NM-34574

NM-62577

NM-81607

NM-56298

Unit Line is

Solid Line

NM-19150

NM-37548

NM-7765

BLM-Open

NM-84664

NM-39532

NM-44456

NM-44453

7-11

BLM-Open

NM-36096

NM-6986

NM-19150

NM-36936

NM-80467

NM-8838

BLM-Open

NM-6986

NMSLO-Open

NEW MEXICO
OIL CONSERVATION DIVISION
EXHIBIT 1
CASE NO. 11470

NM-35543

NM-84677

NM-63804

NM-25601

SAN SIDRO ARROYO

ENGINO TRAILER SCH 13 MI.

STATE OF NEW MEXICO
ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
PO BOX 2088
SANTA FE, NM 87504-2088

NEW MEXICO OIL CONSERVATION DIVISION

FORM C-108
Revised 7-1-81

EXHIBIT 2

APPLICATION FOR AUTHORIZATION TO INJECT

CASE NO. XXX 11470

I. PURPOSE: ____ Secondary Recovery ____ Pressure Maintenance ____ Disposal ____ Storage
Application qualifies for administrative approval? __Yes XX No

II. OPERATOR: ENERGY DEVELOPMENT CORPORATION

ADDRESS: 1000 LOUISIANA, SUITE 2900, HOUSTON, TX. 77002

CONTACT PARTY: BRIAN WOOD c/o PERMITS WEST, INC. PHONE: 505 466-8120

III. WELL DATA: Complete the data required on the reverse side of this form for each well processed for injection. Additional sheets may be attached if necessary.

IV. Is this an expansion of an existing project: ___ Yes XXX No
If yes, give the Division order number authorizing the project _____

V. Attach a map that identifies all wells and leases within two miles of any proposed injection well with a one-half mile radius circle drawn around each proposed injection well. This circle identifies the well's area of review.

VI. Attach a tabulation of data on all wells of public record within the area of review which penetrate the proposed injection zone. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of completion, and a schematic of any plugged well illustrating all plugging detail.

VII. Attach data on the proposed operation, including:

1. Proposed average and maximum daily rate and volume of fluids to be injected;
2. Whether the system is open or closed;
3. Proposed average and maximum injection pressure;
4. Sources and an appropriate analysis of injection fluid and compatibility with the receiving formation if other than reinjected produced water; and
5. If injection is for disposal purposes into a zone not productive of oil or gas at or within one mile of the proposed well, attach a chemical analysis of the disposal zone formation water (may be measured or inferred from existing literature, studies, nearby wells, etc.).

*VIII. Attach appropriate geological data on the injection zone including appropriate lithologic detail, geological name, thickness and depth. Give the geologic name, and depth to bottom of all underground sources of drinking water (aquifers containing waters with total dissolved solids concentrations of 10,000 mg/l or less) overlying the proposed injection zone as well as any such sources known to be immediately underlying the injection interval.

IX. Describe the proposed stimulation program, if any.

* X. Attach appropriate logging and test data on the well. (If well logs have been filed with the Division, they need not be resubmitted.)

* XI. Attach a chemical analysis of fresh water from two or more fresh water wells (if available and producing) within one mile of any injection or disposal well showing location of wells and dates samples were taken.

XII. Applicants for disposal wells must make an affirmative statement that they have examined available geologic and engineering data and find no evidence of open faults or any other hydrologic connection between the disposal zone and any underground source of drinking water.

XIII. Applicants must complete the "Proof of Notice" section on the reverse side of this form.

XIV. Certification: I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

NAME: BRIAN WOOD TITLE: CONSULTANT

SIGNATURE: Brian Wood DATE: 1-24-96

* If the information required under Sections VI, VIII, X, and XI above has been previously submitted, it need not be resubmitted. Please show the date and circumstance of the earlier submittal. _____

DISTRIBUTION: Original and one copy to Santa Fe with one copy to the appropriate District Office

III. WELL DATA

A. The following well data must be submitted for each injection well covered by this application. The data must be both in tabular and schematic form and shall include:

(1) Lease name; Well No.; Location by Section, Township, and Range; and footage location within the section.

(2) Each casing string used with its size, setting depth, sacks of cement used, hole size, top of cement, and how such top was determined.

(3) A description of the tubing to be used including its size, lining material, and setting depth.

(4) The name, model, and setting depth of the packer used or a description of any other seal system or assembly used.

Division District Offices have supplies of Well Data Sheets which may be used or which may be used as models for this purpose. Applicants for several identical wells may submit a "typical data sheet" rather than submitting the data for each well.

B. The following must be submitted for each injection well covered by this application. All items must be addressed for the initial well. Responses for additional wells need be shown only when different. Information shown on schematics need not be repeated.

(1) The name of the injection formation and, if applicable, the field or pool name.

(2) The injection interval and whether it is perforated or open-hole.

(3) State if the well was drilled for injection or, if not, the original purpose of the well.

(4) Give the depths of any other perforated intervals and detail on the sacks of cement or bridge plugs used to seal off such perforations.

(5) Give the depth to and name of the next higher and next lower oil or gas zone in the area of the well, if any.

XIV. PROOF OF NOTICE

All applicants must furnish proof that a copy of the application has been furnished, by certified or registered mail, to the owner of the surface of the land on which the well is to be located and to each leasehold operator within one-half mile of the well location.

Where an application is subject to administrative approval, a proof of publication must be submitted. Such proof shall consist of a copy of the legal advertisement which was published in the county in which the well is located. The contents of such advertisement must include:

(1) The name, address, phone number, and contact party for the applicant;

(2) The intended purpose of the injection well; with the exact location of single wells or the section, township, and range location of multiple wells;

(3) The formation name and depth with expected maximum injection rates and pressures; and

(4) A notation that interested parties must file objections or requests for hearing with the Oil Conservation Division, PO Box 2088, Santa Fe, NM 87504-2088 within 15 days.

NO ACTION WILL BE TAKEN ON THE APPLICATION UNTIL PROPER PROOF OF NOTICE HAS BEEN SUBMITTED.

NOTICE: Surface owners or offset operators must file any objections or requests for hearing of administrative applications within 15 days from the date this application was mailed to them.

I. Purpose is disposal.

II. Operator is Energy Development Corporation.
Address is 1000 Louisiana, Suite 2900, Houston, Tx. 77002.
Contact is Brian Wood (Permits West, Inc.). Phone is (505) 466-8120.

III. A. (1) Lease is BLM oil and gas lease NM-44453, which comprises all of Sections 6-8, T. 20 N., R. & W. When APD was filed, prior to unit formation, lease was known as Johnson 7-11. Well name and number is San Isidro (Shallow) Unit 7-11. Well is at 2074' FSL and 1650' FWL Sec. 7, T. 20 N., R. 2 W.

A. (2) Surface casing (9-5/8", 36#, J-55) was set at 595' in a 13-1/2" hole and cemented to the surface (visually observed) with 135 sx (448 cu ft) 65/35 Pozmix and 150 sx (177 cu ft) Class B. Intermediate string (7", 23#, J-55) was set at 3666' KB in a 8-3/4" hole and cemented to 325' (checked by log) with 230 sx (766 cu ft) 65/35 Pozmix and 100 sx (118 cu ft) Class B. Long string (4-1/2", 10.5#, J-55) was set at 4762' KB in a 6" hole and cemented to 3339' (checked by log) with 165 sx (208 cu ft) 50/50 Pozmix.

A. (3) Tubing will be ceramic lined 2-7/8" 6.5# injection string set at 2349' (disposal interval is 2438' - 2624').

A. (4) Model R packer from Baker will be set at 2350'.

B. (1) Disposal zone will be Menefee Formation.

B. (2) Disposal interval will be 2438' - 2624'. It was perforated (0.36") with 2 shots per foot through 6 intervals (2438'-2441', 2516'-2522', 2550'-2562', 2590'-2594', 2600-2604', 2614'-2624') in 1992 during testing for a possible oil well completion (Mancos was completed in 1984, but became sub-marginal and was abandoned).

B. (3) Well was drilled in 1984 as a Mancos oil well.

B. (4) Mancos was perforated from 4169' to 4290'. During 1992 recompletion into Menefee a CIBP was set at 2667' and 4 perforations at 3160'-3162' were squeezed.

B. (5) Top of Mancos is 3112', which is 488' below the lowest Menefee perforation. While neither produce locally, Pt. Lookout top (2940') is

316' below the lowest Menefee perforation and the Cliff House top (1632') is 806' above the highest Menefee perforation.

IV. This is not an expansion of an existing injection project.

V. A map is attached showing all wells within a half mile (there are none, closest is the 7-3 which is 2765' north and its BHL is 4757' north) and within 2 miles (12 oil + 3 P&A; all 15 wells are within the unit). The same map also shows all leases within a half mile (all Federal and all within the unit) and within two miles (all Federal or state).

VI. This is the only well within a half mile. Profile is attached.

VII. 1. Average injection rate = 100 bwpd. Maximum rate = 1000 bwpd.
2. System will be open (trucked to well). Two 300 bbl steel tanks, Gasso 3211 triplex pump with Waukesha CRG 155 engine, and a 20" filter cartridge with two 75 micron filters will be installed.
3. Average injection pressure = 700 psi. Maximum = 2000 psi.
4. Water source will be unit wells producing from Mancos. Analyses of receiving (7-11) and injected waters are attached. A summary follows:

Parameter	Drink. Water Stand.	7-11*	7-3	5-15	12-10
pH	6.5-8.5	7.6-8.0	7.5	7.5	7.3
TDS	500	8790	3243	27356	25495
Bicarbonate	-	630-2020	988	744	598
Chloride	250	1029-3800	1300	16000	15000
Sulfate	250	<300	11	81	3
Calcium	-	58-116	120	1080	120
Magnesium	-	0.1-64	389	98	170
Sodium	-	3062	348	9271	9495
Iron	0.3	1.0	2.6	36	3.6
Barium	1.0	17.0	85	46	105
Total Hardness	-	200	1900	3100	1000

*range of 3 different samples

5. Analysis of disposal zone water is attached. Salient points are that the disposal zone water TDS exceeds drinking water standards by over 17 times, chlorides by 4 to 15 times, iron by 3 times, and barium 17 times. The Menefee is a mix of coal, shale, claystone, carbonaceous siltstone, and sandstone layers. Its depositional environment was a marine lagoon. An analysis (S. E. Craigg's 1980 Hydrogeology and water resources of the Chico Arroyo - Torreon Wash Area, McKinley and Sandoval Counties, New Mexico) of Menefee water 20-30 miles southwest of the 7-11 well found TDS increased from southwest to northeast to a high of 10,272. Five unit wells (5-2, 6-16, 11-14, 12-10, 13-11) which penetrated the Menefee and reported what they found, found oil in the Menefee. All five wells are within 2 miles of the 7-11.

VIII. The Menefee consists of coal, shale, claystone, carbonaceous siltstone, and sandstone. Menefee oil pools are found at the Rusty (≈30 mi. W in 22n-7w) and Seven Lakes (≈50 mi. SW in 18n-10w) Fields. It is 627' thick in the 7-11 wellbore. Top is 2312' and bottom is 2939'. Fracture gradient is 0.82 psi/ft.

Two zones (Pictured Cliffs and Cliff House) above the Menefee are water bearing. Local TDS data from these zones is lacking. Basin wide, specific conductance of Pictured Cliffs and Cliff House water ranges from 2000 μmhos near outcrops to 30,000 μmhos in deeper gas prone areas. Five unit wells (5-2, 6-16, 11-14, 12-10, 13-11) penetrated the Pictured Cliffs and reported what was found there. All five found gas in the Pictured Cliffs. Three unit wells (5-2, 11-14, 12-10) penetrated the Cliff House and reported what was found there. All three found gas in the Cliff House.

The water bearing Pt. Lookout lies immediately below the Menefee. Four unit wells penetrated the Pt. Lookout and reported what was found there. Two (11-14, 12-10) of the four reported they found gas and two (6-16, 13-11) reported they found oil and gas.

IX. Stimulation, if needed, will be acidization.

X. Induction, CDL, GR, Compensated Density, Sidewall Neutron, and CBL logs were run and are on file.

XI. Based on a field inspection (Dec. 20) and the NM State Engineer's Office record review (Oct. 26), there are no fresh water wells within a mile of the 7-11.

XII. Geologic and engineering data at the NM Oil Conservation Div. and NM Institute of Mining & Technology have been examined. No evidence of open faults or other hydrologic connection between the Menefee and any underground source of water has been found. An injectivity test was run on 9-28-95 and the Menefee tested at a rate of 720 bwpd and 700 psi.

XIII. Notice has been sent to the surface owner (BLM Albuquerque District). Energy Development Corporation is the operator of all leases within a half mile since all leases within a half mile are in its San Isidro (Shallow) Unit.

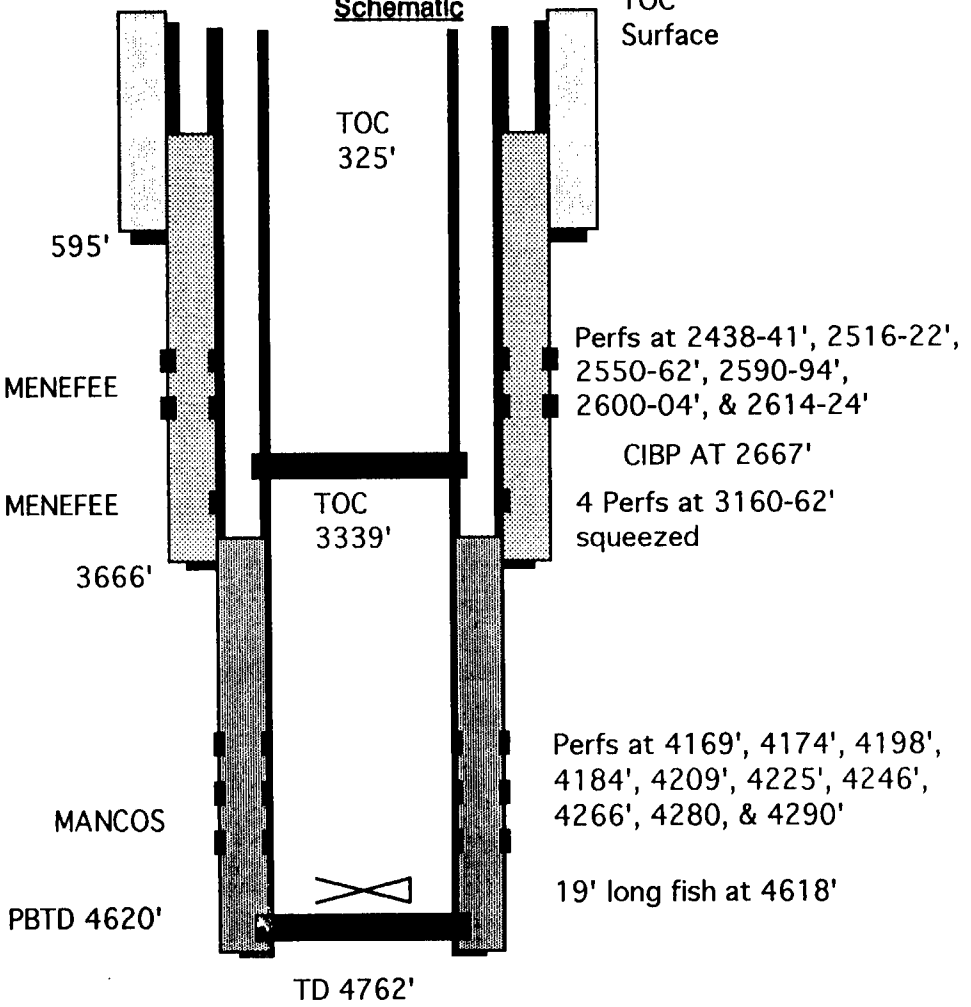
INJECTION WELL DATA SHEET

Side

OPERATOR: Energy Development Corporation — LEASE: NM-44453

WELL NO.: San Isidro (Shallow) Unit 7-11 — FOOTAGE LOCATION: 2074' FSL & 1650' FWL — SECTION: 7 — TOWNSHIP: 20n — RANGE: 2w

Schematic



Well Construction Data

Surface Casing

Size 9-5/8" • Cemented with 285 sx.

TOC Surface feet determined by Visual

Hole Size 13-1/2" (448 cf 65/35 Poz + 177 cf Class B)

Intermediate Casing

Size 7" • Cemented with 330 sx.

TOC 325' feet determined by Log

Hole Size 8-3/4" (766 cf 65/35 Poz + 118 cf Class B)

Long String

Size 4-1/2" • Cemented with 165 sx.

TOC 3,339' feet determined by Log

Hole Size 6" (208 cf 50/50 Poz)

Total Depth 4,775' (PBTD 4620' with CIBP @ 2,667')

Injection Interval

2,438' feet to 2,624' feet

(perforated or open-hole; indicate which)

page 5

INJECTION WELL DATA SHEET

Tubing Size 2-7/8" 6.5# lined with Ceramic set in a
(type of internal coating)
Baker packer at 2,350' feet

Other type of tubing / casing seal if applicable N/A

Other Data

1. Is this a new well drilled for injection? ____ Yes __X__ No

   If no, for what purpose was the well originally drilled? Drilled & produced briefly as Mancos oil well. Later recompleted in Menefee (no production).

2. Name of the injection formation Menefee

3. Name of Field or Pool (if applicable) Rio Puerco Mancos

4. Has the well ever been perforated in any other zone(s)? List all such perforated intervals and give plugging detail, i.e., sacks of cement or plug(s) used. Mancos perf'ed. between 4,169' & 4,290' at 10 different levels (1 spf, 0.32" holes, 3-1/8" carrier gun). CIBP @ 2667'.

5. Give the names and depths of any over or underlying oil of gas zones (pools) in this area.

   Over: None designated, but some unproductive oil & gas zones present

   Under: Mancos

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SAN ISIDRO

7-11

WATER ANALYSIS REPORT

page 1

Company : E D C
Address : CUBA, N.M.
Lease : REO PERCO
Well : INJ. WELL
Sample Pt. : SWAB

Date : 10-26-95
Date Sampled : 10-25-95
Analysis No.

ANALYSIS		mg/L		* meq/L
1. pH	8.0			
2. H2S	N/A			
3. Specific Gravity	1			
4. Total Dissolved Solids		8790.1		
5. Suspended Solids				
6. Dissolved Oxygen				
7. Dissolved CO2				
8. Oil In Water				
9. Phenolphthalein Alkalinity (CaCO3)				
10. Methyl Orange Alkalinity (CaCO3)				
11. Bicarbonate	HCO3	1830.0	HCO3	30.0
12. Chloride	Cl	3800.0	Cl	107.2
13. Sulfate	SO4	0.0	SO4	0.0
14. Calcium	Ca	80.0	Ca	4.0
15. Magnesium	Mg	0.1	Mg	0.0
16. Sodium (calculated)	Na	3062.1	Na	133.2
17. Iron	Fe	1.0		
18. Barium	Ba	17.0		
19. Strontium	Sr	0.0		
20. Total Hardness (CaCO3)		200.0		

PROBABLE MINERAL COMPOSITION

*milli equivalents per Liter

				Compound	Equiv wt	X meq/l.	= mg/l.
4	*Ca	*HCO3	30	Ca(HCO3)2	81.0	4.0	324
				CaSO4	68.1		
0	*Mg	*SO4	0	CaCl2	55.5		
				Mg(HCO3)2	73.2	0.0	0
133	*Na	*Cl	107	MgSO4	60.2		
				MgCl2	47.6		

Saturation Values Dist. Water 20 C
CaCO3 13 mg/L
CaSO4 * 2H2O 2090 mg/l.
BaSO4 2.4 mg/L

NaHCO3	84.0	26.0	2184
Na2SO4	71.0		
NaCl	58.4	107.2	6264

REMARKS:

Petrolite Oilfield Chemicals Group

Respectfully submitted, D. STEWART

SAN ISIDRO (SHALLOW) UNIT 7-11

SCALE TENDENCY REPORT

Company	: E D C	Date	: 10-26-95
Address	: CUBA, N.M.	Date Sampled	: 10-25-95
Lease	: REO PERCO	Analysis No.	:
Well	: INJ. WELL	Analyst	: D. STEWART
Sample Pt	: SWAB		

STABILITY INDEX CALCULATIONS
(Stiff-Davis Method)
CaCO3 Scaling Tendency

S.I. = 1.3 at 80 deg. F or 27 deg. C
S.I. = 1.3 at 100 deg. F or 38 deg. C
S.I. = 1.3 at 120 deg. F or 49 deg. C
S.I. = 1.4 at 140 deg. F or 60 deg. C
S.I. = 1.4 at 160 deg. F or 71 deg. C

****

CALCIUM SULFATE SCALING TENDENCY CALCULATIONS
(Skillman-McDonald-Stiff Method)
Calcium Sulfate

S = 2290 at 80 deg. F or 27 deg. C
S = 2320 at 100 deg. F or 38 deg. C
S = 2315 at 120 deg. F or 49 deg. C
S = 2301 at 140 deg. F or 60 deg. C
S = 2264 at 160 deg. F or 71 deg. C

Petrolite Oilfield Chemicals Group

Respectfully submitted, D. STEWART

HALLIBURTON DISTRICT LABORATORY
WATER ANALYSIS DATA SHEET

page 9

Analysis Date: ~~8-11-92~~ Report No. ———

To Veteran Exploration

Submitted By ——— Date Received ~~8-11-92~~

Well Number Johnson 7-11 Location 2560'-2570' (2nd Swab) Formation Menefee
Data for Report

Specific Gravity ~~1.001~~ 1.001

pH ~~7.64~~ 7.64

Aliquot or Dilution	Ion	Calculation	
	Fe Log		~~Nil~~ Nil
	K %T		~~Nil~~ Nil
	Na %T		
	Ca		~~116~~ 116
	Mg		~~64~~ 64
	Cl		~~1030~~ 1029
	SO4 Log		~~<300~~ <300
	CO3		
	HCO3		~~630~~ 630
	TDS		

Rw 2.74 at ~~75~~ °F

NOTICE

This report is based on sound engineering practices, but because of variable well conditions and other information which must be relied upon, Halliburton makes no warranty, express or implied, as to the accuracy of the data or of any calculations or opinions expressed herein. You agree that Halliburton shall not be liable for any loss or damage whether due to negligence or otherwise arising out of or in connection with such data calculations or opinions.

HALLIB' :TON DISTRICT LABORATORY
WATER ANALYSIS DATA SHEE

Analysis Date: ~~8-11-92~~ Report No. ———

page 10

To Veteran Exploration

Submitted By ——— Data Received 8-11-92

Well Number Johnson 7-11 Location 2560'-2570' (8th Swab) Formation Menefee
Data for Report

Specific Gravity ~~1.001~~ 1.001

pH ~~7.71~~ 7.71

Aliquot or Dilution	Ion	Calculation	
	Fe Log		~~Nil~~ NiL
	K %T		~~Nil~~ NiL
	Na %T		
	Ca		~~58~~ 58
	Mg		~~21~~ 21
	Cl		~~1074~~ 1074
	SO4 Log		~~<300~~ <300
	CO3		
	HCO3		~~2020~~ 2020
	TDS		

Rw 1.52 at ~~75~~ °F

NOTICE

This report is based on sound engineering practices, but because of variable well conditions and other information which must be relied upon, Halliburton makes no warranty, express or implied, as to the accuracy of the data or of any calculations or opinions expressed herein. You agree that Halliburton shall not be liable for any loss or damage whether due to negligence or otherwise arising out of or in connection with such data calculations or opinions.

08. 12. 92 10:33 AM P01

B. Schwank

page 11

WATER ANALYSIS REPORT

Company : E.D.C.
Address : CUBAN, M.
Lease : REO PUERCO
Well : [redacted] #5-15 Producer
Sample Pt. : WELLHEAD

Date : 1-13-95
Date Sampled : 1-10-95
Analysis No. :

	ANALYSIS		mg/L		* meq/L
1.	pH	7.5			
2.	H2S	1			
3.	Specific Gravity	1.02			
4.	Total Dissolved Solids		27356.2		
5.	Suspended Solids				
6.	Dissolved Oxygen				
7.	Dissolved CO2				
8.	Oil In Water				
9.	Phenolphthalein Alkalinity (CaCO3)				
10.	Methyl Orange Alkalinity (CaCO3)				
11.	Bicarbonate	HCO3	744.0	HCO3	12.2
12.	Chloride	Cl	16000.0	Cl	451.3
13.	Sulfate	SO4	81.0	SO4	1.7
14.	Calcium	Ca	1080.0	Ca	53.9
15.	Magnesium	Mg	97.9	Mg	8.1
16.	Sodium (calculated)	Na	9271.3	Na	403.3
17.	Iron	Fe	36.0		
18.	Barium	Ba	46.0		
19.	Strontium	Sr	0.0		
20.	Total Hardness (CaCO3)		3100.0		

PROBABLE MINERAL COMPOSITION

*milli equivalents per Liter

54	*Ca <----- *HCO3	12
	/------->	
8	*Mg -----> *SO4	2
	<----------/	
403	*Na -----> *Cl	451

Saturation Values Dist. Water 20 C

CaCO3	13 mg/L
CaSO4 * 2H2O	2090 mg/L
BaSO4	2.4 mg/L

Compound	Equiv wt	X meq/L	= mg/L
Ca(HCO3)2	81.0	12.2	988
CaSO4	68.1	1.7	115
CaCl2	55.5	40.0	2220
Mg(HCO3)2	73.2		
MgSO4	60.2		
MgCl2	47.6	8.1	383
NaHCO3	84.0		
Na2SO4	71.0		
NaCl	58.4	403.3	23568

REMARKS:

Petrolite Oilfield Chemicals Group

Respectfully submitted,
D. STEWART

WATER ANALYSIS REPORT

page 12

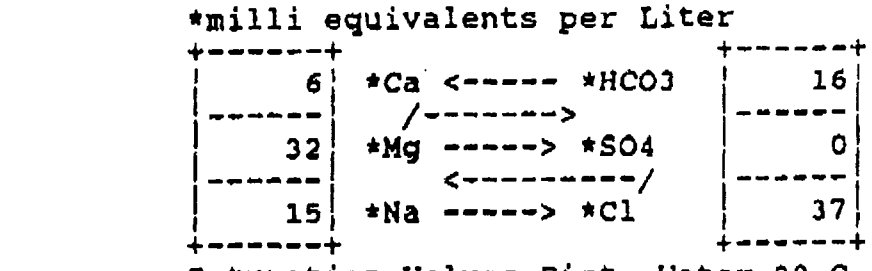
Company : E.D.C.
Address : CUBA, N.M.
Lease : REO PUERCO
Well : 7-3 ~Producer
Sample Pt. : SEPARATOR

Date : 9-3-93
Date Sampled : 9-1-93
Analysis No. : 1

	ANALYSIS		mg/L		* meq/L
1.	pH	7.5			
2.	H2S	1			
3.	Specific Gravity	1.01			
4.	Total Dissolved Solids		3243.1		
5.	Suspended Solids				
6.	Dissolved Oxygen				
7.	Dissolved CO2		22		
8.	Oil In Water				
9.	Phenolphthalein Alkalinity (CaCO3)				
10.	Methyl Orange Alkalinity (CaCO3)				
11.	Bicarbonate	HCO3	988.0	HCO3	16.2
12.	Chloride	Cl	1300.0	Cl	36.7
13.	Sulfate	SO4	11.0	SO4	0.2
14.	Calcium	Ca	120.0	Ca	6.0
15.	Magnesium	Mg	388.7	Mg	32.0
16.	Sodium (calculated)	Na	347.8	Na	15.1
17.	Iron	Fe	2.6		
18.	Barium	Ba	85.0		
19.	Strontium	Sr	0.0		
20.	Total Hardness (CaCO3)		1900.0		

PROBABLE MINERAL COMPOSITION

*milli equivalents per Liter



Saturation Values Dist. Water 20 C

CaCO3	13 mg/L
CaSO4 * 2H2O	2090 mg/L
BaSO4	2.4 mg/L

Compound	Equiv wt	X meq/L	= mg/L
Ca(HCO3)2	81.0	6.0	485
CaSO4	68.1		
CaCl2	55.5		
Mg(HCO3)2	73.2	10.2	747
MgSO4	60.2	0.2	14
MgCl2	47.6	21.5	1026
NaHCO3	84.0		
Na2SO4	71.0		
NaCl	58.4	15.1	884

REMARKS:

Petrolite Oilfield Chemicals Group

Respectfully submitted,
D. STEWART

WATER ANALYSIS

page 13

Company : E.D.C.
Address : CUBA, N.M.
Lease : REO PUERCO
Well : 12-10 PRODUCER
Sample Pt. : SEPARATOR

Date : 9-3-93
Date Sampled : 9-1-93
Analysis No. : 1

	ANALYSIS		mg/L		* meq/L
1.	pH	7.3			
2.	H2S	2			
3.	Specific Gravity	1.01			
4.	Total Dissolved Solids		25494.9		
5.	Suspended Solids				
6.	Dissolved Oxygen				
7.	Dissolved CO2		66		
8.	Oil In Water				
9.	Phenolphthalein Alkalinity (CaCO3)				
10.	Methyl Orange Alkalinity (CaCO3)				
11.	Bicarbonate	HCO3	598.0	HCO3	9.8
12.	Chloride	Cl	15000.0	Cl	423.1
13.	Sulfate	SO4.	3.0	SO4	0.1
14.	Calcium	Ca	120.0	Ca	6.0
15.	Magnesium	Mg	170.1	Mg	14.0
16.	Sodium (calculated)	Na	9495.2	Na	413.0
17.	Iron	Fe	3.6		
18.	Barium	Ba	105.0		
19.	Strontium	Sr	0.0		
20.	Total Hardness (CaCO3)		1000.0		

PROBABLE MINERAL COMPOSITION

*milli equivalents per Liter

6	*Ca <----- *HCO3	10
	/------->	
14	*Mg -----> *SO4	0
	<----------/	
413	*Na -----> *Cl	423

Saturation Values Dist. Water 20 C

CaCO3	13 mg/L
CaSO4 * 2H2O	2090 mg/L
BaSO4	2.4 mg/L

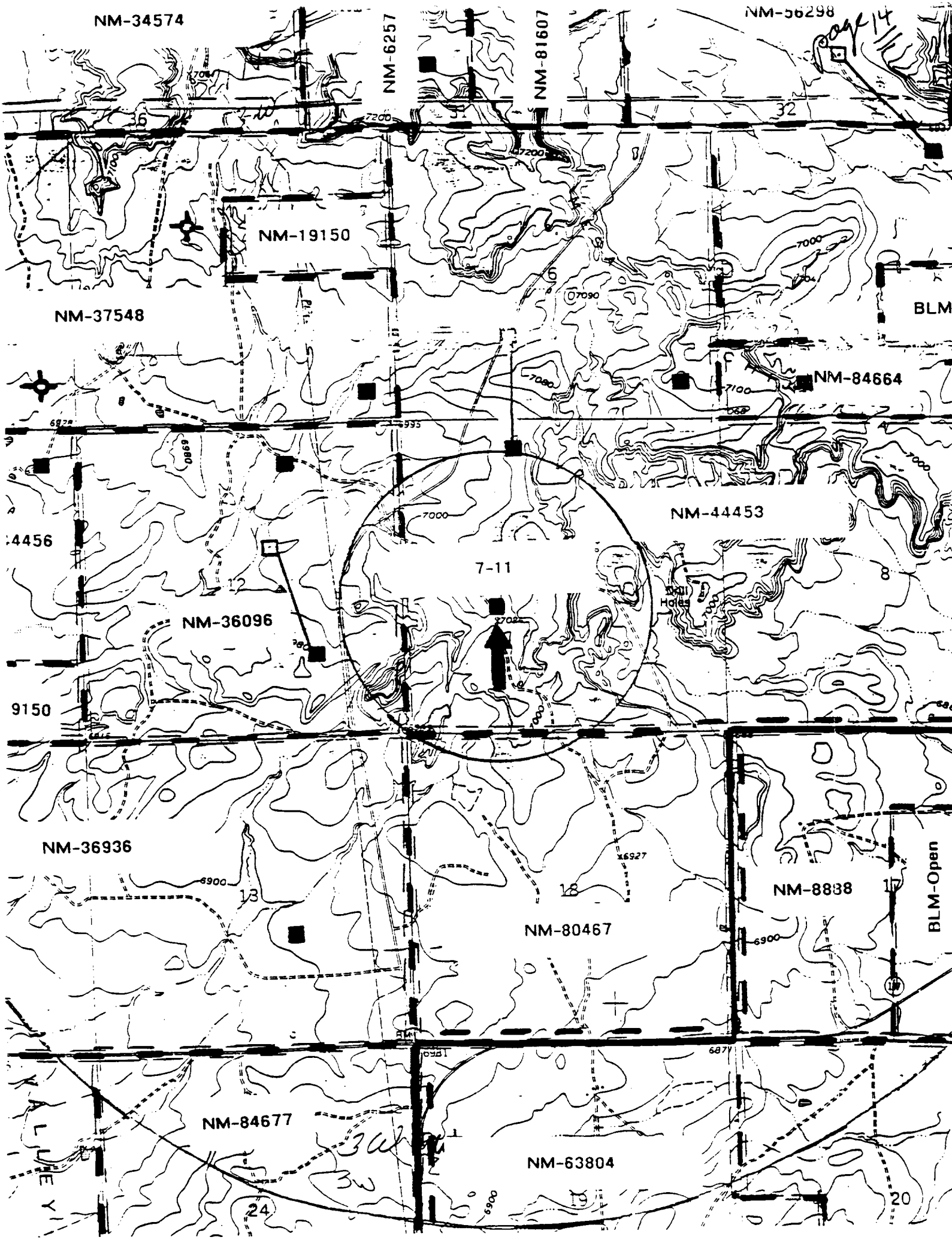
Compound	Equiv wt	X meq/L	= mg/
Ca(HCO3)2	81.0	6.0	48
CaSO4	68.1		
CaCl2	55.5		
Mg(HCO3)2	73.2	3.8	27
MgSO4	60.2	0.1	
MgCl2	47.6	10.1	48
NaHCO3	84.0		
Na2SO4	71.0		
NaCl	58.4	413.0	2413

REMARKS:

Petrolite Oilfield Chemicals Group

Respectfully submitted,
D. STEWART

SAN ISIDRO (SHALLOW) UNIT 12-10


NM-34574
NM-6257
NM-81607
NM-56298
NM-19150
NM-37548
NM-84664
BLM
NM-44453
7-11
NM-36096
NM-36936
NM-80467
NM-8888
BLM-Open
NM-84677
NM-63804
36
32
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12
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13
18
17
24
19
20

NEW MEXICO
OIL CONSERVATION DIVISION

SELECTED REFERENCES EXHIBIT 3

CASE NO. 11470

Cooper, James and Fredrick Tauger "Geography, Geology, and Hydrology" in Water Resources of New Mexico Occurrence, Development and Use, compiled by New Mexico State Engineer in cooperation with New Mexico Interstate Stream Committee and United States Geological Survey. Published by State Planning Office, Santa Fe, NM, 1967.

The Mesa Verde Group is not listed as a "probable aquifer".

Water bearing characteristics of the Mesa Verde group (which includes the Menefee) are "Mostly poor everywhere, except for the Gallup sandstone at the base, which, in the southwest part of the basin, yields fair to moderate amounts of fresh water. Sandstone units toward base of the group act as reservoir rock for oil and gas. Water in most rocks of the group is saline."

Except for San Jose and Nacimiento "few of the rock formations are capable of yielding large quantities of water, and water from those that can yield large quantities is likely to be of poor quality."

The "deeper-lying formations yield more water than do the shallow aquifers, but the quality of the water is likely to be poorer."

"Formations older than the Ojo Alamo Sandstone constitute important oil and gas reservoirs in much of the basin. They also may contain much water, but water in association with the oil and gas is invariably highly mineralized."

Stone, W. J. and Tim Kelly "Ground Water for Energy Development, Northwestern New Mexico" in Proceedings of the Twentieth Annual New Mexico Water Conference, compiled by New Mexico Water Resources Research Institute. Published by New Mexico State University, Las Cruces, NM, 1975.

The Menefee west of the Divide is "generally not considered and aquifer in the sub-surface, that is, where it lies at some depth below the surface...." East of Divide was not considered.

"Adequate quantities of ground water probably exist in the coal bearing areas, however, its poor quality usually renders it unsuitable for domestic use and undesirable for industrial use."

Wilson, Lee and Randy Albright and Ann Claassen, Aquifer Evaluation for UIC: San Juan Basin, New Mexico. Submitted to Environmental Improvement Division, Santa Fe, NM, 1981.

In general "... fresh water occurs in rocks with a transmissivity

greater than 100 sq. feet per day ...." The Menefee has a transmissivity of 10-50 sq ft./day.

" ... fingers of saline water point toward the southwest basin margin; each saline finger is associated with a relatively impermeable formation, most often a shale." The Menefee is a shale coal layer.

W. J. Stone, and F. P. Lyford, P. F. Frenzel, N. H. Mizell, and E. T. Padgett, Hydrogeology and water resources of San Juan Basin, New Mexico. Published by New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 1983.

Transmissivity of coal beds south of Torreon did not exceed 20 sq ft/day. Only known Menefee transmissivity reading that exceeded 50 ("about 100") was at Mexican Springs which is over 100 miles west of the 7-11.

WATER WELLS IN
T. 20 N., R. 2 W.; T. 20 N., R. 3 W.
T. 21 N., R. 2 W.; T. 21 N., R. 3 W.

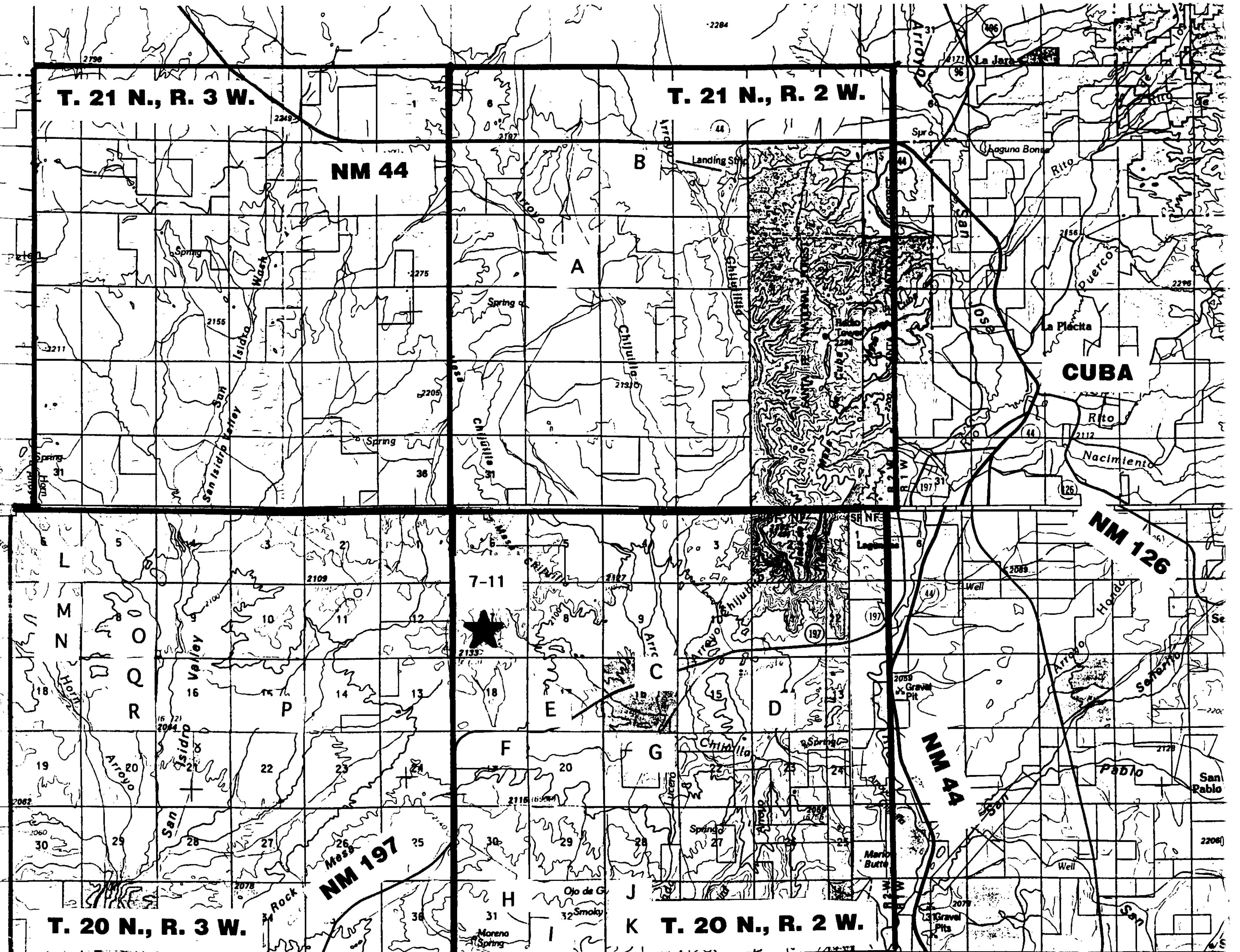
Well*	Location	Depth (if known)	Formation
A	17-21n-2w	405'	San Jose
B	9-21n-2w	N/A	San Jose
C	16-20n-2w	N/A	Animas
D	14-20n-2w	N/A	Animas
E**	17-20n-2w	240'	Animas
F	19-20n-2w	300'	Animas
G	21-20n-2w	N/A	Animas
H	31-20n-2w	N/A	Animas
I	32-20n-2w	N/A	Animas
J	33-20n-2w	N/A	Animas
K	33-20n-2w	N/A	Animas
L	6-20n-3w	827'	Animas
M	7-20n-3w	794'	Animas
N	7-20n-3w	758'	Animas
O	8-20n-3w	767'	Animas
P	15-20n-3w	390'	Pyramid Shale
Q	17-20n-3w	73'	Alluvium
R	17-20n-3w	638'	Animas

*See letter on attached map
** E is the closest water well to 7-11. It is $\geq$5,470' away.
Known depth range is 73' to 827'. Average known depth is 519'.

All data from USGS, N.M. Water Resources Div. files checked 1-23-96.

NEW MEXICO
OIL CONSERVATION DIVISION
EXHIBIT 4
CASE NO. 11410

PERMITS WEST, INC.
PROVIDING PERMITS for LAND USERS


T. 21 N., R. 3 W.
T. 21 N., R. 2 W.
T. 20 N., R. 3 W.
T. 20 N., R. 2 W.
NM 44
NM 126
NM 197
CUBA
La Placita
La Jara
Laguna Bonita
Landing Strip
Radio Tower
Rito
Puerco
Nacimiento
Chijuilla
Arroyo
San Isidro Valley
San Isidro Wash
Spring
Gravel Pit
Gravel Pits
Well
Marlo Butte
Ojo de G
Smoky
Moreno Spring
Horn
Mesa
Rock
Pablo
San Pablo
Hondo
Senorito
7-11
A
B
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O
P
Q
R

SIU 7-11

Menefee SWS Proposed

Assumptions

Porosity,%	18.8	%
Sw, %	75	%
Reservoir Pressure	1,000	psia
Reservior Temperature	105	deg F
Avg Thickness	75	ft
Avg Permeability	5	md
BWPD to be Injected	150	
Time of Injection	15	years
Total Amount of Water to be Injected	821,250	bbls
Reservior Size	640	acres
Water In Place	52,506	Mbbls

Time Years	Amt Inj bbls	Cuml Inj bbls	Area Affected Acres	% of Resr Affected
1	54,750	54,750	0.5	0.104
2	54,750	109,500	1.0	0.209
3	54,750	164,250	1.5	0.313
4	54,750	219,000	2.0	0.417
5	54,750	273,750	2.5	0.521
6	54,750	328,500	3.0	0.626
7	54,750	383,250	3.5	0.730
8	54,750	438,000	4.0	0.834
9	54,750	492,750	4.5	0.938
10	54,750	547,500	5.0	1.043
11	54,750	602,250	5.5	1.147
12	54,750	657,000	6.0	1.251
13	54,750	711,750	6.5	1.356
14	54,750	766,500	7.0	1.460
15	54,750	821,250	7.5	1.564

NEW MEXICO
OIL CONSERVATION DIVISION
EXHIBIT 5
CASE NO. 11,690

CASE NO

EXHIBIT

OIL CONSERVATION DIVISION
NEW MEXICO

LARGE FORMAT EXHIBIT HAS BEEN REMOVED AND IS LOCATED IN THE NEXT FILE

BEFORE THE NEW MEXICO OIL CONSERVATION DIVISION

APPLICATION OF ENERGY DEVELOPMENT CORPORATION FOR SALT WATER DISPOSAL, SANDOVAL COUNTY, NEW MEXICO

CASE NO. 11470

AFFIDAVIT REGARDING NOTICE

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

Brian Wood, being duly sworn upon his oath, deposes and states:

1. I am over the age of eighteen and have personal knowledge of the matters stated herein.

2. I am a consultant for Applicant herein.

3. Applicant has conducted a good faith, diligent effort to find the correct addresses of interest owners entitled to receive notice of the Application herein.

4. Notice of the Application was provided to the pertinent interest owner at its correct address by mailing it, by certified mail, a copy of the Application. Copies of the notice letter and certified return receipt are attached hereto.

5. Applicant has complied with the notice provisions of Rule 1207.

Brian Wood

NEW MEXICO
OIL CONSERVATION DIVISION
EXHIBIT 7
CASE NO. 11470

SUBSCRIBED AND SWORN TO before me this 26th day of ~~February,~~ MARCH 1996, by **Brian Wood.**

Brenda S. Crawford
NOTARY PUBLIC

My commission expires:

10-29-99

Is your RETURN ADDRESS completed on the reverse side?

SENDER:

- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

BLM
435 Montano NE
Albuquerque, NM
87107

4a. Article Number
Z 209 479 364

4b. Service Type
☐ Registered ☐ Insured
☐ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery
1/26/96

5. Signature (Addressee)

8. Addressee's Address (Only if requested and fee is paid)

6. Signature (Agent)
X

PS Form 3811, December 1991 ☆U.S. GPO: 1992—323-402 **DOMESTIC RETURN RECEIPT**

Thank you for using Return Receipt Service.

PERMITS WEST, INC.
PROVIDING PERMITS for LAND USERS
37 Verano Loop, Santa Fe, New Mexico 87505 (505) 466-8120

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

January 24, 1996

Robert Kent, Petroleum Engineer
Albuquerque District Office
Bureau of Land Management
435 Montano NE
Albuquerque, NM 87107

Dear Robert,

Enclosed are 5 copies of an application which will be filed at the New Mexico Oil Conservation Division by Energy Development Corporation to convert its San Isidro (Shallow) Unit Well No. 7-11 to injection. The well is located on Federal land in the NESW of Section 7, Township 20 North, Range 2 West, in Sandoval County. The matter will be heard at 8:15 am on Thursday, February 22, 1996 at the Division's office at 2040 South Pacheco Street, Santa Fe, New Mexico.

Sincerely,

Brian Wood

cc: Bruce
Linton

Form 3160-4
(November 1983)
(formerly 9-330)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SUBMIT IN DUPLICATE* (See other instructions on reverse side)

Form approved.
Budget Bureau No. 1004-0137
Expires August 31, 1985

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

RECEIVED
SEP 17 1985
BUREAU OF LAND MANAGEMENT
FARMINGTON RESOURCE AREA

BEFORE EXAMINER CATANACH
OIL CONSERVATION DIVISION
EXHIBIT NO. 8
CASE NO. 10470

5. LEASE DESIGNATION AND SERIAL NO.: NM-36936

6. IF INDIAN, ALLOTTEE OR TRIBE NAME:

1a. TYPE OF WELL: OIL WELL XX GAS WELL ☐ DRY ☐ OTHER

b. TYPE OF COMPLETION: NEW WELL XX WORK OVER ☐ DEEP EN ☐ PLUG BACK ☐ DIFF. RESVR ☐ Other

7. UNIT AGREEMENT NAME:

8. FARM OR LEASE NAME: San Isidro 13

2. NAME OF OPERATOR: Gary-Williams Oil Producer, Inc.

9. WELL NO.: 11

3. ADDRESS OF OPERATOR: 115 Inverness Drive East, Englewood, CO 80112-5116

10. FIELD AND POOL, OR WILDCAT: Rio Puerco Mancos

4. LOCATION OF WELL (*Report location clearly and in accordance with any State requirements.*)
At surface: 1980' FSL and 1980' FEL Section 13, T20N-R3W
At top prod. interval reported below: same as above
At total depth: same as above

11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: NE SW 13-T20N-R3W

14. PERMIT NO.	DATE ISSUED	12. COUNTY OR PARISH	13. STATE
	6/26/84	Sandoval	NM

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (*Ready to prod.*)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	19. ELEV. CASINGHEAD
6/19/85	6/26/85	9/2/85	6879' GL 6892' KB	6879'

20. TOTAL DEPTH, MD & TVD	21. PLUG, BACK T.D., MD & TVD	22. IF MULTIPLE COMPL., HOW MANY*	23. INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
4265' KB	4219' KB	--	→	0-4265' KB	

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*: Gallup 3610'-4200' KB

25. WAS DIRECTIONAL SURVEY MADE: Yes

26. TYPE ELECTRIC AND OTHER LOGS RUN: Mud Drilled Intermediate 8-3/4" DIL-GR-SP CDL-GR-CAL; Air Drilled Productive 6¼" DIL-SP-GR CNL-CDL-CAL

27. WAS WELL CORED: No

28. CASING RECORD (*Report all strings set in well*)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
9-5/8"	36#	436' KB	13-1/2"	379.5 cf Class B 6# sk sperlite followed w/147.5 cf Class B 2% CaCl	
7"	23#	3346' KB	8-3/4"	562 cf Class B foamed w/N2 Tailed in w/177 cf Class B, Capped w/ 78 cf Class B	

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
4-1/2"	3140' KB	4262' KB	197 cf 65/35 poz 92 cf Class B	

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
2-3/8"	3691' KB	None

31. PERFORATION RECORD (*Interval, size and number*)
Select fire .39 EHD Total 16 Holes
3691', 3727', 3771', 3792', 3810', 3841', 3883', 3890', 3915', 3941', 3960', 3972', 4007', 4025', 4065', 4127'

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
3691'-4127'	Broke down w/222 bbl diesel 25 bb 7½% HCl
Frac	22,610 gal Diesel, 20,400# 100 Me 29,700# 20/40 and 37,400# 10/20

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (*Flowing, gas lift, pumping—size and type of pump*)	WELL STATUS (*Producing or shut-in*)
9/2/85	Flowing	Producing

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
9/13/85	24	18/64		36	90	0	2500:1

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
75	290		36	90	0	42

34. DISPOSITION OF GAS (*Sold, used for fuel, vented, etc.*): Vented

TEST WITNESSED BY: Chuck Emerson

35. LIST OF ATTACHMENTS

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED Ray Hager (Ray Hager) TITLE Operations Superintendent DATE 9/13/85

*(See Instructions and Spaces for Additional Data on Reverse Side)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

NMOCD

37. SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem, tests, including depth interval tested, cushion used, time tool open, flowing and shut-in pressures, and recoveries):

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.
Ojo Alamo	120'	334'	sd (wtr)
Fruitland	334'	492'	sd sh (coal)
Picture Cliffs	492'	652'	ss (gas)
Lewis	652'	905'	sd sh
Chacra	905'	1330'	sh int w/ sd (gas)
Cliff House	1330'	1998'	ss sh (wtr)
~~Menefee~~	1998'	2650'	sd sh coal (oil and gas)
Point Lookout	2650'	2836'	sd (oil and gas) wtr
Mancos	2836'	3610'	sh (oil)
Gallup	3610'	4210'	sd, sh (oil and gas)

38. GEOLOGIC MARKERS

NAME	TOP	
	MEAS. DEPTH	TRUE VERT. DEPTH

OIL CONSERVATION DIVISION
RECEIVED
'92 AUG 13 AM 9 09

Form 3160-4
(November 1983)
(formerly 9-330)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SUBMIT IN DUPLICATE* (See other instructions on reverse side)

Form approved.
Budget Bureau No. 1004-0137
Expires August 31, 1985

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

1a. TYPE OF WELL: OIL WELL [X] GAS WELL [ ] DRY [ ] Other	5. LEASE DESIGNATION AND SERIAL NO. N.M. 36096
b. TYPE OF COMPLETION: NEW WELL [X] WORK OVER [ ] DEEP EN [ ] PLUG BACK [ ] DIFF. RESVR. [ ] Other	6. IF INDIAN, ALLOTTEE OR TRIBE NAME N/A
2. NAME OF OPERATOR Veteran Exploration, Inc.	7. UNIT AGREEMENT NAME Rio Puerco (Horizontal)
3. ADDRESS OF OPERATOR 7535 E. Hampden Ave., Suite 506, Denver, CO. 80231	8. FARM OR LEASE NAME San Isidro
4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)* At surface 1545' FSL 1420' FEL; At top prod. interval reported below; At total depth 3700' FSL 2090' FEL	9. WELL NO. #12-10
	10. FIELD AND POOL, OR WILDCAT Rio Puerco Mancos
	11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA T20N R3W SEC. 12
14. PERMIT NO.	12. COUNTY OR PARISH Sandoval
DATE ISSUED	13. STATE N.M.

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (Ready to prod.)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	19. ELEV. CASINGHEAD
11/9/90	12/7/90	12/28/90	G.L. 6973'	

20. TOTAL DEPTH, MD & TVD	21. PLUG, BACK T.D., MD & TVD	22. IF MULTIPLE COMPL., HOW MANY*	23. INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
6130' M.D.	3470' MD Pilot Hole	OPEN HOLE/LINER	→	YES	NO

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*	25. WAS DIRECTIONAL SURVEY MADE
GALLUP A, B & C ZONES	YES

26. TYPE ELECTRIC AND OTHER LOGS RUN	27. WAS WELL CORED
CYBIL & GAMMA RAY IN VERTICAL PILOT HOLE	NO

28. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
13 3/8"		130' K.B.	17 1/2"	150 Sx	
9 5/8"		3406' K.B.	12 3/4"	600 Sx	

29. LINER RECORD					30. TUBING RECORD		
SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)	SIZE	DEPTH SET (MD)	PACKER SET (MD)
7"	3147'	5000'	N/A		2 7/8"	4000'	

31. PERFORATION RECORD (Interval, size and number)
3471'-5000'
1 shot per foot
ACCEPTED FOR RECORD
7/21/92

RECEIVED
JUL 17 1992
OIL CON. DIV.
DIST. 3

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
N/A	

33. PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut-in)
12-28-90	PUMPING	PRODUCING

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
1/17/91	24	26/64		240	51	0	

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
57 lbs.	75 lbs.		240	51	0	40

34. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.) VENTED — TEST WITNESSED BY Mr. Ed Mays

35. LIST OF ATTACHMENTS

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records.

SIGNED [signature] TITLE President DATE 7/15/92

*(See Instructions and Spaces for Additional Data on Reverse Side)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

OIL CONSERVATION DIVISION
RECEIVED
'92 AUG 27 AM 11 05

37. SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem, tests, including depth interval tested, cushion used, time tool open, flowing and shut-in pressures, and recoveries):

38. GEOLOGIC MARKERS

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.	NAME	TOP MEAS. DEPTH	TOP TRUE VERT. DEPTH
TURE CLIFF	755'	825'	Gas, Water			
HACRA	1180'	1655'	MINOR OIL SHOWS			
LIFF HOUSE	1655'	2311'	MINOR GAS SHOWS } T.V.D.			
NEFEE	2311'	2875'	Oil, Gas, Water			
NT LOOKOUT	2875'	3065'	MINOR GAS SHOWS			
ANCOS	3065'	3837'	Gas	MANCOS		
"	3905'	4149'	Oil, Gas	"A"	3905'	3837'
" MEASURED DEPTH	4149'	4387'	Oil, Gas — ANGLED HOLE	"B"	4149'	4020'
"	4387'	6445'	Oil, Gas, Water	"C"	4387'	4150'

There were no cores, or drill stem tests on this well.

Form 3160-4
(November 1983)
(formerly 9-330)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SUBMIT IN DUPLICATE*

CONSERVATION DIVISION
RECEIVED
'90 APR 7 AM 8 13

Form approved.
Budget Bureau No. 1
Expires August 31, 1

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

1a. TYPE OF WELL:	OIL WELL [X] GAS WELL [ ] DRY [ ] Other
b. TYPE OF COMPLETION:	NEW WORK OVER [X] DEEP-EN [ ] PLUG BACK [ ] DIFF. RESVR. [ ] Other
2. NAME OF OPERATOR	VETERAN EXPLORATION INC.
3. ADDRESS OF OPERATOR	4643 SO. ULSTER # 1190 DENVER, CO. 80237
4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)*	
At surface	934' FSL 1975' FWL
At top prod. interval reported below	
At total depth	3059' FSL 1162' FWL
5. LEASE DESIGNATION AND SERIAL NO.	NM 39532
6. IF INDIAN, ALLOTTEE OR TRIBE NAME	N/A
7. UNIT AGREEMENT NAME	RIO PUERCO (HORI
8. FARM OR LEASE NAME	SAN ISIDRO
9. WELL NO.	San FS. dr. C. RENEGADE 11-14
10. FIELD AND POOL, OR WILDCAT	RIO PUERCO
11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA	T20N R3W SEC.1
12. COUNTY OR PARISH	SANDOVAL
13. STATE	N.I
14. PERMIT NO.	30-043-20855
DATE ISSUED	8-2-90
15. DATE SPUDDED	10/8/90
16. DATE T.D. REACHED	11/4/90
17. DATE COMPL. (Ready to prod.)	1-3-91 5-16-93
18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	G.L.6865' K.B.6878'
19. ELEV. CASINGHEAD	
20. TOTAL DEPTH, MD & TVD	T.D.6309'TVD4625
21. PLUG, BACK T.D., MD & TVD	N/A
22. IF MULTIPLE COMPL., HOW MANY*	OPEN HOLE
23. INTERVALS DRILLED BY	
ROTARY TOOLS	YES
CABLE TOOLS	NO
24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*	GALLUP A,B,C,D
25. WAS DIRECTIONAL SURVEY MADE	YES
26. TYPE ELECTRIC AND OTHER LOGS RUN	FOUR ARM CALIPER & GAMMA RAY IN VERTICAL SECTION
27. WAS WELL CORED	NO

CONFIDENTIAL CONFIDENTIAL

28. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT
9 5/8"	36	3507' 3204'	14 3/4"	200 1400 Sx	
16"		80'	24"	150 Sx G	

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
NONE				

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
2 7/8"	3981	

31. PERFORATION RECORD (Interval, size and number)

Producing through tubing
in open hole

Shirley Mondy 2/28/91
ACCEPTED FOR RECORD

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
NONE	NONE

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut-in)
1-11-91 5-16-93	PUMPING	PRODUCING

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
1-11-91	13	16/64"		11	23	2	

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API
185 lbs.	1030 lbs.		11.8	23	2	40

34. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.)

VENTED

TEST WITNESSED BY Mr. Ed Mays

35. LIST OF ATTACHMENTS

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED _____ TITLE PRESIDENT DATE 1/21/9

*(See Instructions and Spaces for Additional Data on Reverse Side)

NMOCD

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency

SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem, tests, including depth interval tested, cushion used, time tool open, flowing and shut-in pressures, and recoveries):				38. GEOLOGIC MARKERS		
FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.	NAME	TOP MEAS. DEPTH	TOP TRUE VERT. DEPTH
O ALAMO	480'					
UITLAND	675'		GAS			675'
CTURE CLIFF	890'		GAS			890'
WIS SHALE	1070'					1070'
ACRA SANDS	1325'		GAS			1325'
IFF HOUSE	1780'		GAS			[illegible]
NEFEE	2248'		OIL			2248'
INT LOOKOUT	2930'		GAS			2930'
NCOS	3114'		FAIR TO GOOD SAMPLE SHOWS			3114'
			CIRCULATE OIL TO PITS			
", A	3770'		" " " "			3767'
" B	4280'		" " " "			4073'
" C	4690'		" " " "			4250'
" D	5090'		" " " "			4390'
ITO	6214'		" " " "			4611'

SAME

SAME

HORIZONTAL — MEASURED DEPTH - 2

2 HORIZONTAL HOLE

Form 3160-4

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

OIL CONSER. DIVISION
RECEIVED
'94 JUN 15 AM 8 50

FOR APPROVED
OMB NO. 1004-0137
Expires: December 31, 1992

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

5. Lease Designation and Serial No.: NM-7765, NM-56298
6. If Indian, Allotee or Tribe Name: NA
7. Unit Agreement Name: San Isidro (Shallow)
8. Farm or Lease Name, Well No.: San Isidro #5-2
9. API Well No.: 30-043-20895-00S1
10. Field and Pool, or Wildcat: Rio Puerco-Mancos
11. Sec., T., R., M., or Block & Survey Are: Sec. 5-T20N-R2W

1a. TYPE OF WELL: Oil /XX/ Gas /__/ Dry /__/ OTHER ____

b. TYPE OF COMPLETION: New /XX/ Workover /__/ Deepen /__/ Plug Back /__/ Diff. Resvr. / / OTHER

2. Name of Operator: Energy Development Corporation

3. Address and Telephone No.: 1000 Louisiana, Ste. 2900, Houston, TX 77002 713-750-7563

4. Location of Well (Report location clearly & in accordance w/any State Require)
At surface 475' FNL & 1750' FEL, Sec. 5-T20N-R2W
At top prod. interval reported below 107' FSL & 1081' FEL, Sec. 32, T21N-R2W
At total depth 1200' FSL, 1975' FEL, Sec. 32-T21N-R2W

14. Permit No.	Date Issued	12. County or Parish	13. State
	7-16-93	Sandoval	New Mexico

15. Date Spudded	16. Date TD Reached	17. Date Compl.(Ready to prod).	18. Elevations (DF,RKB,RT,GR)*	19. Elev Csghd
7-19-93	10-18-93	11-2-93	6936' RKB	

20. Total Depth, MD & TVD	21. Plugback TD, MD, TVD	22. If multiple compl., how many?	23. Intervals Drilled by:	Rotary Tools	Cable Tools
6714'MD,4878'TVD	6714'MD,4878'TVD			XX	

24. Producing Interval(s) of this completion - Top, Bottom, Name (MD & TVD)*
Top: 5215' MD, 4766' TVD Bottom: 6714' MD, 4878' TVD Mancos

25. Was Directiona Survey Made? yes

26. Type Electric & Other Logs Run: DIL-GR

27. Was Well Cored yes

28. CASING RECORD (Report all strings set in well)

Casing Size/Grade	Weight, Lb/ft	Depth set (MD)	Hole Size	Top of Cement, Cementing Record	Amount Pulled
9-5/8" K-55	36# STC	374'	12-1/4	195 sxs STD + 2% CaCl	
7" N-80	23# LTC	3,565' DV tool @ 1972	8-3/4	1st stage-280 sxs 2nd stage-260 sxs	

29. LINER RECORD

Size	Top (MD)	Bottom (MD)	Sxs Cement	Screen (MD)

30. TUBING RECORD

Size	Depth Set (MD)	Packer Set (MD)
2-7/8	4,393'	

31. PERFORATION RECORD (Interval, size & number)
Producing through tbg in open hole.

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

Depth Interval (MD)	Amount & Kind of Material Used

33.* PRODUCTION

Date First Production	Production Method (Flowing, gas lift, pumping--size & type of pump)	Well Status (Producing or
11-2-93	Pumping	Producing shut-in)

Date of Test	Hours Tested	Choke Size	Prod'n for Test Period:	Oil-Bbl.	Gas-MCF	Water-Bbl.	Gas-Oil Ratio
11-3-93	24	NA		132	TSTM	0	NA

Flow Tubing Pressure	Casing Pressure	Calculated 24 Hour Rate:	Oil-Bbl.	Gas-MCF	Water-Bbl	Oil Gravity API (Corr).
25	25		132	TSTM	0	41.5

34. Disposition of Gas (Sold, used for fuel, vented, etc).: NA

Test Witnessed By

35. List of Attachments: Logs-Deviation Report

ACCEPTED FOR RECORD

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED [signature] TITLE Super., Prod. Accounting DATE 3-8-94

Gene Linton

37. SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem tests, including depth interval tested, cushion used, time tool open, flowing & shut-in pressures, and recoveries):

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.
Ojo Alamo	654	993	Gas
Picture Cliffs	993	1090	Gas
Lewis Shade	1090	1923	Gas
Cliff House	1923	2582	Gas
Menefee	2582	3438	Oil
Mancos	3438	4244	Oil
Gallup "A"	4244	4380	Oil
Gallup "B"	4380	4550	Oil
Gallup "C"	4550	4670	Oil
Gallup "D"	4670	4823	Oil
Tocito	4828	5040	Oil
Juana Lopez	5040	6214	Oil

38. GEOLOGIC MARKERS

NAME	TOP	
	MEAS. DEPTH	TRUE VERTICAL DEPTH
Ojo Alamo	654	654
Picture Cliffs	993	993
Lewis Sh	1090	1090
Cliff Hou.	1923	1923
Menefee	2582	2582
Mancos	3438	3438
Gallup "A"	4244	4244
Gallup "B"	4380	4380
Gallup "C"	4550	4550
Gallup "D"	4670	4670
Tocito	4823	4823
Juana Lopez	5040	5040

Form 9-330
(Rev. 5-63)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUBMIT IN DUPLICATE* (See other instructions on reverse side)

Form approved.
Budget Bureau No. 42-R355.5.

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

5. LEASE DESIGNATION AND SERIAL NO.: NM-44453

6. IF INDIAN, ALLOTTEE OR TRIBE NAME:

7. UNIT AGREEMENT NAME:

8. FARM OR LEASE NAME: Johnson 6

9. WELL NO.: #16

10. FIELD AND POOL, OR WILDCAT: Rio Puerco Gallup

11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: Section 6, T20N-R2W

12. COUNTY OR PARISH: Sandoval

13. STATE: NM

1a. TYPE OF WELL: OIL WELL [X] GAS WELL [ ] DRY [ ] Other

b. TYPE OF COMPLETION: NEW WELL [X] WORK OVER [ ] DEEP-EN [ ] PLUG BACK [ ] DIFF. RESVR. [ ] Other

2. NAME OF OPERATOR: Gary-Williams Oil Producer, Inc. c/o Ned Dollar, Agent

3. ADDRESS OF OPERATOR: P. O. Box 399 Aztec, NM 87410

4. LOCATION OF WELL (*Report location clearly and in accordance with any State requirements*)*
At surface: 660' FSL & 660' FEL Section 6, T20N., R2W.
At top prod. interval reported below:
At total depth:

APR 8 1985
OIL CONSERVATION DIVISION
SANTA FE

14. PERMIT NO. | DATE ISSUED

15. DATE SPUDDED: 11-2-84
16. DATE T.D. REACHED: 11-12-84
17. DATE COMPL. (*Ready to prod.*): 1-4-85
18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*: 7091' GR
19. ELEV. CASINGHEAD: 7091'

20. TOTAL DEPTH, MD & TVD: 4996'
21. PLUG, BACK T.D., MD & TVD: 4983'
22. IF MULTIPLE COMPL., HOW MANY*: NA
23. INTERVALS DRILLED BY: →
ROTARY TOOLS: 0-4996
CABLE TOOLS:

RECEIVED
JAN 10 1985
BUREAU OF LAND MANAGEMENT
FARMINGTON RESOURCE AREA

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*: 4156', 4582', (Selected perfs) Gallup

25. WAS DIRECTIONAL SURVEY MADE: Yes

26. TYPE ELECTRIC AND OTHER LOGS RUN: IES-GR, SNP-CDL-GR-CAL

27. WAS WELL CORED: No

28. CASING RECORD (*Report all strings set in well*)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
9-5/8"	36#	224.96	13-1/2"	200 sx (236 cu ') Class B	None
7"	23#	3710.19	8-3/4"	Stg. 1 300 sx 532 cu' 65/35 Long Star Class H, Stg 2-280 sx 492 cu' 65/35 Long Star Class H +	100 sx (118 Class B.

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
4-1/2"	3388'	4993'	115 (173 cu')	65/35 poz Mix

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
with 50 sx (89 cu') Cl B 2-3		
2-3/8"	3333' KB	NA

31. PERFORATION RECORD (*Interval, size and number*)
4697' 4963, 4955, 4945, 4936, 4932, 4930, 4582, 4559, 4498, 4458, 4438, 4426, 4412, 4397, 4383, 4355, 4326, 4249, 4244, 4237, 4231, 4156, with 0.31 EHD hole.

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
4930' - 4967'	Breakdown w/78 Bbls Lease cruc
4930' - 4967'	Acidiza w/4000 Gal 7½ %
4156' - 4582'	HcL Frac w/77334 Gals
4156' - 4582'	Foamed diesel, 15,000 # 100 Me sand, 40,000# 20/40 sand + 60, 12/

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (*Flowing, gas lift, pumping—size and type of pump*)	WELL STATUS (*Producing or shut in*)
11-12-84	Flow	Producing san

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
1-5-85	24	24/64		368	47	-0-	128/1

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
120	350		368	47	-0-	40 @ 60°

34. DISPOSITION OF GAS (*Sold, used for fuel, vented, etc.*): 17 MCF used to fire Test Treater

TEST WITNESSED BY: C. Emerson

35. LIST OF ATTACHMENTS: Well flowing via Frac String, revised tubing setting will be filed when frac string is removed and production string is run in hole.

ACCEPTED FOR RECORD
JAN 10 1985
FARMINGTON RESOURCE AREA
BY

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED: Ned Dollar TITLE: Agent DATE: January 9, 1985

*(See Instructions and Spaces for Additional Data on Reverse Side)

OPERATOR

or both, pursuant to applicable Federal and/or State laws and regulations. Any necessary special instructions concerning the use of this form and the number of copies to be submitted, particularly with regard to local, area, or regional procedures and practices, either are shown below or will be issued by, or may be obtained from, the local Federal and/or State office. See instructions on items 22 and 24, and 33, below regarding separate reports for separate completions.

If not filed prior to the time this summary record is submitted, copies of all currently available logs (drillers, geologists, sample and core analysis, all types electric, etc.), formation and pressure tests, and directional surveys, should be attached hereto, to the extent required by applicable Federal and/or State laws and regulations. All attachments should be listed on this form, see item 35.

Item 4: If there are no applicable State requirements, locations on Federal or Indian land should be described in accordance with Federal requirements. Consult local State or Federal office for specific instructions.

Item 18: Indicate which elevation is used as reference (where not otherwise shown) for depth measurements given in other spaces on this form and in any attachments.

Items 22 and 24: If this well is completed for separate production from more than one interval zone (multiple completion), so state in item 22, and in item 24 show the producing interval, or intervals, top(s), bottom(s) and name(s) (if any) for only the interval reported in item 33. Submit a separate report (page) on this form, adequately identified, for each additional interval to be separately produced, showing the additional data pertinent to such interval.

Item 29: *"Sacks Cement":* Attached supplemental records for this well should show the details of any multiple stage cementing and the location of the cementing tool.

Item 33: Submit a separate completion report on this form for each interval to be separately produced. (See instruction for items 22 and 24 above.)

CONFIDENTIAL

37. SUMMARY OF POROUS ZONES:
SHOW ALL IMPORTANT ZONES OF POROSITY AND CONTENTS THEREOF; CORED INTERVALS; AND ALL DRILL-STEM TESTS, INCLUDING DEPTH INTERVAL TESTED, CUSHION USED, TIME TOOL OPEN, FLOWING AND SHUT-IN PRESSURES, AND RECOVERIES

38. GEOLOGIC MARKERS

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.	NAME	TOP MEAS. DEPTH	TOP TRUE VERT. DEPTH
Ojo Alamo	534'	715'	Sand, water			
Fruitland	715'	890'	Sand, shale, coal			
Pictured Cliff	890'	1300'	SF (Gas)			
Chacra	1300'	1773'	SS INT w/sand			
Cliff House	1773'	2400'	SF, SH			
Menefee	2400'	3034'	Sand Shale & Coal (oil & gas)			
Pt. Lookout	3034'	3270'	Sand (Wtr oil & gas)			
Mancos	3270	4040'	Shale (oil)			
Gallup	4040'	4618'	Sand. Shale (oil & gas)			
Semilla	4860'	4983'	L, Sand, LS, (oil)			

U.S. GOVERNMENT PRINTING OFFICE: 1963—O-683684
837-497

871-233

Form 3160-4

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FOR APPROVED
OMB NO. 1004-0137
Expires: December 31, 1992

5. Lease Designation and Serial No.
NM-7765, NM-56298

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

6. If Indian, Allotee or Tribe Name
NA

1a. TYPE OF WELL: Oil /XX/ Gas /__/ Dry /__/ OTHER _____

b. TYPE OF COMPLETION: New /XX/ Workover /__/ Deepen /__/ Plug Back /__/ Diff. Resvr. / / OTHER

7. Unit Agreement Name
San Isidro (Shallow)

8. Farm or Lease Name, Well No.
San Isidro #5-2

2. Name of Operator
Energy Development Corporation

9. API Well No.
30-043-20895-00S1

3. Address and Telephone No.
1000 Louisiana, Ste. 2900, Houston, TX 77002 713-750-7563

10. Field and Pool, or Wildcat
Rio Puerco-Mancos

4. Location of Well (Report location clearly & in accordance w/any State Require)
At surface 475' FNL & 1750' FEL, Sec. 5-T20N-R2W
At top prod. interval reported below 107' FSL & 1081' FEL, Sec. 32, T21N-R2W
At total depth 1200' FSL, 1975' FEL, Sec. 32-T21N-R2W

11. Sec., T., R., M., or Block & Survey Area
Sec. 5-T20N-R2W

14. Permit No.	Date Issued	12. County or Parish	13. State
	7-16-93	Sandoval	New Mexico

15. Date Spudded	16. Date TD Reached	17. Date Compl.(Ready to prod).	18. Elevations (DF,RKB,RT,GR)*	19. Elev Csghd
7-19-93	10-18-93	11-2-93	6936' RKB	

20. Total Depth, MD & TVD	21. Plugback TD, MD, TVD	22. If multiple compl., how many?	23. Intervals Drilled by:	Rotary Tools	Cable Tools
6714'MD,4878'TVD	6714'MD,4878'TVD		XX		

24. Producing Interval(s) of this completion - Top, Bottom, Name (MD & TVD)*
Top: 5215' MD, 4766' TVD Bottom: 6714' MD, 4878' TVD Mancos

25. Was Directional Survey Made?
yes

26. Type Electric & Other Logs Run
DIL-GR

27. Was Well Cored?
yes

28. CASING RECORD (Report all strings set in well)

Casing Size/Grade	Weight, Lb/ft	Depth set (MD)	Hole Size	Top of Cement, Cementing Record	Amount Pulled
9-5/8" K-55	36# STC	374'	12-1/4	195 sxs STD + 2% CaCl	
7" N-80	23# LTC	3,565' DV tool @ 1972	8-3/4	1st stage-280 sxs 2nd stage-260 sxs	

29. LINER RECORD

Size	Top (MD)	Bottom (MD)	Sxs Cement	Screen (MD)

30. TUBING RECORD

Size	Depth Set (MD)	Packer Set (MD)
2-7/8	4,393'	

31. PERFORATION RECORD (Interval, size & number)
Producing through tbg in open hole.

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

Depth Interval (MD)	Amount & Kind of Material Used

NEW MEXICO OIL CONSERVATION DIVISION
EXHIBIT 1
CASE NO. 11470

33.* PRODUCTION

Date First Production	Production Method (Flowing, gas lift, pumping--size & type of pump)	Well Status (Producing or shut-in)
11-2-93	Pumping	Producing

Date of Test	Hours Tested	Choke Size	Prod'n for Test Period:	Oil-Bbl.	Gas-MCF	Water-Bbl.	Gas-Oil Ratio
11-3-93	24	NA		132	TSTM	0	NA

Flow Tubing Pressure	Casing Pressure	Calculated 24 Hour Rate:	Oil-Bbl.	Gas-MCF	Water-Bbl	Oil Gravity API (Corr).
25	25		132	TSTM	0	41.5

34. Disposition of Gas (Sold, used for fuel, vented, etc).
NA

Test Witnessed By

35. List of Attachments
Logs-Deviation Report

ACCEPTED FOR RECORD

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED Gene Linton TITLE Super., Prod. Accounting DATE 3-8-94

37. SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem tests, including depth interval tested, cushion used, time tool open, flowing & shut-in pressures, and recoveries):

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.
Ojo Alamo	654	993	Gas
Picture Cliffs	993	1090	Gas
Lewis Shade	1090	1923	Gas
Cliff House	1923	2582	Gas
Menefee	2582	3438	Oil
Mancos	3438	4244	Oil
Gallup "A"	4244	4380	Oil
Gallup "B"	4380	4550	Oil
Gallup "C"	4550	4670	Oil
Gallup "D"	4670	4823	Oil
Tocito	4828	5040	Oil
Juana Lopez	5040	6214	Oil

38. GEOLOGIC MARKERS

NAME	TOP	
	MEAS. DEPTH	TRUE VERTICAL DEPTH
Ojo Alamo	654	654
Picture Cliffs	993	993
Lewis Sh	1090	1090
Cliff Hou.	1923	1923
Menefee	2582	2582
Mancos	3438	3438
Gallup "A"	4244	4244
Gallup "B"	4380	4380
Gallup "C"	4550	4550
Gallup "D"	4670	4670
Tocito	4823	4823
Juana Lopez	5040	5040

5-2 Well

Form 9-330
(Rev. 5-63)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUBMIT IN DUPLICATE* (See other instructions on reverse side)

Form approved.
Budget Bureau No. 42-R355.5.

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

5. LEASE DESIGNATION AND SERIAL NO.: NM-44453

6. IF INDIAN, ALLOTTEE OR TRIBE NAME:

7. UNIT AGREEMENT NAME:

8. FARM OR LEASE NAME: Johnson 6

9. WELL NO.: #16

10. FIELD AND POOL, OR WILDCAT: Rio Puerco Gallup

11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: Section 6, T20N-R2W

1a. TYPE OF WELL: OIL WELL [X] GAS WELL [ ] DRY [ ] Other

b. TYPE OF COMPLETION: NEW WELL [X] WORK OVER [ ] DEEP-EN [ ] PLUG BACK [ ] DIFF. RESVR. [ ] Other

2. NAME OF OPERATOR: Gary-Williams Oil Producer, Inc. c/o Ned Dollar, Agent

3. ADDRESS OF OPERATOR: P. O. Box 399 Aztec, NM 87410

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)*
At surface: 660' FSL & 660' FEL Section 6, T20N., R2W.
At top prod. interval reported below
At total depth

APR 8 1985
OIL CONSERVATION DIVISION
SANTA FE

14. PERMIT NO. | DATE ISSUED

12. COUNTY OR PARISH: Sandoval | 13. STATE: NM

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (Ready to prod.)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	19. ELEV. CASINGHEAD
11-2-84	11-12-84	1-4-85	7091' GR	7091'

20. TOTAL DEPTH, MD & TVD	21. PLUG, BACK T.D., MD & TVD	22. IF MULTIPLE COMPL., HOW MANY*	23. INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
4996'	4983'	NA		0-4996	

RECEIVED
JAN 10 1985
BUREAU OF LAND MANAGEMENT
FARMINGTON RESOURCE AREA

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*: 4156', 4582', (Selected perfs) Gallup

25. WAS DIRECTIONAL SURVEY MADE: Yes

26. TYPE ELECTRIC AND OTHER LOGS RUN: IES-GR, SNP-CDL-GR-CAL

27. WAS WELL CORED: No

28. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
9-5/8"	36#	224.96	13-1/2"	200 sx (236 cu ') Class B	None
7"	23#	3710.19	8-3/4"	Stg. 1 300 sx 532 cu' 65/35 Long Star Class H, Stg 2-280 sx 492 cu' 65/35 Long Star Class H +	100 sx (118 cu Class B.

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
4-1/2"	3388'	4993'	115 (173 cu')	65/35 poz Mix

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
2-3/8"	3333' KB	NA

31. PERFORATION RECORD (Interval, size and number)
4697' 4963, 4955, 4945, 4936, 4932, 4930, 4582, 4559, 4498, 4458, 4438, 4426, 4412, 4397, 4383, 4355, 4326, 4249, 4244, 4237, 4231, 4156, with 0.31 EHD hole.

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
4930' - 4967'	Breakdown w/78 Bbls Lease crude
4930' - 4967'	Acidiza w/4000 Gal 7½ %
4156' - 4582'	HCL Frac w/77334 Gals
4156' - 4582'	Foamed diesel, 15,000 # 100 Mesh sand, 40,000# 20/40 sand + 60,00 12/20 sand.

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut in)
11-12-84	Flow	Producing

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
1-5-85	24	24/64		368	47	-0-	128/1

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
120	350		368	47	-0-	40 @ 60°

34. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.): 17 MCF used to fire Test Treater

TEST WITNESSED BY: C. Emerson

35. LIST OF ATTACHMENTS: Well flowing via Frac String, revised tubing setting will be filed when frac string is removed and production string is run in hole.

ACCEPTED FOR RECORD
JAN 10 1985
FARMINGTON RESOURCE AREA
BY

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED Ned Dollar TITLE Agent DATE January 9, 1985

*(See Instructions and Spaces for Additional Data on Reverse Side)

OPER

INSTRUCTIONS

General: This form is designed for submitting a complete and correct well completion report and log on all types of lands and leases to either a Federal agency or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Any necessary special instructions concerning the use of this form and the number of copies to be submitted, particularly with regard to local, area, or regional procedures and practices, either are shown below or will be issued by, or may be obtained from, the local Federal and/or State office. See instructions on items 22 and 24, and 33, below regarding separate reports for separate completions.

If not filed prior to the time this summary record is submitted, copies of all currently available logs (drillers, geologists, sample and core analysis, all types electric, etc.), formation and pressure tests, and directional surveys, should be attached hereto, to the extent required by applicable Federal and/or State laws and regulations. All attachments should be listed on this form, see item 35.

Item 4: If there are no applicable State requirements, locations on Federal or Indian land should be described in accordance with Federal requirements. Consult local State or Federal office for specific instructions.

Item 18: Indicate which elevation is used as reference (where not otherwise shown) for depth measurements given in other spaces on this form and in any attachments.

Items 22 and 24: If this well is completed for separate production from more than one interval zone (multiple completion), so state in item 22, and in item 24 show the producing interval, or intervals, top(s), bottom(s) and name(s) (if any) for only the interval reported in item 33. Submit a separate report (page) on this form, adequately identified, for each additional interval to be separately produced, showing the additional data pertinent to such interval.

Item 29: "*Sacks Cement*": Attached supplemental records for this well should show the details of any multiple stage cementing and the location of the cementing tool.

Item 33: Submit a separate completion report on this form for each interval to be separately produced. (See instruction for items 22 and 24 above.)

CONFIDENTIAL

37. SUMMARY OF POROUS ZONES:
SHOW ALL IMPORTANT ZONES OF POROSITY AND CONTENTS THEREOF; CORED INTERVALS, AND ALL DRILL-STEM TESTS, INCLUDING DEPTH INTERVAL TESTED, CUSHION USED, TIME TOOL OPEN, FLOWING AND SHUT-IN PRESSURES, AND RECOVERIES

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.
Ojo Alamo	534'	715'	Sand, water
Fruitland	715'	890'	Sand, shale, coal
Pictured Cliff	890'	1300'	SF (Gas)
Chacra	1300'	1773'	SS INT w/sand
Cliff House	1773'	2400'	SF, SH
Menefee	2400'	3034'	Sand Shale & Coal (oil & gas)
Pt. Lookout	3034'	3270'	Sand (Wtr oil & gas)
Mancos	3270	4040'	Shale (oil)
Gallup	4040'	4618'	Sand. Shale (oil & gas)
'Semilla	4860'	4983'	L, Sand, LS, (oil)

38. GEOLOGIC MARKERS

NAME	TOP MEAS. DEPTH	TOP TRUE VERT. DEPTH

6-16 Well

U.S. GOVERNMENT PRINTING OFFICE: 1983—O-403636
837-497

871-233

Form 3160-4
(November 1983)
(formerly 9-330)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SUBMIT IN DUPLICATE

CONSERVATION DIVISION
RECEIVED
APR 7 1993
OIL CON. DIV.
DIST. 3

Form approved.
Budget Bureau No. 1004-01
Expires August 31, 1985

5. LEASE DESIGNATION AND SERIAL NO.: NM 39532
6. IF INDIAN, ALLOTTEE OR TRIBE NAME: N/A
7. UNIT AGREEMENT NAME: RIO PUERCO (HORIZON
8. FARM OR LEASE NAME: SAN ISIDRO
9. WELL NO.: SAN FS, dyc
RENEGADE 11-14
10. FIELD AND POOL, OR WILDCAT: RIO PUERCO
11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: T20N R3W SEC.11 S

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

1a. TYPE OF WELL: OIL WELL [X] GAS WELL [ ] DRY [ ] Other
b. TYPE OF COMPLETION: NEW WELL [X] WORK OVER [ ] DEEP EN [ ] PLUG BACK [ ] DIFF. RESVR. [ ] Other
2. NAME OF OPERATOR: VETERAN EXPLORATION INC.
3. ADDRESS OF OPERATOR: 4643 SO. ULSTER # 1190 DENVER, CO. 80237
4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.*)
At surface: 934' FSL 1975' FWL
At top prod. interval reported below
At total depth: 3059' FSL 1162' FWL

14. PERMIT NO.	DATE ISSUED	12. COUNTY OR PARISH	13. STATE
30-043-20855	8-2-90	SANDOVAL	N.M.

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (Ready to prod.)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	19. ELEV. CASINGHEAD
10/8/90	11/4/90	1-3-91 5-16-93	G.L.6865' K.B.6878'	

20. TOTAL DEPTH, MD & TVD	21. PLUG, BACK T.D., MD & TVD	22. IF MULTIPLE COMPL., HOW MANY*	23. INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
T.D.6309'TVD4625	N/A	OPEN HOLE	→	YES	NO

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*: GALLUP A,B,C,D

CONFIDENTIAL CONFIDENTIAL

25. WAS DIRECTIONAL SURVEY MADE: YES

26. TYPE ELECTRIC AND OTHER LOGS RUN: FOUR ARM CALIPER & GAMMA RAY IN VERTICAL SECTION

27. WAS WELL CORED: NO

28. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
9 5/8"	36	3507' 3204'	14 3/4"	200 1400 Sx	
16"		80'	24"	150 Sx G	

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
NONE				

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
2 7/8"	3981	

31. PERFORATION RECORD (Interval, size and number)
Producing through tubing in open hole

Shirley Mondy 2/25/91
ACCEPTED FOR RECORD

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
NONE	NONE

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut-in)
1-11-91 5-16-93	PUMPING	PRODUCING

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
1-11-91	13	16/64"		11	23	2	

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
18 5 lbs.	1920 lbs.	25.8		23	2	40

34. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.): VENTED
TEST WITNESSED BY: Mr. Ed Mays
35. LIST OF ATTACHMENTS

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records.

SIGNED _____ TITLE PRESIDENT DATE 1/21/91

*(See Instructions and Spaces for Additional Data on Reverse Side)

NMOCD

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of th

SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem, tests, including depth interval tested, cushion used, time tool open, flowing and shut-in pressures, and recoveries):

38. GEOLOGIC MARKERS

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.	NAME	TOP MEAS. DEPTH	TOP TRUE VERT. DEPTH
JO ALAMO	480'					675'
RUITLAND	675'		GAS			890'
ICTURE CLIFF	890'		GAS			1070'
EWIS SHALE	1070'					1325'
HACRA SANDS	1325'		GAS			1780'
LIFF HOUSE	1780'		GAS			2248'
ENEFEE	2248'		OIL			2930'
OINT LOOKOUT	2930'		GAS			3114'
ANCOS	3114'		FAIR TO GOOD SAMPLE SHOWS CIRCULATE OIL TO PITS			
" A	3770'		" " " "			3767'
" B	4280'		" " " "			4073'
" C	4690'		" " " "			4250'
" D	5090'		" " " "			4390'
OCITO	6214'		" " " "			4611'

SAME

SAME

MEASURED DEPTH

HORIZONTAL

11-14 Well

HORIZONTAL HOLE

OIL CONSERVATION DIVISION
RECEIVED
'92 AUG 13 AM 9 09

Form approved.
Budget Bureau No. 1004-0137
Expires August 31, 1985

(November 1983)
(formerly 9-330)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SUBMIT IN DUPLICATE*
(See other instructions on reverse side)

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

5. LEASE DESIGNATION AND SERIAL NO.: N.M. 36096
6. IF INDIAN, ALLOTTEE OR TRIBE NAME: N/A
7. UNIT AGREEMENT NAME: Rio Puerco (Horizontal)
8. FARM OR LEASE NAME: San Isidro
9. WELL NO.: #12-10
10. FIELD AND POOL, OR WILDCAT: Rio Puerco Mancos
11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: T20N R3W SEC. 12
12. COUNTY OR PARISH: Sandoval
13. STATE: N.M.

1a. TYPE OF WELL: OIL WELL [X] GAS WELL [ ] DRY [ ] Other
b. TYPE OF COMPLETION: NEW WELL [X] WORK OVER [ ] DEEP EN [ ] PLUG BACK [ ] DIFF. RESVR. [ ] Other
2. NAME OF OPERATOR: Veteran Exploration, Inc.
3. ADDRESS OF OPERATOR: 7535 E. Hampden Ave., Suite 506, Denver, CO 80231
4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)*
At surface: 1545' FSL 1420' FEL
At top prod. interval reported below
At total depth: 3700' FSL 2090' FEL

RECEIVED JUL 22 1992 OIL CON. DIV.

14. PERMIT NO. — DATE ISSUED

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (Ready to prod.)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	19. ELEV. CASINGHEAD
11/9/90	12/7/90	12/28/90	G.L. 6973'	

20. TOTAL DEPTH, MD & TVD	21. PLUG, BACK T.D., MD & TVD	22. IF MULTIPLE COMPL., HOW MANY*	23. INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
6130' M.D. 3435' T.V.D.	3470' MD Pilot Hole	OPEN HOLE/LINER	→	YES	NO

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*: CALLUP A, B & C ZONES

25. WAS DIRECTIONAL SURVEY MADE: YES

26. TYPE ELECTRIC AND OTHER LOGS RUN: CYBIL & GAMMA RAY IN VERTICAL PILOT HOLE

27. WAS WELL CORED: NO

28. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
13 3/8"		130' K.B.	17 1/2"	150 Sx	
9 5/8"		3406' K.B.	12 3/4"	680 Sx	

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
7"	3147'	5000'	N/A	

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
2 7/8"	4000'	

31. PERFORATION RECORD (Interval, size and number)
3471'-5000'
1 shot per foot

ACCEPTED FOR RECORD
7/21/92

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
N/A	

RECEIVED JUL 17 1992 OIL CON. DIV. DIST. 3

33. PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut-in)
12-28-90	PUMPING	PRODUCING

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
1/17/91	24	26/64		240	51	0	

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
57 lbs.	75 lbs.		240	51	0	40

34. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.): VENTED
TEST WITNESSED BY: Mr. Ed Mays

35. LIST OF ATTACHMENTS

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records.

SIGNED [signature] TITLE President DATE 7/14/92

*(See Instructions and Spaces for Additional Data on Reverse Side)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

U-12-2111-SW

OIL CONSERVATION DIVISION
RECEIVED
'92 AUG 27 AM 11 05

37. SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem, tests, including depth interval tested, cushion used, time tool open, flowing and shut-in pressures, and recoveries):

38. GEOLOGIC MARKERS

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.	NAME	TOP MEAS. DEPTH	TOP TRUE VERT. DEPTH
PICTURE CLIFF	755'	825'	Gas, water			
CHACRA	1180'	1655'	MINOR OIL SHOWS			
CLIFF HOUSE	1655'	2311'	MINOR GAS SHOWS } T.V.D.			
MENEFEE	2311'	2875'	Oil, Gas, water			
POINT LOOKOUT	2875'	3065'	MINOR GAS SHOWS			
MANCOS	3065'	3837'	Gas	MANCOS		
"A"	3905'	4149'	Oil, Gas	"A"	3905'	3837'
"B" MEASURED DEPTH	4149'	4387'	Oil, Gas — ANGLED HOLE	"B"	4149'	4020'
"C"	4387'	6445'	Oil, Gas, water	"C"	4387'	4150'

There were no cores, or drill stem tests on this well.

21-10 well

Form 3160-4
(November 1983)
(formerly 9-330)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SUBMIT IN DUPLICATE* (See other instructions on reverse side)

Form approved.
Budget Bureau No. 1004-0137
Expires August 31, 1985

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

RECEIVED
SEP 17 1985
BUREAU OF LAND MANAGEMENT
FARMINGTON RESOURCE AREA

5. LEASE DESIGNATION AND SERIAL NO.: NM-36936

6. IF INDIAN, ALLOTTEE OR TRIBE NAME:

7. UNIT AGREEMENT NAME:

8. FARM OR LEASE NAME: San Isidro 13

9. WELL NO.: 11

10. FIELD AND POOL, OR WILDCAT: Rio Puerco Mancos

11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: NE SW 13-T20N-R3W

1a. TYPE OF WELL: OIL WELL XX GAS WELL ☐ DRY ☐ OTHER

b. TYPE OF COMPLETION: NEW WELL XX WORK OVER ☐ DEEP EN ☐ PLUG BACK ☐ DIFF. RESVR ☐ Other

2. NAME OF OPERATOR: Gary-Williams Oil Producer, Inc.

3. ADDRESS OF OPERATOR: 115 Inverness Drive East, Englewood, CO 80112-5116

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)*
At surface: 1980' FSL and 1980' FEL Section 13-T20N-R3W
At top prod. interval reported below: same as above
At total depth: same as above

14. PERMIT NO.	DATE ISSUED	12. COUNTY OR PARISH	13. STATE
	6/26/84	Sandoval	NM

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (Ready to prod.)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	19. ELEV. CASINGHEAD
6/19/85	6/26/85	9/2/85	6879' GL 6892' KB	6879'

20. TOTAL DEPTH, MD & TVD	21. PLUG, BACK T.D., MD & TVD	22. IF MULTIPLE COMPL., HOW MANY*	23. INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
4265' KB	4219' KB	--	→	0-4265' KB	

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*: Gallup 3610'-4200' KB

25. WAS DIRECTIONAL SURVEY MADE: Yes

26. TYPE ELECTRIC AND OTHER LOGS RUN: Mud Drilled Intermediate 8-3/4" DIL-GR-SP CDL-GR-CAL; Air Drilled Productive 6¼" DIL-SP-GR CNL-CDL-CAL

27. WAS WELL CORED: No

28. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
9-5/8"	36#	436' KB	13-1/2"	379.5 cf Class B 6# sk sperlite followed w/147.5 cf Class B 2% CaCl	
7"	23#	3346' KB	8-3/4"	662 cf Class B foamed w/N, Tailed in w/177 cf Class B, Capped w/ 78 cf Class B	

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)
4-1/2"	3140' KB	4262' KB	197 cf 65/35 poz 92 cf Class B	

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)
2-3/8"	3691' KB	None

31. PERFORATION RECORD (Interval, size and number)
Select fire .39 EHD Total 16 Holes
3691', 3727', 3771', 3792', 3810', 3841', 3883', 3890', 3915', 3941', 3960', 3972', 4007', 4025', 4065', 4127'

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED
3691'-4127'	Broke down w/222 bbl diesel 25 bbl 7½% HCl
Frac	22,610 gal Diesel, 20,400# 100 Mes 29,700# 20/40 and 37,400# 10/20

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut-in)
9/2/85	Flowing	Producing

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
9/13/85	24	18/64		36	90	0	2500:1

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)
75	290		36	90	0	42

34. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.): Vented

TEST WITNESSED BY: Chuck Emerson

35. LIST OF ATTACHMENTS

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED Ray Hager TITLE Operations Superintendent DATE 9/13/85

*(See Instructions and Spaces for Additional Data on Reverse Side)

NMOCC

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

37. SUMMARY OF POROUS ZONES: (Show all important zones of porosity and contents thereof; cored intervals; and all drill-stem, tests, including depth interval tested, cushion used, time tool open, flowing and shut-in pressures, and recoveries):

FORMATION	TOP	BOTTOM	DESCRIPTION, CONTENTS, ETC.
Ojo Alamo	120'	334'	sd (wtr)
Fruitland	334'	492'	sd sh (coal)
Picture Cliffs	492'	652'	ss (gas)
Lewis	652'	905'	sd sh
Chacra	905'	1330'	sh int w/ sd (gas)
Cliff House	1330'	1998'	ss sh (wtr)
Menefee	1998'	2650'	sd sh coal (oil and gas)
Point Lookout	2650'	2836'	sd (oil and gas) wtr
Mancos	2836'	3610'	sh (oil)
Gallup	3610'	4210'	sd, sh (oil and gas)

Well 11-31

38. GEOLOGIC MARKERS

NAME	TOP	
	MEAS. DEPTH	TRUE VERT. DEPTH

LARGE FORMAT EXHIBIT HAS BEEN REMOVED AND IS LOCATED IN THE NEXT FILE

NEW MEXICO
OIL CONSERVATION DIVISION
EXHIBIT 10
CASE NO. 11470

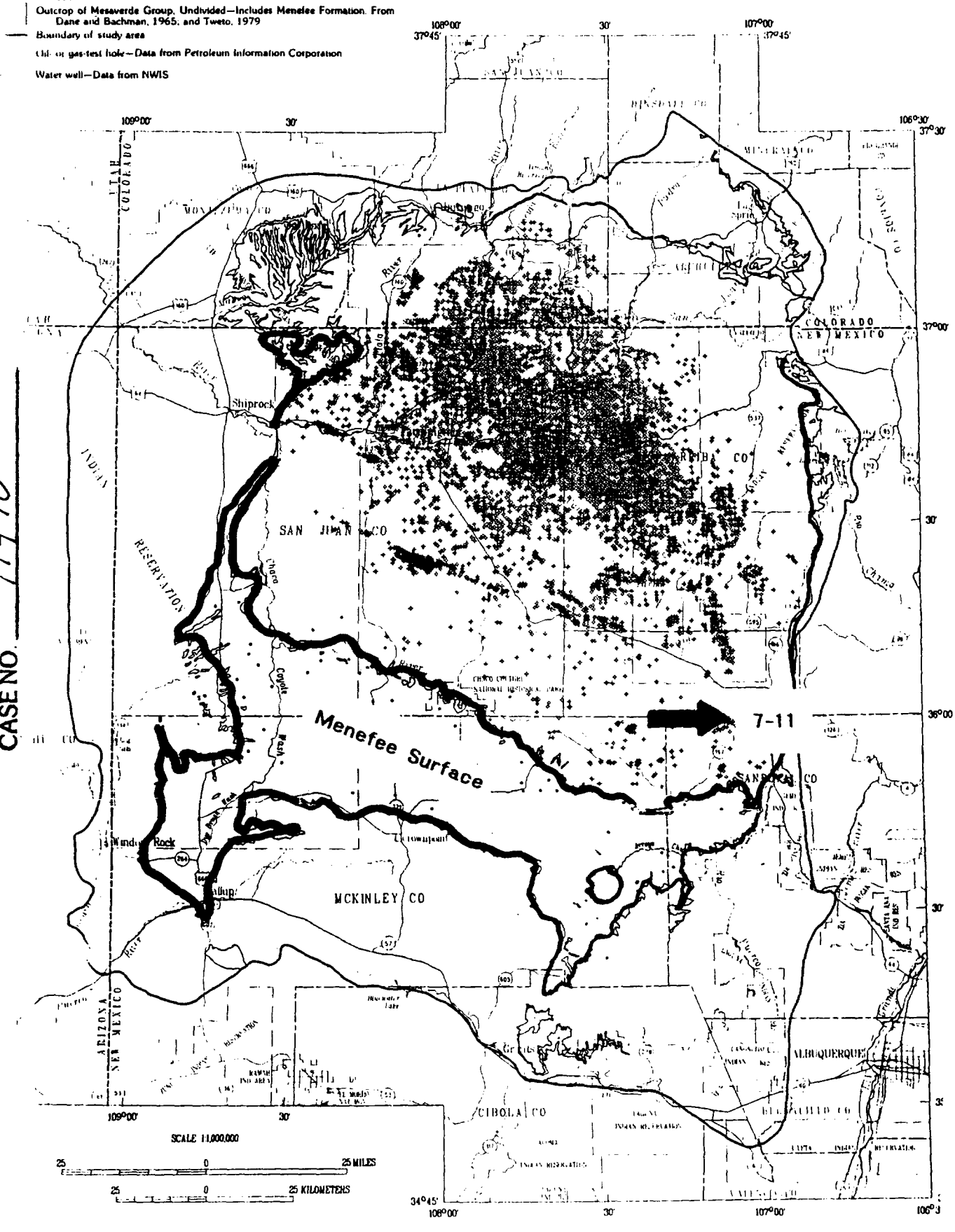


Figure 4. Location of oil- or gas-test holes and water wells used to compile depth to and altitude of the top of the Menefee Formation.

EXEMPTION OF THE MENEFEE FORMATION AS AN UNDERGROUND SOURCE OF DRINKING WATER IN THE VICINITY OF THE JOHNSON 7-11 WELL SANDOVAL COUNTY, NEW MEXICO

Submitted To

PRIDE ENERGY COMPANY
7666 East 61st Street, Suite 605
Tulsa, Oklahoma, 74170

Tel: 918-252-4100
Fax: 918-252-3795

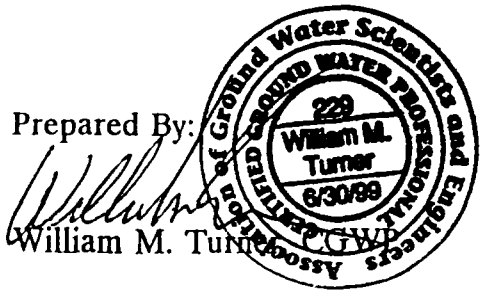
Submitted By

TURNER ENVIRONMENTAL CONSULTANTS
610 Gold Avenue, SW Suite 111
Albuquerque, NM 87102

Tel. 505-843-7643
Fax. 505-246-2232

NEW MEXICO
OIL CONSERVATION DIVISION
Pride EXHIBIT 11
CASE NO. 11470 (Reopened)

Prepared By:



William M. Turner, CGWP

January 14, 1997

TABLE OF CONTENTS

APPENDICES

EXECUTIVE SUMMARY

Pride Energy Company, as successor in interest to Energy Development Corporation, has filed for an aquifer exemption pursuant to 40 CFR § 144.8. This report demonstrates that there are no aquifers within the zone of endangering influence that are used for a water supply for human consumption and that the quality of the water exceeds either federal or state drinking water standards for some constituents.

The proposed injection zone is within the Menefee Formation which produces hydrocarbons in the area. Oil or gas have also been reported in other production unit wells in the Ojo Alamo, Pictured Cliffs and Cliff House Sandstones as well as the Lewis, Kirtland, Menefee, and Mancos Formations.

The injection zone and other overlying water-bearing units cannot be considered as aquifers under the definition of an aquifer given in 40 CFR § 114.3 because they cannot produce significant quantities of water for any use.

The proposed injection zones and other underground sources of drinking water likely to be affected by the waste water injection are so deep and of such variable water quality as to make them economically and technologically impractical for use as sources of domestic water supply.

Because the cost of water wells capable of exploiting underground sources of drinking water is very high and the yields are expected to be low, the development of domestic ground-water supply is economically impractical

The natural direction of horizontal ground-water flow is to the southwest. There is also ground-water flow vertically upward toward to Cliff House Sandstone. The volumetric rate of movement and the mean approach velocity is very slow.

The proposed injection zone is overlain and underlain by a confining zone that virtually will prevent the migration of injected fluids into any other possible USDW over the period of the project and for at least twice the period of the project after injection terminates.

The zone of endangering influence (ZEI) and the area for which the aquifer exemption is sought lie within a radial distance of six (6) miles from the proposed injection well. There are no water wells within six (6) miles of the project which are deeper than 1,030 feet (ft) and which encounter the proposed injection zone and which could act as short-circuiting conduits to convey injected water into shallower water-bearing units. Oil and gas wells in the area are cased and cemented through the Menefee Formation.

INTRODUCTION

A Disposal Well Application was filed on January 24, 1996 and subsequently went to hearing. The EPA rejected the request of the New Mexico Oil Conservation Divisions for an aquifer exemption on May 30, 1996 because the aerial description of the exemption must encompass the ZEI created by the proposed injection to ensure adequate protection from contamination of the redefined underground source of drinking water (USDW) by upward migration.

Turner Environmental Consultants was retained by Pride Energy Company to assist with the exemption of the Menefee Formation near Cuba, New Mexico as an USDW.

LEGAL FRAMEWORK

Under 40 CFR § 146.4 an aquifer can be exempted under 40 CFR § 144.8 if

(a) it does not currently serve as a source of drinking water; and

(b) It cannot now and will not in the future serve as a source of drinking water because:

(1) It is a mineral, hydrocarbon or geothermal energy producing, or can be demonstrated to contain minerals.

(2) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;

(3) It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or

(4) It is located over a Class III well mining area subject to subsidence, or

(c) The total dissolved solids content of the ground water is more than 3,000 and less than 10,000 mg/l and it is not reasonably expected to supply a public water system.

Under 40 CFR § 146.5, the area of administrative review is determined based on the determination of the Zone of Endangering Influence (ZEI) for an injection well. The ZEI is defined in 40 CFR § 146.6 and the modified Theis equation for determination of the ZEI is presented. The Theis equation was developed for single phase applications. . The calculations given in the report are based on more familiar oilfield mathematical methods and oilfield units.

40 CFR § 146.3 defines an aquifer as a geological formation, group of formations, or part of a formation that is capable of yielding a ***significant*** amount of water to a well or spring.

BACKGROUND INFORMATION

The injection well is the Johnson 7-11 (API No. 30043207290000) which was renamed the San Isidro 7-11 (API No. 30043207290001) located 2,074 ft from the south line and 1,650 ft from the west line of Section 7, Township 20 North, Range 2 East (20.02.07.321 in State Engineer notation) in Sandoval County, New Mexico. The well is situated about 8 miles west-southwest of Cuba.

Depths given in the Disposal Well Application are referenced to the elevation of the Kelly Bushing at 7,030 ft above mean sea level (ft amsl). The ground surface elevation at the well is given the well logs and by Petroleum Information Service (PI) as 7,017 ft amsl.

Depths in this report are given in terms of depth below the Kelly Bushing and depths below ground level (ft bgl). Elevations, where relevant, are given as feet above mean sea level.

Well locations are given according to the notation used by the State Engineer Office.

Permeabilities (hydraulic conductivities) have been obtained from the hydrologic literature where they are given as feet per day (ft/d) which is a field unit rather than an intrinsic permeability which has dimensions of L^2. We have converted the hydrologic units of ft/d to intrinsic permeability in millidarcies (md) using a multiplier of 411 assuming a specific gravity of water of 1 gram per cubic centimeter (gm/cm^3) and a viscosity of 1 centipoise (cp) (Journal of Ground Water, v. 35, n. 1, p. 187).

The Johnson 7-11 well was completed by setting 9-5/8 inch casing to 595 ft and 7-inch casing to 3,366 ft. A 4-1/2 inch liner was set from 3,339 to 4,762 ft when the well was originally drilled. The well was plugged back. The injection zone is 7-inch steel pipe.

This report relies on information provided with the Disposal Well Application. In addition, figures showing the regional geology of the San Juan Basin and the proposed injection well site and maps showing the distribution of transmissivity, hydraulic conductivity, and potentiometric surfaces and gradients from Kernoodle (1996) are in Appendix 1.

GROUND WATER OCCURRENCE

Ground water is found in all Cretaceous and Tertiary sand units throughout the San Juan Basin. The yield of wells varies depending on the transmissivity of the rock units. The usability of the water depends on the chemical quality.

Generally, wells in the Cretaceous rocks are of low yield and produce poor quality water. The yield of wells in Tertiary sand units is much higher and the quality of the water tends to be much better.

GEOLOGICAL SETTING

The Johnson 7-11 well is situated about eight (8) miles southwest of Cuba on the boundary between the Central San Juan Basin and Chaco Slope to the south (Kelley, 1950).

The Central San Juan Basin is defined as that part of the San Juan Basin containing Cenozoic sediment at the surface. The Cenozoic sediment overlies a thick section of Cretaceous sediment. It is the Cretaceous sediment that has been developed for oil and gas.

HYDROSTRATIGRAPHY

The generalized nomenclature of the San Juan Basin stratigraphy is given by Kernoodle (1996, Figure 5) (Appendix 1). The proposed injection zone is within the Menefee Formation. The area of review covered by 40 CFR § 146.6 is concerned with possible contamination of potable water zones above the injection zone. Only the stratigraphy above the Menefee Formation is considered.

SAN JOSE FORMATION

Geometry and Lithology

The San Jose Formation of Eocene age is exposed along the southern part of the Central San Juan Basin where it dips to the north. The formation thickens toward the center of the basin ranging from 200 to 2,700 ft thick (Tansey, 1984, p. 22).

The San Jose Formation overlies the Animas Formation and is comprised of alternating zones of sandstone and shale. The sandstones are fine- to coarse-grained, arkosic, and occasionally conglomeratic. The basal contact of the San Jose Formation with Late Cretaceous rock units is unconformable around the edge of the San Juan Basin. In the Central San Juan Basin, it conformably overlies the Nacimiento Formation (Fassett and Hinds, 1971)

The San Jose Formation has been subdivided into the Cuba Mesa Member, the Regina Member, the Llaves Member and the Tapacitos Member. These units are lithologically sandstone-shale-sandstone-shale respectively. Fassett and Hinds (Fassett, 1974) report tracing the Cuba Mesa Member a few miles west of Cuba where it pinched out. Turner (1972) completed a water well in the Cuba Mesa Member north of Regina, NM at a depth of about 1,500 ft. The shale zones within the San Jose Formation are bentonitic and heaving conditions occur when the formation is drilled.

The San Jose Formation does not occur at the location of the proposed injection well.

The municipal wells serving Cuba are spudded in the San Jose Formation about eight (8) miles to the northeast. It is likely they obtain their water from the Cuba Mesa Member.

ANIMAS FORMATION

Geometry and Lithology

The Animas Formation occurs in the northern part of the San Juan Basin. The Animas grades laterally to the south into the Nacimiento Formation in the vicinity of Dulce, New Mexico, far north of the area of interest.

NACIMIENTO FORMATION

Geometry and Lithology

The Paleocene Nacimiento Formation conformably overlies and intertongues with the Ojo Alamo Sandstone in the Cuba area. The Nacimiento Formation is comprised of black and gray shale with occasional sandstone channel beds. Where it occurs near Bloomfield, it is an unctuous green shale. The sand component of the Nacimiento Formation increases to the north in the San Juan Basin where it grades laterally into the Animas Formation.

The Nacimiento Formation is about 900 ft thick south of the southern tip of Cuba Mesa west of Cuba (Fassett, 1966). At the location of the Cuba municipal wells it is about 1,500 ft thick (Kernoodle, 1996, p. 25). It is very thin at the proposed injection well.

Hydraulic Properties

The primary use of water from the Nacimiento Formation is for livestock and domestic supplies. There are no known aquifer performance test of the Nacimiento Formation. The fine material comprising the Nacimiento Formation, particularly in the Cuba area, will restrict upward and downward movement of water.

Tansey (1984, p. 117) reports the following vertical hydraulic conductivities for the Nacimiento Formation aquitards.

Table 1. Vertical hydraulic conductivity of the Nacimiento Formation

WELL NAME	LOCATION	HYDRAULIC CONDUCTIVITY ($X10^{-9}$m/s)	(md)
Blanco #2	29.09.08	4.8	0.56
Gobernador	27.05.03	5.45	0.63
Jones A #9	28.08.14	68.5	7.94

Tansey (1984, p. 117) gives the geometric mean vertical field hydraulic conductivities of the Nacimiento aquitards as 5.66E-3 ft/d (2E-8 m/s, 2E-6 cm/s, 2.32 md). The Nacimiento Formation is a confining zone.

Engineered earthen liners and/or caps for landfills, tailings pond, and wastewater lagoons must have permeability (hydraulic conductivity) of 1E-06 cm/s. Using this as a criteria for whether or not a rock unit is an aquitard or a confining zone, the Nacimiento Formation may or may not be a confining zone.

OJO ALAMO SANDSTONE

Geometry and Lithology

The Ojo Alamo Sandstone is Paleocene in age. It conformably underlies the Nacimiento Formation. It is the lowermost Tertiary rock unit of the San Juan Basin. It is a sheetlike sandstone unit with some shale zones. It thins northwestward from the Nacimiento Uplift towards Farmington. It is a coarse-grained, arkosic, conglomeratic sandstone.

The Ojo Alamo Sandstone unconformably overlies Late Cretaceous rocks in the Cuba area. As much as 2,100 ft of Kirtland and Fruitland rocks may be missing along the east edge of the basin. Southeast of Cuba, the Ojo Alamo rests directly on the Kirtland Shale-Fruitland Formation.

The Ojo Alamo Sandstone is present in the subsurface at the location of the Cuba municipal wells. At the site of the injection well, it occurs several hundred feet below the surface. In the Johnson 6-16, about one mile northeast of the Johnson 7-11 well, it occurs at 534 ft and is 181 ft thick. In the San Isidro 13-11 about 1.5 miles southwest of the Johnson 7-11 the Ojo Alamo is at 120 ft and is 214 ft thick.

1 ulic Properties

The median transmissivity of the Ojo Alamo near the outcrop is about 780 gpd/ft (K rnoodle, 1996, p. 28) based on 10 aquifer tests. Anderholm (1979) measured a transmissivity of 91 ft^2/d (682 gpd/ft) near Cuba. Aquifer tests of the Ojo Alamo away from the outcrop yield transmissivity values of 0.37 to 2.9 gpd/ft.

Water Quality

The Ojo Alamo is generally a source of good quality water. Tansey (1984, p. 20) reports 18 analyses. Electrical conductivity ranges from 650 to 1,500 micromhos/cm. In some cases, the sulphate concentration exceeds the 250 mg/l drinking water standard.

Records that are on file with the New Mexico Oil Conservation Division generally indicate the Ojo Alamo contains water without stating its quality. However, a number of records indicate the Ojo Alamo contains gas. This is the case for the San Isidro 5-1, located in 20.02.05 about two miles northeast of the Johnson 7-11, and the San Isidro 11-14, about two miles west of the Johnson 7-11.

KIRTLAND SHALE AND FRUITLAND FORMATION

Geometry and Lithology

The combined Kirtland Shale and Fruitland Formation are Late Cretaceous in age and represents swamp, river, lake, and flood plain continental deposits overlying the Pictured Cliffs Sandstone. The Kirtland Shale overlies the Fruitland Formation. The Kirtland Shale does not contain coal. The Fruitland is comprised of shale, siltstone, coal, carbonaceous shale, and rarely sandstone.

The Kirtland Shale and Fruitland Formation occur within the central part of the San Juan Basin and underlie the Tertiary rocks.

In the vicinity of the proposed injection well, the Kirtland Shale and Fruitland Formation are about 200 ft thick (Kernoodle, 1996, p. 30).

The NTUA wells are likely spudded in or close to the outcrop of the Kirtland Shale and Fruitland Formation.

Kernoodle (1996, p. 32) notes that "recently, there has been extensive exploration for methane gas resources from coal beds in the Fruitland Formation. The gas resources in the coal beds had largely been ignored because initial production from most wells was large quantities of poor-quality water and the gas potential was not recognized." Kernoodle goes on to say "gas and water production is thought to be from both coal in the Fruitland Formation and sandstone in the underlying Pictured Cliffs Sandstone.

Hydraulic Properties

Kernoodle (1996, p. 29) reports that transmissivity determined from five aquifer tests ranges from 4.5 to 972 gpd/ft. The only value of hydraulic conductivity calculated is 0.00001 ft/d. The yield to wells is very low. Tansey (1984) calculated field vertical hydraulic conductivities using thermal methods. His determinations are given in Table 2.

Table 2. Vertical hydraulic conductivity of the Kirtland Formation

WELL NAME	LOCATION	HYDRAULIC CONDUCTIVITY ($x\ 10^{-9}$ m/s)	md
Angel Peak #3	27.11.20	10.3	1.19
Gasbuggy	29.104.36	0.01	0.0012
Jones A #9	28.08.14	11	1.28
San Juan 72-4	28.04.17	29	3.36

Tansey (1984, p. 117) gives the geometric mean horizontal hydraulic conductivity of the Kirtland-Fruitland aquitard as 1.4E-4 ft/d (5E-10 m/s, 0.058 md)

Kernoodle (1996, Figure 41) (Appendix 1) indicates the combined vertical hydraulic conductivity of the Kirtland Shale-Fruitland Formation is 0.0001 ft/d (3.53E-8 cm/s, 0.041 md).

With a vertical hydraulic conductivity of 3.53E-8 cm/s, the Kirtland Shale-Fruitland Formation is a confining zone. Kernoodle (1996, Figure 36) (Appendix 1) also designates the Kirtland Shale-Fruitland Formation as a confining unit.

Water Quality

There are no chemical analysis of water from the Kirtland Shale-Fruitland Formation. However, the San Isidro 11-14 encountered gas in the Fruitland Formation. All wells encountered coal beds in the Fruitland Formation.

PICTURED CLIFFS SANDSTONE

Geometry and Lithology

The Pictured Cliffs Sandstone is a regressive strandline sandstone deposited during the last retreat of the Late Cretaceous sea from the San Juan Basin. It conformably underlies the Fruitland Formation and conformably overlies the Lewis Shale. In the southern part of the San Juan Basin, the Pictured Cliffs is poorly cemented.

In the injection well, PI indicates the top of the Pictured Cliffs is at 732 ft below the Kelley Bushing and the top of the underlying Lewis Shale is 900 ft. The Pictured Cliffs is 168 ft thick.

Hydraulic Properties

The transmissivity of the Pictured Cliffs from five aquifer tests ranges from 0.0075 to 22 gpd/ft.

Horizontal hydraulic conductivity determined from drill-stem tests in deeper holes averages 0.007 ft/d (2.87 md). In the digital computer model of the San Juan Basin, Kernoodle (1996, Figure 40-D) (Appendix 1) assigned a horizontal hydraulic conductivity of 0.007 ft/d (2.87 md) and vertical hydraulic conductivity of 0.0007 ft/d (2.5E-7 cm/s, 0.287 md).

Under the criteria given above, the Pictured Cliffs Sandstone is a confining bed for vertical flow.

Water Quality

Chemical analyses of water are not available from the Pictured Cliffs Formation. However, the Disposal Well Application reports five unit wells (5-2, 6-16, 11-4, 12-10, 13-11) penetrated the Pictured Cliffs and reported natural gas.

Kernoodle (1996, p. 34) states; "Few water wells are completed in the Pictured Cliffs Sandstone because of the generally poor quality water found in the unit."

LEWIS SHALE

Geometry and Lithology

The Lewis Shale, of Late Cretaceous age, crops out around the margin of the central San Juan Basin. It conformably overlies the Cliff House Sandstone and conformably underlies the Pictured Cliffs Sandstone. It is a gray to dark-gray transgressive marine shale.

The Lewis Shale contains a widespread marker bed known as the Huerfano Bentonite Bed.

PI indicates the top of the Lewis Shale is 900 ft below the Kelly Bushing (6,130 ft amsl) and the top of the Chacra Tongue of the Cliff House Sandstone is 1,160 ft (5,870 ft amsl). The Lewis Shale in the proposed injection well is 260 ft thick.

Hydraulic Properties

Kernoodle (1996, p. 34) states: "The Lewis Shale is not recognized as an aquifer and there are no known tests to determine hydraulic properties of the unit." Furthermore, "The Lewis Shale serves as a confining unit that hydraulically separates the overlying Pictured Cliffs Sandstone and the underlying Cliff House Sandstone aquifers. The low-permeability shale also rejects recharge from precipitation.

For the digital computer model of the San Juan Basin, Kernoodle (1996, Figure 40-E) (Appendix 1) assigned a vertical hydraulic conductivities of 0.00005 ft/d (1.76E-8 cm/s, 0.021 md) and 0.000005 ft/d (1.8E-9 cm/s, 0.002 md).

With a maximum vertical hydraulic conductivity of 1.76E-8 cm/s, the Lewis Shale is a confining zone. Kernoodle (1996, Figure 36) (Appendix 1) also defines the Lewis Shale as a confining bed.

Water Quality

Gas is reported in the San Isidro 5-2 well.

CLIFF HOUSE SANDSTONE

Geometry and Lithology

The Mesaverde Group was subdivided into the Cliff House Sandstone, the Menefee Formation and the Point Lookout Sandstone.

The Cliff House Sandstone represents a transgressive phase of Late Cretaceous sedimentation during which medium- to fine-grained sandstone was deposited. It intertongues upward into the Lewis Shale

The Cliff House consists of two major sandstone tongues - the Chacra Tongue and the La Ventana Tongue. The Chacra Tongue is stratigraphically above and not connected to the La Ventana Tongue.

The Cliff House Sandstone consists of thick- to very thick-bedded sandstone with calcite or silica cement. and a clay matrix. The Cliff House sandstone is moderately well cemented.

PI indicates the top of the Chacra Tongue is 1,160 ft (5,870 ft amsl). It bottoms at about 1,330 ft (5,700 ft amsl). The La Ventana Tongue is not identified in the dual laterolog for the proposed injection well; however, it is likely the lower sand unit identified at 1,632 ft (5,398 ft amsl). The La Ventana Tongue bottoms above the Menefee which PI indicates has its top at 2,312 ft (4,718 ft amsl).

Hydraulic Properties

Transmissivity and hydraulic conductivity data for the Cliff House Sandstone are sparse. A recovery test on a water well in 1961 indicated a transmissivity of 15 gpd/ft (Kernoodle, 1996, p. 38). The median specific capacity for 27 water wells is 0.06 gpm/ft and the estimated transmissivity is 120 gpd/ft (Walton, 1987, p. 19).

Average horizontal hydraulic conductivity from drill stem tests in the deeper part of the San Juan Basin is 0.0015 ft/d (6.16 md).

For the digital computer model of the San Juan Basin, Kernoodle (1996, Figure 40-F) (Appendix 1) assigned a horizontal hydraulic conductivity of 0.1 ft/d (41.1 md) and a vertical hydraulic conductivity of 0.001 ft/d (3.5E-7 cm/s, 0.41 md) to the Cliff House Sandstone.

The Cliff House Sandstone can be considered a confining zone with regard to vertical ground water flow.

Water Quality

Natural gas is reported in the San Isidro 5-2, 11-14, and 13-11 wells. Small amounts of oil and gas are reported in the San Isidro 12-10

MENEFEE FORMATION

Geometry and Lithology

The Menefee Formation is a continental fluvial, interbedded sequence of sandstone, siltstone, shale and coal unit conformably overlying the Point Lookout Sandstone.

PI indicates the top of the Menefee is at 2,312 ft (4,718 ft amsl) and the top of the Point Lookout Sandstone is at 2,940 ft (4,090 ft amsl). The Menefee Formation in the proposed injection well is 628 ft thick.

Hydraulic Properties

Transmissivity of the Menefee Formation depends on the thickness of sandstone lenses penetrated. The median transmissivity from nine aquifer tests is about 75 gpd/ft.

Horizontal hydraulic conductivity calculated from drill-stem tests in oil and gas wells averages 0.017 ft/d (6.98 md). Kernoodle (1996, Figure 40-G) (Appendix 1) assigned a value of 0.05 ft/d (20.5 md) for the horizontal hydraulic conductivity of the Menefee Formation and a vertical hydraulic conductivity of 0.00001 ft/d (3.5E-9 cm/s, 0.0041 md).

With a vertical hydraulic conductivity of 3.5E-9 cm/s, the Menefee Formation is classified as a confining zone. Kernoodle (1996, Figure 36) (Appendix 1) also indicates it is a confining bed.

Water Quality

An analysis of water from the proposed injection well included in the Disposal Well Application reports the total dissolved solids concentration of water in the injection zone is 8,790 mg/l.

An analysis in the records of the U.S. Geological Survey for a well producing from the Allison Member of the Menefee Formation six (6) miles west of the proposed injection well has an electrical conductivity of 28,400 micromhos per centimeter. This is equivalent to a total dissolved solids concentration of about 19,312 mg/l.

Oil and gas is reported in the San Isidro 6-16 and 13-11 wells. Oil alone is reported in the Menefee in San Isidro wells 5-2, 11-14, and 12-10.

SUMMARY OF VERTICAL HYDRAULIC PROPERTIES

The rate of vertical ground-water flow into overlying potential USDWs is determined by the vertical component of hydraulic conductivity. Usually, the vertical component of hydraulic conductivity is very low in shales to classify them as confining zones or confining beds. Therefore, the Kirtland Shale-Fruitland Formation, Lewis Shale, and Menefee Formation are classified as aquitards, confining zones, or confining beds.

Where the vertical component of hydraulic conductivity is very low for sandstones, they too may be considered as aquitards, confining zones, or confining beds. In the San Juan Basin, in the Pictured Cliffs and the Cliff House Sandstones both can be considered as aquitards, confining zones, or confining beds based on the criteria that the vertical component of hydraulic conductivity must be greater than 1E-6 cm/s.

DIRECTION AND SPEED OF GROUND WATER FLOW

HORIZONTAL

The horizontal direction of ground-water flow within the Menefee and Cliff House is to the southwest according to steady state potentiometric contours given by Kernoodle (1996, Figure 48) (Appendix 1).

The horizontal mean approach velocity of flow is calculated from Darcy's Law

$$Q = TIW/A\phi$$

where

Q = Darcian flow rate, L^3/T
T = aquifer transmissivity, L^2/T
I = hydraulic gradient, L/L
W = width of flow section, L
A = unit cross section of aquifer through which flow occurs, L^2
ϕ = effective porosity, percentage

In the present case, the transmissivity of the Cliff House and Menefee are taken as 100 and 75 gpd/ft (13.4 and 10 ft^2/d). The horizontal hydraulic gradients from Kernoodle (1996, Figures 47 and 48 (Appendix 1) for the Cliff House and Menefee are about 5E-3 and 6.3E-3 respectively. If the effective porosity is as high as 20 percent, the mean approach velocity of moving water in the Cliff House and Menefee will be 0.33 and 0.32 ft/d respectively.

VERTICAL

Kernoodle (1996, Figure 48) (Appendix 1) indicates the average potentiometric surface for the Menefee Formation at the location of the injection well is about 7,000 ft amsl. The potentiometric surface for the Cliff House Sandstone is given by Kernoodle (1996, Figure 47 (Appendix 1) as about 6,950 ft amsl. The potentiometric head for the Point Lookout Sandstone, below the Menefee Formation, is given by Kernoodle (1996, Figure 49 (Appendix 1) as about 6,800 ft amsl.

Therefore, the direction of ground-water flow under natural conditions is from the Menefee Formation both upward into the Cliff House Sandstone and downward into the Point Lookout Sandstone.

*

From Darcy's Law, the upward mean approach velocity of ground water is

$$v = K_v I_v/\phi$$

where

Q_v = vertical volumetric flow rate, L^3/T
K_v = vertical hydraulic conductivity, L/T
I_v = vertical hydraulic gradient, L/L
ϕ = porosity, percentage

From Kernoodle (1996, Figures 47 and 48 (Appendix 1) we can calculate the vertical hydraulic gradient as about 1.30 ft H_2O/ft (0.56 psi/ft). If the vertical hydraulic conductivity is 0.00001 ft/d and the effective porosity is 20 percent, the vertical mean approach velocity is about 6.65E-5 ft/d.

HYDRAULIC PROPERTIES FOR COMPUTING THE ZONE OF ENDANGERING INFLUENCE

POROSITY

Exhibit 5 of Case No 11470 gives the porosity of the injection zone within the Menefee Formation as 18.8 percent.

Careful inspection of the compensated density log of the Johnson 7-11 indicates that the perforated interval between 2,438 and 2,624 below the Kelly Bushing ranges from 18 to 26 percent. The average porosity is about 20 percent.

The Archie formula may be used to calculate the porosity also. Archie's Law states:

$$F = \frac{R_o}{R_w} = \frac{1}{\phi^m}$$

where

R_o = resistivity of the saturated formation determined from the deep induction laterolog, ohm-m
R_w = resistivity of the water from the formation, ohm-m
ϕ = porosity, percentage
m = Archie's coefficient

In the present case, analysis of the water from the Menefee injection interval between 2,438 and 2,624 ft gives a total dissolved solids concentration of 8,790 mg/l. This must be converted to electrical conductivity and resistivity (R_w).

The relationship between electrical conductivity expressed as "micromhos/cm" and total dissolved solids expressed as "mg/l" is well known and usually varies between 0.55 and

0.75 (Hem, 1989, p. 66-68). Analysis of the municipal water supply for the Cuba South and West wells (Garcia and Olaechea, 1974) shows that the electrical conductivity can be approximated by dividing the total dissolved solids concentration by 0.68.

For the injection zone, the electrical conductivity will be about 12,926 micromhos/cm or 1.29 mho/m. The resistivity is the reciprocal of the conductivity and the resistivity "R_w" of the formation water in the injection zone will be about 0.77 ohm-m.

The dual induction laterolog shows that the formation conductivity for the injection zones averages about 92 millimhos/m and the average formation resistivity "R_o" is about 11 ohm-m.

The formation resistivity factor then is the quotient of "R_o" and "R_w" or about 14.

If the formation resistivity factor is 14, Archie (1950) indicates that the percent porosity for sandstones falls in the 20 to 30 percent range and varies depending on the cementation of the formation. The hydraulic properties of the Late Cretaceous sandstone described above suggest the sandstone units are moderately well cemented. The Cliff House Sandstone above, the Menefee Formation is a widespread cliff forming unit in the San Juan Basin.

Birdwell (1963, p. F-11) indicates the "m" exponent in the Archie equation for moderately consolidated sandstone is about 1.8. If the formation resistivity factor is 14, the porosity will be 23 percent. This is in excellent agreement with the porosity estimated from the compensated density log.

For further calculations, we will use a conservative porosity value of 20 percent.

WATER SATURATION

Exhibit 5 of Case No. 11470 gives the water saturation as 75 percent.

We can estimate water saturation from

$$S = (FR_w/R_o)^{1/n}$$

where "n" is a cementation factor. Levorsen (1967, p.159) indicates that for moderately cemented sandstone, a cementation factor of about 1.8 is appropriate. If "$\bar{F}$" is 14, "R_w" is 0.77 ohm-m and R_o is 11 ohm-m, the water saturation is 99 percent. That is, the rock unit in the injection zone is effectively saturated.

For further calculations, we will consider that the injection zone is completely saturated. The saturation factor is 1.

TOTAL COMPRESSIBILITY

The total compressibility of the saturated rock of the injection zone is equivalent to the volume fraction of water times the compressibility of water plus the compressibility of the rock matrix expressed as psi^{-1}. Water saturation is 100 percent and the volume fraction is "1".

A compressibility of 3E-06 psi^{-1} is usually suitable for water (Mathews and Russell, 1967, p. 21). The effective rock compressibility is dependant on porosity. Mathews and Russell (1967, Figure G.5) indicates an effective rock compressibility of about 3.7E-06 psi^{-1} for sandstone with 20 percent porosity.

The total compressibility for the injection zone is about 6.7E-06 psi^{-1}

RESERVOIR PRESSURE

Exhibit 5 of Case No. 11470 gives the reservoir pressure within the injection zone as 1,000 psia.

The injection zone is between 2,438 and 2,624 ft below the Kelly Bushing. The injection zone is very near the middle of the Menefee Formation.

Kernoodle (1996, Figure 48 (Appendix 1) indicates the average steady state potentiometric surface associated with the Menefee Formation in the vicinity of the proposed injection well is about 7,000 ft amsl. Under slab hydrodynamic theory, the average potentiometric head is attributable to the middle of the slab of rock. Because the injection zone is very near the middle of the Menefee Formation, the average steady state potentiometric head is the head within the injection zone.

The elevation of the base of the injection zone is 2,611 ft bgl or 4,406 ft amsl. The hydrostatic head above the base of the injection zone is about 2,594 ft of water with a specific gravity near one (1). The water within the injection zone is not a brine and the hydrostatic gradient is probably about 0.433 psi/ft. The bottom hole pressure will be about 1,123 psia.

If the average potentiometric surface of the Menefee Formation is 7,000 ft amsl, the depth to water in the injection well with a surface elevation of 7,017 ft amsl is about 17 ft.

For further calculations, we will use an original bottom hole pressure of 1,123 psi.

RESERVOIR TEMPERATURE

Exhibit 5 of Case No. 11470 gives the reservoir temperature of the Menefee injection zone as 105 degrees Fahrenheit (°F). No data was presented to support this estimate.

The dual induction laterolog and the compensated density dog for the Johnson 7-11 well indicate that logging took place on July 19, 1984 to a depth of 3,664 ft and on July 22, 1984 from 3,664 to 4,769 ft. The logs indicate the bottom hole temperature at 3,664 ft was 120°F and at 4,769 it was 145°F.

Reynolds (1956) gives the mean annual surface temperature at Cuba at a station elevation of 6,945 ft amsl as about 46.5°F. Therefore, the increase in temperature from the surface to 3,664 ft is about 74°F and from 3,664 to 4,769 ft it is 25°F. The geothermal gradient from the surface to 3,664 ft is 2.02E-2 degrees Fahrenheit per foot of depth (°F/ft). The geothermal gradient from 3,664 ft to 4,769 ft is 2.26E-2 °F/ft. The lower gradient in the upper part of the hole may be caused by shallow ground-water movement and convective heat transfer. Using the gradient in the upper part of the hole, the temperature at a depth of 2,624 ft (2,611 ft bgl) will be about 99°F.

For further calculations, we will use a bottom-hole temperature of 100°F.

FLUID SPECIFIC GRAVITY

Analysis of fluid produced from several wells that is intended for injection is given in Table 3 below. The specific gravity represents laboratory determination by Petrolite Oilfield Chemicals Group. The specific gravity of the injected fluid at the injection zone must be adjusted for a bottom hole injection pressure. The bottom hole pressure of the injected fluid will increase from 1,123 psi for formation water to 1,146 psi plus the injection pressure ((2,594 ft + 17 ft)*0.439 psi/ft) During an injection test of the well 720 bblpd was injected at a pressure of 700 psi. If the injection pressure is 0.97 psi/bblpd an additional 146 psi must be added for an injection rate of 150 bblpd. The total bottom hole injection zone pressure will be about 1,292 psi.

The specific gravity must be corrected for a pressure of about 1,292 psi and a temperature of 100°F.

Table 3. Specific gravity determination of injection fluid.

WELL NAME	LAB SPECIFIC GRAVITY	GRADIENT (psi/ft)	TEMPERATURE (°F)	INJECTION SPECIFIC GRAVITY*
5-15	1.025	0.444	100	1.014
7-3	1.01	0.437	100	1.004
12-10	1.01	0.437	100	1.004

* Phillips Petroleum Corporation, 1961, Hydrodynamics Manual, Section A-0.

For further calculations, a hydrostatic gradient of 0.439 psi/ft will be used for the injected brine.

VISCOSITY

The viscosity of the fluids on injection have been determined based the percent sodium chloride for fluids at one atmosphere pressure and temperature below 212°F corrected for elevated pressure. The results are given in Table 4 below.

Table 4. Determination of viscosity of injection fluid.

WELL NAME	PERCENT NACL	TEMPERATURE (°F)	INJECTION VISCOSITY (cp)*
5-15	22.9	100	1.17
7-3	0.88	100	0.69
12-10	23.5	100	1.22

* Mathews and Russell, 1967, Figure G.4.

The pressure correction factor is very small at a temperature of 100°F.

For further calculations, we assume that the viscosity of the injected brine is 1.22 cp.

AVERAGE PERMEABILITY (HYDRAULIC CONDUCTIVITY)

The average hydraulic conductivity (permeability) in the injection zone given in Exhibit 5 of Case File No. 11470 is 5 md. Hearing testimony indicated the hydraulic conductivity is in the 5 to 10 md range but no supporting documentation was presented.

Item XII in the Disposal Well Application indicates that an injection test was run on September 28, 1995 and the Menefee tested at a rate of 720 barrels of water per day (bblpd) at a surface injection pressure of 700 psi. This can be considered the mathematical analog of specific capacity in a well which is the production rate of the well divided by the fluid level decline.

In this case, 720 bblpd is 21 gallons per minute (gpm) and the surface pressure of 700 psi is equivalent to a column of fresh water 1,616 ft high. To this must be added the calculated depth to brine in the proposed injection well of 17 ft. The total injection pressure was 1,633 ft of water. The specific capacity is about 0.013 gpm/ft.

Walton (1987, p. 19) indicates that the transmissivity in gallons per day per ft (gpd/ft) of an artesian aquifer can be estimated by multiplying the specific capacity by 2,000. In the present case, the transmissivity of the injection zone will be about 26 gpm/ft.

The transmissivity is the product of the hydraulic conductivity and the injection thickness. The injection interval is 75 ft thick, the hydraulic conductivity will be about 0.046 ft/d or 19 md in oilfield units.

Kernoodle (1996) reported that drill-stem tests of the Menefee indicated a hydraulic conductivity of 0.017 ft/d (6.98 md). He assigned a value of 0.05 ft/d (20.55 md) for the horizontal hydraulic conductivity. This is close to the 0.041 ft/d (16.85 md) estimated from the injection test.

We may say that the horizontal hydraulic conductivity of the injection zone is about 0.05 ft/d or 20 md.

INJECTION ZONE

The injection zone is given as 2,438 to 2,624 ft below the Kelly Bushing.

FORMATION VOLUME FACTOR

Because we are dealing only with water, one stock tank barrel of water is equivalent to one barrel of formation water and the formation volume factor is one (1).

AVERAGE THICKNESS OF INJECTION ZONE

Well logs, presented as Exhibit 6 of Case No. 11470, and Exhibit 5 of Case No 11470 indicate the thickness of the injection zone is 75 ft.

DEPTH TO BASE OF FRESH WATER ZONE

The depth to the base of the nearest fresh water zone having water quality less than a total dissolved solid concentration of 3,000 mg/l can be estimated from the dual induction laterolog of the well.

Using Archie's Law, we can determine the formation resistivity for a formation that is saturated with water of 3,000 mg/l or more. R_w will be about 2.27 ohm-m and R_o will be 31.7 ohm-m.

Based on this criteria, the first sand unit above the injection zone that contains water of 3,000 mg/l occurs at about 1,670 ft below the Kelly Bushing. The total sand thickness is about 30 ft.

Exhibit 6 of Case File No. 11470 indicates that this sand unit is the top of the Cliff House Sandstone or the Chacra Tongue. Chemical analyses of water are not available from the Cliff House Sandstone. However, the Disposal Well Application reports three unit wells (5-2, 11-14, 12-10) encountered natural gas in the Cliff House Sandstone.

It is unlikely that such a thin sand unit will become a USDW not only because of the low yield of wells but because the likely variability of water quality in the Cliff House Sandstone will make it an unreliable and costly aquifer to explore for potable water.

For the purpose of further computations, we assume that the base of the first sand containing less than 3,000 mg/l of total dissolved solids is at 1,670 ft (5,360 ft amsl).

INJECTION RATE

The average injection rate is given in Exhibit 5 of Case File No. 11470 as 150 barrels per day (bblpd).

INJECTION PERIOD

The injection period is given in Exhibit 5 of Case File No. 11470 as 15 years (5,479 days).

TOTAL VOLUME OF WATER INJECTED

The total volume of water to be injected is given in Exhibit 5 of Case File No. 11470 as 821,250 bbl.

RESERVOIR AREA

The surface area overlying the reservoir for brine disposal is given in Exhibit 5 of Case File No. 11470 as 640 acres.

In a letter dated May 30, 1996 from William B. Hathaway, Director of the Water Quality Division of Region 6 of the U.S. Environmental Protection Agency to Mr. William J. LeMay, Director to the New Mexico Oil Conservation Division, it appears that the aquifer exemption covers an area of 720 acres.

WATER IN PLACE

The water presently in place in the injection zone is given in Exhibit 5 of Case File No. 11470 as 52,506 thousand barrels.

If the reservoir area is 640 acres and the thickness of the injection zone is 75 ft with a porosity of 20 percent, the volume of water in place is 9,600 acre ft or about 74,480 barrels.

SUMMARY

For calculational purposes, the relevant information discussed above is given in Table 5.

Table 5. Summary of relevant parameters for calculating the Zone of endangering influence around the injection well.

ITEM	UNITS	VALUE
Specific Gravity	dim	1.014
Hydrostatic Gradient of Injected Fluid	psi/ft	0.439
Injection Rate	B/d	150
Thickness of Injection Zone	ft	75
Compressibility	psi E-1	6.70E-06
Injected Fluid Viscosity	cps	1.22
Injection Period	days	5479
Horizontal Hydraulic Conductivity of Injection Zone	md	20
Vertical Hydraulic Conductivity from TOIC to USDW	ft/d	0.00001
Porosity	%	0.2
Formation Volume Factor	dim	1
Potentiometric Surface of Injection Zone	ft amsl	7000
Base of Injection Zone	ft amsl	4406
Initial Reservoir Pressure	psi	1123
Potentiometric Surface of USDW	ft amsl	6950
Elevation of USDW	ft amsl	5358
USDW Reservoir Pressure	psi	689
Top of Injection Zone	ft bgl	2425
Base of USDW	ft bgl	1657
Distance from TOIZ to Base of USDW	ft	768
Hydrostatic Gradient from TOIZ to Base of USDW	psi/ft	0.56
Hydrostatic Gradient from TOIZ to Base of USDW	ft/ft	1.30

CALCULATION OF THE ZONE OF ENDANGERING INFLUENCE

The zone of endangering influence (ZEI) is calculated from

$$P_r = P_i + 162.6\frac{Q\mu B}{kh}\log\left[\frac{kt}{70.4\phi\mu c r^2}\right]$$

where "P_r" is the reservoir pressure at distance "r" from the injection well and all other terms are as described in Table 6. The ZEI is normally the distance at which the increase in reservoir pressure is below the base of the USDW. This assumes that the reservoir pressure in the injection zone is always below the potentiometric head in any overlying USDW. This is not always the case. In the present case, there is a very small vertical component of natural ground-water flow. Regardless of the computations of the ZEI, ground-water flow will always be upward from the Menefee Formation into the Cliff House Sandstone.

Table 6 shows the elevation of the potentiometric head in the injection zone above the potentiometric head associated with the Cliff House Sandstone. At a distance of 10,000 ft the potentiometric head in the injection zone is 99 ft above the head in the Cliff House. Though not in Table 6, at a distance of six (6) miles, it is three (3) ft above the head in the Cliff House.

AREA OF AQUIFER EXEMPTION

The radius around the injection well beyond which injection effects will not cause an increase in upward fluid flow in excess of the natural upward ground-water flow at the end of the injection period is about six (6) miles. At a distance of six miles, the increase in reservoir pressure is very near the original reservoir pressure. The area of exemption is 72,382 acres.

EFFECT OF CONFINING BED

The increase in the potentiometric head in the injection zone will create a greater upward hydraulic gradient.

The vertical volumetric flow rate is directly proportional to the vertical hydraulic gradient. We can calculate the maximum percentage increase in vertical flow. The maximum increase in vertical flow will be at the injection well itself where the reservoir pressure during injection will be at a maximum.

Kernoodle (1996) gives the vertical component of the field hydraulic conductivity as 0.00001 ft/d. Under normal conditions, the upward flow rate per square foot of surface area will be 1.30E-5 $ft^3/d\text{-}ft^2$. If the gradient is increased to 0.80 psi/ft, the upward flow rate is increased to 1.85E-5 $ft^3/d\text{-}ft^2$.

The maximum increase in upward vertical volumetric flow is about 42 percent of the original flow.

Before the injected water can enter the Cliff House, however, it must first displace the water within the Menefee Formation and the Cliff House Sandstone below the fresh water zone. The stratigraphic thickness between the top of the injection interval and the base of the good water zone in the Cliff House is about 1,582 ft. If the average total porosity for the shale and cemented sandstone is 20 percent, the total volume of water that must be displaced within one-half mile of the injection well will be 1.23E9 bbls. The total amount of injected fluid is only about 821,813 bbls. Consequently, the injected fluid is of insufficient volume to reach the good water zone at the top of the Chacra Member of the Cliff House Sandstone by displacing the natural formation water.

The upward advance of the injected fluid at any time after injection began can be found from

$$vt = Qt/\phi A$$

where

v = approach velocity, L/T
t = elapsed time since injection began, T
Q = volumetric flow rate, L^3/T
ϕ = porosity, percentage
A = surface area through which flow occurs, L^2

Table 6 shows the upward distance of invasion of injected fluids above the injection zone at the end of the injection period.

Table 6. Reservoir pressures and hydraulic gradients and fluid flow rates.

Radial Distance (ft)	Reservoir Pressure (psi)	Pr Above USDW (ft H2O)	Vertical Gradient (psi/ft)	Vertical Gradient (ft/ft)	Vertical Flow Rate ($ft^3/d\text{-}ft^2$	Mean Pore Velocity (ft/d)	15-Year Fluid Advance (ft)
1	1303	465	0.80	1.85	1.85E-05	0.000092	0.51
10	1263	374	0.75	1.73	1.73E-05	0.000086	0.47
100	1224	282	0.70	1.61	1.61E-05	0.00008	0.44
800	1188	199	0.65	1.50	1.50E-05	0.000075	0.41
10000	1144	99	0.59	1.37	1.37E05	0.000068	0.37
INFINITE	1123	50	0.56	1.30	1.30E-05	0.000065	0.36

WATER WELLS

Table 7 lists three wells which were reportedly drilled by the Navaho Tribal Utilities. Recent conversations with Navajo Tribal Utilities Authority personnel indicate they have no knowledge of them. These wells were likely drilled during an exploration program in the 1950's. Their total depths and screened intervals are unknown as are the water quality and the yields of the wells.

Table 7. List of Navajo Tribal Utility Authority wells listed by the State Engineer.

SEO FILE NUMBER	LOCATION*	DEPTH	OWNER
RG-64587	20.03.07.444	Unk	Navajo Tribal Utility (NTUA)
RG-64588	20.03.08.424	Unk	Navajo Tribal Utility (NTUA)
RG-64589	20.03.06.444	Unk	Navajo Tribal Utility (NTUA)

* SEO Locational system.

Table 8 lists other wells and springs found in the files of the U.S. Geological Survey and the New Mexico State Engineer.

Table 8. Wells and springs in the vicinity of the proposed injection well

LOCATION	TYPE	PRODUCING FORMATION	DEPTH	USE	YIELD	SOURCE
20.02.14.3214	Well	Ojo Alamo	65	S	2	USGS
20.02.10.433	Well		150	S		SEO
20.02.16.2144	Well			S	1.3	USGS
20.02.17.1324	Well	Ojo Alamo	240	S		USGS
20.02.19.2131	Well	Ojo Alamo	300	S	20	USGS
20.02.20.11	Well		NWR	S		SEO
20.02.21.220	Spring	Ojo Alamo		S	20	USGS
20.02.23.433	Well		NWR	S		SEO
20.02.31.112	Well		125	S		SEO
20.02.31.2	Well	Ojo Alamo	7	S		USGS
20.02.32.3344	Spring	Ojo Alamo		S	<0.1	USGS
20.02.13.1243	Spring	Ojo Alamo		S	<0.1	USGS
20.02.33.1441	Spring	Ojo Alamo		S	<0.1	USGS
20.03.06	Well		827	S		SEO
20.03.07.44	Well	Allison	794	D?		USGS
20.03.07	Well		758	S		SEO
20.03.08	Well		767	S		SEO
20.03.15.4431	Well	Ojo Alamo	390	S	22	SEO&USGS
20.03.17.223	Well		665	S		SEO
20.03.17.23	Well		1030	O&G		SEO
20.03.17.4444	Well	Alluvium	73	S	75	USGS
20.03.36.411	Well		NWR	S		SEO
21.02.09.124	Well	San Jose		S		USGS
21.02.17.441	Well		600	S		SEO
21.02.17.441	Well		406	S		SEO
21.02.17.444	Well	San Jose	340	S		USGS
21.02.28.142	Well		NWR	C		SEO
21.02.35.	Well		545	S		SEO

S = stock well, O&G = oil and gas drilling water supply, C = construction, D = domestic

The nearest well to the proposed injection well is the well at 20.02.17.1324. The well is reported to be 240 ft deep and producing from the Ojo Alamo Sandstone. The water produced by the well contains 760 mg/l of sulphate. Though it is an aesthetic standard, the sulphate drinking water standard is 250 mg/l. All other water wells are more than two (2) miles from the proposed injection well.

The well at 20.03.07.44 is probably the NTUA well RG-64587. It produces from the Allison Member of the Menefee Formation. The ground water has an electrical conductivity of 28,400 micromhos per centimeter. This is equivalent to a total dissolved solids concentration of about 19,312 mg/l. The well is six (6) miles west of the proposed injection well. It is likely that the NTUA carried out a ground-water exploration program in the 1950's. NTUA officials have no present recollection of wells in this area of the San Juan Basin.

Well 20.02.28.142 was drilled for highway construction purposes. Well 21.02.35 was drilled for water for oil and gas drilling. The remainder of the wells are most likely stock wells.

Most wells are shallow stock wells. The deepest well was drilled to 1,030 ft as a source of water for oil and gas drilling. Well yields are commonly only several gallons per minute. The shallow depths of the wells and their water quality suggest that it is economically impractical to drill deep domestic water supply wells in the area.

The Cuba water supply wells are about eight (8) miles north of the Johnson 7-11. The Cuba water supply wells likely obtain their water from the Cuba Mesa Member of the Nacimiento Formation which is not present at the location of the proposed injection well.

A search was conducted of the U.S. EPA STORET water quality database for a large area around the proposed injection well and no chemical analyses were found for ground water.

OIL AND GAS WELLS

A search of the Petroleum Information System data base was conducted to determine the number of well that have been drilled for oil and gas within six (6) miles of the proposed injection well. The PI search identified 94 oil and gas wells. The results of the search are in Appendix 2.

The search was further refined to determine the main production zones within the wells. The Mancos Shale and Gallup Sandstone are the major producing zones. One well was completed as a Dakota producer and one and a Menefee Producer.

The results of this survey indicate that no wells were completed in any USDW and there is no possibility for inside-the-casing uphole flow into the potential USDWs. If

all wells were cemented in place, as is the practice, there should be no behind the pipe flow either.

Of the 94 wells identified, 40 have been abandoned.

WELL CONSTRUCTION COSTS

The depth to the Cliff House is about 1,657 ft bgl. Drilling equipment capable of drilling a water well to the Cliff House will require a 12-inch borehole. Experience in the area and elsewhere in New Mexico suggests that the well will be cased with 8-inch steel casing. The author has recently drilled a 1,000 foot well near Taos for a cost of about $35,000 or $35/ft. The larger equipment necessary to drill a deeper hole should boost drilling costs.

We obtained drilling costs including mobilization and demobilization costs for wells ranging in depth from 1,670 ft to 2,624 ft from Stewart Brothers Drilling Company in Grants, New Mexico. Stewart Brothers has extensive experience in drilling in this area. Their estimated drilling cost for these wells is about $92/ft. Therefore, a well to 1,670 feet will cost about $162,000 including tax. A well constructed to 2,624 ft will cost about $255,000 including tax. Pumping and surface equipment including power lines is not included.

If the well is intended as a municipal supply well, to the cost of the well should be added the cost of any pipeline to move the water to Cuba, the nearest community. Six-inch buried PVC water line will cost about $10/ft to install. Cuba is about 10 miles to the northeast and water line costs will be about $528,000.

We regard the construction of a well for a domestic supply as economically impractical. We regard the expenditure of at least $150,000 for a well in this area as speculative because of low and unknown well yield and unknown water quality.

Poor quality water would require treatment and we regard this as technologically difficult and economically impractical for the small community of Cuba.

DISCUSSION

There is very slow natural ground-water flow from the Menefee upward toward the Cliff House Sandstone. The injection well will increase pressure and the rate of ground-water flow vertically upward. Because the vertical hydraulic conductivity of the shale and sandstone above the injection zone is extremely low, the rate of upward migration of injected fluids will be very low. The zone of invasion above the injected zone will be very small.

The volume of fluid invasion into the rock units overlying the injection zone is small compared to the amount of fluid that must be displaced before injected fluids

could reach the overlying zone of better quality water. Cessation of injection in 15 years will reduce the vertical hydraulic gradient. Dissipation of pressure in the injection zone will return hydraulic gradients to normal in about 30 years.

The low vertical hydraulic conductivity and computations carried out in this report make the Menefee shale an effective confining bed as defined in 40 CFR § 146.3.

CONCLUSIONS

In conclusion, we may say that

1. The Menefee Formation contains producible oil and gas and is an exempt aquifer pursuant to 40 CFR § 146.4(b)(1)(a).

2. The Menefee Formation and the Cliff House Sandstone are not aquifers pursuant to 40 CFR § 146.3 because they can not produce *significant* quantities of water.

3. The first sand above the Menefee Formation containing water of 3,000 mg/l and the Menefee Formation are not now sources of drinking water in the area and are unlikely to become drinking water sources because the depth of the water zones and the variable quality of the water make it economically and technologically impractical to obtain water from these zones.

4. All Late Cretaceous rock stratigraphic units within six (6) miles of the proposed injection well may be considered as confining zones with vertical components of hydraulic conductivity less than 1E-06 cm/s.

5. The location of the proposed injection well is distant from Cuba making it unlikely that it will ever be used as a drinking water source.

6. Though the total dissolved solids concentration of water in the Menefee Formation is less than 10,000 mg/l, the water exceeds federal and state drinking water standards for chloride and barium. It is economically and technologically impractical to treat this water for human consumption.

7. The shale of the Menefee Formation is an effective confining zone as defined in 40 CFR § 146.3 that is capable of limiting fluid movement above the injection zone.

8. Water wells within six (6) miles of the proposed injection well do not penetrate any USDW that may be affected by disposal operations.

9. Oil and gas wells within six (6) miles of the proposed injection well are cemented across all USDWs.

RECOMMENDATIONS

Based on our exhaustive technical analysis we conclude that there is no danger to underground sources of drinking water and that the Menefee Formation should be classified as an exempt aquifer pursuant to 40 CFR § 144.8.

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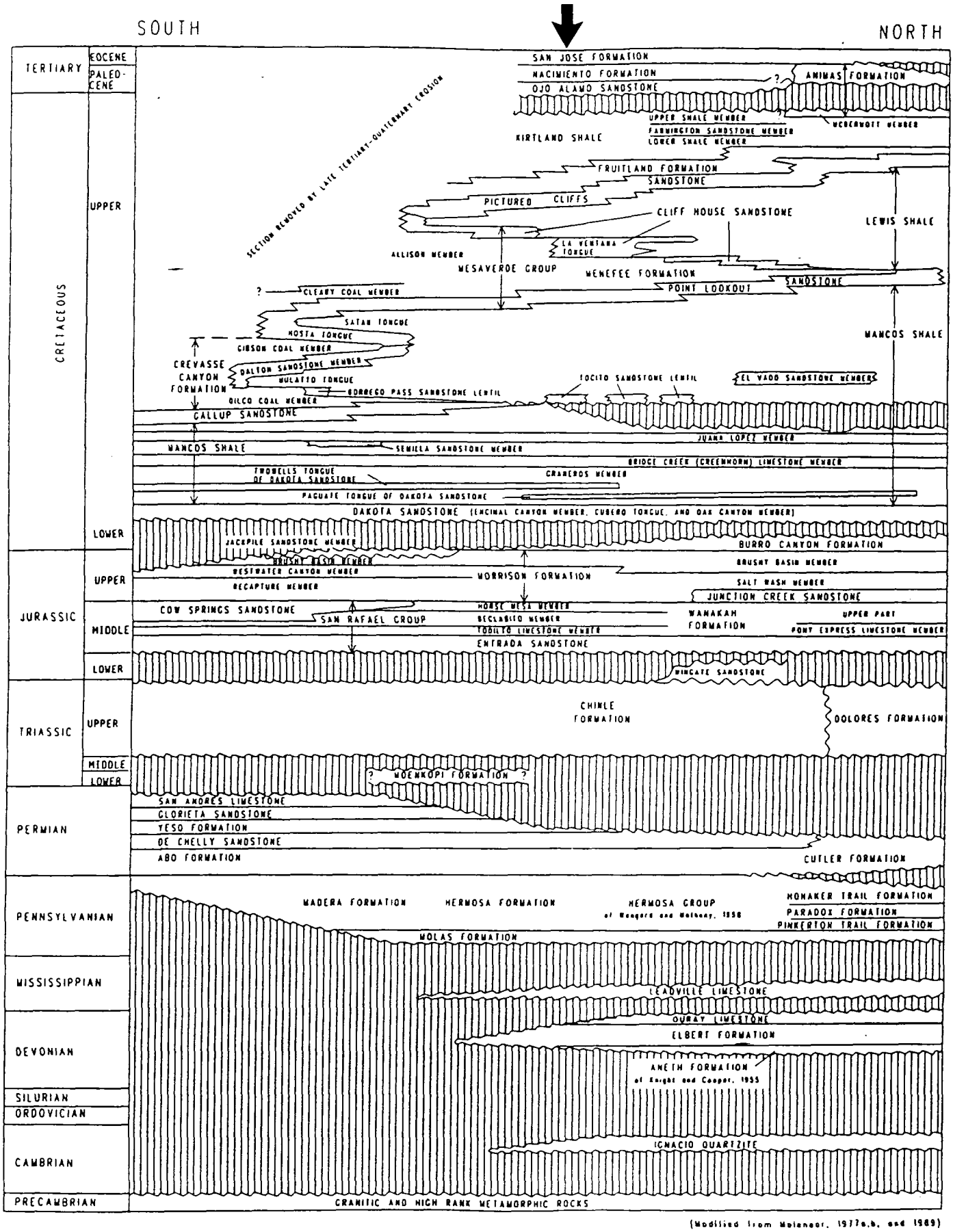
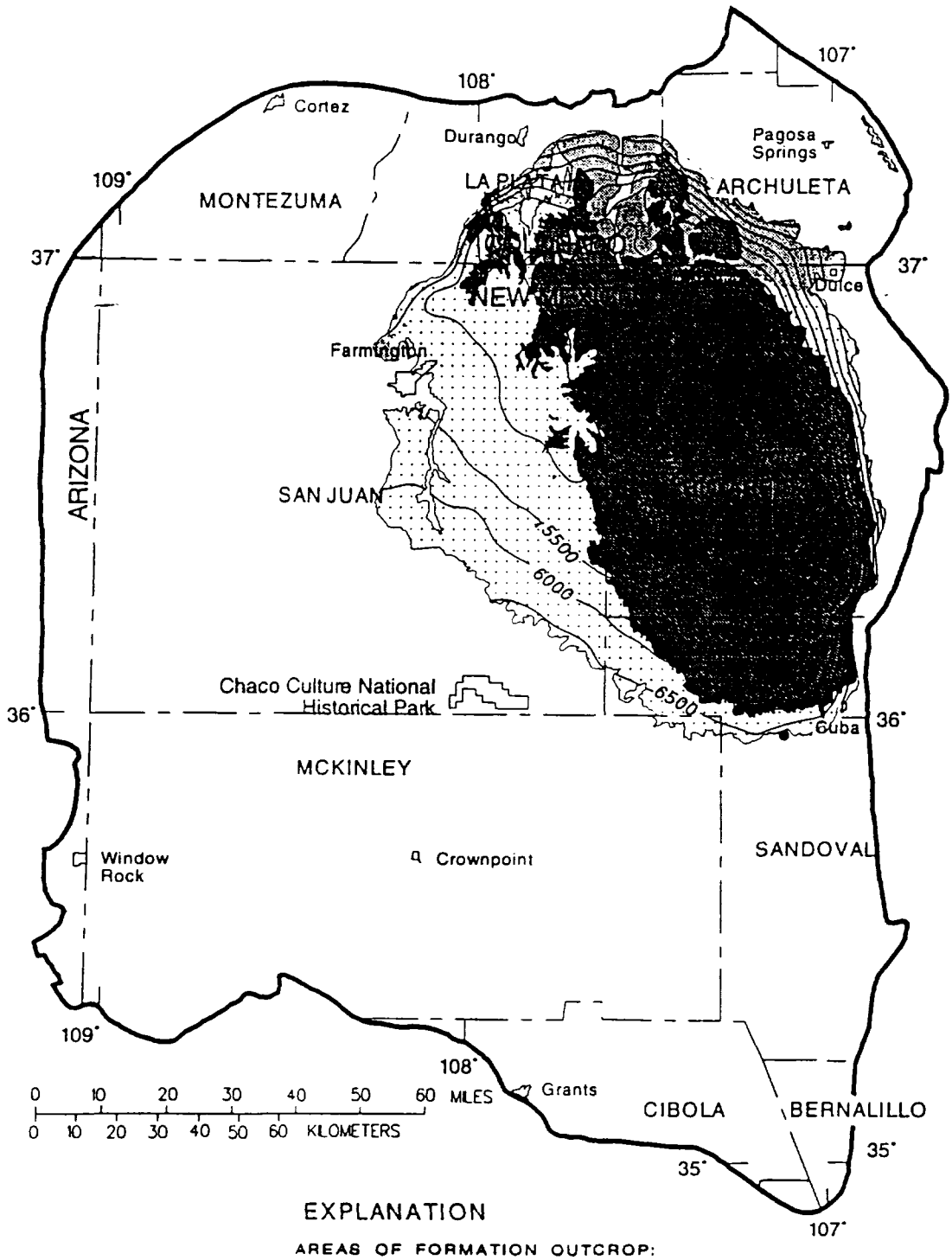
APPENDIX 1

FIGURES



(Modified from Molenaar, 1977a,b, and 1989)

Figure 5.--Time- and rock-stratigraphic framework and nomenclature.



EXPLANATION

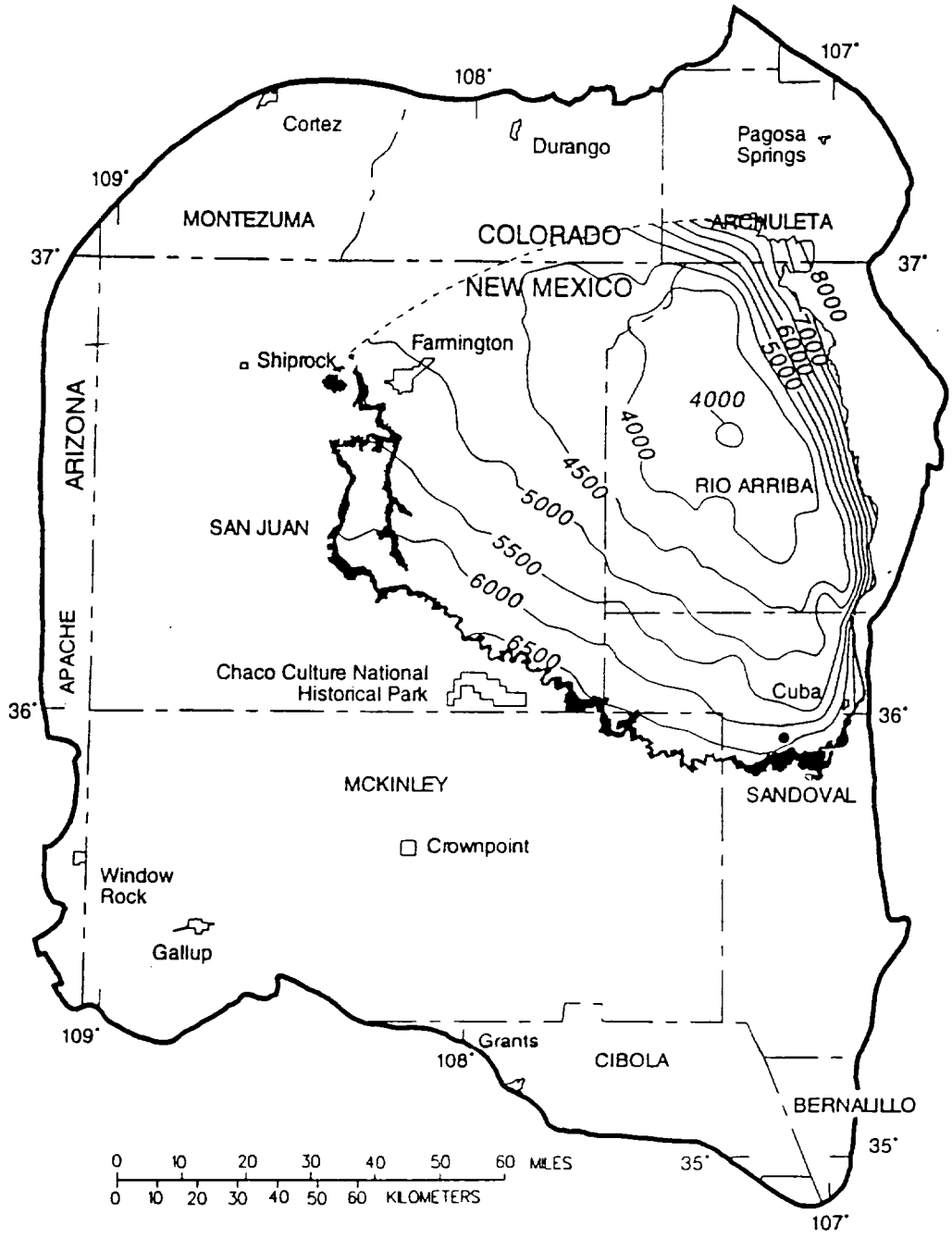
AREAS OF FORMATION OUTCROP:

- SAN JOSE FORMATION
- ANIMAS FORMATION
- NACIMIENTO FORMATION

5000 — LINE OF EQUAL ALTITUDE OF THE BASE OF THE ANIMAS AND NACIMIENTO FORMATIONS--Number indicates altitude, in feet. Contour interval 500 feet. Datum is sea level

STUDY AREA BOUNDARY

Figure 13.--Approximate altitude and configuration of the base of the Animas and Nacimiento Formations.



EXPLANATION

OUTCROP OF OJO ALAMO SANDSTONE

APPROXIMATE NORTHERN SUBSURFACE EXTENT OF THE OJO ALAMO SANDSTONE

6500 LINE OF EQUAL ALTITUDE OF THE TOP OF THE OJO ALAMO SANDSTONE--Number indicates altitude, in feet. Contour interval 500 feet. Datum is sea level

STUDY AREA BOUNDARY

Figure 15.--Approximate altitude and configuration of the top of the Ojo Alamo Sandstone.

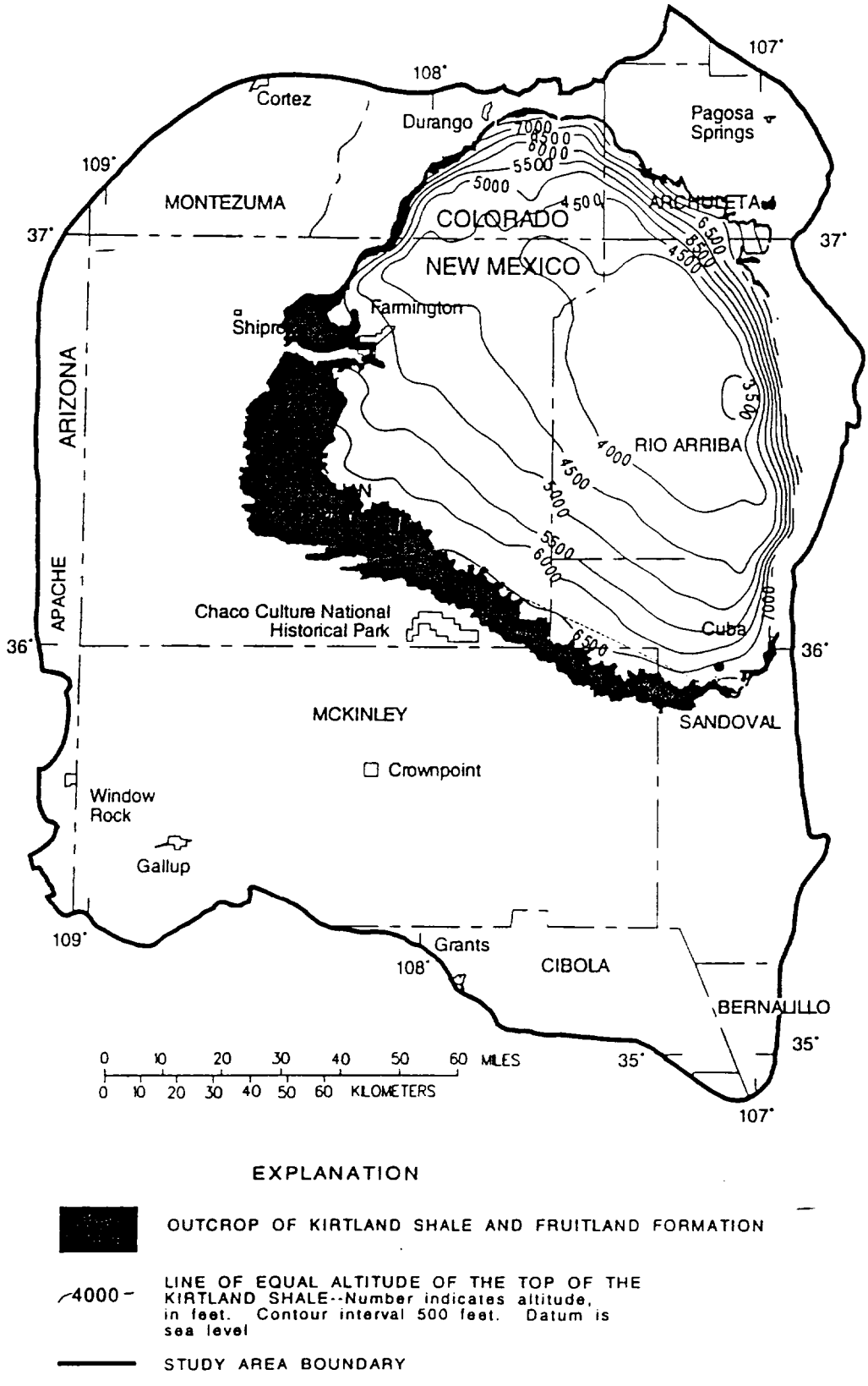
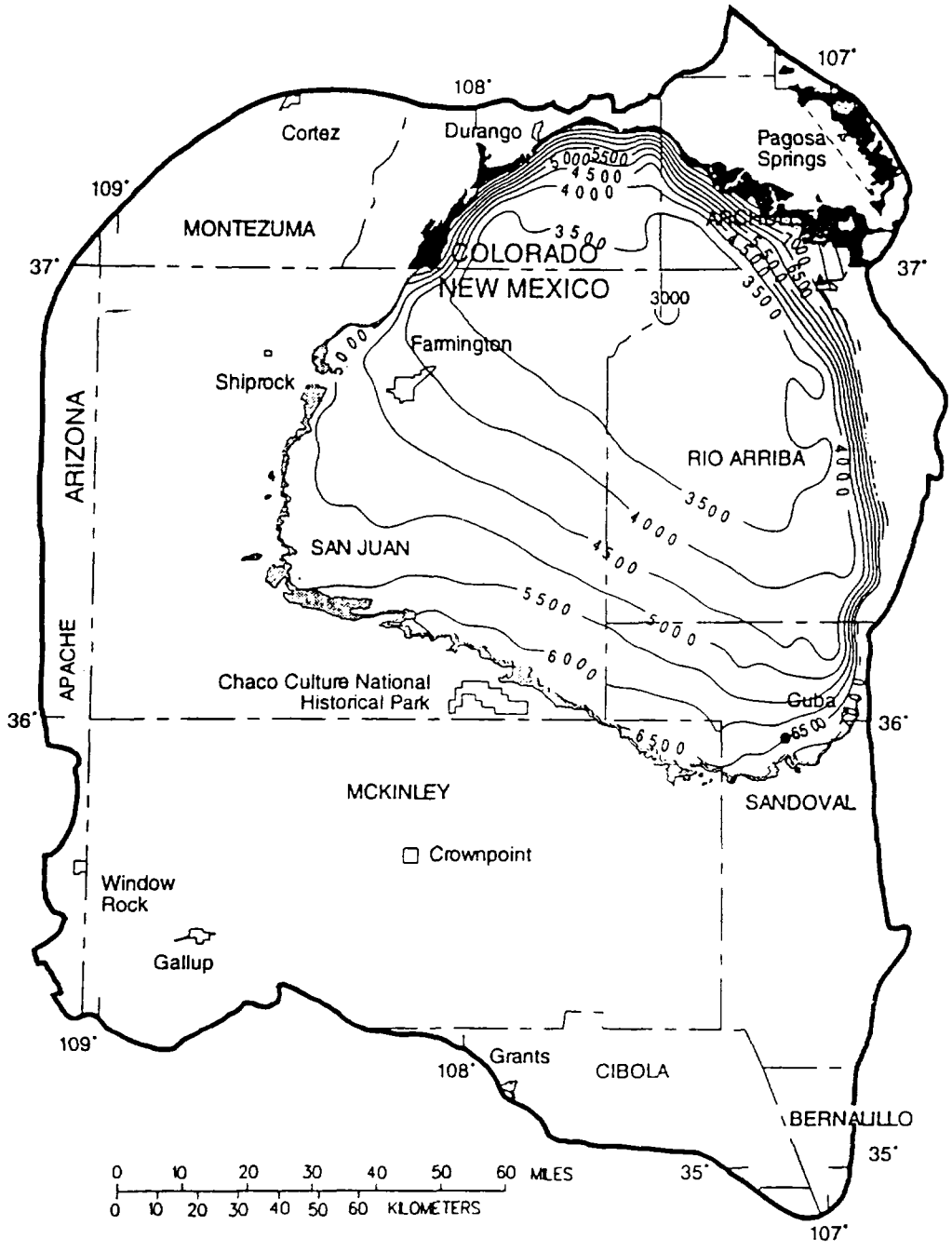


Figure 17.--Approximate altitude and configuration of the top of the Kirtland Shale.



EXPLANATION

AREAS OF FORMATION OUTCROP:

PICTURED CLIFFS SANDSTONE

PICTURED CLIFFS SANDSTONE AND LEWIS SHALE, UNDIVIDED

–6500– LINE OF EQUAL ALTITUDE OF THE TOP OF THE PICTURED CLIFFS SANDSTONE--Number indicates altitude, in feet. Contour interval 500 feet. Datum is sea level

STUDY AREA BOUNDARY

Figure 18.--Approximate altitude and configuration of the top of the Pictured Cliffs Sandstone.

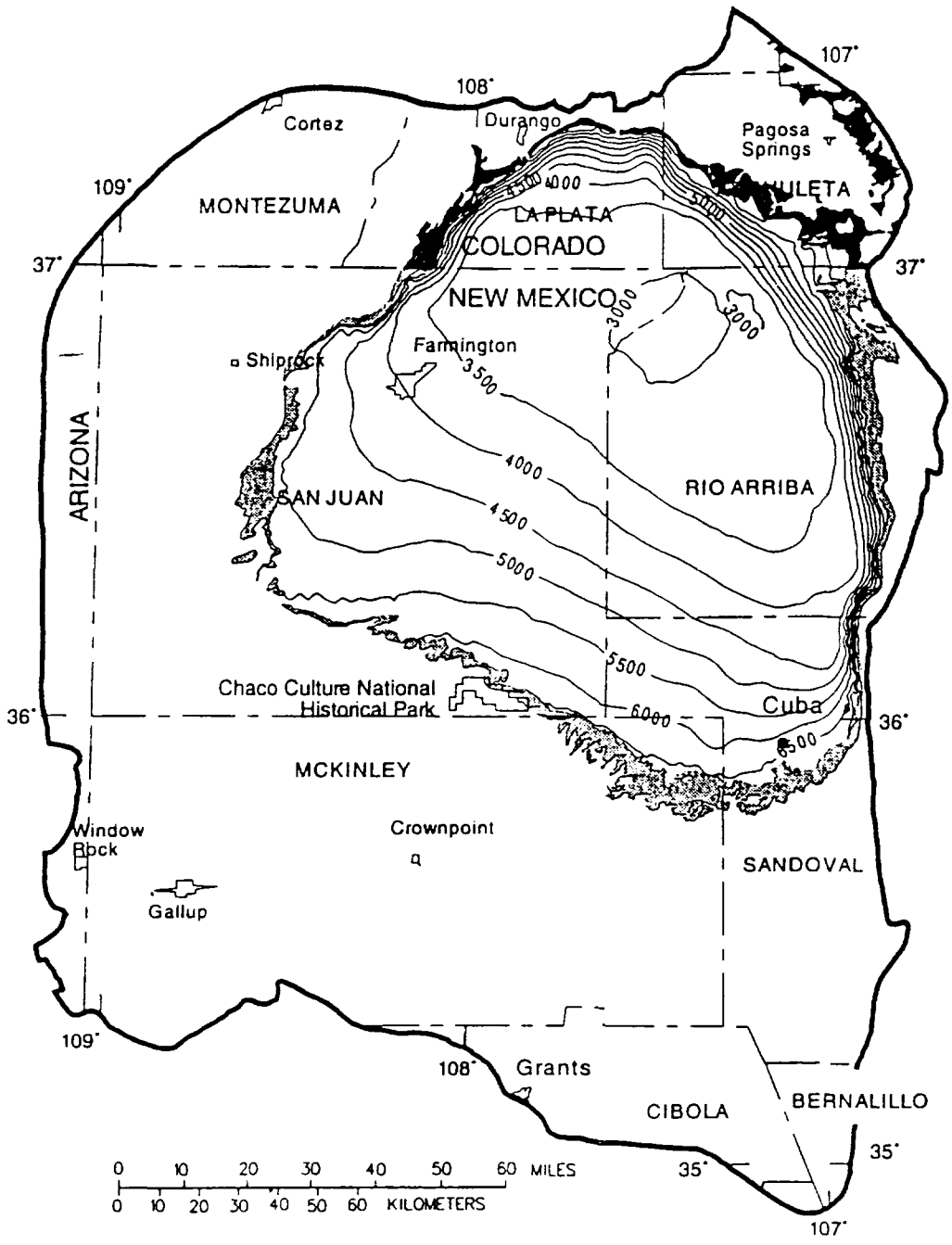


Figure 19.--Approximate altitude and configuration of the top of the Lewis Shale.

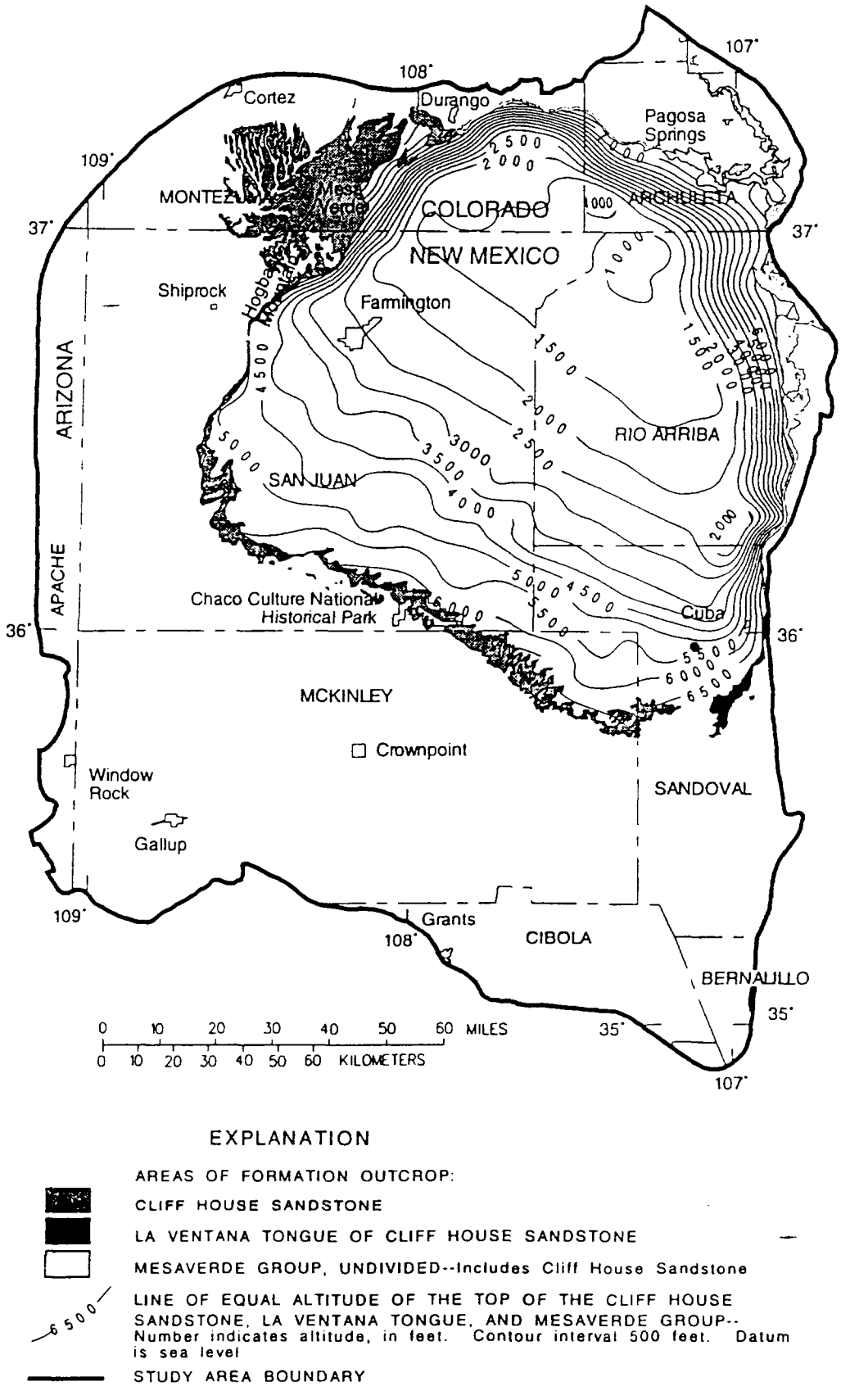


Figure 20.--Approximate altitude and configuration of the top of the Cliff House Sandstone.

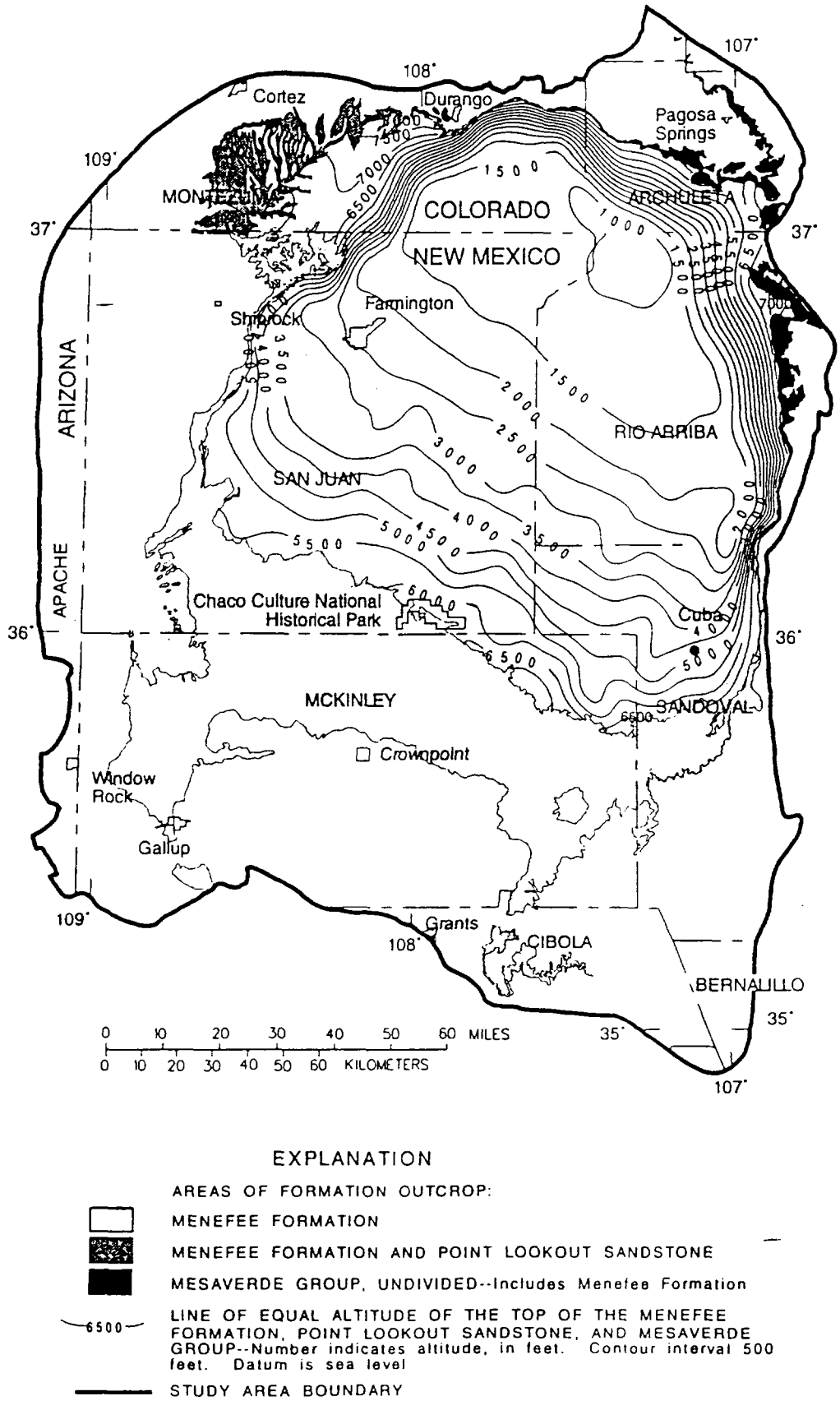


Figure 21.--Approximate altitude and configuration of the top of the Menefee Formation.

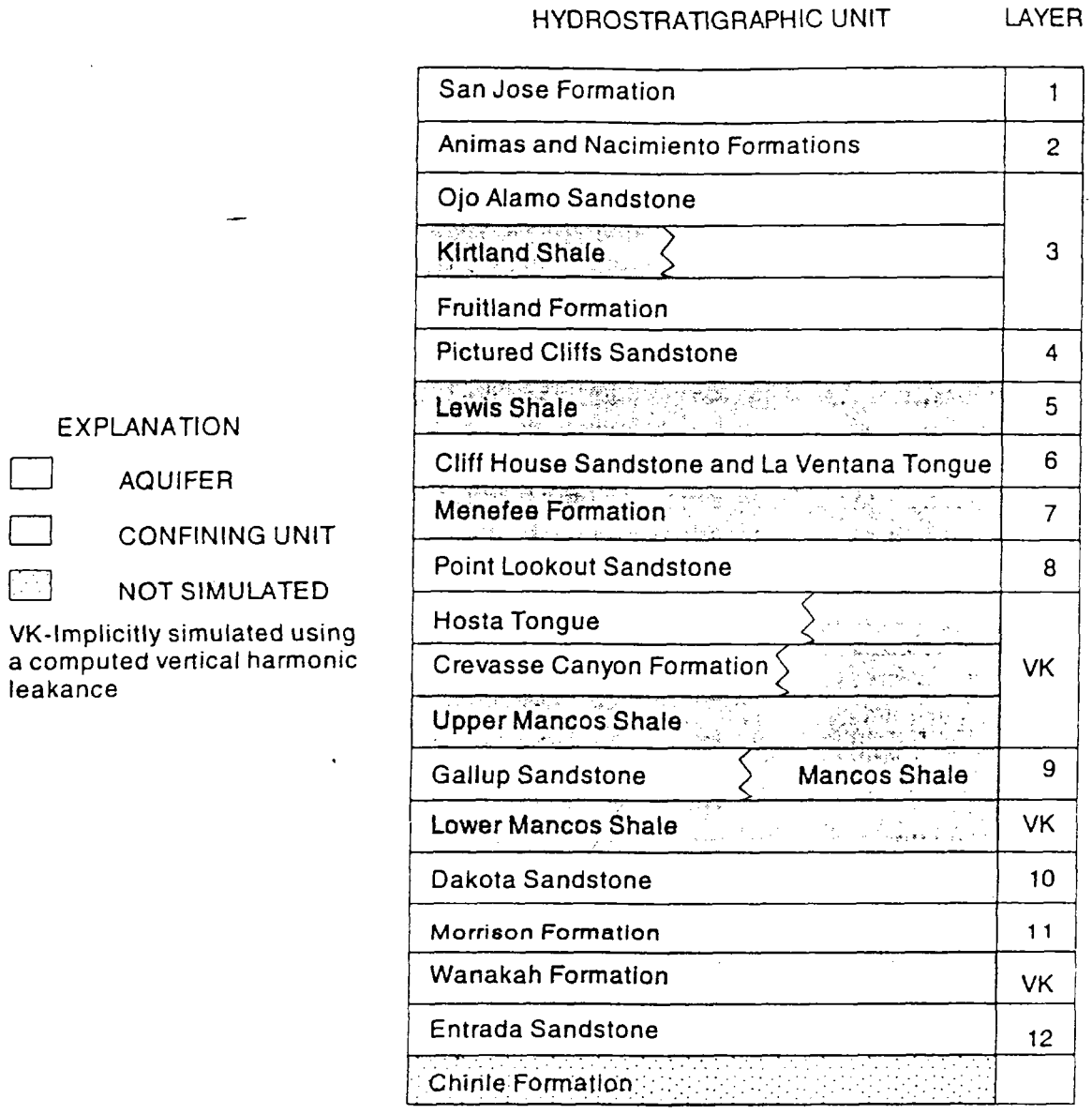
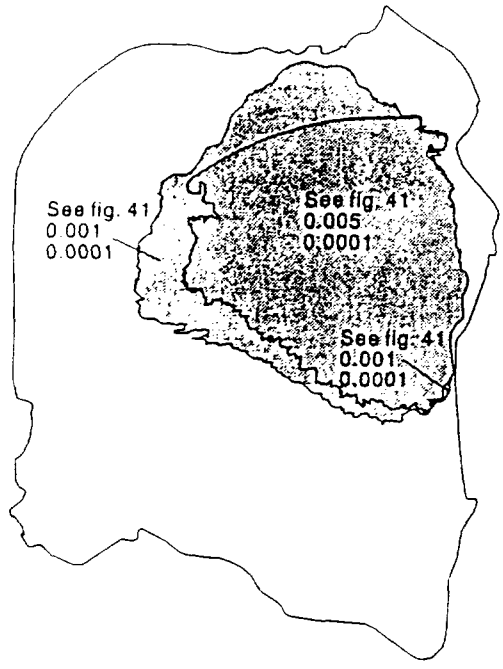
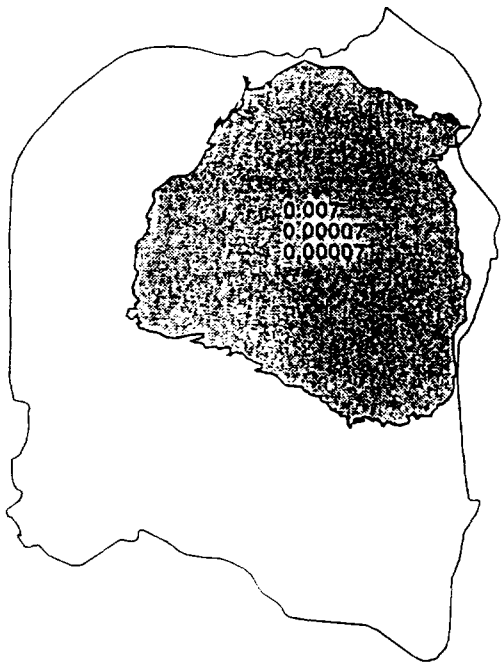


Figure 36.--Correlation of geologic units and model layers.

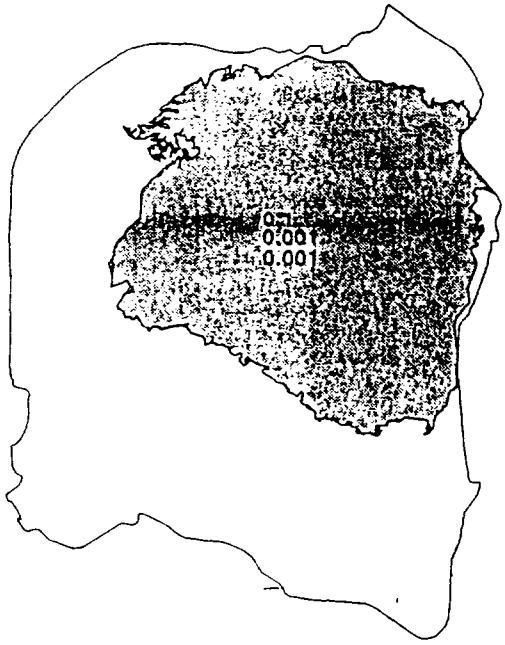


C. Simulated vertical hydraulic conductivities for the combined Ojo Alamo Sandstone, Kirtland Shale, and Fruitland Formation.



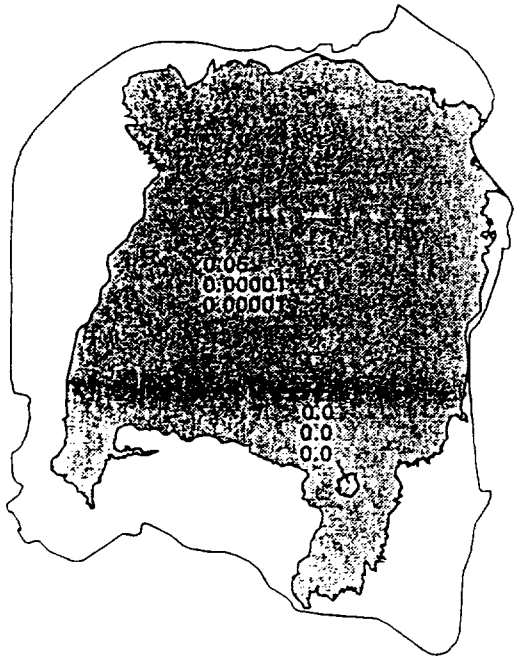
D. Simulated horizontal and vertical hydraulic conductivities for the Pictured Cliffs Sandstone.

E. Simulated horizontal and vertical hydraulic conductivities for the Lewis Shale

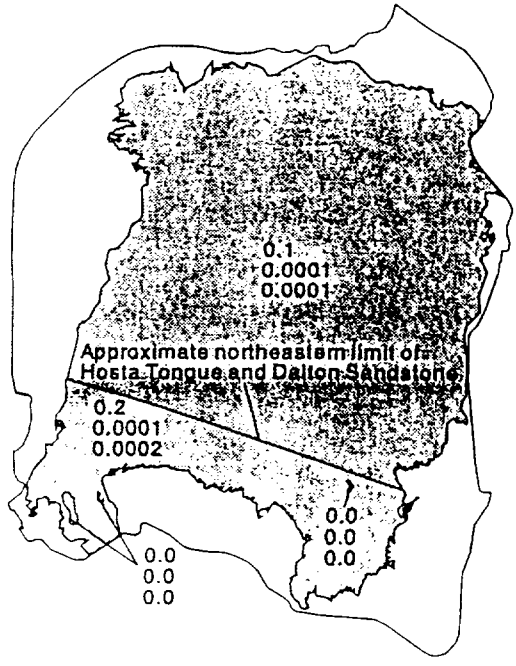


F. Simulated horizontal and vertical hydraulic conductivities for the Cliff House Sandstone

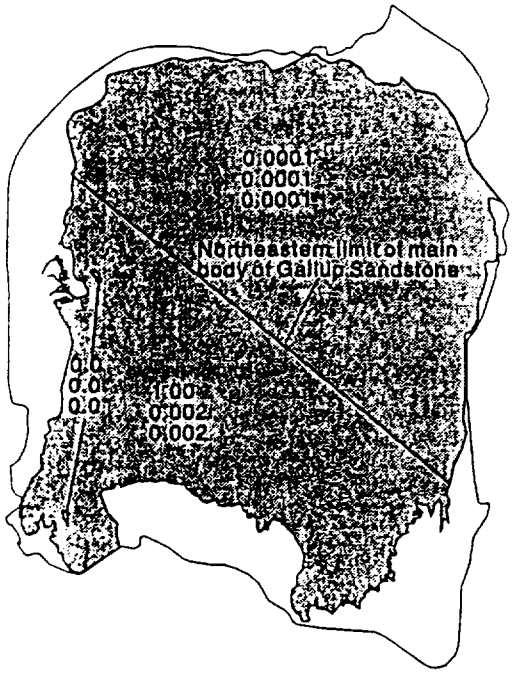
Figure 40.--Simulated horizontal and vertical hydraulic conductivities--Continued.



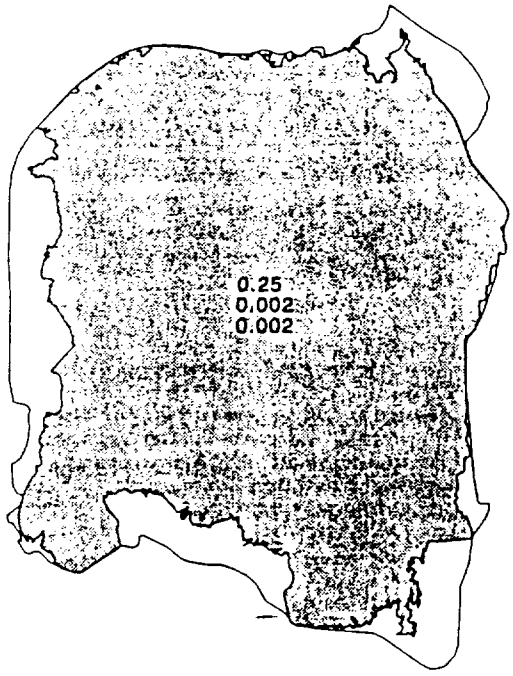
G. Simulated horizontal and vertical hydraulic conductivities for the Menefee Shale.



H. Simulated horizontal and vertical hydraulic conductivities for the Point Lookout Sandstone.



I. Simulated horizontal and vertical hydraulic conductivities for the Gallup Sandstone and Mancos Shale.



J. Simulated horizontal and vertical hydraulic conductivities for the Dakota Sandstone.

Figure 40.--Simulated horizontal and vertical hydraulic conductivities--Continued.

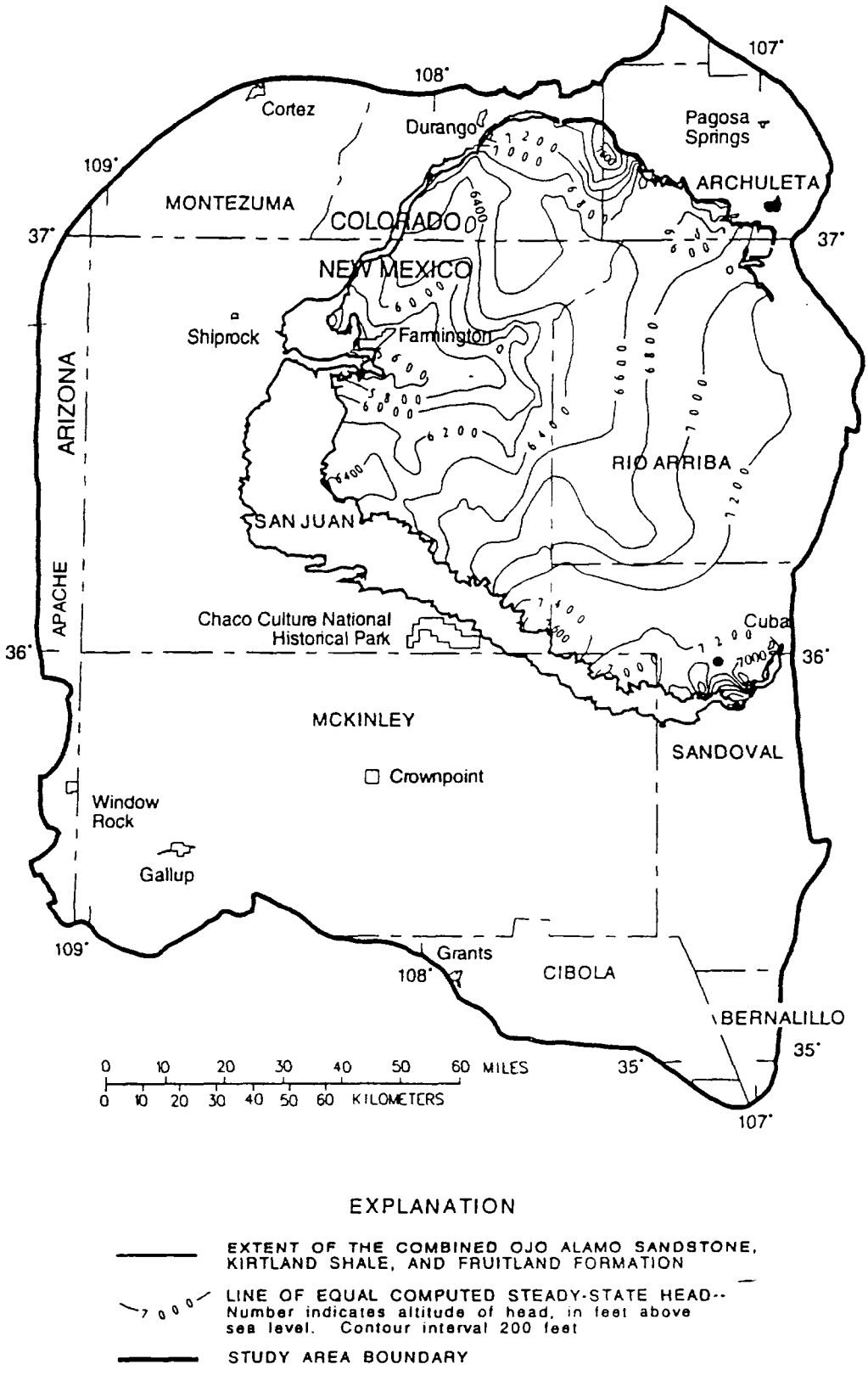
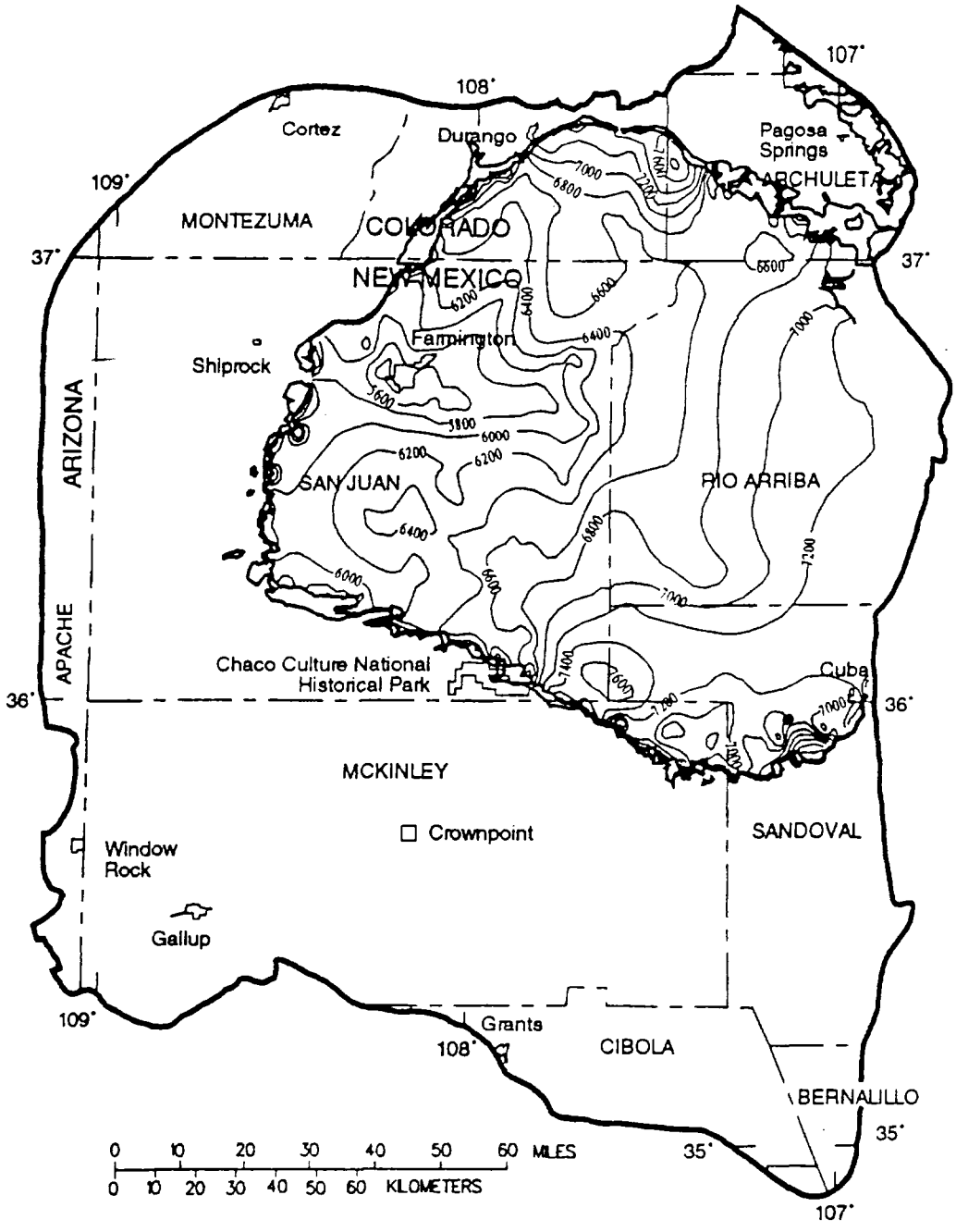


Figure 45.--Computed steady-state head in the combined Ojo Alamo Sandstone, Kirtland Shale, and Fruitland Formation.



EXPLANATION

EXTENT OF THE PICTURED CLIFFS SANDSTONE

7000 LINE OF EQUAL COMPUTED STEADY-STATE HEAD-- Number indicates altitude of head, in feet above sea level. Contour interval 200 feet

STUDY AREA BOUNDARY

Figure 46.--Computed steady-state head in the Pictured Cliffs Sandstone.

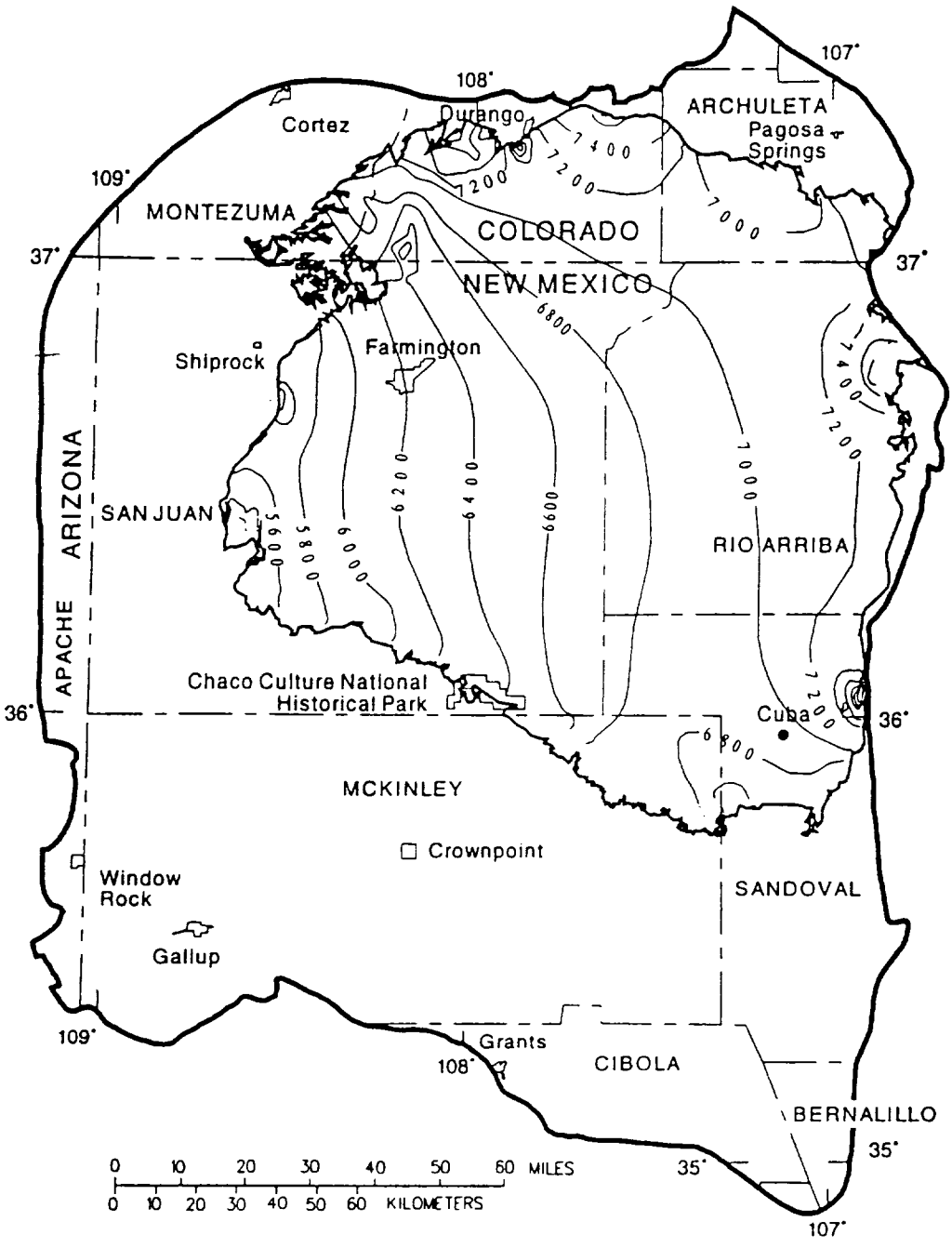


Figure 47.--Computed steady-state head in the Cliff House Sandstone.

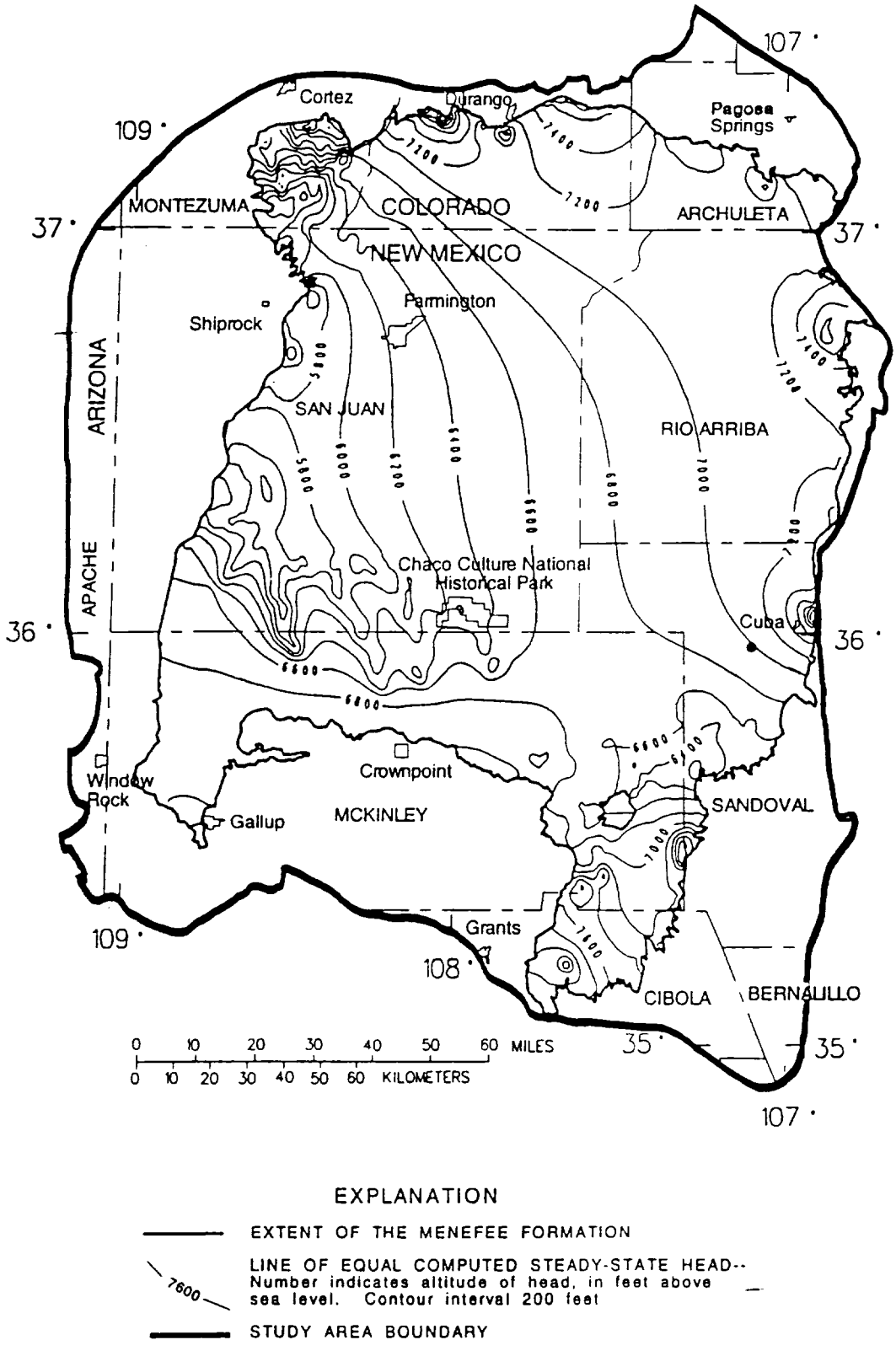


Figure 48.--Computed steady-state head in the Menefee Formation.

APPENDIX 2

RESULTS OF PETROLEUM INFORMFORMATION SERVICES SEARCH

Magellan (R) On-Line - Run Current Select
Counts for Historical Well Data -- Rocky Mountains

	Records Found	
Starting number of records	231,160	
Distance from API = "6 miles from API 3004320729"		
		94
Producing Formation Name among:		
NACIMIENTO (651NCMN)	0	
OJO ALAMO (604OJAM)	0	
SAN JOSE (652SNJS)	0	
KIRTLAND (604KRLD)	0	
All of the "FRUITLAND" matches	0	
All of the "PICTURED CLIFFS" matches	0	
LEWIS /SD/ (604LWIS)	0	
CLIFF HOUSE (604CLFH)	0	
MENEFEE (604MENF)	1	
POINT LOOKOUT (604PNLK)	0	
All of the "MANCOS" matches	22	
All of the "GALLUP" matches	32	
All of the "DAKOTA" matches	1	54

BEFORE THE NEW MEXICO OIL CONSERVATION DIVISION

APPLICATION OF PRIDE ENERGY COMPANY TO REOPEN ENERGY DEVELOPMENT CORPORATION'S CASE NO. 11470 FOR SALT WATER DISPOSAL AND DESIGNATION OF A PORTION OF THE MENEFEE MEMBER OF THE MESAVERDE FORMATION AS AN "EXEMPTED AQUIFER," SANDOVAL COUNTY, NEW MEXICO.

Case No. 11470 (Reopened)

AFFIDAVIT REGARDING NOTICE

STATE OF NEW MEXICO)
COUNTY OF SANTA FE) ss.

James Bruce, being duly sworn upon his oath, deposes and states:

1. I am over the age of 18, and have personal knowledge of the matters set forth herein.

2. I am an attorney for Applicant.

3. Applicant has conducted a good faith, diligent effort to find the names and correct addresses of the interest owners entitled to receive notice of the Application filed herein.

4. Notice of the Application was provided to the interest owner at its correct address by mailing it a copy of the Application, by certified mail. Copies of the notice letter and certified return receipt are attached hereto as Exhibit A.

5. Applicant has complied with the notice provisions of Division Rule 1207.

James Bruce

James Bruce

SUBSCRIBED AND SWORN TO before me this 4th day of ~~January~~ March, 1997, by James Bruce.

My Commission Expires:

NOTARY PUBLIC

NEW MEXICO
OIL CONSERVATION DIVISION
Pride EXHIBIT 12
CASE NO. 11470 (Reopened)

JAMES BRUCE
ATTORNEY AT LAW

POST OFFICE BOX 1056
SANTA FE, NEW MEXICO 87504

SUITE B
612 OLD SANTA FE TRAIL
SANTA FE, NEW MEXICO 87501

(505) 982-2043
(505) 982-2151 (FAX)

February 11, 1997

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Bureau of Land Management
Albuquerque District Office
435 Montaño N.E.
Albuquerque, New Mexico 87107

Attn: Robert Kent

Dear Sirs:

Pride Energy Company has filed an application at the New Mexico Oil Conservation Division to reopen Case No. 11470 in order to submit additional evidence regarding its request to inject produced water into the San Isidro (Shallow) Unit Well No. 7-11, located in the NE¼SW¼ of Section 7, Township 20 North, Range 2 West, NMPM, Sandoval County, New Mexico. A copy of the advertisement for the case is attached hereto. This application will be heard at 8:15 a.m. on Thursday, March 6, 1997 at the Division's offices at 2040 South Pacheco Street, Santa Fe, New Mexico. As an interested party, you have the right to enter an appearance and participate in the hearing. Failure to appear at that time will preclude you from contesting this matter at a later date.

Very truly yours,

James Bruce

James Bruce

Attorney for Pride
Energy Company

P 551 049 3[illegible]

US Postal Service
Receipt for Certified Mail
No Insurance Coverage Provided.
Do not use for International Mail (See reverse)

Sent to: Bureau of Land Mgt	
Street & Number: 435 Montano, NE	
Post Office, State, & ZIP Code: Albuquerque, NM 87107	
Postage	$ .32
Certified Fee	1.10
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	1.10
Return Receipt Showing to Whom, Date, & Addressee's Address	
TOTAL Postage & Fees	$ 2.52
Postmark or Date	SANTA FE NM FEB 11 1997

PS Form 3800, April 1995

EXHIBIT A

Case No. 11470 (Reopened)

Application of Pride Energy Company
to Reopen Energy Development Corporation's
Case No. 11470 for Salt Water Disposal
and Designation of a Portion of the Menefee
Member of the Mesaverde formation as an
"Exempted Aquifer", Sandoval County,
New Mexico.

Applicant, being the successor operator to Energy Development Corporation within the San Isidro (Shallow) Unit, seeks to reopen Case No. 11470 which was heard by the Division on March 21 and May 2, 1996, to present additional technical evidence in its application for authority to inject produced water into the Menefee interval through perforations from 2,438 feet to 2,624 feet in its existing San Isidro (Shallow) Unit Well No. 7-11, located 2074 feet from the South line and 1650 feet from the West line (Unit K) of Section 7, Township 20 North, Range 2 West. Applicant also seeks to designate the Menefee interval underlying the W/2 E/2 and W/2 of Section 7 and the N/2 NW/4 of Section 18, Township 20 North, Range 2 West, and the E/2 E/2 of Section 12, Township 20 North, Range 3 West, as an "Exempted Aquifer"pursuant to Division Rule No. 701.E. and applicable Federal Underground Injection Control Program Rules and Regulations, as contained within the Code of Federal Regulations, 40 CFR Parts 145 and 146, thereby enabling the injection of produced water, for purpose of disposal, into said interval. Said area is located approximately 8 miles southwest of Cuba, New Mexico.

Is your RETURN ADDRESS completed on the reverse side?

SENDER:

- Complete items 1 and for additional services.
- Complete items 3, 4a, 4b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "*Return Receipt Requested*" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):

1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:

BUREAU OF LAND MANAGEMENT
ALBUQUERQUE DISTRICT OFFICE
435 MONTANO, NE
ALBUQUERQUE, NEW MEXICO
87107

4a. Article Number
P 551 049 304

4b. Service Type

- ☐ Registered
- ☒ Certified
- ☐ Express Mail
- ☐ Insured
- ☒ Return Receipt for Merchandise
- ☐ COD

7. Date of Delivery

5. Received By: *(Print Name)*

8. Addressee's Address *(Only if requested and fee is paid)*

6. Signature: *(Addressee or Agent)*
X Millie Chapin

PS Form **3811**, December 1994 Domestic Return Receipt

Thank you for using Return Receipt Service.