GTLT - 2

NMSU PG-1-LRG 521
UL:A 27-23S-02E
Dona Ana County

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NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

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SANTA FE

Form G-101
Adopted 10/1/74

APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK---GEOTHERMAL RESOURCES WELL

5. Indicate Type of Lease: STATE ☐ FEE ☐

5.a State Lease No.: N/A

1a. Type of Work: Drill ☐ Deepen ☒ Plug Back ☐

b. Type of Well: Geothermal Producer ☐ Low-Temp Thermal ☒ Temp Observation ☐ Injection/Disposal ☐

7. Unit Agreement Name: NMSU Land

8. Farm or Lease Name: NMSU-PG-1-LRG 521

2. Name of Operator: New Mexico State University, Physical Plant Dept.

9. Well No.: NMSU

3. Address of Operator: New Mexico State University
P.O. Box 3548, Las Cruces, NM 88003

10. Field and Pool, or Wildcat:

4. Location of Well: UNIT LETTER A LOCATED 1000 FEET FROM THE North LINE
AND 500 FEET FROM THE East LINE OF SEC. 27 TWP. 23S RGE. 2E NMPM

12. County: Dona Ana

19. Proposed Depth	19A. Formation	20. Rotary or C.T.
2,000	Limestone	Rotary

21. Elevations (Show whether DF, RT, etc.)	21A. Kind & Status Plug. Bond	21B. Drilling Contractor	22. Approx. Date Work will start
4200 feet above MSL	635 8013	TBD	1 July 1983

PROPOSED CASING AND CEMENT PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	SACKS OF CEMENT	EST. TOP
9 7/8-inch	8 5/8-inch	24.70	870	20	790
7 7/8-inch	5 9/16-inch	14.62	2,000	None	860

Present production zone is 700-792 feet of depth, with sand and cement plugs from 792-860 feet. These plugs will be drilled out to 870 feet TD, and a minimum of 180 feet of 8 7/8-inch casing will be set with a 15-feet cement bottom plug and packer at 790 feet. A 7 7/8-inch hole will be drilled thru the bottom plug, and completed to 2,000 feet. After logging, the well will be completed with 5 9/16-inch liner with screen at identified production zones. Completed well will be test pumped for 24 hours. Expected flow will be geothermal water at 145-150 F, with same TDS as existing well. (1980 mg/l TDS)

OIL CONSERVATION COMMISSION TO BE NOTIFIED WITHIN 24 HOURS OF BEGINNING OPERATIONS

APPROVAL VALID FOR 90 DAYS
PERMIT EXPIRES 8-29-83
UNLESS DRILLING UNDERWAY

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen or plug back, give data on present productive zone and proposed new productive zone. Give blowout preventer program, if any.

I hereby certify that the information above is true and complete to the best of my knowledge and belief.

Signed Calvin D. Black Title Director, Physical Plant Dept, NMSU Date

(This space for State Use)

APPROVED BY Carl Wong TITLE DISTRICT SUPERVISOR DATE 6-1-83

CONDITIONS OF APPROVAL, IF ANY:

NEW MEXICO OIL CONSERVATION COMMISSION

Form G-102
10-1-74

GEOTHERMAL RESOURCES WELL LOCATION AND ACREAGE DEDICATION PLAT

All distances must be from the outer boundaries of the Section

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Operator	Lease	Well No.
NMSU - Lokesh Chaturvedi	University Landy "D"	

Unit Letter	Section	Township	Range	County
A	27	23S	2E	Dona Ana

Actual Footage Location of Well:
1000 feet from the north line and 500 feet from the east line

Ground Level Elev.	Producing Formation	Pool	Dedicated Acreage:
4200 ft.	sediment		Acres

1. Outline the acreage dedicated to the subject well by colored pencil or hachure marks on the plat below.

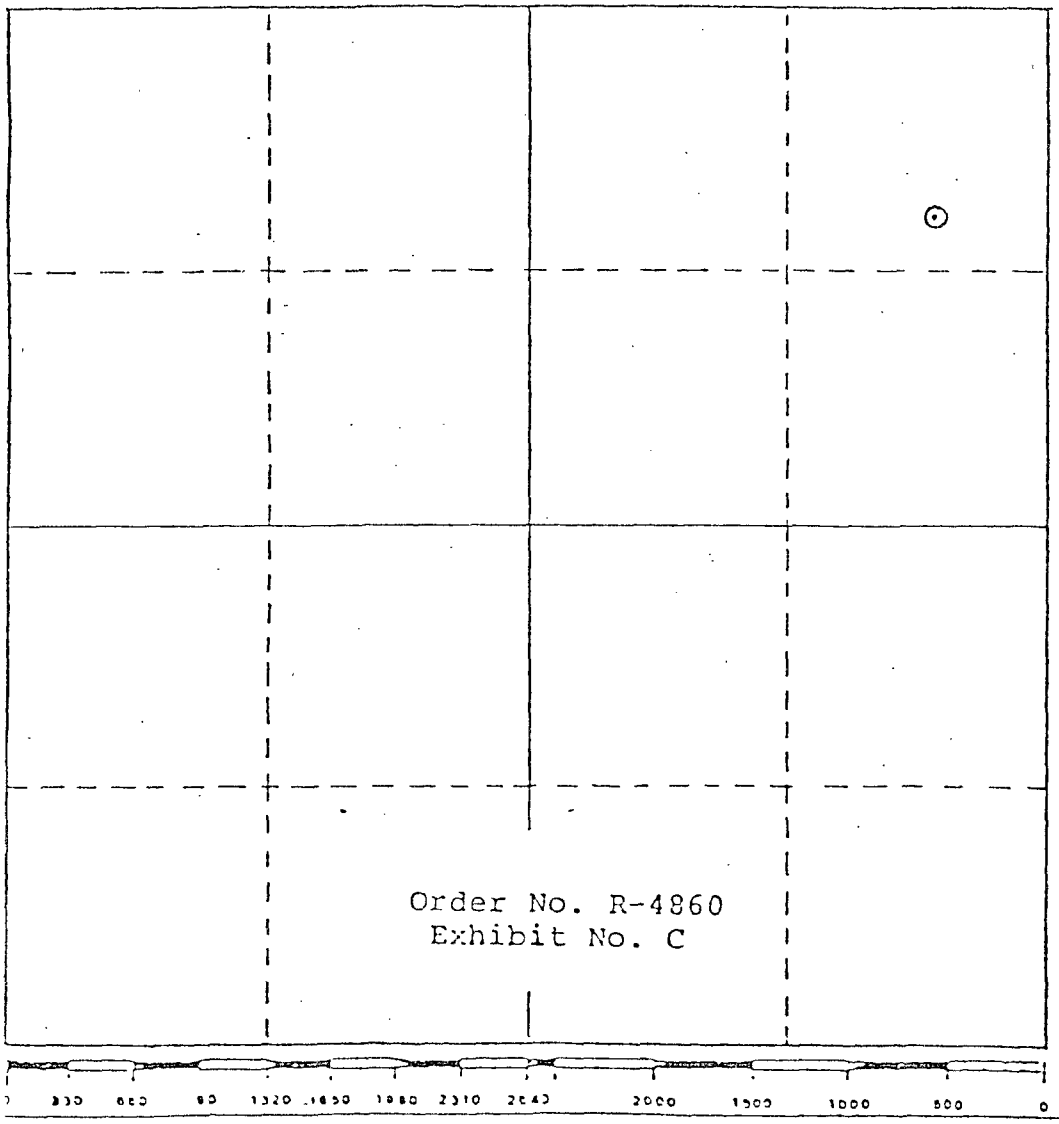
2. If more than one lease is dedicated to the well, outline each and identify the ownership thereof (both as to working interest and royalty).

3. If more than one lease of different ownership is dedicated to the well, have the interests of all owners been consolidated by communitization, unitization, force-pooling. etc?

☐ Yes ☐ No If answer is "yes," type of consolidation _____

If answer is "no," list the owners and tract descriptions which have actually been consolidated. (Use reverse side of this form if necessary.) _____

No allowable will be assigned to the well until all interests have been consolidated (by communitization, unitization, forced-pooling, or otherwise) or until a non-standard unit, eliminating such interests, has been approved by the Commission.



CERTIFICATION

I hereby certify that the information contained herein is true and complete to the best of my knowledge and belief.

L N Chaturvedi

Name: Lokesh Chaturvedi

Position: Associate Professor

Company: New Mexico State University

Date: August 24, 1979

I hereby certify that the well location shown on this plat was plotted from field notes of actual surveys made by me or under my supervision, and that the same is true and correct to the best of my knowledge and belief.

Date Surveyed

Registered Professional Engineer and/or Land Surveyor

Certificate No.

NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

Form G-104
Adopted 10/1/74

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File

CERTIFICATE OF COMPLIANCE AND AUTHORIZATION TO PRODUCE GEOTHERMAL RESOURCES

OWNER OR OPERATOR
Name New Mexico State University
Address Box 3445 NMSU, Las Cruces, NM 88003

TYPE OF WELL
Geothermal Producer [ ] Low-Temperature Thermal [XX] Injection/Disposal [ ]

REASON FOR FILING
New Well [X] Recompletion [ ]
Change in Ownership [ ] Designation of Purchaser [ ]
Other (Please Explain) [ ]

DESCRIPTION OF WELL
Lease Name NMSU-PG1-LRG Well No. 521 Name of Reservoir NMSU
Kind of Lease (Fee, Fed. or State) Private Lease Number

LOCATION
Unit Letter A ; 1000 feet from the East line and
2000 feet from the North line of
Section 27 Township 23S Range 2E
County

TYPE OF PRODUCT
Dry Steam Steam and Water Low Temp. Thermal Water X

DESIGNATION OF PURCHASER OF PRODUCT
Name of Purchaser
Address of Purchaser
Product Will Be Used For

CERTIFICATE OF COMPLIANCE
I hereby certify that all rules and regulations concerning geothermal resources wells in the State of New Mexico, as promulgated by the Oil Conservation Commission of New Mexico, have been complied with, with respect to the subject well, and that the information given above is true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Position Project Director Date 2 Nov. 1981

Approved Carl Ulvog Position SENIOR PETROLEUM GEOLOGIST Date 12/8/81

Form G-105
Adopted 10/1/74

NEW MEXICO OIL CONSERVATION COMMISSION

P. O. Box 2088, Santa Fe 87501

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SANTA FE

GEOTHERMAL RESOURCES WELL LOG

Operator New Mexico State University

Address Box 3445 NMSU, Las Cruces, NM 88003

Reservoir NMSU

Lease Name NMSU-PG1-LRG Well No. 521 Unit Letter A

Location: 1000 feet from the East line and
2000 feet from the North line Section 27

Township 23S Range 2E County Dona Ana

FORMATIONS PENETRATED BY WELL

DEPTH TO		Thickness	Drilled or Cored	Recovery	DESCRIPTION
Top of Formation	Bottom of Formation				
270	860	1200 or more	Drilled		Santa Fe group fill to 770 feet; fractured rhyolite alluvial deposits (Pennsylvanian) to TD.

Attach Additional Sheets if Necessary

See attached Technical ompletion Report

This form must be accompanied by copies of electric logs, directional surveys, physical or chemical logs, water analyses, tests, and temperature surveys (See Rule 205).

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Position Project Director Date 3 Nov. 1981

NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

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Form G-106
Adopted 10/1/74

GEOTHERMAL RESOURCES WELL SUMMARY REPORT

Operator New Mexico State University Address Box 3445 NMSU, Las Cruces, NM 88003

Lease Name NMSU-PG1-LRG Well No. 521

Unit Letter A Sec. 27 Twp. 23S Rge 2E

Reservoir NMSU County Dona Ana

Commenced drilling 9 October 1980

Completed drilling 2 November 1980

Total depth 860 Plugged depth

Junk

GEOLOGICAL MARKERS	DEPTH
Santa Fe Gravel	0 - 860 feet

Commenced producing 1 January 1982 (Date)

Geologic age at total depth: Recent Quatenary

Date	Static test Shut-in well head		Production Test Data								
			Total Mass Flow Data					Separator Data			
	Temp. °F	Pres. Psig.	Lbs/Hr	Temp. °F	Pres. Psig.	Enthalpy	Orifice	Water cuft/Hr	Steam Lbs/Hr	Pres. Psig.	Temp. °F
7-1-80	142°F	0	150,000	142°F	150						

CASING RECORD (Present Hole)

Size of Hole	Size of Casing	Weight of Csg/ft.	Grade of Casing	New or Used	Seamless or Lapweld	Depth of Shoe	Top of Casing	Number of Sacks Cement	Top of Cement	Cement Top Determined By
17"	10 3/4	40.00		New	Seamless	N/A	2' above GL	120 cubic feet	Surface	Inspection

PERFORATED CASING

(Size, top, bottom, perforated intervals, size and spacing of perforation and method.)

Slotted steel, 1/10" slots, 60 slots/foot, from 700 to 850 feet of depth.

Was analysis of effluent made? Yes Electrical log depths 860 Temperature log depths 860

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A Cunniff Position Project Director Date 4 December 1981

Form G-107
Adopted 10/1/74

NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

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SANTA FE

GEOTHERMAL RESOURCES WELL HISTORY

Operator New Mexico State University Address Box 3445 NMSU, Las Cruces, NM 88003
Lease Name NMSU-PG-1-LRG Well No. 521
Unit Letter A Sec. 27 Twp. 23S Rge 2E
Reservoir NMSU County Dona Ana

It is of the greatest importance to have a complete history of the well. Use this form to report a full account of all important operations during the drilling and testing of the well or during re-drilling, altering of casing, plugging, or abandonment with the dates thereof. Be sure to include such items as hole size, formation test details, amounts of cement used, top and bottom of plugs, perforation details, sidetracked junk, bailing tests, shooting, and initial production data and zone temperature. (Attach additional sheets if necessary.)

Date	
Nov 79	Completed drilling, set screen and casing.
Feb 80	Commenced 48-hour pump test with contractor-operated pump. 200 gpm at 142°F. Water initially contained large amounts of sand and mud, which cleared.
July 80	Set Peerless 50 hp surface turbine pump, and conducted 10-day flow test. Well was pumped at 200 gpm and 142°F for ten days. Water analysis showed 2000 ppm TDS. Subsequently, water was analysed for dissolved gases, and analysis showed CO_2 at 220 cc/liter, with 14 cc/liter of N_2 and traces of other rare gases.
July 81	A combined flow test was conducted using NMSU-PG-1-LRG-521, and NMSU-PG-3-LRG-520. This 48-hour test showed a combined flow rate of 550 gpm was possible. During this test, the Peerless pump malfunctioned incident to an aquifier surge in which the flow rate increased to 350 gpm and large amounts of sand and mud were discharged. Effluent became clean after 30 minutes.
Aug 81	Using a 100 hp TRW-REDA submersible pump, the well was test-pumped at 365 gpm for 24 hours. Water temperature, water quality, and dissolved gases remained constant during these tests. Pump produced 365 gpm at 0 psig, at planned flow rate of 250 gpm, the pump will produce 240 psig back pressure. Pump has been connected to gas separator complex, which produces separation of 120 cc of CO_2 gas per liter of fluid, at a flow rate of 200 gpm.

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Position Project Director Date 2 Nov. 1981

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NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

Form G-101
10-1-74

NOV 20 1978

APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK---GEOTHERMAL RESOURCES WELL

Santa Fe

5. Indicate Type of Lease: STATE [ ] FEE [ ]

5A. State Lease No.

1a. Type of Work: Drill [x] Deepen [ ] Plug Back [ ]

7. Unit Agreement Name

b. Type of Well: Geothermal Producer [ ] Temp Observation [X] Low-Temp Thermal [ ] Injection/Disposal [ ]

8. Farm or Lease Name: NMSU

2. Name of Operator: Lokesh Chaturvedi, Co-Investigator, Dept. of Energy Research Project

9. Well No.: X 521

3. Address of Operator: Box 3CE, New Mexico State University, Las Cruces, NM 88003

10. Field and Pool, or Wildcat

4. Location of Well: UNIT LETTER E LOCATED 1500 FEET FROM THE North LINE AND 1000 FEET FROM THE West LINE OF SEC. 35 TWP. 23S RGE. 2E NMPM

12. County: Dona Ana

19. Proposed Depth	19A. Formation	20. Rotary or C.T.
1000' to 1500'	Sediment	Rotary

21. Elevations (Show whether DF, RT, etc.)	21A. Kind & Status Plug. Bond	21B. Drilling Contractor	22. Approx. Date Work will start
Approx. 4100' above m.s.l.	not required	to be selected	November 24, 1978

23. PROPOSED CASING AND CEMENT PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	SACKS OF CEMENT	EST. TOP

The proposed well is located on New Mexico State University property where NMSU has both surface and subsurface mineral rights. The primary purpose of drilling this well is to obtain temperature gradient information. The well will be plugged after logging.

Order No. R-4860
Exhibit No. B

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOWOUT PREVENTER PROGRAM, IF ANY.

I hereby certify that the information above is true and complete to the best of my knowledge and belief.

Signed: LChaturvedi Title: Assistant Professor Date: 11/14/78

(This space for State Use)

APPROVED BY: Carl Ulvog TITLE: SENIOR PETROLEUM GEOLOGIST DATE: 12/5/78

CONDITIONS OF APPROVAL, IF ANY:

Form G-103
Adopted 10/1/74

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NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe, New Mexico 87501

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AUG 18 1983
CONSERVATION DIVISION
SANTA FE

SUNDRY NOTICES AND REPORTS ON GEOTHERMAL RESOURCES WELLS

Indicate Type of Lease: State ☐ Fee ☐

5.a State Lease No.: N/A

Do Not Use This Form for Proposals to Drill or to Deepen or Plug Back to a Different Reservoir. Use "Application For Permit —" (Form G-101) for Such Proposals.)

1. Type of well: Geothermal Producer ☐ Temp. Observation ☐ Low-Temp Thermal ☒ Injection/Disposal ☐

7. Unit Agreement Name: NMSU Land

2. Name of Operator: New Mexico State University, Physical Plant Department

8. Farm or Lease Name: N/A

3. Address of Operator: P. O. Box 3545, Las Cruces, New Mexico 88003

9. Well No.: NMSU-PG-1-LRG-521

4. Location of Well
Unit Letter A 1,000 Feet From The North Line and 500 Feet From The East Line, Section 27 Township 23S Range 2E NMPM.

10. Field and Pool, or Wildcat: Las Cruces - East Mesa

15. Elevation (*Show whether DF, RT, GR, etc.*): 4,200 GR

12. County: Dona Ana

16. Check Appropriate Box To Indicate Nature of Notice, Report or Other Data

NOTICE OF INTENTION TO:		SUBSEQUENT REPORT OF:	
PERFORM REMEDIAL WORK ☐	PLUG AND ABANDON ☐	REMEDIAL WORK ☐	ALTERING CASING ☐
TEMPORARILY ABANDON ☐		COMMENCE DRILLING OPNS. ☐	PLUG & ABANDONMENT ☐
PULL OR ALTER CASING ☐	CHANGE PLANS ☒	CASING TEST AND CEMENT JOB ☐	
OTHER ☐		OTHER ☐	

17. Describe Proposed or completed Operations (*Clearly state all pertinent details, and give pertinenet dates, including estimated date of starting any proposed work*) SEE RULE 203.

The deepening of PG-1/LRG-521, requested in May and approved June 1, 1983, is hereby canceled. The well will continue to operate in its previous configuration.

18. I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNED [signature] TITLE Director, Physical Plant Dept. DATE August 15, 1983.

APPROVED BY Carl Ulvog TITLE DISTRICT SUPERVISOR DATE 8/15/83

CONDITIONS OF APPROVAL, IF ANY:

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

Well File #521
PG-1

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

December 11, 1980

Mr. Roy Cunniff
Physical Science Laboratory
New Mexico State University
Box 3-PSL
Las Cruces, New Mexico 88003

Dear Mr. Cunniff:

Permission is hereby granted to test wells PG-1 and PG-3 as outlined in your letter of December 5, 1980.

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

cc: Carl Ulvog

PHYSICAL PLANT DEPARTMENT

Box 3545/Las Cruces, New Mexico 88003
Telephone (505) 646-3021

NEW MEXICO STATE UNIVERSITY

20 May 1983

Mr. Carl Ulvog
Oil Conservation Division
P.O. Box 2088
Santa Fe, NM 87503

Dear Mr. Ulvog,

Enclosed please find an original and three copies of Form G-101 for our planned well deepening program for NMSU-PG-1-LRG 521. Also enclosed is one copy of the original form G-102 filed for this well.

Please note that the plugging bond is identified as No. 635 8013, which currently applies to our wells PG-3 and OW-1. We are in process of realigning the three separate, multi-well plugging bonds to consolidate all of our geothermal wells in one bond (No. 635 8013). You will receive shortly a letter from our bond agent, Grindell and Robbins advising you.

Sincerely,

Calvin D. Black
Director, Physical Plant Department
New Mexico State University

Enclosures

NEW MEXICO STATE UNIVERSITY

Physical Science Laboratory

BOX 3-PSL, LAS CRUCES, NEW MEXICO 88003
AREA (505) 522-9100 TWX 910-983-0541

PG-1

#521

January 15, 1981

Mr. Joe D. Ramey
Director, Oil Conservation Division
P.O. Box 2088
Santa Fe, New Mexico 87501

Dear Mr. Ramey,

For continuing information to you, please find attached diagrams which reflect the extent of impoundment of geothermal waters from NMSU-PG-1, along with our plans for NMSU-PG-3.

NMSU-PG-1 was tested for 48 hours on 18-19 December, 1980, and again on a limited duration on 22 December. These tests were necessary to provide information on aquifer transmissibility, water quality, dissolved gas content and hydraulic head. As you can note from Enclosure One, almost all the water was contained within the first two check dams, and quickly percolated into the very porous soil.

We are planning to conduct a 48-hour flow test on NMSU-PG-3 sometime during the period 23-28 January 1981. If conditions warrant, during the latter part of the 48-hour period, we will pump NMSU-PG-1 in order to gain information on maximum possible sustained flow rate. We will use the check dams (four total) for NMSU-PG-1, along with those new dams we are erecting in the discharge channel from NMSU-PG-3. I can state with confidence that the geothermal waters will be contained within 300 yards distance from the wells.

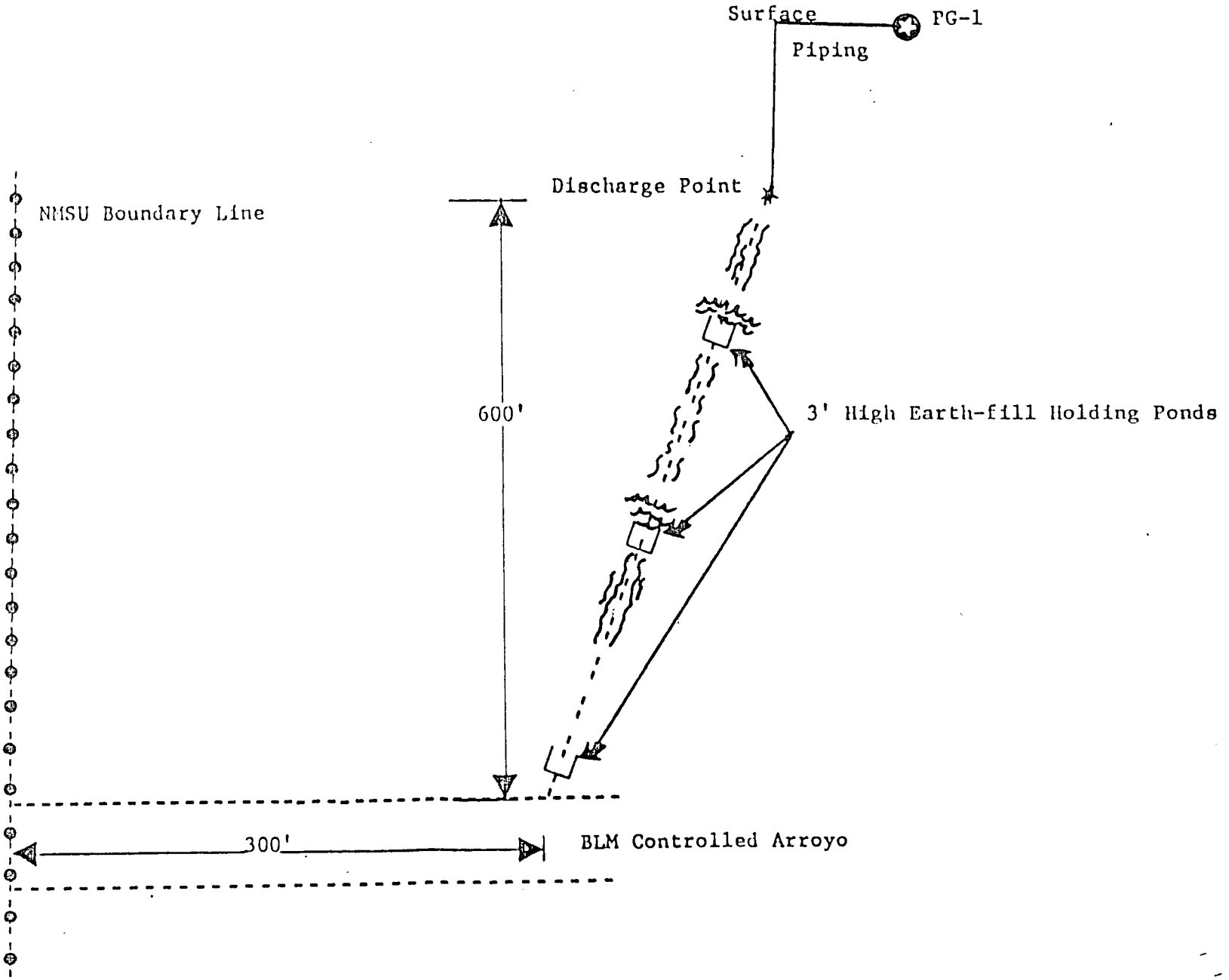
Sincerely,

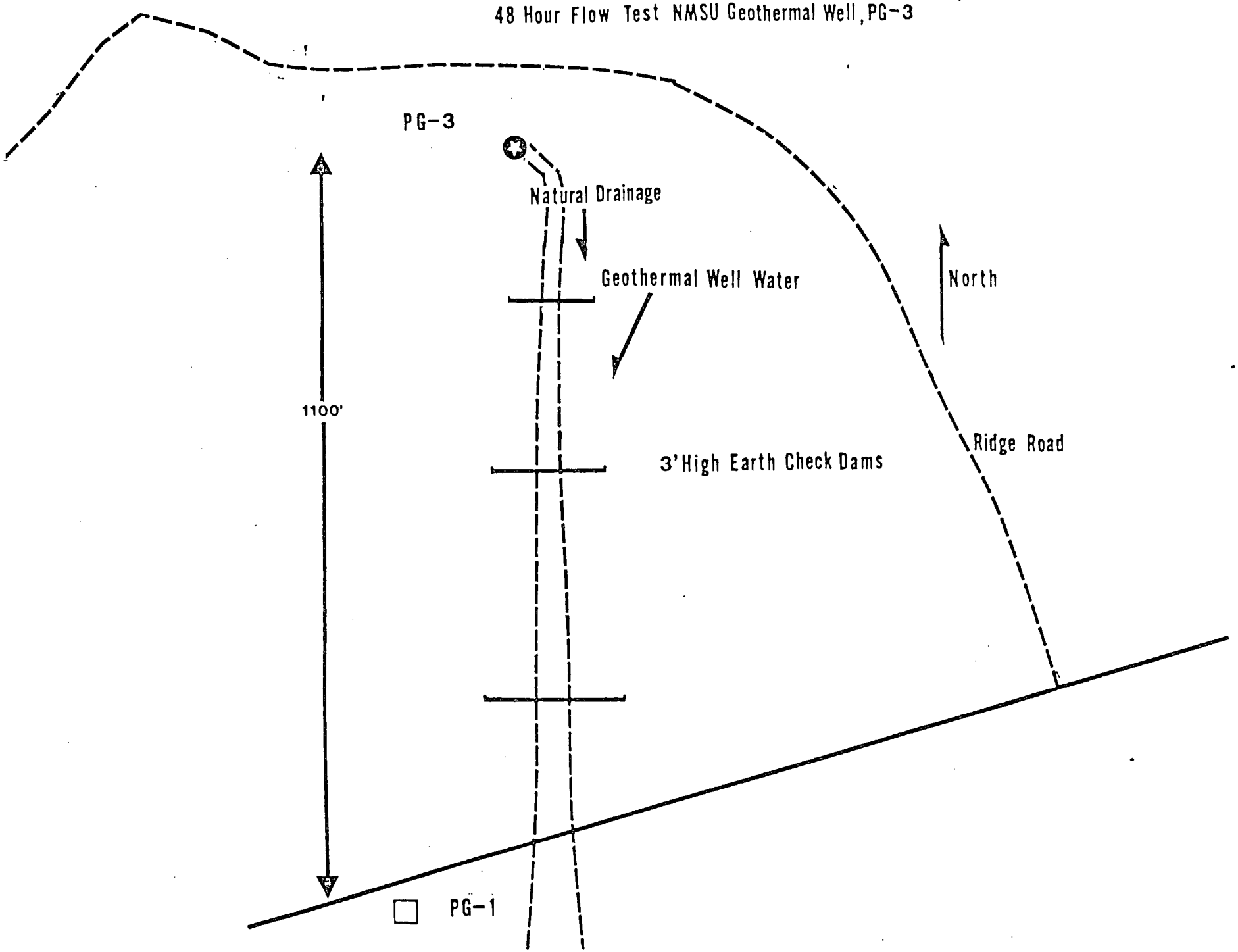
Roy A. Cunniff
NMSU Geothermal Project

Enclosures: 2 as stated

Control Measures in the
Vicinity of NMSU PG-1

Figure 3




48 Hour Flow Test NMSU Geothermal Well, PG-3
PG-3
Natural Drainage
Geothermal Well Water
North
1100'
3' High Earth Check Dams
Ridge Road
PG-1

#521

Well File
PG-1
Approval letter
12/11/80

NEW MEXICO STATE UNIVERSITY

Physical Science Laboratory

BOX 3-PSL, LAS CRUCES, NEW MEXICO 88003
AREA (505) 522-9100 TWX 910-983-0541

December 5, 1980

Subject: Request for approval of temporary surface discharge of geothermal water.

To: Oil Conservation Division
State Land Office Bldg.
P.O. Box 2088
Santa Fe, NM 87501
Attn: Mr. Joe Ramey

Dear Mr. Ramey:

Reference is made to my letter of November 12, 1980, and your response of November 20, 1980. Moreover, reference is made to the meeting with you on November 25, 1980, during which you provided additional guidance.

Forwarded herewith is a completed Form G-112, with supplementary data, in compliance with Rule 502 of your regulations. This form, however, does not appear to be completely adaptable to the problem of temporary surface discharge of geothermal water. Accordingly, fuller details are provided in the following paragraphs.

The requested approval is for the period December 10, 1980 through December 31, 1981. During that time frame, we will be testing the current production well PG-1, and also the new production well, PG-3, for which a permit application is pending. During testing of these wells, at least four tests will be conducted of 48-hours duration. For each test, we estimate approximately 2.2 acre feet of water will be discharged on the ground surface. In addition, we anticipate a need to operate the well pump on a more limited basis once each week to acquire water and gas samples, and to evaluate design changes in the pumps. Each of these limited-duration tests will discharge an estimated 0.1 to 0.2 acre feet of water onto the ground surface.

Our initial 48-hour test on PG-1 well is planned for 13-14 December, 1980, subject to your approval.

A brief summation of each of the key exhibits is as follows.

- Figure 1, together with Table 1, depicts the location and water chemistry analysis for all wells located near the PG-1 well. Also depicted is the location of all geothermal wells located within one mile of the PG-1. Figure 1 indicates a probable westerly limit of the geothermal aquifer. This is an artificial line of demarcation, however, because our tests and water chemistry analyses indicate that it is most likely that the warm geothermal water rises along a subsurface fault, and these migrate westerly and gradually mix with the cooler Rio Grande valley water. In support of this assumption, wells #16 and #17 in Figure 1 (DG-2 and DG-1 on Table 1) both intersected the water table at the same depth, and both encountered the same formations to total depth. In terms of temperature, however, the wells are significantly different. The DG-2 well had a positive temperature gradient and a temperature of 145°F at 1000 feet. Well DG-1, drilled 0.4 mile to the west, had a slightly negative gradient from the water table to bottom, and the 122°F temperature at the water table was then duplicated at hole bottom of 1200 feet.

- Depicted in Figure 1 and 2 are the natural drainage channels which the surface discharge would normally follow in the vicinity of PG-1. As is depicted, natural drainage is via a small arroyo southwesterly, intersecting with a BLM controlled arroy which passes west-southwest through NMSU property and adjoining private property, and then terminates in a large BLM flood control dam approximately three miles from the well. From measurements on the ground, the natural surface flow channel is approximately 300 yards (900 feet) from the well to NMSU boundary.

- Figure 3 depicts the earthen holding ponds constructed, to assure the geothermal water is contained on NMSU property. From the generalized lithologic logs of well PG-2, also enclosed, we believe that the geothermal water will percolate to the water table, and act to recharge the aquifer.

- Attached chemical analyses for PG-1 and PG-2 clearly indicate that the geothermal water permeates all water bearing formations from water table down to at least 1200 feet (the deepest well we have drilled). There is no evidence of fresh water formations overlying the geothermal waters at any point to the east of our assumed geothermal aquifer limit.

- Review of the chemical analysis indicates that the geothermal water meets all primary water standards. It does, however, exceed slightly the secondary standards for sodium, total alkalinity, chlorides, sulfates, manganese, and iron. This water meets the water quality standards for irrigation and other general use.

Request expeditious approval of this request for temporary surface discharge so as to enable us to meet our scheduled tests.

Sincerely,

Roy A. Cunniff
Principal Investigator,
NMSU Campus Geothermal Project

RAC:njb

Enclosures:

Form G-112
Figure 1, Location of Wells on and Near NMSU Land
Table 1, Summary of Data on Wells
Figure 2, Location of Wells within 1 mile of NMSU-PG-1
Figure 3, Control Measures in the Vicinity of NMSU-PG-1
Chemical Analysis of water from NMSU-PG-1
Chemical Analysis of water from NMSU-PG-2 (President's Well)
Technical Completion Report on NMSU-PG-1, containing lithologic and electric logs

Form G-103
Adopted 10/1/74

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U. S. G. S		
Operator	1	
Land Office		

NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

SUNDRY NOTICES AND REPORTS ON GEOTHERMAL RESOURCES WELLS

5. Indicate Type of Lease State ☐ Fee ☐
5.a State Lease No.

Do Not Use This Form for Proposals to Drill or to Deepen or Plug Back to a Different Reservoir. Use "Application For Permit —" (Form G-101) for Such Proposals.)

1. Type of well: Geothermal Producer ☐ Temp. Observation ☐ Low-Temp Thermal ☒ Injection/Disposal ☐
7. Unit Agreement Name

2. Name of Operator: New Mexico State University
8. Farm or Lease Name: NMSU-PG-1-LRG

3. Address of Operator: Box 3-PSL NMSU, Las Cruces, NM 88003
9. Well No.: 521

4. Location of Well
Unit Letter A 1,000 Feet From The East Line and 2,000 Feet From The North Line, Section 27 Township 23S Range 2E NMPM.
10. Field and Pool, or Wildcat: NMSU

15. Elevation (Show whether DF, RT, GR, etc.): 4200 ft. above MSL
12. County: Dona Ana

16. Check Appropriate Box To Indicate Nature of Notice, Report or Other Data

NOTICE OF INTENTION TO:				SUBSEQUENT REPORT OF:			
PERFORM REMEDIAL WORK	☐	PLUG AND ABANDON	☐	REMEDIAL WORK	☐	ALTERING CASING	☐
TEMPORARILY ABANDON	☐			COMMENCE DRILLING OPNS.	☐	PLUG & ABANDONMENT	☐
PULL OR ALTER CASING	☐	CHANGE PLANS	☒	CASING TEST AND CEMENT JOB	☐		
OTHER	☐			OTHER	☐		

17. Describe Proposed or completed Operations *(Clearly state all pertinent details, and give pertinenet dates, including estimated date of starting any proposed work)* SEE RULE 203.

This well was originally permitted as a temperature observation well, but its location was changed from unit letter E, 1500 feet from the North line, and 1000 feet from the West line, Sec. 35, Township 23S, Range 2E. The correct location is as now listed in Block 4. This well is also changed to a Low-Temp thermal well, instead of a Temp Observation. In addition, the well has been renumbered as NMSU-PG-1-LRG-521 in place of NMSU 2, to conform with the OCD and State Engineer well numbering systems.

18. I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNED Ryla Lewis Jeff TITLE Project Director DATE 5/15/80

APPROVED BY Carl Wong TITLE SENIOR PETROLEUM GEOLOGIST DATE 5/15/81

CONDITIONS OF APPROVAL, IF ANY:

NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

Form G-104
Adopted 10/1/7

CERTIFICATE OF COMPLIANCE AND AUTHORIZATION TO PRODUCE GEOTHERMAL RESOURCES

OWNER OR OPERATOR
Name New Mexico State University
Address Box 3445 NMSU, Las Cruces, NM 88003

TYPE OF WELL
Geothermal Producer [ ] Low-Temperature Thermal [X] Injection/Disposal [ ]

REASON FOR FILING
New Well [X] Recompletion [ ]
Change in Ownership [ ] Designation of Purchaser [ ]
Other (Please Explain) [ ] _____

DESCRIPTION OF WELL
Lease Name NMSU-PG1-LRG Well No. 521 Name of Reservoir NMSU
Kind of Lease (Fee, Fed. or State) Private Lease Number _____

LOCATION
Unit Letter A ; 1000 feet from the East line and 2000 feet from the North line of
Section 27 Township 23S Range 2E
County _____

TYPE OF PRODUCT
Dry Steam _____ Steam and Water _____ Low Temp. Thermal Water X

DESIGNATION OF PURCHASER OF PRODUCT
Name of Purchaser _____
Address of Purchaser _____
Product Will Be Used For _____

CERTIFICATE OF COMPLIANCE
I hereby certify that all rules and regulations concerning geothermal resources wells in the State of New Mexico, as promulgated by the Oil Conservation Commission of New Mexico, have been complied with, with respect to the subject well, and that the information given above is true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Roy A. Cunniff Position Project Director Date 2 Nov. 1981

Approved Carl Ulvog Position SENIOR PETROLEUM GEOLOGIST Date 12/8/81

Form G-105
Adopted 10/1/74

NEW MEXICO OIL CONSERVATION COMMISSION

P. O. Box 2088, Santa Fe 87501

RECEIVED
DEC 07 1981
OIL CONSERVATION DIVISION
SANTA FE

GEOTHERMAL RESOURCES WELL LOG

Operator New Mexico State University

Address Box 3445 NMSU, Las Cruces, NM 88003

Reservoir NMSU

Lease Name NMSU-PG1-LRG Well No. 521 Unit Letter A

Location: 1000 feet from the East line and
2000 feet from the North line Section 27

Township 23S Range 2E County Dona Ana

FORMATIONS PENETRATED BY WELL

DEPTH TO		Thickness	Drilled or Cored	Recovery	DESCRIPTION
Top of Formation	Bottom of Formation				
270	860	1200 or more	Drilled		Santa Fe group fill to 770 feet; fractured rhyolite alluvial deposits (Pennsylvanian) to TD.

Attach Additional Sheets if Necessary

See attached Technical ompletion Report

This form must be accompanied by copies of electric logs, directional surveys, physical or chemical logs, water analyses, tests, and temperature surveys (See Rule 205).

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Position Project Director Date 3 Nov. 1981

Form G-106
Adopted 10/1/74

NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

RECEIVED
DEC 07 1981
OIL CONSERVATION DIVISION
SANTA FE

GEOTHERMAL RESOURCES WELL SUMMARY REPORT

Operator New Mexico State University — Address Box 3445 NMSU, Las Cruces, NM 88003
Lease Name NMSU-PG1-LRG — Well No. 521
Unit Letter A — Sec. 27 — Twp. 23S — Rge 2E
Reservoir NMSU — County Dona Ana

Commenced drilling 9 October 1980
Completed drilling 2 November 1980
Total depth 860 — Plugged depth
Junk

GEOLOGICAL MARKERS	DEPTH
Santa Fe Gravel	0 - 860 feet

Commenced producing 1 January 1982 (Date)
Geologic age at total depth: Recent Quatenary

Date	Static test Shut-in well head		Production Test Data								
			Total Mass Flow Data					Separator Data			
	Temp. °F	Pres. Psig.	Lbs/Hr	Temp. °F	Pres. Psig.	Enthalpy	Orifice	Water cuft/Hr	Steam Lbs/Hr	Pres. Psig.	Temp. °F
7-1-80	142°F	0	150,000	142°F	150						

CASING RECORD (Present Hole)

Size of Hole	Size of Casing	Weight of Csg/ft.	Grade of Casing	New or Used	Seamless or Lapweld	Depth of Shoe	Top of Casing	Number of Sacks Cement	Top of Cement	Cement Top Determined By
17"	10 3/4	40.00		New	Seamless	N/A	2' above GL	120 cubic feet	Surface	Inspection

PERFORATED CASING

(Size, top, bottom, perforated intervals, size and spacing of perforation and method.)

Slotted steel, 1/10" slots, 60 slots/foot, from 700 to 850 feet of depth.

Was analysis of effluent made? Yes — Electrical log depths 860 — Temperature log depths 860

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A Cunniff — Position Project Director — Date 4 December 1981

Form G-107
Adopted 10/1/74

NEW MEXICO OIL CONSERVATION COMMISSION

P. O. Box 2088, Santa Fe 87501

RECEIVED
DEC 07 1981
OIL CONSERVATION DIVISION
SANTA FE

GEOTHERMAL RESOURCES WELL HISTORY

Operator New Mexico State University Address Box 3445 NMSU, Las Cruces, NM 88003

Lease Name NMSU-PG-1-LRG Well No. 521

Unit Letter A Sec. 27 Twp. 23S Rge 2E

Reservoir NMSU County Dona Ana

It is of the greatest importance to have a complete history of the well. Use this form to report a full account of all important operations during the drilling and testing of the well or during re-drilling, altering of casing, plugging, or abandonment with the dates thereof. Be sure to include such items as hole size, formation test details, amounts of cement used, top and bottom of plugs, perforation details, sidetracked junk, bailing tests, shooting, and initial production data and zone temperature. (Attach additional sheets if necessary.)

Date	
Nov 79	Completed drilling, set screen and casing.
Feb 80	Commenced 48-hour pump test with contractor-operated pump. 200 gpm at 142°F. Water initially contained large amounts of sand and mud, which cleared.
July 80	Set Peerless 50 hp surface turbine pump, and conducted 10-day flow test. Well was pumped at 200 gpm and 142°F for ten days. Water analysis showed 2000 ppm TDS. Subsequently, water was analysed for dissolved gases, and analysis showed CO_2 at 220 cc/liter, with 14 cc/liter of N_2 and traces of other rare gases.
July 81	A combined flow test was conducted using NMSU-PG-1-LRG-521, and NMSU-PG-3-LRG-520. This 48-hour test showed a combined flow rate of 550 gpm was possible. During this test, the Peerless pump malfunctioned incident to an aquifier surge in which the flow rate increased to 350 gpm and large amounts of sand and mud were discharged. Effluent became clean after 30 minutes.
Aug 81	Using a 100 hp TRW-REDA submersible pump, the well was test-pumped at 365 gpm for 24 hours. Water temperature, water quality, and dissolved gases remained constant during these tests. Pump produced 365 gpm at 0 psig, at planned flow rate of 250 gpm, the pump will produce 240 psig back pressure. Pump has been connected to gas separator complex, which produces separation of 120 cc of CO_2 gas per liter of fluid, at a flow rate of 200 gpm.

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Position Project Director Date 2 Nov. 1981

Form G-105
Adopted 10/1/74

NEW MEXICO OIL CONSERVATION COMMISSION

P. O. Box 2088, Santa Fe 87501

GEOTHERMAL RESOURCES WELL LOG

Operator New Mexico State University

Address Box 3445 NMSU, Las Cruces, NM 88003

Reservoir NMSU

Lease Name NMSU-PG1-LRG Well No. 521 Unit Letter A

Location: 1000 feet from the East line and
2000 feet from the North line Section 27

Township 23S Range 2E County Dona Ana

FORMATIONS PENETRATED BY WELL

DEPTH TO		Thickness	Drilled or Cored	Recovery	DESCRIPTION
Top of Formation	Bottom of Formation				
270	860	1200 or more	Drilled		Santa Fe group fill to 770 feet; fractured rhyolite alluvial deposits (Pennsylvanian) to TD.

Attach Additional Sheets if Necessary

See attached Technical ompletion Report

This form must be accompanied by copies of electric logs, directional surveys, physical or chemical logs, water analyses, tests, and temperature surveys (See Rule 205).

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Position Project Director Date 3 Nov. 1981

NEW MEXICO OIL CONSERVATION COMMISSION
P. O. Box 2088, Santa Fe 87501

Form G-106
Adopted 10/1/74

GEOTHERMAL RESOURCES WELL SUMMARY REPORT

Operator New Mexico State University Address Box 3445 NMSU, Las Cruces, NM 88003

Lease Name NMSU-PG1-LRG Well No. 521

Unit Letter A Sec. 27 Twp. 23S Rge 2E

Reservoir NMSU County Dona Ana

Commenced drilling 9 October 1980

Completed drilling 2 November 1980

Total depth 860 Plugged depth

Junk

Commenced producing 1 January 1982 (Date)

GEOLOGICAL MARKERS	DEPTH
Santa Fe Gravel	0 - 860 feet

Geologic age at total depth: Recent Quatenary

Date	Static test Shut-in well head		Production Test Data								
			Total Mass Flow Data					Separator Data			
	Temp. °F	Pres. Psig.	Lbs/Hr	Temp. °F	Pres. Psig.	Enthalpy	Orifice	Water cuft/Hr	Steam Lbs/Hr	Pres. Psig.	Temp. °F
7-1-80	142°F	0	150,000	142°F	150						

CASING RECORD (Present Hole)

Size of Hole	Size of Casing	Weight of Csg/ft.	Grade of Casing	New or Used	Seamless or Lapweld	Depth of Shoe	Top of Casing	Number of Sacks Cement	Top of Cement	Cement Top Determined By
17"	10 3/4	40.00		New	Seamless	N/A	2' above GL	120 cubic feet	Surface	Inspection

PERFORATED CASING
(Size, top, bottom, perforated intervals, size and spacing of perforation and method.)

Slotted steel, 1/10" slots, 60 slots/foot, from 700 to 850 feet of depth.

Was analysis of effluent made? Yes Electrical log depths 860 Temperature log depths 860

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A Cunniff Position Project Director Date 4 December 1981

Form G-107
Adopted 10/1/74

NEW MEXICO OIL CONSERVATION COMMISSION

P. O. Box 2088, Santa Fe 87501

GEOTHERMAL RESOURCES WELL HISTORY

Operator New Mexico State University Address Box 3445 NMSU, Las Cruces, NM 88003

Lease Name NMSU-PG-1-LRG Well No. 521

Unit Letter A Sec. 27 Twp. 23S Rge 2E

Reservoir NMSU County Dona Ana

It is of the greatest importance to have a complete history of the well. Use this form to report a full account of all important operations during the drilling and testing of the well or during re-drilling, altering of casing, plugging, or abandonment with the dates thereof. Be sure to include such items as hole size, formation test details, amounts of cement used, top and bottom of plugs, perforation details, sidetracked junk, bailing tests, shooting, and initial production data and zone temperature. (Attach additional sheets if necessary.)

Date	
Nov 79	Completed drilling, set screen and casing.
Feb 80	Commenced 48-hour pump test with contractor-operated pump. 200 gpm at 142°F. Water initially contained large amounts of sand and mud, which cleared.
July 80	Set Peerless 50 hp surface turbine pump, and conducted 10-day flow test. Well was pumped at 200 gpm and 142°F for ten days. Water analysis showed 2000 ppm TDS. Subsequently, water was analysed for dissolved gases, and analysis showed CO_2 at 220 cc/liter, with 14 cc/liter of N_2 and traces of other rare gases.
July 81	A combined flow test was conducted using NMSU-PG-1-LRG-521, and NMSU-PG-3-LRG-520. This 48-hour test showed a combined flow rate of 550 gpm was possible. During this test, the Peerless pump malfunctioned incident to an aquifier surge in which the flow rate increased to 350 gpm and large amounts of sand and mud were discharged. Effluent became clean after 30 minutes.
Aug 81	Using a 100 hp TRW-REDA submersible pump, the well was test-pumped at 365 gpm for 24 hours. Water temperature, water quality, and dissolved gases remained constant during these tests. Pump produced 365 gpm at 0 psig, at planned flow rate of 250 gpm, the pump will produce 240 psig back pressure. Pump has been connected to gas separator complex, which produces separation of 120 cc of CO_2 gas per liter of fluid, at a flow rate of 200 gpm.

CERTIFICATION

I hereby certify that the information given above and the data and material attached hereto are true and complete to the best of my knowledge and belief.

Signed Roy A. Cunniff Position Project Director Date 2 Nov. 1981

NEW MEXICO STATE UNIVERSITY

Physical Science Laboratory

BOX 3-PSL, LAS CRUCES, NEW MEXICO 88003
AREA (505) 522-9100 TWX 910-983-0541

PG-1

#521

November 23, 1981

Mr. Carl Ulvog
Oil Conservation Commission
P.O. Box 2088
Santa Fe, NM 87501

Dear Mr. Ulvog,

As we have previously discussed, I can find no record of an approved G-103 for NMSU-PG-1. This well was completed in November 1979.

Accordingly, forwarded herewith in duplicate is a properly completed G-103. You will note that this well is now identified as follows:

Name	Number
NMSU-PG1-LRG	521

From our records, it appears the forms G-101 and G-102 for permission to drill this well identified it as NMSU-DG-3. Please amend the G-101 and G-102 on this well to the correct name and number identified above.

Sincerely,

Roy A. Cunniff

RAC/sm

Encl. G-103

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

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U. S. G. S		
Operator	1	
Land Office		

OIL CONSERVATION DIVISION

P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

RECEIVED
DEC 01 1981
OIL CONSERVATION DIVISION
SANTA FE

Form G-103
Adopted 10-1-74
Revised 10-1-78

SUNDRY NOTICES AND REPORTS ON GEOTHERMAL RESOURCES WELLS

Do Not Use This Form for Proposals to Drill or to Deepen or Plug Back to a Different Reservoir. Use "Application For Permit –" (Form G-101) for Such Proposals.)

5. Indicate Type of Lease: State ☐ Fee ☐
5.a State Lease No.: N/A

1. Type of well: Geothermal Producer ☐ Temp. Observation ☐ Low-Temp Thermal ☒ Injection/Disposal ☐
7. Unit Agreement Name: N/A
2. Name of Operator: New Mexico State University
8. Farm or Lease Name: NMSU-PG1-LRG
3. Address of Operator: Box 3445 NMSU Las Cruces, NM 88003
9. Well No.: 521
4. Location of Well: Unit Letter A 1,000 Feet From The East Line and 2,000 Feet From The North Line, Section 27 Township 235 Range 2E NMPM.
10. Field and Pool, or Wildcat: NMSU
15. Elevation (*Show whether DF, RT, GR, etc.*): 4160 Feet above MSL
12. County: Dona Ana

16. Check Appropriate Box To Indicate Nature of Notice, Report or Other Data

NOTICE OF INTENTION TO:
- PERFORM REMEDIAL WORK ☐
- PLUG AND ABANDON ☐
- TEMPORARILY ABANDON ☐
- PULL OR ALTER CASING ☐
- CHANGE PLANS ☐
- OTHER ☐

SUBSEQUENT REPORT OF:
- REMEDIAL WORK ☐
- ALTERING CASING ☐
- COMMENCE DRILLING OPNS. ☐
- PLUG & ABANDONMENT ☐
- CASING TEST AND CEMENT JOB ☐
- OTHER Well completion ☐

17. Describe Proposed or completed Operations (*Clearly state all pertinent details, and give pertinenet dates, including estimated date of starting any proposed work*) SEE RULE 203.

Well was drilled by Guffey Drilling, and completed 2 November 1979. Casing is 10 3/4-inch, Schedule 40 steel. Casing extends from ground surface to 700 feet of depth. Screen section extends from 700 feet to 850 feet. Screen consists of slotted steel pipe, with 60 slots per feet. Each slot is 1/10-inch by 3-inches.

Hole was drilled 17-inches in diameter, and screen is gravel packed from 860 to 700 feet, sand packed from 700 to 670 feet, and cemented from 670 feet to ground surface.

Baling established water temperature of 142 °F, and 2000 ppm TDS.

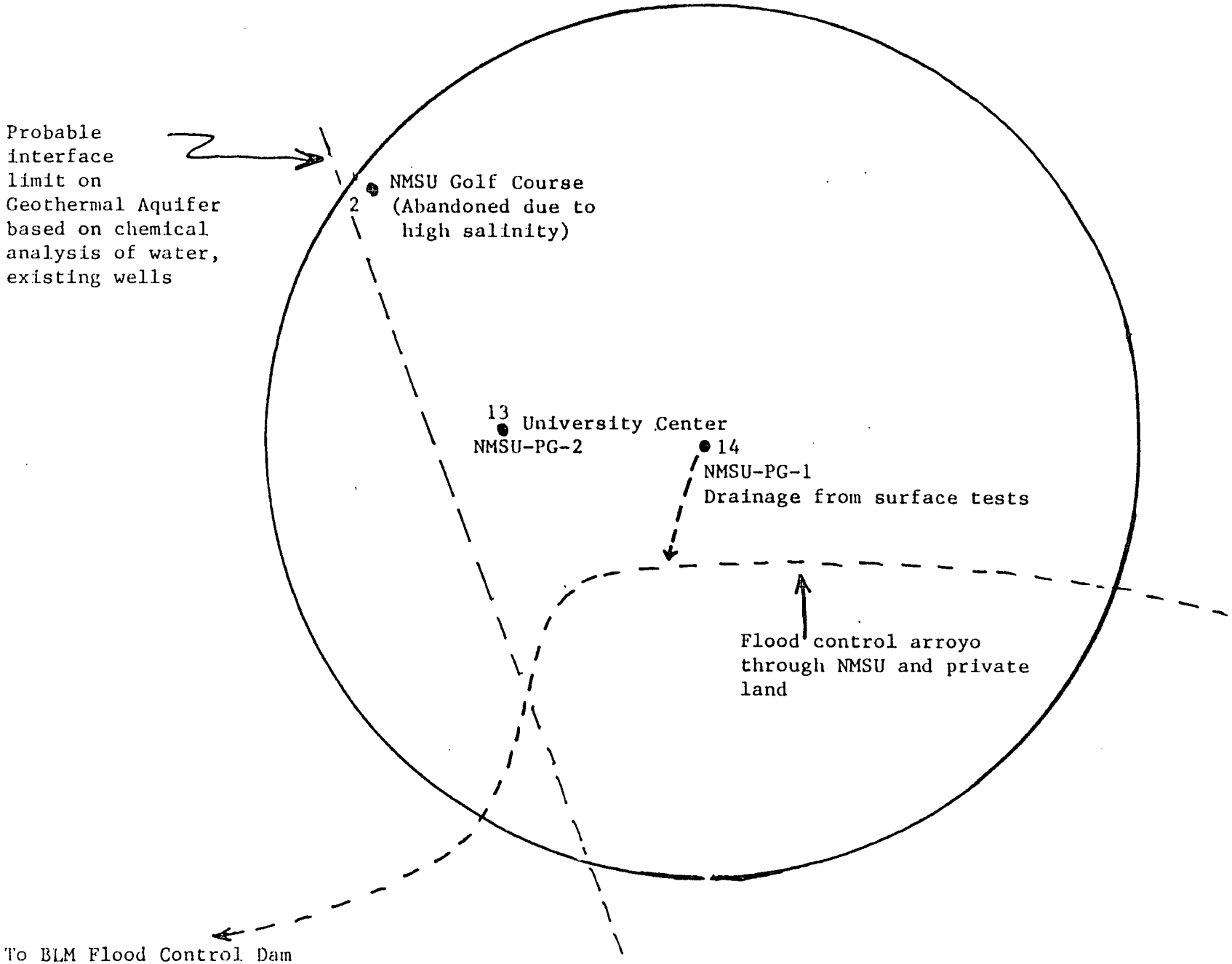
Subsequently, well was test-pumped with contractor test pump at 200 gpm for 48 hours.

18. I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNED Roy A. Cunniff TITLE Project Director DATE 23 November 1981

APPROVED BY Carl Ulvog TITLE SENIOR PETROLEUM GEOLOGIST DATE 12-1-81

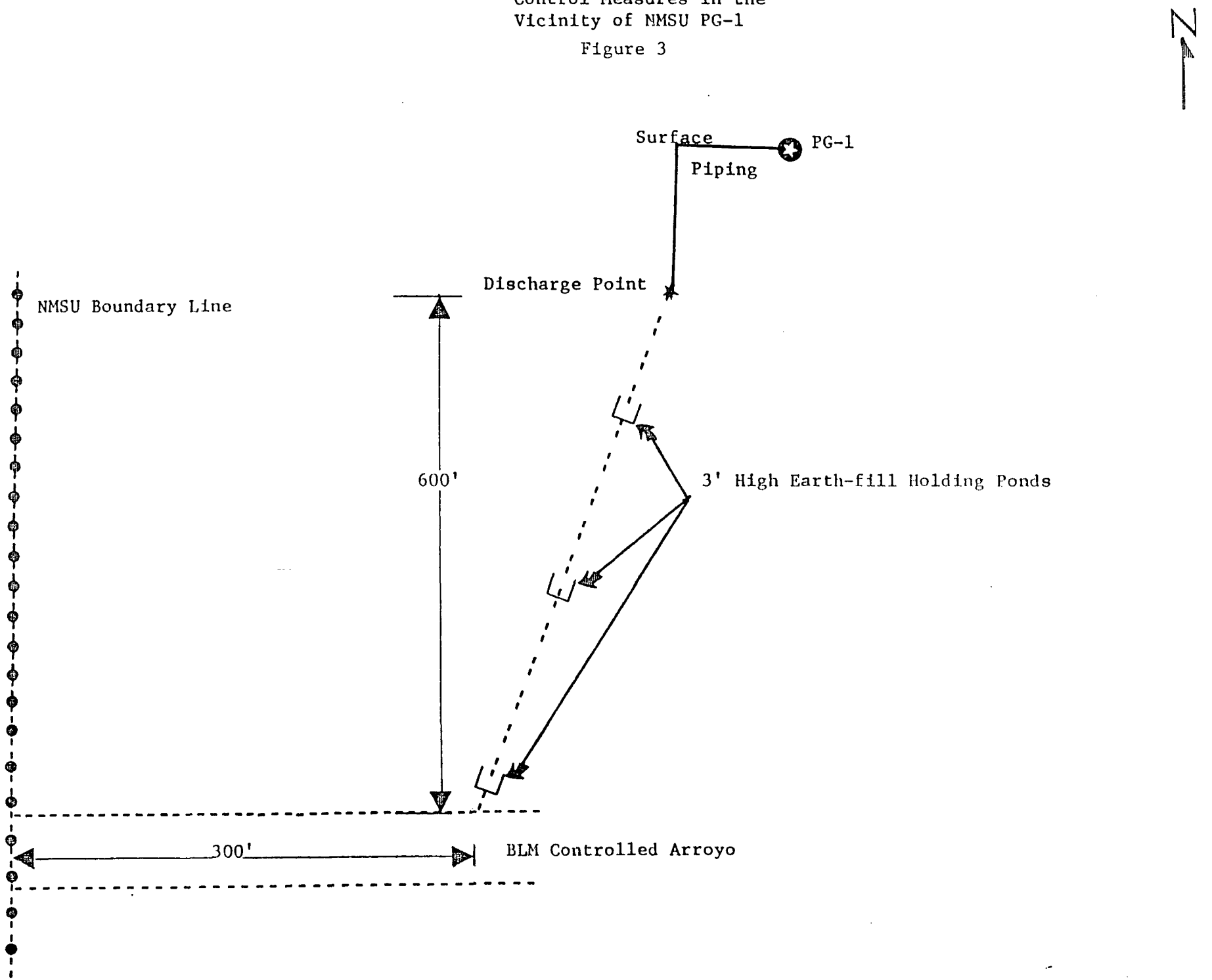
CONDITIONS OF APPROVAL, IF ANY:



Location of Wells Within 1 Mile of NMSU-PG-1
Figure 2

Control Measures in the
Vicinity of NMSU PG-1

Figure 3



NEW MEXICO STATE UNIVERSITY

DEPARTMENT OF AGRONOMY — COLLEGE OF AGRICULTURE AND HOME ECONOMICS

INTER-OFFICE MEMORANDUM

To: George Mitchell

Date: 8-14-80

From: Andrew Lee Bristol

Subject: Geothermal Well Samples (NMSU-PG-1)

Sample	µmhos/cm E.C.	pH	meq/L Na	K	Ca	Mg	Cl	CO_3	HCO_3	SO_4
13A hot	3,060	7.95	20.20	1.40	7.87	2.48	16.16	0	10.20	6.09
27A hot	3,110	7.79	21.00	1.50	7.45	2.42	16.35	0	10.22	6.08
27 cool	3,110	7.36	20.89	1.48	7.77	2.44	16.66	0	10.04	5.93

	mg/L TDS	NO_3-N	Na	K	Ca	Mg	Cl	CO_3	HCO_3	SO_4
13A hot	1950	.03		54.7			572.9	0	622.4	292.5
27A hot	1988	.02		58.6			579.6	0	623.6	292.0
27 cool	2000	.02		57.9			590.6	0	612.6	285.0

	mg/L Fe	Mn	As	Ba	Cd	Cr	Pb	Hg	Se	Ag	Cu
13A hot	.78	.11	.002	<.4	<.005	<.05	<.005	.0003	.002	<.05	<.10
27A hot	.43	.05	.004	<.4	<.005	<.05	<.005	.0005	.002	<.05	<.10
27 cool	.38	.06	.002	<.4	<.005	<.05	<.005	<.0002	.002	<.05	<.10

	mg/L P	B	Zn	SiO_2	F	Hardness	Alkalinity
13A hot	.05	.17	.02	81.5	1.27		510
27A hot		.16	<.02	90.0	1.31		511
27 cool		.16	<.02	92.0	1.12		502

M E M O R A N D U M

November 11, 1980

TO: Roy Cunniff, PSL

FROM: Fernando Cadena, CE [illegible]

SUBJECT: Geothermal Well Water Analyses (Cool)
(NMSU-PG-1)

Method:	Atomic Absorption			EDTA Titration	
Sampling Date	Ca^{++} (mg/l)	Mg^{++} (mg/l)	Na^{++} (mg/l)	Ca^{++} (mg/l)	Mg^{++} (mg/l)
10/24/80	75.6	19.0	445.0	78.4	12.7
7/21/80	75.3	19.0		77.6	12.7
7/16/80				78.8	12.7

Sampling Date	pH	HCO_3 (mg/l)	CO_3 (mg/l)	TDS (mg/l)
10/24/80	6.85	616	0	1936
7/21/80	7.10	625	0	1904
7/16/80	7.15	617	0	1913

Sampling Date	Total Hardness * (mg/l as $CaCO_3$)	Total Alkalinity (mg/l as $CaCO_3$)
10/24/80	248	505
7/21/80	246	512
7/10/80	249	506

* Using EDTA Titration Results

rs
cc: C. G. Keyes, Jr.
George Mitchell

NEW MEXICO STATE UNIVERSITY

Physical Science Laboratory

BOX 3-PSL, LAS CRUCES, NEW MEXICO 88003
AREA (505) 522-9100 TWX 910-983-0541

PG-1 #521

November 12, 1980

Subject: Request for approval of temporary surface discharge of geothermal water.

To: Oil Conservation Division
State Land Office Bldg.
P.O. Box 2088, Santa Fe, NM 87501
ATTN: Mr. Carl Ulvog

Dear Mr. Ulvog,

As we discussed by telephone on 12 November, 1980, forwarded herewith is a request for approval of temporary surface discharge of geothermal water from NMSU wells PG-1 and (new) PG-3. This request is submitted based on the need for temporary surface disposal of geothermal waters during testing of the geothermal aquifer during the next 12 month period, and is in compliance with Rule 502 of your regulations.

Attached are exhibits which define the probable limits of the geothermal aquifer, and the location of the current production well NMSU-PG-1. As is shown, the only wells located within one mile of the PG-1 are the University Center well NMSU-PG-2, and the abandoned NMSU golf course well. The newest well, NMSU-PG-3, for which a permit application is pending, will be drilled approximately 1,000 feet North-East of PG-1. Because only these wells are involved, request a waiver of the 20-day period defined in Rule 502.

The attached plot plans (Enclosures 1 and 3) also depict the natural drainage system for surface waters in the vicinity of PG-1. As is depicted, natural drainage is via a small arroyo southwesterly, intersecting with a BLM controlled arroyo which passes west-southeast through NMSU property and adjoining private property, and then terminates in a large BLM flood control dam approximately three miles from the well. From measurements on the ground, the natural surface flow channel is approximately 300 yards (900 feet) from the well to NMSU boundary. This is a key point, because at the tested flow rate of 100-200 gpm, the surface discharge percolates into the very porous arroyo soil within 600 feet distance from the well. Accordingly, the surface discharge is contained within NMSU property.

Also depicted on the attached plots is the inferred westerly boundary of the geothermal aquifer. From chemical analysis of existing wells, the water quality at the water table is in the range of 1500-2000 gpm total dissolved solids everywhere to the East of the dashed line denoting probable aquifer limits. Accordingly, the conclusion is that percolation of the surface discharged geothermal water acts to recharge the existing geothermal aquifer at the water table.

Chemical analyses of the geothermal water from NMSU-PG-1 are attached. From these analyses, it can be determined that the water meets all primary water standards, and slightly exceeds secondary standards for sodium and total alkalinity.

This request is designed to cover surface disposal of geothermal water from a planned 48-hour flow test on or about 30 November 1980, and a follow-on 48-hour pumping test of the new well (PG-3) in late December 1980. During each test, it is estimated that 2.2 acre feet of geothermal water will be discharged on the surface. In addition, other tests in the next year are planned on a twice monthly basis for limited operation. These tests discharge roughly 0.1 acre feet per test. We also envision at least two additional 48-hour flow tests during the period January-August, 1981.

Request expeditious approval of this request so as to enable us to complete the scheduled tests. If re-application is necessary using form G-112, please advise.

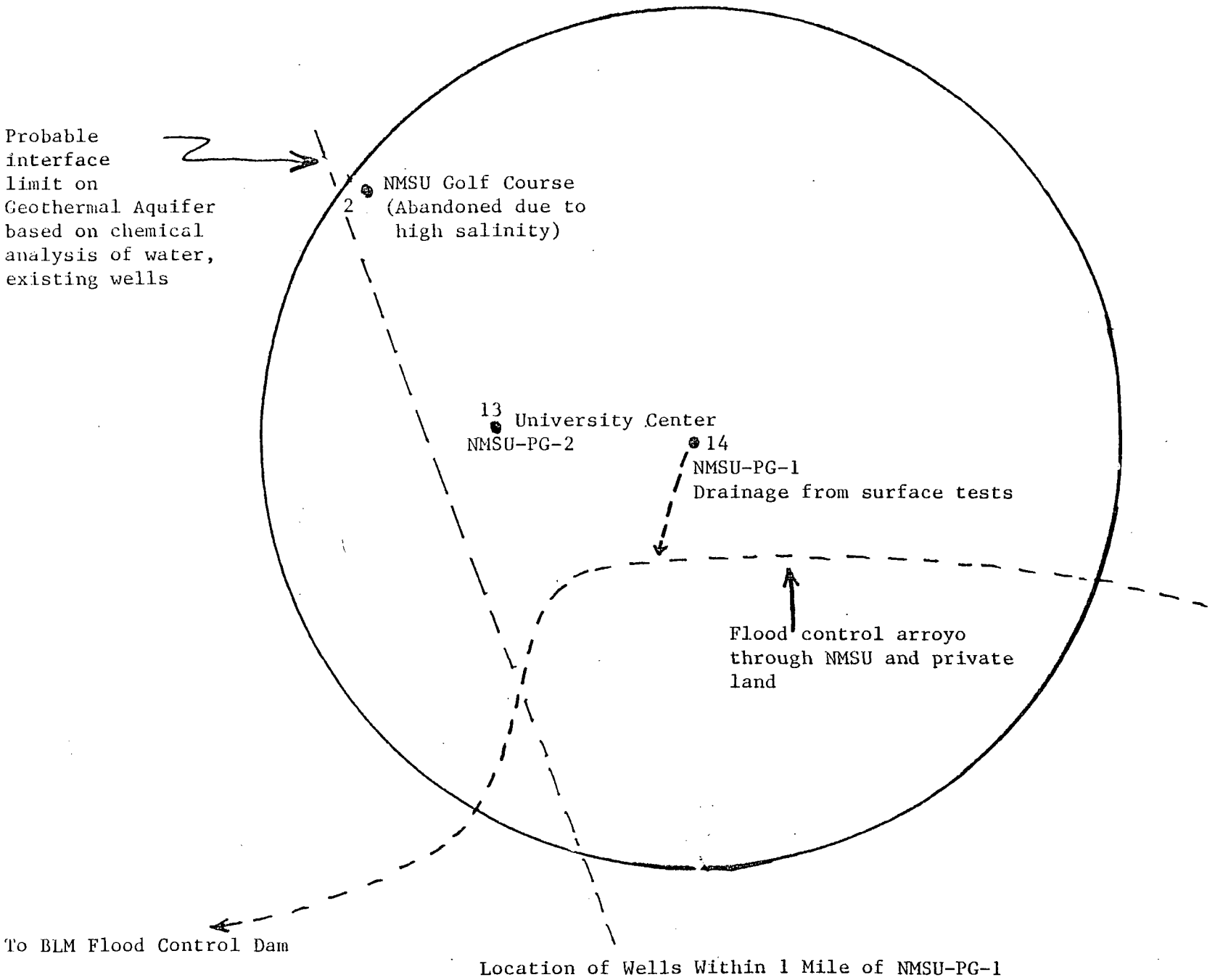
Sincerely,

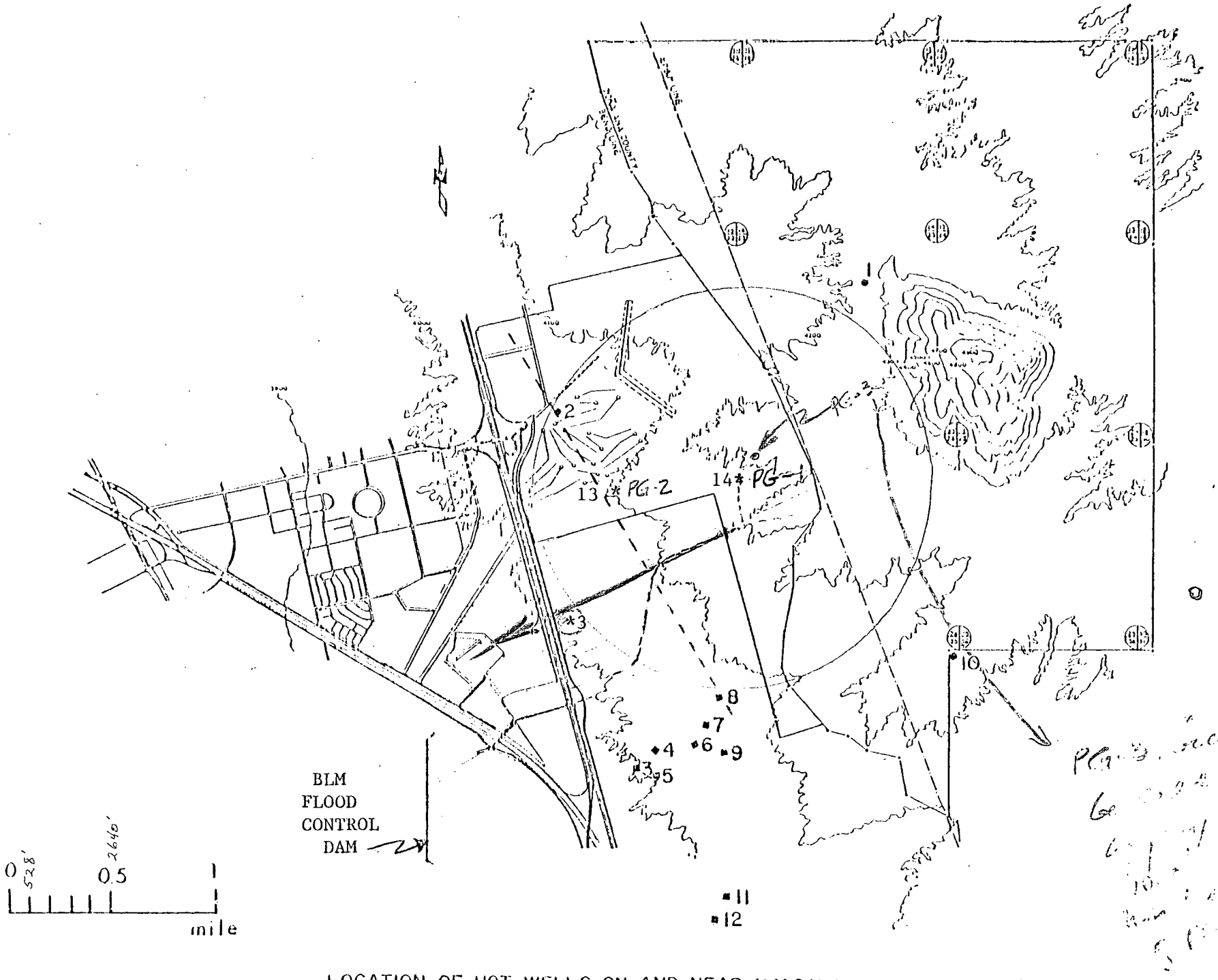
Roy A. Cunniff
Principal Investigator, NMSU Campus Geothermal Project

RAC:sm

Enclosures:

Figure 1, Location of hot wells on and near NMSU land.
Table 1, Summary of data on hot wells in Las Alturas and surrounding area.
Figure 2, Location of wells within 1 mile of the NMSU-PG-1.
Chemical analysis of geothermal water from NMSU-PG-1.


Probable interface limit on Geothermal Aquifer based on chemical analysis of water, existing wells
2
NMSU Golf Course (Abandoned due to high salinity)
13
University Center
NMSU-PG-2
14
NMSU-PG-1
Drainage from surface tests
Flood control arroyo through NMSU and private land
To BLM Flood Control Dam
Location of Wells Within 1 Mile of NMSU-PG-1



LOCATION OF HOT WELLS ON AND NEAR N.M.S.U. LAND

Figure 1

TABLE 1

SUMMARY OF DATA ON HOT WELLS IN LAS ALTURAS AND SURROUNDING AREA

(Numbering of wells same as Fig. 1)

Well No.	Year of Drilling	Owner and Location (Past and Present)	Max. Temperature	Water Level (ft.)	Total Depth	Total Dissolved Solids PPM	Remarks
1	1960	NMSU Near Antenna Towers NW Tortugas Mtns.	Hot	Dry	200	-	Dry; hot well, "Tools too hot to hold in hand
2	1961-62	NMSU Golf Course	24°C	-	630	1575	Abandoned due to high salinity
3	1957	Soules Las Alturas Estate	25°C	161	296	-	
4	1963	L. R. Evans	Hot	174	332	-	
5	1964	Wm. Evans/Partridge	Hot	-	256	-	
6	1964	Rowan	36.7°C	190-200	330	-	
7	1964	White/Cutcher	34°C	190	311	-	
8	1964	Mattons/Huddleston	45°C	240	335	1625	
9	1964	Husand/Kinzer	42.5	180	348	520	
10	1948-49	Clary & Ruther State No. 1	Hot	526	2573	-	
11	1975	Charles Jordan	46°C	200	330	-	4" casing being used for drinking water
12	1966 to 1969	Wayne Johnson	70°F	165	280	Potable	4" PVC being used for domestic purposes on Trailer Park 2000 gallons per day from two wells
13	1979	NMSU-PG-2	118°F	278	505	1575	20 gpm flow tested
14	1979	NMSU-PG-1	141°F	255	860	1900-2000	200 gpm flow tested

M E M O R A N D U M

November 11, 1980

TO: Roy Cunniff, PSL

FROM: Fernando Cadena, CE F.C.

SUBJECT: Geothermal Well Water Analyses (Cool) PG-1

Method:	Atomic Absorption			EDTA Titration	
Sampling Date	Ca^{++} (mg/l)	Mg^{++} (mg/l)	Na^{++} (mg/l)	Ca^{++} (mg/l)	Mg^{++} (mg/l)
10/24/80	75.6	19.0	445.0	78.4	12.7
7/21/80	75.3	19.0		77.6	12.7
7/16/80				78.8	12.7

Sampling Date	pH	HCO_3 (mg/l)	CO_3 (mg/l)	TDS (mg/l)
10/24/80	6.85	616	0	1936
7/21/80	7.10	625	0	1904
7/16/80	7.15	617	0	1913

Sampling Date	Total Hardness * (mg/l as $CaCO_3$)	Total Alkalinity (mg/l as $CaCO_3$)
10/24/80	248	505
7/21/80	246	512
7/10/80	249	506

* Using EDTA Titration Results

rs
cc: C. G. Keyes, Jr.
George Mitchell

NEW MEXICO OIL CONSERVATION COMMISSION

Form G-102
10-1-74

GEOTHERMAL RESOURCES WELL LOCATION AND ACREAGE DEDICATION PLAT

All distances must be from the outer boundaries of the Section.

Operator	Lease	Well No.
NMSU - Lokesh Chaturvedi	University Land	NMSU-2 521

NOV 28 1978

CONS.

Unit Letter	Section	Township	Range	County
E	35	23S	2E	Dona Ana

Actual Footage Location of Well:
1500 feet from the North line and 1000 feet from the West line

Ground Level Elev.	Producing Formation	Pool	Dedicated Acreage:
4100 ft.			Acres

1. Outline the acreage dedicated to the subject well by colored pencil or hachure marks on the plat below.

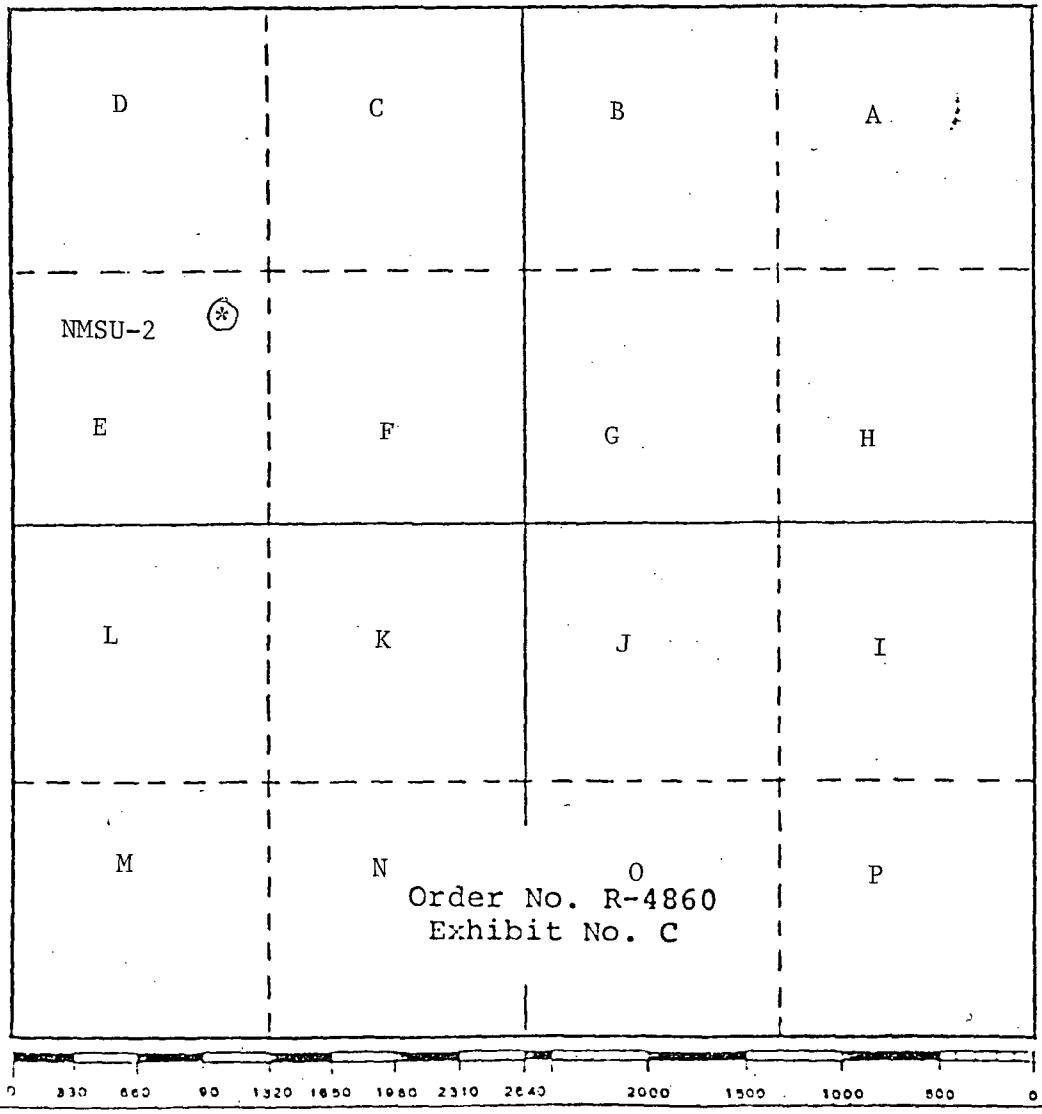
2. If more than one lease is dedicated to the well, outline each and identify the ownership thereof (both as to working interest and royalty).

3. If more than one lease of different ownership is dedicated to the well, have the interests of all owners been consolidated by communitization, unitization, force-pooling. etc?

☐ Yes ☐ No If answer is "yes," type of consolidation _____

If answer is "no," list the owners and tract descriptions which have actually been consolidated. (Use reverse side of this form if necessary.) _____

No allowable will be assigned to the well until all interests have been consolidated (by communitization, unitization, forced-pooling, or otherwise) or until a non-standard unit, eliminating such interests, has been approved by the Commission.



CERTIFICATION

I hereby certify that the information contained herein is true and complete to the best of my knowledge and belief.

Lokesh Chaturvedi

Name
Assistant Professor

Position
New Mexico State University

Company
Las Cruces, NM 88003

Date
November 14, 1978

I hereby certify that the well location shown on this plat was plotted from field notes of actual surveys made by me or under my supervision, and that the same is true and correct to the best of my knowledge and belief.

Date Surveyed

Registered Professional Engineer and/or Land Surveyor

Certificate No.

PG-1 also #521

EMD 77-2218

NEW MEXICO STATE UNIVERSITY GEOTHERMAL PRODUCTION WELL

Lokesh Chaturvedi

January 1981

New Mexico Energy Research and Development Program

EMD 77-2218

NEW MEXICO STATE UNIVERSITY

GEOTHERMAL PRODUCTION WELL

Technical Completion Report
(1/1/78 - 12/31/79)

Principal Investigator:

Lokesh Chaturvedi
Associate Professor, Geological Engineering
New Mexico State University
Las Cruces, New Mexico 88003

May 1980

The work from which this material is drawn was conducted with the support of the New Mexico Energy and Minerals Department Contract No. 77-2218 through the New Mexico Energy Institute at New Mexico State University, and the United States Department of Energy Division of Geothermal Energy Contract No. EW-78-05-07-1717. However, the author remains solely responsible for the content of this material.

EXPLANATORY NOTES TO ACCOMPANY THE TECHNICAL COMPLETION REPORT ON NMSU GEOTHERMAL PRODUCTION WELL BY LOKESH CHATURVEDI

1. This report was written as Chapter 12 of the Technical Completion Report for the DOE State Coupled Direct Heat Low Temperature Geothermal Project. This is the explanation for references to Chapters 10 and 11 on page 2.

2. Exploratory holes DT-1 and DT-2 (Fig. 1) were originally named NMSU-DG-2 and NMSU-DG-1 respectively. In writing this report, the author agreed to use New Mexico Energy Institute nomenclature of DT-1 and DT-2 for the two exploratory geothermal gradient wells and PG-1 for the first production geothermal well. The nomenclature in Appendix A is the old one because it is a true copy of the technical specifications for the production well as distributed to the potential bidders. In brief, DT-1 = NMSU-DG-2 and DT-2 = NMSU-DG-1.

3. Appendix B contains the lithologic analysis of cuttings from well NMSU-PG-1 down to 1,000 feet when the total depth of this well is 860 feet. Since DT-1 is only about 15 feet away from PG-1 and the well cuttings were identical from the two wells, the analysis of cuttings from DT-1 were used for the interval 860 feet to 1,000 feet in order to provide a lithologic section down to 1,000 feet depth in one place.

LOCATION

The New Mexico State University geothermal production well (NMSU-PG-1) is located at 1,000 feet from North line, 500 feet from East line, Section 27, Township 23S, Range 2E, in Dona Ana County, New Mexico. The well is located at a ground level of 4,163 feet above mean sea level, approximately 1 mile east of highway I-25 in Las Cruces, New Mexico. The New Mexico State University owns the land and the mineral resources under the land at the site of the well. Figure 1 shows the location of the production well PG-1, as well as the two temperature gradient wells, DT-1 and DT-2.

SITE SELECTION

The site for this well was selected on the basis of electrical resistivity surveys, shallow gradient wells and two deep exploration wells, DT-1 and DT-2. The geophysical work leading to the selection of site for this well is described in Chapter 10. The analyses of geological and geophysical logs of the two deep exploration wells are reported in Chapter 11. The production well (NMSU-PG-1) was designed on the basis of data contained in Chapter 11.

WELL DESIGN

Figures 2 and 3 summarize the interpreted subsurface conditions encountered in wells DT-1 and DT-2 respectively. The production well (PG-1) was designed to tap the aquifer between 700 feet and 850 feet, as seen in Figure 2. A copy of the detailed technical specifications for the production well is given in Appendix A. The well was drilled according to these specifications without any cost cutting modifications.

LOGGING

Lithologic samples (cuttings) were obtained for every 10 feet of drilling. Detailed lithologic analysis of these samples was performed under a binocular microscope at 10x-25x magnification. Samples of the source rocks from the Organ Mountains area were collected and the percentage of minerals and rocks found in each sample were determined. Results of the lithologic analysis are given in Appendix B. A suite of geophysical logs, consisting of Electrical Resistivity, Spontaneous Potential, Gamma Ray and Neutron was run soon after the hole was drilled. These logs are included in Appendix C. The decision to install perforated pipe from 700 feet to 850 feet depth was made on the basis of

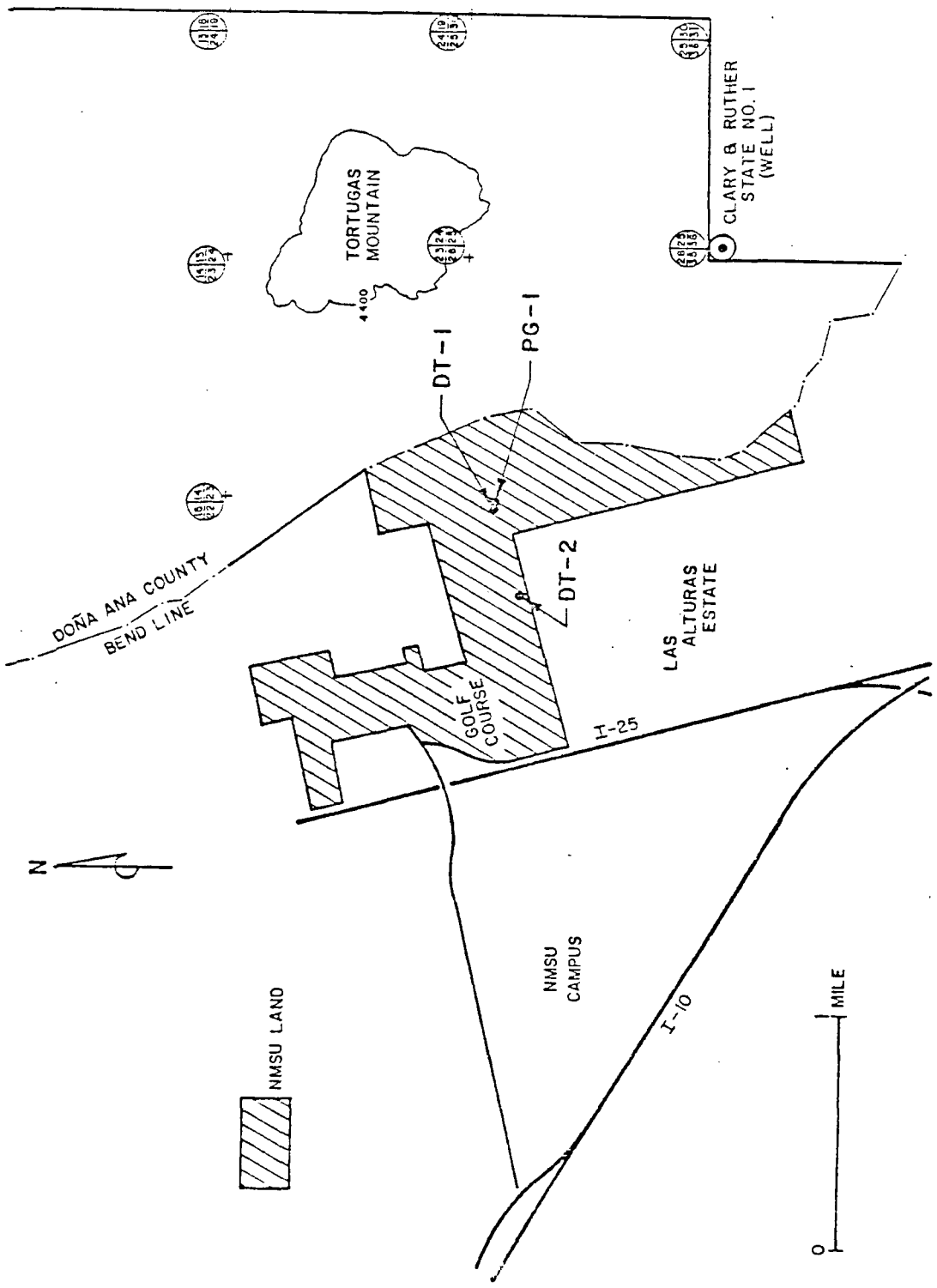


Fig. 1 Location of Exploratory Wells DT-1 (1,000 feet), DT-2 (1,200 feet) and the Production Well PG-1 (850 feet)

these logs. The temperature of the drilling fluid at the well head was continuously recorded during drilling of the production well. A plot of mud temperature versus the depth of drilling is shown in figure 4.

WELL DEVELOPMENT

The well was developed by bailing the water for 24 hours. A 70 gallon bailer brought out water at 55°c (131°F). From preliminary indications, it is anticipated that the well should be able to supply about 200 gallons per minute water at approximately 60°c (140°F) temperature.

INTERPRETED SUBSURFACE CONDITIONS BASED ON ALL LOGS

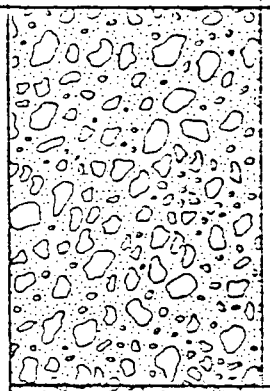
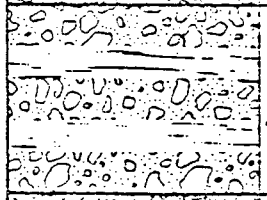
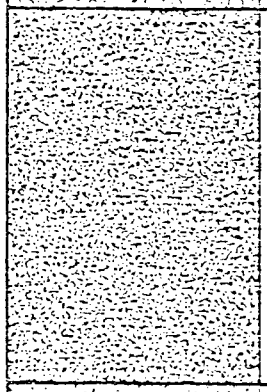
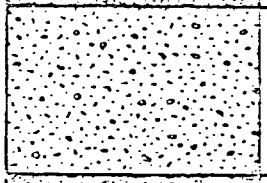
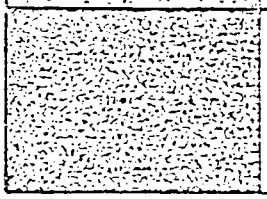
DEPTH (FEET)	GRAPHIC LOG	DESCRIPTION
0 50 100 150 200 250		SAND AND GRAVEL. ROUNDED TO SUBROUNDED GRAVEL PIECES CONSIST OF QUARTZ, FELDSPARS, RHYOLITE, ASH FLOW TUFFS, A VARIETY OF IGNEOUS ROCKS, ETC. HIGH RESISTIVITY, UNIFORM CALIPER WITH MINOR FLUCTUATIONS, UNIFORM GAMMA RAY AND UNIFORM LOW POROSITY DENSILOG AND NEUTRON. PROBABLY SANTA FE GROUP BASIN FILL. DRY. ABOVE THE WATER TABLE.
300 350 400		WATER TABLE CLEARLY INDICATED BY ALL LOGS AT 265FT BELOW SURFACE. FROM 265FT. DOWN TO ABOUT 420FT., THERE APPEAR TO BE LAYERS OF SAND AND GRAVEL ALTERNATING WITH LAYERS OF CLAY. LOW RESISTIVITY, CAVED ZONES, FLUCTUATING GAMMA RAY, HIGH POROSITY VALUES AND LITHOLOGY ALL INDICATE THIS.
450 500 550 600 650 700		BETWEEN 420 AND 450FT. BELOW SURFACE DOWN TO 720FT., THERE IS A ZONE OF SUBANGULAR TO SUBROUNDED FRAGMENTS OF RHYOLITE, RHYOLITIC ASH FLOW TUFF, ANDESITE AND ANDESITE ASH FLOW TUFF - APPROX. ¼ INCH DIAMETER PIECES OR FINER. UNIFORM RESISTIVITY AND HIGH GAMMA RAY FOR THIS ZONE.
750 800 850		FROM 720FT. TO 850FT., THERE ARE GRAVEL AND SAND OF MORE HETEROGENEOUS COMPOSITION WITH SOME FLATTENED, ROUNDED GRAVELS OF ANDESITE.
900 950 1000		FROM 850FT TO THE BOTTOM OF THE WELL, THE ZONE IS CHARACTERIZED BY VERY UNIFORM PROFILES OF RESISTIVITY, GAMMA RAY, NEUTRON AND DENSILOG. LITHOLOGY SHOWS FINE CHIPS OF RHYOLITE AND MINOR AMOUNTS OF QUARTS, FELDSPARS, ETC.

Fig. 2 Interpreted Subsurface Conditions in DT-1

INTERPRETED SUBSURFACE CONDITIONS BASED ON ALL LOGS

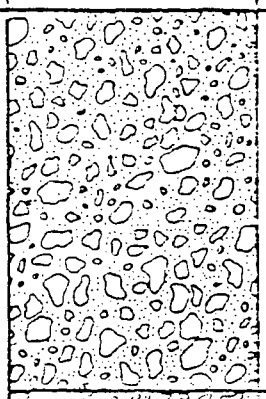
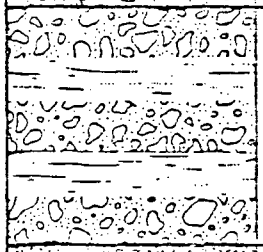
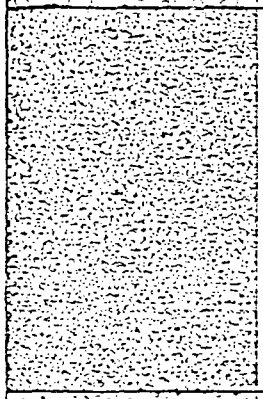
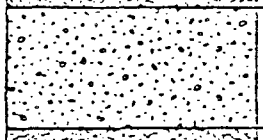
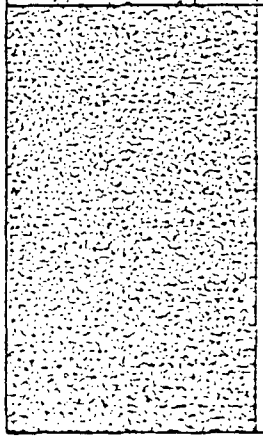
DEPTH (FEET)	GRAPHIC LOG	DESCRIPTION
0 50 100 150 200 250		SAND AND GRAVEL. ROUNDED TO SUBROUNDED GRAVEL PIECES CONSIST OF QUARTZ, FELDSPARS, RHYOLITE, ASH FLOW TUFFS, VARIETY OF IGNEOUS ROCKS, ETC. PROBABLY SANTA FE GROUP BASIN FILL. DRY. ABOVE THE WATER TABLE.
300 350 400 450		WATER TABLE AT 265 FT. BETWEEN 265 FT. AND 450 FT., THE SECTION CONSISTS OF LAYERS OF SAND, GRAVEL AND CLAY WITH LITHOLOGIC REPRESENTATION OF RHYOLITE, OTHER IGNEOUS ROCKS AND LIMESTONE (?). ASSOCIATED SAND IS INVARIABLY CALCAREOUS. SATURATED SANTA FE GROUP BASIN FILL.
500 550 600 650 700 750		FROM 450 FT. TO ABOUT 770 FT., ALL LOGS SHOW A VERY UNIFORM SECTION. CUTTINGS FROM DRILLING YIELD ANGULAR TO SUBANGULAR FRAGMENTS WITH AN AVERAGE OF 1/4" DIAMETER OR FINER. LITHOLOGY CONSISTS OF ALMOST 100% RHYOLITIC ROCK FRAGMENTS, WHICH SOMETIMES SHOW BANDED TUFF FEATURES AND SOME PIECES APPEAR GREYISH LIKE ANDESITIC ROCK. IS IT A FANGLOMERATE DEPOSIT OR FRACTURED RHYOLITIC FLOW?
800 850		LENSES OF SAND AND GRAVEL, COURSE SAND AND CLAY CONSISTING OF MORE HETEROGENEOUS LITHOLOGY THAN ABOVE. PROBABLY CONTAINS WATER.
900 950 1000 1050 1100 1150 1200		LITHOLOGY AND TEXTURE VERY SIMILAR TO THE 450-770 FT. ZONE. RESISTIVITY, GAMMA RAY, COMPENSATED NEUTRON AND COMPENSATED DENSILOG VERY SIMILAR TO THE ABOVE ZONE AS WELL. CALIPER SHOWS RUGGED WALL CONDITIONS. AT 950 FT. HEAVY MUD LOSS WAS ENCOUNTERED. RESISTIVITY SHOWS A LOW RESISTIVITY LAYER AND NEUTRON AND DENSILOG SHOW A HIGH POROSITY ZONE ABOUT 5 FT. POSSIBLY A FRACTURED ZONE WITH HOT WATER.

Fig. 3 Interpreted Subsurface Conditions in DT-2

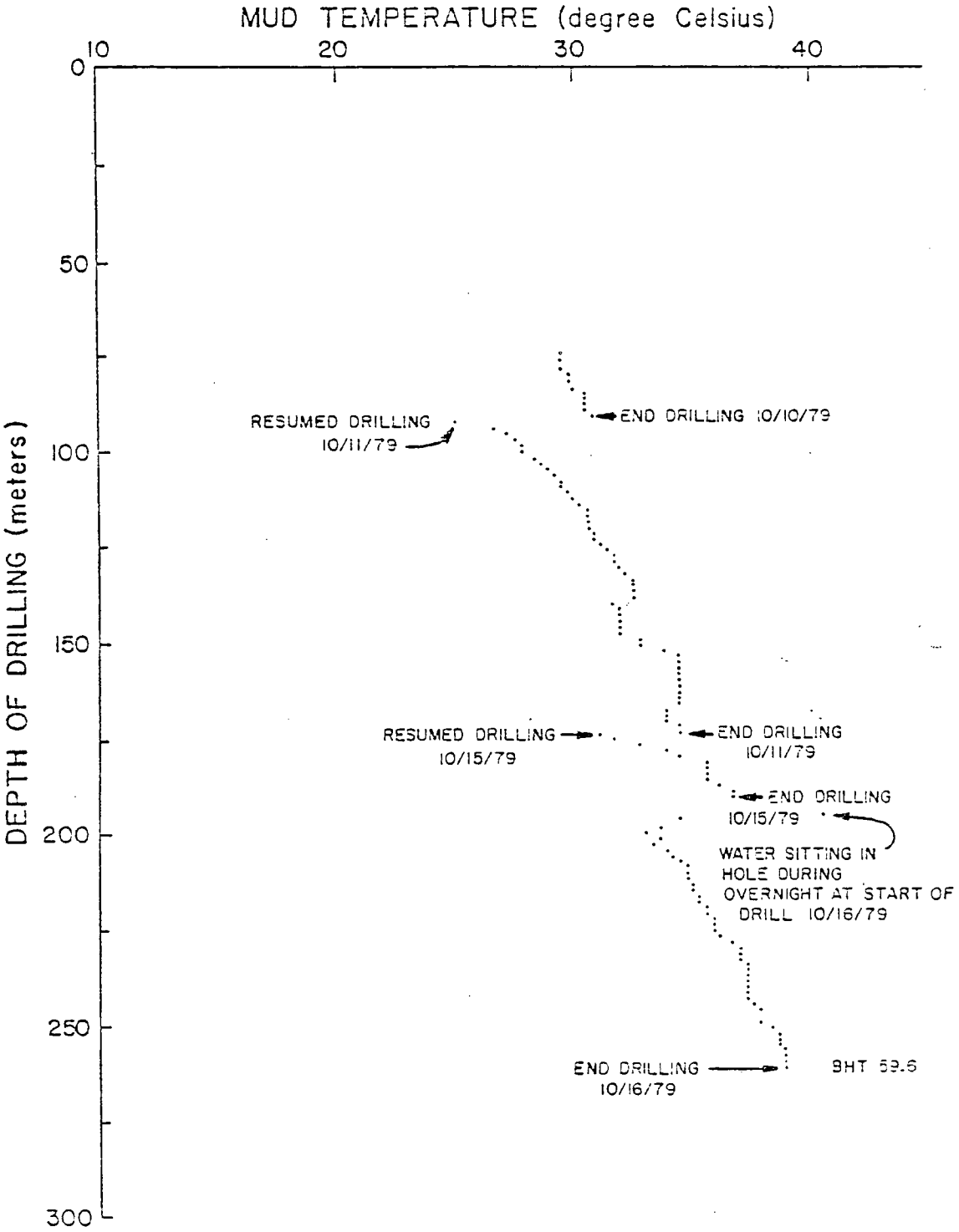


Fig. 4 Mud Temperature at Well Head
(NMSU Geothermal Production Well, PG-1)

Appendix A

Technical Specification for Well NMSU - PG-1

SECTION I

NOTICE TO BIDDERS

New Mexico State University, an Equal Employment Employer, requests bids for drilling a hot water production well about 2 miles east of the New Mexico State University campus in Las Cruces, New Mexico.

Bids will be opened at _____, _____, 1979, in the office of the Director of Purchasing at the main campus of New Mexico State University in Las Cruces, New Mexico. Bids not received by opening time will be returned unopened.

The site may be inspected between the hours of 8:00 a.m. and 5:00 p.m. Monday through Friday by contacting Dr. Lokesh Chaturvedi, Professor of Civil Engineering (Telephone: (505) 646-3233), or Dr. Harry Beyer, Consultant to the New Mexico Energy Institute (Telephone: (505) 646-2493).

If the bid amount exceeds $20,000 a Bid Bond payable to New Mexico State University in an amount of not less than 5% of the largest possible total bid submitted must accompany each bid as a guarantee that, if awarded the bid, the bidder will enter into a contract with the University. If successful, the vendor will be required to submit a 100% Performance Bond payable to New Mexico State University to guarantee that the vendor will promptly commence and complete all work as called for in these specifications. Reference is made to the Public Works Act 6-6-11 where the Owner is required to obtain a bond on the work in excess of $500. If the bid amount is over $20,000, the 100% Performance Bond will take the place of this Surety Bond. If the amount is under $20,000, no 5% Bid Bond will be required, and the 100% Performance Bond will be substituted with a 50% Surety Bond. (A personal surety in the form of a check - cashiers or personal 0 may be substituted for the Bond, but must be in the amount of 100% of the bid instead of 50%).

6-6-11. Bonds of public contractors--Sureties.--Whenever any contract shall be entered into with the state or any county, municipality, district department board, or public corporation thereof, for the construction, alteration, improvement or repair of any public building, structure or highway, or for any public work the contract price for which exceeds five hundred dollars ($500), the contractor shall, before beginning work thereunder, furnish a bond executed by the contractor and some surety company authorized to do business in the state, or any suitable sureties to be approved by the state board of finance in an amount equal to fifty percent (50%) of the contract price, conditioned for the performance and completion of such contract according to its terms, compliance with all requirements of law, and the payments as they become due of all just claims for labor performed, and materials and supplies furnished, upon or for the work under said contract, whether said labor be performed, and said materials and supplies be furnished under the original con-

tract or under any subcontract. The said bond shall be in form as approved by the attorney general, district attorney, or attorney for the obligee in said contract and as to sureties subject to approval of the authorities letting the contract. Personal sureties may be accepted if the authorities letting the contract so determine, but in such case the amount of the bond shall be the full contract price and the sureties shall justify under oath in amounts above liabilities and exemptions aggregating double the amount of the bond.

The New Mexico State University reserves the right to reject any or all bids and to waive any or all formalities.

Should any doubt or questions arise respecting the true meaning of these specifications, reference shall be made to the Owner's Representative, whose decision thereon shall be final: Dr. Lokesh Chaturvedi, Civil Engineering Department, New Mexico State University, Las Cruces, N.M. (Telephone: (505) 646-3233), or Dr. Harry Beyer, New Mexico Energy Institute, New Mexico State University, Las Cruces, N.M. (Telephone: (505) 646-2493).

Bidders are required to inform themselves fully of the conditions relating to the locations and labor required for the execution of this work.

Attention is called to the fact that the inclusion of a schedule of minimum wages to be paid employees engaged in work under this contract does not relieve the Contractor from compliance with any State Wage Law of any Municipality, and must pay not less than the rates legally prescribed or as set forth herein, whichever is higher. The wage rates shall only be applicable if the proposal is over Two Thousand Dollars ($2,000).

In case of a difference in written words and figures in a proposal, the amount stated in written words shall govern. It is the Bidder's responsibility to deliver its bid proposals at the proper time to the proper place. The mere fact that a bid proposal was dispatched will not be considered. The Bidder must have the proposal actually delivered.

All bid proposals must be made upon the blank form of the Proposal attached hereto and should give the price by lot number for the work, both in written words and figures, and must be signed and acknowledged by the Bidder, in accordance with the directions in the Proposal. In order to insure consideration, the Proposal should be enclosed in a return envelope, marked, "Proposal, Do Not Open Until_____," and addressed to the Director of Purchasing, New Mexico State University, Las Cruces, New Mexico.

Within 30 days after the opening of the Proposals, the Owner will act upon them. The acceptance of the Proposal will be a notice in writing signed by a duly authorized representativeof the Owner, and no

act of the Owner shall constitute the acceptance of a proposal.

The rights and obligations provided for in the Contract shall become effective and binding upon the parties only with its formal execution by both parties.

In the event that New Mexico State University employs attorneys or incurs other expenses it may deem necessary to protect or enforce its rights under this contract, the other party must agree to pay the attorney's fees and expenses so incurred by New Mexico State University.

The contractor must be willing to sign a contract for the specifications or option selected by the university by September 24, 1979. Preference will be given to contractors who can guarantee to complete the job within 60 days of signing the contract.

SECTION II

TECHNICAL SPECIFICATIONS

AND INFORMATION FOR BIDDERS

General description

These specifications are for drilling a hot water production well east of the NMSU campus, about 1 mile east of Interstate 25. An approximate description of the job is:

1. drill a 17-inch hole to 850 ft
2. run a string of 100 ft of 10-inch screen and 750 ft of 10-inch casing
3. set a cement plug in the bottom of the hole
4. gravel pack 150 ft, and sand pack 30 ft of the 3-inch annular space
5. cement the remaining 3-inch annular space from 670 ft to the surface.

Location

The well is to be drilled on New Mexico State University land east of the campus. The site will be near well NMSU-DG-2 shown in Figure 1, and is accessible by about one mile of dirt road. Bidders will be held as having examined the drilling site in order to acquaint themselves with the conditions of the roads and terrain. If road grading or clearing is necessary, the bidder shall notify the university in writing at the time of submission of the bid.

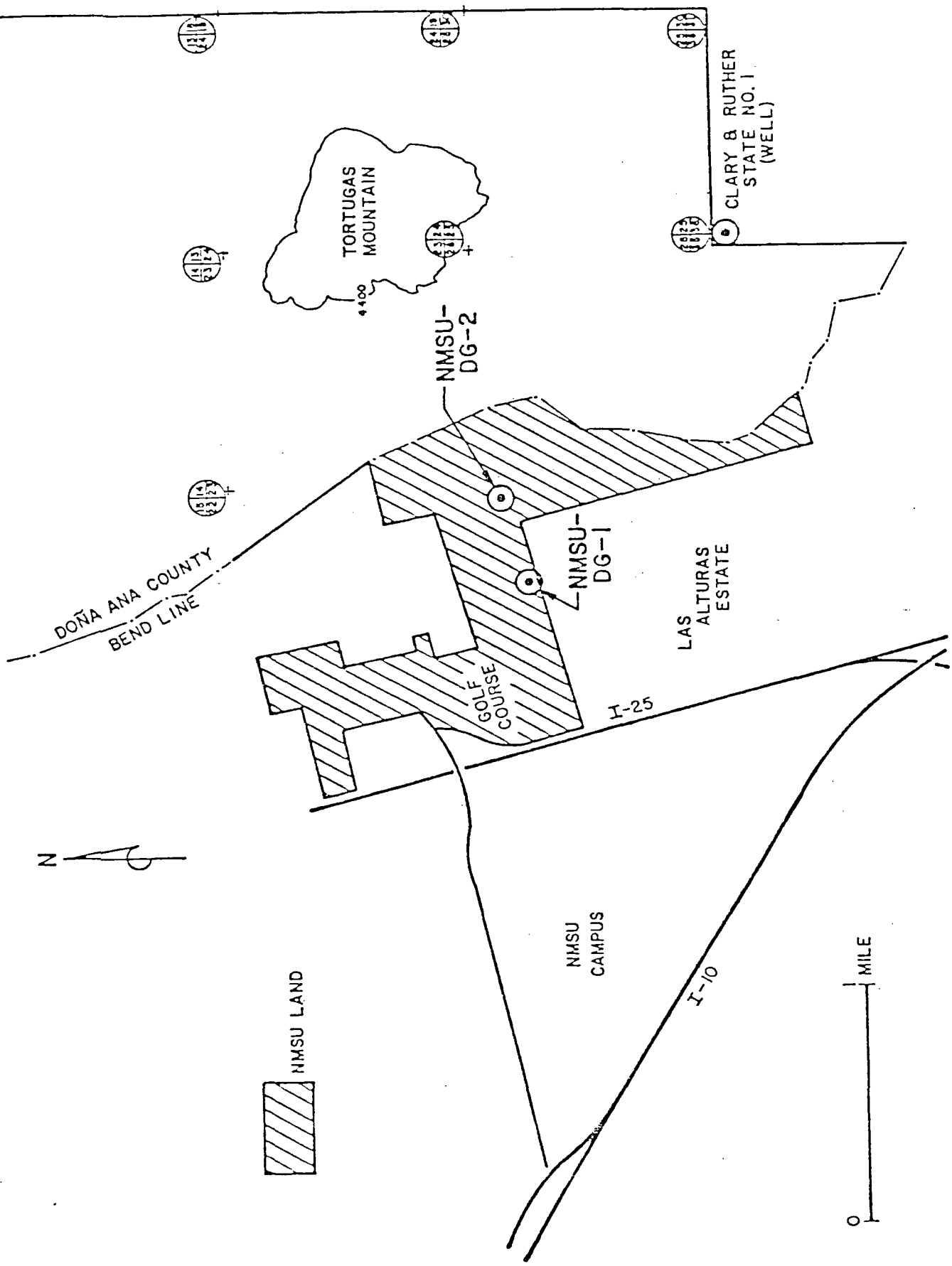


Fig. 1. Location of wells NMSU-DG-1 and NMSU-DG-2

Local Conditions and Geology

Figures 2 and 3 give interpreted logging and lithologic data for well NMSU-DG-2. The data for well NMSU-DG-1 are nearly identical. The actual logs, cutting samples, and information for estimating penetration rate, can be seen by contacting Dr. Lokesh Chaturvedi, Department of Civil Engineering, New Mexico State University, phone number 646-3233.

Well NMSU-DG-2 reaches a maximum temperature of 63°C (145°F) at the bottom of the hole at 1000 ft. Well NMSU-DG-1 reaches a maximum temperature of 51°C (123°F) at a depth of 525 ft, and displays lower temperatures on down to TD at 1200 ft.

This information is given as a guide to the driller, however geologic conditions at the site are not guaranteed by the university.

Equipment and Personnel to be Furnished by the Contractor

The contractor shall provide the necessary rotary drilling rig, all tools, equipment, accessories, water, mud, power, bits, lighting, well casing, screen, cement, gravel, sand, and experienced personnel necessary to conduct without difficulty the drilling, casing, and cementing operation described in these specifications.

Equipment and Personnel to be Furnished by the University

Samples of drill cuttings will be obtained at 10-ft intervals by university personnel, and will be put in containers supplied by the university.

Geophysical logging of the hole before casing is run will be handled by the university.

NMSU-DG-2 (NMSU DEEP GEOTHERMAL WELL NO. 2)

INTERPRETED SUBSURFACE CONDITIONS BASED ON ALL LOGS

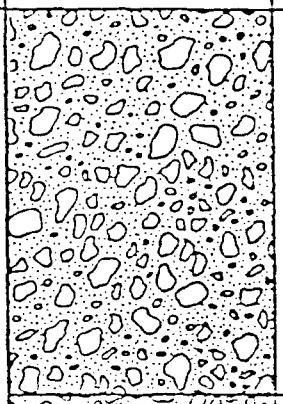
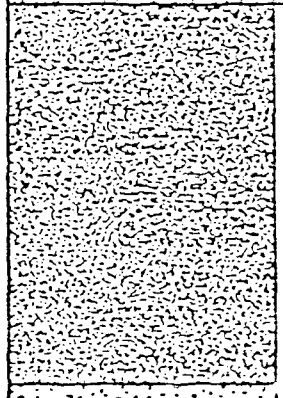
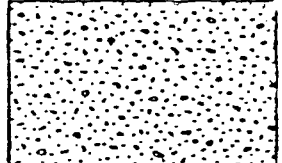
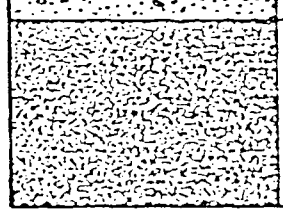
DEPTH (FEET)	GRAPHIC LOG	DESCRIPTION
0 50 100 150 200 250		SAND AND GRAVEL. ROUNDED TO SUBROUNDED GRAVEL PIECES CONSIST OF QUARTZ, FELDSPARS, RHYOLITE, ASH FLOW TUFFS, A VARIETY OF IGNEOUS ROCKS, ETC. HIGH RESISTIVITY, UNIFORM CALIPER WITH MINOR FLUCTUATIONS, UNIFORM GAMMA RAY AND UNIFORM LOW POROSITY DENSILOG AND NEUTRON. PROBABLY SANTA FE GROUP BASIN FILL. DRY. ABOVE THE WATER TABLE.
300 350 400		WATER TABLE CLEARLY INDICATED BY ALL LOGS AT 265FT BELOW SURFACE. FROM 265FT. DOWN TO ABOUT 420FT., THERE APPEAR TO BE LAYERS OF SAND AND GRAVEL ALTERNATING WITH LAYERS OF CLAY. LOW RESISTIVITY, CAVED ZONES, FLUCTUATING GAMMA RAY, HIGH POROSITY VALUES AND LITHOLOGY ALL INDICATE THIS.
450 500 550 600 650 700		BETWEEN 420 AND 450FT. BELOW SURFACE DOWN TO 720FT., THERE IS A ZONE OF SUBANGULAR TO SUBROUNDED FRAGMENTS OF RHYOLITE, RHYOLITIC ASH FLOW TUFF, ANDESITE AND ANDESITE ASH FLOW TUFF - APPROX. ¼ INCH DIAMETER PIECES OR FINER. UNIFORM RESISTIVITY AND HIGH GAMMA RAY FOR THIS ZONE.
750 800 850		FROM 720FT. TO 850FT., THERE ARE GRAVEL AND SAND OF MORE HETEROGENEOUS COMPOSITION WITH SOME FLATTENED, ROUNDED GRAVELS OF ANDESITE.
900 950 1000		FROM 850FT TO THE BOTTOM OF THE WELL, THE ZONE IS CHARACTERIZED BY VERY UNIFORM PROFILES OF RESISTIVITY, GAMMA RAY, NEUTRON AND DENSILOG. LITHOLOGY SHOWS FINE CHIPS OF RHYOLITE AND MINOR AMOUNTS OF QUARTS, FELDSPARS, ETC.

Fig. 2. Interpreted composite log of NMSU-DG-2

NMSU-DG-2 (NMSU DEEP GEOTHERMAL WELL NO. 2)

LOCATION: 1000'+ FNL, 500'+ FEL, SEC. 27, TWP. 23S, R2E
DONA ANA COUNTY, NEW MEXICO
GROUND LEVEL: 4163 FEET ABOVE MEAN SEA LEVEL
BIT SIZE: 5-1/8 INCHES
DATE LOGGED: 1-4-1979

DEPTH (FEET)	LITHOLOGY	RESISTIVITY/SP	CALIPER	GAMMA-RAY	COMPENSATED NEUTRON	COMPENSATED DENSILOG
0 50 100 150 200 250	SAND AND GRAVEL, SOME CLAY. ROUNDED TO SUBROUNDED (QUARTZ, RHYOLITE, IGNEOUS ROCKS)	HIGH RESISTIVITY (DRY SAND AND GRAVEL)	UNIFORM 5FT.	UNIFORM 80-100 API UNITS FLUCTUATIONS 80-160 API UNITS	4-10 %	4-10 %
300 350	COURSE GRAVEL AND SAND SAND WITH SOME GRAVEL.	LOW RESISTIVITY, MINOR FLUCTUATIONS (WATER SATURATED SAND AND GRAVEL WITH SOME CLAY LAYERS)	CAVING CAVING CAVING UNCAVED		22-30 % (WATER SAT.)	22-30 % (WATER SAT.)
400 450 500 550 600 650 700	SAND AND GRAVEL SUBANGULAR TO SUBROUNDED FRAGMENTS, MOSTLY RHYOLITE AND ANDESITIC ASH FLOW TUFF -APPROX. 1/4 INCH PIECES	VERY UNIFORM RESISTIVITY PROFILE AT 10-20 ohm-m. VERY LITTLE SEPARATION BETWEEN DEEP INDUCTION AND SHALLOW FOCUSED LOGS	MANY ZONES OF CAVING 2' TO 10' THICK EACH (MAXIMUM HOLE DIAMETER IS 7 INCHES)	HIGH GAMMA-RAY > 200 API UNITS	16-20 %	16-20 %
750 800 850 900 950 1000	GRAVEL AND SAND OF VARIED COMPO. WITH SOME ROUNDED GRAVEL OF ANDESITE FINE PIECES OF RHYOLITE, SOME QUARTZ & FELDSPARS, ETC	LOW RESISTIVITY, MINOR FLUCTUATIONS (POSSIBLE WATER SAT. WITH SAND & GRAVEL WITH CLAY LAYERS) VERY UNIFORM RESISTIVITY PROFILE AT 10-15 ohm-m VERY LITTLE SEPARATION		100-160 API >200 API 100-200 API >200 API UNITS	12-26 % 12-16 %	12-26 % 12-16 %

Fig. 3. Summary of all logs for NMSU-DG-2

The contractor will cooperate with the university in obtaining cuttings and performing logging.

Technical Specifications

1. Bore hole. The target production horizon is shown in Figure 2 between about 720 and 850 feet. The hole shall be drilled to a depth of 850 ft. If the analysis of drill cuttings at this point indicates that the hole should be deeper to reach the bottom of this horizon, the university will pay the bid price per foot for any extra hole. It is not contemplated at this time to go more than 950 feet TD.

The diameter of the hole shall be such that after 10-in minimum I.D. casing is installed the annular space all around the casing shall be at least 3 inches wide. Thus, the minimum hole diameter shall be 16 3/4 inches.

The contractor should bear in mind that the university requires a hole sufficiently straight and plumb that casing can be properly installed and gravel packed all around, that tools and bailers can be run freely to the bottom of the hole, and that a downhole pump with 300 gpm capability can be installed and operated at a depth of 450 feet.

2. Casing. The casing shall have a minimum inside diameter of 10 inches, and shall be Schedule 40 (e.g., for 10-in I.D. pipe: 10.750 inches O.D., 40.48 #/foot, 0.365-inch wall thickness) new steel pipe, electric welded or seamless, with mill ends machined and beveled for welding. It is anticipated that about 750 feet of this blank casing will be installed.

The screen shall be the same type of pipe as the casing, with slots added. The length, width, and spacing of the slots shall be determined by the university and the contractor based upon analysis of the drill cuttings. Centering guides shall be secured at the top, bottom, and at about 35-ft intervals along the screen assembly. At each of these locations three guides will be attached, spaced at 120 degrees around the circumference of the screen. Each guide shall protrude at least 1 3/4 inch and no more than 2 1/4 inch beyond the surface of the screen. The portion of the hole to be screened will be determined by the university and the contractor based upon the geopnysical logs. It is anticipated that about 100 feet of hole will be screened.

The casing and/or screen shall be welded together by the metallic arc process utilizing direct current, and is subject to approval by the university representative. All sections must be accurately aligned before welding. The casing ends shall be uniform, beveled, and butt welded utilizing at least three separate passes of the arc welder. Between each welding pass, the deposition of slag and scale will be removed. The Contractor may utilize reinforcement straps if necessary. The Contractor shall guarantee all welds to at least 75 percent of the ultimate strength of the casing tensile strength, and shall be responsible for all damage or costs resulting from failure of the weld or casing during construction of the well.

3. Bottom hole plug. A cement mix designed to harden in 24 hours shall be emplaced at the bottom of the hole to form a plug which is the full width of the hole and about 3-ft high. The casing string will be hanging in the hole so that its bottom end will be partly embedded in the

cement plug. All down-hole operations will cease for 24 hours to allow time for the cement to harden.

At a later date the well may be drilled deeper. The purpose of the cement plug is to prevent the gravel packing from falling down any new hole that is drilled.

4. Gravel and Sand Packing. From the bottom of the hole to 50 feet above the top of the screen (approximately 150 ft) the annular space between the casing and the well bore shall be packed with clean, screened pea gravel. The size of the gravel shall be determined by the university representative and the contractor based upon examination of the drill cuttings. The gravel shall contain little or no calcareous or organic material, such as limestone, shell fragments, wood fragments, or lignite, and shall be acceptable to the university representative. For the next 30 feet above the gravel the annular space shall be packed with medium to coarse sand to prevent the intrusion of cement into the gravel packed production zone.

Prior to placement of gravel, all drilling fluid in the hole shall be thinned and conditioned to facilitate placement and settlement of the gravel. The contractor shall pay particular attention to mud weight and shall exercise caution to prevent caving of the hole.

The gravel and sand may be placed by pumping with water through a pipe run down the outside of the casing to the bottom of the hole and pulled back as the gravel or sand level rises in the annular space outside the screen assembly or casing. If gravel or sand is placed in the annular space at the surface of the ground, the casing shall be sealed to prevent mud

from flowing up the inside of the casing; if this is not done, air could be introduced into the annular space, which might result in caving.

The contractor shall furnish and operate sounding equipment to check the gravel and sand level during placement.

5. Cementing. After the sand packing has been emplaced, about two barrels of cement will be placed on top of the sand packing (at a depth of about 670 feet) using a pipe run down the annular space outside the casing. This cement will be allowed to harden for 24 hours before additional cementing is undertaken. Then the rest of the annular space shall be filled to the surface with neat cement using a grout pipe or other method acceptable to the university representative.

6. Development. The well will be developed until it is cleaned of sand. It will be bailed for eight hours, or until a good water sample can be obtained.

Inspection

All casing and screen will be inspected by the university representative before it is placed in the hole.

Final Site Condition

The contractor will leave the top of the casing 4 feet above the ground level with a plate welded to the top.

The well site will be left clean and all tools and trash removed from the well site when the contractor removes the rig.

Drillers Logs

The driller shall keep a log indicating time, depth (if relevant), significant activities performed, observations, etc. A copy of this log will be supplied to the university.

Possible Cost-Cutting Modifications to the Technical Specifications

As a result of financial considerations the university may have to modify-or eliminate some items from the technical specifications given above. The modifications might reduce the possibility of drilling the well deeper at a later date, or might reduce productivity.

Option A

1. Bore hole. (Same as above.)

2. Casing. (Same as above.)

3. Bottom hole plug. Instead of emplacing a cement plug at the bottom of the hole, a cement plug will be allowed to harden in the bottom 2 feet of the bottom joint of screen on casing before it is lowered into the hole. (This will eliminate rig standby time waiting for the cement to harden.)

4. Gravel and sand packing. (Same as above.)

5. Cementing. Same procedure as above with the exception that cement will extend for only 200 feet above the sand packing. The rest of the annular space, from about 470 feet to the surface, will be filled with drill cuttings and heavy mud.

6. Development. (Same as above.)

Option B

1. Bore hole. (Same as above.)

2. Casing. (Same as above.)

3. Bottom hole plug. (Same as in Option A.)

4. Gravel packing. Gravel packing will be performed, as described above, to 50 feet above the top of the screen. However, no sand packing will be done.

5. No cementing will be done. Instead, the annular space from the top of the gravel (at about 700 feet) to the surface will be filled with drill cuttings and heavy mud.

6. Development. (Same as above.)

Option C

For this option no gravel packing of the production zone will be attempted, so a smaller diameter bore hole can be drilled.

1. Bore hole. (The same target depth, and the same requirements for the hole to be straight and plumb, as described above.)

The diameter of the hole shall be such that 10-inch I.D. casing (10.75-in O.D.) can be inserted to TD, and a grouting pipe can be inserted in the annular space to a depth of 250 feet. It may be advantageous to run the grouting pipe into the hole before the casing.

2. Casing. (Same as above.)

3. Bottom hole plug. (Same as Option A)

4. Bonnet. In order to cement the annular space from about 250 feet to the surface, a bonnet will be attached to the casing to prevent cement

penetration below this depth. About 20–40 feet of sand packing material will be placed in the annular space on top of the bonnet, and then about two barrels of cement will be emplaced on the sand using the grouting pipe to form a cement plug. This plug will be allowed to harden for 24 hours.

5. Cementing. The annular space from 250 feet to the surface will be cemented using the grouting pipe.

6. Development. The well will be developed for eight hours or more until a good water sample can be obtained. This may require the use of a sand pump or suction-type bailer.

SECTION III

BID FORM

Place: _____

Date: _____

Project No: _____

Proposal of _____
(Hereinafter called Bidder) a corporation, partnership, or an individual.

TO: The Purchasing Agent
New Mexico State University
Las Cruces, New Mexico 88003

Gentlemen:

The Bidder, in compliance with your invitation for bids for drilling a warm water production well on New Mexico State University land east of the campus in Las Cruces, New Mexico, having examined the specifications and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials, equipment and labor, hereby proposes to furnish all materials, equipment, labor, and supplies and to complete the project at the prices stated below. These prices are to cover all expenses incurred in performing the work, including taxes, as required in the specifications.

UNIT PRICES: For changing quantities of work items from those indicated by the contract specifications, upon written instructions from the university representative, the following unit prices shall prevail. These unit prices shall include all materials, labor, and equipment to cover the finished work of the several kinds called for.

Full program described in complete technical specifications

BID LOT	QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
#1	1	Mobilization, demobilization, clean-up	$_____	$_____
#2	850 ft.	Drill well bore	$_____	$_____
#3	4 hours	Standby time during logging, etc.	$_____	$_____
#4	100 ft.	Set screen	$_____	$_____
#5	750 ft.	Set casing	$_____	$_____
#6	1	Set bottom hole cement plug	$_____	$_____
#7	180 ft.	Gravel and sand pack annular space	$_____	$_____
#8	670 ft.	Cement annular space	$_____	$_____
#9	8 hours	Develop and clean out well	$_____	$_____

Bidder agrees to perform all work described in these specifications for the sum stated:

_____ $( )

OPTION A

BID LOT	QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
#1	1	Mobilization, demobilization, cleanup	$_____	$_____
#2	850 ft.	Drill well bore	$_____	$_____
#3	4 hours	Standby time during logging, etc.	$_____	$_____
#4	100 ft.	Set screen with cement plug already in bottom joint	$_____	$_____
#5	750 ft.	Set casing	$_____	$_____
#6	180 ft.	Gravel and sand pack annular space	$_____	$_____
#7	200 ft.	Cement annular space	$_____	$_____
#8	8 hours	Develop and clean out well	$_____	$_____

Bidder agrees to perform all work described in the Option A specifications for the sum stated:

_____ $(_____)

OPTION B

BID LOT	QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
#1	1	Mobilization, demobilization, cleanup	$_____	$_____
#2	850 ft.	Drill well bore	$_____	$_____
#3	4 hours	Standby time during logging, etc.	$_____	$_____
#4	100 ft.	Set screen with cement plug already in bottom joint	$_____	$_____
#5	750 ft.	Set casing	$_____	$_____
#6	150 ft.	Gravel pack annular space	$_____	$_____
#7	8 hours	Develop and clean out well	$_____	$_____

Bidder agrees to perform all work described in the Option B specifications for the sum stated:

_____ $(_____)

OPTION C

BID LOT	QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
#1	1	Mobilization, demobilization, cleanup	$_____	$_____
#2	850 ft.	Drill well bore	$_____	$_____
#3	4 hours	Standby time during logging, etc.	$_____	$_____
#4	100 ft.	Set screen with cement plug already in bottom joint	$_____	$_____
#5	750 ft.	Set casing	$_____	$_____
#6	1	Bonnet, installed in annulus with sand packing and cement plug at 250 ft.	$_____	$_____
#7	250 ft.	Cement annular space	$_____	$_____
#8	8 hours	Develop and clean out well	$_____	$_____

Bidder agrees to perform all work described in Option C specifications for the sum stated:

_____ $(_____)

ADDRESS OF FIRM:

_____

_____

DATE: _____

RESPECTFULLY SUBMITTED:

_____

BY: _____

TITLE: _____

NEW MEXICO CONTRACTORS LICENSE NUMBER: _____

Appendix B

Lithologic Analysis of Cuttings From Well NMSU - PG-1

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Caliche	SS	Chert	Dark Ig. Rock			
10-20	~	30	20	10	5	~	~	5	30	-	-	-	rounded and subrounded	3 mm	free quartz and caliche cemented fines
20-30	~	20	40	20	~	~	5	5	10	-	-	-	rounded	4 mm	rounded edges with sharp faces (rounded prim.)
30-40	5	50	25	10	~	~	5	5	~	-	-	-	subangular to angular	2 mm	considerable clay
40-50	2	20	5	5	~	~	3	~	60	-	-	5	subrounded	.05 mm	questionable sample
50-60	20	20	10	10	~	5	5	15	10	-	-	5	subrounded subangular	5 mm	numerous smooth faces on chips (occasionally rounded)
60-70	15	20	15	15	5	~	5	15	5	-	-	5	subrounded subangular	5 mm	large rounded gravels, probably cave-in material
70-80	5	30	20	15	5	~	~	5	10	-	5	5	rounded to subrounded	4 mm	some chalcedony noted; smooth faces noted on chips
80-90	5	50	15	10	5	~	~	5	5	-	-	5	rounded to subrounded	4 mm	smooth faces on chips
90-100	10	50	10	10	3	~	2	~	5	-	-	10	rounded to subrounded	5 mm	smooth faces on chips; about half of quartz is .005 mm and caliche cements
100-110	5	40	15	10	5	~	5	~	5	-	10	5	subrounded to subangular	4 mm	still considerable caliche cemented quartz (.005 mm); angular fragments common
*110-120	10	35	10	15	10	~	Trace	10	5	-	-	5	subrounded to subangular	3 mm	distinct Soledad Rhyolite present; numerous rounded fragments
120-130	5	25	20	25	15	~	Trace	5	2	-	-	3	subangular to angular some round faces on chips	3 mm	occasionally large (6 mm) pieces, probably cave-in material

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Caliche	SS	Chert	Dark Ig. Rock			
130-140	Trace	20	30	35	5	-	-	5	-	-	-	5	subangular to angular some round faces on chips	3 mm	sandstone noted (Abo formation); some large rounded (6-7 mm) gravel
140-150	5	15	30	40	5	-	-	5	-	-	-	-	angular	4 mm	Cueva Rhyolite noted; few subangular & some rounded
150-160	Trace	40	30	10	10	Trace	5	-	-	-	-	5	subrounded to subangular	3 mm	Considerable caliche cemented quartz; (cave-in?) Numerous rounded dendrites on rhyolite
160-170	10	30	40	5	5	-	-	-	5	-	-	-	subangular to angular	3 mm	caliche cemented quartz sandstone; few rounded
170-180	3	40	35	15	5	Trace	Trace	-	1	1	-	-	subrounded to angular	4 mm	carbonate cement noted
180-190	5	30	25	20	10	-	-	-	5	-	-	5	subrounded	3 mm	Chips common with one rounded edge. Considerable well-rounded (2-3 mm) coarse sand.
190-200	1	20	10	40	2	2	-	-	5	15	2	3	subrounded to subangular	3 mm	sandstone with carbonate cement composed of >60% dark minerals, remainder qtz. (15% of sample)
200-210	-	30	10	50	2	-	Trace	-	2	5	-	1	subrounded to subangular	3 mm	very angular chips of rhyolite tuff noted
210-220	2	20	10	40	10	-	3	-	3	10	-	2	subrounded	3 mm	chips with one smooth face becoming more common; fewer well rounded grains noted
220-230	10	30	10	20	10	-	5	5	2	5	-	3	subrounded to subangular	2 mm	average grain size decreased
230-240	5	15	10	45	5	-	-	-	3	15	-	2	subangular	2 mm	large 4-5 mm well rounded gravel still present (uphole caving?)

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Caliche	SS	Chert	Dark Ig. Rock			
240-250	5	25	5	50	5	-	1	-	3	5	-	1	subangular	2 mm	
250-260	5	20	15	40	10	-	-	2	3	5	-	-	subrounded to subangular	<2 mm	numerous very angular small chips present
260-270	3	22	10	40	5	-	-	-	3	10	2	5	subangular	2 mm	most grains are angular on at least one face
270-280	-	30	5	45	5	-	5	-	2	3	-	5	subrounded to subangular	3 mm	Very fine sand (<1 mm), typically well rounded. Numerous large, well rounded grains (4-5 mm) present.
280-290	5	3	10	40	40	-	-	-	-	2	-	-	subangular to angular	2 mm	30-40% clay. Volcanics are distinctly locally derived andesites (Orejon) and rhyolites (Cueva and Soledad) <5% of clastics are not locally derived. Previously <50% volcanics were locally derived.
290-300	-	10	10	45	30	-	-	-	2	3	-	-	subangular to angular	1.5 mm	Few rounded grains. ≈ 60% clay. Chips are locally derived volcanics.
300-310	5	5	5	55	20	-	5	-	-	5	-				≈40% clay. Weathered Soledad Rhyolite is sometimes difficult to distinguish from very fine grained sandstone.
310-320	-	20	15	50	5	-	-	3	5	2	-	-	subangular to angular	1 mm	60% clay. <50% of chips >1 mm
320-330	-	10	5	50	25	-	-	-	3	2	-	5	subangular to angular	1 mm	30% clay. Some chips have one or two rounded faces, the remainder angular. None were entirely rounded.
330-340	-	3	5	25	2	-	-	-	60	5	-	-	angular	1 mm	60% clay. Several angular 5-6 mm diam. chips (rhyolite) noted. Chips examined are primarily recrystalized carbonates and carbonate-cemented siltstone.

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Cal-iche	SS	Chert	Dark Ig. Rock			
340-350	-	5	5	10	-	-	-	-	75	5	-	-	subangular to angular	1.5 mm	70% clay. One large angular chip (8 mm diam) noted. Remainder of chips <2 mm. Chips are (recrystalized?) carbonates.
350-360	-	10	10	60	5	-	-	-	10	-	-	5	subangular to angular	1.5 mm	40% clay. Several rounded quartz grains noted.
360-370	10	5	10	70	3	-	-	2	-	-	-	-	subrounded to subangular	2 mm	30% of initial sample clay. A few rounded grains noted.
370-380	5	5	10	70	5	-	-	-	-	5	-	-	subangular to angular	2 mm	Predominately Soledad Rhyolite. 20% clay.
380-390	2	5	10	75	5	-	-	-	-	-	-	5	angular	2 mm+	10% clay. Soledad Rhyolite predominates.
390-400	-	5	5	80	5	-	-	-	-	-	-	5	angular	2 mm	≈5% clay. The only rounded grains are 1.0 mm quartz.
400-410	-	5	10	65	15	-	-	-	-	-	-	5	subangular to angular	2 mm	15% clay. Considerable variation in appearance of rhyolite.
410-420	Trace	-	15	80	5	-	-	-	-	-	-	-	angular	3 mm	≈2% clay. Soledad Rhyolite predominates. Some Cueva Rhyolite noted.
420-430	5		5	85	5	-	-	-	-	-	-	-	angular	3 mm	<1% clay. Cueva Rhyolite comprises less than 5% of total "rhyolite," "Flow banded rhyolite" is Soledad.
430-440	2	-	5	90	3								angular to very angular	4 mm	<1% clay. Soledad Rhyolite predominates.
440-450	5	-	5	90	-	-	-	-	-	-	-	-	angular	3 mm	≈5% clay. Numerous angular rhyolite fragments 5 to 7 mm diam. Andesite is conspicuously absent.
450-460	-	-	5	90	5	-	-	-	-	-	-	-	angular to subangular	3 mm	<1% clay. Greater percentage of "red" rhyolites noted; ≈10%.

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Cal-iche	SS	Chert	Dark Ig. Rock			
460-470	"	"	3	95	2	"	"	"	"	"	"	"	angular	3 mm	<1% clay. Still considerable variation in color, flow banding, etc. in rhyolite
420-480	"	"	8	90	2	"	"	"	"	"	"	"	subangular to angular	3 mm	<1% clay. Cueva Rhyolite comprises about 15% of sample; remainder of rhyolite is Soledad, which is still variable in features. Many chips have one weathered face.
480-490	2	"	5	90	1	"	"	"	"	"	"	2	subangular to angular	3 mm	<1% clay. Rhyolite variable.
490-500	"	"	2	95	3	"	"	"	"	"	"	"	angular	3 mm+	<1% clay. ≈10% of sample is Soledad Rhyolite chips 8-10 mm diam. Rhyolites variable.
500-510	"	"	3	96	1	"	"	"	"	"	"	"	angular to subangular	3 mm	<1% clay.
510-520	1	"	3	95	1	"	"	"	"	"	"	"		2 mm	<1% clay. Rhyolites are consistent in variation.
520-530	3	"	7	85	5	"	"	"	"	"	"	"	angular	3 mm	≈5% clay. Rhyolites variable.
530-540	"	"	1	97	2	"	"	"	"	"	"	"	angular	3 mm	Chips are exceptionally clean. ≈30% of rhyolite is "reddish" in color. Previous samples averaged ≈10%. Most of remaining rhyolite is light purple basal Soledad. ≈25% of chips have at least one weathered face.
540-550	"	"	2	93	5	"	"	"	"	"	"	"	subangular to angular	3 mm	same as above; about 10% of samples are rounded.
550-560	"	"	1	98	1	"	"	"	"	"	"	"	angular		Soledad rhyolite comprises ≈95% of sample. Rounded grains are present (≈5%)

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Caliche	SS	Chert	Dark Ig. Rock			
560-570	~	~	3	96	1	~	~	~	~	~	~	~	angular	3 mm	Rhyolites are more variable in features than 530-560 samples. No carbonates.
570-580	~	~	1	98	1	~	~	~	~	~	~	~	angular to very angular	3 mm	Rhyolite chips are clean but variable in appearance. A few rounded grains noted.
580-590	~	~	5	94	1	~	~	~	~	~	~	~	angular	3 mm	15% of rhyolite is "reddish" in color (upper Soledad). ≈60% of sample is light purple basal Soledad Rhyolite. ≈5% is Cueva Rhyolite. ≈30% of chips have at least one weathered face.
590-600	2	~	5	85	8	~	~	~	~	~	~	~	angular	3 mm	same as above
600-610	~	~	5	90	5	~	~	~	~	~	~	~	angular	4 mm	same as above
610-620	~	~	10	80	10	~	~	~	~	~	~	~	angular	4 mm	"Red" rhyolite comprises about 5% of sample. Most of remainder is Soledad Rhyolite.
620-630	~	~	5	93	2	~	~	~	~	~	~	~	angular to subangular	4 mm	same as 580-610 depth
630-640	1	~	5	90	2	~	~	2	~	~	~	~	angular to subangular	3 mm	same as 580-610 depth
640-650	~	~	3	96	1	~	~		~	~	~	~	angular	3 mm	same as 580-610 depth
650-660	~	~	2	96	1	~	~	1	~	~	~	~	angular to subangular	3 mm	"Red" rhyolite comprises about 10% of sample. Cueva Rhyolite <3%; remainder of rhyolite is Soledad from various members.
660-670	~	~	5	94	1	~	~	~	~	~	~	~	angular to subangular	2 mm	Same as above. ≈30% of chips have one or more weathered faces.
670-630	1	~	2	95	2	~	~	~	~	~	~	~	angular to subangular	2 mm	Chips are very angular and of uniform size; many have at least one weathered face. "Red" rhyolite ≈10% of sample; remainder is variable in appearance.

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Caliche	SS	Chert	Dark Ig. Rock			
680-690	"	"	5	93	2	"	"	"	"	"	"	"	angular	3 mm	Chips are very angular and of uniform size; many have at least one weathered face. "Red" rhyolite ≈10% of sample; remainder is variable in appearance.
690-700	"	"	3	96	1	"	"	"	"	"	"	"	angular		~5% of rhyolite is "red". Light purple basal Soledad Rhyolite ≈70% of sample. ≈5% is Cueva Rhyolite; remainder is undifferentiated Soledad.
700-710	"	"	5	90	5	"	"	"	"	"	"	"	angular	4 mm	Same as above. Chips 690-710 are mostly angular but 10-20% have one weathered face.
710-720	"	2	8	85	5	"	"	"	"	"	"	"	angular to subangular	3 mm	same as 690-710
720-730	"	2	2	95	1	"	"	"	"	"	"	"	angular	2 mm	same as 690-710
730-740	"	"	5	94	1	"	"	"	"	"	"	"	angular to subangular	4 mm	Numerous rounded, unbroken 2-3 mm grains of Soledad Rhyolite. Otherwise, same as 690-710.
740-750	"	1	2	96	1	"	"	"	"	"	"	"	subangular to angular	3 mm	≈10% of rhyolite is "red" (probably upper Soledad Rhyolite). ≈5% Cueva Rhyolite; remainder of rhyolite represents lower Soledad Rhyolite. Chips are primarily very angular with occasional weathered face; some rounded grains.
750-760	5	3	10	80	2	"	"	"	"	"	"	"	subangular to angular	3 mm	≈2-3% clay. Numerous rounded grains. Otherwise, same as 740-750.
760-770	10	5	2	78	5	"	"	"	"	"	"	"	subrounded to subangular	4 mm	≈15% clay. ≈20% of sample is 5-7 mm pebbles, many of which are rounded. ≈30% of sample (2-3 mm) is composed of rounded grains. Rhyolite percentages same as 740-750.

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Caliche	SS	Chert	Dark Ig. Rock			
770-780	2	1	5	90	2	~	~	~	~	~	~	~	subangular	4 mm	≈3% clay. Otherwise, same as 760-770.
780-790	~	1	2	96	1	~	~	~	~	~	~	~	subangular to angular	3 mm	≈15% clay. Few rounded grains; most of sample is chips; about 30% of chips have one or more rounded, weathered sides. Rhyolite composition unchanged.
790-800	~	2	2	93	2	~	1	~	~	~	~	~	angular		≈5% clay. Otherwise, same as 780-790.
800-810	~	1	3	95	1	~	~	~	~	~	~	~	angular		≈2% clay. Sample is mostly rhyolite chips. Few rounded grains noted. Little variation in rhyolite composition with depth.
810-820	~	3	5	90	2	~	~	~	~	~	~	~	subangular to angular	3 mm	<1% clay. ≈15% of sample is rounded grains. Otherwise, same as above.
820-830	~	1	2	96	1	~	~	~	~	~	~	~	subangular to angular	3 mm	≈2% clay. ≈15% of sample is rounded grains. Little variation in rhyolites.
830-840	~	1	5	90	3	~	1	~	~	~	~	~	angular	3 mm	same as 820-830, with exception that <5% of grains are rounded
840-850	1	2	4	92	1	~	~	~	~	~	~	~	angular	3 mm	≈20% "red" rhyolite. <5% Cueva Rhyolite. ≈20% basal Soledad Rhyolite; remainder of Soledad undifferentiated. Most of sample is chips; <5% of grains are rounded.
850-860	~	1	2	92	5	~	~	~	~	~	~	~	angular	3 mm	Same as 840-850. Chips are noticeably more uniform in size (2.5-3 mm).
860-870	~	1	4	94	1	~	~	~	~	~	~	~	angular to subangular	3 mm	Same ad 840-850. ≈30% chips have at least one weathered face.
870-880	~	1	4	95	~	~	~	~	~	~	~	~	angular to subangular	3 mm	same as 860-870 with exception that ≈10% of grains are rounded.
880-890	1	1	3	94	1	~	~	~	~	~	~	~	subangular to angular	3 mm	same as 870-880

DEPTH	MINERALOGY (%)												ROCK TEXTURE	AVG. SIZE	REMARKS
	Qtz. Monz.	Qtz.	Tuff	Rhy.	Ande.	Mica	Feld.	Ls.	Cal-iche	SS	Chert	Dark Ig. Rock			
890-900	-	1	2	97	-	-	-	-	-	-	-	-	angular	2 mm	Rhyolite type percentages unchanged. 10-15% of 1-mm grains are rounded. A few larger grains are rounded; 20% of chips have at least one weathered face.
900-910	1	1	2	93	3	-	-	-	-	-	-	-	subangular to angular	3 mm	same as 890-900
910-920	-	1	7	91	1	-	-	-	-	-	-	-	angular	2 mm	same as 890-910
920-930	-	-	3	96	1	-	-	-	-	-	-	-	angular	4 mm	same as 890-920 except for noticeable lack of Cueva Rhyolite
930-940	-	-	4	95	1	-	-	-	-	-	-	-	subangular to angular	3 mm	same as 890-910 except Cueva Rhyolite present
940-950	-	1	8	90	1	-	-	-	-	-	-	-	subangular to angular	3 mm	same as 890-910
950-960	-	1	3	94	2	-	-	-	-	-	-	-	subangular to angular	4 mm	Rhyolite type percentages unchanged. Chips are no longer of uniform size. 10-15% of sample is 5-7 mm very angular rhyolite chips. 8-10% of grains are rounded.
960-970	-	1	2	95	2	-	-	-	-	-	-	-	subangular to angular	3 mm	Same as 950-960. 30-40% of chips have at least one weathered face.
970-980	1	1	3	93	2	-	-	-	-	-	-	-	subangular to angular	4 mm	same as 950-970
980-990	-	1	1	97	1	-	-	-	-	-	-	-	angular	3 mm	same as 950-980
990-1000	-	1	2	95	2	-	-	-	-	-	-	-	angular	3 mm	Chips are uniform in size-(1.5-2 mm). Rhyolite type percentages remain unchanged. 5-7% of grains are rounded. 15-25% of chips have at least one weathered face.

Appendix C
Geophysical Logs for Well NMSU - PG-1

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

OPERATOR: STEVE GREGG | DATE: 10-17-79

UNIT NO: 7750 | FIELD OFFICE: GRANTS

COMPANY: NEW MEXICO STATE UNIVERSITY

BOREHOLE: EAST PRODUCTION WELL

AREA: EAST UNIVERSITY | ELEVATION:

COUNTY: DONA ANA | STATE: N.M.

SECTION: | TOWNSHIP: | RANGE:

HOLE DATA

TOTAL DEPTH — DRILLER	862'	BIT SIZE	5 7/8"
TOTAL DEPTH — LOGGER	860'	CASING — TYPE & SIZE	
TOTAL FOOTAGE LOGGED	860'	CASING DEPTH	
LOGGING SPEED	@60'/MIN	BOREHOLE FLUID	H2O + MUD
REFERENCE LEVEL	GL	FLUID RESISTIVITY	@80°F
PROBE NO	9055A-12	SOFTWARE LEVEL	V928
TIME IN 13:45		S.P. 15/115	
OUT 15:00		RES 10/20	

REMARKS: 4R para-plot + DEV + TEMP
Config #126

EQUIPMENT DATA

PROBE MODEL	9010	9110	9055A	9110	
PROBE DIAMETER	1 3/8"	2 1/8"	1 3/8"	1 1/8"	
NATURAL GAMMA — DETECTOR TYPE	NaI	NaI	NaI	NaI	
NATURAL GAMMA — DETECTOR SIZE	0.75" x 1.25"	1.25" x 4.5"	0.75" x 4.0"	5" x 3.0"	
NATURAL GAMMA — STD K FACTOR	1.59 x 10⁻⁴	—	5.58 x 10⁻⁴	1.62 x 10⁻⁴	
NATURAL GAMMA — STD DEADTIME	1 μsec	—	1.18 μsec	1 μsec	
NATURAL GAMMA — CALIB. MODEL LOC.		—	GRANTS		
NATURAL GAMMA — CALIB DATE		—	10-5-79		
NATURAL GAMMA — K FACTOR		—	5.58 x 10⁻⁴		
NATURAL GAMMA — DEADTIME		—	1.252 μsec		
NATURAL GAMMA — TEST READING		—			
NATURAL GAMMA — WATER FACTOR		—			
NATURAL GAMMA — CASING FACTOR		—			
DENSITY — DETECTOR TYPE	—	NaI	—	NaI	
DENSITY — DETECTOR SIZE	—	1" x 1.5"	—	1" x 3.0"	
DENSITY — SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷	
DENSITY — SOURCE NO.	—		—		
DENSITY — SOURCE STRENGTH	—		—		
DENSITY — SOURCE SPACING	—		—		
NEUTRON — DETECTOR TYPE	—	—	He³	—	
NEUTRON — DETECTOR SIZE	—	—	1.0" x 6.0"	—	
NEUTRON — SOURCE TYPE	—	—	Am-Be	—	
NEUTRON — SOURCE NO.	—	—	4U 2.11	—	
NEUTRON — SOURCE STRENGTH	—	—	4 Ci	—	
NEUTRON — SOURCE SPACING	—	—	9"	—	
SNGL. PT RESISTANCE	16"D x 2.5"T	—	16"D x 2.5"T	16"D x 2.5"T	
RESISTIVITY	—	16" FOCUSED	—	—	
SELF POTENTIAL	YES	—	YES	YES	
TEMPERATURE	—	—	YES	—	
DEVIATION	—	—	NO (YES)	—	
CALIPER	—	YES	—	—	

CT 102 REV 11-78

N.M.S.U.

EAST PRODUTION WELL

HOLE DIAMETER : 09.9

CAL STD CPS = 0161 CAL RUN CPS = 0197

PROBE # 9055A -012 PROBE CAL BIAS = +00000

TRUCK # 7750 DATA: V3L8

APPL.#126 B

STEVE GREGG

VERTICAL DEVIATION

COMPULOG V3L1 DEVIATION

HOLE ID: EAST PRODUCTION WELL

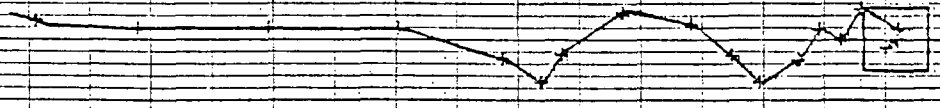
SCALE: 1 FT/IN + = 50 FOOT INCR

MAG DECL: 13.5 △ = TOP OF ZONE

TRUE DEPTH: 861. FT ◇ = BOTTOM OF ZONE

AZIMUTH: 272.

DISTANCE: 7.2 FT TRUE NORTH



CENTURY GEOPHYSICAL CORP. PART NO. 786-0022

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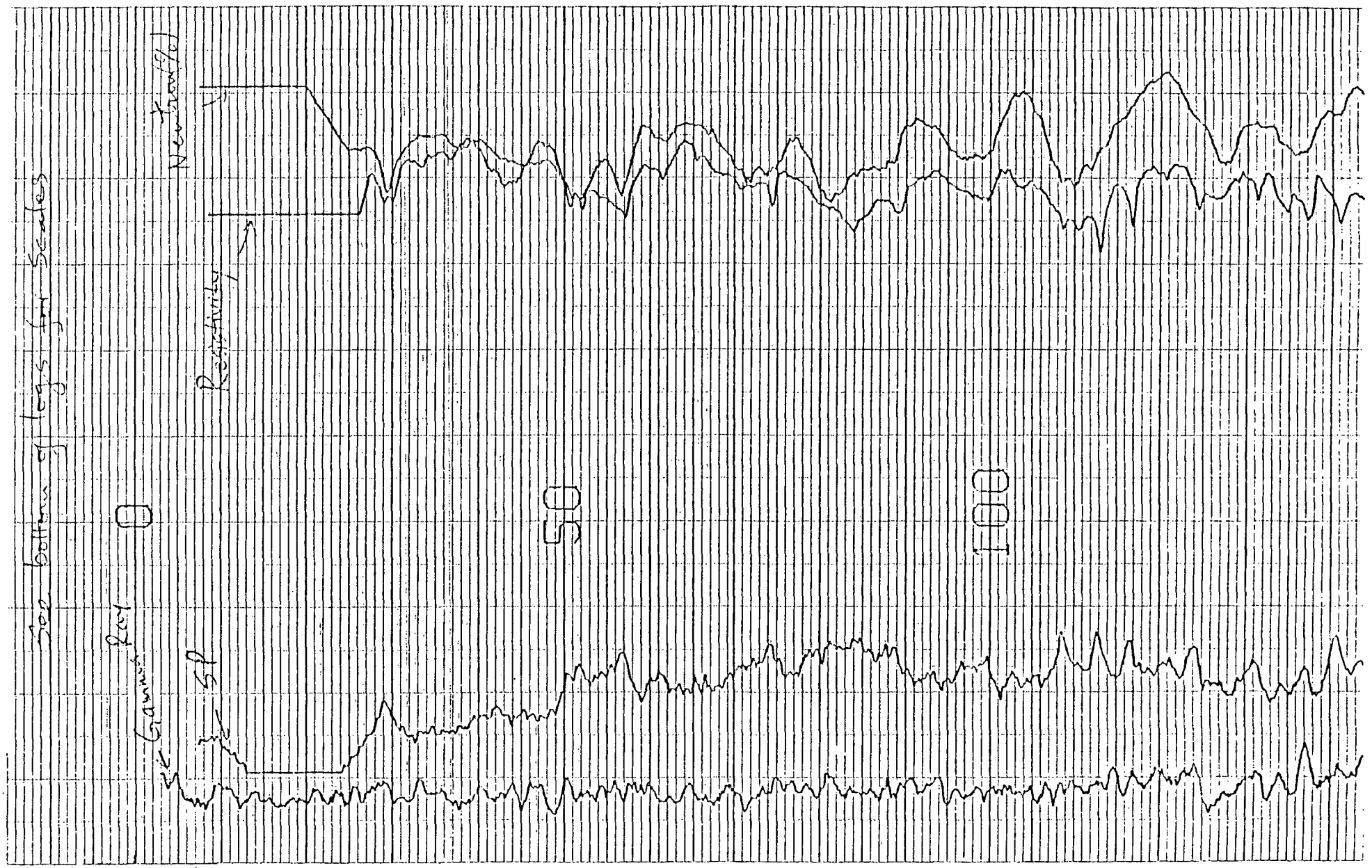
CENTURY GEOPHYSICAL CORP. PART NO. 786-0022



40

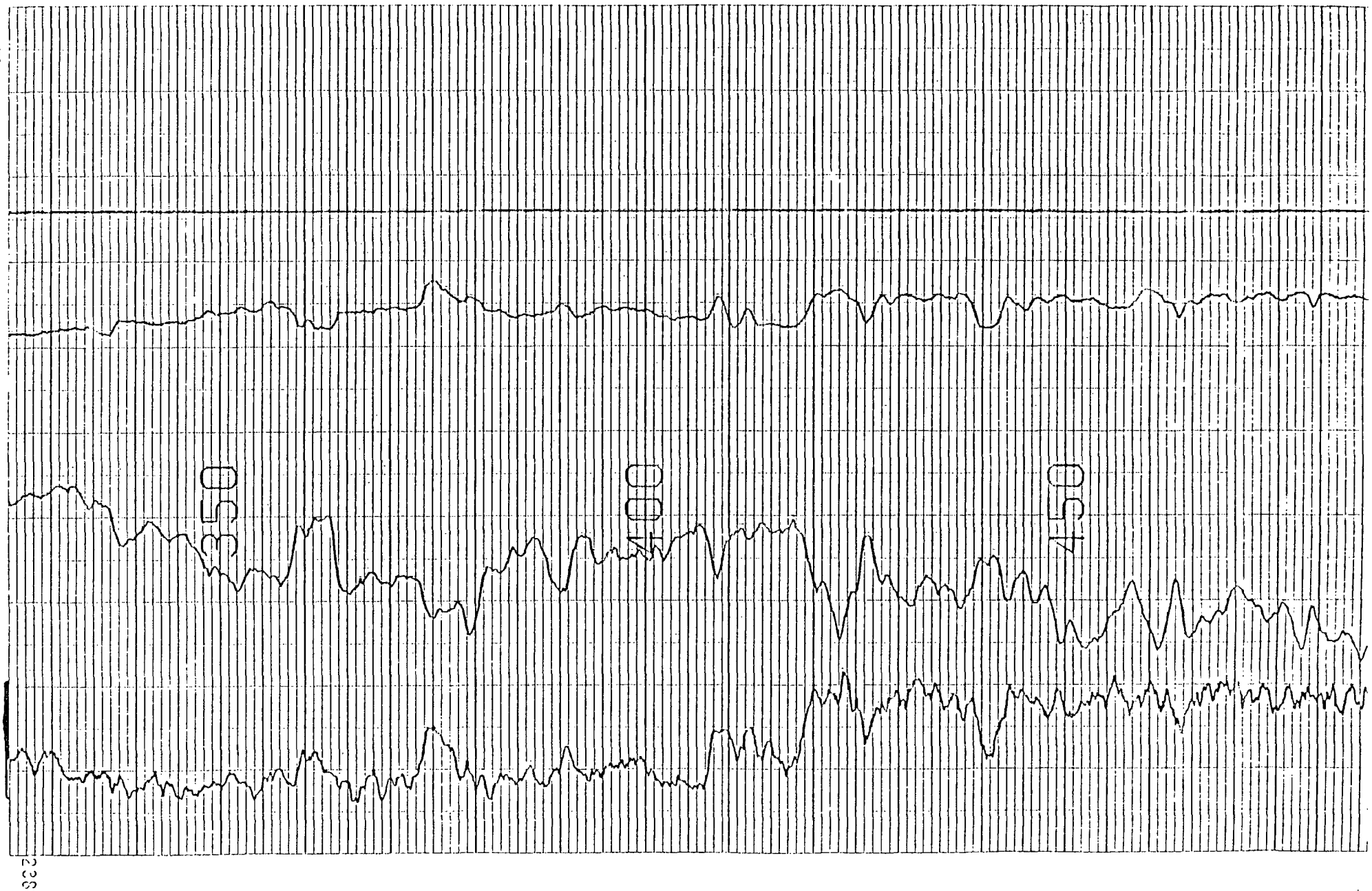
0.72

CENTURY GEOPHYSICAL CORP. PART NO. 786-0022

CENTURY GEOPHYSICAL CORP. PART NO. 786-0022

CENTURY GEOPHYSICAL CORP. PART NO. 786-0022

CENTURY GEOPHYSICAL CORP. PART NO. 786-0022



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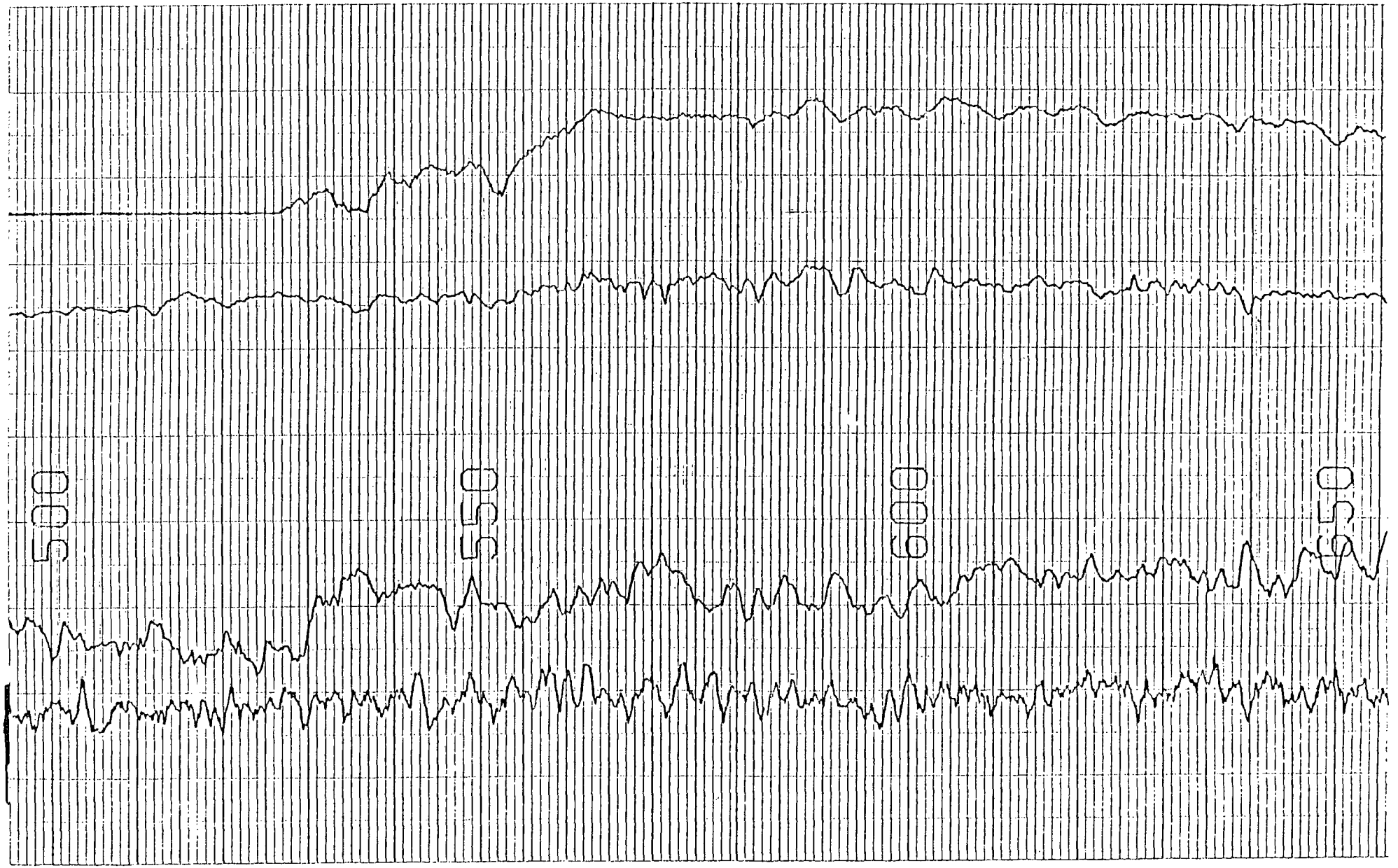
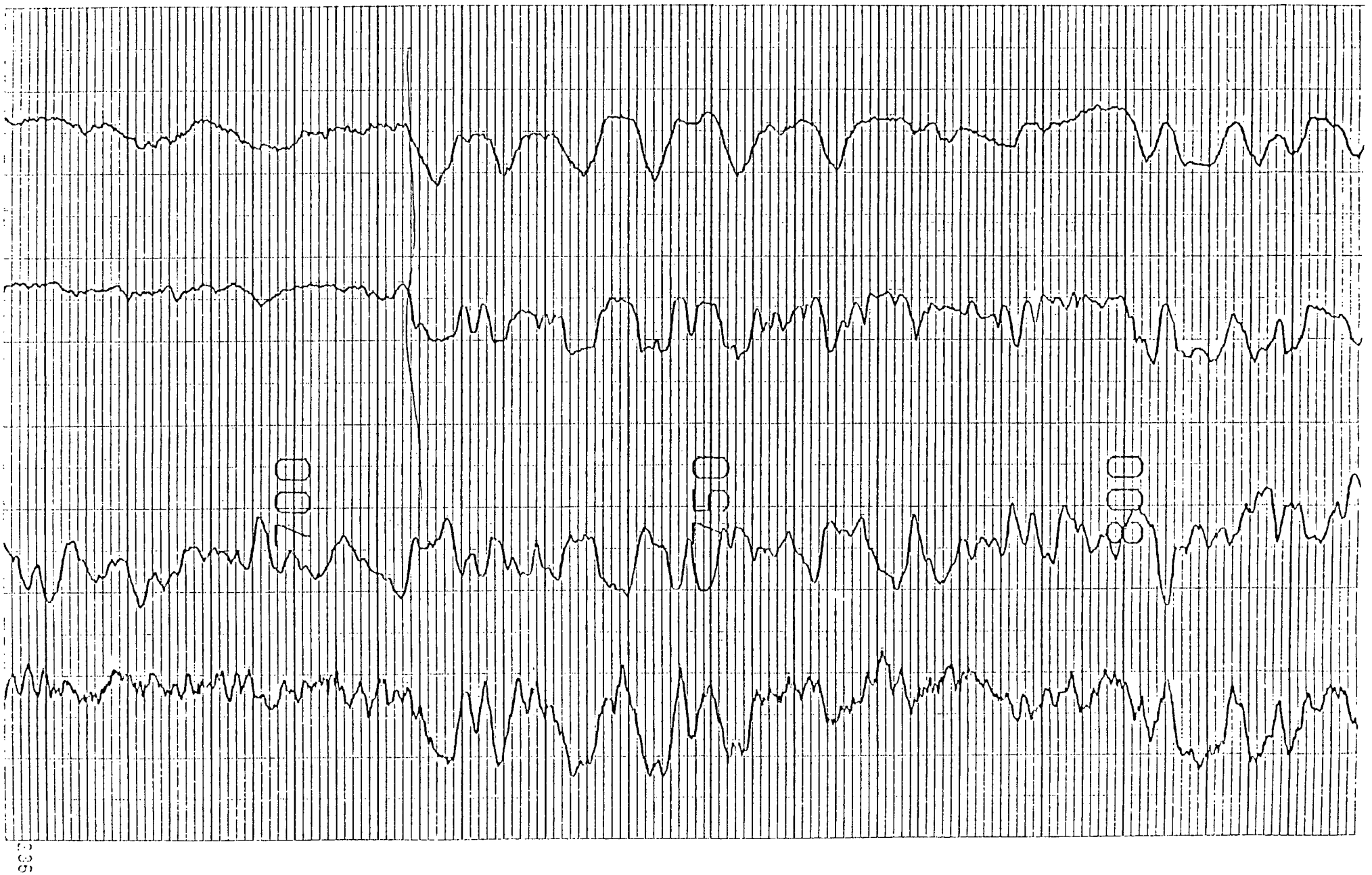
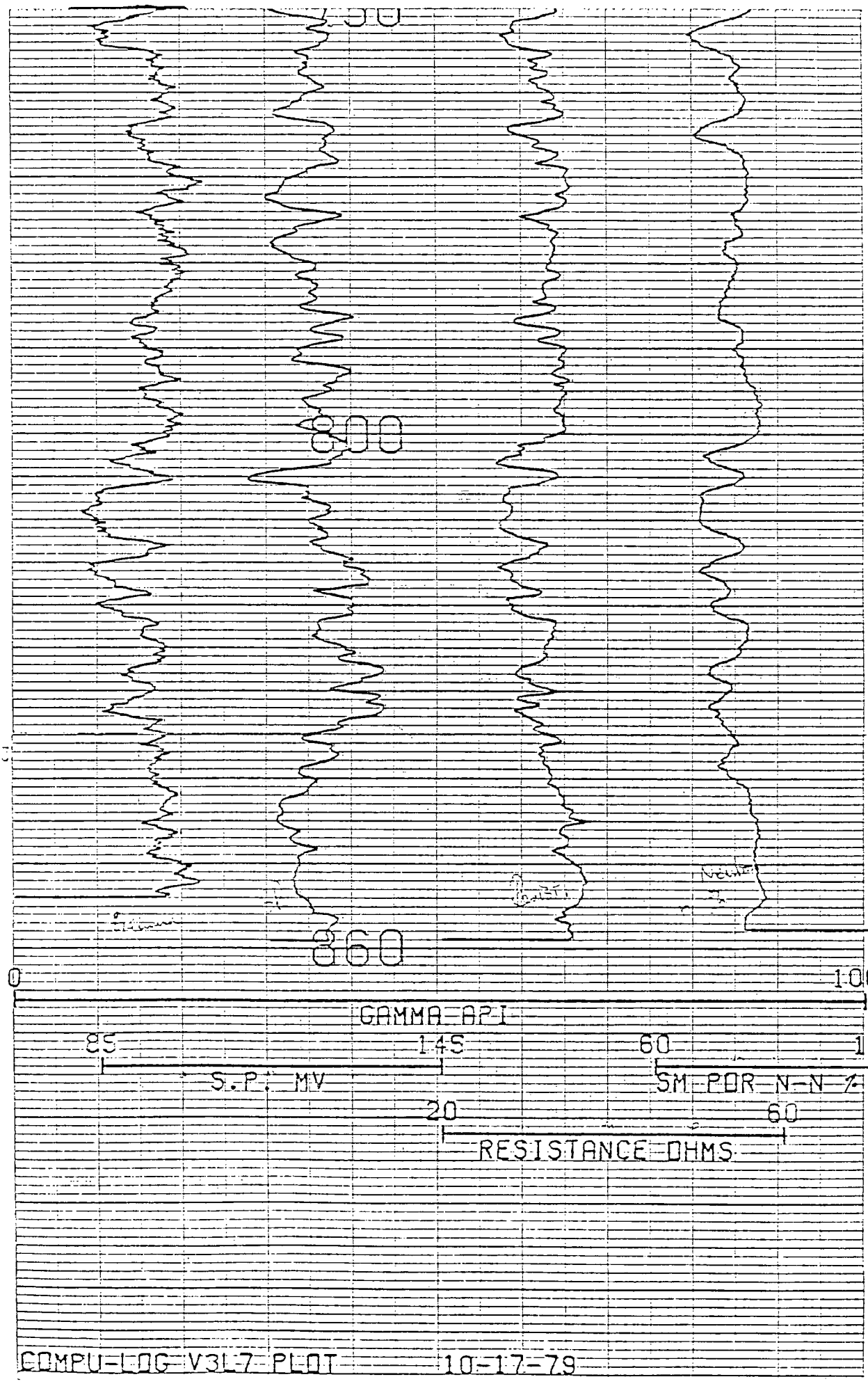
CENTURY GEOPHYSICAL CORP. PART NO. 786-0022



CENTURY GEOPHYSICAL CORP. PART NO. 786-0022

CENTURY GEOPHYSICAL CORP. PART NO. 786-0022




CENTURY GEOPHYSICAL CORP. PART NO. 786-0022
800
860
0
100
GAMMA API
85
145
S.P. MV
60
100
SM POR N-N %
20
60
RESISTANCE OHMS
COMPU-LOG V3L7 PLOT
10-17-79
CENTURY GEOPHYSICAL CORP. PART NO. 786-0022

CENTURY GEOPHYSICAL CORPORATION

* * * COMPU-LOG TEMPERATURE SURVEY * * *

CLIENT: N.M.S.U. HOLE ID: EAST PRODUCTION WELL
LOCATION: EAST PRODUCTION WELL DATE: 10-17-79
TRUCK NO.: 7750 PROBE TYPE: 9055

TEMPERATURE (DEG. F.)

SENSOR DEPTH	TEMP DEG.F	95 100 105 110 115 120
		X---------X---------X---------X---------X---------X
10.0	95.2	I * I
15.0	95.6	I * I
20.0	96.1	I * I
25.0	96.4	I * I
30.0	96.9	I * I
35.0	97.1	I * I
40.0	97.9	I * I
45.0	98.0	I * I
50.0	98.3	I * I
55.1	98.7	I * I
60.1	98.8	I * I
65.1	99.1	I * I
70.2	99.5	I * I
75.2	99.7	I * I
80.2	99.9	I * I
85.2	100.1	I * I
90.2	100.4	I * I
95.3	100.6	I * I
100.3	100.8	I * I
105.3	101.1	I * I
110.3	101.2	I * I
115.3	101.4	I * I
120.3	101.5	I * I
125.3	101.9	I * I
130.3	102.0	I * I
135.3	102.0	I * I
140.3	102.3	I * I
145.3	102.3	I * I
150.3	102.7	I * I
155.3	102.7	I * I
160.3	102.9	I * I
165.3	103.0	I * I
170.3	103.1	I * I
175.3	103.5	I * I
180.3	103.7	I * I
185.3	103.7	I * I
190.3	103.8	I * I
195.3	104.0	I * I
200.3	104.0	I * I
205.3	104.4	I * I
210.3	104.5	I * I
215.3	104.6	I * I
220.3	104.7	I * I
225.3	104.9	I * I
230.3	105.0	I * I
235.3	105.0	I * I
240.3	105.1	I * I
245.3	105.5	I * I
250.3	105.5	I * I
255.3	105.5	I * I
260.3	105.5	I * I
265.3	105.6	I * I
270.3	105.7	I * I
275.3	105.7	I * I
280.3	105.6	I * I
285.3	105.8	I * I
290.3	105.7	I * I
295.3	105.8	I * I
300.3	106.0	I * I
305.3	106.0	I * I
310.3	106.0	I * I
315.3	106.3	I * I
320.3	106.5	I * I
325.3	106.5	I * I
330.3	106.6	I * I
335.3	106.7	I * I
340.3	106.8	I * I
345.4	106.8	I * I
350.4	107.0	I * I
355.4	106.8	I * I
360.4	107.0	I * I
365.4	107.4	I * I
370.4	107.5	I * I
375.4	107.4	I * I
380.4	107.5	I * I
385.4	107.6	I * I

SENSOR DEPTH	TEMP DEG.F	X 95	X 100	X 105	X 110	X 115	X 120
385.4	107.5			*			
390.4	107.9			*			
395.4	108.0			*			
400.4	108.3			*			
405.4	108.4			*			
410.4	108.6			*			
415.4	108.7			*			
420.4	108.8			*			
425.4	109.0			*			
430.4	109.1			*			
435.4	109.4			*			
440.4	109.5			*			
445.4	109.8			*			
450.4	110.0			*			
455.4	110.1			*			
460.4	110.2			*			
465.4	110.5			*			
470.4	110.8			*			
475.4	111.0			*			
480.4	111.0			*			
485.4	111.5			*			
490.4	111.7			*			
495.4	112.0			*			
500.4	112.2			*			
505.4	112.5			*			
510.4	112.8			*			
515.4	113.1			*			
520.4	112.9			*			
525.4	113.2			*			
530.4	113.2			*			
535.4	113.4			*			
540.4	113.2			*			
545.4	113.4			*			
550.4	113.4			*			
555.4	113.7			*			
560.4	113.7			*			
565.4	114.0			*			
570.4	114.0			*			
575.4	114.0			*			
580.4	113.7			*			
585.4	114.2			*			
590.4	114.0			*			
595.4	114.2			*			
600.4	114.2			*			
605.4	114.3			*			
610.4	114.3			*			
615.4	114.3			*			
620.4	114.3			*			
625.4	114.2			*			
630.4	114.3			*			
635.4	114.2			*			
640.4	114.5			*			
645.4	114.3			*			
650.4	114.3			*			
655.4	114.6			*			
660.4	114.8			*			
665.4	114.8			*			
670.4	114.8			*			
675.4	114.8			*			
680.4	115.3			*			
685.4	115.0			*			
690.4	115.0			*			
695.4	115.3			*			
700.4	115.3			*			
705.4	115.3			*			
710.4	115.3			*			
715.4	115.4			*			
720.4	115.4			*			
725.4	115.4			*			
730.4	115.3			*			
735.4	115.6			*			
740.4	115.4			*			
745.4	115.4			*			
750.4	115.4			*			
755.4	115.3			*			
760.4	115.5			*			
765.4	115.6			*			
770.4	115.4			*			
775.4	115.4			*			
780.4	115.6			*			
785.4	115.4			*			
790.4	115.4			*			
795.4	115.0			*			
800.4	115.0			*			
805.4	115.0			*			
810.4	115.0			*			
815.4	114.8			*			
820.4	115.0			*			
825.4	114.8			*			
830.4	114.8			*			
835.4	114.6			*			
840.4	114.8			*			
845.4	114.6			*			
850.4	114.5			*			
855.4	114.6			*			
860.3	114.5			*			

CENTURY GEOPHYSICAL CORPORATION

*** VERTICAL DEVIATION SURVEY ***

COMPU-LOG V3L1 DEVIATION

HOLE ID: EAST PRODUCTION WELL

TD = TOTAL DEPTH
T = TOP OF ZONE
B = BOTTOM OF ZONE

DEPTH	TRUE DEPTH	NORTH DEV	EAST DEV	DISTANCE	AZIMUTH	SR	SRB
.0	.00	.00	.00	.0	.0	0	.0
50.0	49.99	-.07	-.08	.1	229.6	.1	229.6
100.0	99.99	.08	.01	.0	10.2	.2	32.3
150.0	149.99	.24	-.29	.3	310.1	.3	297.1
200.0	199.99	-.01	-.45	.4	268.6	.3	212.3
250.0	249.99	.07	-.63	.6	277.1	.2	295.2
300.0	299.99	-.17	-.80	.8	257.7	.3	213.8
350.0	349.98	-.35	-1.12	1.1	252.2	.4	239.9
400.0	399.98	-.13	-1.34	1.3	264.1	.3	313.7
450.0	449.98	.11	-1.67	1.6	273.9	.4	307.9
500.0	499.98	.21	-2.23	2.2	275.4	.6	279.9
550.0	549.97	-.12	-2.72	2.7	267.2	.6	235.0
600.0	599.97	-.36	-2.89	2.9	252.9	.3	215.7
650.0	649.97	-.16	-3.29	3.2	266.9	.4	301.3
700.0	699.96	.08	-4.05	4.0	271.1	1.0	286.3
750.0	749.95	.08	-5.11	5.1	270.9	1.2	270.1
800.0	799.94	.08	-6.18	6.1	270.7	1.2	269.9
850.0	849.93	.14	-7.02	7.0	271.1	.9	274.2
TD 861.0	860.93	.20	-7.22	7.2	271.6	1.1	286.6