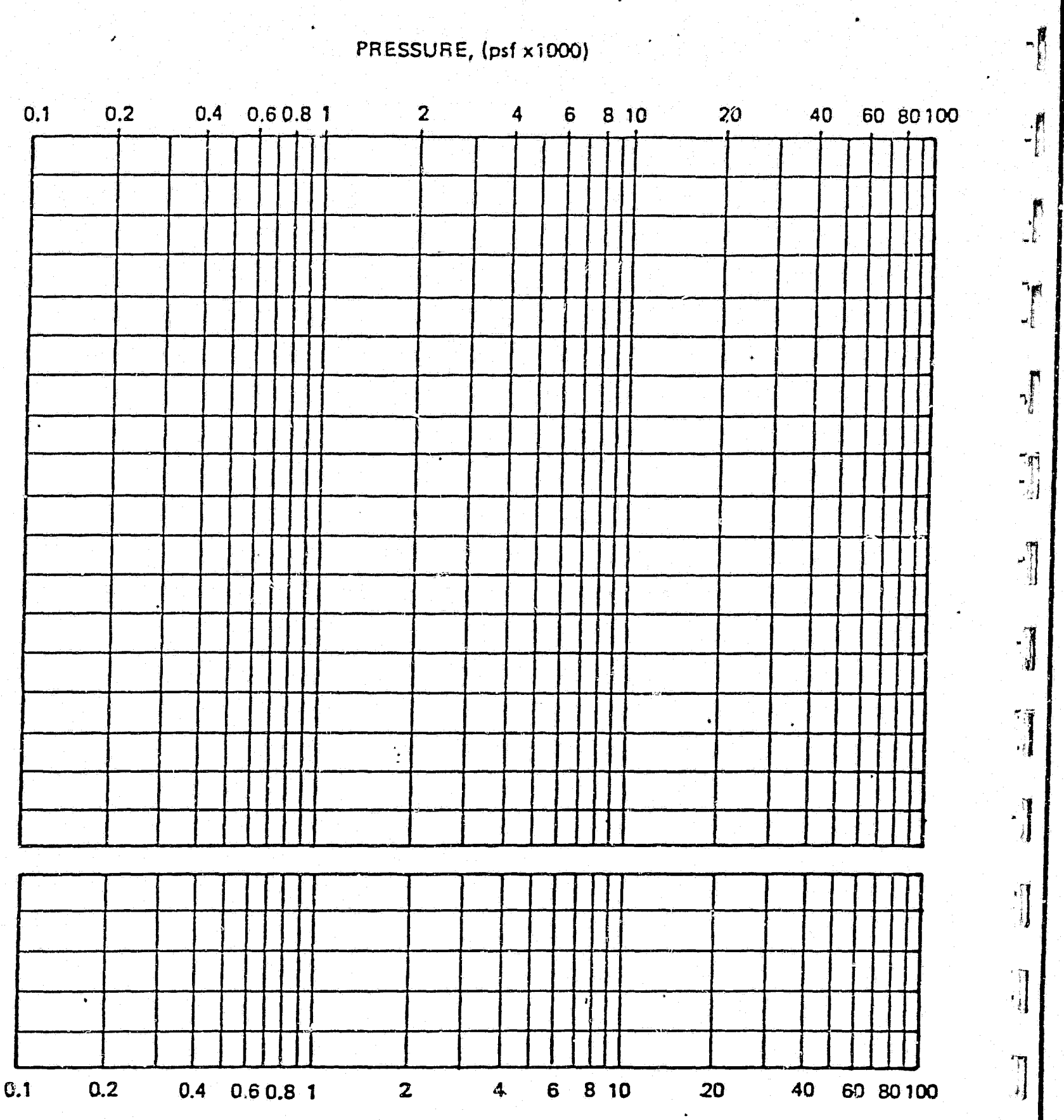
Date & Pressure / /	Time	Elapsed Time Min.	Dial Rdg 10^{-4}	Deformation 10^{-4} in.	Date & Pressure / /	Time	Elapsed Time Min.	Dial Rdg 10^{-4}	Deformation 10^{-4} in.

Remarks: _____

Tested by: _____

Computed by: _____

Checked by: _____



TYPE OF SPECIMEN			BEFORE TEST				AFTER TEST	
DIAMETER(in)	HEIGHT(in.)		MOISTURE CONTENT	w_o	%	w_f		%
OVERBURDEN PRESS., σ_{vo}'		psf	VOID RATIO	e_o		e_f		
PRECONSOL PRESS.,(σ_{vo}') max		psf	SATURATION	S_o	%	S_f		%
COMPRESSION INDEX,C_c			DRY DENSITY	γ_d	pcf	γ_d		
LL	PL		PI		G_s			
CLASSIFICATION			SOURCE					

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Consolidation Test Report

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE

HARDING-LAWSON ASSOCIATES

Engineers, Geologists and Geophysicists

WORK SHEET — TRIAXIAL SHEAR

Job:		Job No.	Date
Hole No.	Sample Dia.	Depth	Unit No.
Description of Sample and Remarks:			Specific Gravity, G
			+No. 4 / -No. 4
Back Pressure Saturated w/ PJS			

WEIGHTS AND WATER CONTENTS

Formula: Water Content, $w = \frac{W_w}{W_s} \times 100$

		Initial Test		Before Shear			After Shear			
Tare No.										
Weighs in lbs. grams	Tare + Wet Soil									
	Tare + Dry Soil									
	Water W_w									
	Tare									
	Wet Soil									
	Dry Soil W_s							+	=	
Water Content, % w										

DIMENSIONS

	Areas in sq. cm.							Height	in	cm.
	Top	Middle	Bottom	Avg.	Membrane Thick.	Membrane Corr.	A, Net Area			
Before Test								h_o =	=	
After Evacuation										
After Saturation								h =	=	
After Consolidation										

SATURATION DATA

Date & Time	Specimen Pressures Ext. psi	Interior, psi Top	Interior, psi Bottom	Int. Burettes Top cc	Int. Burettes Bottom cc	Sat. Tubes Top cc	Sat. Tubes Bottom cc	Quan. of Flow cc	Ext. Burette cc

V_o =

=

A =

=

=

CONSOLIDATION DATA

Chamber Pressure, σ_{CH}	psi	0						Sketch of Specimen
Back Pressure	psi	0						
Date								
Hour								
Strain Dial Reading	in.	.200						
Interior Burette,	cc.							
Exterior	cc.							
Volume of Specimen, V= AxH	cc.							
Volume of Solids, $V_s = W_s \div G$	cc.							
Volume of Voids, $V_v = V - V_s$	cc.							
Void Ratio, $e = V_v \div V_s$								
Dry Density, $\gamma_d = 62.4\ W_s \div V$,	lbs/ft^3							
Saturation, $S = V_w \div V_v \times 100$,	%							

ARDING-LAWSON ASSOCIATES LABORATORY STRENGTH TESTS ☐ UNCONFINED ☐ TRIAXIAL

JOB: ______________________ NO. __________ DATE __________ BY: __________

SOIL: ______________________ DIA. __________ BCR. __________ DEPTH __________

Cup + W Soil		Tube + W Soil	
Cup + D Soil		Tube	
Moist. Loss		Wet Soil	
Cup No.		Ht ___ Factor	
Dry Soil		Wet Density	
Moist. Content	%	Dry Density	

Strain - ϵ	%	%	%	%	%
σ (psi)					
Load Dial					
τ Factor					
τ (psf)					
σ_3 (psf)					
Center (psf)					

PR.NO. ___ 10 20 30 40 50 60

25 50 75 100 125 150

50 100 150 200 250 300

DEFLN	LOAD
00	MAX.-
02	
04	
06	
08	
10	
12	
14	
16	
18	
20	
22	
24	
26	
28	
30	
32	
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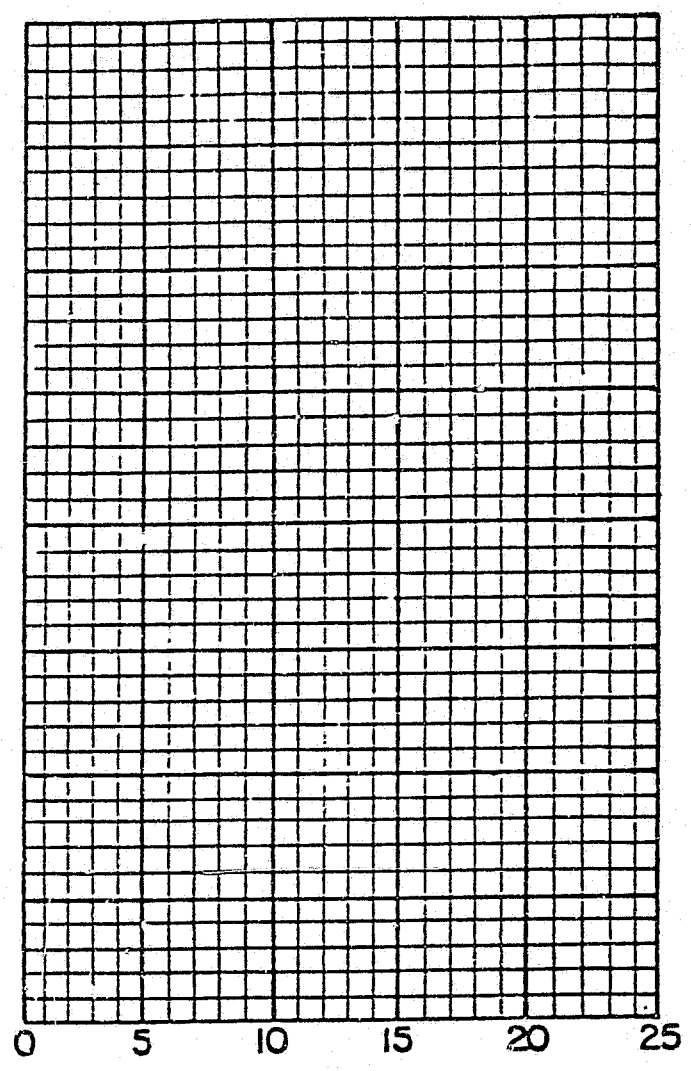
FAILURE SKETCH



DIAMETER (in): _____

HEIGHT (in): _____

MOISTURE CONTENT (%): _____

DRY DENSITY (pcf): _____

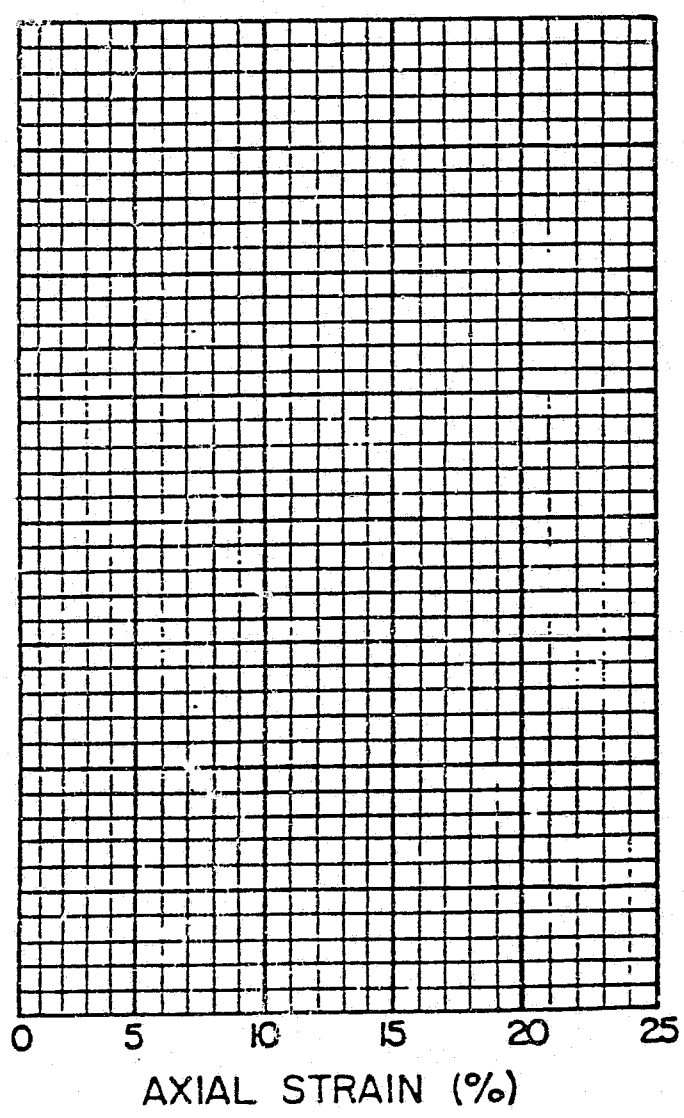
CELL PRESSURE (psf): _____

SHEAR STRENGTH (psf): _____

SAMPLE SOURCE: _____

CLASSIFICATION: _____

_____



DIAMETER (in): _____

HEIGHT (in): _____

MOISTURE CONTENT (%): _____

DRY DENSITY (pcf): _____

CELL PRESSURE (psf): _____

SHEAR STRENGTH (psf): _____

SAMPLE SOURCE: _____

CLASSIFICATION: _____

_____

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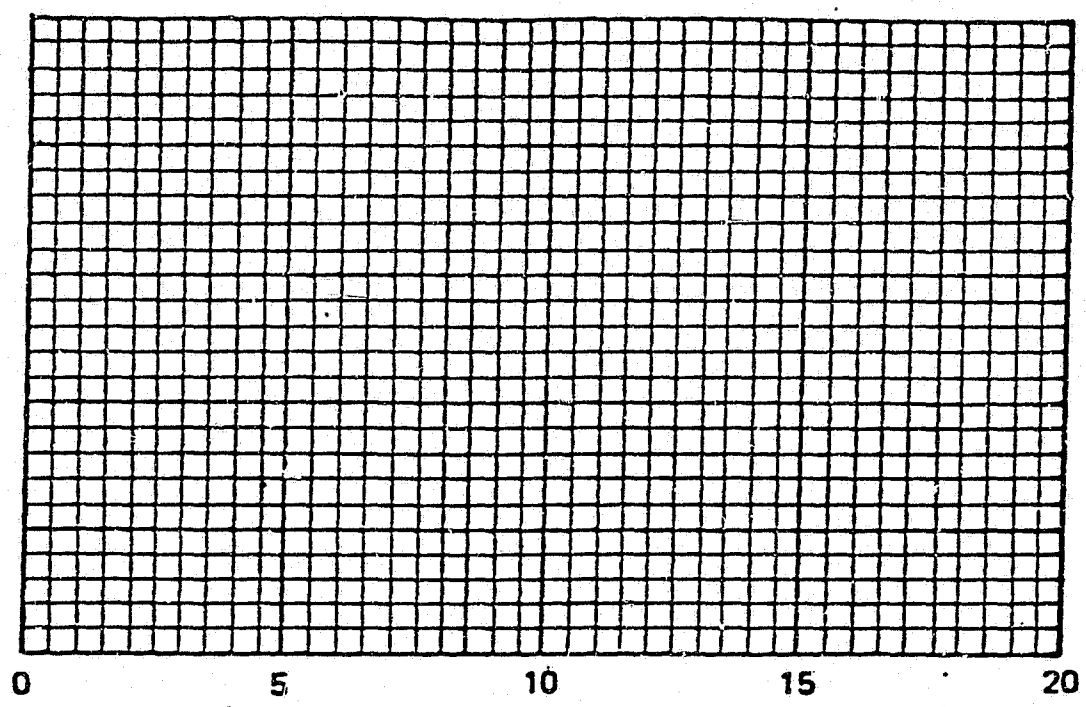
Unconsolidated-Undrained Triaxial Compression Test Report

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE

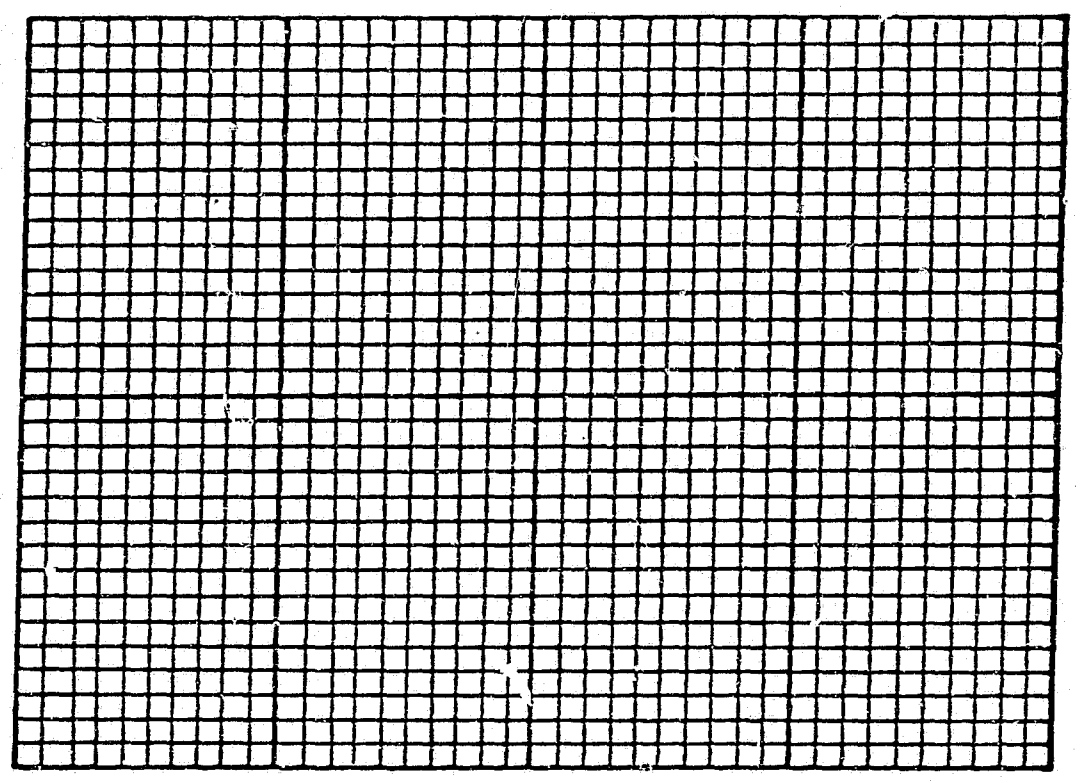
NORMALIZED DEVIATOR STRESS
$[(\sigma_1'-\sigma_3')/\sigma_c'],(\bullet)$



AXIAL STRAIN (%)

EFFECTIVE PRINCIPLE STRESS RATIO
$(\sigma_1'/\sigma_3'),(O)$

NORMALIZED PORE PRESSURE
$(\Delta u/\sigma_c'),(\bullet)$



AXIAL STRAIN (%)

PORE PRESSURE PARAMETER A
$\left(\frac{\Delta u-\Delta\sigma_3}{\Delta\sigma_1-\Delta\sigma_3}\right),(O)$

TYPE OF SPECIMEN			BEFORE TEST			AFTER TEST	
DIAMETER(in.)	HEIGHT(in)		MOISTURE CONTENT	w_o		w_f	
OVERBURDEN PRESS., σ_{vo}'		psf	VOID RATIO	e_o		e_f	
CONSOLIDATION PRESS.,) σ_c'		psf	SATURATION	S_o		S_f	
STRAIN RATE		%/min	DRY DENSITY	γ_d		γ_d	pcf
LL	PL		PI		G_s		
CLASSIFICATION			SOURCE				

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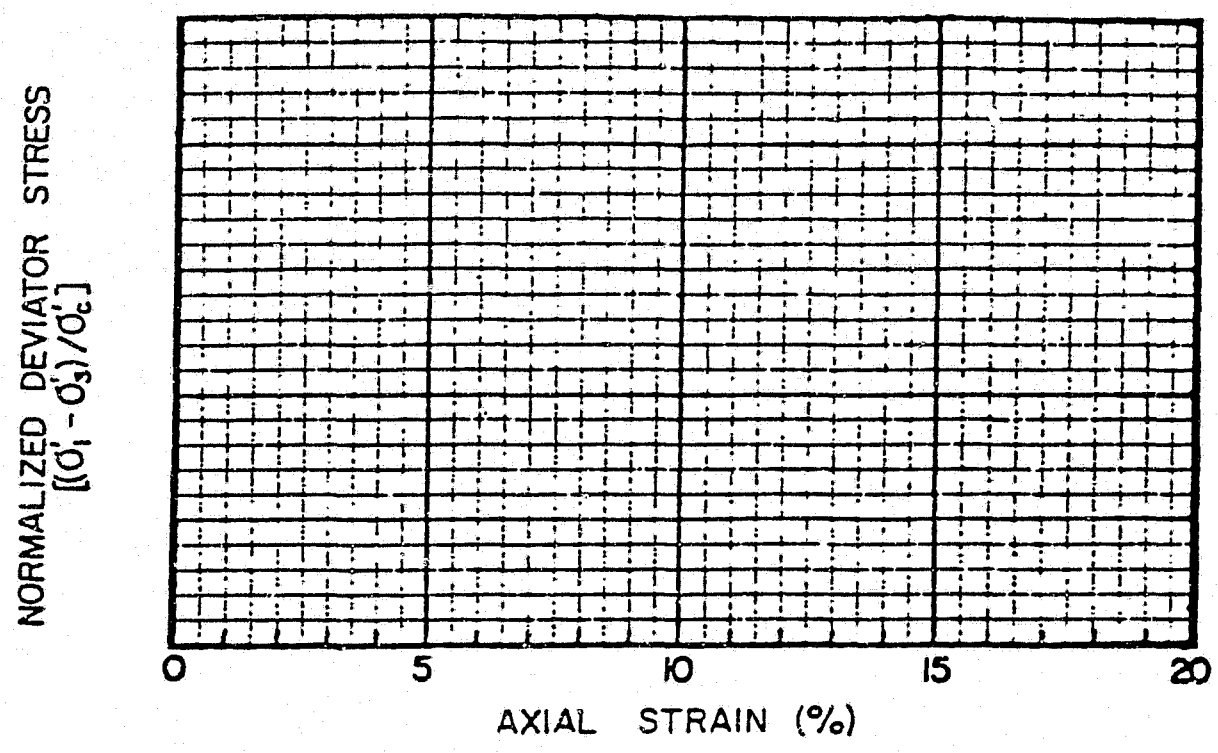
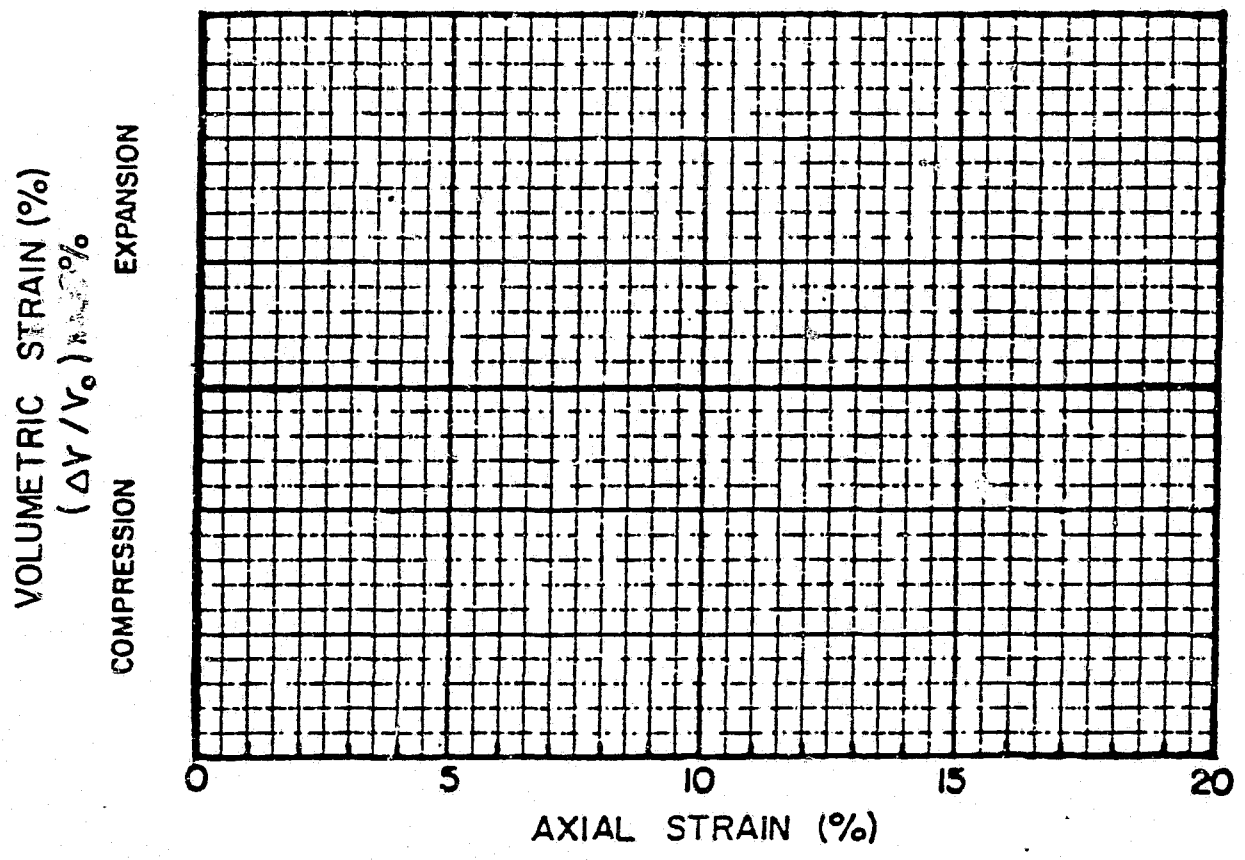
Consolidated-Undrained Triaxial Compression Test Report

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE





TYPE OF SPECIMEN			BEFORE TEST			AFTER TEST	
DIAMETER (in.)	HEIGHT (in.)		MOISTURE CONTENT	w_o	%	w_f	%
OVERBURDEN PRESS., P_o		psf	VOID RATIO	e_o		e_f	
CONSOLIDATION PRESS., σ_c		psf	SATURATION	S_o	%	S_f	%
STRAIN RATE		%/min	DRY DENSITY	γ_d	pcf	γ_d	pcf
LL	PL		PI		Gs		
CLASSIFICATION			SOURCE				

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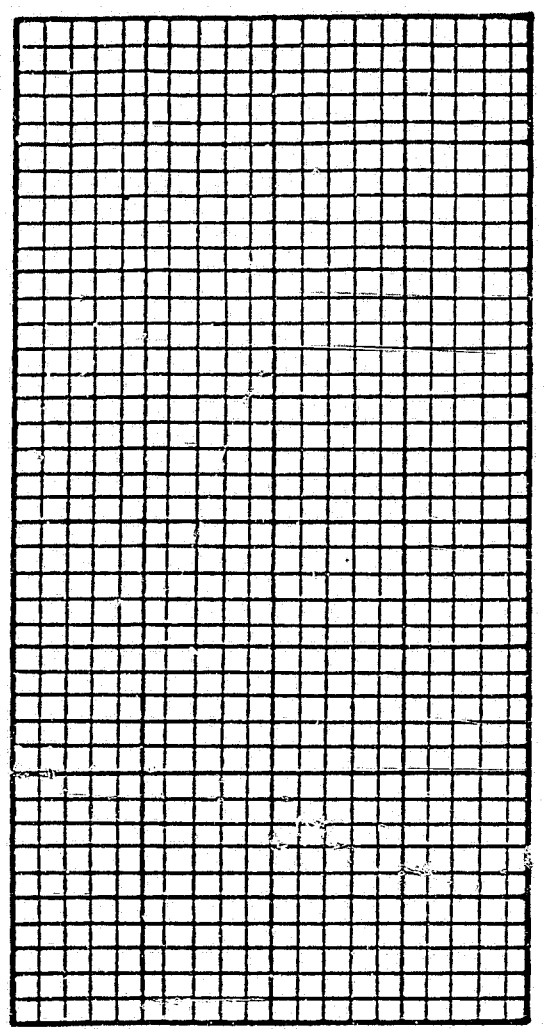
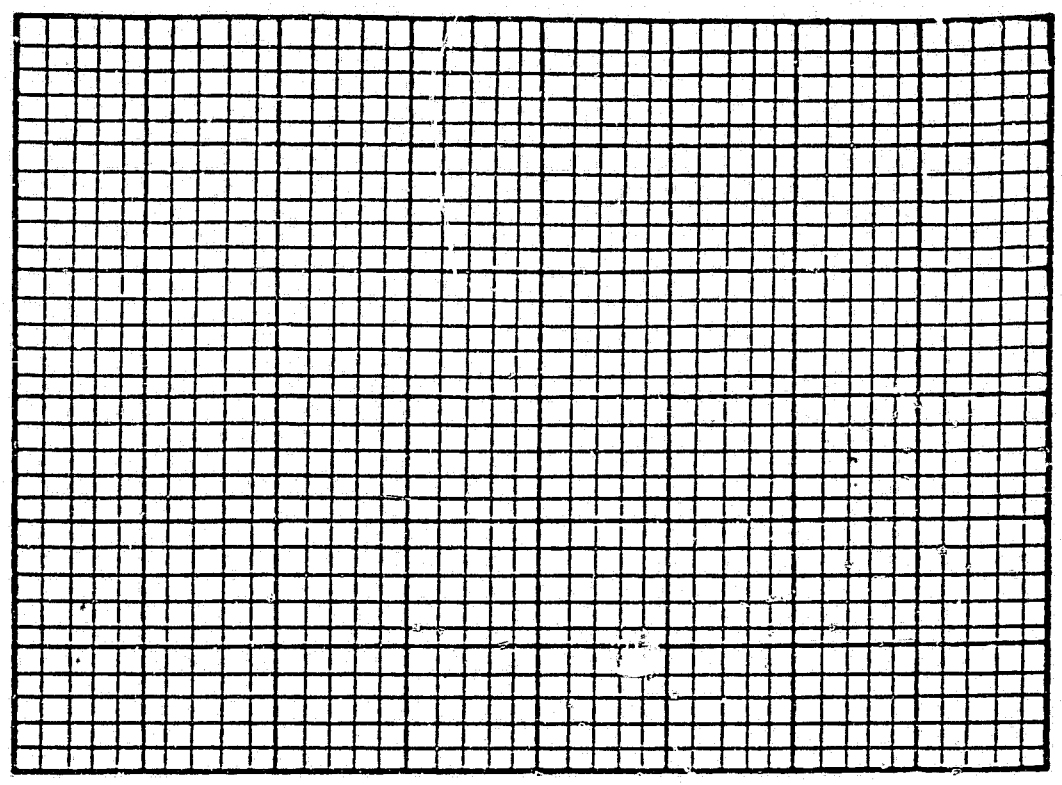
Consolidated-Drained Triaxial Compression Test Report

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE

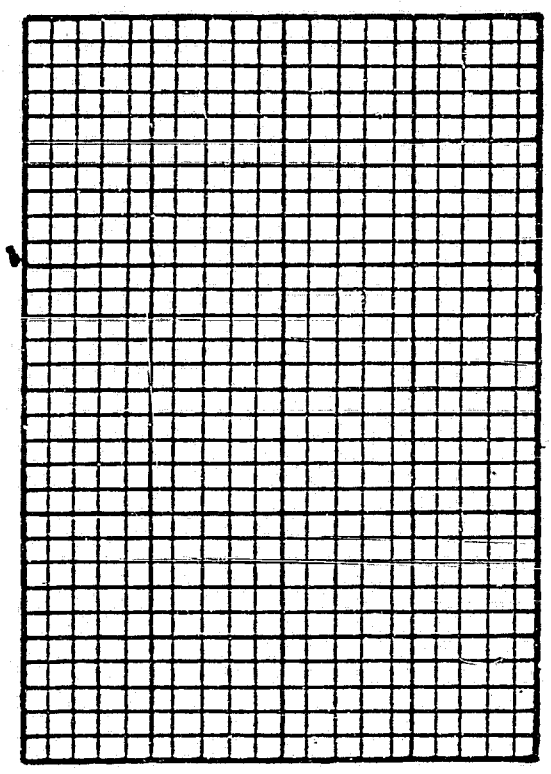


SHEAR STRESS (psf x 1000)



SHEAR STRESS (psf x 1000)

NORMAL STRESS (psf x 1000)



THICKNESS CHANGE (in.)

HORIZONTAL DEFORMATION (in.)

HORIZONTAL DEFORMATION (in.)

Test Type: Consolidated Drained Controlled _____

Gs _____

Test No.		A	B	C
Initial	Height (in.)			
	Moisture Content	%	%	%
	Void Ratio			
	Saturation	%	%	%
	Dry Density (pcf)			
Before Test	Time for 50% Consolidation (min.)			
	Time for 100% Consolidation (min.)			
	Void Ratio after Consolidation			
Final	Moisture Content	%	%	%
	Void Ratio			
	Saturation	%	%	%
Normal Stress (psf)				
Maximum Shear (psf)				
Time to Failure (min.)				
Sample Source				
Classification				

ϕ' =
C' =

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Direct Shear Test Report

PLATE

DRAWN | JOB NUMBER | APPROVED | DATE | REVISED | DATE

APPENDIX C

QUALITY ASSURANCE

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Quality Assurance

PROCEDURE / INSTRUCTION

Subject: Equipment Calibration and Maintenance No. 12.1.1 Rev. 0

Issued: March, 1982

Supersedes:

Prepared By: Dennis H. Furby Date: February, 1982

Approved By: Date:

Date:

Date:

Date:

1.0 PURPOSE

This procedure presents methods for identifying and documenting the calibration and maintenance of measuring and testing equipment used by HLA for safety-related projects.

2.0 EQUIPMENT IDENTIFICATION

2.1 All operating equipment that is used for measuring or testing on safety-related projects shall be identified by a manufacturer's serial number, HLA inventory tag, or other reliable marking to indicate each specific piece of equipment. The exceptions are handtools or equipment that can be checked either visually or by simple physical measurements; these can be identified by type or generic name.

2.2 Each office or department shall prepare and maintain a list of equipment requiring calibration and maintenance; Form QA 13, or equivalent, can be used for this purpose. The list

(Use additional sheets as necessary)

should give the name or type of equipment and the identification number, along with the frequency and method of calibration and allowable tolerances.

3.0 CALIBRATION AND MAINTENANCE CHECKS

3.1 Measuring and test equipment shall be periodically calibrated and maintained in accordance with the manufacturer's specifications, operating manual or instructions, or other commonly accepted standards. The method and interval of calibration should be based on the type of equipment, stability characteristics, required accuracy, and other conditions which might affect measurement control.

3.1.1 If there are no specific calibration or maintenance procedures available, they should be prepared by knowledgeable HLA personnel. All calibration and maintenance instructions should be kept on file in the appropriate office or department.

3.1.2 Where appropriate, the equipment should be marked by a tag or sticker to indicate frequency and status of calibration as a reminder to operating personnel. The

equipment identification and status of calibration should be indicated in the daily field reports or on the data sheets.

3.2 Whenever possible, calibration equipment should have a known valid relationship to nationally recognized standards. If none exists, or this degree of verification is not appropriate, then the basis or standard for calibration should be documented and maintained in the equipment file.

4.0 CALIBRATION/MAINTENANCE RECORDS AND DOCUMENTATION

4.1 Each office or department shall maintain records of equipment calibration and maintenance using Form QA 14, or equivalent type of card file. This record should indicate the date and by whom all calibration or maintenance checks are performed, along with the results. Routine checks performed only to verify operating condition of equipment prior to use can be indicated directly in the daily field report or on the original data sheet.

4.2 All required calibration and maintenance checks shall be reported to and verified by a supervisor or other qualified personnel.

4.2.1 If the results of any calibration or maintenance checks indicate that the equipment is not in calibration or proper working order, the supervisor shall be notified immediately. An evaluation shall be made and documented regarding the validity of previous results obtained from that equipment. The supervisor shall, in turn, notify the Office Head or Project Manager of any affected projects so that a similar evaluation may be made and documented regarding the test results in question.

4.2.2 If equipment tags or stickers are used, they should be changed to indicate the current status of calibration.

4.3.2 Any equipment found to be out of calibration or not in proper operating condition shall be conspicuously marked to prevent further use until the equipment is either repaired or calibrated.

4.3 If equipment is rented by HLA, written certification or documentation shall be provided that indicates the equipment is in proper calibration. If this is not available, qualified HLA personnel shall perform and document their own calibration checks prior to using the equipment.

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Quality Assurance

GENERAL EQUIPMENT CALIBRATION
IDENTIFICATION & NUMBERING SYSTEM

Office or Department: LABORATORY

Location: ALL HLA OFFICES

4/14/82

Equipment Type	Office	Identification and Numbering System
LOAD RINGS and LOAD CELLS	All	Manufacturer's name and model and serial numbers plus data on electronics (load cells)
DIAL INDICATORS	Novato	DI plus a number from the series 0 - 75
	Reno	DI 76 - 125
	Honolulu	DI 126 - 175
	Anchorage	DI 176 - 225
	Seattle	DI 226 - 275
	Houston	DI 276 - 325
LVDT or DCDT	All	Manufacturer's name and model and serial numbers plus data on electronics
PRESSURE GAUGES	Novato	PG plus a number from the series 0 - 50
	Reno	PG 51 - 100
	Honolulu	PG 101 - 150
	Anchorage	PG 151 - 200
	Seattle	PG 201 - 250
	Houston	PG 251 - 300
PRESSURE TRANSDUCER SYSTEM	All	Manufacturer's name and model and serial numbers plus data on electronics
SCALES	All	Manufacturer's name and model and serial numbers
CONSOLIDATION APPARATUS	All	Manufacturer's name and model and serial numbers

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Quality Assurance

GENERAL EQUIPMENT CALIBRATION / MAINTENANCE LOG

Office or Department: LABORATORY

Location: ALL HLA OFFICES Sheet ____ of ____

4/14/82

Equipment Type	Frequency of Calibration*/ Maintenance*	Method of Calibration **/Tolerance
LOAD RINGS	12 months	Proving ring or dead weight ±1.0%
LOAD CELL SYSTEM	1 month	Proving ring or dead weight ±1.0%
DIAL INDICATOR	12 months	Calibrated blocks ±1.0%
LVDT or DCDT system	1 month	Calibrated blocks ±1.0%
PRESSURE GAUGES	12 months	Reference gauges or equipment ±1.0%
PRESSURE TRANSDUCER SYSTEM	1 month	Reference gauges or equipment ±1.0%
SCALES (mechanical)	6 months	Calibrated dead weights ±1.0%
SCALES (electronic)	2 months	Calibrated dead weights ±1.0%
CONSOLIDATION APPARATUS (including stone correlations)	12 months	Proving ring ±1.0%

*If it is suspected that a piece of equipment is not functioning properly, it immediately should be removed from service until it can be checked for calibration.

**At the present time, the Novato laboratory will supply the calibration equipment.

Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Quality Assurance

EQUIPMENT CALIBRATION / MAINTENANCE RECORD

Sheet ____ of ____

Office or Department: ANCHORAGE - LABORATORY

Equipment & Identification: _____

Specifications for calibration / maintenance (frequency, method, tolerances): _____

Calibration/Maintenance Record:

Date	By	Results*	Verified

* Notify supervisor immediately if results indicate equipment is out of calibration!

SUBTASK 5E - CAMP ACTIVITIES - CIRI

The Watana Camp operation, maintenance, and catering services required to provide subsistence support of Task 1 personnel will be provided through June 30, 1983.

A soils laboratory will be constructed at the site in accordance with Harding Lawson drawings approved by HARZA/EBASCO.

A new water well for the camp will be installed and connected in addition to logistical support for the supply of camp expendables and fuel.

Rock core samples will be demobilized from the camp warehouse to suitable Anchorage storage.

Support activities will be provided for the scheduling and performance of a fuel haul to the camp storage tanks.

Labor will be provided for the development of a 2500' long snow strip at the camp site.

Maintenance and Operation Assumptions

Full Camp -

2 - bc - 12 hours

1 cook - 14 hours

1 cook/baker - 10 hours

1 maintenance man - 12 hours

Breakfast and dinner - 7 a.m.; spike lunch - noon

Breakfast and dinner - 7 p.m.; spike lunch - midnight

Hot stew daily to drillsite

All food consumables FOB Talkneetna; transportation TKA - camp by others.

All personnel to be transported from Anchorage to camp by others - we can provide price for other location.

Catering crew on 4 & 2 R&R cycle.

Well working & water haul from lake not necessary.

Assumptions on Warehouse Remodelling and Well House

1) Notice to proceed so that purchase of table material can be placed 12/14/82.

2) Floor agreed to be shimmed and trimmed. It is not intended to be level, but 4 X 12 joints where possible will be shimmed or trimmed to make plywood joints match. Plywood may therefore not be totally supported by 4 X 12 decking.

3) Agreement to support for panellized 34' wall. Bracing and support detailed labor and material not quantified.

4) Materials FOB Anchorage until discussion of potential for demobilization of samples has taken place. Probable material weight of 15 tons to camp would indicate semi truck and trailer necessity. A more efficient planning of mobilization and demobilization could include scheduling of manpower and helicopters to maximize the hauling from Hurricane to camp of building materials and return on the same trip of the core samples from camp to Hurricane.

5) Transportation by others of building materials from Hurricane to inside the warehouse at Watana.

6) Wiring - romex not in conduit stapled or surface fastened.

Assumptions on Snow Strip

1) Utilizing at no charge D-7 brought into camp by others for five days to push snow and the Nodwell for three days to pack the snow.

2) Snow and temperature conditions similar to those of today.

3) Use at no charge of snowcat and tank to ice snow.

Assumptions on Fuel Haul

1) Diesel by others

2) Helicopter by others

3) Transportation from Talkeetna to camp by others; 2 - trips mob & 2 - demob.

Camp Modification and Upgrade

I	New well and relocated pipeline:	
	Material	$ 3230
	Labor - 2.5 days @ 261.3 2.5 days @ 465.3	1820
	SUBTOTAL	$ 5050
II	New Lab and Conveyor System:	
	Material	6280
		1780
	Labor - 5.5 days @ 261.3 5.5 days @ 465.3	4000
	Lab Tables Labor	1600
	SUBTOTAL	$13660
III	Bulk Storage:	
	Material	950
	Labor - 2 days @ 261.3 2 days @ 465.3	1450
	SUBTOTAL	$ 2400
IV	Relocated Security Cage KNIK/ADC:	
	Material	1980
	Labor	1820
	SUBTOTAL	$ 3800
	Contingency	$ 3500
	GRAND TOTAL	$28410

TRANSITION PERIOD COST ESTIMATES

JANUARY 1 - JUNE 30, 1983

	Weekly Cost	Projected Cost
A. SERVICES (CIRI-H&N LABOR)		
Project Manager	$2,447	$63,620
Camp Manager (Watana Camp)	3,184	82,780
Camp Manager 7 Weeks (During R&R)	3,184	22,300
Office Manager	1,272	33,070
Bookkeeper (half-time)	488	12,690
Secretary	885	23,010
SUB - TOTAL		$237,470
Fixed Professional Fee @ 10%		23,750
		$261,220
B. CIRI-H&N DIRECT COSTS		
Direct Costs		61,000
2% Handling Fee (for ODC and KNIK/ADC)		9,600
SUB - TOTAL		70,600
C. SUBCONTRACT (KNIK/ADC LABOR AND ODCs)		
Labor and other direct costs; Food, Consumables and parts		434,000
2% Handling Fee		8,700
SUB - TOTAL		443,000
ESTIMATED JAN 1 - JUNE 30, 1983 COSTS		774,820
10% Contingency		77,480
TOTAL		$852,300

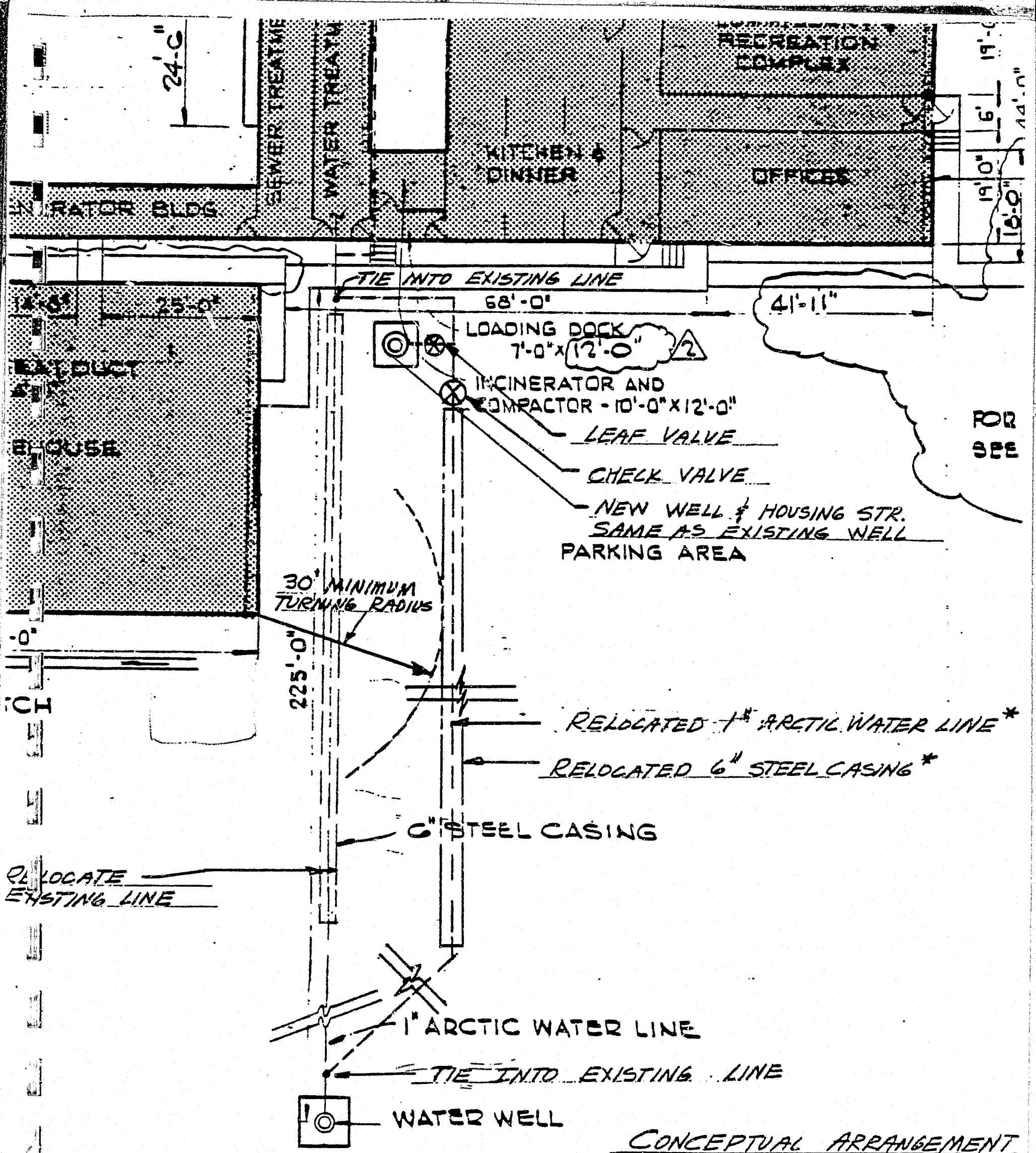
JYS:jrs

BUDGET ESTIMATE
JAN 1 ~ JUN 30, 1983

by CIRI/H&N

	DEC '82	JAN '83	FEB '83	MAR '83	APR '83	MAY '83	JUN '83
CAMP OPER. & MAINT. AT WATANA		186 MD $123,600	186 MD 123,600	186 MD 123,600	186 MD 123,600	156 MD 98,600	156 MD 98,600
MAJOR FUEL LIFT		60 MD 60,000 GAL $17,700			60 MD 65,000 GAL $19,400		
CAMP MODIFICAT'N & UPGRADE	SEE ATTACHED $28,410						
SPECIAL PROJECTS	WAREHSE O/H DR REPAIR $ 4,000	SNOW STRIP $ 4,600				CAMP LEVELING $9,200	
SUGGESTED ITEMS		WATER SAVR WASHER/DRYER $ 3,500	CORP. ENG TRAILER REVAMP (?)			RF MATCH $1,000	WAREHSE FLOORING $ (?)

EXAMPLE: 5 MEN × 31 DAYS/MO = 60 MD (PER MONTH.)



CONCEPTUAL ARRANGEMENT
- RELOCATION OF EXISTING WATER WELL LINE MAXIMIZIN USE OF EXISTING MATERIALS
- LOCATION OF NEW WELL AND PIPING ARRANGEMENT

*LENGTHS BY FIELD

HAMZA-EBASCO 11/29/82

HARDING-LAWSON ASSOCIATES
624 W. International Airport Road
Anchorage, Alaska 99502
Phone (907) 276-8102

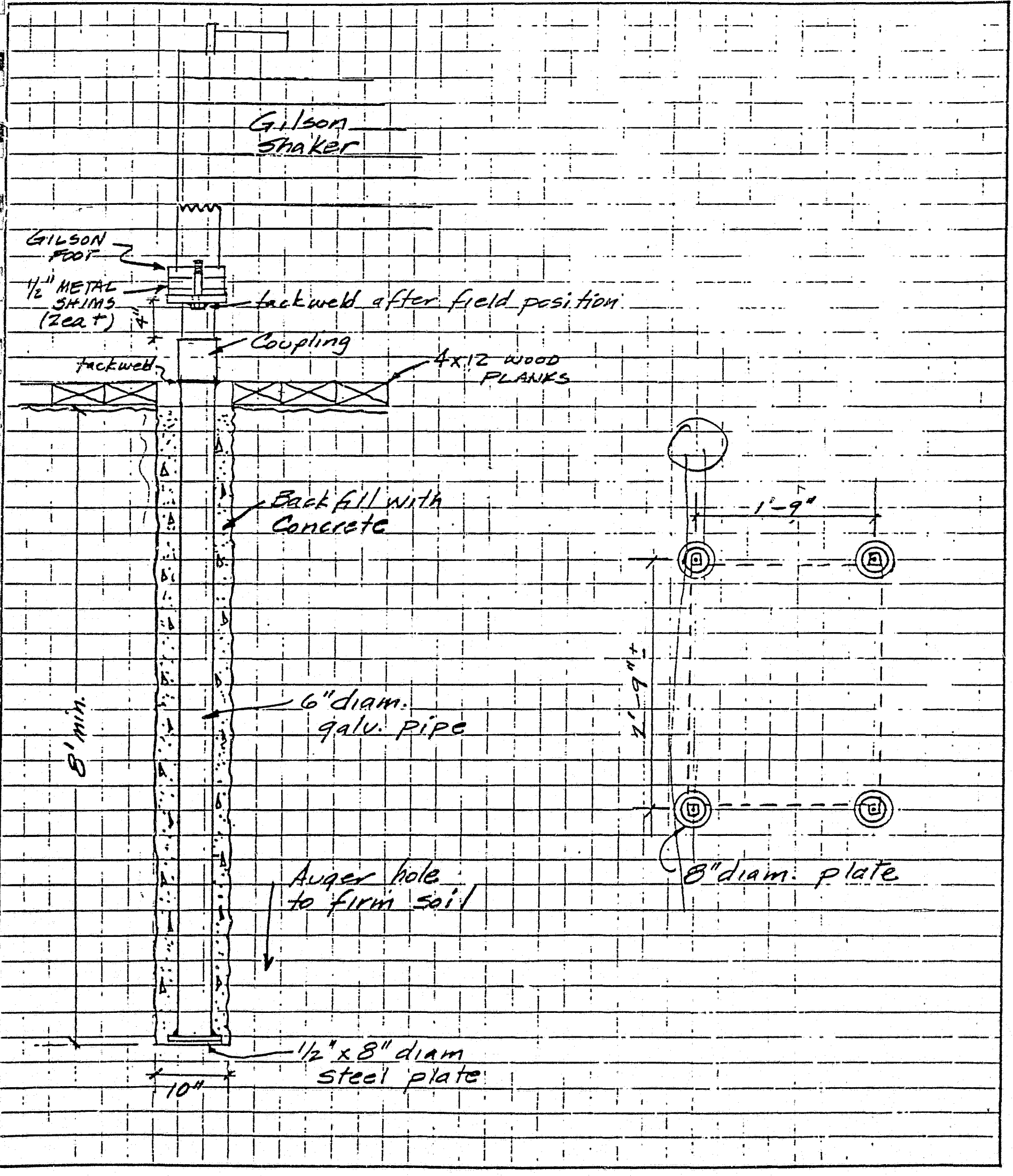
JOB WATANA DAM

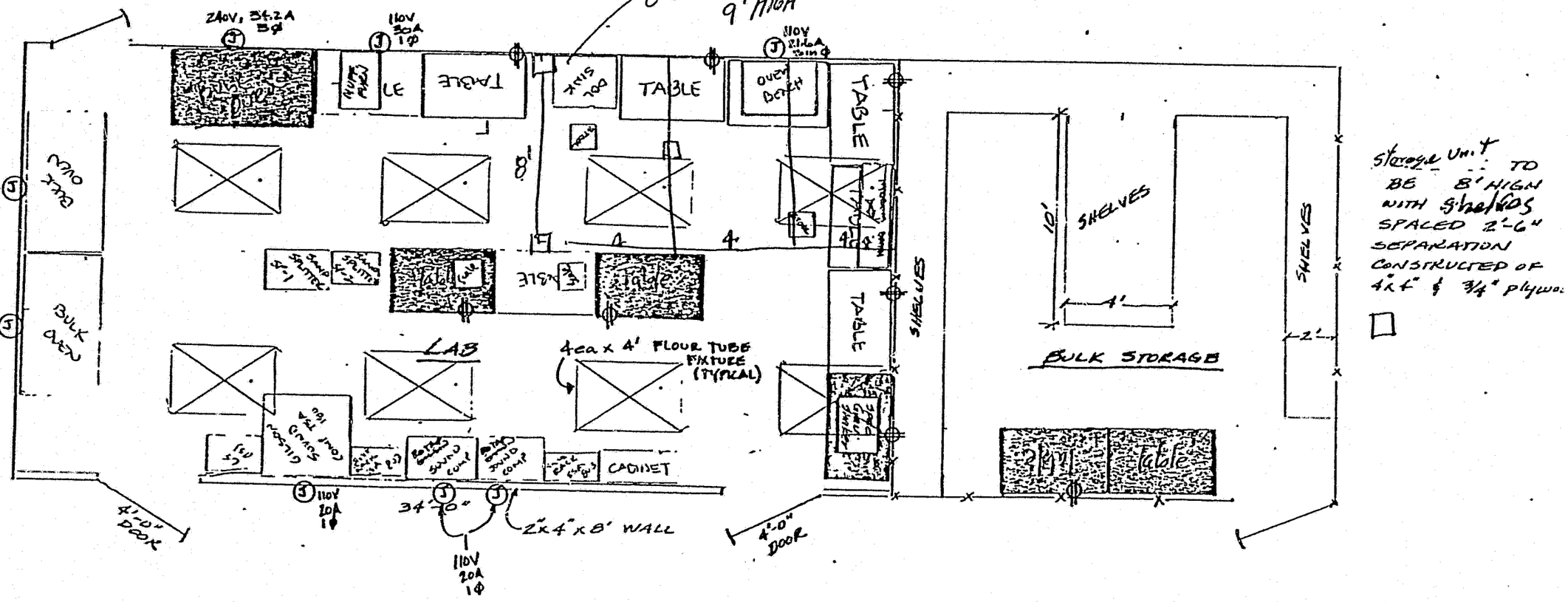
SHEET NO. 1 OF

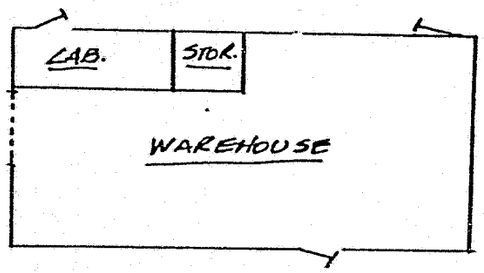
CALCULATED BY JFC DATE 11-29-82

CHECKED BY DATE

SCALE GILSON FOUNDATION







NOTE: COVER FLOOR (4'x12' PLANKS) WITH 3/4" PLYWOOD IN LAB, STORAGE AND 8' WIDE RECEIVING ADJACENT TO LAB & STORAGE.

SCALE 1/4" = 1'

Harding Lawson Associates
Engineers, Geologists & Geophysicists

LABORATORY LAYOUT
WATANA DAM SITE
ALASKA

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
JFL			11/82		

Harding Lawson Associates

Transmittal/Memorandum

To: EBASCO-HARZA
ANCHORAGE AK
ATTN MYROM TEMPSHUM % FMAA CIRI BLDG FLOOR 4

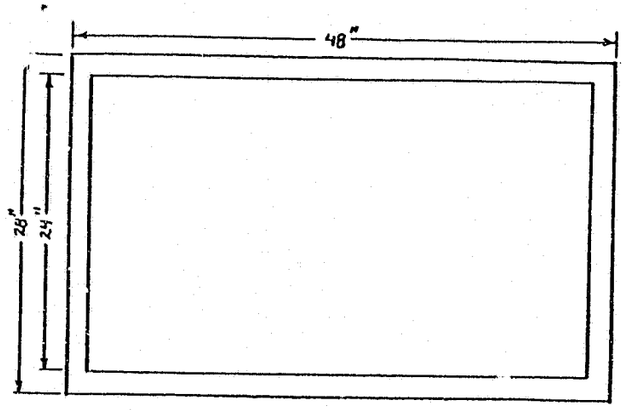
From: JOHN CHAMBERS
Date: 12-1-82
Subject: LAB TABLES + PLATFORM
Job No.: WATANA DAM

Remarks: ATTACHED IS A SKETCH SHOWING THE DETAIL FOR THE LAB TABLES. WE PLAN TO USE 14 OF THESE TABLES; 2 OF WHICH WILL BE USED IN THE SAMPLE STORAGE AREA. THE MATERIALS LIST AND COSTS ARE SHOWN ON THE SKETCH.

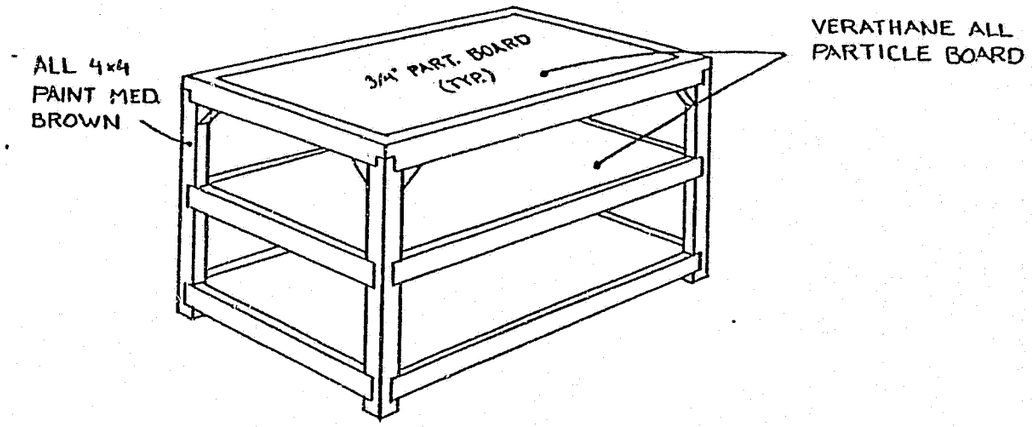
IN ADDITION THE 8'x12' x 8' HIGH SUPPORT PLATFORM ABOVE THE LAB SHOULD NEED THE FOLLOWING MATERIALS. SUGGEST A CARPENTER LOOK IT OVER.

DESCRIPTION	QTY	UNIT COST	TOTAL COST
2"x12" x 8'	20ea	1.00/LF	$160.00
6"x6" x 8'	6 ea	4.94/LF	93.12
3/4" x 4x 8 CDX	3 SHTS	18.43/SHT	55.29
JOIST HANGER	24 ea	0.69	16.56
16d Nails	5#	0.85/#	4.25
10d Nails	5#	0.85/#	4.25
		TOTAL	$333.47

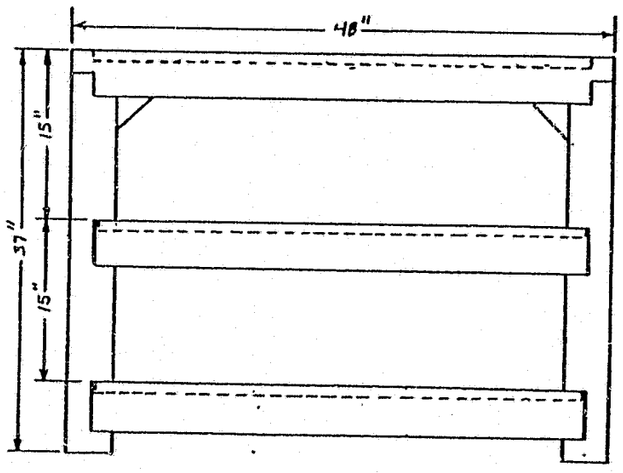
cc:



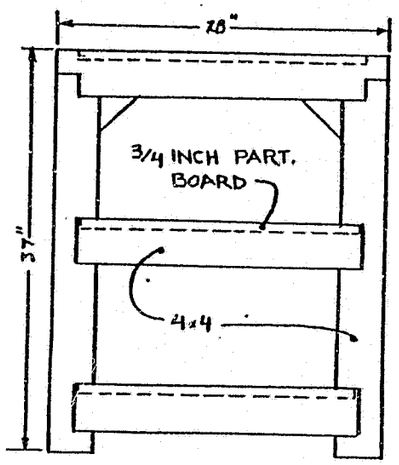
TOP PLAN



ISOMETRIC



SIDE VIEW



END VIEW

MATERIALS LIST:

SINGLE TABLE
4"x4" - 36 LF
3/4" x 4' x 8' PART. BOARD 3/4 SHT.
16d NAILS - 1#

$43.00/TABL

14 TABLES

4"x4" - 506 LF @ $0.67/LF	339.02
3/4" x 4' x 8' PART. BOARD 11 SHTS. @ $15.04 SHT.	165.44
16d NAILS - 15# @ $ 0.85/#	12.75
VERATHANE - 2 GAL. @ $23.00/GAL	46.00
BROWN ENAMEL PAINT - 2 GAL @ $20.00/GAL	40.00
TOTAL MATERIALS COST	$603.21

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& Geophysicists

TYPICAL LAB TABLE

WATANA DAM
ALASKA

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
JP			12/82		

SUBTASK 5F - AIR SUPPORT - AIR LOGISTICS OF ALASKA

Air support will be provided as required to meet requirements of Task 1 activities in addition to the maintenance of camp facilities. Air support will consist of both helicopter and fixed-wing aircraft.

AIR LOGISTICS OF ALASKA, INC. A DIVISION OF OFFSHORE LOGISTICS, INC.

December 3, 1982

Mr. Thomas A. Clary
Consulting Geologist
Ebasco Services, Inc.
1227 W. Ninth, 2nd Floor
Anchorage, Alaska 99501

Dear Mr. Clary:

Enclosed is our proposal for providing continuing helicopter service at the Watana Dam project.

Air Logistics proposes maintaining the same rates for service as provided Acres American for all Bell 206 B and Bell 205 A-1 helicopters contracted during Fiscal Year 1983 and used in conjunction with Susitna studies. Additionally, Air Logistics is including an optional rate for an additional class of small helicopter (Bell 206 L and 206 L-1) which has more capacity than the Bell 206 B, the historical mainstay at Watana.

Further, as a possible inducement to extending these proposed terms beyond FY' 83's end, Air Logistics offers a reduction of existing rates effective immediately upon acceptance and applicable to all contract Bell 206 B and Bell 205 A-1 helicopters used by Ebasco Services, Inc., at Susitna or for related activity. Air Logistics proposes that this reduction remain in effect through Oct. 31, 1983 at which time a new agreement may be sought. Air Logistics also proposes that should Ebasco Services, Inc., desire to extend this agreement for the balance of contract years, Air Logistics may not increase its rates through negotiation not to exceed 10 percent per annum beginning Nov. 1, 1983 and annually thereafter.

Air Logistics understands that Susitna studies are subject to some forces beyond the control of Ebasco Services, Inc., and is sympathetic to the social, political and economic pressures exerted. However, solely as a means of protection, Air Logistics proposes that a penalty clause be agreed to by Ebasco Services, Inc., on the contract.

6601 S. AIRPARK PLACE • ANCHORAGE, ALASKA 99502 • (907) 243-4600 • TELEX 090-25-335

Air Logistics proposes that the agreed upon penalty clause may include language cancelling the reduced helicopter contract rate if the contract period is not extended through Oct. 31, 1983. Termination prior to Oct. 31, 1983 may subject Ebasco Services, Inc., to back payment in full within 90 days of the difference between the two contract rates offered.

PROPOSED RATES DECEMBER 1982 THROUGH JUNE 30, 1983

	Daily	Hourly
1.) Bell 206 B	$535	$135
2.) Bell 206 L/L-1	$585	$150
3.) Bell 205 A-1	$1,180	$300

PROPOSED RATES DECEMBER 1982 THROUGH NOV. 1, 1983

1.) Bell 206 B	$510	$135
2.) Bell 206 L/L-1	$560	$150
3.) Bell 205 A-1	$1,050	$300

ADDITIONAL CREWS

1.) $175 per day per crewmember

AIR LOGISTICS OF ALASKA, INC. A DIVISION OF OFFSHORE LOGISTICS, INC.

In addition to operating a helicopter service in Alaska, Air Logistics also maintains a modern fleet of cargo and executive fixed wing aircraft. In order to benefit fully from Air Logistics' complete transportation service, the following proposal is offered to Ebasco Services Inc.

1.) A 15 percent reduction in the hourly rates of our proposed unfiled tariff. Or, a 15 percent reduction of the published daily base rate on all fixed and rotary wing aircraft flown on a casual charter basis. Copies of the proposed tariff rates are included. A complete filing shall be presented upon acceptance by the Alaska Transportation Commission. In future years, the then-current tariff shall determine rates, less the 15 percent discount.

Air Logistics appreciates the opportunity to participate in this process and looks forward to future opportunities. If areas within this proposal need clarification, please do not hesitate to call.

Sincerely,

D Craig Clark
for Leslie W. Bays.

Leslie W. Bays
General Manager

LWB/DCC/cf
encl

6601 S. AIRPARK PLACE • ANCHORAGE, ALASKA 99502 • (907) 243-4600 • TELEX 090-25-335

DAILY RATES

The following daily rates are available at the Anchorage and Fairbanks bases. All rates are "DRY" (i.e., without fuel). In addition to the daily base rate, charges will be billed for actual hours flown. As indicated, hourly charges will be greater for all hours flown in excess of five (5) hours on any given day. Aircraft use during a single day may not exceed applicable FAA requirements for crew duty time. No standby charges are applicable for aircraft chartered on the daily rates

Type Aircraft	Daily Base Rate	Hourly Charge (up to 5.0 hrs)	Hourly Charge (All over 5.0 hrs/day)
Bell 206B	940.00/day	140.00/hr.	330.00/hr.
Bell 206L	1150.00/day	170.00/hr.	400.00/hr.
Bell 206L-1	1340.00/day	180.00/hr.	450.00/hr.
Bell 205	1980.00/day	320.00/hr.	715.00/hr.
Bell 412 VFR	2155.00/day	525.00/hr.	960.00/hr.
Bell 412 IFR	2350.00/day	550.00/hr.	1020.00/hr.
Aerospatiale			
AS355 VFR	1450.00/day	250.00/hr.	500.00/hr.
AS355 IFR	1745.00/day	275.00/hr.	625.00/hr.

Air Logistics of Alaska, Inc.	Amendment No. 18 Cancels All Previous	Page I-3

AIRCRAFT TIME AND DISTANCE TARIFF

Air Logistics of Alaska, Inc.
6601 S. Airpark Place
Anchorage, AK 99502

Air Commerce
Certificate No. E-201

Base of Operations: Anchorage, AK & Fairbanks, AK

Type of Aircraft	R A T E S		
	Per Hour	Per Day	Stand-By Time
Rotary Wing			
Bell 206B	410.00 (Dry)	See Page I-4	100.00/Hr
Bell 206L	500.00 (Dry)		125.00/Hr
Bell 206L-1	560.00 (Dry)		140.00/Hr
Bell 205A	895.00 (Dry)		225.00/Hr
Bell 412 VFR	1195.00 (Dry)		300.00/Hr
Bell 412 IFR	1275.00 (Dry)		320.00/Hr
Aerospatiale			
AS355 VFR	680.00 (Dry)		170.00/Hr
AS355 IFR	780.00 (Dry)		195.00/Hr

Above rates are subject to the following:

See Section II - Rules governing published tariff.

Issued By: L. W. Bays Title: Division Manager	Date of Issue:	Effective date:

Air Logistics of Alaska, Inc.	Amendment No. 18 Cancels All Previous	Page I-2

AIRCRAFT TIME AND DISTANCE TARIFF

Air Logistics of Alaska, Inc.
6601 S. Airpark Place
Anchorage, AK 99502

Air Commerce
Certificate No. E-201

Base of Operations: Anchorage, AK and Fairbanks, AK

Type of Aircraft	RATES		
	Per Hour	Per Day	Stand-By Time
Fixed Wing:			
CASA 212-100	670.00 (Dry)		170.00/Hr
CASA 212-200	910.00 (Dry)		230.00/Hr
Cessna 206	175.00 (Dry)		45.00/Hr
Cessna 441			
Single Pilot	650.00 (Dry)		160.00/Hr
Dual Pilot	700.00 (Dry)		175.00/Hr
Cessna 404			
Single Pilot	350.00 (Dry)		90.00/Hr
Dual Pilot	400.00 (Dry)		100.00/Hr
Britten-Norman BN2A-26			
Single Pilot	290.00 (Dry)		75.00/Hr
Dual Pilot	340.00 (Dry)		85.00/Hr

Above rates are subject to the following:

See Section II - Rules governing published tariff.

Issued By: L. W. Bays Title: Division ger	Date of Issue:	Effective date:

Renew

ALASKA POWER AUTHORITY

July 1, 1982

* MUST BE RENEWED

ALASKA POWER AUTHORITY
Federal I.D. No. 92-0071121

Sales Tax and Excise Tax Exemption Certificate

I hereby certify that I am the Executive Director of the Alaska Power Authority; that I am authorized to execute this certificate and that all orders placed by Acres American Incorporated in connection with the Susitna Hydroelectric Project for the period commencing July 1, 1982 and ending on September 30, 1982, are or will be purchased for the exclusive use of the Alaska Power Authority.

I understand that the exemption from sales and excise tax under this exemption certificate is limited to the sale of articles purchased for the exclusive use of the Alaska Power Authority. I understand that the fraudulent use of this certificate for the purpose of securing this exemption will subject me and all parties making such fraudulent use of this certificate to a fine of no more than $10,000 or to imprisonment for not more than five years, or both, together with cost of prosecution.

Eric P. Yould
Executive Director
Alaska Power Authority
334 West 5th Avenue
Anchorage, Alaska 99501