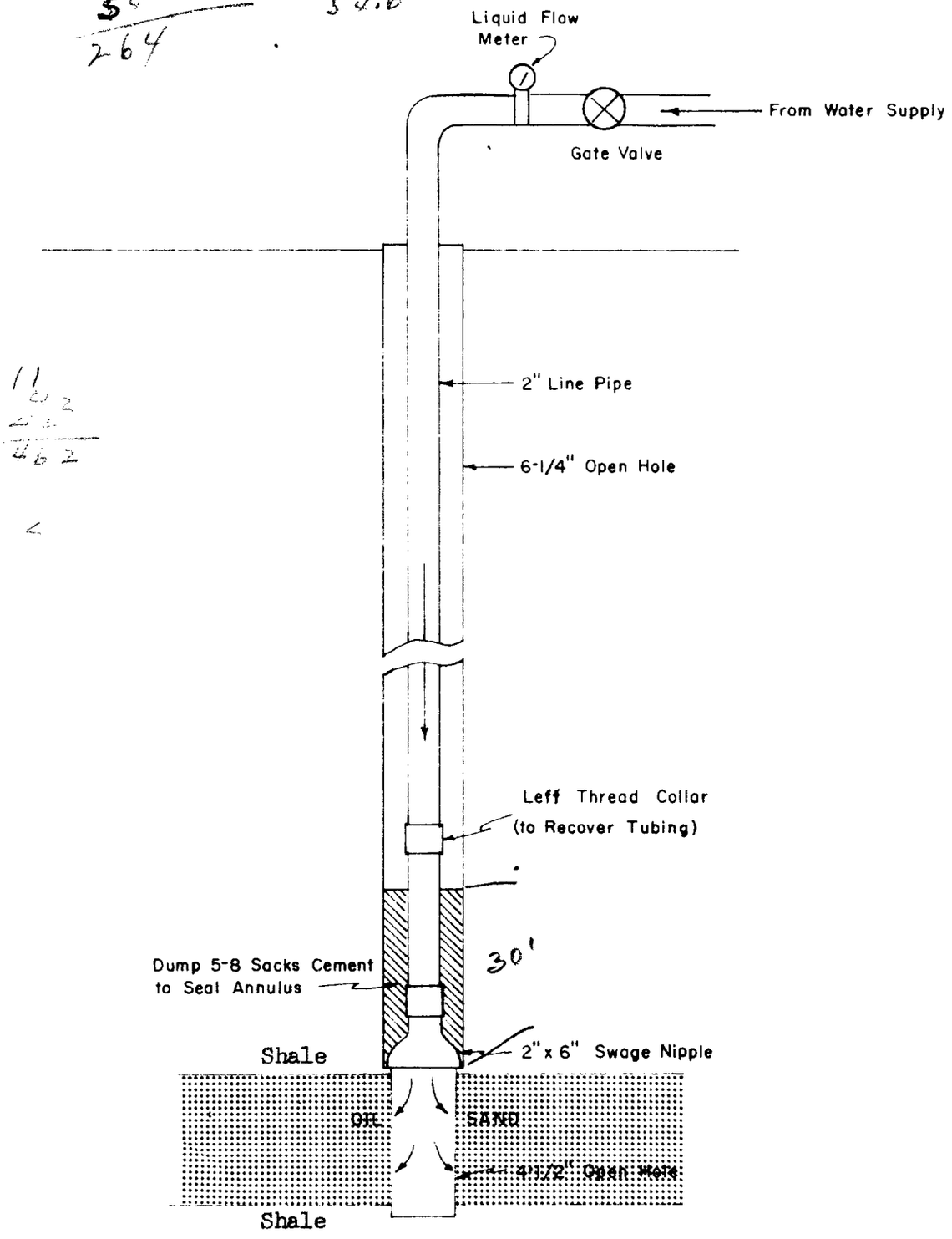
N.M.O.C.C. Case Exhibit



CHACO OIL COMPANY

Typical Water Injection Well Completion Method

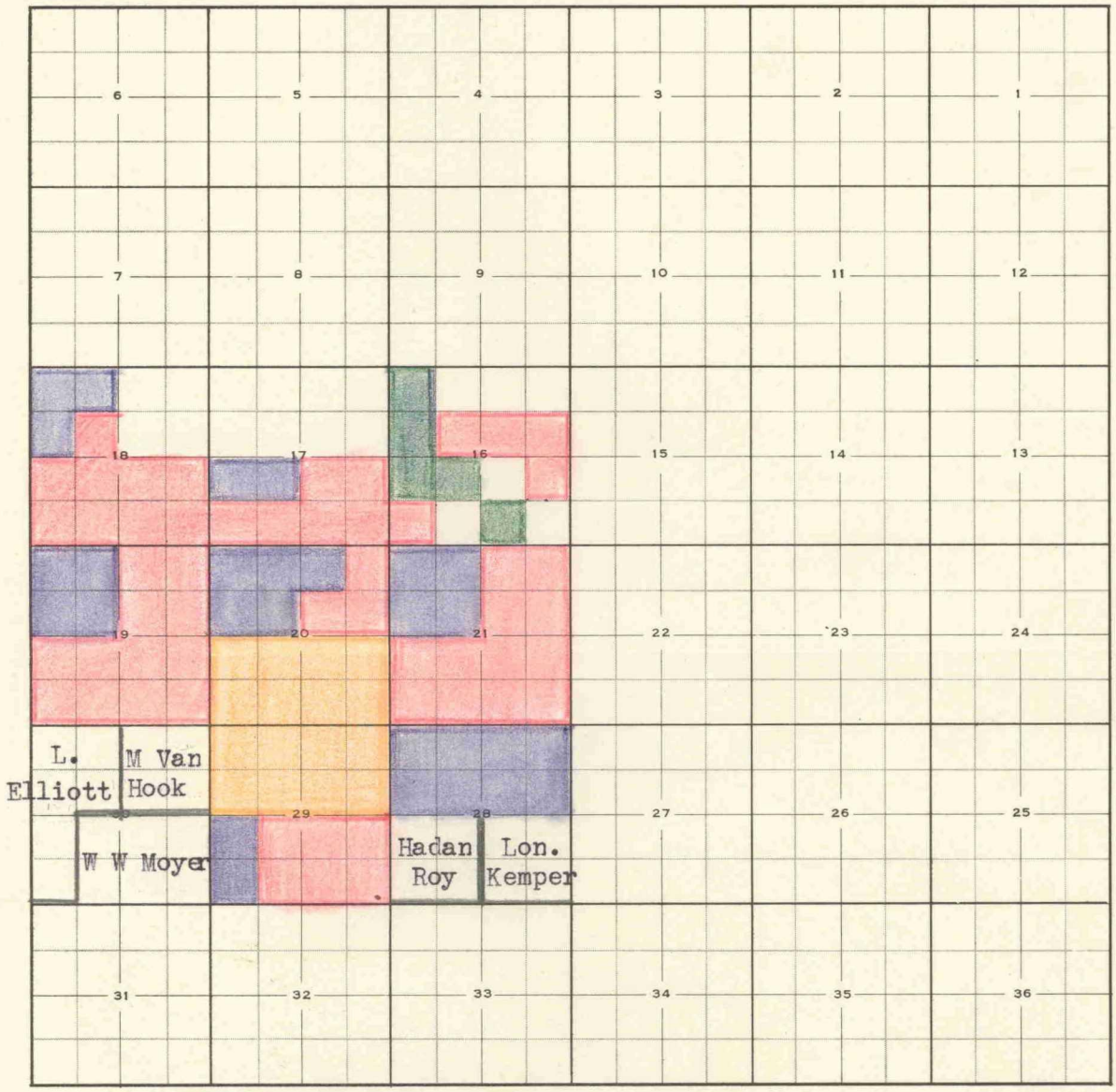
Red Mountain Secondary Recovery Program

Kardex 892 ROSS-MARTIN CO. TULSA 1, OKLAHOMA TOWNSHIP PLAT (SCALE 1 IN.—1 MI.)

TOWNSHIP 20 N. RANGE 9 W. COUNTY McKinley STATE New Mexico

REMARKS: Ownership Plat showing offset operators to proposed Chaco Oil Company water injection program

COMPANY
CHACO OIL COMPANY



KEY:
- Sinclair Oil & Gas Co.
- Santa Fe Pacific Railroad Co.
- CHACO OIL COMPANY
- Sun Oil Company

N. M. O. C. C. Case 1805:
Application of Chaco Oil Company
for a Peripheral Water Flood Project
in the Red Mountain Pool
Township 20 North, Range 9 West
McKinley County, New Mexico

BEFORE EXAMINER UTZ
OIL CONSERVATION COMMISSION
EXHIBIT NO. 5
CASE NO. 1805

Henry S. Birdseye
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N. M. O. C. C. CASE 1805:
APPLICATION OF CHACO OIL COMPANY FOR A PERIPHERAL WATER FLOOD PROJECT IN THE RED MOUNTAIN POOL, TOWNSHIP 20 NORTH, RANGE 9 WEST, McKINLEY COUNTY, NEW MEXICO

INTRODUCTION

Location

The Red Mountain Field is located in Sections 20 and 29, Township 20 North, Range 9 West, in northern McKinley County, New Mexico. The field is 55 airline miles north of Grants, 50 air miles west of Cuba, 57 air miles south-southeast of Farmington, and 93 air miles northwest of Albuquerque.

Access

The field is reached via 59 miles of dirt road from U. S. Highway 66 at Prewitt, New Mexico, or by 41 miles of dirt road from a point on State Road 44 which is 34 miles west of Cuba. A 3,000-foot dirt landing strip one mile west of the field is satisfactory for light airplanes.

HISTORY

Production was discovered on the Red Mountain structure by the Stacey, Webber et al #1 Santa Fe in Section 29, T. 20 N., R. 9 W., in June, 1934. The discovery well was completed for a reported daily potential of five barrels of oil per day from a Mesaverde sand at 475-498 feet. During the next three years approximately 25 wells were drilled, of which seven were reported productive. State records indicate cumulative production in excess of 26,000 barrels of 39° gravity oil through October, 1959. However, since the field was discovered prior to the establishment of the Oil Conservation

Commission, production and technical data now available are incomplete. The productive area of the field, now covered by a lease from the Santa Fe Pacific Railroad Company on the south half of Section 20 and the north half of Section 29, has changed hands intermittently since the field discovery. In 1955 this lease was assigned to Ben and Celia Sapir. In November, 1957, operation of the lease was assumed by Chaco Oil Company, a joint venture of Ben Sapir and Henry S. Birdseye.

In July, 1958, Chaco Oil Company drilled a Morrison test in the southeast quarter of Section 20. Bottomed at a total depth of 3936 feet, this well was plugged and abandoned after encountering gas-cut salt water in the Dakota formation. However, of great significance to the projected waterflood program was the recovery of 40 barrels per hour of slightly brackish water on a drill-stem test of the lower one-half of the Hospah formation (about 2700 feet) and 50 barrels per hour of water from about 15 percent of the Gallup formation (about 2800 feet). This artesian flow showed surface pressure of about 100 pounds per square inch, extrapolated from the shut-in pressure.

A series of ten stratigraphic holes from 200 to 300 feet deep was drilled in the early part of 1958, and served to established subsurface control for the delineation of the structure, as shown in Exhibit 2.

In January and February, 1959, four new wells were drilled to the oil sand at an average depth of 450 feet. Each of these wells was cored in the pay section, recovering from $5\frac{1}{2}$ feet to 18 feet of saturated sandstone with high porosity (about 25%) and permeability (averaging 341 millidarcies). For financial reasons, completion was attempted on only one of these new wells. It was found that reservoir pressure was insufficient to produce the

oil known to be in place.

GEOLOGIC SETTING

Physiography

The Red Mountain structure is situated in a broad strike valley in shale members of the Mesaverde formation some two miles south of the escarpment known as Chacra Mesa, which is capped by the uppermost member of the Mesaverde Group, the Cliff House sandstone. Topographic relief in this portion of the San Juan Basin is generally slight, interrupted by occasional buttes capped by erosion-resistant sandstone beds. Such a butte lies just south of the Red Mountain field, rising to an elevation of about 6700 feet, some 350 feet higher than the field area itself.

Structure

In a regional sense, the Red Mountain field is on the Chaco Slope between the Zuni Uplift to the south and the San Juan Basin to the north. Regional dip is to the northeast at an average of about 100 feet per mile. On the south flank of the San Juan Basin, local structure reversal has played an important role in the accumulation of oil at the Hospah field, which has produced more than $3\frac{1}{2}$ million barrels of oil from an area of about 400 acres on a small north-trending, faulted anticline. Various other small structures in this area have been drilled with negative results, probably because of unfavorable stratigraphic and hydrodynamic conditions. The Red Mountain structure has been mapped by personnel of the U. S. Geological Survey as an anticline within a wedge-shaped down-dropped fault block. However, it is apparent that structural reversal is present aside from fault closure, possibly accentuating a fault trap.

Stratigraphy

Surface exposures at Red Mountain are of the Menefee formation of the Mesaverde Group. The uppermost beds of the Menefee formation and the entire Cliff House Formation have been removed by erosion. The approximate stratigraphic section (through the Permian only) at this locality is as follows:

PERIOD	FORMATION	DEPTH TO TOP
Upper Cretaceous	Menefee formation	Surface
	Point Lookout ss.	1650'
	Crevasse Canyon fm.	1760'
	Hospah sandstone	2690'
	Gallup sandstone	2750'
	Lower Mancos shale	2860'
	Dakota sandstone	3710'
Jurassic	Morrison formation	3920'
	Entrada sandstone	4985'
Triassic	Chinle shale	5200'
	Moenkopi formation	6100'
Permian	Glorieta	6365'
	Yeso	6520'

FACTORS AFFECTING HYDROCARBON ACCUMULATION

While the majority of oil and gas fields to the north in the San Juan Basin are controlled almost entirely by lateral variations in porosity and permeability, production on the south flank of the Basin, as at Stoney Butte, Red Mountain, and Hospah, is dominantly controlled by structural features, with minor control by lenticularity of producing sands. Extensive wildcat drilling by various operators to the north, east, south, and west of Red

Mountain has failed to establish production where structure is absent, even though lenticularity of porosity and permeability may be present. This is probably the result of excessive water saturations due to the proximity of recharging outcrops to the south. The only examples of stratigraphic entrapment in this area are at Seven Lakes, 14 miles southwest of Red Mountain, and in the Torreon area, some 20 miles east of Red Mountain, where lenticularity has permitted the segregation of minor quantities of oil independent of structure. Thus, exploration has rather clearly established that structural closure, by either faulting or folding or both, is important to commercial oil accumulations within a few tens of miles of the outcrops on the south flank of the San Juan Basin. Vertical closure in the important Hospah field is at least 100 feet. The amount of closure on the Red Mountain structure is not yet known; however, it is considered possible that upwards of 50 feet of closure may be established as a result of future development. Rather sparse subsurface control has shown continuity in the Menefee producing zone. An attempt has been made to estimate the area of primary depletion during the production of some 26,000 barrels of oil to date. As shown on Exhibit 2, the depleted area of about 14 acres lies northwest (down-dip) from the axis of the nosing or dome. This is probably the result of a tilted water table, due to the hydrodynamic potential of the recharging outcrops to the south.

FEASIBILITY OF A SECONDARY RECOVERY PROGRAM

Production of oil from the "450-foot" zone at Red Mountain has totalled about 26,000 barrels to date. Four wells are now productive, with a combined daily capacity of about eight barrels, which is barely adequate to pay the costs of operating the property. In view of geological and engineering data

acquired during the past two years by Chaco Oil Company, it is now apparent that a profitable operation at Red Mountain will ensue only as a result of repressuring and flushing the producing zone by a water-flooding program. The reasons for anticipating success by such a secondary recovery program are as follows:

(1) Reservoir Drive: the quantity of gas produced with oil at present is so slight as to be unmeasureable. It is evident from the amounts of water produced with oil in the various wells, and from the low fluid fill-up in the wells (averaging less than 50 feet), that the only drive mechanism in the reservoir is a very low pressure water drive. By injecting water from the supply well in the southeast quarter of Section 20, even the hydrostatic head of 450 feet would bring about 200 pounds per square inch to bear on the sand in the vicinity of the injection wells. The repressuring effect on a well-planned peripheral injection program should be ample in forcing the migration of the remaining oil to interior producing locations.

(2) Remaining Recoverable Oil Reserves: as shown on appendix page A-3 of this report, it is possible that as little as 15% of the recoverable oil in the Red Mountain field has been produced to date. That is, using known data from core analyses it is calculated that about 170,000 barrels of oil should be recoverable from an assumed productive area of 40 acres, and of this reserve only 25,569 barrels was produced through 1958, leaving a remaining recoverable reserve under secondary recovery of about 144,000 barrels.

(3) Physical Feasibility of Water-Flooding: porosity and permeability of the pay zone, as found in 25 core analyses from the four wells cored in

January and February, 1959, are sufficiently high and uniform that the reservoir sandstone should yield well to flushing by water-flooding. (See Core Analyses, Page A-8). While it was not possible to preserve the cores by freezing for connate water and oil saturation determinations, the past performance of the field, in which most of the wells produced clean oil with only minor amounts of water, indicates that connate water saturations are low enough to permit migration of essentially clean oil.

(4) Projected Development of Water-Flood: on Exhibit 2, the Structural Map of the Red Mountain Field, there is shown the apparent (primary) depleted area of the reservoir, the additional area which may be expected to yield to flooding, and the proposed locations of eleven injection wells. In order not to by-pass an appreciable quantity of oil around the periphery of the field, it is planned that the injection wells be situated an average of 500 feet from the nearest producing well. As Exhibit 2 shows, the injection wells will be spaced from 400 to 700 feet apart, distances which should establish a continuous flood front within 120 days after injection commences. At the injection points where the stratigraphic test holes are not available for deepening, it will be necessary to drill new wells to the 450-foot pay sand. After logging, two-inch line pipe will be run to a shoulder at the top of the pay zone, with a two-inch by six-inch swage nipple cemented immediately above the injection zone to prevent loss of injection water. (See Exhibit 3).

The water supply well will be the deep well located 660 feet from the south and east lines of Section 20, approximately 1300 feet from the center of the field. (See Page A-10). The basic requirements for injection water are: (1) Available in adequate quantities as needed, (2) free from silt or

other suspended material, and (3) chemically stable and inactive with respect to compounds and elements present in the reservoir.

Availability of injection water. The water supply well, Chaco Oil #20-1 Santa Fe, produced artesian water at the rate of 90 barrels per hour on two drill-stem tests which included only 50 feet of the 196 feet of water sand present. It is reasonable to extrapolate that when the entire Hospah and Gallup water sand intervals are completed for production, the well should have a capacity of more than 300 barrels per hour, or over 7,000 barrels of artesian water per day. Applying porosity of 24 percent for the Hospah and Gallup sands as determined by Sinclair Oil & Gas Company in wildcat wells near Red Mountain, and using a sand thickness of 200 feet as found in the Chaco Oil #20-1 well, the calculated water in place in the Hospah and Gallup water sands amounts to 372,000 barrels per acre. The rule of thumb used to approximate the quantity of water required to flood a given property is to multiply the reservoir pore volume in barrels by $1\frac{1}{2}$. Roughly half of this quantity will be available as produced water, while the other half must be supplied from an outside source. Since the total reservoir pore volume in the Red Moutain Menefee pool is calculated at 896,049 barrels, the above rule indicates that about 672,000 barrels of injection water will ultimately be needed for the flood. The virtually inexhaustible water supply will clearly be more than adequate for the proposed edgewater or peripheral flood. It is pertinent to point out here, that an artesian Hospah-Gallup water well ten miles west of Red Mountain has been flowing an estimated 10,000 barrels of artesian water per day for more than thirty years.

Quality of injection water. Water analyses of both Hospah and Gallup

formation water recovered on drill-stem tests accompany this report. (See Exhibits 5-a and 5-b). The analyses show such similarity of constituents that one may conclude the Hospah and Gallup sandstones to be a common reservoir in a regional sense. At any rate, microscopic laboratory tests on cores of the Menefee pay sand show an absence of any chemical reaction which could plug the sand face at the injection well or further into the sand body itself. Also, during the drill-stem tests, when the water flowed for approximately a half hour, rapid clearing of the water occurred, indicating an absence of suspended material which could block the injection.

Preparation of injection well. To prepare the well for use, it will be necessary to drill out six cement plugs, each about 25 feet long. A retrievable production packer will then be run on 2-7/8" tubing to the top of the Hospah sandstone at about 2700 feet. As the accompanying schematic plan shows, 3-inch semi-rigid plastic pipe will then be laid from the water supply well to the open storage reservoir on the high ground just south of the field. This line will be buried to a depth of about two feet to prevent freezing during the winter. The open storage reservoir will be some 50 feet topographically higher than the supply well, to permit gravity feed to all injection wells. While it is anticipated that artesian pressure in the water supply well will be sufficient to raise the water to the reservoir, experience may prove that a booster pump is necessary. A pump satisfactory for this purpose is already owned by Chaco Oil Company. (See Exhibit 4).

Later water supply system. From the open storage water reservoir, 2-inch polyethylene plastic pipe will be laid to the eleven injection wells. It is expected that for at least the first several months, until reservoir

pressure has built up to perhaps 100 pounds per square inch, the hydrostatic pressure of some 200 p.s.i. will be ample to force water into the porous and permeable pay sand. After pressure build-up prevents satisfactory gravity injection, a small booster pump may be required to maintain proper injection rates. Gate valves at each well-head and between each injection well will permit injection simultaneously into any combination of the eleven wells. Liquid flow meters at each well-head will enable the keeping of accurate records of water injection, an important factor in the efficient operation of the secondary recovery program.

(5) Anticipated Cost of Water-Flood Program: the principal cost items in establishing secondary recovery are the following: (a) drilling out plugs in the water supply well, and installing production packer and tubing; (b) drilling eleven injection wells and equipping with 2-inch line pipe (tubing); (c) electrical and gamma logging of the supply and injection wells and certain oil wells where these data are needed; (d) stringing and burying water supply and injection feeder lines; (e) booster injection pump when reservoir pressure reaches a point prohibiting gravity injection.

The total estimated cost of instituting secondary recovery should not exceed $20,000, as itemized in the Appendix of this report.

Respectfully submitted,

Henry S. Birdseye

Albuquerque, New Mexico

RED MOUNTAIN OIL FIELD

Key to Wells Shown on Base Map (Exhibit 1)

Number on Map	Operator, Well No.	Total Depth	Casing, Depth	Depth Oil ss	When Drld.	Grnd. Elev.	Present Status
1	Forth #4 or Grier #5	473	6¼/458	462	1936	6427	Producing
2	Newton 2 or Grier 2	483	?	?	1947	6394	Producing
3	Newton 3 or Walker 6	455 460?	6-5/8/426	439-455	1937	6404	Producing
4	Walker 7	435	?	423	?	6391	Producing
5	Naposuta 1	501	5"/422	422-6½ 458-62	1944	6369	Plugged
6	Naposuta 2	483 PB 430	6"/415	415-27	1944	6378	Plugged (no water s.o.)
7	No Record					6377	Plugged
8	Walker 4	460	?	?	1936	6416	Temp. Aband.
9	Grier 10	952	6"/455?	446-56	1953-1954	6421	Plug @ 442
10	No Record					6404	Open to 338
11	Forth 1 or Grier 4	438 527?	?	430-38	1936?	6436	Plugged
12	Grier 6	503	5½/459	476-90	1954	6455	Plug @ 460
13	Naposuta 5	971	5"/930	445-51 942-71	1944	6431	Plugged
14	Bennett ?	527?	4½"/445?	469-72?	1934	6423	Plugged
15	Sapir (Chaco) 15	538	none	insuff. depth	1958	6417	Temp. aband.
16	Smith 1	125	est. 20'	insuff. depth	?	6414	Plugged
17	Dibble 1	586	6-5/8/388	?	1943	6435	Plugged

PRODUCTION SUMMARY, RED MOUNTAIN FIELD
McKINLEY COUNTY, NEW MEXICO

Barrels of Oil Produced

	1951	1952	1953	1954	1955	1956	1957	1958	1959
January	Unk.	213	119	210	60	0	0	175	174
February	"	77	0	80	135	0	0	200	29
March	"	308	494	162	135	0	0	250	74
April	"	297	0	140	195	0	0	225	0
May	"	306	180	115	195	0	0	125	0
June	"	231	156	180	165	0	0	125	116
July	"	153	200	225	0	0	0	100	105
August	"	231	0	195	0	0	314	50	105
September	"	0	222	75	0	0	376	95	100
October	"	201	128	75	0	0	287	170	
November	"	0	180	0	0	0	300	149	
December	517	0	71	120	0	0	284	130	
TOTALS	517?	2017	1750	1577	885	0	1561	1794	
CUMULATIVE:	15985	18002	19752	21239	22214	22214	23775	25569	

ASSUMED RESERVOIR DATA SHEET

RED MOUNTAIN OIL FIELD

McKinley County, New Mexico

"450-foot" Producing Sand (Menefee formation)

Average Porosity (from core anal.)	26%
Average Connate Water Saturation	40%
Original Reservoir Pressure	195 psi
Reservoir Temperature	70°F
Average Net Pay Thickness (core)	10½ feet
Average Recoverable Oil per Acre-foot	173 barrels (primary only)
Average Recoverable Oil per Acre	1,815.4 barrels (primary only)
Reservoir Volume Factor	1.05
Estimated Recovery Factor (primary)	15%
Oil Produced to 11/1/58	25,290 barrels
Number of Reservoir Acres Voided	13.93 acres (primary only)
Estimated Recovery Factor (secondary)	35%
Estimated Productive area (secondary)	40 acres

Estimated Secondary Recovery	169,435 barrels
Less Production to Date	25,290 barrels
Remaining Recoverable Oil under Secondary Recovery	144,145 barrels

DATA REGARDING CHACO OIL COMPANY WELLS, McKINLEY CO.

#20-9

Sec. 20, T. 20 N., R. 9 W. 110/S, 1910/EL
Spudded: 1/7/59. Completed: Total Depth: 458'
Casing: 5½" 14# J-55 @ 454' with 50 sax.
Perforated 128 (1 per foot) from 416-432.
Acidized perfs. with 200 gal. mud acid.
Drilled to 410 feet; cored 410-453. Reamed hole to 7-7/8" to 458'.
Core Descriptions:

#1. 410-19. Rec. 7':
2' dk gry shale
2' grn sdy shale
3' mg glauc gry ss, oil sat., good poros.

#2. 419-20½. Rec. 2':
2' mg glauc gry ss, oil sat., good poros.

#3. 420½-421. Rec. 0

#4. 421-426. Rec. Rec 4½':
2½' hd tight fg gry ss, no show
2' mg soft gry ss, oil sat., v. good poros.

#5. 426-433½. Rec 6½':
3½' oil ss as above
2½' mg soft gry ss, good odor, less vis. oil
½' dk brn carb shale

#6. 433½-437. Rec 3½':
1' dk brn carb shale
2½' lt gry carb siltstone

#7. 437-446. Rec. 8':
8' gry fiss shale

#8. 446-453. Rec 5':
5' gry fiss shale

DATA REGARDING CHACO OIL COMPANY WELLS

#29-18

Sec. 29, T. 20 N., R. 9 W. 100'/N, 1380'/EL
Spudded: 12/29/58. Completed: Total Depth: 464'
Casing:
Perforated:
Drilled to 410'; 410-464'.
Core Descriptions:

#1. 410-19. Rec. 6':
2' fg gry ss
4' dk gry carb shale

#2. 419-21. Rec. 2':
2' shale as above

#3. 421-26. Rec. 2':
2' shale as above

#4. 426-32. Rec. 7':
7' shale as above

#5. 432-37. Rec. 6':
6' shale as above

#6. 437-49. Rec. 10':
2' gry sdy shale
3' fg oil-sat. ss
4' mg gry oil-sat. ss., good poros.
2' vfg hd tight gry ss

#7. 449-56. Rec. 7½':
½' vfg hd tight ss
7' mg gry oil-sat. ss, good poros.

#8. 456-64. Rec. 5':
½' mg gry oil-sat. ss, good poros.
1' lt gry sdy sh
3' fg lt gry ss
½' gry siltstone

DATA REGARDING CHACO OIL COMPANY WELLS

#29-19

Sec. 29, T. 20 N., R. 9 W. 100'/N, 1800'/EL
Spudded: 1/5/59. Completed: Total Depth: 457'.
Casing:
Perforations:
Drilled to 410'. Cored 410-457'.
Core Descriptions:

#1. 410-15. Rec. 4':
$3\frac{1}{2}$' lt gry siltstone
$\frac{1}{2}$' coaly siltstone

#2. 415-24. Rec. 8':
2' dk gry carb sh
1' lt gry sdy sh
$1\frac{1}{2}$' lt gry vfg shly ss, oil-sat.
$3\frac{1}{2}$' lt gry sdy sh

#3. 424-31. Rec. $6\frac{1}{2}$':
$4\frac{1}{2}$' dk gry carb sh
$\frac{1}{2}$' fg lt gry ss, fair oil-sat
1' interbedd blk sh & vfg ss
$\frac{1}{2}$' mg gry ss, fair oil-sat

#4. 431-34. Rec. 2'
2' hd tight vfg ss, good 0, no vis oil

#5. 434-$38\frac{1}{2}$. Rec. 1':
1' mg gry ss, fair sat, good 0 & poros.

#6. $438\frac{1}{2}$-39. Rec. $2\frac{1}{2}$':
$2\frac{1}{2}$' vfg hd tight ss, good 0, no vis oil

#7. 439-41. Rec. 2':
2' hd tight fg gry ss, good 0
Drilled 441-443 through hard bed

#8. 443-49. Rec. $5\frac{1}{2}$':
$5\frac{1}{2}$' mg v. soft oil-sat ss

#9. 449-51. Rec. 2':
dk gry-brn carb sh

#10. 451-57. Rec. $6\frac{1}{2}$':
$6\frac{1}{2}$' dk gry carb sh

DATA REGARDING CHACO OIL COMPANY WELLS

#29-20

Sec. 29, T. 20 N., R. 9 W. 300'/N, 1800'/EL
Spudded: 1/3/59. Completed: Total depth: 467'
Casing:
Perforations:
Drilled to 420 feet. Cored 420-467'.
Core Descriptions:

#1. 420-427. Rec. 7':
- 4' gry carb. sh
- 2' vfg shaly gry ss
- 1' dk gry sh

#2. 427-432. Rec. 4':
- 4' dk gry sh

#3. 432-437. Rec. 6':
- 6' dk gry sh

#4. 437-447. Rec. 9':
- 1' vfg shly ss, good odor
- 5' vfg shly ss, no show
- 2' dk gry sh
- 1' vfg shly ss

#5. 447-457. Rec. 8':
- 2' mg oil-sat ss
- 2' very hd tite ss
- 4' mg oil-sat ss

#6. 457-467. Rec. 10':
- 5' mg oil-sat ss
- 5' dk gry carb sh

CORE ANALYSIS RESULTS

Well No.	Interval (depth)	Permeability (millidarcies)	Porosity (percent)
20-9	416-16½	21	23.1
	431-31½	981	28.9
29-18	442	68	26.8
	443	158	26.1
	444	32	23.8
	445	256	27.7
	446	60	17.9
	449½	tr.	4.9
	450½	145	24.0
	451½	760	26.7
	452½	201	26.2
	453½	113	24.8
	454½	2.6	21.7
	455½	128	27.5
	456	125	24.9
29-19	458½	91	24.2
	459½	882	27.4
	460½	785	29.0
29-20	447½	204	22.9
	448½	102	27.8
	453½	24	11.6
	454½	656	22.1
	455½	908	27.8
	456½	565	25.5
	457½	913	27.2
		341 md avg.	24.8% avg. por.

ANTICIPATED COSTS OF WATER FLOOD EQUIPMENT & SERVICES

Equipment	Cost	Salvage
2700 ft. 2-7/8" EUE tubing, J-55, @ 83¢/ft.	$2241.00	$1300.00
600 ft. 2" black line pipe @ 44¢/ft.	2640.00	1320.00
1600 ft. ABS plastic pipe, 3", w/fittings	840.00	?
5200 ft. 2" polyethylene pipe w/fittings	1697.00	?
11 each 2" x 6" swage nipple @ $15	165.00	----
11 each 2" rt.-left thread collars @ 85¢	10.00	----
100 sacks common cement @ $2.00	200.00	
1 Open-Hole Guiberson Production Packer	335.00	150.00
11 each 1" Liquid Flow Meters @ $53	583.00	200.00
11 each 2" T's and L's	22.00	10.00
22 Bronze Gate Valves, 2", @ $9	198.00	100.00
TOTAL ESTIMATED EQUIPMENT COST - - -	$8931.00	
TOTAL ESTIMATED SALVAGE VALUE - - -		$3080.00

Labor and Services	Est. Cost
Drilling Plugs, Running Tubing, Supply Well	$ 500.00
Drilling, coring, reaming, equipping inj. wells	3000.00
Electrical and Gamma Logging	1500.00
Ditching Water and Oil Lines	500.00
Trucking (pipe, ditcher, etc.)	500.00
Labor (laying pipe, ditching, nippling up, etc.)	1750.00
Digging Open Water Storage Reservoir	500.00
Supervision and Incidental Expense	1100.00
TOTAL ESTIMATED LABOR AND SERVICES - - -	$9350.00

WELL RECORD

Chaco Oil Company #20-1 Santa Fe Pacific

Location: 660 feet from South and East Lines of Sec. 20, T. 20 N., R. 9 W.
Spudded: July 15, 1958. Completed: July 31, 1958.
Elevation: 6471, ground level (L & S)
Total Depth: 3935 feet
Casing: 8-5/8" (new) 24-lb. at 96 ft. with 75 sacks, circulated
Cement Plugs as follows:

0-30'	10 sacks
90-120'	10 sacks
1690-1720'	10 sacks
1810-1840'	10 sacks
2660-2690'	10 sacks
2750-2780'	10 sacks
2900-2930'	10 sacks
3740-3780'	10 sacks

Formation Tops:

Menefee	surface
Point Lookout	1652
Crevasse Cn.	1840
Hospah	2692
Gallup	2772
Mancos	2907
Dakota	3714
Morrison	3920

Deviation Surveys (Totco):

1955 feet: $\frac{1}{2}^{o}$
3675 feet: 2^{o}

Drill-Stem Tests (all Straddle Tests):

#1. 3880-3902. Open 45 minutes. Good blow air throughout. Recovered 1020' drlg mud (small leak in drill pipe), 180' water-and heavily gas-cut mud, 420' heavily gas-cut water. HP 1990#. FP 190-495#. SIP (15") 1485#.

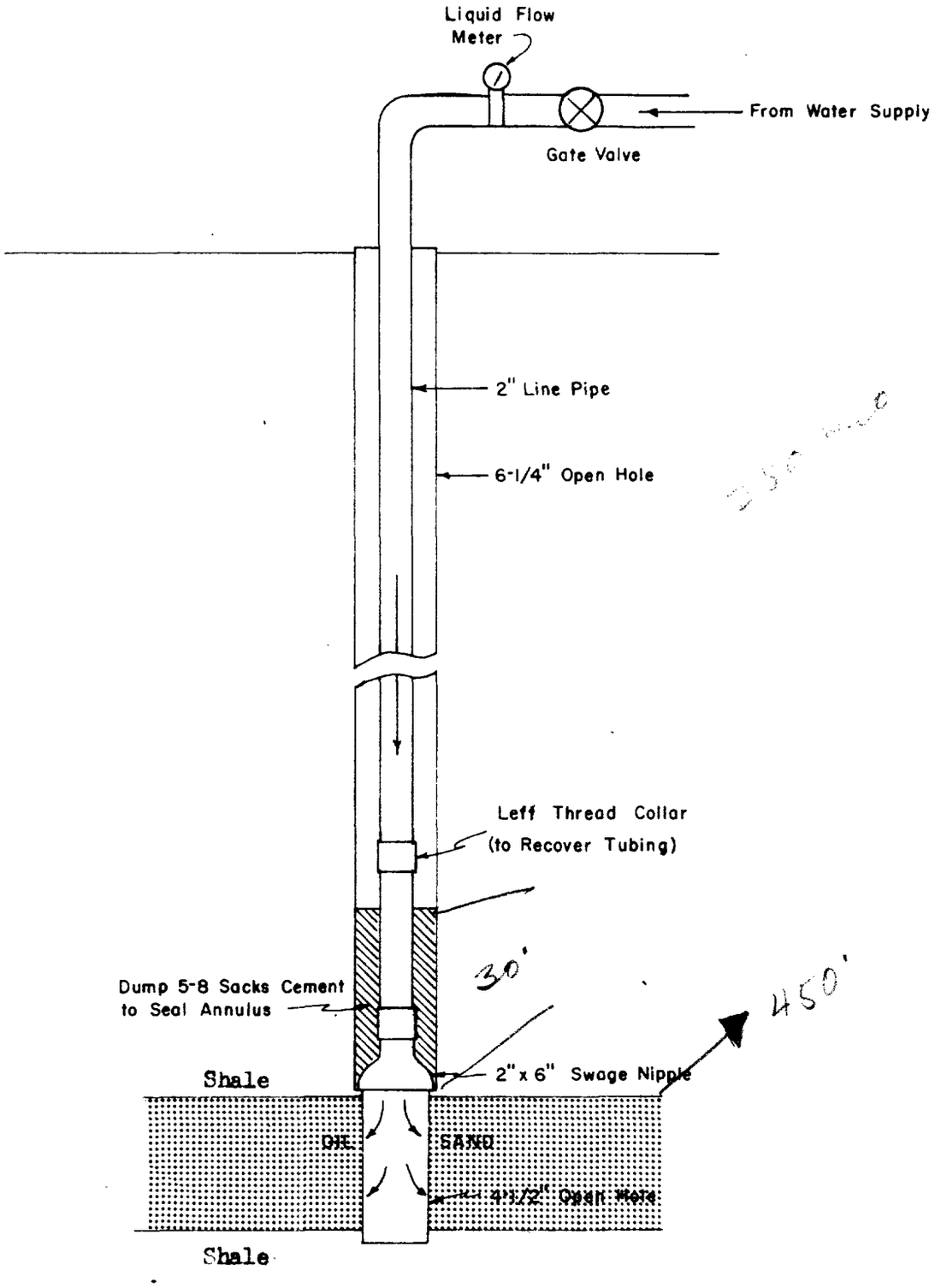
#2. 3812-3828. Open 105 minutes. Good blow air throughout. Recovered 3400' heavily gas-cut salt water. IHP 1975#. FHP 1965#. FP 200-1475#. SIP (30") 1665#.

#3. 2750-2782. Open 48 minutes. Good blow air. Fresh water to surface in 12 minutes, flowed at rate of 50 barrels per hour. IHP 1382#. FHP 1382#. FP 693-1217#. SIP (43") 1272#.

#4. 2710-2748. Misrun (packer failed).

#5. 2718-2750. Open 45 minutes. Good blow air. Fresh water to surface in 16 minutes, flowed at rate of 40 barrels per hour. HP 1382#. FP 583-1161#. SIP (42") 1245#.

N.M.O.C.C. Case Exhibit 3



CHACO OIL COMPANY

Typical Water Injection Well Completion Method

Red Mountain Secondary Recovery Program

SRL 507 3-M-8-58

NCLAIR RESEARCH LABORATORIES, INC.

TULSA, OKLAHOMA

SAMPLE NO S-7104 ANALYST SIP;IE FORMATION Gallup DEPTH DST #3 2772'-[illegible]'

DESCRIPTION Chaco Oil Company-Santa Fe Pacific #20-1, C SE SE Sec.20-20N-9W,

COUNTY McKinley STATE New Mexico TAKEN 7-30-58 RECD 8-11-58 ANALYZED 8-19-58

CONSTITUENTS IN PARTS PER MILLION			MEQ. PER LITER	REACTING VALUES IN PERCENT
POTASSIUM (K)	None	[illegible]		
SODIUM (Na)	338	[illegible]	14.7107	46.8
LITHIUM (Li)	None	[illegible]		
CALCIUM (Ca)	10	[illegible]	0.49900	1.58
MAGNESIUM (Mg)	6	MAGNESIUM	0.49344	1.58
BARIUM (Ba)	-	BARIUM		
STRONTIUM (Sr)	None	[illegible]		
MANGANESE (Mn)	None	[illegible]		
CARBONATE (CO_3)	36	[illegible]	1.1980	3.71
BICARBONATE (HCO_3)	381	[illegible]	6.24459	19.89
HYDROXIDE (OH)	None	[illegible]		
SULPHATE (SO_4)	1,409	[illegible]	3.97339	12.65
CHLORIDE (Cl)	152	[illegible]	4.28680	13.65
TOTAL SOLIDS	2,332	[illegible] 1.003		pH 8.26 @ 78 F

PROPERTIES OF REACTION IN PERCENT

PRIMARY SALINITY 52.60 PRIMARY ALKALINITY 41.08 [illegible] 31.90 RES 2,672 PPM 7 PF

SECONDARY SALINITY - SECONDARY ALKALINITY 6.32 [illegible] 46.10 SC 1,321 PPM

NOLAN[illegible] LABORATORIES, INC.

TULSA, OKLAHOMA

ILLEGIBLE

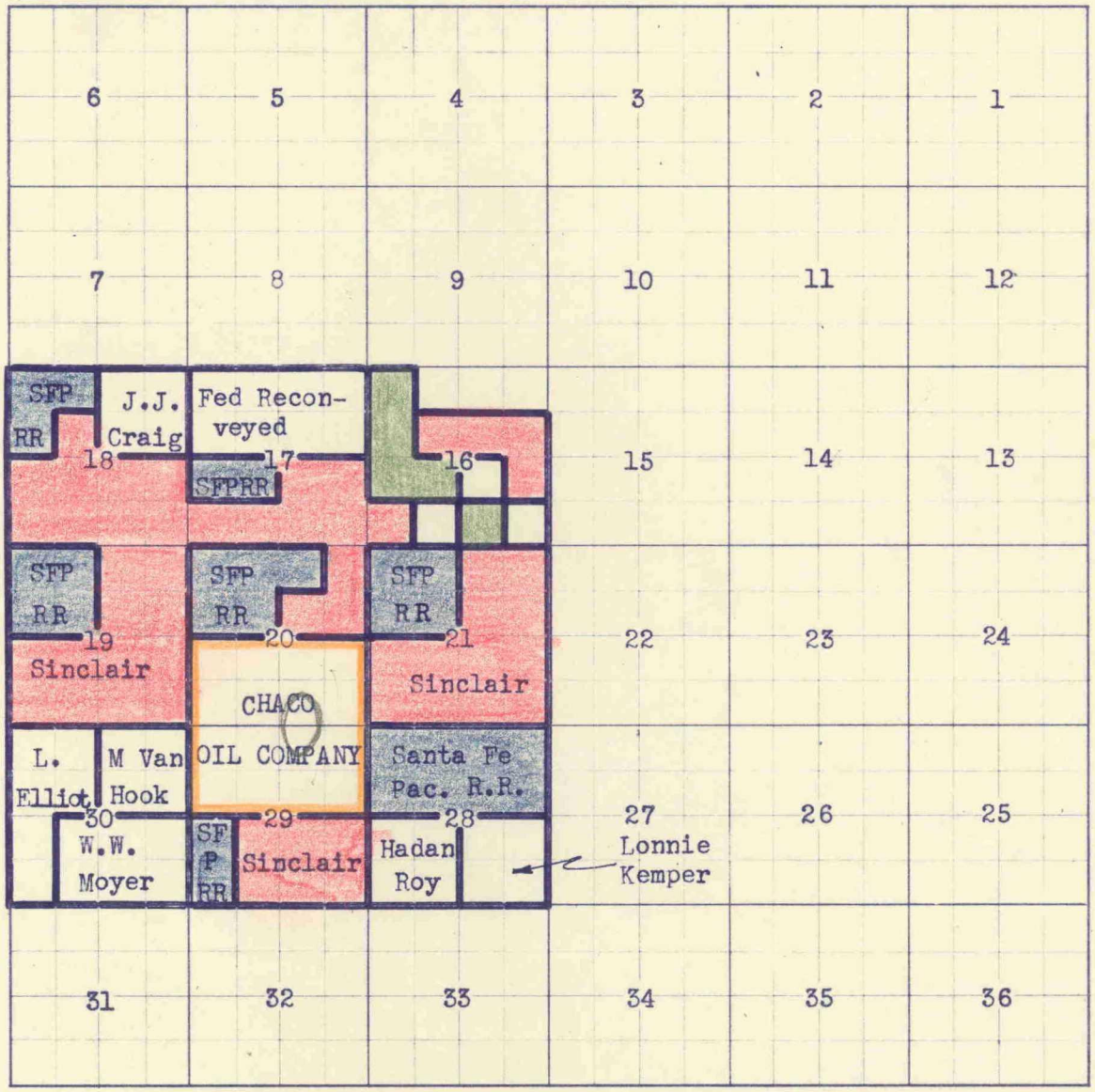
NMOCC Case 1805. Applic. Exh. 6

TOWNSHIP 20 N RANGE 9W COUNTY McKinley STATE New Mexico

REMARKS:

Plat Showing Ownership in Vicinity of
Proposed Water Flood Project

COMPANY
CHACO OIL COMPANY



KEY:

- Chaco Oil Co.
- Sinclair O & G
- Santa Fe Pac R R
- Sun Oil Company

OIL CONSERVATION COMMISSION
P. O. BOX 871
SANTA FE, NEW MEXICO

April 20, 1960

COPY

Chaco Oil Company
P. O. Box 8294
Albuquerque, New Mexico

ATTENTION: Henry S. Birdseye

Gentlemen:

Pursuant to the provisions of Order No. R-1533 and Rule 104 of the Commission Rules and Regulations, you are hereby authorized to relocate the following-described injection wells in the Red Mountain Oil Pool, McKinley County, New Mexico, as follows:

Well No. I-6, to be located 395 feet from the North line and 1265 feet from the East line of Section 29.

Well No. I-7, to be located 225 feet from the North line and 1265 feet from the East line of Section 29.

It is our understanding that the relocation of the above-described injection wells is necessitated by the extremely rough terrain in the area. It is also our understanding that these relocations will place the injection wells in a pattern which will result in a thorough and efficient sweep of the oil by the water flood.

Very truly yours,

A. L. PORTER, Jr.
Secretary-Director

ALP/OEP/ir

cc: Mr. Emery Arnold

CHACO OIL COMPANY
P. O. Box 8294
Albuquerque, New Mexico
17 April, 1960

Case file 1805

New Mexico Oil Conservation Commission
Box 871
Santa Fe, New Mexico

Gentlemen:

Chaco Oil Company hereby requests administrative approval from the Oil Conservation Commission to move two of the unorthodox locations of water injection wells in the Red Mountain Field, T20N, R9W, Mckinley County, New Mexico, due to prohibitively rough terrain.

Permission is requested to change the location of injection well I-6 from 600 feet from the north line and 1500 feet from the east line of Section 29 to 395 feet from the North Line and 1265 feet from the East line of Section 29. It is also requested to move Well #I-7 from 370 feet from the north line and 1150 feet from the East Line to 225 feet from the North Line and 1265 feet from the East Line of Section 29.

The original unorthodox locations were approved under NMOCC Order No. R-1533, which also provided for the establishment of an administrative procedure for relocating injection wells. From the enclosed plat, is may be seen that the desired relocations will place wells I-6 and I-7 in a pattern which will result in a thorough and efficient sweep of the oil by the water flood.

The relocations are necessitated by extreme terrain, namely a steep butte more than 300 feet high, which would require costly road-building and location work if the original locations were adhered to.

Your prompt consideration of this request will be appreciated.

Cordially,
Henry S. Birdseye
Henry S. Birdseye
Co-owner

HSB:lm
encl: plat

LOGGING DATA

PROBE SIZE: 1-3/8" | CALIBRATION: 300

DATE: 10-2-57 | FIELD HDQTRS: Grants

	INITIAL RUN	RE-RUN	RE-RUN	RE-RUN	RE-RUN	RE-RUN	RE-RUN
HOLE NO.	29-9						
HOLE DIA.	5-7/8 IN	casing					
DRILLED DEPTH	? FT						
LOGGED DEPTH	442 FT						
GAMMA SCALE	25 CPS						
TIME CONSTANT	8 SEC						
PAPER SPEED	10 FT/IN						
LOGGING SPEED	10 FT/M	FT/M	FT/M	FT/M	FT/M	FT/M	FT/M
RESISTANCE SCALE	100 ohm						
SELF POT SCALE	-- MV/IN			SELF POT T.D.			
BORE HOLE MEDIUM	Oil	WITH					
MUD READINGS	RESISTIVITY			TYPE BASE			
	VISCOSITY			SALINITY			
	WEIGHT		LBS/GAL				
CALIPER SCALE	INCH	LEG SIZE		PAPER SCALE			
TIME IN	1415	CASED TO				I. D.	IN
TIME OUT	1515	CORE INT.				DIAM	IN

LOCATION	TIME
SEC. 29 TWP. 20 RGE. 9W	OFFICE:
COUNTY: McKinley	DRIVE: 0.1
STATE N. M.	STANDBY:
AREA:	FIELD: 1.0
CLIENT: CHACO OIL	TOTAL: 1.1
Dr. Contractor	BREAKDOWN:
Log Received and Approved By	OPERATOR: Mash & Meek
H S Birdseye	PARTY NO: U-1

COPY

Century

GEOPHYSICAL CORP.

TULSA, OKLA., U.S.A.

EXPLORATION LOG

COMPANY: CHACO OIL CO.

BORE HOLE NO. 29-9

FIELD Red Mountain

COUNTY McKinley, N.M.

LOCATION: SEC. 29 TWP. 20N RGE. 9W

LOG. MEAS. FROM ..... FILE .....

DRLG. MEAS. FROM ..... NO. .....

DATE:

FOOTAGE

TOTAL DEPTH (DR)

HOLE DIAM.

LOGGING SPEED

TIME CONSTANT

MUD TYPE

CASED TO

LOCATION OF HOLE

ELEVATION

KB

GL 6421

BKGRD. COUNT .....

SLUSH PIT CT. .....

REMARKS: Oil in casing

MINERALIZATION OR *DIRECTIONAL DRIFT METER*

COUNTS PER SEC.	BED THICKNESS	K KD	CORR. CPS.	% U_3O_8
Reading	*Depth*	*Drift*	*Mag Brng*	*True Bearing*

RADIOMETRIC % VALUES COMPUTED WITHOUT BENEFIT OF LOCAL ORE EQUILIBRIUM FACTOR

INTERPRETATION BY:

GEOLOGIC TOPS

FORMATION	DEPTHS	THICKNESS

SELF POTENTIAL

— -- MV +

CALIPER

NATURAL GAMMA RAY
COUNTS PER SECOND

RESISTANCE
OHMS

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

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

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