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OIL AND GAS DEVELOPMENT AND PRODUCTION, EASTERN SAN JUAN BASIN

by

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DEVELOPMENT AND PRODUCTION SUMMARY

Oil and gas production in the eastern portion of the San Juan Basin is confined to Rio Arriba and Sandoval Counties with by far the major portion coming from Rio Arriba County. Most of the dry gas produced in San Juan Basin occurs in stratigraphic reservoirs in the Pictured Cliffs Sandstone, Mesaverde Group and Dakota Formation all of Upper Cretaceous age. Minor amounts of dry gas are produced from sand and coal zones in the Fruitland Formation, in what has been designated as the "Chacra" Formation and from the Gallup Sandstone. Rio Arriba and Sandoval County gas production is confined to the above listed formations; although, in the western part of the basin additional gas has been found in the Farmington Sandstone and in Pennsylvanian, Mississippian and Devonian strata. In Rio Arriba County, oil is produced from several Gallup zones, from fractured zones in the Mancos Shale on the extreme east edge of the basin, from the Dakota Formation in Southern Rio Arriba County and from the Mesaverde Group in small areas south of the Blanco Mesaverde Gas Pool. Sandoval County also produces a small amount of oil from the Mesaverde Group, Gallup Sandstone, Dakota Formation and the Entrada Sandstone.

Total dry and casing head gas production in Rio Arriba County in 1973 was 178.65 billion cubic feet. This production came from a total of 3742 producing wells, 3438 of which were classed as dry gas wells. Gas production from Sandoval County totaled 1.04 billion cubic feet. This production came from a total of 86 wells, 52 of which were classed as dry gas wells. Total dry gas production for Northwestern New Mexico in 1973 was 550.12 billion cubic feet; thus, the eastern half of the San Juan Basin produced 32.7% of that total. Oil production in Rio Arriba County for 1973 was 1,615,735 barrels from 304 producing wells. Oil and condensate production from northwest New Mexico in 1973 totaled 7,569,550 barrels; thus, the eastern half of the San Juan Basin produced 24% of that total. Tables 1 and 2 list cumulative production totals for all oil and gas pools in the San Juan Basin. Tables 3 and 4 list oil and gas production totals for Rio Arriba County.

MAJOR PRODUCING STRATIGRAPHIC UNITS

Fruitland Formation

The Fruitland Formation has not produced significant amounts of gas in Rio Arriba County. However, several wells have been completed in the northern part of the county in Township 30 North, Ranges 5 West and 6 West, and Township 32 North, Range 5 West. Although two pools have been established by the New Mexico Oil Conservation Commission, production has been insignificant. Presently only three wells are producing from the Fruitland in Rio Arriba County and cumulative production through 1972 was only 108,207 MCF. However, there is considerable interest in future gas development of known gas reserves in the area. As in most San Juan Basin reservoirs, controlling mechanisms are primarily stratigraphic, with gas occurring in lenticular sandstones and in coals. Open hole completions result in wells which produce large amounts of water with the gas, and production problems develop because the water logs off the gas production. It is difficult to define zones that should be perforated to produce the gas with minimum water production, if casing is installed through the formation. Improved logging techniques may provide a clue to successful exploitation of gas reserves in the Fruitland.

Pictured Cliffs Sandstone

A total of 1666 wells were producing gas from the Pictured Cliffs Sandstone in Rio Arriba County as of January 1, 1974. Of those 303 are producing from the Ballard Pool, 1016 from the South Blanco Pool, 221 from the Tapacito Pool, 90 from the Gavilan Pool, 9 from the Choza Mesa Pool, 21 from the East Blanco Pool and 6 from undesignated pools. Most of the wells are concentrated in the southern portion of the county, and occur in trends extending east to west across nearly the full width of the county. Many individual well capacities are low due to low sand permeabilities. In all the pools, the gas has accumulated in elongate, northwest-southeast trending beach or near-shore sandstone bodies, which are separated somewhat imperfectly by shale and siltstone trending in the same direction. The sandstone units terminate abruptly to the southwest but wedge out gradually to the northeast in several of the pools. Net pay thickness varies from 10 feet to 50 feet and averages about 30 feet. Permeabilities vary widely but generally decrease as the sandstone units thin. Pictured Cliffs Sandstone coregraphs (Core Lab) show the following average values for all wells in the San Juan Basin: range of producing thickness 8 to 72 feet, average 29 feet; permeability range 0-159 millidarcies, average 2.96 millidarcies; range of porosity 2.8% to 32.2%, average 18.1%; average oil saturation 1.4%; average water saturation 44% (Reneau and Harris, 1957).

Sandoval County has had some gas development in the Pictured Cliffs Sandstone in Township 23 North, Ranges 2, 3, and 4 West. Forty wells are now producing in the county with 37 being located in the Ballard Pool and 13 being located in the South Blanco Pool.

Cumulative production from the Pictured Cliffs in the San Juan Basin as of January 1, 1974 was 1.80 trillion cubic feet. Approximately 831.12 billion feet of that was produced in Rio Arriba County and 14.31 billion cubic feet was produced in Sandoval County. The eastern half of the basin has therefore contributed 47% of the basin total from Pictured Cliffs Sandstone.

"Chacra" Formation

The term "Chacra Formation" has been applied by the oil and gas industry to a sandy zone in the Lewis Shale ranging

Table 1. Cumulative Dry Gas and Condensate Production by Stratigraphic Unit to January 1, 1974, in Northwestern New Mexico.

Producing Zone	Pool	Wells 1-1-74	Gas, MCF	Condensate, Bbls.
Mississippian	Table Mesa	1	1,193,006	0
	Undesignated	1	188,821	996
Total		2	1,381,827	996
Pennsylvanian	Barker Creek	8	98,848,418	0
	Blue Hill	0	1,221,724	0
	Tocito Dome, North	1	104,913	0
	Ute Dome	6	35,041,888	0
	Undesignated	1	0	52
Total		16	135,216,943	52
Dakota	Basin	2277	2,261,016,222	23,879,675
	Barker Creek	4	18,645,808	0
	Lone Pine	1	0	0
	Snake Eyes	4	820,186	27,634
	Ute Dome	13	4,792,773	33,632
	Undesignated	1	154,185	8,588
Total		2299	2,285,429,174	23,949,529
Greenhorn	Undesignated	1	255,652	0
Total		1	255,652	0
Gallup	BS Mesa	12	6,585,061	59,254
	Flora Vista	3	4,289,855	60,893
	Largo	4	9,058,938	74,102
	Lindrith	1	332,041	15,856
	Ojo	1	722,390	8,741
	Shiprock, North	1	82,894	0
	Wild Horse	12	26,277,866	123,268
	Undesignated	2	105,296	0
Total		36	47,454,341	342,114
Mesaverde	Blanco	2095	3,713,985,823	14,766,155
	Crouch Mesa	3	3,098,069	11,338
	Flora Vista	10	16,347,090	89,872
	Gonzales	12	1,630,205	16,509
	Twin Mounds	0	652,995	0
	Undesignated	2	295,458	0
Total		2122	3,736,009,640	14,883,874
Chacra	Harris Mesa	2	323,168	0
	Largo	4	358,512	0
	Otero	137	56,456,377	4,746
	Undesignated	15	887,176	3,017
Total		158	58,025,233	7,763
Pictured Cliffs	Aztec	475	199,413,089	9,069
	Ballard	561	245,384,821	23,851
	Blanco	391	143,443,538	121,428
	Blanco, East	21	11,045,813	719
	Blanco, South	1330	679,770,373	50,093
	Choza Mesa	8	2,235,980	0
	Fulcher Kutz	335	194,057,263	5,445
	Gavilan	88	37,463,181	103,026
	Huerfano	2	1,228,659	0
	Kutz, West	199	110,472,344	0
	Tapacito	217	168,314,494	11,932
	Twin Mounds	2	1,160,861	0
	Undesignated	20	1,937,241	119
Total		3649	1,795,927,657	325,682
Fruitland	Aztec	34	11,358,329	0
	Aztec, North	0	15,138	0
	Blanco	8	821,245	13,090
	Cottonwood	0	0	0
	Flora Vista	4	980,804	0
	Gallegos	1	772,978	0
	Gallegos, South	5	1,763,572	0
	Harper Hill	2	279,705	0
	Kutz	7	3,582,695	0
	Kutz, West	2	606,576	0
	La Jara	1	54,008	0
	Los Pinos, North	2	554,520	0
	Los Pinos, South	1	732,966	0
	Mt. Nebo	1	57,662	0
	Pinon	9	4,340,610	0
	Pinon, North	1	68,099	0
	Pump Mesa	1	233,755	0
	Undesignated	8	1,595,122	0
Total		86	27,817,784	13,090
Farmington	Kutz	2	208,701	0
	Undesignated	5	667,174	0
Total		7	875,875	0
Grand Total		8375	8,088,340,118	39,523,073

from 600 to 800 feet above the top of the Cliff House Sandstone, as defined in the Blanco Mesaverde Gas Pool. The sandy zone is normally from 130 to 200 feet thick and, in the best producing areas, has two relatively clean sandstone developments, one at the top and one near the bottom, with gray shale and silt between. The upper sandstone normally has better development with the net effective pay zone ranging from 10 to 40 feet thick. Net effective pay in the lower unit, when present, seldom exceeds 20 feet. Sandstone characteristics, including permeabilities, are similar to those of the Cliff House Sandstone; Sandstones are light medium gray, very fine grained to fine grained, and well cemented. Well potentials are in the range 500 MCFPD to 2000 MCFPD, averaging about 1000 MCFPD. Flow rates into the pipeline vary from 30 MCFPD to 500 MCFPD but average about 100 to 150 MCFPD.

Production from the "Chacra" has been confined to a narrow belt not exceeding four miles in width, and trending southeast to northwest across the central portion of the San Juan Basin. The major development has been in Townships 25 North and 26 North, Ranges 5 West and 6 West in southern Rio Arriba County. Depth of the zone within the producing area ranges from 3000 to 4000 feet. Extensive exploration and development fo the "Chacra" producing zone is now being pursued along a northwest trending line extending as far north as Township 29 North, and West to Range 11 West in San Juan County. It will not be a major gas producing zone in the basin but may provide several hundred additional producing gas wells.

As of January 1, 1974, 158 wells were producing from the "Chacra Zone" with 140 located in Rio Arriba County and only 18 in San Juan County. Total cumulative production from the Chacra Zone was 58.03 billion cubic feet with 56.75 billion cubic feet or 97.8% of that production coming from Rio Arriba County, primarily from wells in the Otero Chacra Pool. The zone produces very little liquid with total condensate production totaling only 4700 barrels.

Mesaverde Group

The Mesaverde Group as defined in the Blanco Mesaverde Gas Pool is composed of three formations, the Cliff House Sandstone, Menefee Formation and Point Lookout Sandstone. The major portion of dry gas produced comes from the Cliff House and Point Lookout Sandstones, although sand and coals in the Menefee also contribute gas. The Blanco Mesaverde Pool is a stratigraphic reservoir about 70 miles long and 40 miles wide. Porosities of the Mesaverde sandstones range from 4 to 14% and average about 9%. Average permeability of the Cliff House is 0.9 millidarcy; the Point Lookout average about 2 millidarcys (Pritchard, 1957). Natural fracturing influences well productivity.

The Mesaverde Group has contributed more gas than any other unit in Rio Arriba County. Of the 919 wells completed in the Mesaverde Group in Rio Arriba County 906 are in the Blanco Mesaverde Pool. Of the 2095 wells producing in this pool as of December, 1973, 43.2% are located in Rio Arriba County. Of the 3.71 trillion cubic feet of gas produced from this pool to January 1, 1974, 1.06 trillion cubic feet or 28.6% came from Rio Arriba County. Thus, Mesaverde reservoir characteristics in Rio Arriba County are somewhat inferior to those of that portion of the pool located in San Juan County. Pay sands in the Cliff House and Point Lookout thin from west to east in the Blanco Pool. Total Mesaverde net effective pay in Townships 29 and 30 North, Ranges 8, 9 and 10 West in north central San Juan County reaches a thickness of 150 feet and averages 120 feet. Net effective pay gradually thins eastward; at the Rio Arriba County line (Range 7 West) maximum thickness is 120 feet and average thickness is 100 feet, and at the eastern portion of Range 6 West maximum thickness is 90 feet and average thickness is 60 feet. However, a lobe which

Table 2. Cumulative Oil and Casinghead Gas Production by Stratigraphic Unit to January 1, 1974, in Northwestern New Mexico.

Producing Zone	Pool	Wells 1-1-74	Oil, Barrels	Gas, MCF
Devonian	Ak-ah-nez	0	17,199	0
Total		0	17,199	0
Pennsylvanian	Buena Suerte	0	5,296	0
	Cone	1	14,574	340,863
	Four Corners	0	91,945	0
	Hogback	0	385,029	0
	Pajarito	1	140,123	0
	Rattlesnake	0	405,270	0
	Table Mesa	4	171,922	0
	Tocito Dome	31	7,807,049	14,469,933
	Undesignated	0	69,835	0
Total		37	9,031,016	14,810,796
Entrada	Media	7	492,255	0
Total		7	492,255	0
Dakota	Blackeye	1	1,253	0
	Dufers Point	2	37,842	0
	Five Lakes	3	40,847	0
	Hogback	31	4,869,322	0
	Hospah	6	53,189	306,640
	Lindrith	0	27,141	0
	Lone Pine	29	2,217,198	3,692,712
	Ojito	3	201,375	312,626
	Rattlesnake	25	4,796,472	0
	Salt Creek	4	54,046	0
	Shiprock, North	1	639	0
	Slick Rock	21	308,724	0
	Table Mesa	9	1,347,530	0
	Wild Horse	2	86,073	747,697
	Undesignated	8	43,993	867,020
Total		145	14,085,644	5,926,695
Graneros	Undesignated	0	17,535	0
Total		0	17,535	0
Gallup-Dakota Commingled	Lindrith, South	3	6,917	31,588
	Lindrith, West	26	763,336	5,055,300
	Undesignated	1	4,229	0
Total		30	774,482	5,086,088
Mancos	Boulder	18	1,635,568	1,411,481
	Puerto Chiquito, East	35	2,866,431	506,866
	Puerto Chiquito, West	15	4,695,817	2,273,698
	Undesignated	3	44,382	4,618
Total		71	9,242,198	4,196,663
Sanastee	Otero	0	29,882	0
Total		0	29,882	0
Tocito	Blanco, South	20	3,875,026	7,670,164
Total		20	3,875,026	7,670,164
Gallup	Amarillo	2	47,586	0
	Angel Peak	35	610,595	45,583,922
	Bisti, Lower	275	33,000,730	65,979,317
	Cha Cha	78	8,285,273	17,106,202
	Devils Fork	34	1,895,169	30,293,001
	Escrito	47	2,326,644	11,133,930
	Gallegos	40	1,587,051	23,781,525
	Horseshoe	367	33,654,331	7,653,937
	Hospah, Lower Sand South	50	2,171,603	0
	Hospah, Upper Sand	58	5,999,245	0
	Hospah, Upper Sand South	55	2,392,951	0
	Jewett Valley	3	21,486	0
	Kutz	15	535,912	1,635,284
	La Plata	5	487,119	372,660
	Lybrook	21	530,457	3,640,411
	Many Rocks	65	2,867,295	1,029,470
	Many Rocks, North	14	285,247	0
	Meadows	3	83,587	208,618
	Mesa	22	393,089	83,088
	Otero	59	2,093,493	10,922,635
	Pinon	3	284,776	617,700
	Rattlesnake	1	1,425	0
	Shiprock	34	191,615	0
	Simpson	8	812,681	3,148,603
	Tapacito	12	403,072	16,258,062
	Totah	51	3,229,316	
	Verde	91	7,534,697	2,333,019
	Waterflow, South	3	198,948	248,786
	Undesignated	27	534,007	3,571,936
Total		1478	112,459,300	241,105,202
Mesaverde	Blackeye	3	3,399	0
	Chaco Wash	13	9,834	0
	Cuervo	1	38,428	0
	Devils Fork	1	12,175	7,867
	Nenahnezad	1	1,025	0
	Otero Point Lookout	0	18,881	0
	Parlay	2	34,031	50,969
	Red Mountain	32	230,062	0
Mesaverde	San Luis	5	51,783	0
	San Luis, South	2	155	0
	Seven Lakes Menefee	0	572	0
	Venado	2	24,435	14,057
	Undesignated	1	16,440	0
Total		63	441,637	72,893
Pictured Cliffs	Sleeper	3	61,287	174,194
	Undesignated	1	13,874	0
Total		4	75,161	174,194
Farmington	Alamo	1	13,128	0
	Bloomfield	3	8,244	0
	Oswell	3	14,989	0
	Undesignated	2	21,319	0
Total		9	57,680	0
Grand Total		1864	150,792,231	*

* Casinghead Gas Totals Incomplete

extends into Township 27 north, Ranges 4 and 5 West reaches a thickness of 100 feet and averages about 80 feet.

Gallup Sandstone

The term "Gallup" has been used in the oil and gas industry to identify a series of generally thin, lenticular sandstone units at the Niobrara level of the Mancos Shale. The subsurface sandstone units are generally correlative with the Gallup Sandstone which outcrops on the south and west sides of the San Juan Basin; however, the subsurface sandstones were deposited some distance offshore and are not continuous with the Gallup identified in the outcrop. The sandstone lenses are encased in impermeable shale; in individual sandbars gas occurs up dip to the southwest and oil occurs down dip to the northeast. Ten oil and gas reservoirs have been discovered and developed in Rio Arriba County. In all of these reservoirs the sandstones are thin, fine grained, and have low permeabilities, and are poorer quality reservoirs than Gallup reservoirs such as Bisti, Totah, Cha Cha, and the Horseshoe Gallup Pools, in San Juan County. Production is from a series of thin sandstone lenses which occur in a three hundred foot section, with individual lenses being separated by 20 to 40 feet of shale. The section is located from 700 to 1000 feet above the top of the Dakota Sandstone. Producing depths range from 5200 to 6000 feet in the developed pools. Some operators have perforated several thin sand stringers distributed throughout a 300 feet section of a single well bore.

Oil and gas cumulative production for Gallup pools is listed in Tables 1-4. Three of the Gallup pools in Rio Arriba County are defined by the New Mexico Oil Conservation Commission as oil pools. Four are defined as gas pools and three as associated oil and gas pools. The associated pools (Tapacito, Devils Fork, and Escrito Gallup pools) were so designated because of the wide variation in producing characteristics; some have relatively low gas oil ratios and others are essentially gas wells. The Devils Fork Gallup Pool, which was developed in the early 1960's, proved to have a well defined gas-oil contact in a single, well-developed sandbar. A volumetric formula was devised to prorate the production, which was designed to provide for equal withdrawals from the oil and gas zones. Eighty acre spacing was established for oil wells and 320 acre spacing for gas wells, with the definition between oil and gas wells set at a gas/oil ratio of 30,000 cubic feet of gas per barrel of oil. The same definition and spacing has been used in the Tapacito and Escrito Pools; however, it has not been practical to utilize a volumetric formula in these pools since production does not come from a single sand lens, and oil and gas contacts cannot be established easily. Gas and oil production in these two pools is related by a limiting gas/oil ratio of 2000 cubic feet of gas per barrel of oil; gas wells which are spaced on 320 acres receive proportionately larger gas production in relation to acreage assigned. The South Blanco, Lybrook and Otero Pools are classified and spaced as oil pools, and BS Mesa, Largo, Lindrith and Wildhorse Pools are classified as gas pools and developed on 160 acre spacing.

Individual pool cumulative production is shown in Tables 3 and 4. Gallup producing zones in Rio Arriba County have produced 11,282,683 barrels of oil and gas well liquids and 122.36 billion cubic feet of dry and casinghead gas as of January 1, 1974. This production has come from 239 wells.

Table 3. Cumulative Dry Gas and Condensate Production by Stratigraphic Unit to January 1, 1974, in Rio Arriba County, New Mexico.

Producing Zone	Pool	Wells 1-1-74	Gas, MCF	Condensate, Bbls.
Dakota	Basin	695	528,818,241	5,417,699
Total		695	528,818,241	5,417,699
Greenhorn	Undesignated	2	255,652	0
Total		2	255,652	0
Gallup	BS Mesa	12	6,585,061	59,254
	Largo	4	9,058,938	74,102
	Lindrith	1	332,041	15,856
	Wild Horse	12	26,277,866	123,268
	Undesignated	2	105,296	0
Total		31	42,359,202	272,480
Mesaverde	Blanco	906	1,060,643,862	2,769,324
	Gonzales	12	1,630,205	16,509
	Undesignated	1	159,949	0
Total		919	1,062,434,016	2,785,833
Chacra	Otero	137	56,456,377	4,746
	Largo	1	92,719	0
	Undesignated	2	196,216	0
Total		140	56,745,312	4,746
Pictured Cliffs	Ballard	302	103,888,059	0
	Blanco, East	21	11,045,818	719
	Blanco, South	1004	507,915,777	44,991
	Choze Mesa	8	2,235,980	0
	Gavilan	88	37,463,181	103,026
	Tapacito	217	168,314,495	11,932
	Undesignated	5	257,016	0
Total		1648	831,120,326	160,668
Fruitland	Cottonwood	1	0	0
	La Jara	1	54,008	0
	Undesignated	1	54,199	0
Total		3	108,207	0
Grand Total		3438	2,521,840,956	8,641,426

Mancos Shale

Commercial oil production has been developed in Mancos Shale in the extreme northwest portion of the San Juan Basin at the Verde Pool and on the extreme east edge of the basin at the Boulder, West Puerto Chiquito and East Puerto Chiquito pools. Production is in areas where flexure of the strata has created fracture systems which provide an oil trap with sufficient permeability. The Boulder Mancos Pool in the eastern portion of T. 28 N., R. 1 W. was discovered in 1961. Twenty-five wells have been produced in this pool on 80 acre spacing

Table 4. Cumulative Oil and Casinghead Gas Production by Stratigraphic Unit to January 1, 1974, in Rio Arriba County, New Mexico.

Producing Zone	Pool	Wells 1-1-74	Oil, Barrels	Gas, MCF
Dakota	Lindrith	1	27,141	0
	Ojito	3	201,375	312,626
	Wild Horse	2	86,073	747,697
Total		6	314,589	1,060,323
Gallup-Dakota Commingled	Lindrith, South	3	6,917	31,588
	Lindrith, West	28	763,336	5,055,300
Total		31	770,253	5,086,888
Mancos	Boulder	18	1,635,568	1,411,481
	Puerto Chiquito, East	35	2,866,431	506,866
	Puerto Chiquito, West	15	4,695,817	2,273,698
	Undesignated	2	44,204	4,618
Total		70	9,241,820	4,196,663
Gallup	Blanco Tocito, South	20	3,875,026	7,670,164
	Devils Fork	34	1,895,069	30,293,001
	Escrito	47	2,102,891	10,626,916
	Lybrook	16	472,898	3,519,679
	Otero	59	2,093,493	10,922,635
	Tapacito	12	403,072	16,258,062
	Undesignated	4	195,265	707,014
Total		192	11,037,714	79,997,471
Mesaverde	Devils Fork	1	12,175	7,867
	Otero Point Lookout	0	18,881	0
Total		1	31,056	7,867
Pictured Cliffs	Sleeper	3	61,287	174,194
	Undesignated	1	13,874	0
Total		4	75,161	174,194
Grand Total		304	21,470,593	90,523,406

at producing depths ranging from 3300 to 5300 feet in steeply dipping strata. The pool has exhibited an excellent fracture system, and many wells have had initial potentials in excess of 100 barrels per day, with several wells exceeding 500 barrels per day. Rapid production decline and low per well cumulative production totals indicated that drilling density was too close. Better overall economics would have been experienced if fewer wells had been drilled and if an attempt had been made to maintain higher reservoir pressures during early production. Cumulative production to January 1, 1974 was 1,635,568 barrels, for an average production of 65,423 barrels per well. The Puerto Chiquito Pool (central and western portions of Townships 26 North and 27 North, Range 1 East) was discovered in 1960 and designated by the New Mexico Oil Conservation in 1963. After further development, Benson Montin-Greer Drilling Corporation, who has operated the major portion of the pool since discovery, called a hearing before the Commission in order to abolish the original Puerto Chiquito Pool and to establish two pools, the East Puerto Chiquito and West Puerto Chiquito pools. The pools represent two separate fracture areas. One hundred and sixty acre spacing was established in the East Puerto Chiquito Pool and 320 acre spacing was established in West Puerto Chiquito Pool. Present pool boundaries are shown in Figure 1. Based upon recommendation of the operator, large spacing areas were established for both pools to provide for orderly future development. Because the fracture systems extend vertically through much of the Niobrara Member of the Mancos Shale, the vertical limits for the pools is fixed as the entire Niobrara Member.

Operations in the Puerto Chiquito area have provided a classic example of how to properly develop and produce a fractured shale reservoir. Wells have been carefully located and prudently produced in order to enhance optimum recovery. The primary producing mechanism in the Puerto Chiquito Pool is gravity drainage. The operator has determined that ultimate recovery of oil from such a reservoir is substantially increased if production rates are controlled, high gas-oil ratio wells are not produced, and reservoir pressures are maintained as high as possible. In the West Puerto Chiquito Pool a pressure maintenance program has been initiated by the re-injection of produced gas into four up dip wells. The net result has been to insure excellent recovery of the oil in place.

As of January 1, 1974, 35 completed wells were located in the East Puerto Chiquito Pool. Nineteen of them were being pumped and 16 had been shut in. Cumulative production for this pool was 2,866,431 barrels. The West Puerto Chiquito Pool had contained 15 completed wells, with 11 producing and 4 being used as gas injection wells. Cumulative production for this pool was 4,695,817 barrels.

Dakota Formation

The Basin Dakota Gas Pool, like the Blanco Mesaverde Pool, is a huge stratigraphic gas reservoir with structure playing little part in gas accumulation. The Dakota is productive over much of the area occupied by the Blanco Mesaverde Pool; in addition, Dakota productive limits extend 12 to 15 miles southwest and 20 miles southeast of the Blanco Mesaverde Pool boundary. However, productive sands in the Dakota pool are less continuous. Dakota reservoir quality is also inferior to that of the Mesaverde and average per acre reserves are smaller. Net

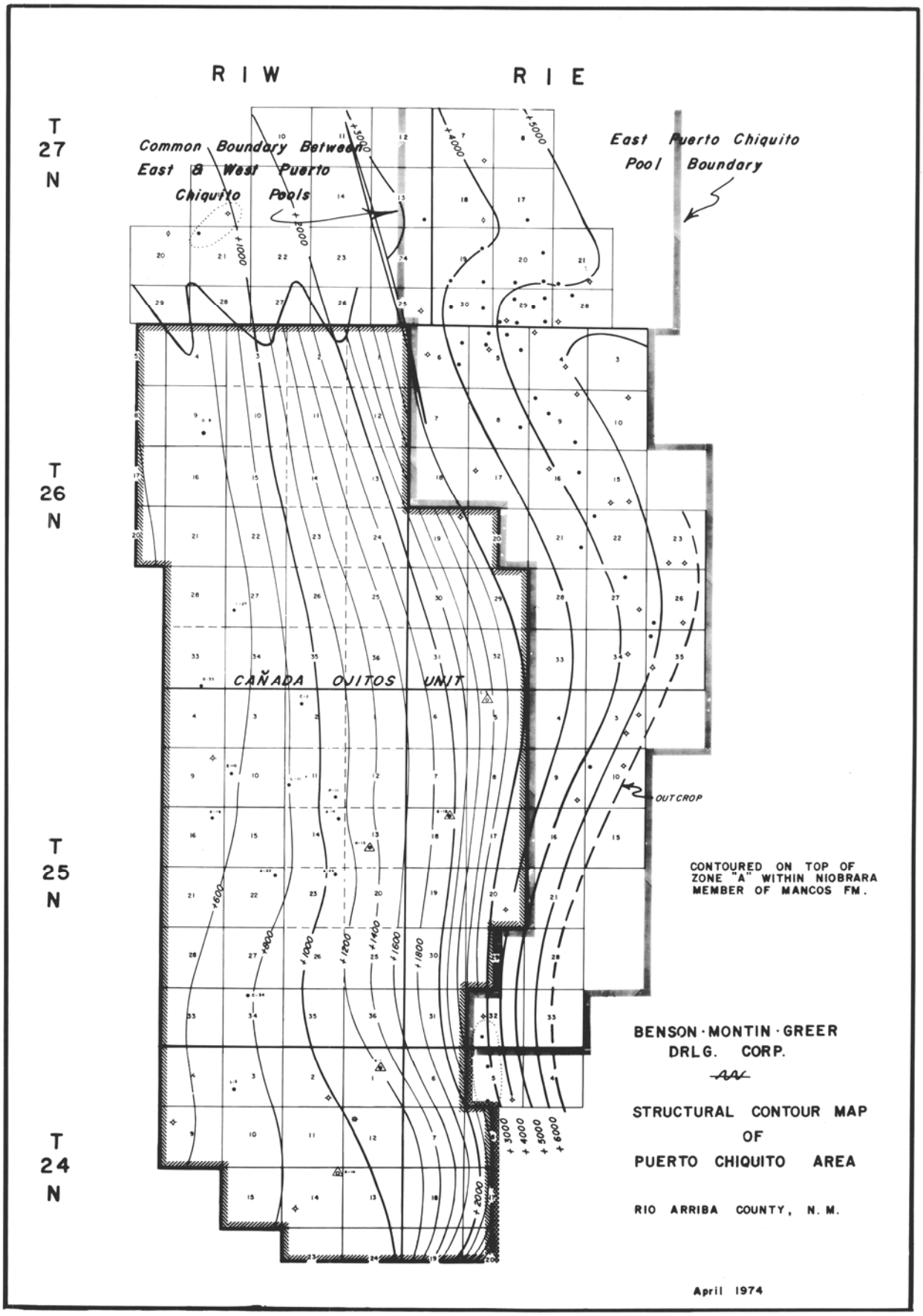
R 1 W
R 1 E
T 27 N
T 26 N
T 25 N
T 24 N
Common Boundary Between East & West Puerto Chiquito Pools
East Puerto Chiquito Pool Boundary
CAÑADA OJITOS UNIT
OUTCROP
CONTOURED ON TOP OF ZONE "A" WITHIN NIOBRARA MEMBER OF MANCOS FM.
BENSON · MONTIN · GREER DRLG. CORP.
STRUCTURAL CONTOUR MAP OF PUERTO CHIQUITO AREA
RIO ARRIBA COUNTY, N. M.
April 1974

Figure 1.

effective pay in the Rio Arriba portion of the Basin Dakota Pool ranges from 40 to 100 feet with the average thickness being about 60 feet. Prorosities in Dakota pay sands range from 7 to 11 percent and permeabilities average 0.15 millidarcys (Deischl, 1973). Fracturing, both natural and induced, is necessary in order to attain commercial flow rates. Dakota gas production has been excellent in some areas such as the Angel Peak, Huerfano, and Gallegos Canyon areas in San Juan County and the South Blanco, and Otero areas in Rio Arriba County. Dakota gas wells on the average produce more liquids than Mesaverde gas wells. In Southern Rio Arriba County several areas of low ratio Dakota oil production have been developed, primarily in Townships 24 North and 25 North, Range 4 West. This oil is also a stratigraphic accumulation and production rates are low, usually not exceeding 30 barrels per well per day.

As of January 1, 1974, 2277 gas wells were producing from the Basin Dakota Gas Pool. Of these 1582 are located in San Juan County, 695 in Rio Arriba County and 1 in Sandoval County. Production from the Basin Dakota Pool totaled 2.26 trillion cubic feet with 1.73 trillion cubic feet coming from San Juan County and 528.82 billion cubic feet coming from Rio Arriba County. Of the wells in the Basin Dakota Pool 30.6 percent are located in Rio Arriba County and 23.4 percent of the total cumulative production has come from Rio Arriba County. Average production per well in the Basin Dakota Pool as a whole is 993 million cubic feet, and in Rio Arriba County the average per well production is 761 million cubic feet. Oil and condensate production separated from the gas stream at the well has totaled 22,571,000 barrels, with 17,513,000 barrels coming from San Juan County Wells and 5,058,000 barrels coming from Rio Arriba County Wells. Three Dakota Polls in Rio Arriba County have been designated as oil pools. These are the Lindrith Pool (1 well), the Ojito Pool (3 wells), and the Wildhorse Pool (2 wells). Total cumulative production from these three pools to January 1, 1974 was 314,589 barrels of oil and 1.06 billion cubic feet of casinghead gas.

FUTURE EXPLORATION

The largest factor in the determination of future exploration activity on the east side of the San Juan Basin is the improving price schedule for both oil and gas. Some wildcat drilling activity has continued along the northeast side of the basin and in the Chama Embayment for a number of years. Most of this exploration has been structure oriented. Shows of oil and gas have been reported from wildcats drilled in the Chama area but there has not been a successful commercial completion. With prices improving this area should receive increasing attention. Similarly, price increases will cause many additional small producing oil and gas wells to be drilled to Cretaceous stratigraphic production zones in areas which were previously considered sub-marginal economic prospects.

The Entrada Sandstone has become a target for wildcat drilling in the basin as a result of successful exploitation of the Media Entrada Pool in T. 19 N., R. 3 W., Sandoval County by Fluid Power Pump Company and Petro Lewis Corporation. Localized thickening of the Entrada Sandstone plus some structural nosing has provided an effective closure of about 125 feet in this pool. The height of the oil column varies from 10 to 45 feet above the oil water contact. The oil is 32.6 gravity and has a very high pour point of 90° to 92° Farenheit. The oil is difficult to handle as production and transportation equipment must be insulated. High production rates can only be maintained by handling large volumes of water along with the oil. In spite of these problems, the pool has been averaging 10,000 to 12,000 barrels of production per month and cumulative production to January 1, 1974 was 492,255 barrels from 7 wells. The Entrada Sandstone exhibits excellent porosity and permeability so potential reservoirs in this formation will be eagerly sought.

Between 5000 and 6000 feet of sedimentary section below the Dakota Sandstone is practically unexplored in the inner San Juan Basin. Not more than 20 basement tests have been drilled in an area 80 miles square. Rio Arriba County, within the basin proper, has had only four tests. The Sandoval County portion of the basin has had seven basement tests. It is clear that additional deep exploration must be undertaken in the future and undoubtedly it will be.

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