Case No. 4067

Application, Transcripts, Small Exhibits, Etc.

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
February 26, 1969

EXAMINER HEARING

IN THE MATTER OF:

Application of Benson-Montin-Greer Drilling Corporation for special pool rules, San Juan County, New Mexico.) Case No. 4067

BEFORE: Elvis A. Utz, Examiner.

TRANSCRIPT OF HEARING

MR. UTZ: Case 4067.

MR. HATCH: Case 4067. Application of Benson-Montin-Greer Drilling Corporation for special pool rules, San Juan County, New Mexico.

The applicant has asked that the case be continued to March 5th, 1969.

MR. UTZ: Case 4067 will be continued to 3-5-69.

STATE OF NEW MEXICO)
)ss
COUNTY OF BERNALILLO)

I, GLENDA BURKS, Court Reporter in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me; and that the same is a true and correct record of the said proceedings, to the best of my knowledge, skill and ability.

Witness my hand this 29th day of March, 1969.

Glenda Burks
Court Reporter

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 4067, heard by me on Feb 26 1969.
[signature], Examiner
New Mexico Oil Conservation Commission

BENSON-MONTIN-GREER DRILLING CORP.

EXHIBITS IN CASE NO. 4067
BEFORE THE
NEW MEXICO OIL CONSERVATION
COMMISSION

March 5, 1969

INDEX

REFERENCES

1. B-M-G, "METHODS OF INTERPRETATION OF PRESSURE BEHAVIOR IN THE OIL PRODUCING FRACTURED SHALE RESERVOIRS OF THE PUERTO CHIQUITO POOL, RIO ARRIBA COUNTY, NEW MEXICO November 1, 1966", Pages 23 - 28 and Figures 9, 10, 11 and 12.

2. MUSKAT, "PHYSICAL PRINCIPLES OF OIL PRODUCTION", Pages 485 - 486.

3. MUSKAT, "PHYSICAL PRINCIPLES OF OIL PRODUCTION", Page 887.

4. MUSKAT, "PHYSICAL PRINCIPLES OF OIL PRODUCTION", Page 487, Equation 2.

5. "METHODS OF INTERPRETATION etc." (see Reference 1).

6. "METHODS OF INTERPRETATION etc." (see Reference 1), Page 12, 20, Figure 30, Figure 6.

7. "METHODS OF INTERPRETATION etc." (See Reference 1), Page 40.

8. "METHODS OF INTERPRETATION etc." (see Reference 1), Reference 18.

9. "METHODS OF INTERPRETATION etc." (see Reference 1), Page 28.

B

GEOLOGICAL BASIS FOR DETERMINING AREA OF EXPLORATION

Two criteria form the basis for the determination of the subject exploratory area. These are:

1. Adequate development of a zone within the Niobrara member of the Mancos Shale, and

2. Proximity to the steeply dipping Hogback rising out of the basin.

The exploratory area lies on a portion of the west rim of the basin, and as shown by the structural contour map (Figure 2) at the end of this section, the formations exhibit some of the steepest dips found anywhere in the San Juan Basin. Some of the dips are twice as steep as was found in the Verde Gallup Pool to the southwest.

Development of a critical zone within the Niobrara is shown by three cross-sections prepared from electric and radioactive logs of wells in the area. These cross-sections are included at the end of the text in this section. These cross-sections show certain correlative markers within the Niobrara, which for convenience are listed alphabetically from A to E. We consider Marker A to be the top of the Niobrara.

The first of these cross-sections, Figure 3, which is along a southwest-northeast line, goes through the well in which first production was obtained in this area. This well was originally drilled by Standard of Texas and is now operated by Benson-Montin-Greer Drilling Corp. and designated on the cross-section as Benson-Montin-Greer Drilling Corp. No. M-5 Standard of Texas. The well was completed with an uncemented liner in 800 feet of open hole, so it is impossible to tell exactly the zone from which the production originates. It is believed, however, that in this well it is coming from the zone colored in brown on the cross-section.

This zone is obviously better developed in the wells in the central part of the cross-section. Definite thinning of the zone occurs to the southwest, as is evident in the non-commercial well drilled by Standard of Texas in the southeast quarter of Section 14, Township 31 North, Range 14 West (left-hand log on Figure 3). The zone also appears to be deteriorating to the northeast as shown by the Southern Union No. 1 Jones in Section 22, Township 32 North, Range 13 West (right-hand log on cross-section). Interpretation of this well's log, however, is more indefinite than interpretation of logs of wells in the area to the south and west in which the zone definitely thins. The well with the apparently thickest section of the zone colored in brown is the Texas National No. 1 Johns. We believe its section is probably no thicker, however, than the three wells next south of it, for as can be seen from the cross-section, this well also has an apparently thicker section all the way from Marker A to E. This anomaly is probably best explained by assuming this well to have a straighter hole than the others and therefore indicating thicker sections.

The second cross-section (Figure 4) is also from the southwest to the northeast, displaced approximately two miles east of the first cross-section for the greater part of its length. It lies a little more directly north and south and is designated as a south-north cross-section.

All the logs on this cross-section, except the Southern Union No. 1 Jones, are ES Induction surveys and the correlations are a little more definite than the wells on the first cross-section. Here again the positive thinning of the main prospective producing interval is noted to the south, along with possible deterioration to the north in the vicinity of the Southern Union No. 1 Jones.

The third cross-section (Figure 5) is an east-west cross-section and goes through the other producing well in the proposed unit area. This well is the Lloyd B. Taylor No. 1 Vic Walker in the northwest quarter of Section 6. Here the producing interval is defined a little more closely (as compared to the B-M-G M-5) in that 5½" casing was set in this well at 2248 feet and the well was completed with approximately 260 feet of open hole. A natural oil show of approximately 3 barrels of oil per day was encountered in this well below the casing between 2250 and 2400 feet. It is believed the bulk of this oil show was picked up in the first 70 feet below the casing. This is not definite, however, as actual productivity tests of the oil shows were not made in the open hole below the 5½" casing.

It also appears from this cross-section that the zone has deteriorated in the westernmost well, Pan American Petroleum Corporation No. 1 Ute Mountain Tribal H. This is not definite, however, as we have no assurance that the logs are exactly comparable in electrical characteristics. Even so, with the information now available, the logical interpretation is that the main prospective zone would be non-productive in the vicinity of this well.

No effort has been made to contour the thickness or attempt to analyze the relative quality of the indicated main prospective pay zone. The area of the obviously better zone, however, is shown on the contour map, Figure No. 6 at the end of this section. The area which carries this significantly better section has been colored on Figure No. 6 in blue. It is noted that this area generally follows the synclinal trend as indicated by the structural contours. Whether this is of significance is at this time unknown.

As to the second criterion (proximity to the area of steeply dipping beds), we consider as most promising the area along the strike of the steepest dipping beds, with no limits laterally along the strike, but with certain down-dip and up-dip limits, the locations of which are estimated as follows:

Down-Dip: Here we draw on experience in West Puerto Chiquito, in which high capacity production has been obtained as far as one mile basinward from point of basin flexure. We have accordingly estimated the down-dip limit as being within one mile of this point, which approximately coincides with the zero contour on the structural maps herein.

Up-Dip: Here we have bases for three separate postulations for the location of the up-dip limit. These are:

1. Comparison with earlier pools.

2. Locus of possible up-dip faulting.

3. Indication of possible boundary condition affecting pressure build-up survey in the Taylor No. 1 Vic Walker.

Each of these are discussed as follows:

1. Up-dip limit of commercial production found in the Boulder Pool is within the contour interval 100 feet to 200 feet higher than the point of up-dip flexure. In the Verde Gallup Pool, the wells drilled at a position structurally higher than the 200 foot contour interval above the point of up-dip flexure were substantially poorer wells than those drilled in the main field. On the average, wells in this area would be considered not commercial. If this structural position of up-dip limit of commercial production in the Boulder and Verde Gallup Pools has any significance, and it seems to us it does, then one hesitates to include in the La Plata area as lands holding promise of production anything which lies structurally higher than 200 feet above the point of maximum up-dip flexure.

2. Locus of possible faulting: As discussed in Section D herein, there is strong evidence that a fault occurs in the vicinity of basin flexure. Since the amount of flexure is nearly the same on the up-dip side of the Hogback as on the basin side, it seems possible that an area of faulting may occur at or near this line of maximum flexure on the up-dip side. If so, this would place an area of faulting along the 4,000 to 4,100

foot contour interval (contour reference point being "E" marker).

3. Information from pressure build-up survey on the No. 1 Vic Walker: As discussed in Section D herein, there appears to be a good possibility that some kind of boundary affecting fluid flow characteristics lies within a distance of about 2,000 feet from the Taylor No. 1 Walker. In view of Items 1 and 2 above, plus the fact that the better developed part of the Niobrara section appears to deteriorate to the west of the No. 1 Walker, it is logical to assume that this boundary condition ison the up-dip side. 2,000 feet horizontally from the No. 1 Walker is the approximate location of the 4,100 foot contour interval, and this accordingly seems a likely location for the up-dip limit of production.

With down-dip and up-dip limits as above described, the prospective area meeting the qualifications of our second criterion becomes the area colored in red on Figure 7.

If we now define the most prospective area for production as being the one which meets both criteria, we arrive at the area on Figure 8 which is colored in yellow. A secondary area, or area with potential producing possibilities but regarded as inferior to the primary area, is shown on this Figure 8 as the area colored in brown. These primary and secondary areas (yellow and brown on Figure 8) are sometimes herein referred to as Areas A and B respectively.

On the north side of the proposed unit, Area B lies approximately along the strike and within a distance of about one mile from the north boundary of Area A. On the southwest side of the unit it lies within approximately one mile of the boundary of Area A but restricted somewhat because of the poor section in the Elizabeth Elliott well in the northwest quarter of Section 8.

It appears likely that Areas A and B are divided into at least two fault blocks by a sealing fault in the vicinity of the zero contour. Location of this fault and the method in which it divides Areas A and B into two fault blocks is shown on Figure No. 9. Elsewhere herein, particularly with respect to Area A, reference is made to the fault blocks lying on either side of this fault. The basinward fault block is sometimes referred to as the "basin block" and the up-dip fault block sometimes referred to as the "rim block".

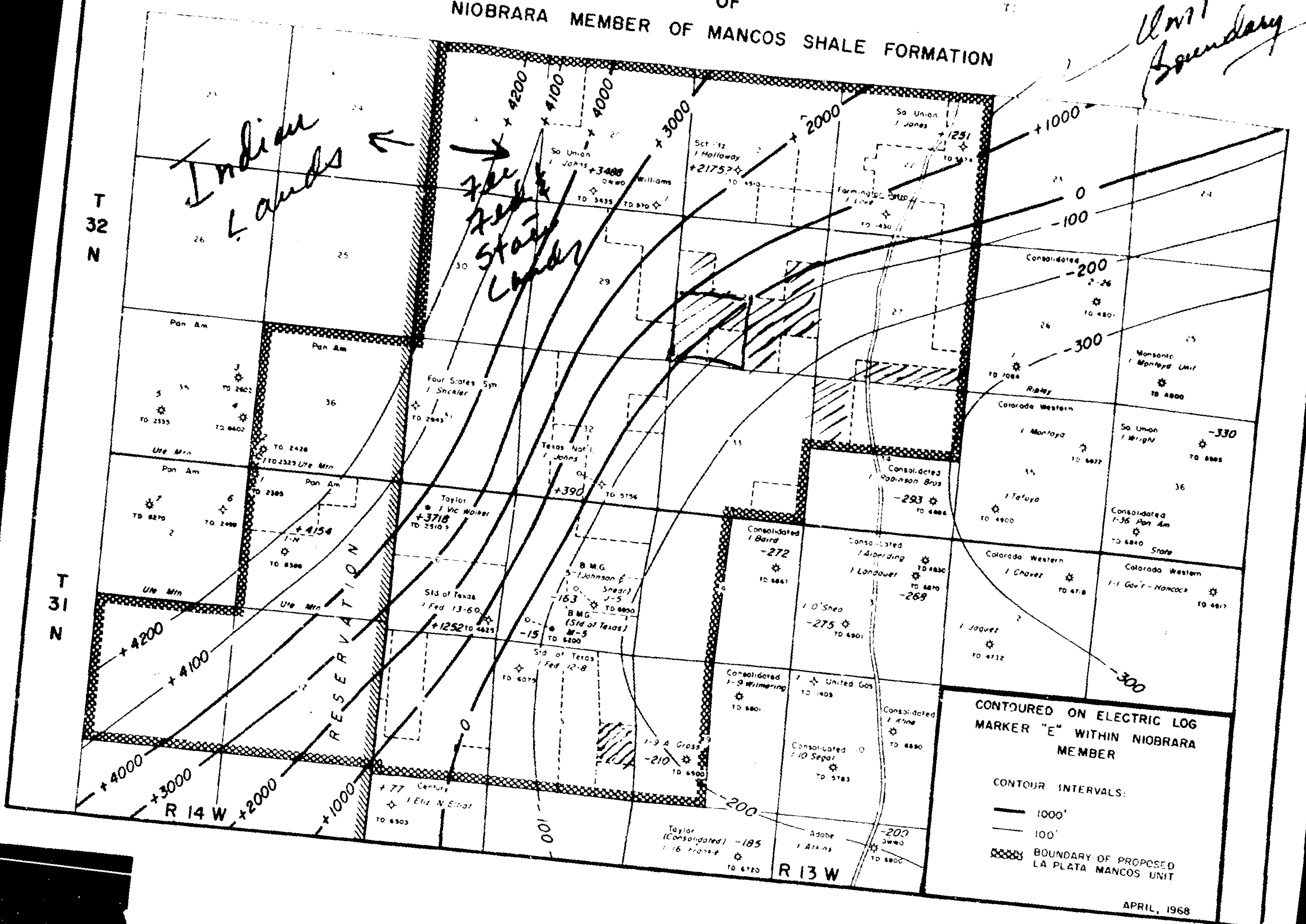
Mention should also be made in this section of possible additional zones of production. As previously indicated, the principal zone of interest is the one colored in brown on the three cross-sections. The adjacent yellow and green zones may also be productive, and completion methods should include stimulation of these zones. In addition, however, to the section lying between the D and E markers, we believe the zones lying between markers B and C deserve testing. These three zones lying between the B and C markers appear to have adequate continuity across the lands covered by the proposed unit area to offer possibilities of commercial production. In the drilling of his No. 1 Walker, Lloyd Taylor reported oil shows at depths which correspond roughly with the zones between the B and C markers. When the No. 1 Walker was at a depth of 2,250 feet a 24-hour bailing test, which was witnessed by a Benson-Montin-Greer representative, indicated a natural productivity of 3 barrels per day. This show, having persisted to the depth drilled in the time required, is considered a show which warrants testing. These prospective producing zones in the No. 1 Walker are cemented off behind the $5\frac{1}{2}$" casing, which is bottomed at 2,248 feet.

Further, regarding additional zones of interest, attention is called to the apparent development below the E marker in the Texas National No. 1 Johns shown on cross-sections Figures 2 and 4.

This apparent anomaly might of course be explained as a partial duplication of the overlying zones, resulting from faulting, particularly since this well lies close to the postulated fault along the basin flexure. On the other hand, this would require reverse or thrust faulting, and we do not know if tectonics in this area have been such as to permit this type faulting. Faults have been penetrated in East Puerto Chiquito with vertical displacement of as much as 280 feet. These, however, were normal (slip-type) faults. Accordingly, unless strong evidence to the contrary were developed, we would anticipate here at La Plata that faults would also be normal.

Accordingly we believe wells in the area should be drilled to a depth adequate to penetrate this possible additional zone. And in fact, for wells in the vicinity of the Texas National No. 1 Johns, consideration should be given to coring this interval.

STRUCTURAL CONTOUR MAP OF NIOBRARA MEMBER OF MANCOS SHALE FORMATION



CONTOURED ON ELECTRIC LOG MARKER "E" WITHIN NIOBRARA MEMBER

CONTOUR INTERVALS:

1000'

100'

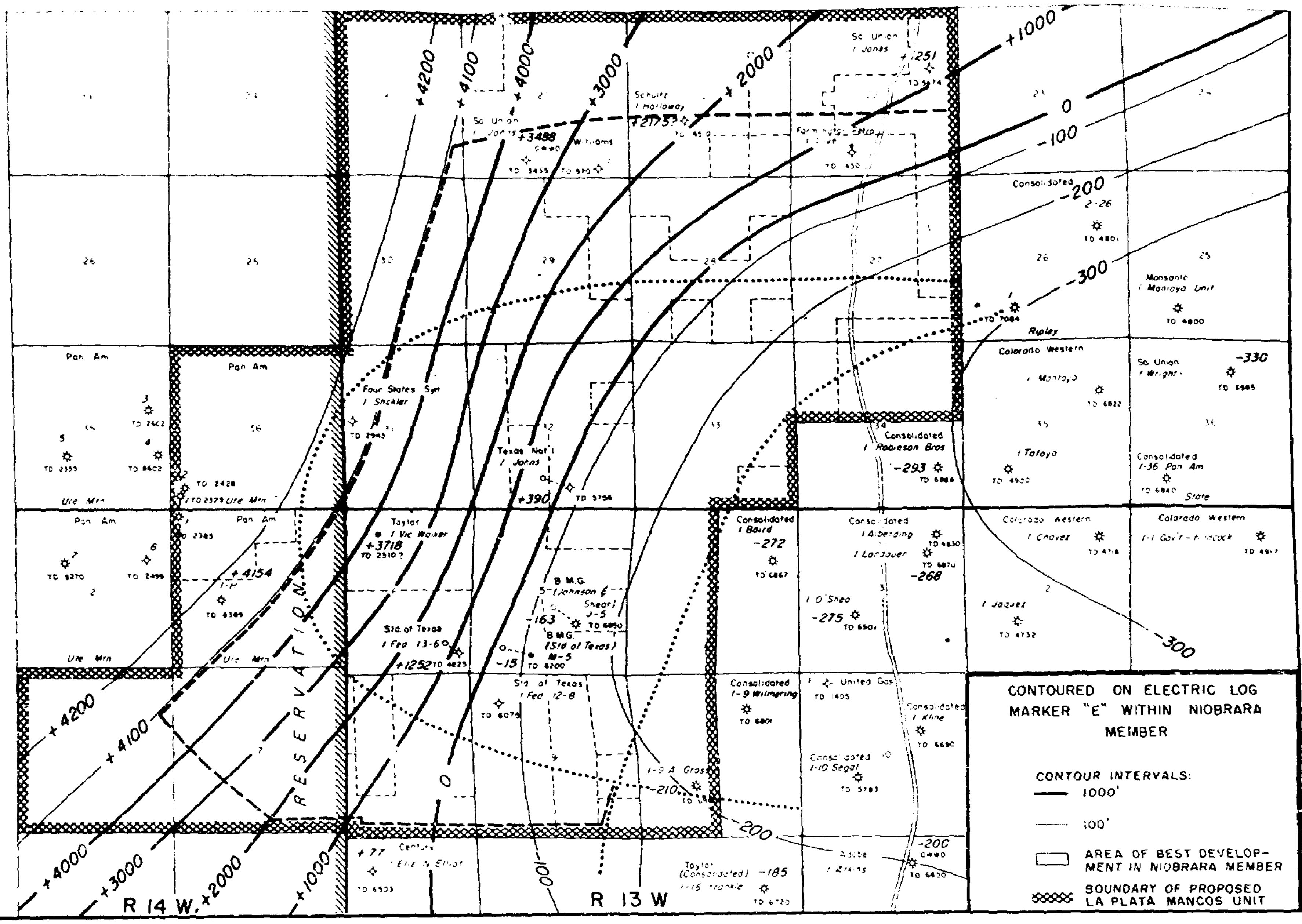
BOUNDARY OF PROPOSED LA PLATA MANCOS UNIT

APRIL, 1968

STRUCTURAL CONTOUR MAP

OF

NIOBRARA MEMBER OF MANCOS SHALE FORMATION



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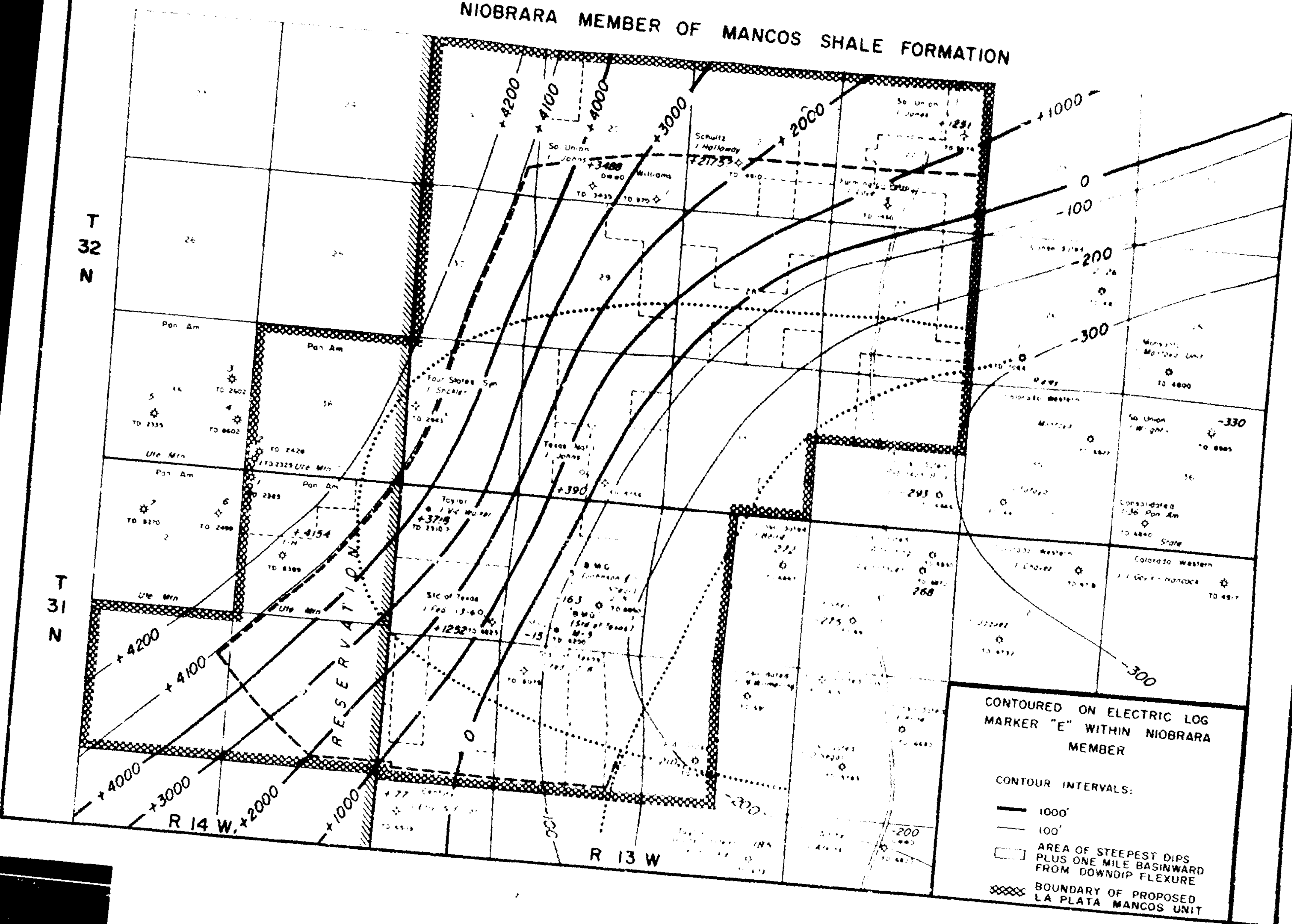

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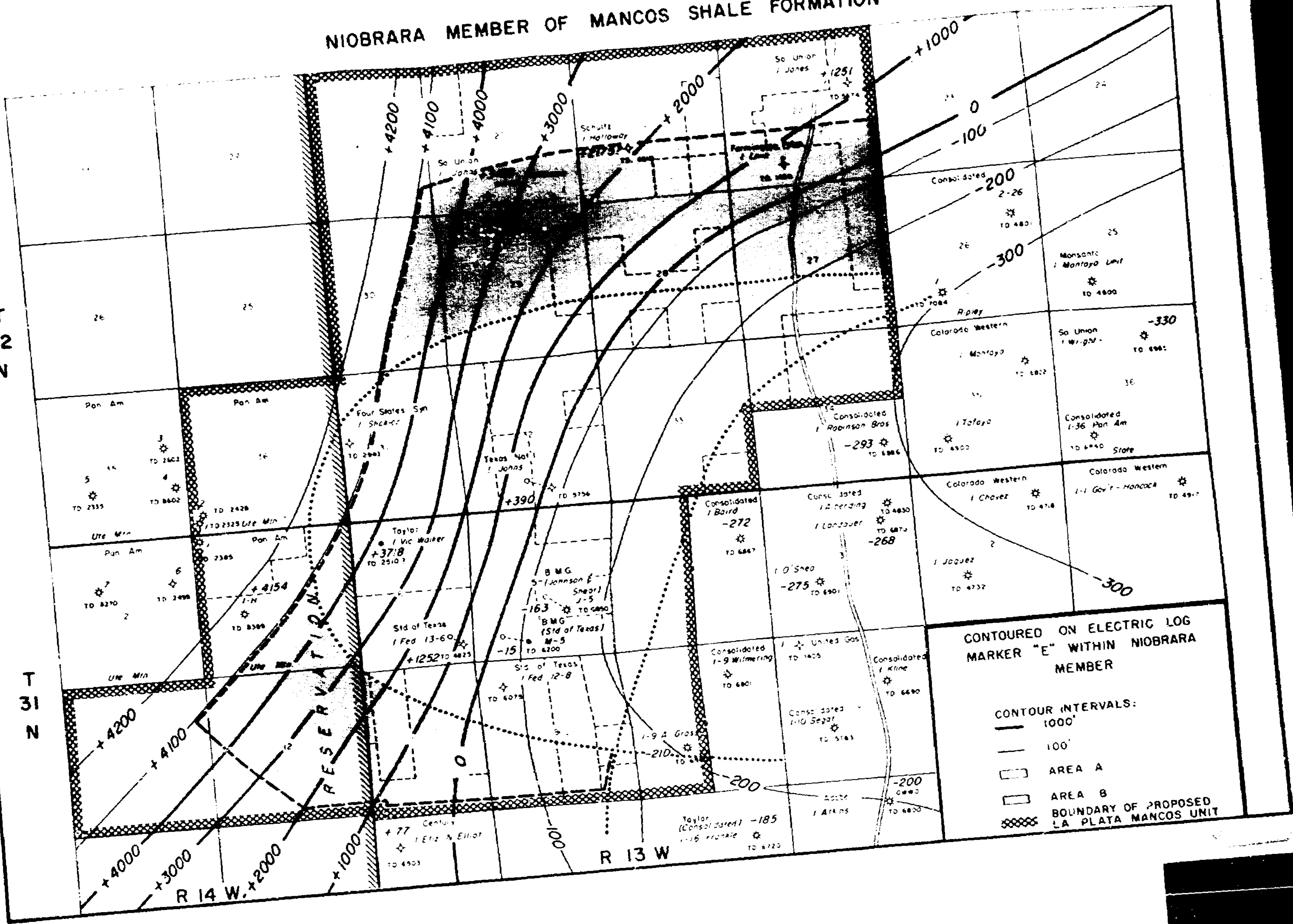

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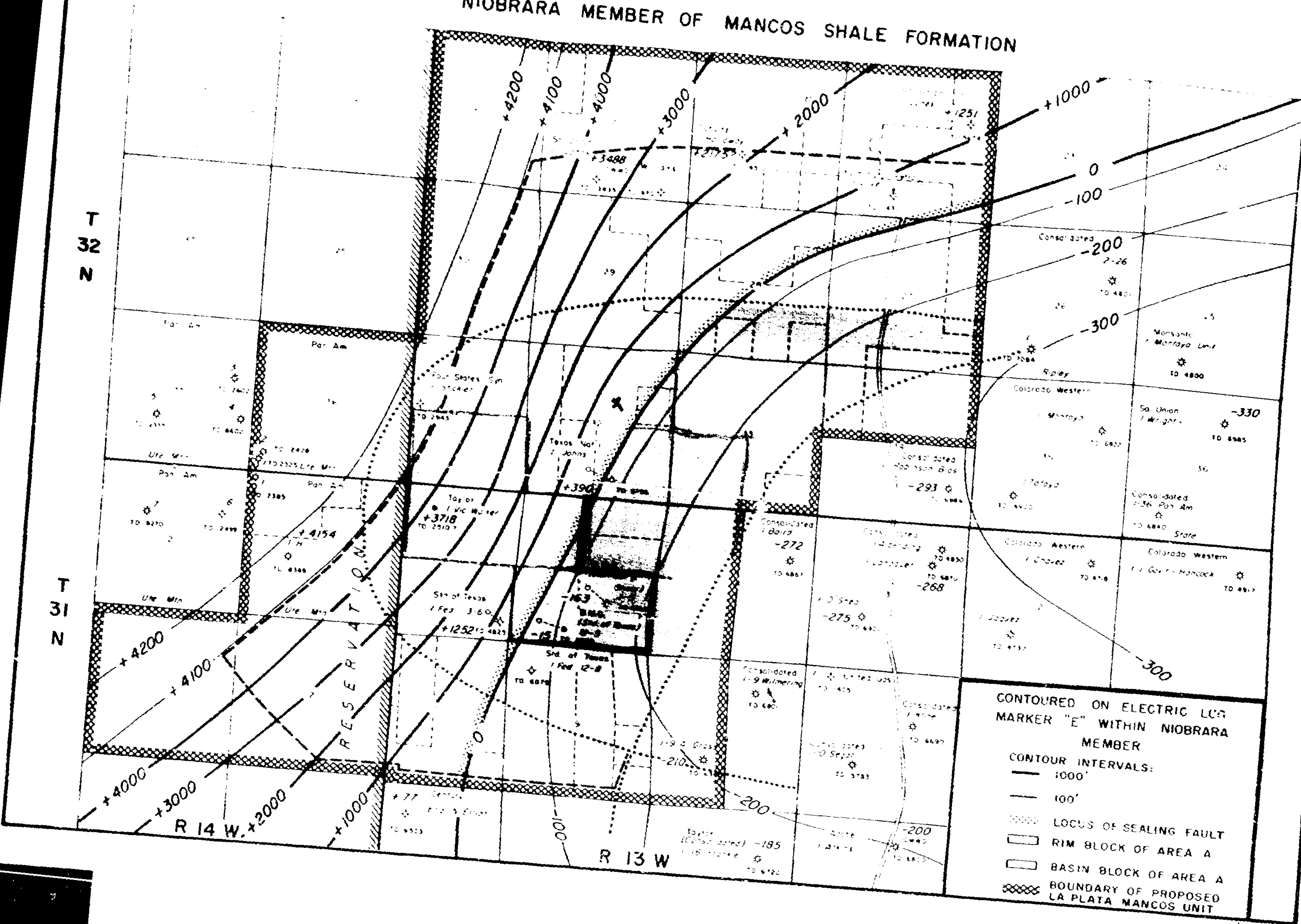

DISCUSSION OF RESERVOIR MECHANICS AND POSSIBLE OIL RECOVERIES

PART I COMPARISON WITH OTHER POOLS

The prospective producing zone or zones are in the Niobrara member of the Mancos Shale Formation. Pools in the San Juan Basin which produce or have produced from this fractured shale, and from which generalized conclusions may be drawn respecting possible production and oil recoveries in this proposed unit, are the following:

a. Verde Gallup

b. Boulder Mancos

c. East Puerto Chiquito

d. West Puerto Chiquito.

General information as to oil in place, recoveries and reservoir characteristics of each of these pools is discussed briefly below.

VERDE GALLUP

We do not have information as to initial reservoir pressures, pressure decline, fluid samples, productivity indices or other information which would be helpful in analyzing this reservoir performance. The better part of the reservoir, however, exhibited an excellent fracture system, and many wells were completed for natural production without requiring stimulation. Unofficial estimates of productivity suggest some of the better wells may have had productivities measured in terms of thousands of barrels per day. Communication was obviously extensive throughout the field and undoubtedly large-scale migration across the pool toward the better wells resulted.

Accordingly it is difficult to estimate accurately oil recovery per acre, let alone initial oil in place. Average recoveries for the better part of the pool, however, were on the order of 500 to 1,000 barrels per acre. It is almost a certainty that any group of wells that shows greater than 1,000 barrels per acre ultimate recovery has benefited by draining adjoining tracts. About all that can be gained from a study of the Verde Gallup history is that recoveries on the order of 500 to 1,000 barrels per acre on the average (with 1,000 maximum) may be anticipated from a comparable reservoir produced under competitive conditions.

BOULDER MANCOS

More information is available for the Boulder Pool than for Verde Gallup. Ultimate production from this pool will approximate 1½ million barrels, or about 750 barrels per acre. Some pressure data is available, as well as a fluid sample. Although pressure data for this pool is not as complete as might be desired, it nevertheless is adequate to provide an approximate calculation of total oil in place. Since the oil was originally undersaturated and rates of pressure decline both above and below the bubble point are available, it is possible to calculate the amount of free gas which originally existed in the reservoir, which quantity must be known in order to properly interpret the pressure behavior and determine volume of oil in place. These figures are of course only as accurate as the pressure decline data used in the calculations. It is believed, however, that the data and resultant analyses are accurate enough to provide approximate values for these reservoir characteristics. They show 12 to 13 percent of the reservoir space originally occupied by free gas, and 4.3 to 4.4 million barrels of oil in place. This means a recovery approximating 34 to 35 percent of oil in place was realized in Boulder. The Boulder Pool exhibited an excellent fracture system. Many of the wells in Boulder were completed for natural production without requiring stimulation. Standard of Texas reported transmissibilities as high as 47 darcy feet for one of its wells, and although capacities this high are difficult to measure with accuracy, there is no doubt that the fracture system in Boulder was of a high transmissibility. One of Mobil's wells flowed uncontrolled for a short period at rates approximating 4,000 barrels per day. Such productivity would require a transmissibility on the order of 10 to 30 darcy feet. It is probable that the main fracture system in Boulder had a transmissibility in excess of 10 darcy feet. The Boulder Pool reservoir characteristics may accordingly be summarized as approximating 2,200 barrels per acre in place, 750 barrels per acre recoverable, for approximately 34 to 35 percent recovery of initial oil in place, and initially having a main fracture system transmissibility in excess of 10 darcy feet.

EAST PUERTO CHIQUITO

East Puerto Chiquito is a small pool, approximately the size of Boulder, and is characterized by a comparatively inferior fracture system, at least to the extent that all but one of the wells have required stimulation in order to produce at commercial rates. No information is available as to fracture system transmissibility other than by comparison with Boulder, in which it is obviously of much lower transmissibility and probably much lower volume of oil in place per acre. The chief benefit gained from a study of East Puerto Chiquito is the apparent benefit of reservoir control which has been exercised in the manner of producing the wells. Effect of this is discussed briefly in Part III of this section.

WEST PUERTO CHIQUITO

A great deal of information has been obtained in West Puerto Chiquito as to reservoir pressures, reservoir fluid samples, and interference tests. Calculations of oil in place per acre made from interference tests at a time when the pressure was above the bubble point indicate oil in place in West Puerto Chiquito to be between 1,000 and 2,500 barrels per acre, depending upon the compressibility of the reservoir rock. Little information is available as to the compressibility of a fractured shale reservoir rock, and the resulting calculations are indefinite to the extent of this uncertainty. A reasonable estimate at this time, however, of initial oil in place in West Puerto Chiquito, determined from interference tests, would be an average of the above estimated extremes, or approximately 1,700 barrels per acre. Estimate 50% recovery on gravity drainage mech.

Interference tests have placed the transmissibility of the main fracture system in West Puerto Chiquito on the order of 5 to 6 darcy feet. We summarize the information as to West Puerto Chiquito at this time as being approximately 1,700 barrels per acre in place, with a transmissibility of 5 to 6 darcy feet. West Puerto Chiquito is a relatively large reservoir. The limits have not yet been defined, but the reservoir is believed to cover in excess of 10,000 acres.

SUMMARY OF PART I

Although it is virtually impossible from cores and logs to determine the reservoir void space in these fractured shale reservoirs, a study of flow characteristics of fractured systems indicates that a net producing interval of 10 to 50 feet thickness with porosities of 2 percent ranging down to 0.5 percent will generally satisfy the requirements of reservoir volume and transmissibilities exhibited by the fractured shale reservoirs found in the San Juan Basin. One such study (1) * compares transmissibilities and diffusivity constants of fractured reservoirs with sandstone reservoirs. These studies indicate that the relatively high well productivities as compared to sandstone or intergranular limestone reservoirs (for a like volume of oil in place) are to be expected, and that a general relation may be anticipated to exist between porosity and permeability, though probably covering a wider range than for sandstone and intergranular limestone. Accordingly this relation might be used in a general way to estimate oil in place by comparing transmissibilities. Although one is ordinarily hesitant to base reserve estimates on well productivity or

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* All references are listed under Section I

formation transmissibility alone, this is often about all the data available early in the life of a fractured shale reservoir. The relation of pore volume to permeability (and hence transmissibility for comparison of zones of equal thickness) is shown in Figure 10 * at the end of this section, for one type of fractured system.

One might interpret from this Figure 10 that if two reservoirs are compared and they have approximately the same number of fractures per foot of thickness of producing section, and the zones are of approximately the same thickness, the porosity can be expected to be higher in the reservoir of higher permeability. The relation is approximately a twofold increase in porosity for a tenfold increase in transmissibility. Expressed mathematically, we may say that the ratio of pore space in the two reservoirs would approximate the ratio of their transmissibilities taken to the .3 power.

Our present estimate of fracture system transmissibility for La Plata is 1 to 2 darcy feet. If we assume it to be 1.5 darcy feet and estimate oil in place through the above described relation by comparison with Boulder (10 darcy feet, 2,200 bbl/acre STO, FVF 1.1) and West Puerto Chiquito (6 darcy feet, 1,700 bbl/acre STO, FVF 1.29) we obtain:

1,370 bbl/acre of pore space (Boulder comparison)

1,450 bbl/acre of pore space (West Puerto Chiquito comparison)

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* Reproduced from Figure 9 of Reference (1).

or an average of approximately 1,400 bbl/acre. Stock tank oil in place per acre would accordingly be 1,150 bbl/acre for a FVF of 1.2 (basin block) or 1,250 bbl/acre for a FVF of 1.12 (estimated average of the rim block). Since this method is at best approximate we now estimate, for both the rim block and the basin block, 1,200 bbl/acre of stock tank oil originally in place for the main producing zone.

Bbl/acre in place in La Plata

if gravity drainage much is effective, recovery could approach 60%

PART II OIL RECOVERIES BY THE GRAVITY DRAINAGE DEPLETION MECHANISM

As explained by Muskat [2] the quantitative determination of the contribution of the gravity drainage mechanism to the ultimate recovery of many oil pools is extremely difficult. There are, however, some general theoretical considerations which point so strongly to the significantly higher ultimate recovery which may be realized if this mechanism be allowed to play a substantial role in the depletion of a steeply dipping fractured shale reservoir that we believe they should not be disregarded, and accordingly every effort should be made, in producing one of these reservoirs, to take maximum advantage of this depletion mechanism.

Residual liquid saturations which may result in a reservoir depleted by gravity drainage have been variously estimated as low as 20 to 25 percent. This is for relatively permeable sandstones. One intuitively would estimate that a fractured reservoir would have even a lower residual saturation, in view of the probably lower amount of surface area exposed and probably less retention of oil by the forces of capillary action. Accordingly we believe we might reasonably expect residual saturations of 20 to 25 percent in these fractured shale reservoirs if depleted by gravity drainage. Then, for an oil-wet reservoir depleted by gravity drainage, if the original reservoir pressure can be maintained such that no shrinkage occurs in the residual oil, as much as 75 to 80 percent of the initial oil in place might be recovered by gravity drainage. On the other hand, if 10 percent of the pore space were occupied by connate water, then the residual oil saturation might be as low as 10 to 15 percent of the initial oil in place (total residual fluid saturation 20 to 25 percent). This means, then, that as high as 85 to 90 percent of the original oil in place might be recovered through gravity drainage.

As stated by Muskat (3) the gravity drainage mechanism is inherently rate sensitive and little benefit may be realized from a reservoir with good gravity drainage possibilities if it is depleted at a rate too fast to permit the gravity drainage to operate. Under such conditions only solution gas drive recoveries may be anticipated.

Here, then, is a tremendous difference in ultimate recoveries dependent simply on the method of operation of the pool. Solution gas drive recoveries will ordinarily be on the order of 15 percent of oil in place, and so, with gravity drainage recoveries of 75 to 90 percent, we have a five to six-fold increase in ultimate recovery possible by taking advantage of the superior depletion mechanism.

Although fractured shales appear to have characteristics which will permit high gravity drainage efficiency, they also possess the characteristic which permits extremely rapid depletion rates under the solution gas drive mechanism, which if allowed to operate will destroy the gravity drainage potential. This characteristic is the ratio of permeability to porosity. The relative values of this function for fractured systems are compared to sandstones by the data set out on Figure 10. Simply stated, this means that wells producing from fractured shale reservoirs have such high capacities to produce (with respect to oil in place) and accordingly are so rapidly depleted that the only effective producing mechanism is solution gas drive. In other words, a pool which is indiscriminately developed and produced cannot be expected to have a high gravity drainage efficiency simply through the happenstance role gravity drainage may play in the overall producing mechanism. Obviously, to enjoy the benefit of gravity drainage, a pool must be intelligently controlled and operated.

Without experience in other fields with which to make comparisons, we cannot be certain that the theoretically high gravity drainage efficiencies can be realized. We can be reasonably sure, however, that if the pool be produced in such a fashion that the solution gas drive mechanism is the primary method of depletion, there can be little hope of achieving these high recoveries.

Obviously the practical method to develop a pool with potential gravity drainage possibilities is to so regulate production that the rates will not exceed the reasonable rate of gravity drainage available from the reservoir, providing of course that these rates allow the pool to be depleted in a reasonable length of time. Muskat (4) has shown how we may estimate this rate for a particular reservoir. Applying this relation to the present case and modifying the formula so that it expresses in barrels per day per linear mile along the strike the theoretically possible rate of down-dip gravity drainage, we have constructed the graph (Figure 11) included at the end of this section.

When we realize that dips in the rim block approximate 4,000 feet per mile and that transmissibilities may be in the order of 1 to 2 darcy feet, it becomes evident from inspection of Figure 11 that for the approximately three mile distance of the strike along the rim block this reservoir can adequately support gravity drainage rates of 1,000 to 1,500 barrels per day, which at this time is believed will deplete the reservoir in a reasonable length of time.

These high rates of gravity drainage, of course, will not long obtain if pressures are allowed to decline and high gas-oil ratio wells permitted to produce. Although it is difficult to quantitatively place values on the effect of pressure reduction on gravity drainage rates, we realize that it will have adverse effects in three specific instances. These are:

1. Viscosity will be lowered.

2. There will be an increase in the relative permeability ratio of gas to oil and a consequent decrease in relative permeability of oil.

3. Reduction of pressure will probably permit the fractures to squeeze together and further reduce transmissibility.

The combination of these effects can be drastic, reducing the original gravity drainage rates by a factor measured in terms of hundreds; and consequently completely destroying any possibility of efficient gravity drainage.

We believe we have an example in the East Puerto Chiquito Pool which may be viewed on a qualitative, if not quantitative, basis, that indicates we are achieving higher efficiencies than would otherwise result, through control of production. Up-dip high gas-oil ratio wells in this pool have been shut in (by "high gas-oil ratio" in this pool we are speaking in terms of 500 to 1,500 cubic feet per barrel). This pool, which has an unquestionably inferior fracture system than Boulder and accordingly is believed to have contained originally much less oil in place per acre than Boulder, has already produced over 500 barrels per acre, and it appears may ultimately produce as much oil per acre as Boulder (750 barrels per acre) despite its inferior qualities. The reason, we believe, is because the up-dip high gas-oil ratio wells have been shut in and the maximum benefit from gravity drainage is being realized. Not only this, but East Puerto Chiquito is developed on 160-acre spacing rather than on 80-acre spacing as was Boulder. So here we have an example of an inferior reservoir drilled on wider spacing, yet realizing as good an ultimate recovery as the better pool. This can only be attributed to the more efficient method of production - which method of production is, of course, not possible under competitive conditions.

Another interesting feature has been observed in East Puerto Chiquito. This is that the up-dip wells, during the life of the pool, have become impotent in terms of ability to produce down-dip oil. Not only are the gas-oil ratios of these up-dip wells high, but they seem to have no ability to bring the oil up to the well bore. Evidently, as the gas and oil move out of smaller fractures into larger ones, a critical condition is reached at which the gas slips through the oil and leaves it below, much in the same fashion that a flowing well may cease to flow if tubing of too great a diameter is installed and excess slippage in the flow stream results. We have here a situation quite different from the usual one in which gas caps must be controlled to prevent mass migration of oil into them with consequent loss of recoverable oil. About all the up-dip wells achieve is to "boil" the gas out of the down-dip oil and dissipate the pressure.

In the La Plata Pool this same characteristic is anticipated, only to a far greater extent because of the steeper dips. The main purpose the up-dip wells can serve will be either (1) as injection wells or (2) as observation wells. In this respect the Taylor No. 1 Vic Walker can probably serve both functions, and accordingly it does not at this time seem necessary to drill another up-dip well in the rim block.

PART III ESTIMATED RECOVERIES AS DEPENDENT UPON METHOD OF EXPLOITATION

If a main fracture system in La Plata exists as in other fractured shale reservoirs in the San Juan Basin, the ultimate oil recovery from the pool will have very little dependency on the number of wells drilled to it. It will of course be necessary to properly expose, within each fault block, all the producing zones to wells; and an adequate number of wells must be drilled within each fault block to establish the productivity required to deplete the respective reservoir in a reasonable length of time. Also, for fault blocks in the steeply dipping part of the formation, the producing wells should be located as nearly as practicable to the down-dip side of the fault block. If gas injection is instituted, it will of course be necessary to have a satisfactorily completed injection well relatively high structurally in each fault block in which gas injection is desired, and if waterflooding is used to sweep the bottoms of the fault blocks, this can probably be done with one of the producing wells not necessarily located close to the bottom of the fault block. The reason for this is the high transmissibility and steep dip of the formation will cause the water to gravitate to the bottom of the fault block and float the oil up to the producing wells.

Aside from the above listed considerations, numbers of wells or spacing of wells will have little bearing on the ultimate recovery from the pool. The important factor influencing ultimate recovery in a pool such as this is not numbers of wells but the method in which the pool is operated. If producing conditions are so controlled as to permit maximum operation of the gravity drainage mechanism, we believe recoveries as high as 70 percent of the oil in place, or even higher, may be realized. This can only be achieved, however, at reasonable rates of production by maintaining pressures above those which would normally be encountered in depletion by the solution gas drive mechanism, and keeping the gas in solution as long as possible. This can be partially accomplished by shutting in up-dip wells as soon as produced gas-oil ratios exceed the solution ratio. It will probably not be possible, however, to realize both high efficiency and high rates of production unless pressures are at least partially maintained by gas injection. Control of up-dip wells and institution of gas injection, of course, both require unitization. As to percent of oil in place which will be recoverable under competitive conditions, our only yardstick for comparison is Boulder. It is logical to conclude that Boulder's high recovery of 34 to 35 percent of oil in place is due in part to some gravity drainage and in part to a high relative permeability characteristic for its fracture system with its high transmissibility, which in itself may be caused by gravity drainage forces. With the lower transmissibility in the La Plata Pool, operating under competitive conditions, it is doubtful that recoveries will be as high. We accordingly estimate a recovery of 25 percent for the basin block and 30 percent for the rim block if development is under competitive conditions.

We estimate under unitized conditions that 70 percent of the oil in place in the rim block will be recovered and 30 percent for the basin block. Whether gas injection will be necessary to achieve this efficiency can only be estimated after the rim block wells are drilled and the reservoir characteristics better known.

These recovery figures applied to the approximately 1,200 bbl/acre estimated to be initially in place, and assuming 2,000 acres for the basin block and 2,400 acres for the rim block, yield the following:

FOR COMPETITIVE OPERATIONS

	Oil in Place (bbls)	Recoverable Oil (bbls)	Produced Oil (bbls)	Remaining Reserve (bbls)
Basin Block	2,400,000	600,000	300,000	300,000
Rim Block	2,900,000	870,000	-	870,000
			TOTAL	1,170,000

FOR UNITIZED OPERATIONS

	Oil in Place (bbls)	Recoverable Oil (bbls)	Produced Oil (bbls)	Remaining Reserve (bbls)
Basin Block	2,400,000	720,000	300,000	420,000
Rim Block	2,900,000	2,000,000	-	2,000,000
			TOTAL	2,420,000

It is, of course, possible that the rim block will contain undersaturated oil, and consequently more oil in place and more recoverable oil. This alone could add another 400,000 barrels to the rim block recovery.

PART IV VERTICAL SEPARATION OF ZONES WITHIN THE NIOBRARA MEMBER

Although one intuitively would expect vertical fracturing and vertical communication of zones within the Niobrara, and such vertical fracturing has been reported in the Verde Gallup Pool, experience in the Puerto Chiquito Pools has been to the contrary. We accordingly believe vertical separation may exist at La Plata, and certainly any drilling program should take this possibility into account and be so designed as to insure that each prospective producing zone will be satisfactorily opened to the well bore.

Apparent vertical separation of the zones within the Niobrara was observed in early wells in the Puerto Chiquito Pool. Because of this, precautions were taken in the drilling of subsequent wells to sand fracture individual zones separately. Carefully controlled drilling, testing and completion programs ensued, and although exceptionally good horizontal communication has been determined to exist in the Puerto Chiquito fractured shale reservoirs over long distances (measured in miles) no definite evidence has yet been developed as to vertical communication along the zones relatively close together (separation measured in terms of tens of feet). This vertical separation has been noted in some of the East Puerto Chiquito Pool wells even after fracture treatment.

We recognize that it seems illogical to conclude that a fractured shale reservoir could by any acts of nature be created in such a fashion as to have lateral dimensions measured in miles and at the same time have vertical limits so constrained that zones separated by vertical distances measured in tens of feet would not be in the same effective communication. We have no explanation for this enigma other than to assume the apparent producing zones are more brittle and able to retain a fracturing system than the intervening solid shales, which being less competent may tend to "flow" back into their original non-permeable states.

Regardless of the reason, however, we do know this condition to exist in similar pools, and believe operations in La Plata should be conducted under the premise that it may exist here. If we follow this reasoning, the well drilling and completion program should contemplate fracturing of the prospective producing zones individually. This will be necessary because if the sand fracture treatment enters only one zone and there are other zones in the well bore, it is entirely possible that the other zones will not be depleted by the subject well. This in turn means that substantial oil may remain unrecovered in the reservoir unless through happenstance enough wells receive fracture treatments in each of the zones to insure depletion. Since often one zone will be more susceptible to fracture treatment than the others, the chances are that this zone which breaks down more easily will be the one which will ordinarily receive the fracture treatment in all wells, unless precautions are taken to isolate the zones with separate treatments.

PART V SUMMARY

In view of the dry holes drilled in the La Plata area and the character of the fracture system as indicated by the pressure build-up test on the Benson-Montin-Greer No. M-5 Standard of Texas (as discussed in Section D herein) we classify this pool as a substandard reservoir, more comparable in character to the Puerto Chiquito Pools than to Verde Gallup or Boulder. There is not enough data available to establish the transmissibility of the main fracture system, however it now appears to be on the order of 1 to 2 darcy feet. Although this is adequate to support commercial production, it suggests that we should anticipate lower volumes of oil in place than occurred in Boulder and Verde Gallup.

The areas of low permeability (as found around the M-5 and the dry holes drilled in the pool) indicate a situation similar to the Puerto Chiquito Pools, in which there are apparently small (measured in terms of acres) barren areas throughout the reservoir. Wells drilled into these barren or poorly fractured local areas will find little or no natural production. Large fracture treatments will probably be required in order to establish satisfactory communication with the main fracture system. Accordingly, the dry holes which have been drilled in Area A do not in themselves condemn any part of this area. On the contrary, analysis of the logs of these wells serves to confirm the presence of a reservoir which will support commercial wells.

The main prospective reservoirs are identified in this section as the "rim block" and the "basin block". There may be a third reservoir up-dip from the rim block across the fault which we presume lies along the point of up-dip flexure. If a small reservoir does in fact exist here, it should not be drilled until such time as a substantial pressure drop occurs in the rim block, so that pressures in wells drilled in this third area will establish the presence or absence of an impermeable barrier between this area and the rim block wells, thus permitting analysis of reservoir conditions which will dictate the method of development.

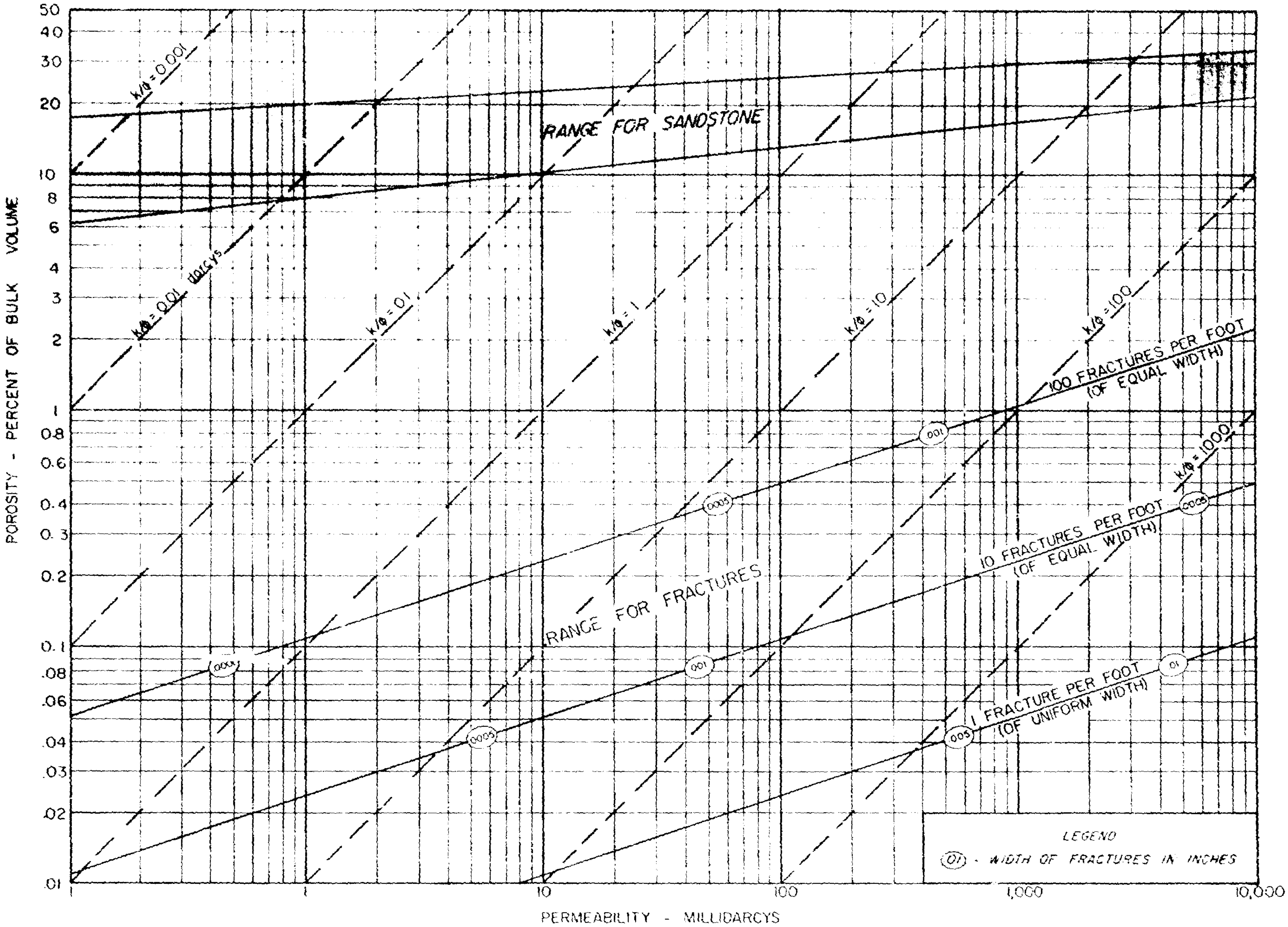
The volume of oil in place in the basin block as estimated in Part III of this section has been virtually proven from the pressure-production behavior of the Benson-Montin-Greer M-5. This is discussed in Section D herein. This confirmation by the M-5 pressure-production behavior of total amount of oil initially in place in the basin block, estimated in Part III, does not necessarily confirm either the per-acre estimate of oil in place or the basin block area as outlined therein. There is no positive data available at this time to confirm either of these estimated quantities, and the close (for the data available) agreement of the volume of oil determined by these two independent methods could, of course, merely be the result of a fortuitous choice of acreage and per-acre oil in place quantities. This total volume confirmation, though not proving the ideas advanced in this section, certainly does not detract from them.

As indicated in Part III of this section, the rim block offers the greater possibility for development at a profit. It must be recognized, however, that the volume of oil estimated for the rim block is more speculative than that shown for the basin block, as we have no pressure confirmation of reservoir volume in the rim block. If the rim block were proved to be highly faulted, such that rather than one continuous reservoir there are a number of smaller ones separated by sealing faults, it may be that the rim block will require so many wells to satisfactorily deplete it that it will be uneconomic to develop. Also it must be recognized that with the sealing fault (at the basin flexure) we cannot be certain that the lower part of the rim block in fact contains oil. It could very well have bottom water, and the estimated recoverable oil volume accordingly be reduced by the amount of reservoir space occupied by it, and which we have heretofore estimated to contain oil.

It should be recognized that the estimates made in this section of oil in place and recoverable oil apply only to the zone colored in brown on the cross-sections. Should additional reserves be developed in the B-C zones, this volume of oil will be in addition to the recoveries estimated in this section.

VALUES OF K/φ FOR SANDSTONE RESERVOIRS AND FOR FLOW SYSTEMS OF FRACTURES IN AN IMPERMEABLE MATRIX

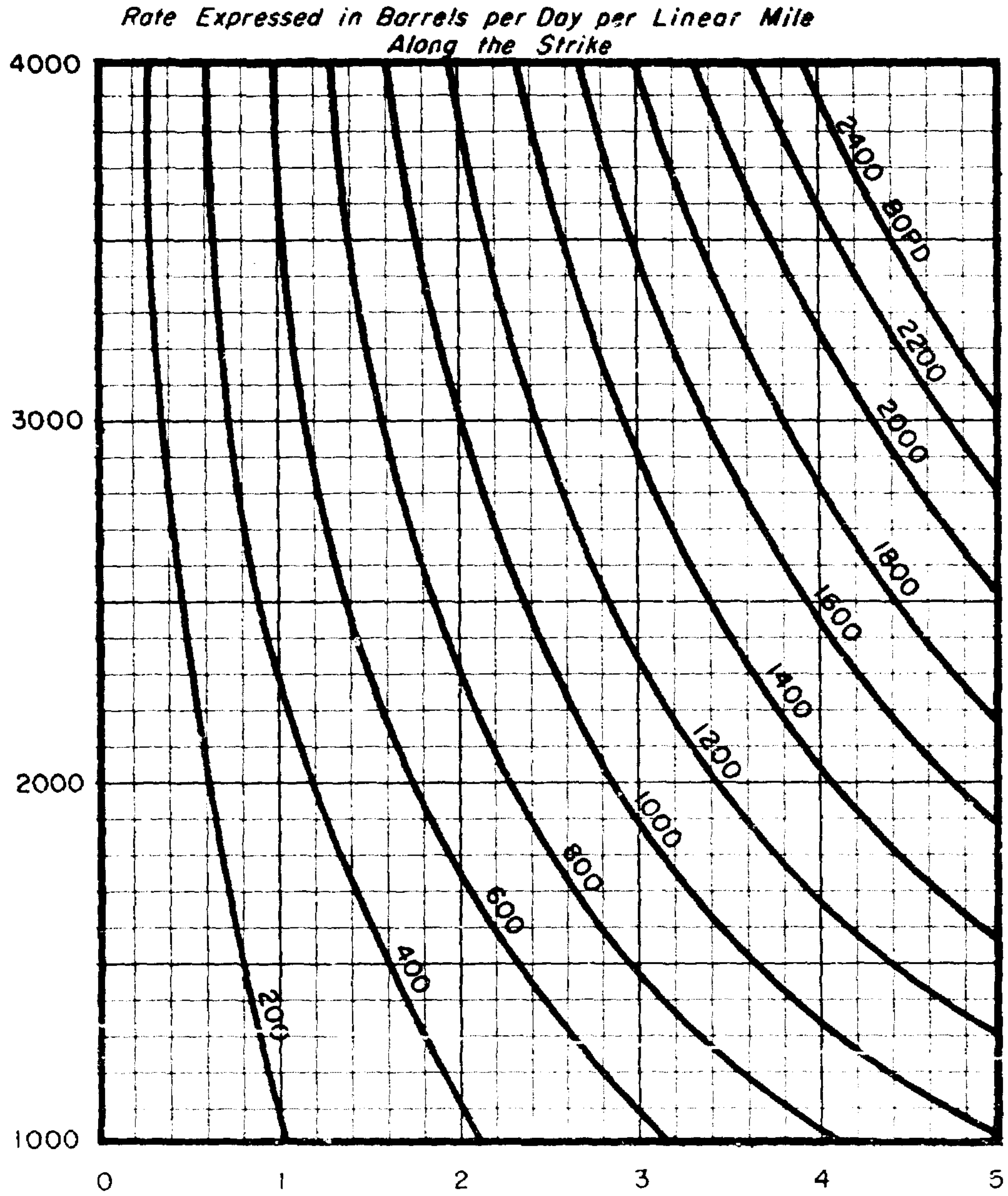
FRACTURES PARALLEL TO DIRECTION OF FLOW



MAXIMUM GRAVITY DRAINAGE RATES
LA PLATA MANCOS RIM BLOCK

VICOSITY = 2 cp

Specific Gravity = .8



APRIL, 1968

PRESSURE-PRODUCTION DATA
OF PRESENTLY COMPLETED WELLS
AND INTERPRETATIONS

PART I PRESSURE-PRODUCTION DATA OF BENSON-MONTIN-GREER NO. M-5 STANDARD OF TEXAS

A. Pressure Build-Up Data for Survey run April, 1968

A bottom hole pressure build-up survey was made for the B-M-G No. M-5 Standard of Texas in April, 1968. At the end of this section is a tabulation of the data for the first twelve days shut in. Also at the end of this section are two plots of the data, being Figures 12 and 13. Figure 13 is merely a more detailed plot of the pressures taken after the second day of shut in.

B. Pressure-Production Relation for B-M-G No. M-5

Additional bottom hole pressure data of this well as furnished to us by the previous operator (Hoss) follows:

8 -6-59	1,462 pounds
September 1962	1,312 pounds

We have no information as to how long the well was shut in for the above pressures. We understand, however, that it was shut in at least 24 hours. Pressures were measured at a well depth of 5,932 feet (ground level). These pressures, plus two of the pressures taken by B-M-G in the April, 1968 survey, are plotted against cumulative production on Figure 14 at the end of this section.

C. Interpretations

1. Estimated Initial Reservoir Static Pressure

The data in Figure 14 indicates the initial reservoir static pressure in the subject well was between 1,470 and 1,480 pounds. This assumes the first pressure taken in August, 1959, was shut in long enough to approach static conditions. Since the well had only produced for a short time and the reservoir probably had a reasonably high diffusivity constant then, the measured pressure should be fairly close to the true static pressure. Since we do not have the data with which to make this determination, we can only say the initial pressure appears to be in the order of 1,475 to 1,500 pounds.

2. Current Static Reservoir Pressure

Pressures measured by B-M-G and shown on the table at the end of this section in the April survey were measured at 5,900 feet RKB. To adjust these pressures to the depth at which Standard of Texas ran its pressures requires the addition of 12 pounds to the figures shown in the April test. This means the well exhibited a 48-hour shut-in pressure of 1,058 pounds and a 12-day shut-in pressure of 1,107 pounds when adjusted to the datum of the original pressures. Both of these points are plotted on Figure No. 14. It is impossible to estimate accurately how much this pressure is below the current true static reservoir pressure. With the limited data available as to reservoir transmissibility and geometry of the reservoir, we can only make certain maximum and minimum estimates. The often used plot of $\frac{\Delta t}{t + \Delta t}$ does of course not apply in this instance (5). Inspection of Figures 12 and 13 indicate the well is completed in a local area of permeability considerably lower than the next adjacent area. This is a typical situation in this kind of reservoir, and although we cannot state positively, it is logical to assume the transmissibility of the main fracture system will be something in excess of that shown by the last slope on Figure No. 14, which is .46 darcy feet. Allowing for errors of measurement, we accordingly estimate the minimum transmissibility at this time for the main fracture system to be .4 darcy feet. It is doubtful that the geometry of the reservoir is such that the difference in the 12-day pressure and the true static pressure could exceed that represented by a reservoir of quarter-circle pie shape in which the well is located at the point of the wedge. If this be the true situation, the actual reservoir pressure will be approximately 200 pounds higher than the 12-day shut-in pressure. If, however, the reservoir is circular in shape with the well in the approximate center and permeability is as high as 1.5 darcy feet (which seems entirely possible) then the true reservoir pressure will be less than 10 pounds greater than the 12-day shut-in pressure. Accordingly there is a wide range from 1,100 to 1,300 pounds in which the current static reservoir pressure may be. Since the maximum pressure increase noted above is probably an extreme situation, we believe it doubtful that the true reservoir pressure would be more than 100 pounds above the present 12-day pressure. Accordingly we have plotted this point on Figure No. 14 as the probable maximum pressure at this time. We can now determine from Figure 14 that the production-pressure relation for the reservoir in which the B-M-G No. M-5 Standard of Texas is completed is between 800 barrels per pound and 1,050 barrels per pound.

3. Total Reservoir Oil in Place

Although we do not have a fluid sample analysis for oil from this well, we would judge from gas-oil ratio, reservoir temperature and initial pressure that it would be comparable to that found in West Puerto Chiquito. If this be true, we can estimate (6) the compressibility of the reservoir system to be on the order of 350×10^{-6} to 400×10^{-6} for the average pressure decline from inception to the present date. With 400×10^{-6} and 800 barrels per pound, we arrive at 2 million barrels in place, and using 350×10^{-6} and 1,050 barrels per pound, the result is 3 million barrels in place. Accordingly we estimate as the two extremes 2 million and 3 million barrels of oil. A fair estimate at this time of total oil in place would be an average of the two extremes, or 2½ million barrels.

4. As indicated above, the M-5 is completed in a local area of low permeability. The size of this local area of low permeability can be calculated (7) following the work of Miller, Dyer and Hutchinson (8). This indicates the reservoir volume in the area of low permeability (.047 darcy feet) to be about 6,000 barrels. This means, then, that if the well were subject to a sand-fracture treatment of a volume of 6,000 barrels, it would be connected to a part of the reservoir with higher permeability and accordingly the well's productivity would be increased. It is, of course, possible that if the fracture treatment were conducted at high enough injection rates, some channelling would result and it would not be necessary to saturate

the entire 6,000 barrels to achieve a satisfactory treatment. Two or three thousand barrels might be enough. If a treatment is planned for this well, however, it probably should be designed to reach the higher permeability of .46 darcy feet. This volume of oil has not been calculated, but it would be substantially greater than the 6,000 barrels indicated to reach the first break in permeability. If this part of the reservoir could be reached with a fracture treatment, the productivity of the well could be increased approximately ten to one, from its present 100 barrels per day capacity to approximately 1,000 barrels per day. Workover on this well is not at this time recommended, however, as we are not certain as to the mechanical condition of the well and if it would stand such a treatment. In addition, although the fracture treatment would probably enter the zone now producing, there is some question in this regard, since the well is completed with about 800 feet of open hole. At the present time it seems a more logical course of action would be to fracture the adjoining well (B-M-G No. J-5 Johnson) which well is approximately 2,000 feet from the M-5, rather than risk mechanical failure of the M-5 which might result from the fracture treating process.

5. All interpretations of data are necessarily based on the assumption the M-5 is producing from one zone and that no "thief" zones have affected the pressure build-up test. We believe this is true - but of course, under the circumstances must qualify our interpretation to this extent.

PART II   PRESSURE-PRODUCTION DATA OF TAYLOR NO. 1 VIC WALKER

The Taylor No. 1 Vic Walker was completed in February, 1968 and produced approximately twenty days, when it was shut in March 8th for a pressure build-up survey. Data regarding this test is set out on the schedule at the end of this section. Under conditions governing this pressure build-up the conventional plot of $\frac{\Delta t}{t + \Delta t}$ is useful. Accordingly such a plot was made and is enclosed at the end of this section as Figure No. 15. In interpretation of the data shown on Figure 15, we have assumed that the oil is saturated and that accordingly the diffusivity constant is not so high as to invalidate the type calculation used [9]. With this qualification, we make the following interpretations:

1. Transmissibility in the vicinity of the well is approximately 2.5 darcy feet.

2. The change in slope of the points plotted at about the 10-day period after shutting in the well indicates some type of boundary condition affecting the pressure build-up in the well. This could of course be the result of an overall decrease in permeability at distances away from the well, or it could be a straight-line boundary as for instance a fault at a distance of approximately 2,000 feet from the well.

3. There is no evidence from the pressure build-up data of a "closed" type reservoir. Rather the plot has the typical appearance of well pressure building up under "infinite

conditions". Accordingly no estimate can be made as to the size of the reservoir other than to know that it is something greater than the volume of oil which can be calculated from this data, which indicates a minimum reservoir measured in terms of hundreds of acres.

4. Pressures have not yet been run in this well, but it is possible to estimate the static bottom hole pressure in the vicinity of the well at this time from estimated density of the column of oil in the well. From the plot of Figure 15 we estimate the static fluid level to be on the order of 1,380 feet. This means an oil column of 940 feet above the E marker in this well. With an estimated average density of the oil column of .35 psi/foot, we arrive at an estimated pressure at the 2,320 foot depth in this well of 329 pounds.

5. If we adjust this pressure to the datum at which the M-5's first pressures were taken (which is + 102 feet subsea after correcting for depth difference due to deviation of hole) we arrive at a pressure for the comparable datum approximating 1,500 pounds (using estimated reservoir gradient of .33 psi/foot).

PART III SUMMARY

In addition to the interpretations previously set out in this section, the pressure data indicate that a fault lies between the two wells herein discussed. We say this for the following reasons:

1. There appears to be continuity in the general area of all zones which appear prospectively productive.

2. Both wells are obviously in communication with reservoir areas of substantial size. The M-5 reservoir is measured in terms of thousands of acres and the Vic Walker No. 1 reservoir has a minimum size measured in terms of hundreds of acres. Accordingly these two wells should be in communication, since they are only one mile apart. They are not, however, for their pressures, adjusted to the same datum, are at least 300 psi apart. Moreover, this current pressure in the No. 1 Walker, adjusted to the datum of the first pressures in the M-5, indicates approximately 1,500 pounds, which is the approximate value estimated for the virgin pressure of this area.

3. Although it may be possible for a steeply dipping reservoir to contain oil with varying degrees of gas in solution, the fractured shale reservoirs thus far discovered in the San Juan Basin have contained oil with the same (from field measurements) volume of gas in solution, regardless of the depth difference. Here are two wells with substantially different volumes of gas in solution. The M-5 gas-oil ratios have been reported at approximately 500 cubic feet per barrel, where the No. 1 Walker gas-oil ratio is estimated to be on the order of 50 cubic feet per barrel.

. Pressure data of the M-5 indicates if an interference test is conducted with wells of this character it will take a long time (months, and perhaps over a year) for wells on relatively wide spacing to show the type interference which will be required to demonstrate communication to the Oil Conservation Commission when applying for wider spacing. It is probably just such a set of reservoir conditions as is indicated by the M-5, and unfortunate circumstances of well locations and production rates, which caused failure of Mobil's attempt to establish interference in Boulder.

. Since the relative permeability of the oil in the vicinity of the M-5 is probably less now than originally due to presumed presence of some free gas in the reservoir, it is likely that the initial transmissibility was two or three times as great as now. Accordingly this would place initial minimum transmissibility in the main fracture system around the M-5 as something in excess of 1 to 1.5 darcy feet.

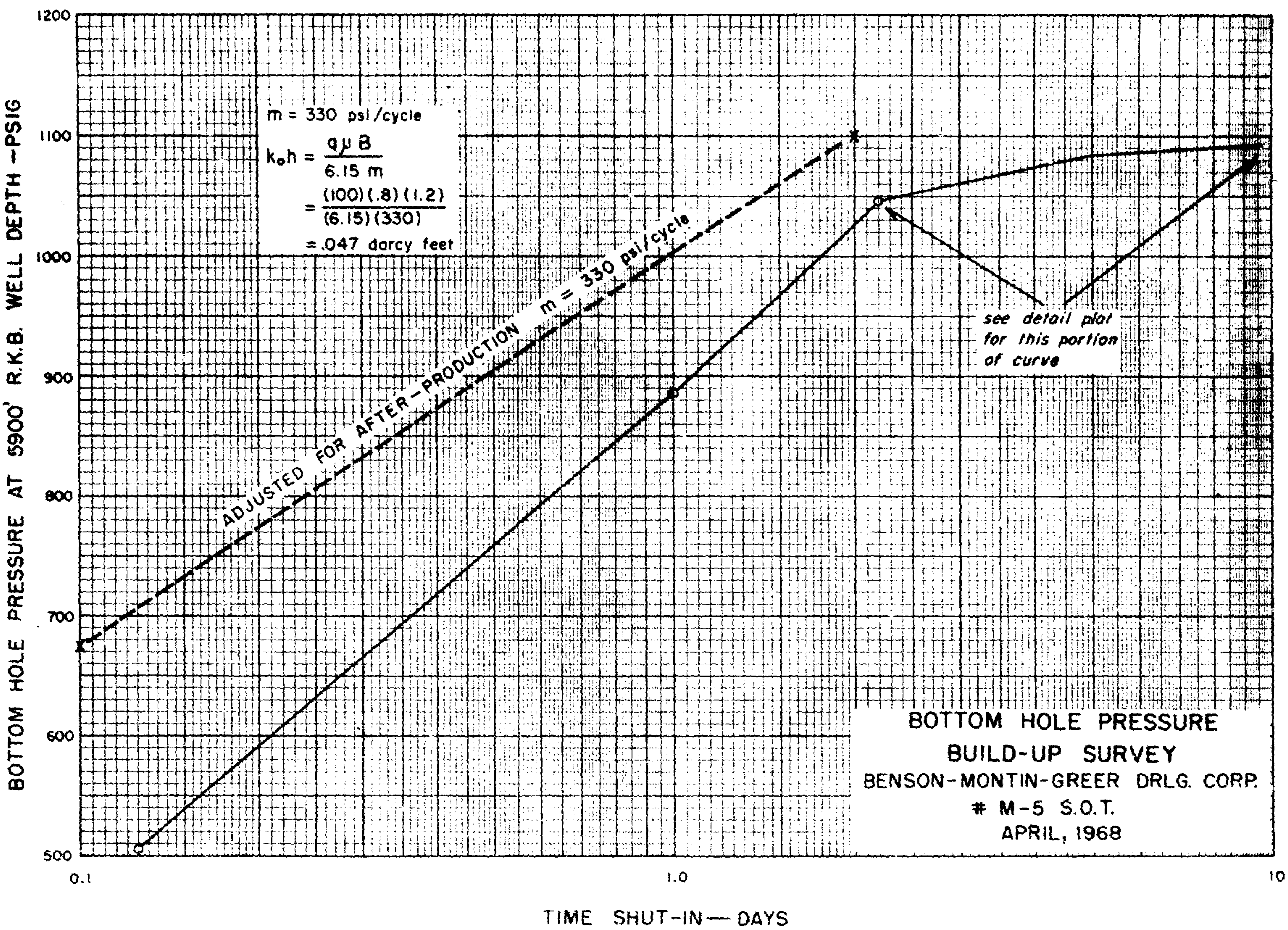
SCHEDULE OF DATA

PRESSURE BUILD-UP TEST
FOR
BENSON-MONTIN-GREER DRILLING CORP.
NO. M-5 STANDARD OF TEXAS

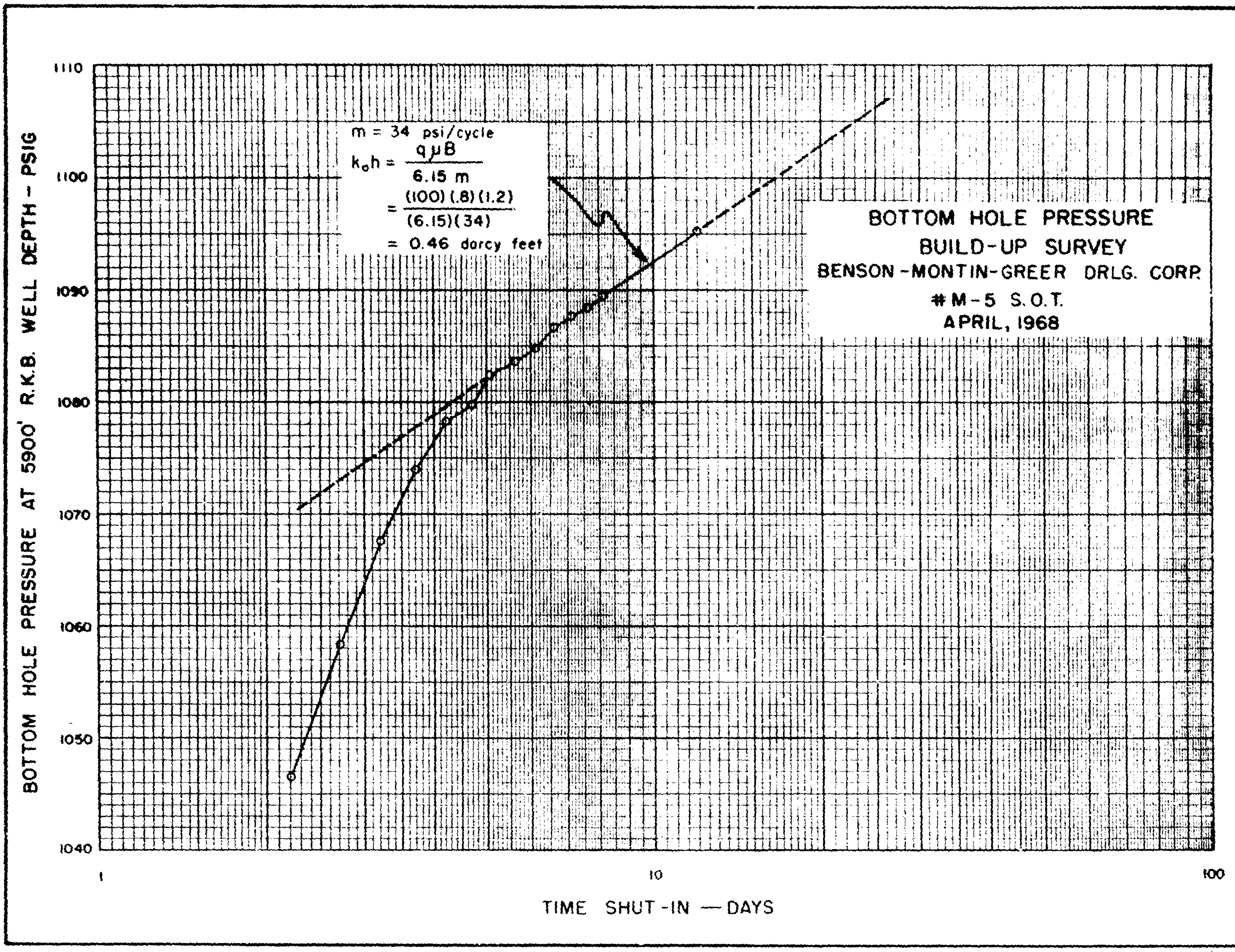
APRIL, 1968

DATE	TIME	DAYS SHUT IN	PRESSURE AT 5900' RKB : ECHOMETER	B.H. BOMB
4- 3-68	10:00 AM	0.12	505	
4- 4-68	10:00 AM	1.12	887	
4- 5-68	12:30 PM	2.2		1046.4
4- 6-68	12:30 AM	2.7		1058.2
	12:30 PM	3.2		1067.5
4- 7-68	12:30 AM	3.7		1074.0
	12:30 PM	4.2		1078.2
4- 8-68	12:30 AM	4.7		1079.8
	9:00 AM	5.05		1082.5
	10:30 PM	5.6		1083.5
4- 9-68	10:30 AM	6.1		1084.9
	10:30 PM	6.6		1086.7
4-10-68	10:30 AM	7.1		1087.7
	10:30 PM	7.6		1088.4
4-11-68	10:30 AM	8.1		1089.3
4-15-68	10:30 AM	12.1		1095.1

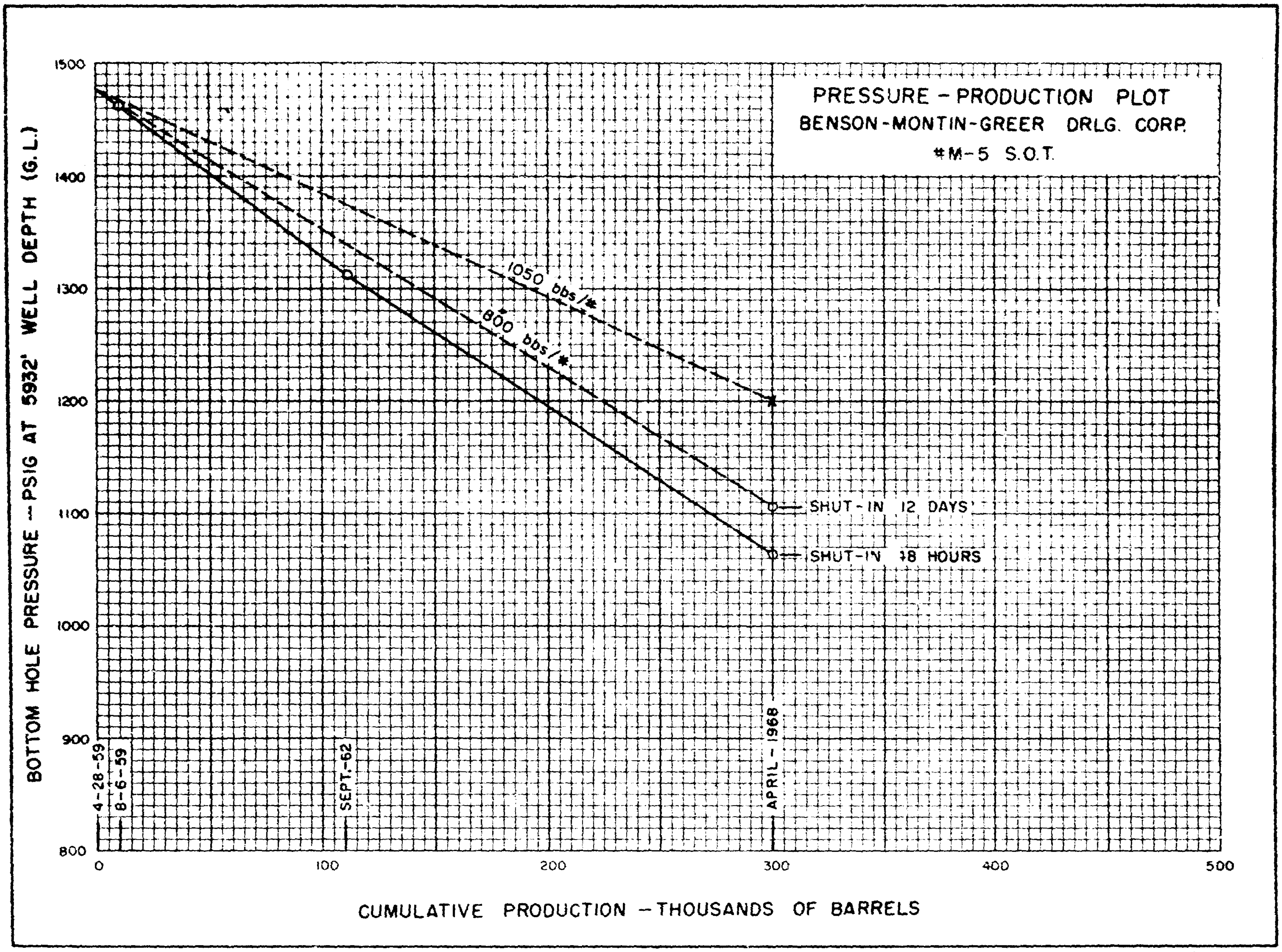
NOTE: Well was producing approximately 100 BOPD prior to shutting in.



BOTTOM HOLE PRESSURE AT 5900' R.K.B. WELL DEPTH –PSIG
1200
1100
1000
900
800
700
600
500
0.1
1.0
10
TIME SHUT-IN — DAYS
m = 330 psi/cycle
kₒh = qμB / 6.15 m
= (100)(.8)(1.2) / (6.15)(330)
= .047 darcy feet
ADJUSTED FOR AFTER-PRODUCTION m = 330 psi/cycle
see detail plot
for this portion
of curve
BOTTOM HOLE PRESSURE
BUILD-UP SURVEY
BENSON-MONTIN-GREER DRLG. CORP.
M-5 S.O.T.
APRIL, 1968



m = 34 psi/cycle
$k_o h = \frac{q \mu B}{6.15\ m}$
$= \frac{(100)(.8)(1.2)}{(6.15)(34)}$
= 0.46 darcy feet
BOTTOM HOLE PRESSURE
BUILD-UP SURVEY
BENSON-MONTIN-GREER DRLG. CORP.
#M-5 S.O.T.
APRIL, 1968
BOTTOM HOLE PRESSURE AT 5900' R.K.B. WELL DEPTH - PSIG
1110
1100
1090
1080
1070
1060
1050
1040
1
10
100
TIME SHUT-IN — DAYS



PRESSURE - PRODUCTION PLOT
BENSON-MONTIN-GREER DRLG. CORP.
#M-5 S.O.T.
BOTTOM HOLE PRESSURE -- PSIG AT 5932' WELL DEPTH (G.L.)
CUMULATIVE PRODUCTION - THOUSANDS OF BARRELS
1500
1400
1300
1200
1100
1000
900
800
0
100
200
300
400
500
1050 bbs/#
800 bbs/#
SHUT-IN 12 DAYS
SHUT-IN 48 HOURS
4-28-59
8-6-59
SEPT.-62
APRIL-1968

FIGURE 14

LLOYD B. TAYLOR #1 VIC WALKER
PRESSURE BUILD-UP SURVEY

WELL HISTORY PRIOR TO SHUTTING IN:

1. SAND-FRAC TREATMENT ± 500 BBLS. OIL, 20,000# 20/40 SAND.
2. RECOVERED LOAD OIL IN 5 DAYS, 2-13 TO 2-18-68.
3. FIRST NEW OIL 2-18-68.
4. PRODUCED LAST 12 DAYS IN FEBRUARY, 1,272 BBLS. OIL

   PRODUCED FIRST 7 DAYS IN MARCH TILL 8:30 AM 3-8-68 MARCH PRODUCTION 653 BBLS. OIL (DOWN ONE DAY).
5. PUMPING RATE WHILE PRODUCING ± 110 BOPD

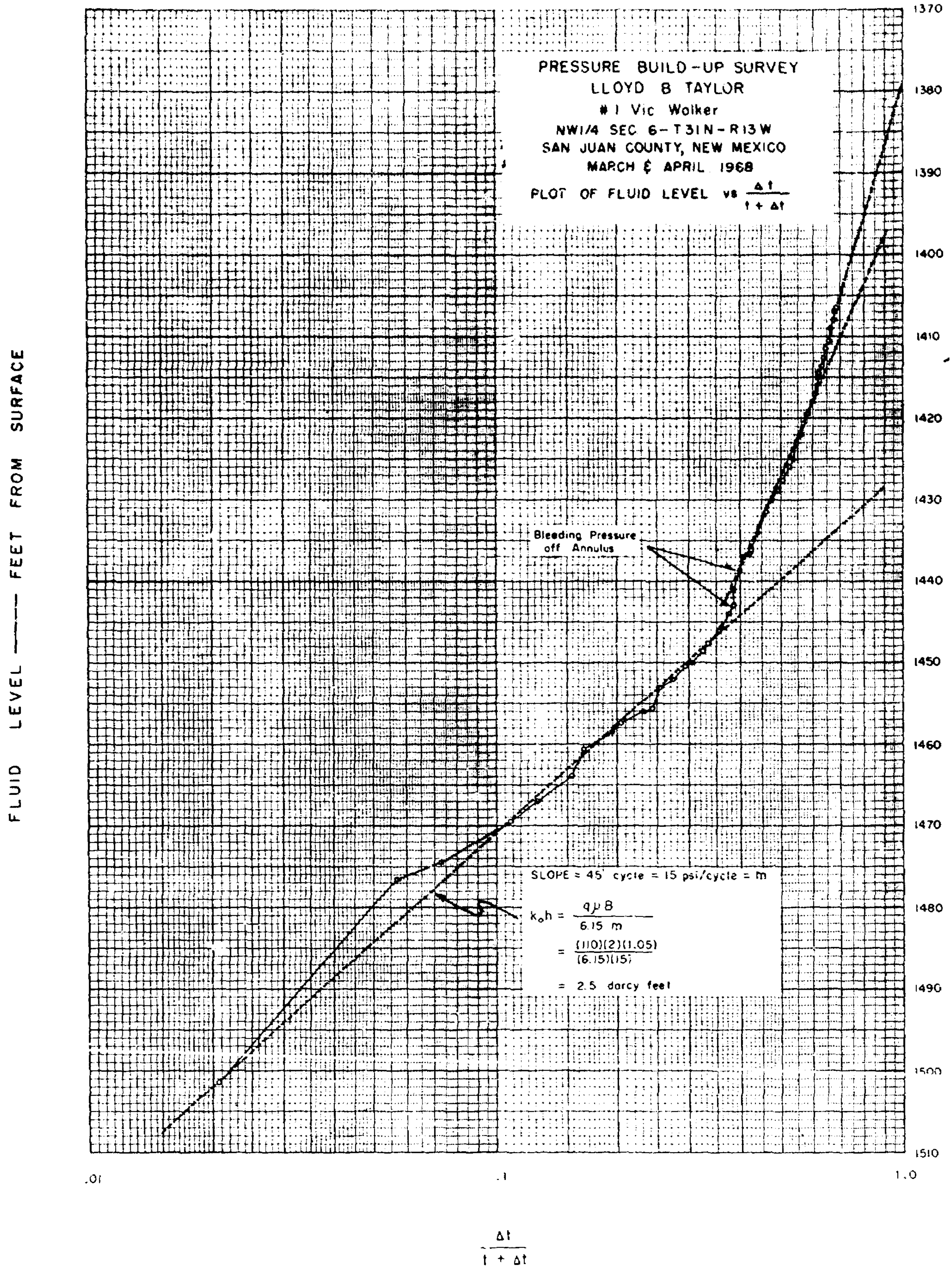
$$\frac{1272 + 653}{110} = 16.6 \text{ days} = \text{time } t\text{, for use in plot of pressure vs. } \frac{\Delta t}{t + \Delta t}$$

FLUID LEVELS MEASURED WITH FLOAT ON WIRE LINE (ZEROED AGAINST SWAGE)

DATE	TIME	Δt (days)	$16.6 + \Delta t$ (days)	$\frac{\Delta t}{16.6 + \Delta t}$	FLUID LEVEL (feet from surface)
3- 8-68	5:00 PM	.35	16.95	.0206	1501½
3- 9-68	8:40 AM	1.00	17.60	.0568	1476½
	4:00 PM	1.31	17.91	.0730	1474½
3-10-68	9:15 AM	2.03	18.63	.1090	1469½
	6:00 PM	2.40	19.00	.126	1467
3-11-68	9:15 AM	3.03	19.63	.154	1464
	4:45 PM	3.33	19.93	.167	1460½
3-12-68	9:15 AM	4.03	20.63	.195	1458½
	4:00 PM	4.31	20.91	.206	1457½
3-13-68	9:15 AM	5.03	21.63	.232	1456
	4:40 PM	5.33	21.93	.243	1455½
3-14-68	8:45 AM	6.00	22.60	.255	1453
	4:15 PM	6.32	22.90	.276	1452

DATE	TIME	Δt (days)	$16.6 + \Delta t$ (days)	$\frac{\Delta t}{16.6 + \Delta t}$	FLUID level (feet from surface)
3-15-68	8:45 AM	7.0	23.6	.297	1450½
	4:30 PM	7.33	23.9	.306	1450
3-16-68	7:40 AM	7.96	24.6	.324	1448½
	4:00 PM	8.31	24.9	.334	1447½
3-17-68	9:15 AM	9.03	25.6	.352	1446
	4:30 PM	9.33	25.9	.360	1445½
3-18-68	9:15 AM	10.03	26.6	.376	1444
				Bled pressure off annulus	
	4:45 PM	10.34	26.9	.384	1443
				Bled pressure off annulus. Fluid level	1441
3-19-68	8:15 AM	11.0	27.6	.398	1438½
				Bled pressure off annulus. Fluid level	1438
	4:45 PM	11.3	27.9	.405	1437
3-20-68	8:15 AM	12.0	28.6	.420	1436½
	5:15 PM	12.3	28.9	.425	1436
3-21-68	8:30 AM	13.0	29.6	.440	1434
	PM				1433
3-22-68	AM	14.0	30.6	.458	1431½
	PM				1431
3-23-68	AM	15.0	31.6	.475	1430
	PM				1429½
3-24-68	AM	16.0	32.6	.490	1429
	PM				1428½
3-25-68	AM	17.0	33.6	.505	1427½
	PM				1427
3-26-68	AM	18.0	34.6	.524	1426
	PM				1425½

DATE	TIME	Δt (days)	$16.6 + \Delta t$ (days)	$\frac{\Delta t}{16.6 + \Delta t}$	FLUID LEVEL (feet from surface)
3-27-68	AM	19.0	35.6	.535	1425
	PM				1423½
3-28-68	AM	20.0	36.6	.546	1423
3-29-68	AM	21.0	37.6	.559	1422
3-30-68	AM	22.0	38.6	.570	1420½
	PM				1420
3-31-68	AM	23.0	39.6	.581	1419½
	PM				1419
4- 1-68	PM	24.3	40.6	.597	1418
4- 2-68	AM	25.0	41.6	.602	1417
4- 3-68	AM	26.0	42.6	.612	1415
4- 4-68	AM	27.0	43.6	.620	1414½
4- 5-68	AM	28.0	44.6	.627	1413½
4- 6-68	AM	29.0	45.6	.636	1412½
4- 7-68	AM	30.0	46.6	.644	1411½
4- 8-68	AM	31.0	47.6	.652	1410½
4- 9-68	AM	32.0	48.6	.660	1410
4-10-68	AM	33.0	49.6	.666	1409
4-11-68	AM	34.0	50.6	.672	1408
4-12-68	AM	35.0	51.6	.680	1407
4-13-68	AM	36.0	52.6	.683	1406½


PRESSURE BUILD-UP SURVEY
LLOYD B TAYLOR
#1 Vic Walker
NW1/4 SEC 6-T31N-R13W
SAN JUAN COUNTY, NEW MEXICO
MARCH & APRIL 1968
PLOT OF FLUID LEVEL vs Δt / (t + Δt)
Bleeding Pressure off Annulus
SLOPE = 45' cycle = 15 psi/cycle = m
k₀h = qμB / 6.15 m
= (110)(2)(1.05) / (6.15)(15)
= 2.5 darcy feet
FLUID LEVEL —— FEET FROM SURFACE
Δt / (t + Δt)
.01
.1
1.0
1370
1380
1390
1400
1410
1420
1430
1440
1450
1460
1470
1480
1490
1500
1510

DRILLING AND COMPLETION METHODS AND COSTS

As indicated in Part IV of Section C herein, experience in other fractured shale pools in the San Juan Basin has shown vertical separation of producing zones and the necessity to separately sand fracture each zone in the Niobrara from which production is desired.

To insure that fracture treatment will reach each potentially productive zone, it is necessary that casing (or liner) be cemented through the entire section in which the zones occur. It is, of course, possible in some instances to drill through the pay zone with mud and conventionally cement the production casing. If, however, drilling is attempted in this manner and the hydrostatic pressure of the mud column breaks down the producing zones and a large volume of mud enters the fractures, the producing ability of the reservoir near the well bore may be so adversely affected that it can never be made to produce at economical rates, even after fracture treatment.

It is accordingly recommended that completion be made by keeping mud off the prospective producing zones. This is accomplished by setting an intermediate string of casing at or near the top of the Niobrara and drilling in with rotary tools, using air or gas as the circulating medium, or with cable tools. If the choice is rotary tools and in the course of drilling too much natural free oil is encountered to permit "dusting" and continued drilling, it may be possible to change to oil as the circulating medium and successfully continue the drilling. Because of this contingency, the intermediate casing should be set through the marker "A" shown on the cross-section in Section B herein, as experience has shown that the Mancos Shale above the Niobrara may seriously slough if exposed to drilling with oil.

Since in at least the first few wells this casing point should not only be below the "A" marker for reasons set out above, it should also be set above the "B" marker, in order to expose to possible production the zones lying between "B" and "C" on the cross-section. This means a carefully controlled casing point, and because of possible faulting, particularly in the area of steep dips, it will be extremely difficult to project. More than one correlation log may be required to determine this casing point, which of course adds to the expense.

Once the hole is made, a liner must be properly cemented through the producing interval. To cement a liner in such a fashion as to protect any possible exposed fractures from cement is in itself a tricky project. By all means this operation should be conducted in a relatively straight hole. Maintenance of a straight hole in drilling in this area will be difficult and expensive. Dips of the beds here are in some places twice as steep as the steepest dips encountered in the Verde Gallup Pool, and straight hole drilling will accordingly be more difficult.

Once a properly cemented liner is set through the prospective producing zones, separate fracture treatment of the zones can only be insured by stage fracture treatments, setting bridge plugs between the stages, or by the "limited entry" procedure. Either method is expensive. If the well is treated in stages there is the possible additional cost of rental of the pumping equipment and rig time, as well as risk in drilling out the bridge plugs. If a limited entry fracture treatment system is used, larger diameter casing is required in order to insure adequate flow rates at the required pressures, especially for the deeper wells.

Under the circumstances, with the information available from other fields, and the number of dry holes already drilled in the subject area, a drilling program for this project should be based only on the assumption that it will be difficult and costly to establish production, and plans should be made accordingly. We believe it would be extremely unwise to drill additional wells in this area in the same manner that all of the dry holes were drilled.

Accordingly we recommend, among other things, that large sand fracture treatments be used in completion attempts, even though the prospective producing zones show no natural production. Also, since the wells will be treated with several thousand barrels of frac oil, it will be necessary to install pumping equipment to attempt to recover the frac oil, even though the well ultimately turns out to be a dry hole. As a result, the dry hole cost is practically the same as the cost of a completed producer, with the exception of the removable equipment.

Since the producing zone or zones are at this time only tentatively identified, all of the three unit obligation wells should be planned to test by sand fracture treatment not only the zones between markers D and E, but also the zones between markers B and C. In addition, an attempt should be made to core the well in Section 32 through the zones below the E marker and possibly the zone just above.

These obligation wells probably should be drilled with rotary tools, setting 7-5/8" casing between markers A and B, and drilling the prospective producing zones with air or gas. A $5\frac{1}{2}$" liner should be cemented with a lap into the 7-5/8" of 200 to 300 feet.

The zones between markers D and E should be fraced with a limited entry procedure insuring treatment of at least two of the three colored zones between these two markers. A bridge plug should then be set between markers C and D and the three zones between markers B and C should be treated by limited entry sandfrac.

These first three wells should then test the B-C zones separately from the D-E zones, in order that future drilling and completion methods be accordingly planned.

Experience in drilling wells in similar fashion in the Puerto Chiquito Pools has resulted in total well costs of $75,000.00 per well for shallow wells and an average of $175,000.00 per well for 6,000 to 7,000 foot wells. The same general range of costs is anticipated here at La Plata.

ECONOMICS OF DEVELOPMENT UNDER COMPETITIVE OPERATION

It is of course impossible at this time to forecast accurately the exact area which will be developed or the number or quality of the wells which will be drilled. It is apparent, however, that for the oil recoveries and well costs estimated herein, development of the area at a profit cannot be realized under competitive conditions with any conventional spacing pattern, even 320 acres per well. Examples of fieldwide economics have been calculated, the results of which are set out herein, showing development costs and oil recoveries of 40-acre, 80-acre, 160-acre and 320-acre competitive development programs. It is realized, of course, that under the more dense spacing programs all of the wells would not be drilled because the field would be depleted before the wells could be drilled. It is interesting, however, to compare economics which might result if locations were drilled on the various spacing patterns set out above.

As economics of each of the patterns is reviewed, one is inclined to think that wells would never be drilled under such conditions. On the other hand, when we realize that wells will be completed here with potentials measured in terms of thousands of barrels per day, we can understand how company managements might, under the wider spacings, authorize the drilling of more wells than are necessary to efficiently deplete the reservoir, if operations are conducted competitively.

As a basis for comparison of economics of the various spacings, it is assumed that Area A would be productive and that recoveries would be as shown under Section C, Part III, which is 1,170,000 barrels. A plat is presented for each of the spacing plans showing producing wells and locations of probable dry holes. For the 320-acre spacing plan only, costs and recoveries are shown, not only for the field as a whole but for individual wells, and by company ownership of the tracts on which they are drilled.

As to well costs, figures for the 320-acre spacing plan were based on those referred to in Section E herein, prorated for intermediate depths. For the 40-acre pattern, costs were estimated to be one-half as much, for the reason that under such a program wells would be drilled as cheaply as possible - perhaps with mud and running the risk of mud damage. Where so many wells are drilled, however, it is not necessary that all wells be properly completed, and through happenstance enough wells would probably penetrate the producing zone at points where the reservoir was not fractured and permit completion without losing mud to the formation. If successful frac treatments resulted in only 10 or 15 percent of the wells so drilled, the reservoir could be depleted. Also, for the closer spacing, allowables will be less and pumping equipment smaller and less costly. Costs for the intermediately spaced wells (80 acres and 160 acres) were arbitrarily prorated between these two extremes. The costs are accordingly summarized as follows:

PER WELL COST ESTIMATES FOR SPACINGS AND DEPTHS INDICATED

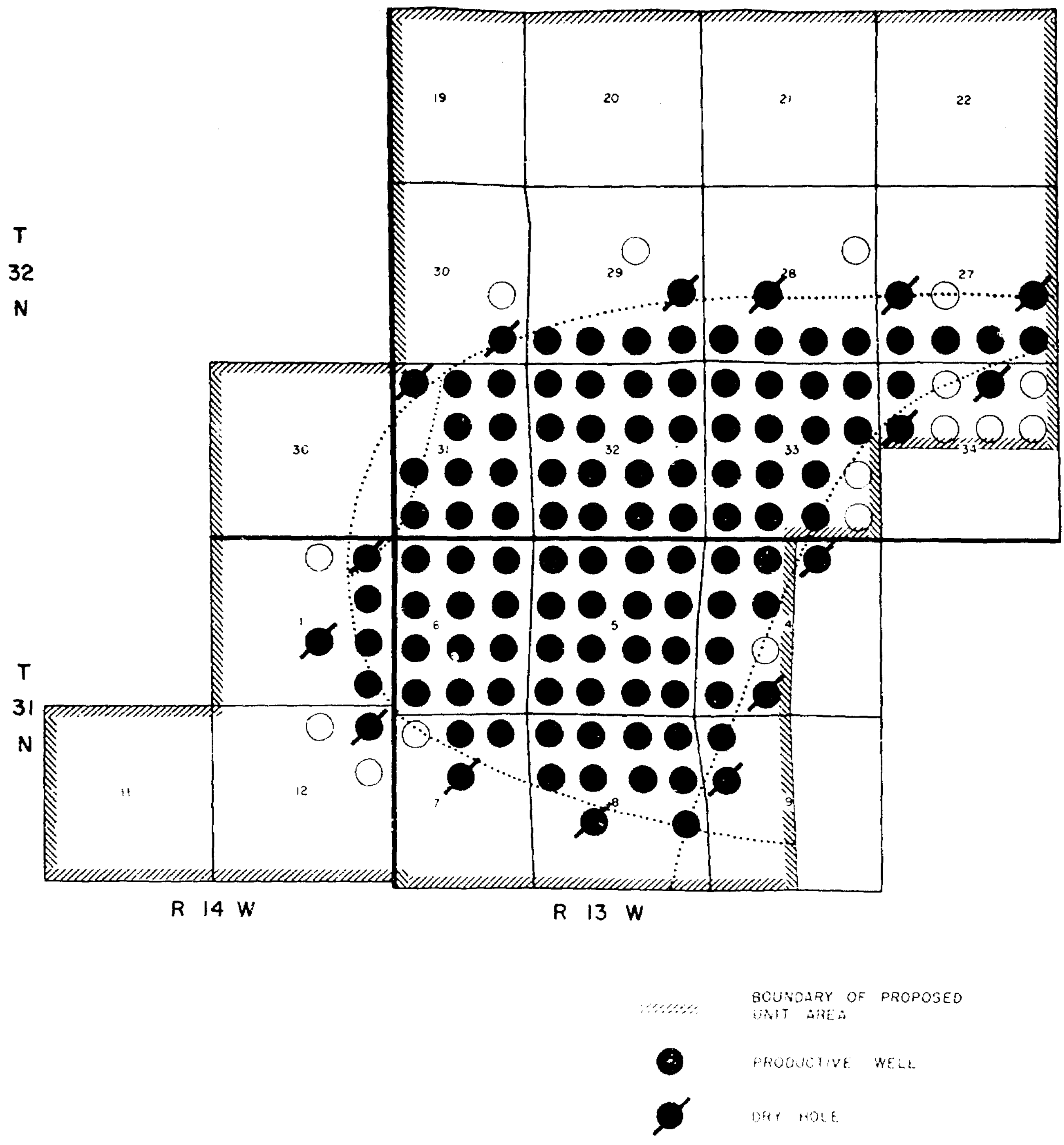
COMPLETION DEPTH (for contour interval shown)	SPACING 40 acres	80 acres	160 acres	320 acres
	($M)	($M)	($M)	($M)
Above 4,000	37	50	63	75
3,000 - 4,000	47	63	80	95
2,000 - 3,000	57	76	95	115
1,000 - 2,000	67	90	112	135
0 - 1,000	77	103	130	155
Below 0	87	116	145	175

Dry holes are estimated at 80 percent of producing well cost.

The economics for each of the well spacing patterns, 40-acre, 80-acre, 160-acre and 320-acre, are set out individually on the pages that follow.

PLAT OF PROPOSED LA PLATA MANCOS UNIT

SHOWING WELL LOCATIONS IF AREA A IS
DRILLED UNDER COMPETITIVE CONDITIONS
ON A WELL SPACING PATTERN OF
40 ACRES PER WELL
(ASSUMING ONLY AREA A TO BE PRODUCTIVE)



ECONOMICS OF DRILLING
ON 40-ACRE SPACING
UNDER COMPETITIVE OPERATIONS

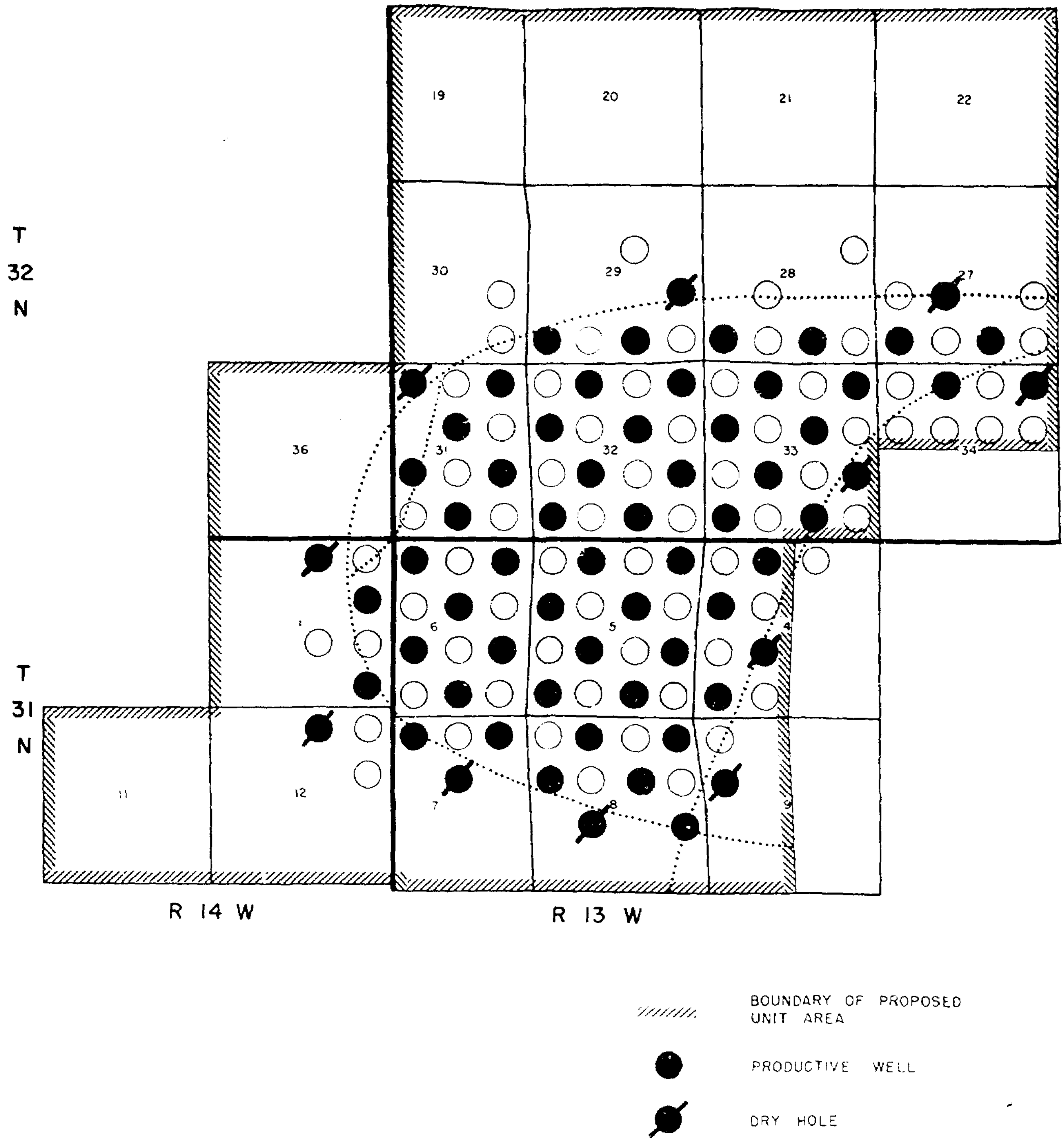
Drilling costs of the development plan on the page facing are summarized as follows:

Depth of wells drilled (in terms of contour interval)	Number of wells drilled			Per well cost		Cost	
	Prod.	Dry Holes	Total	Prod.	Dry Holes	Prod.	Dry Holes
				$M	$M	$M	$M
Above 4,000'	7	3	10	37	30	260	90
3,000 - 4,000'	10	1	11	47	38	380	38
2,000 - 3,000'	8	1	9	57	46	370	46
1,000 - 2,000'	11	1	12	67	54	740	54
0 - 1,000'	12	1	13	77	62	920	62
Below 0	54	9	63	87	70	4,700	630
TOTAL	102	16	118			7,370	920

SUMMARY:	PRODUCING WELLS COST	$7,370,000.00
	DRY HOLES COST	920,000.00
	TOTAL COST	$8,290,000.00
	OIL RECOVERED	1,170,000 barrels
	DEVELOPMENT COST	$7.07/barrel

PLAT OF PROPOSED LA PLATA MANCOS UNIT

SHOWING WELL LOCATIONS IF AREA A IS
DRILLED UNDER COMPETITIVE CONDITIONS
ON A WELL SPACING PATTERN OF
80 ACRES PER WELL
(ASSUMING ONLY AREA A TO BE PRODUCTIVE)



ECONOMICS OF DRILLING
ON 80-ACRE SPACING
UNDER COMPETITIVE OPERATIONS

Drilling costs of the development plan on the page facing are summarized as follows:

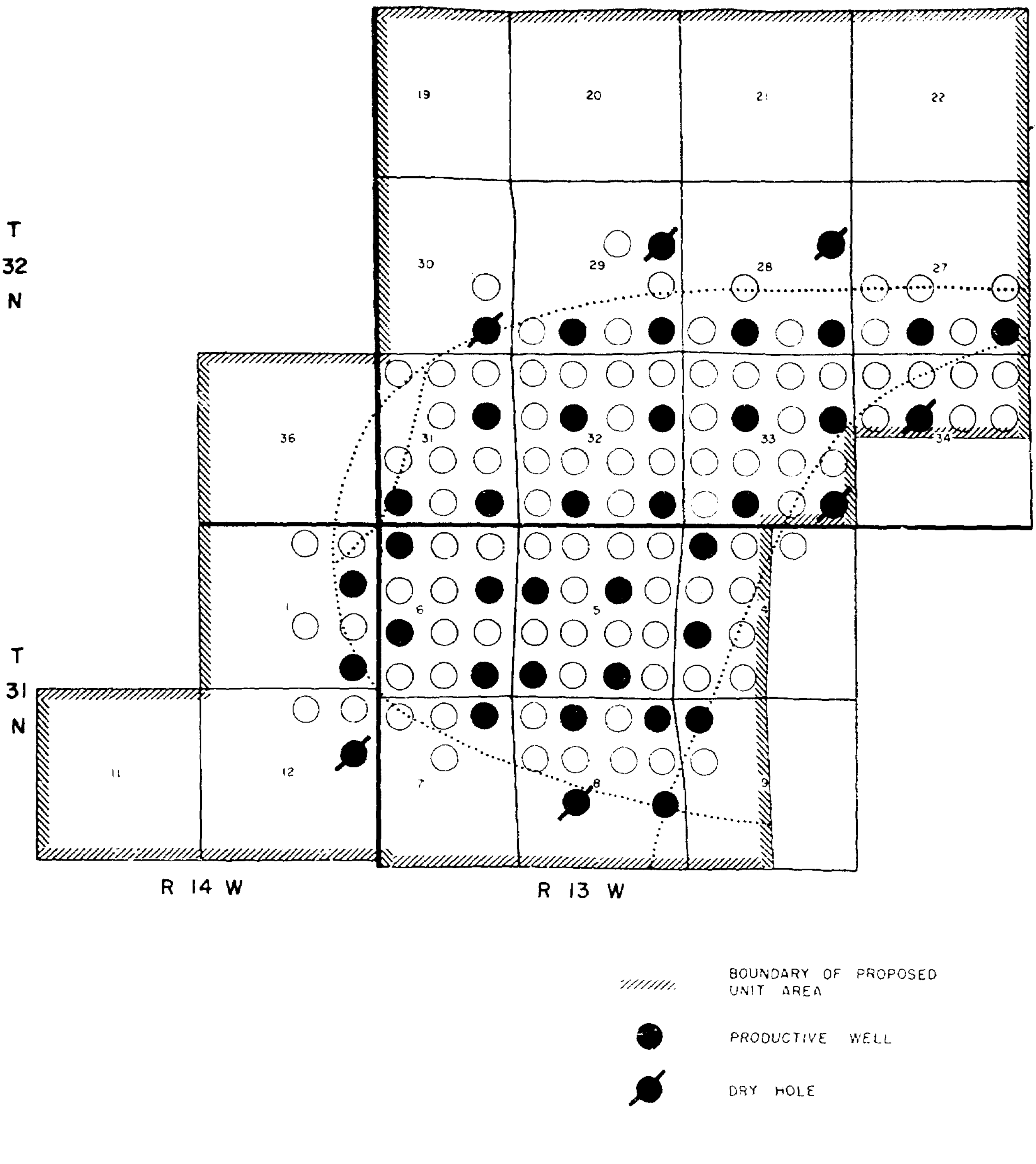
Depth of wells drilled (in terms of contour interval)	Number of wells drilled			Per well cost		Cost	
	Prod.	Dry Holes	Total	Prod.	Dry Holes	Prod.	Dry Holes
				$M	$M	$M	$M
Above 4,000'	4	2	6	50	40	200	80
3,000 - 4,000'	6	1	7	63	50	380	50
2,000 - 3,000'	3	0	3	76	61	230	-
1,000 - 2,000'	5	1	6	90	72	450	72
0- 1,000'	7	1	8	103	82	720	82
Below 0	27	6	33	116	93	3,130	558
TOTALS	52	11	63			5,110	842

SUMMARY:	PRODUCING WELLS COST	$5,110,000.00
	DRY HOLES COST	842,000.00
	TOTAL COST	$5,952,000.00
	OIL RECOVERED	1,170,000 barrels
	DEVELOPMENT COST	$5.08/barrel

PLAT OF PROPOSED LA PLATA MANCOS UNIT

SHOWING WELL LOCATIONS IF AREA A IS DRILLED UNDER COMPETITIVE CONDITIONS ON A WELL SPACING PATTERN OF 160 ACRES PER WELL

(ASSUMING ONLY AREA A TO BE PRODUCTIVE)



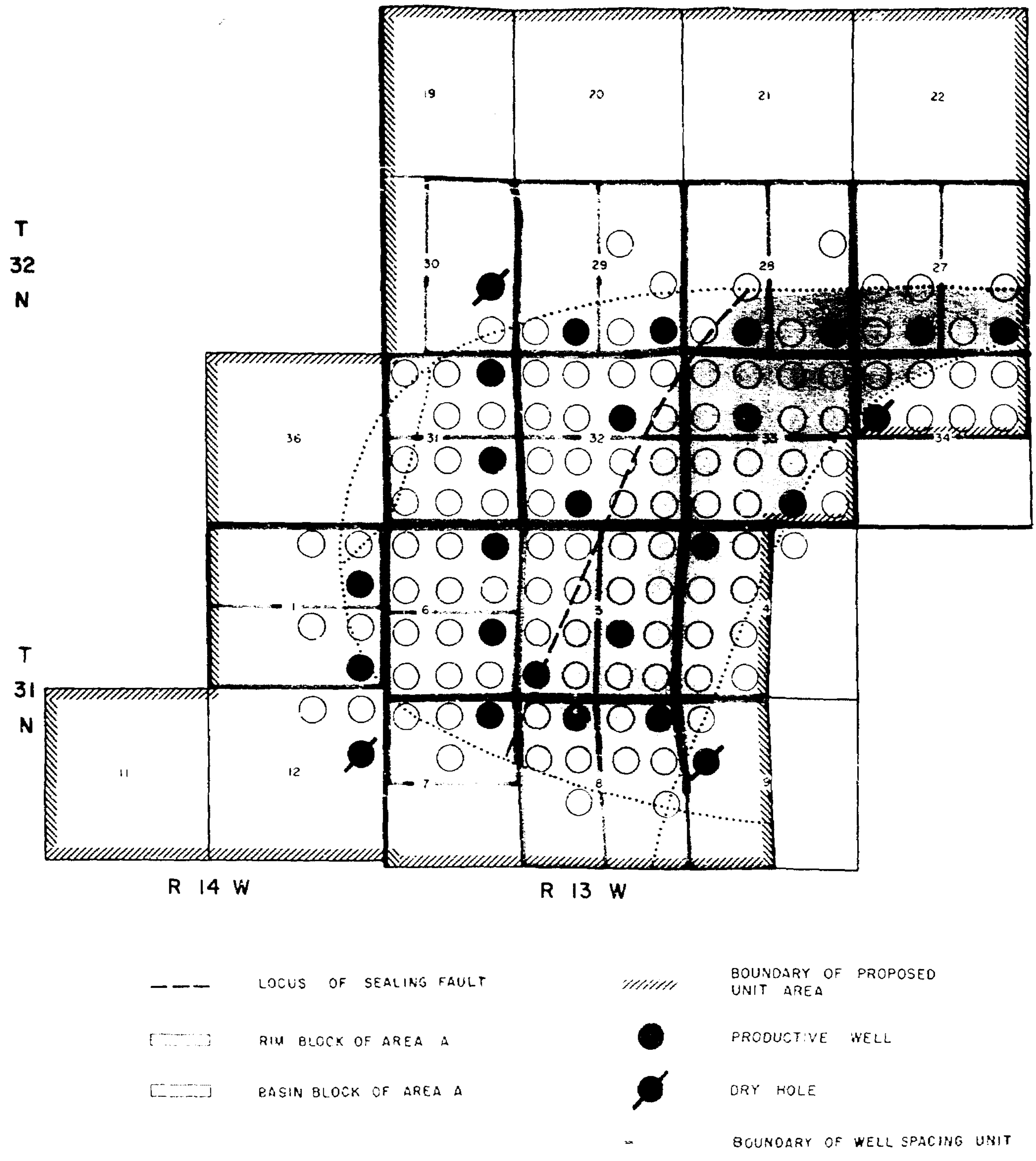
ECONOMICS OF DRILLING
ON 160-ACRE SPACING
UNDER COMPETITIVE OPERATIONS

Depth of wells drilled (in terms of contour interval)	Number of wells drilled			Per well cost		Cost	
	Prod.	Dry Holes	Total	Prod.	Dry Holes	Prod.	Dry Holes
				$M	$M	$M	$M
Above 4,000'	3	1	4	63	50	189	50
3,000 - 4,000'	3	0	3	80	64	240	-
2,000 - 3,000'	2	1	3	95	76	190	76
1,000 - 2,000'	3	1	4	112	90	336	90
0- 1,000'	5	0	5	130	104	650	
Below 0	16	4	20	145	116	2,320	464
TOTALS	32	7	39			3,925	680

SUMMARY:	PRODUCING WELLS COST	$3,925,000.00
	DRY HOLES COST	680,000.00
	TOTAL COST	$4,605,000.00
	OIL RECOVERED	1,170,000 barrels
	DEVELOPMENT COST	$3.83/barrel

PLAT OF PROPOSED LA PLATA MANCOS UNIT

SHOWING WELL LOCATIONS IF AREA A IS DRILLED UNDER COMPETITIVE CONDITIONS ON A WELL SPACING PATTERN OF 320 ACRES PER WELL (ASSUMING ONLY AREA A TO BE PRODUCTIVE)



ECONOMICS OF DRILLING ON 320-ACRE SPACING UNDER COMPETITIVE OPERATIONS

One of the main difficulties in achieving wide spacing benefits in a comparatively small pool operated under competitive conditions is illustrated by the plat on the page facing, on which is shown the 320-acre tracts allotted to each producing well. Here we find 11 producers in the rim block, which has approximately 2,400 productive acres, and 10 producers in the basin block with approximately 2,000 productive acres. These are effective reservoir spacings of 220 and 200 acres per well respectively. It is obvious that an accurate estimate of pool average per well economics for the small pools cannot be made by simply translating barrels per acre recovery and official well spacing into per well recoveries. The practical implication of actual reduced drainage areas per well must be considered.

It is realized, of course, that this situation could be greatly rectified by requiring wells to be located on specific diagonal quarter-section spots. The probability of operators agreeing on such a spacing plan under the extremely erratic conditions (from the standpoint of individual well productivities) which obtain in these fractured shale reservoirs is quite remote. Because of the practical impossibility of this type spacing being set, an economic study of such a plan has not here been made.

Because of the large difference in economics of the basin block development as compared to the rim block development, these two reservoirs were analyzed separately. The overall economics of each are set out below in the same fashion as previously for the more dense development patterns.

BASIN BLOCK

Depth of wells drilled (in terms of contour interval)	Number of wells drilled			Per well cost		Cost	
	Prod.	Dry Holes	Total	Prod.	Dry Holes	Prod.	Dry Holes
				$M	$M	$M	$M
Above 4,000'	-	-	-	75	60	-	-
3,000 - 4,000'	-	-	-	95	76	-	-
2,000 - 3,000'	-	-	-	115	93	-	-
1,000 - 2,000'	-	-	-	135	108	-	-
0 - 1,000'	-	-	-	155	124	-	-
Below 0	9	2	11	175	140	1,575	280

SUMMARY:	PRODUCING WELLS COST	$1,575,000.00
	DRY HOLES COST	280,000.00
	WORKOVER (2 AT $50,000 EACH)	100,000.00
	TOTAL COST	$1,955,000.00
	BASIN BLOCK RECOVERY (SECTION C, PART III)	300,000 barrels
	DEVELOPMENT COST	$6.50/barrel

RIM BLOCK

Depth of wells drilled (in terms of contour interval)	Number of wells drilled			Per well cost		Cost	
	Prod.	Dry Holes	Total	Prod.	Dry Holes	Prod.	Dry Holes
				$M	$M	$M	$M
Above 4,000'	1	1	2	75	60	75	60
3,000 - 4,000'	3	0	3	95	76	285	-
2,000 - 3,000'	2	1	3	115	93	230	93
1,000 - 2,000'	1	0	1	135	108	135	-
0 - 1,000'	4	0	4	155	124	620	-
Below 0	-	-	-	175	140	-	-
TOTALS	11	2	13			1,345	153

SUMMARY:		
	PRODUCING WELLS COST	$1,345,000.00
	DRY HOLES COST	153,000.00
	TOTAL COST	$1,498,000.00
	RIM BLOCK RECOVERY (SECTION C, PART III)	870,000 barrels
	DEVELOPMENT COST	$1.72/barrel

As stated earlier, it is impossible at this time to determine exactly the outline of the producing area and exactly which locations will afford producers and which will give dry holes. However, all oil pools have limits, and the economics reflected here will generally apply to La Plata even though the pool boundaries be somewhat different from that indicated here. We believe, however, for the pool boundaries assumed that the development (including dry holes) would likely be about as shown, and since a possible profit (though not attractive) from overall rim block development is possible, we have examined in more detail the probable individual well costs and recoveries and the resulting economics to the owners of these tracts.

The assumptions in this analysis are:

1. Each well will have a P.I. of 1.0 and no reduction in P.I. is estimated (since for the purpose of this analysis we are interested only in relative tract recoveries rather than time required to produce the oil).

2. Pressure at down-dip limit of reservoir will have straight-line decline to $\frac{1}{4}$ its initial value when $\frac{1}{2}$ of oil is produced and another straight-line decline to 0 pressure for remainder of production.

3. The pressure in (2) above will determine the fluid head above pay in each well and the P.I. will accordingly be: $\frac{\text{Feet of fluid head}}{3}$

4. Top allowable is 8 x 70 = 560 BOPD

This above described type of analysis may at first appear rather hypothetical and one might question whether such a calculation would be of much true value in estimating relative well recoveries. The method has been used, however, in the East Puerto Chiquito Pool with amazing accuracy to forecast when up-dip wells would suffer extreme drops in productivity and concurrently develop high gas-oil ratios.

We believe it shows reasonably well what might be anticipated from this steeply dipping reservoir. For the calculations to be valid, of course, there must be a common reservoir with a fracture system and wells must be completed so as to be satisfactorily in communication with it. This could likely be the case here.

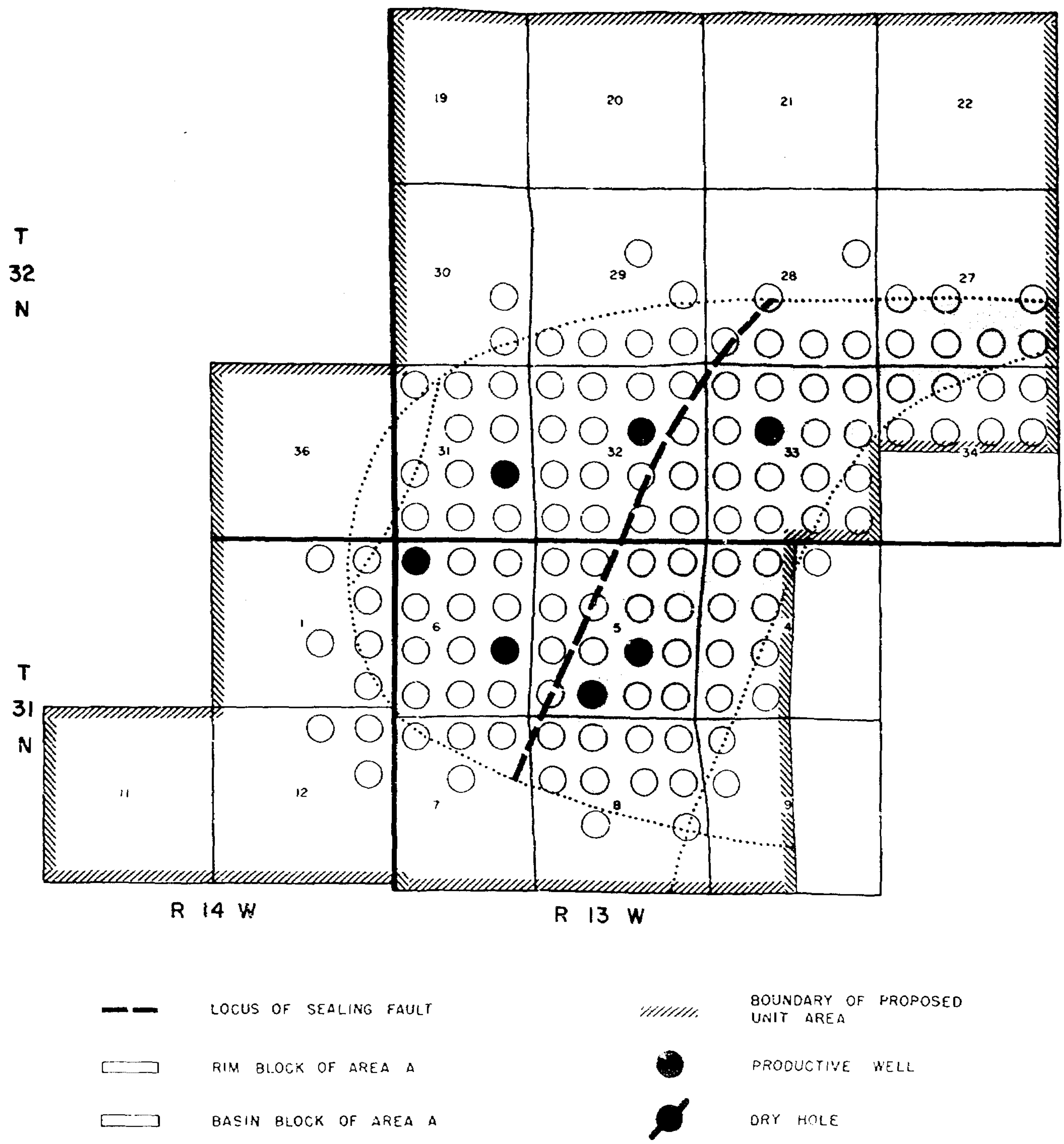
Results of this analysis are set forth in the following table:

	WELLS				
	NE 1	SE 1 SE 31 NE 31	SW 29 NE 6	SE 5	SE 29 SW 32 NE 7
PAY DATUM (feet above sea level)	4,000	3,500	2,200	1,500	500
RECOVERY FOR GROUP (M BBLS)	14	98	163	101	494
RECOVERY PER WELL	14	33	81	101	131
COST PER WELL ($M)	75	95	115	135	155
DEVELOPMENT COST ($/BBL)	5.30	2.88	1.42	1.33	1.31

The above analysis assumes simultaneous development. If the shallow wells are allowed to produce for a substantial period of time before the deeper wells are drilled they will have accordingly higher recoveries than shown above.

PLAT OF PROPOSED LA PLATA MANCOS UNIT

SHOWING WELL LOCATIONS IF AREA A IS
DRILLED UNDER UNITIZED CONDITIONS
(ASSUMING ONLY AREA A TO BE PRODUCTIVE)



ECONOMICS OF DEVELOPMENT UNDER UNIT OPERATION

Because of the relatively high degree of communication (in relation to total oil in place) inherent in fractured shale reservoirs, they are ideally suited for development under unitized operation. Not only can a higher ultimate recovery be realized through unit operation, but the oil can be recovered with a fewer number of wells than results under competitive conditions. The La Plata Pool is no exception to this general rule. If the main fracture system here carries a transmissibility of 1 to 2 darcy feet (which is inferred from data of the two producing wells now in the area) and individual fault blocks are as large as is presently indicated, Area A can be depleted with no more than ten wells, and possibly with as few as eight, if they are successfully connected to the fracture system, and if they are located as shown on the plat facing this page.

The two presently producing wells are shown on this plat (southwest quarter of Section 5 and northwest quarter of Section 6) as well as the three unit obligation wells:

Southeast quarter of Section 31
Southeast quarter of Section 6
Northeast quarter of Section 32

In addition, the plat indicates the well in the southeast quarter of Section 5 worked over to become a producer, and that one new well is drilled in the basin block.

Should the workover on the well in the southeast quarter of Section 5 be successful, consideration might then be given to refracturing the well in the southwest quarter of

Section 5. If this workover also proves successful and the well in Section 33 has a high capacity, it will not be necessary to drill additional wells in the basin block, and one of the two wells in Section 5 could be shut in as an observation well for interference test purposes for the basin block.

As to the rim block, the well in the northwest quarter of Section 6 could be shut in as an observation well for interference tests in this block. It is possible that the working interest owners will want to keep this well permanently shut in as an observation well useful for determining the rate of pressure decline, from which estimates might be made as to the size of the rim block reservoir and whether additional wells should be drilled. * Obviously the exact drilling pattern and recovery estimates will be revised as wells are drilled and pressure and production data obtained.

Using drilling costs in the analysis in the preceding section for 320-acre spacing, total cost to the working interest owners other than Taylor for the development plan described above would be:

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* In this connection it might be well to consider initial completion only in the D-E zone in wells in the rim block, in order to more accurately evaluate the pressure behavior. This means additional expense when the B-C zones would later be stimulated. The cost might be well repaid, however, through the saving of not drilling unnecessary wells.

		$ M
Obligation wells:	SE 31	95
	SE 32	155
	SE 6	135
Development well	NW 33	175
Workover	SE 5	50
Purchase (est.)	SW 5	150
Workover	SW 5	50
		$ 810

For this cost the cross-assigned working interest owners could expect to recover 2,400,000 barrels (Section C, Part III) less the amount of oil going to Taylor for his participation in the unit. Taylor's share of the ultimate recovery will depend partly on how fast the other wells are drilled and exactly what acreage is considered by the U.S.G.S. to be productive in establishing the participating area. It is estimated at this time that Taylor's share of the oil under a divided type unit operation (as now planned) and with a reasonably timed development program will amount to approximately 8 percent of the total pool production, or about 200,000 barrels. Oil recovery, then, to the cross-assigned interest owners would approximate 2,200,000 barrels for a development cost of $810,000.00, or approximately 37 cents per barrel. The above figures are for unit operations without gas injection. If gas injection is required in the rim block (to maintain producing rates as high as desired and still permit the depletion mechanism to be primarily gravity drainage) an additional cost approximating $100,000.00 might be required. Only analysis of the facts after the wells are drilled will determine whether it would be preferable to inject gas as compared to drilling additional wells should the productivity be not as high as necessary to produce the oil in the time desired. If the owners elect to inject gas, it is doubtful that makeup gas would have to be purchased, since the basin block produced gas would be available, as well as gas from the rim block production. Accordingly, additional development cost would approximate another 5 cents per barrel, raising the total to 42 cents per barrel if gas injection were initiated in the rim block.

In addition to the other usual advantages of unitization which include, of course, centralized tank batteries and cost savings from this standpoint, it is probable that unitization would bring about a higher price for the produced oil. Presently oil is being trucked from Taylor's well at a cost of 25 cents per barrel. Oil from the Benson-Montin-Greer M-5 Standard of Texas moves through a six or seven mile flowline to a tank battery in the Verde Gallup Pool, where it is sold for top price. This, of course, would not be a very practical arrangement for each operator to independently consider.

As to the pipeline company extending its system to La Plata, a unitized operation will present a more stable picture, and the company will be able earlier to make its plans for gathering the La Plata oil. An important factor here, of course, would be a central tank battery, possible under a unit operation.

[illegible]

BEFORE EXAMINER NUTTER
OIL CONSERVATION COMMISSION
Appl EXHIBIT NO. 2
CASE NO. 4067

BENSON-MONTIN-GREER DRILLING CORP.

EXHIBITS IN CASE NO. 4067
BEFORE THE
NEW MEXICO OIL CONSERVATION
COMMISSION

March 5, 1969

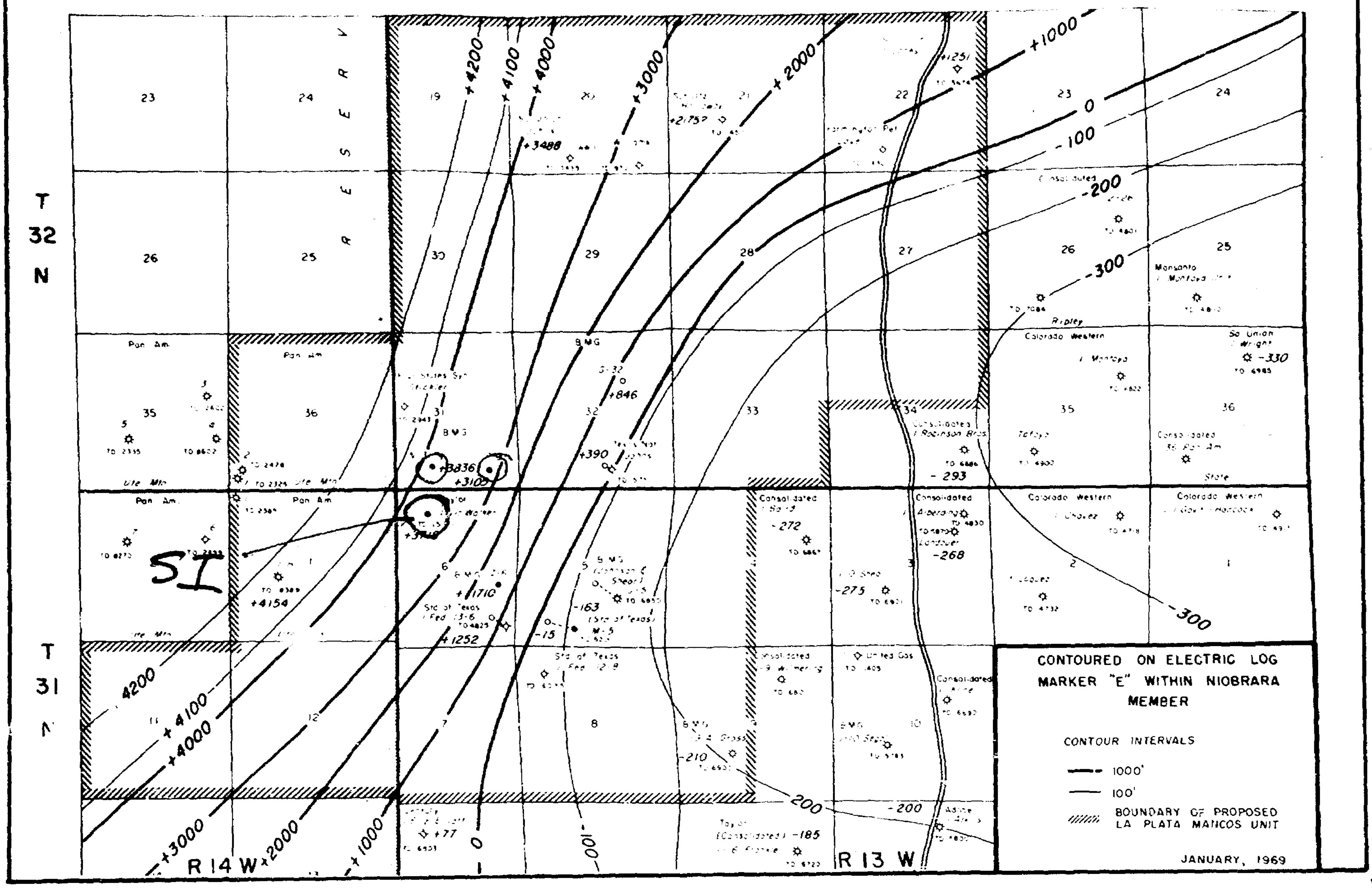
INDEX

Est pi
1500 ~~bbl~~ / lb

STRUCTURAL CONTOUR MAP

OF

NIOBRARA MEMBER OF MANCOS SHALE FORMATION



CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS 75207
July 3, 1968

RESERVOIR FLUID ANALYSIS

Benson-Montin-Greer Drilling Corporation
221 Petroleum Center Building
Farmington, New Mexico

Attention: Mr. Virgil Stoabs

Subject: Reservoir Fluid Study
Lloyd B. Taylor
Vic Walker No. 1 Well
La Plata Gallup Field
San Juan County, New Mexico
Our File Number: RFL 5096

Gentlemen:

Three samples of subsurface fluid were collected at a depth of 2250 feet in the subject well by a representative of Core Laboratories, Inc. on May 27, 1968. These samples were submitted to our Dallas laboratory for use in a reservoir fluid study, and the results of this study are presented on the following pages.

Upon receiving the samples in our laboratory the bubble-point pressure of each sample was measured at 74° F., as requested. Sample No. 1 had a bubble-point pressure of 185 psig, Sample No. 2 was 186 psig and Sample No. 3 was 187 psig. These values were reported by telephone to a representative of Benson-Montin-Greer Drilling Corporation and we were then authorized to complete the remainder of the study using Subsurface Sample No. 3.

The bubble-point pressure of the reservoir fluid was measured to be 234 psig at the reservoir temperature of 107° F. During differential pressure depletion at this temperature the fluid evolved 125 cubic feet of gas at 14.7 psia and 60° F. per barrel of residual oil at 60° F. The associated formation volume factor was 1.090 barrels of saturated fluid per barrel of residual oil.

Benson-Montin-Greer Drilling Corporation
Lloyd B. Taylor
Vic Walker No. 1 Well

The density of the liquid phase and the properties of the evolved gases were measured at several succeeding pressure levels during this depletion.

Under similar depletion conditions at 107° F. the viscosity of the fluid was measured from pressures exceeding reservoir pressure to atmospheric pressure. The viscosity of the liquid phase varied from a minimum of 1.86 centipoises at saturation pressure to a maximum of 2.99 centipoises at atmospheric pressure.

Thank you for the opportunity of performing this study for you. Should you have any questions regarding the data or if we may assist you further in any manner, please do not hesitate to contact us.

Very truly yours,

Core Laboratories, Inc.
Reservoir Fluid Analysis

P. L. Moses HS

P. L. Moses
Manager

PLM:HS:dr
7 cc. - Addressee

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 5096

Company	Lloyd B. Taylor	Date Sampled	May 27, 1968
Well	Vic Walker No. 1	County	San Juan
Field	La Plata Gallup	State	New Mexico

FORMATION CHARACTERISTICS

Formation Name	Gallup
Date First Well Completed	______, 19__
Original Reservoir Pressure	______ PSIG @ ______ Ft.
Original Produced Gas-Oil Ratio	______ SCF/Bbl
Production Rate	______ Bbl/Day
Separator Pressure and Temperature	______ PSIG, ______ °F.
Oil Gravity at 60° F.	______ °API
Datum	______ Ft. Subsea
Original Gas Cap	______

WELL CHARACTERISTICS

Elevation	______ Ft.
Total Depth	2510 Ft.
Producing Interval	2248-2510 Ft.
Tubing Size and Depth	______ In. to ______ Ft.
Productivity Index	______ Bbl/D/PSI @ ______ Bbl/Day
Last Reservoir Pressure	303 PSIG @ 2250 Ft.
Date	May 27, 1968
Reservoir Temperature	105* °F. @ 2250 Ft.
Status of Well	Shut in
Pressure Gauge	Amerada
Normal Production Rate	______ Bbl/Day
Gas-Oil Ratio	______ SCF/Bbl
Separator Pressure and Temperature	______ PSIG, ______ °F.
Base Pressure	______ PSIA
Well Making Water	______ % Cut

SAMPLING CONDITIONS

Sampled at	2250 Ft.
Status of Well	Shut in
Gas-Oil Ratio	______ SCF/Bbl
Separator Pressure and Temperature	______ PSIG, ______ °F.
Tubing Pressure	______ PSIG
Casing Pressure	0 PSIG
Core Laboratories Engineer	NT
Type Sampler	Perco

REMARKS: * Temperature extrapolated to mid-point of producing interval = 107° F.

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 5096
Well Vic Walker No. 1

VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 234 PSIG @ 107 °F.
2. Thermal expansion of saturated oil @ 2000 PSI = $\frac{V @ 107\ °F}{V @ 72.5\ °F}$ = 1.01790
3. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:

   From 2000 PSI to 1100 PSI = 6.61×10^{-6}

   From 1100 PSI to 600 PSI = 6.90×10^{-6}

   From 600 PSI to 234 PSI = 7.28×10^{-6}

4. Specific volume at saturation pressure: ft³/lb 0.02032 @ 107 °F.
5. Bubble-point pressure of subsurface samples at 74° F.:

Sample Number	Pressure, PSIG
1	185
2	186
3	187

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File RFL 5096

Well Vic Walker No. 1

Reservoir Fluid SAMPLE TABULAR DATA

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION @ 107 °F., RELATIVE VOLUME OF OIL AND GAS, V/VSAT.	VISCOSITY OF OIL @ 107 °F., CENTIPOISES	DIFFERENTIAL LIBERATION @ 107 °F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/VR
2000	0.9880	2.16			1.077
1700	0.9899	2.11			1.079
1400	0.9919	2.05			1.081
1100	0.9939	2.00			1.083
800	0.9960	1.95			1.086
700	0.9966				1.086
600	0.9973				1.087
500	0.9981	1.90			1.088
400	0.9988				1.089
300	0.9996	1.87			1.090
234	1.0000	1.86	0	125	1.090
232	1.0025				
230	1.0072				
226	1.0156				
219	1.0314				
210	1.0552				
200		1.87			
198	1.0868				
191			10	115	1.087
184	1.1342				
169	1.1977				
154	1.2846				
150		1.91			
140			23	102	1.081
137	1.3956				
121	1.5383				
106	1.7285				
100		1.97			
90			40	85	1.074
88	2.0268				
72	2.5018				
57			55	70	1.067

V = Volume at given pressure
$V_{SAT.}$ = Volume at saturation pressure and the specified temperature.
V_R = Residual oil volume at 14.7 PSI absolute and 60° F.

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Petroleum Reservoir Engineering
DALLAS, TEXAS 75207

File RFL 5096
Well Vic Walker No. 1

Reservoir Fluid SAMPLE TABULAR DATA

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION @ 107 °F., RELATIVE VOLUME OF OIL AND GAS, V/VSAT.	VISCOSITY OF OIL @ 107 °F., CENTIPOISES	DIFFERENTIAL LIBERATION @ 107 °F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/VR
55	3.2804				
50		2.07			
0		2.99	125	0	1.023
					@ 60° F. = 1.000

Gravity of residual oil = 40.1° API @ 60° F.

V = Volume at given pressure
VSAT. = Volume at saturation pressure and the specified temperature.
VR = Residual oil volume at 14.7 PSI absolute and 60° F.

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 5096

Well Vic Walker No. 1

Differential Pressure Depletion at 107° F.

Pressure PSIG	Oil Density Gms/Cc	Gas Gravity	Deviation Factor Z
234	0.7881		
191	0.7890	0.789	0.903
140	0.7912	0.845	0.932
90	0.7930	0.945	0.953
57	0.7949	1.081	
0	0.8060	1.560	

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DALLAS, TEXAS

File RFL 5096

Well Vic Walker No. 1

SEPARATOR TESTS OF Reservoir Fluid SAMPLE

SEPARATOR PRESSURE, PSI GAUGE	SEPARATOR TEMPERATURE, °F.	SEPARATOR GAS/OIL RATIO See Foot Note (1)	STOCK TANK GAS/OIL RATIO See Foot Note (1)	STOCK TANK GRAVITY, ° API @ 60° F.	SHRINKAGE FACTOR, $V_R/V_{SAT.}$ See Foot Note (2)	FORMATION VOLUME FACTOR, $V_{SAT.}/V_R$ See Foot Note (3)	SPECIFIC GRAVITY OF FLASHED GAS
0	76	122		40.3	0.9149	1.093	1.212
20	76	79	26	41.1	0.9226	1.084	
40	75	60	41	41.1	0.9246	1.082	
80	75	37	70	40.8	0.9199	1.087	

(1) Separator and Stock Tank Gas/Oil Ratio in cubic feet of gas @ 60° F. and 14.7 PSI absolute per barrel of stock tank oil @ 60° F.

(2) Shrinkage Factor: $V_R/V_{SAT.}$ is barrels of stock tank oil @ 60° F. per barrel of saturated oil @ 234 PSI gauge and 107° F.

(3) Formation Volume Factor: $V_{SAT.}/V_R$ is barrels of saturated oil @ 234 PSI gauge and 107° F. per barrel of stock tank oil @ 60° F.

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 5096

Company Lloyd B. Taylor Formation Gallup

Well Vic Walker No. 1 County San Juan

Field La Plata Gallup State New Mexico

HYDROCARBON ANALYSIS OF Reservoir Fluid SAMPLE

COMPONENT	MOL PER CENT	WEIGHT PER CENT	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Hydrogen Sulfide					
Carbon Dioxide	0.07	0.02			
Nitrogen	0.02	0.01			
Methane	5.39	0.53			
Ethane	4.30	0.80			
Propane	7.45	2.04			
iso-Butane	1.45	0.52			
n-Butane	5.87	2.12			
iso-Pentane	2.71	1.22			
n-Pentane	3.45	1.55			
Hexanes	6.68	3.58			
Heptanes plus	62.61	87.61	0.8438	36.0	225
	100.00	100.00			

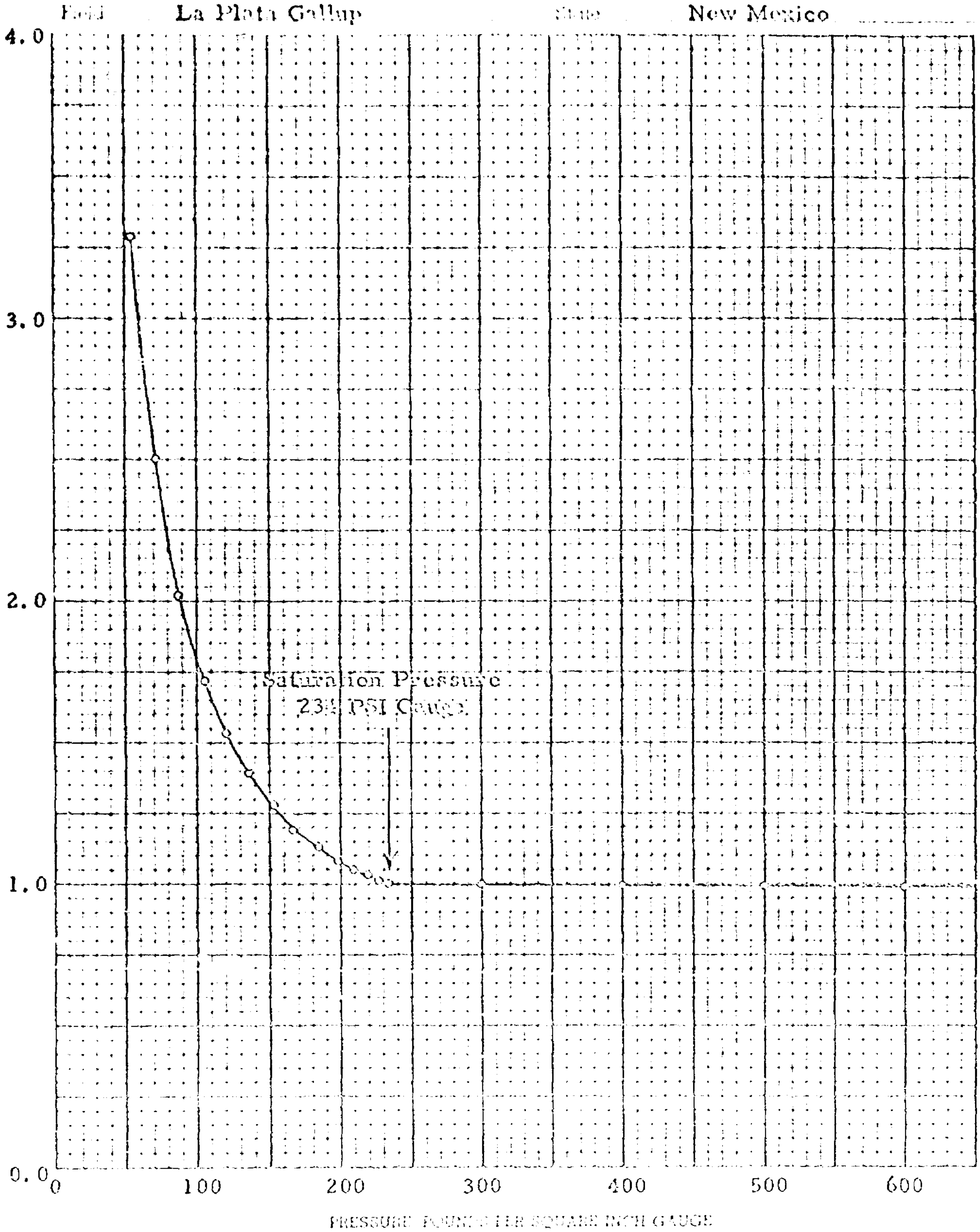
Core Laboratories, Inc.
Reservoir Fluid Analysis

P. L. Moses
P. L. Moses
Manager

PRESSURE VOLUME RELATIONS OF RESERVOIR FLUID

Company Lloyd B. Taylor
Well Vic Walker No. 1
Field La Plata Gallup

Formation Gallup
County San Juan
State New Mexico



CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

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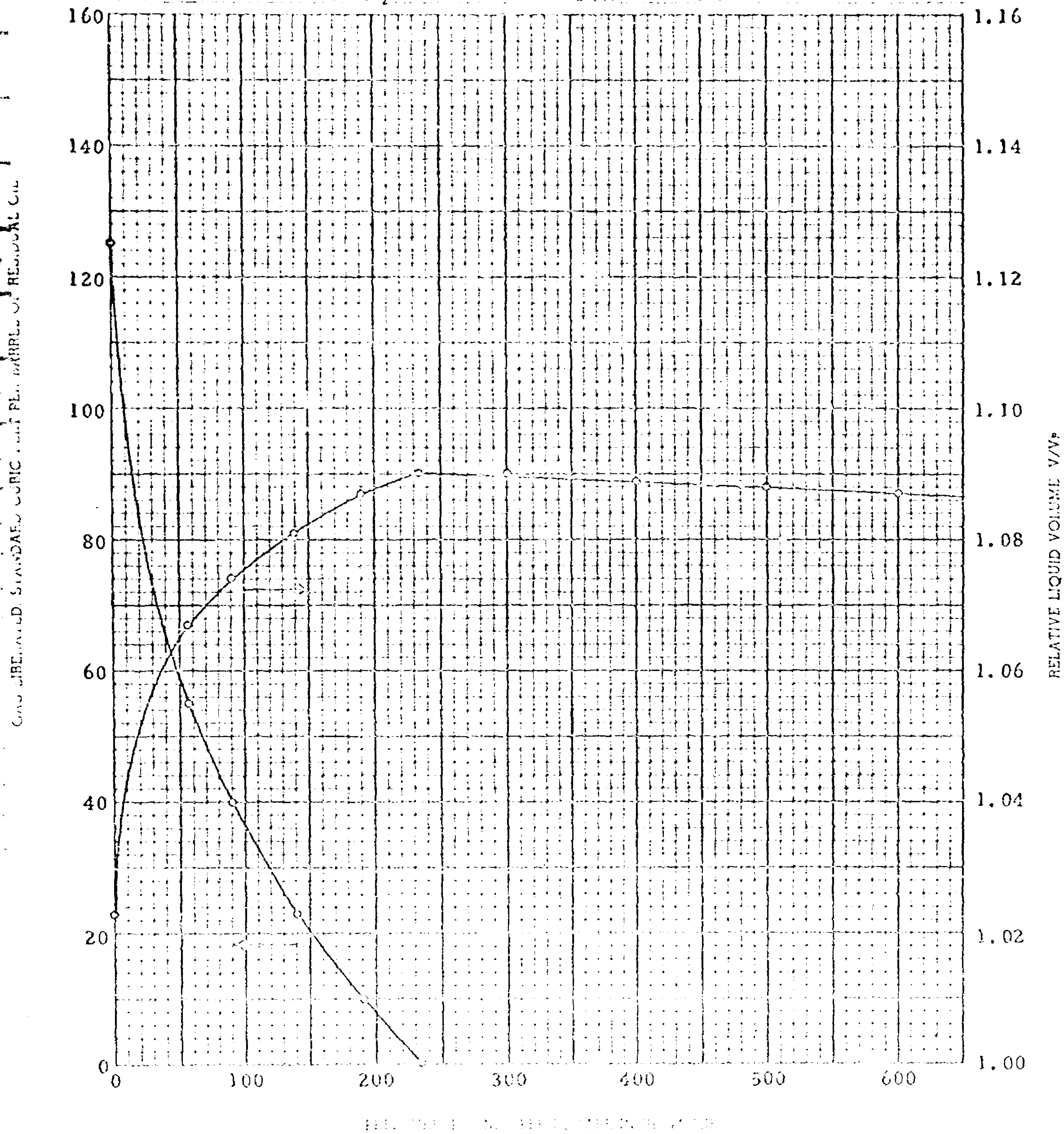
File RFL 5096

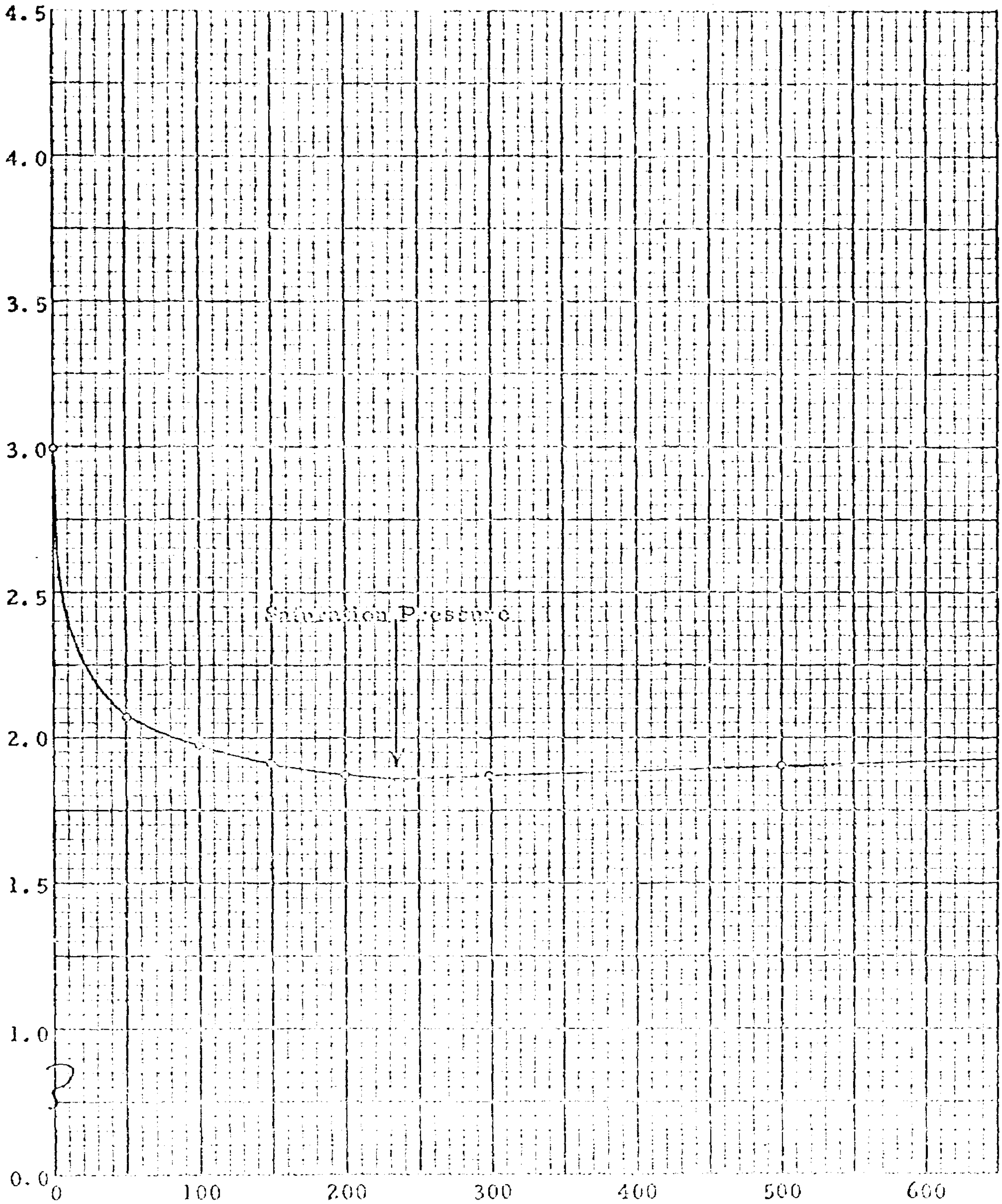
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID

Company Lloyd B. Taylor Formation Gallup
Well Vic Walker No. 1 County San Juan
Field La Plata Gallup State New Mexico



VIS[illegible]OSITY OF [illegible]

Company Lloyd B. Taylor | Formation Gallup
Well Vic Walker No. 1 | County San Juan
Field La Plata Gallup | State New Mexico

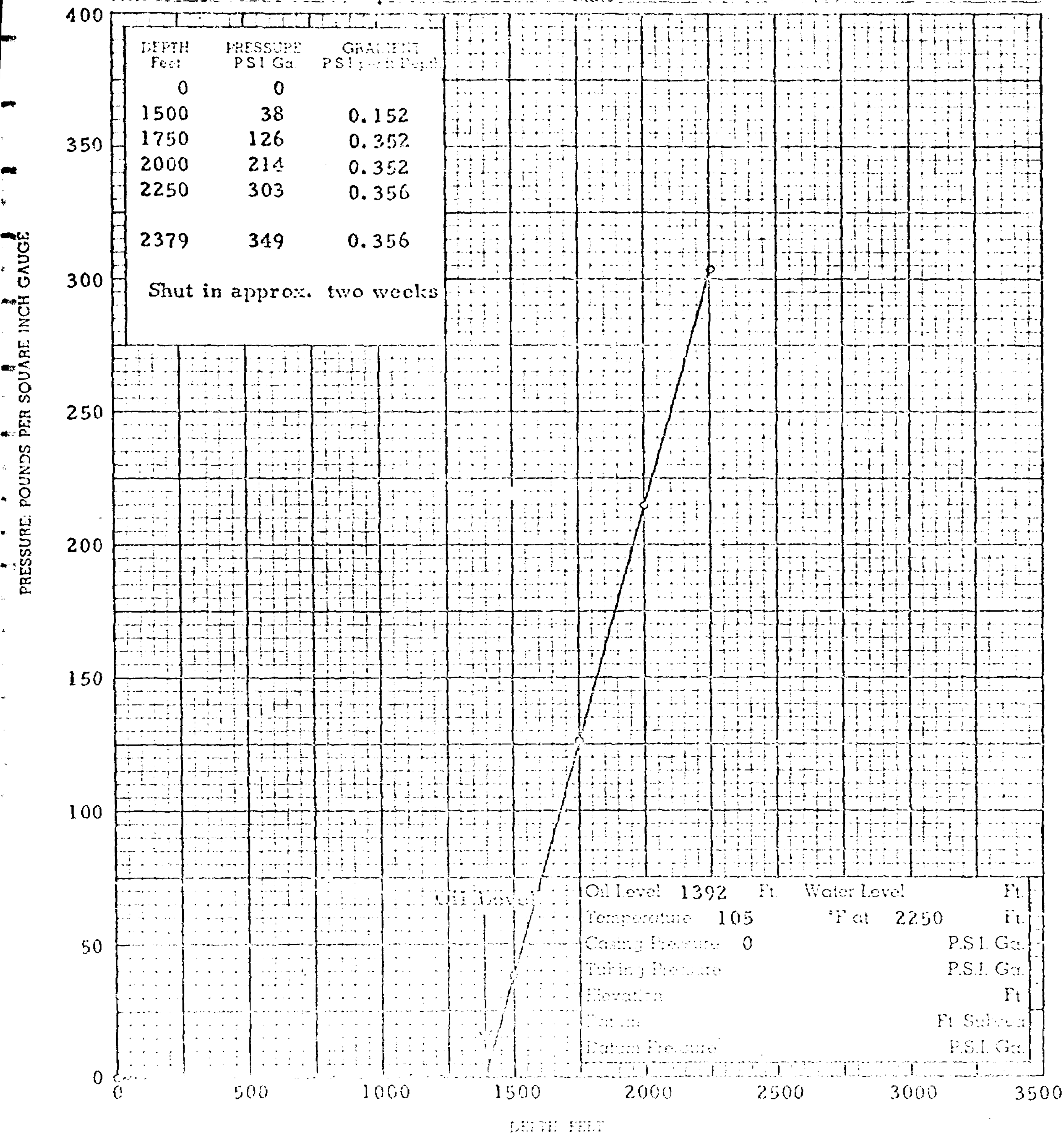


PRESSURE [illegible]

DALLAS, TEXAS

[illegible] 11 [illegible] 11
[illegible] RPL 5096

Company: Lloyd E. Taylor — Formation: Gallup
Well: Vic Walker No. 1 — County: San Juan
Field: La Plata Gallup — State: New Mexico



DEPTH Feet	PRESSURE PSI Ga	GRADIENT PSI per ft Depth
0	0	
1500	38	0.152
1750	126	0.352
2000	214	0.352
2250	303	0.356
2379	349	0.356

Shut in approx. two weeks

Oil Level	1392	Ft.	Water Level	Ft.
Temperature	105	°F at	2250	Ft.
Casing Pressure	0			P.S.I. Ga.
Tubing Pressure				P.S.I. Ga.
Elevation				Ft.
Datum				Ft. Subsea
Datum Pressure				P.S.I. Ga.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
March 5, 1969
EXAMINER HEARING

IN THE MATTER OF:	
Application of Benson-Montin-Greer Drilling Corporation for special pool rules, San Juan County, New Mexico.	Case No. 4067
Application of Benson-Montin-Greer Drilling Corporation for a pressure maintenance project, San Juan County, New Mexico.	Case No. 4074
Application of Benson-Montin-Greer Drilling Corporation for amendment of the La Plata Mancos Unit Agreement, San Juan County, New Mexico.	Case No. 4075

BEFORE: Daniel S. Nutter, Examiner.

TRANSCRIPT OF HEARING

MR. NUTTER: We will go back and call Case No. 4067.

MR. HATCH: Case 4067. (Continued from the February 26, 1969 Examiner Hearing) Application of Benson-Montin-Greer Drilling Corporation for special pool rules, San Juan County, New Mexico.

MR. COOLEY: William J. Cooley, firm of Burr and Cooley, Farmington, New Mexico, appearing on behalf of the Applicants. We have one witness we wish to be sworn, Mr. Albert Greer.

(Witness sworn.)

MR. NUTTER: Mr. Cooley, are this and the following cases closely enough related that you might want to call them all and consolidate them?

MR. COOLEY: They all deal with the same pool and basically nothing incompatible. I will request that they be consolidated for purposes of hearing.

MR. NUTTER: We will call Case 4074.

MR. HATCH: Case 4074. Application of Benson-Montin-Greer Drilling Corporation for a pressure maintenance project, San Juan County, New Mexico.

MR. NUTTER: And Case 4075.

MR. HATCH: Case 4075. Application of Benson-Montin-Greer Drilling Corporation for amendment of the La Plata Mancos

Unit Agreement, San Juan County, New Mexico.

MR. NUTTER: Case 4067, 4074 and Case No. 4075 will be consolidated for purposes of testimony.

(Whereupon, Applicant's Exhibits 1 through 3 were marked for identification.)

ALBERT GREER

called as a witness, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. COOLEY:

Q State your full name for the record, please.

A Albert R. Greer.

Q By whom are you employed, Mr. Greer?

A Benson-Montin-Greer Drilling Corporation.

Q Do you appear today on behalf of Benson-Montin-Greer Drilling Corporation?

A Yes, sir.

Q What role does Benson-Montin-Greer Drilling Corporation play in this application with respect to the La Plata-Gallup Oil Pool?

A Our company has a substantial part of the oil and gas leases in this area and we're operator of the La Plata-Mancos Unit which covers this.

Q Mr. Greer, I hand you what has been marked for purposes of identification, Applicant's Exhibit Number 1 and ask you first when that exhibit was prepared.

A The material in Exhibit 1 was prepared approximately one year ago.

Q For what purpose was it prepared?

A For the purpose of providing geological engineering and other information to the operators in the area to consider unitizing the area.

Q Would you briefly outline the content of that exhibit?

A Yes, sir. Under the index, about the second page in the exhibit, the contents are pretty well described and the different subjects are under different sections. Under Section B is the geological basis for determining the area of exploration, that area of exploration for which this report was originally prepared is the same area which we now request be spaced for 160-acre spacing.

Section C has five parts, has to do with reservoir mechanics and possible oil recoveries. Section D, pressure production data wells completed as of that time, approximately one year ago. Section E has to do with drilling and completion methods and costs. Section F is economics, under competitive operation, and Section G is a comparison of economics, the development of this area under a unitized operation.

Q I now hand you what has been marked as Applicant's Exhibit Number 2 and ask you when this was prepared and why.

A Exhibit 2 was just recently prepared and is for the purpose of adding supplemental information beyond which was available and is in Exhibit 1 to bring all information down to date. It has four parts. Section A is an up-to-date structural contour map. Section B is a cross section through some of the recently completed wells. Section C is a part of the fluid levels in Mr. Taylor's No. 1 Walker well, which shows evidence of communication with other wells in the area. Section D is the reservoir fluid study of an oil sample taken from Taylor No. 1 Walker.

Q Then, in essence, Exhibit 2 supplements and updates Exhibit No. 1 at the present time?

A Yes, sir.

Q I hand you what has been marked as Applicant's Exhibit Number 3 and ask you to briefly identify the contents of this exhibit.

A Exhibit 3 contains summaries of the core analyses of the four wells which have been drilled within the last year in this area. All four wells were cored through the interval of interest, high percentage of recovery was obtained and a good part of t e cores were analyzed. This is a complete record of the co analyses of the four wells.

Q I now call your attention to Section B of Exhibit 1 --

A Section B --

Q -- and ask you to discuss, please, the area which you propose to be spaced at this hearing, and why.

A The area is shown on Figure 2 which follows page 8 under Section B.

Q Is that also the same area as the La Plata-Mancos Unit area?

A Yes, sir, the unit area is shown by the boundary which is a cross-hatched boundary, which is the area of the La Plata-Mancos Unit and the area which we are now requesting be spaced on 160 acres. There's another boundary shown, north-south boundary, with single sliding lines which is on the range line between Ranges 13 and 14. This separates the Indian lands which lie to the west from the other lands which lie to the east. East of this boundary are fee lands, Federal lands and State lands.

Q Was the area which you propose to be spaced at this hearing arrived at by geologic inference?

A Yes, sir. It was determined from geologic inference.

Q Would you please discuss the method of arriving at this area?

A Yes, sir. First, I would like to point out the structure. We're concerned in this hearing with the Niobrara member of the Mancos formation. It sometimes in this area is called the Gallup formation. The Mancos is contoured on an electric log marker within this Niobrara member close to the base of it, which we will see on later cross section exactly where this point is.

The heavy contour lines are a thousand-foot contours. The light contour lines are 100-foot contours. I would like to point out that in the vicinity of Sections 5 and 6, 31 and 32, there's a very high angle of dip of the beds, approximates as much as 4,000 feet per mile. Then there's a sharp break at approximately the zero contour, where the formation flattens out into the basin and the dip then is only on the order of a hundred to maybe two hundred feet per mile.

In our determination of the area with which we are concerned, we consider an area in which there is adequate development of a zone within the Niobrara and where this particular zone is, drapes over or is closely connected with this steeply-dipping part of the hogback.

I think first it would be best to look at the zone, which we feel is adequately developed to have production in this part of the Niobrara, and that is shown on Figure 3. That's following Figure 2 in this Section B.

This cross section shows eight wells, in a southwest, northeast line which crosses the area of interest, as shown on the plat on the right-hand side of the cross section. The zone which we believe is productive in this area is the one colored in brown and we can see from this cross section that the zone deteriorates to the southwest, just about disappears in the two wells on the left-hand side of the cross section. It thickens in the middle of the cross section and it appears to possibly thin and perhaps deteriorate to the northeast, the last well on the cross section on the right.

Q I call your attention, Mr. Greer, to Section B of Exhibit 2 and ask you if it also bears out the analysis that you have just made.

A Yes, sir.

Q This is the cross section, is it not, of the wells completed since preparation of Exhibit 1?

A Yes, sir. And we find the same zone, the same continuity in these additional wells. The left-hand well on this cross section under B of Exhibit 2 was drilled a year ago, that's Mr. Taylor's Number 1 Walker, but it had not been logged through this producing zone. It has since been logged and the other two wells since been drilled and we find the same productive zone in these wells.

I would like to point out at this time that when this cross section was prepared, and I am looking now at Figure 3 of Exhibit 1, at that time we simply postulated that the productive zone in this area was the one colored in brown. Of all these wells on the cross section, only one well was producing, that was the fifth well from the left-hand side of the cross section identified as Benson-Montin-Greer Drilling Corporation Well No. M-5 Standard of Texas. It was drilled about ten years ago by the Standard of Texas.

We purchased this well a little less than a year ago, after we had done this work,and after we purchased the well we obtained the logs to our reports which showed how the well was drilled and the depth at which oil was encountered. The well was drilled through this area, this zone shown on this cross section, with air, and they stopped occasionally to test for shows of oil. The last stop which they made to test for oil and did not have any oil was at 5925. That's about in the little marker colored green on the cross section.

By the time they reached 5970, which is about ten feet below the area colored in brown, they had a substantial show of oil and had shut down at that time to test the oil show. So we now know that the zone which produces in that particular well is the one colored in brown.

Now, the rest of the wells do not produce. Some of them have, completions were attempted in this Gallup formation but they have not found commercial production. The two wells on the left, completion attempts were made. I think one produced two or three thousand barrels of oil and was plugged. No commercial quantities of oil obtained from it.

The third well from the left, I believe, was drilled through the Gallup to the Dakota, made a Dakota well, and I believe a completion attempt was not made in that. The fourth well shown as Standard of Texas 12-8, a completion attempt was made in it but they had mechanical difficulty, I think lost a string of tools in the hole, and the well was plugged without knowing for sure whether it would produce.

The third well from the right on the cross section, BMG No. J-5, was drilled through this zone into the Dakota, completed as a Dakota producer. We're currently making, preparing to recomplete this well in the Gallup zone in this area colored in brown.

The second well from the right was drilled through this interval with air, they found no show and the well was plugged without fracking it. The last well on the right, I believe a completion attempt was made on it. It was unsuccessful.

Q Have you prepared a structural map which shows a planned view of the area of best development of the Niobrara member?

A Yes. I think first we should briefly look at Figures 4 and 5. I would like to look at Figure 4 next. It is another cross section displaced from the first cross section we looked at to the east, approximately one to two miles. Shows about the same type of development deterioration of the brown zone to the south, a thickening to the north, possible deterioration in the furthest north well.

Figure 5, then, is another cross section, an east-west cross section, showing development of the brown zone. On the right-hand side of the cross section, it appears to be entirely missing in the furthest west well, Pan American Tribal "H" No. 1. The second well from the left, at the time this cross section was prepared, had not been logged. It has, however, since been logged and is shown in Exhibit 2 under Section B, and has the zone of interest at just about the same point as we anticipated it.

This cross section shows that we have no development of the zone in which we're interested on the west part of the plat shown on the cross section, which is the edge of the area which we request to be spaced. It would appear from this cross section that the zone does have development to the east of there that has to be spaced.

Q Now, proceeding to the structural contour map, Figure 6 --

A Figure 6 is the same structure contour map which we looked at in Figure 2, except it has superimposed on it our interpretation of the area of best development of this particular zone in the Niobrara. We believe the zone deteriorates north, south and west, probably continues to the east.

Q What is the significance of Figure 7?

A Figure 7 shows in our interpretation the area which would be of interest if we were considering structure alone. That is the area within approximately one mile downdip from the base inflecture and slightly updip from the point of updip flecture. The basin flecture is approximately on the zero contour line, the maximum change in dip of the beds on the updip side is at about the 4,000-foot contour, so if we were considering structure alone, this is where we would look for production in this fractured shale formation.

Q Have we then combined the features of both structure and development of the Niobrara member?

A   Yes, sir. That is shown on Figure 8. The area colored in yellow on Figure 8 shows that area which we believe to be most prospective for production in this particular zone of the Niobrara.

MR. NUTTER: Mr. Greer, let me interrupt you just a minute there. Going back to Figure 7, --

THE WITNESS: Yes, sir.

MR. NUTTER: -- you have got this dashed line which cuts across the middle of Sections 20, 21 and 22, and then diagonally across, down here in the southwest corner across through Section 12, that's the corresponding boundary of the brown area on Figure 8. Now, would you explain what that dashed line represents, please?

THE WITNESS: Yes, sir. The dashed line represents, in our opinion, the probable limits of commercial production. It's very difficult for us to tell where commercial production begins and ends. We think it would be somewhere within the brown area.

MR. NUTTER: So if you come back to Exhibit 7, and you are going on structure alone, you would have between the left-hand side of the pink area and the right-hand side of the pink area, --

THE WITNESS: Yes, sir.

MR. NUTTER: -- but then your commercial production would end at the dashed line on the north and south ends of the pink area?

THE WITNESS: Yes, because of the course of development within Niobrara, --

MR. NUTTER: I see.

THE WITNESS: -- so here we have the primary area and perhaps the secondary area shown on Figure 8. We have attempted to enclose both of these areas with the unit area, and the area which we request to be spaced.

Q (By Mr. Cooley) What is the significance of Figure 9?

A Figure 9 shows a further interpretation of the reservoirs in this pool. We conclude from our study, or had a year ago, that there were at least two fault blocks in this pool. One would be the area colored in brown and the other the one colored in yellow. There could, of course, be more than these two fault blocks. We felt there were at least this many. They're really two separate reservoirs. We believe, however, that from a practical standpoint of administration by the Oil Commission that it should be considered one pool, of one spacing and one proration standard, and accordingly we have requested that it be considered this way. Although we believe it actually has at least two fault blocks. We have indicated here that we believe one zone or area of separation would be the little green-shaded area which shows the locus of what we believe to be the ceiling fault. This is at the point of the maximum change in dip of the beds. It changes from about 40 to 45 degrees to almost flat. We felt that there is probably at least one fault there. Could be a series of faults.

Q Skipping, now, through Exhibit 1 to Figure 10, which follows immediately after page 22 of Section C.

A Figure 10 --

Q Part 1, excuse me for interrupting, Part 1 of Section C of Exhibit 1 deals with comparisons with other pools in the area. However, first, would you explain, make a comparison of the reserves between sandstone and shale reservoirs with equal permeabilities?

A Yes, sir. I would like to refer to Case 3455, in which we went into this in a little more detail. This is one of the exhibits from that case and it shows a comparison of pore space which one might anticipate for a fractured reservoir as compared to the pore space in a sandstone reservoir for the same permeability.

For instance, sandstone of 100 millidarcies, we can see from the brown-shaded area of this Figure 10, one would anticipate a porosity on the order of 12 per cent to perhaps 25 per cent. On the other hand, a fractured system which has that same permeability would probably have a porosity on the order of 200 to perhaps four-tenths of one percent. In other words, we might expect a tenth to a hundredth as much oil in place from a fractured shale oil well which has the same productivity as an oil well producing from sand.

Q In Case Number 3455, you presented a working model, the purpose of which was to portray these same characteristics that you have just discussed, did you not?

A Yes, sir. At that time our working model showed a more rapid rate of depletion on the fractured system as compared to a sandstone system.

Q Have you attempted to estimate the oil in place in the La Plata-Gallup Oil Pool based upon comparison of the characteristics of this pool, with other fractured shale reservoirs in the San Juan Basin?

A Yes, sir.

Q Is that discussed in detail on pages 1 through 7 of Section C?

A Yes, sir.

Q Would you briefly summarize that discussion, please?

A Yes, sir. The other comparative pools are the Verde-Gallup, the Boulder-Mancos Pool, the East and West Porto-Chiquita Pool. In Case 2881 we went into detail showing the recoveries from the Verde-Gallup Pool and those recoveries are 500 to 1,000 barrels per acre.

Q Let me interrupt, please.

MR. COOLEY: Mr. Examiner, in order to shorten the discussion with respect to the Verde-Gallup, could we move that that portion of the transcript in Case 2881 with respect to the oil in place in the Verde-Gallup Oil Pool be incorporated in this case?

MR. NUTTER: What case was that?

MR. COOLEY: This was the first spacing hearing with respect to the Porto-Chiquita Pool.

MR. NUTTER: Was that the Pubco case?

MR. COOLEY: No, sir. It was the first 160-acre spacing in the Porto-Chiquita Pool where the same approach was made in the comparison with other fractured shale reservoirs.

MR. NUTTER: Yes, sir, that portion of the testimony or the record in Case 2881 will be incorporated by reference.

MR. COOLEY: Thank you.

MR. NUTTER: Also, if you desire that portion of Case 3455 that relates to this sand and shale drainage can be incorporated.

MR. COOLEY: Yes, sir.

A In the Boulder Pool we have determined that 750 barrels per acre will be recovered. This pool is nearly completed and there is very little doubt as to the ultimate recovery. This also was reviewed in Case Number 3455. In West Porto-Chiquita an elaborate interference test was run and from that interference test we determined minimum values of oil in place of 1,000 barrels an acre, maximum of 2500, with an average estimated of approximately 1700 barrels in place.

From this information, and comparison with the transmissibility of these pools, we can make an estimate of oil in place for the La Plata-Mancos Pool. In Boulder, we calculated 2200 barrels per acre in place; it has, Boulder has transmissibility on the order of ten darcy feet in its main fracture system. West Porto-Chiquita with 1700 barrels in place has a transmissibility on the order of five to six darcy feet.

We have determined from the La Plata-Mancos, the wells on which we have information in this pool, the transmissibility of the main fracture systems will probably not exceed one and a half darcy feet. We can then compare the amount of oil in place to be expected in the La Plata Pool to be something less than we found in Boulder, something less than was found in West Porto-Chiquita, and if we make the assumption that the relation is as that shown by the trend of porosity to permeability shown on Figure 10 for that type of fracture system, then we arrive at about 1200 barrels per acre in place, is about all we can expect in La Plata.

This calculation is set out in detail in the discussion on pages 1 to 7.

MR. NUTTER: Do you hazard a guess as to recoverable?

THE WITNESS: Yes, sir. The recoverable oil will depend partly on the method of exploitation, whether the gravity drainage mechanism can be utilized or if the recovery will be essentially solution gas drive. In Boulder, we believe that the producing mechanism was primarily solution gas drive with some help from gravity drainage, and we believe the recovery approximated thirty to thirty-five per cent of the oil in place. We think we have a fairly accurate calculation of oil in place of 2200 barrels an acre and recovery of 750 --

MR. NUTTER: Mr. Greer, I don't see an estimate of recoverable in East or West Porto-Chiquita: do you have an estimate of recoverable on either of those with your known transmissibilities?

THE WITNESS: Now, in East Porto-Chiquita we did not obtain transmissibility data. In West Porto-Chiquita we did obtain a lot of transmissibility data. For that pool, for the part of it that we can utilize the gravity drainage mechanism and we hope that that will be for a substantial part of it, we are hoping to have recoveries as high as 60 per cent of the oil in place.

MR. NUTTER: Which was 1700 barrels?

THE WITNESS: 60 per cent of 1700 barrels. We know we cannot realize the gravity drainage mechanism throughout all of West Porto-Chiquita. Here in La Plata it will depend, in my opinion, on which mechanism contributes the greater part of the production, if it has to be solution gas drive, and, of course, it will be solution gas drive if the field is developed on close spacing, then we're looking at a recovery on the order of 30 per cent. 25 per cent under the particular circumstances here.

MR. NUTTER: You have enough dip to help the gravity drainage?

THE WITNESS: Yes.

MR. NUTTER: 45 degrees?

THE WITNESS: Yes. If we can utilize the drainage mechanism, I would expect us to get 60 or 70 per cent recovery.

MR. NUTTER: I think we will take a fifteen-minute recess at this point.

(Whereupon, a recess was taken.)

MR. NUTTER: The hearing will come to order, please. Mr. Cooley, will you proceed?

Q (By Mr. Cooley) Mr. Greer, have you had core samples taken from any of the wells in the La Plata-Gallup Oil Pool?

A Yes, sir, we cored four wells last year.

Q Do you have any of those cores here present?

A Yes, sir.

Q Or portions of them?

A Yes, sir.

Q Would you identify them, please?

A Here are some core samples, this first one is from the N-31 well, that's in Unit N of Section 31. That's a depth of 2279 feet. I would like to show by this core sample the type of vertical fracturing that we have found in some of the zones, and which we believe forms a reservoir. This instance we could see at least one vertical fracture, down approximately the center of the core. There's always a question, when you find a vertical fracture in a core, as to whether the fracture was induced by coring or if it was truly a fracture in the formation before it penetrated the formation.

In this instance, we feel that the fracture was in place in the formation and a little additional evidence that we have is the fact that after we fracked this particular well and cleaned it out, we found some pieces of formation which fell into the hole.

Here is another sample. Incidentally, I would like to have these samples back, these little pieces. You can see where the core, bit cored down through the formation, and then after fracturing, sand fracture treatment, the formation parted along its natural fracture planes and the piece fell into the hole.

MR. NUTTER: How was that recovered?

THE WITNESS: In a sand pump. It was a large hole, we have a large sand pump and naturally we recovered large pieces. Here are a few more.

MR. NUTTER: This is where the side of the hole has sloughed off and fell in after the core had been cut?

THE WITNESS: You can sort of see some little erosion channels, which I believe helped the fractured pieces to part from the formation and fall into the hole as a result of the frack. All those samples we just looked at are from the N-31 well.

A I would like to look at this one next. This next core sample, we can see the steep dip of the formation; this is from the I-6 well at a depth of 4165 feet. It shows some of the streaks of silty limey material which gives a higher reading on the electric log than some of the pure shale. You can actually measure the dip of the beds from, by measuring the angle of those streaks and that well in that --

MR. NUTTER: This is approximately 45 degrees at least?

THE WITNESS: Yes, sir. and there was at that depth. In that well, I believe the hole was deviated a few degrees and, of course, it deviates toward the bed, toward a perpendicular to the bed, which means, then, that the dip of the formation is slightly greater than what we actually cored --

MR. NUTTER: I might point out here to some of you fellows that might be interested, one of the wells that Al mentioned earlier in his testimony, the Standard well, was located right in the center of the Southeast of the Southwest, right on these very steeply-dipping beds and when the well was bottomed they ran a survey on it and found that the bottom of the hole was almost in the middle of the Southwest of the Southwest. It had traveled updip and into the next 40 and bottomed almost into the next 40.

THE WITNESS: Almost off the list.

A This next core sample shows something which we believe causes a separation perhaps of one reservoir from another, in that there are little faults, and we believe they are probably large faults in the vicinity of this well. But you can see from the little streaks in this core, little offsets in the lines. They are tiny faults and we have an idea that they are probably larger faults in the vicinity of this well.

Now, this core is also from the I-6. And it's in an area which is essentially non-productive. It has the, approximately the same electrical log characteristics, the same core analyses as the other wells, but when we fracked this well, the pressure built up after we had injected just a couple thousand barrels of oil, just as though we had reached the end of the reservoir and we feel that probably that's what happened, that we were in a little fault block perhaps no larger than one or two acres.

Q (By Mr. Cooley) In order to identify the core samples that you have just discussed for the record, the one showing the vertical fracturing that you discussed first is identified as Exhibit D-1, is that correct?

A Yes, sir.

Q And the second one that you discussed, showing the dip of the formation, is identified as D-3?

A Yes, sir.

Q And the third one that you discussed, being the non-productive area, is identified as D-2, is that correct?

A Yes, sir, that's correct.

(Whereupon, Exhibits D-1, D-2 & D-3 were marked for identification.)

Q Have you had laboratory analysis made of the cores that you have taken from the wells recently drilled in the La Plata-Gallup Pool?

A Yes, sir.

Q Referring to Exhibit 3, are these the analyses to which you refer?

A Yes, sir.

Q Would you briefly discuss the characteristics shown?

A Yes, sir. The most important characteristic, I believe, which we found as a result of this coring program, we can see if we'll look under Section C of this Exhibit 3, there are two pages of core analyses and then a graph or a plat which shows the core analyses plotted on the same scale as a copy of the electric log.

The significant thing to me is that where we find low resistivity and resistivity curve is the right-hand curve of the electric log section, which has the coloring yellow, green and brown. The scale is ten ohmmeters per division and the oil and water saturation are shown on the graph that has the red coloration and you can almost see a direct correlation between resistivity and oil saturation and, of course, the inverse of water saturation, which is shown with the solid line and the oil with the dashed line. Now, what this means to us in areas which have not been cored, I mean zones which have not been cored, if we have a resistivity, a low resistivity, say ten to twenty ohmmeters, or perhaps even thirty ohmmeters, that we cannot expect to have a high oil saturation. It's simply, the shale is simply saturated with water.

For instance, in the interval from about 5160 to 5200, the water saturation is between 70 and 80 per cent. There just is no oil saturation.

Q Mr. Greer -- Excuse me, was there other discussion?

A Yes, we think this is significant because a part of the Niobrara which has been produced in the San Juan Basin covers several hundred feet and there has been some thought on the part of some people that perhaps the entire several hundred feet of section is oil saturated and possibly could be oil productive if fractured. We are convinced from this coring program that we can anticipate oil production only in those zones that have high resistivity and, of course, there is high resistivity on the electric log and, of course, we know that we can have high resistivity without having high oil saturation, so again, we draw the conclusion that although high resistivity is necessary for oil saturation, it is not in itself an indication that it is only oil-productive, but under any circumstances we must have high resistivity, and by high, in this particular field it appears something in excess of 20 to 30 ohmmeters and, of course, we can go back to the other cross sections and by inspection we can see that only the zones that we have colored are zones which we can reasonably anticipate to produce.

Now, we might look just a little, reviewing in detail some of the analyses that we have. We find that the porosity, total porosity determined in the laboratory, runs on the order of five to eight per cent. And oil saturation in the productive interval from, oh, 40 to 50, possibly 60 per cent. But the significant thing here is that when we add the oil saturation, which is still in the core when we recover it, and bring it up on the ground and it's had an opportunity for whatever oil is in it to produce in a sense, to come out of the core, if we add the oil saturation to the water saturation, we find that these two saturations will total from 80 to 95 per cent of the total pore space. This means, then, that only five to perhaps fifteen or twenty per cent of the total pore space is all that's available for productive, for oil to produce. And, too, we have found a good part of this porosity is tiny fractures, little hairline fractures, that exist and probably exist in the core samples here, but you can't see with your naked eye until you treat the core in some fashion to bring those fractures out. And, of course, the cores now are not under pressure and these fractures have expanded and so it's difficult to tell what the true oil volume of these cores would be without putting them back under the same reservoir pressure. We can only tell the maximum --

MR. NUTTER: Mr. Greer, just to interrupt you here -- How are you able to determine what the oil saturation is in a core? When your drilling fluid is crude oil, I notice here on all your core analyses, how much of that residual oil that's in that core came from the drilling fluid?

THE WITNESS: The answer to that, I think, is, although it's an odd thing, we have found very little invasion of oil into a core and the way we can, of course, demonstrate that there has been very little oil invasion is by looking at the core analyses, for instance, the graph we were looking at under Section C, the oil saturation in the interval from, say, 5180 to 5200 runs from four per cent to fifteen per cent. Yet the permeabilities and porosities are similar to the cores of the hole. This means, of course, that in this instance there was no oil invasion, because there's no oil left when the core was analyzed and yet the characteristics of the core are the same.

From this we assume that we have not had much oil invasion. But to analyze the porosity, which is left after you take oil saturation and water saturation and the fluids that are left in the core, after it's brought to the surface, then we find we are looking at a really small part of the total bulk of the core, something from two or three-tenths of a per cent to maybe a half a per cent. And this is roughly the amount of pore space that it would take to contain the amounts of oil which have been indicated in the other pools to be present; namely, from a thousand to two to three thousand barrels in place.

Q (By Mr. Cooley) Now, Mr. Greer, the data that you have just been discussing reveals that the total oil contained in the core itself, as they were analyzed, was much greater than the amount of oil that you have estimated to be "in place", is that correct?

A Yes, sir. Of course, the total oil in the core is a very large amount of oil, locked into shale that can never be moved.

Q And for purposes of clarification, although it might not be entirely accurate, is it true that the oil that you have calculated to be in place is oil that in the main fracture system that has capability of movement?

A Yes, sir.

Q And that the vast quantity of the oil, percentage of it, is locked in these hairline fractures and has no connection with the main fracture system?

A Yes, sir.

MR. NUTTER: In other words, your oil in place is oil that's in the fractures only and not in the matrix?

THE WITNESS: Yes, sir, the matrix in this instance is, well, for instance, the oil is still in these cores although they have been on the surface of the ground for months, if they were to be analyzed right now they would show the same oil saturation which you have in these core analyses.

Q (By Mr. Cooley) Did you have prepared, Mr. Greer, a photograph of the entire core of one of your wells?

A Yes, sir. On the P-31.

(Whereupon, Applicant's Exhibit E was marked for identification.)

Q I hand you what has been marked as Exhibit E for purposes of identification and ask you if this is the photograph to which you refer?

A Yes, sir, this is a photograph of every bit of the core, which was taken from the P-31 well and, of course, the purpose of this is to give visual evidence or evidence which can be seen visually at this hearing, of the fact that there is no substantial change in the type of formation or the lithology for the entire interval cored, although there is a substantial difference in the amount of oil in the cores from the different depths.

Q Is it your desire, Mr. Greer, to withdraw this exhibit after the case has become final and the Commission has had an opportunity to review it?

A Yes, sir, we would like to have the film, or the picture returned within a matter of months, unless the Commission feels they need them.

MR. COOLEY: Does the Examiner have any objection to the withdrawal of the exhibit?

MR. NUTTER: We have no objection to the withdrawal of the exhibit after the time for the appeal of this case is over.

Q (By Mr. Cooley) Mr. Greer, have you conducted any communication tests in the La Plata-Gallup Pool?

A Yes, sir.

Q Referring to Exhibit 2-C, is this a graphical demonstration of communication within the pool?

A Yes, sir. Perhaps we should look at Exhibit 2-A first, to locate the wells we'll be discussing. On 2-A we can see the well which was shut in and the fluid levels measured in it. It's the Taylor No. 1 Walker in the Northwest Quarter of Section 6.

The two new wells which have been drilled, which communication is evidenced with the Taylor No. 1 Walker, are the P-31 well and the N-31 well, both in Section 31. The first evidence of communication was observed between the No. 1 Walker and the P-31 well.

We might now look at Exhibit 2-C. The vertical scale is fluid level in terms of feet from the surface of the ground. This particular well was completed in February of 1968. And this graph is all for the year 1968. It was produced about twenty days and then shut in. The fluid level started raising as shown in March, and by about the 20th of April was up to approximately 1400 feet.

And as noted on the graph, the scale change, we picked up, down at the bottom of the graph, in April, fluid level continued to rise until in May, for a period of a few days, tubing was run in the well and it was swabbed at the rate of about ten barrels a day, in order to condition it to take a bottom hole sample, a bottom hole sample was taken and at that time the well shut in again and the rise in fluid level continued and it was observed as shown and recorded on this graph.

And then in August, about the 9th of August, the P-31 was given a sand frack treatment and there was an abrupt increase in the rate of rise of the fluid level in Taylor's well, which was shut in all this time. Which we believe was a result of the sand frack treatment.

And then in early September, as shown on the graph, the P-31 was put to production. It started pumping the load oil back and there appears to have been a leveling off in the fluid level rise in the Taylor well at that time.

And then in early November, I believe that's the first of November, the N-31 well was given a sand frack treatment. And the fluid level then showed an abrupt increase, pressure wave more or less went through the Taylor well and then the fluid level started declining for the next few days.

Incidentally, we checked the fluid level rate of increase in the Taylor well within about thirty minutes after fracking the N-31, and we actually measured the fluid level rising while we were there on location, it was rising I believe at the rate of about 20 or 30 feet an hour.

MR. NUTTER: Now, you had a rather abrupt increase in fluid levels in the middle of October there on that well, Mr. Greer. What do you attribute that to?

THE WITNESS: I don't know what caused that. We have postulated that that might be a reflection of the pressure wave created back in August.

MR. NUTTER: Was the N-31 drilling at the time?

THE WITNESS: The N-31 was drilling, and we went back to check our records to see if it was possible that we had oil circulation and perhaps interference from that standpoint and the well was drilling at too high a point clear above the matrix formation, so we felt that was not it. So we really just don't know; of course, it's a small increase of about four feet, about a pound and a half.

A Then in about the 10th of November the N-31 was started to pumping and again a very marked decrease in fluid level was noticed in the Taylor well. It went clear off the scale in three or four days, and by November 23rd the fluid level was down to 1490. At that time, I believe we put the Taylor well to producing and shut the N-31 well in.

The N-31 had started making gas and we felt it would dissipate the reservoir, so we have a marked increase, or increase in fluid level and evidence of communication between the

N-31 and Taylor's well. And not quite such a sharp increase, but a definite increase in fluid level resulting from frack treatment of the P-31.

Now, we have concluded, although we have not shown it on this graph, that the reservoir has a pressure production coefficient on the order of 1500 barrels per pound and that results from the fact when we introduced about 5,000 barrels of oil in the P-31 we had an increase in the fluid level equivalent to about three pounds. By the same token, when the N-31 well was fracked, the fluid level, although there was a pressure wave went through Taylor's well, it was declining at a rate which would appear to us would give the same stabilized increase in reservoir pressure. So we can draw, really, two conclusions from this. One is the pressure production coefficient, 1500 barrels per pound; and the other is, although there is quite a difference in the type of reaction from the frack treatments, the end result is going to be roughly the same. The two wells which had high permeability, namely Taylor's well and the N-31, showed the sharp change in pressure immediately following the frack treatment. But it's pretty evident, it is evident to us, that after two or three weeks the pressure increase will be comparable to that which resulted from fracturing the P-31; so we feel that all three wells then are not only in communication, they are in communication with the same reservoir. It's unlikely that one of them is producing from two zones and another from only one.

Q (By Mr. Cooley) Well, from this study, Mr. Greer, do you draw any conclusions as to the effective area of drainage of the well in this pool, in this portion of the pool?

A The N-31, or the P-31 and Taylor's well, approximately half a mile apart. This would be one-half mile drainage radius or approximately 600 acres, would be the equivalent of 600-acre drainage. The N-31 and Taylor's well are approximately 1500 feet apart, would be roughly equivalent to 160-acre drainage.

Q And is there any doubt in your mind and in your opinion with respect to the effectiveness of this drainage, any economic time?

A No.

Q Moving now, Mr. Greer, to the drainage mechanism of the reservoir drive that is present in the La Plata-Gallup Oil Pool, would you direct your attention to Figure 11, following immediately after Figure 10?

A The Figure 11 shows our calculation of --

Q Excuse me, this is in Exhibit 1. Immediately after page 22 of Section C.

A This shows the rate of drainage which we believe might result in this area if the oil can be maintained in its under saturated condition. Refer to this in the rim block which is in the west part of the pool, the fault block that's along the steeply dipping part of the area.

Q You have just mentioned the under saturated condition of the oil in the La Plata-Gallup Oil Pool, Mr. Greer. What evidence do you have of this fact?

A The under saturated oil to which I refer, we found from a sample in Mr. Taylor's well. And that fluid analysis is in --

Q Section D of Exhibit 2?

A Exhibit 2, Section D.

Q Section D as in "dog" of Exhibit 2.

A It shows a bubble point of approximately 185 pounds at a time the pressure was on the order of 300 pounds in the well. We have carefully conditioned the well such that the pressure in the well bore during the conditioning period, in bringing new oil into the well bore, would have had to have been at least 275 pounds, so the sample was at least 100 pounds under saturated below the lowest pressure which existed in the well bore at the time the well was being conditioned. So we believe this was a very good sample and accurate information.

Now, if we can keep the oil under saturated, and, of course, we keep it under saturated by maintaining pressure on it as the field is produced, we can expect gravity drainage rates as shown on Figure 11, but at different depths. For instance, in the upper part of the reservoir where the depth or the rate of dip is about a thousand feet per mile, for transmissibility of a thousand millidarcy feet, which would be one darcy feet, we have about 200 barrels per day per linear mile on stride. If we have as much as one and a half darcy feet, 2,000 feet per mile, we get up to about 500 barrels per day, per mile, on a stride. This, these gravity drainage rates are discussed under --

Q 14 to 17 --

A -- Section 2, pages 8 to 13. Section C, Part 2. I think we need not go into them now.

Q What would happen, Mr. Greer, if the reservoir is produced at a rate in excess of the gravity, efficient gravity movement?

A In that event, the pressures will drop below the bubble point, gas comes out of solution, you have, in a sense, primarily solution gas drive, and the recoveries then would be solution gas drive recoveries and, of course, this will result if the well is, if the field is drilled on a close spacing, and high rates of production field-wide are realized. The only way that we can expect to have the gravity drainage mechanism work is to restrict rates of production to that comparable to those shown on this graph in Figure 11.

Now, the drastic things that happen when the solution gas drive mechanism takes place, is that the viscosity drops, the permeability to oil drops, and within a short time after the pressures have dropped below the bubble point, then these rates, as shown on Figure 11, will drop by a factor of ten to one hundred; in other words, where initially we have 200 barrels per day per linear mile in the area we can expect an area around the Taylor well, it would soon be down to 20 barrels per day per linear mile or even two barrels per day per linear mile, if we deplete the field by solution gas drive.

Q From this information, Mr. Greer, what conclusion do you draw with respect to the most desirable density of development?

A Well, the density should be, well, first, we need, of course, in each fault block to have enough wells to produce the oil in a reasonable length of time. And it appears from these gravity drainage rates that this can be realized producing the reservoir in a reasonable length of time with just a few wells. Certainly nothing like a 40 or 80-acre pattern would give.

Q Mr. Greer, on page 16 of Section C, you have some estimated recoveries from the various blocks which you refer to as the rim block and the basin block. Recalling once again that this exhibit was prepared over a year ago, prior to drilling of the three most recent wells, do you have any revision to make with respect to your reserves stated there?

A Well, yes, sir, first I think we should explain the figures that show here. The basin block is the block which we show colored in brown on Figure 9. And the rim block is the area we show colored in yellow on Figure 9 of this Exhibit 1. We have some pressure production data for the basin block which allows us to arrive at an estimate of oil in place and recoverable oil in addition to what we would have postulated from our geological work. This is shown on the line opposite the one titled "Basin Block", under both competitive operations and unitized operations.

MR. NUTTER: Mr. Greer, may I interrupt one more time?

THE WITNESS: Yes, sir.

MR. NUTTER: That 300,000 produced oil, that would have come primarily from that Standard --

THE WITNESS: M-5.

MR. NUTTER: -- M-5, right?

THE WITNESS: Yes, sir, all of it came from that.

MR. NUTTER: From the one well?

THE WITNESS: Yes, sir.

A Then in the rim block, if it covered an area shown in Figure 9, with other characteristics as shown, we would estimate for competitive operations nearly three million barrels in place and approximately 870,000 recoverable. Under unitized operations, and we have used this comparison, because under unitized operations we can control gas-oil ratios, control production, perhaps inject water or gas and maintain pressure, we would anticipate a higher recovery, nearly two and a half times as much.

Now, the figures for the basin block, of course, we must qualify to the extent that we, although we have some pressure production data for the basin block reservoir, we don't know how much gas, free gas was originally in place there. With this unknown factor, it's difficult to put an exact number on the remaining reserves.

For the rim block, of course, we had no pressure production data and all we can go on is the size of the area, and if it has these chracteristics; we now know that the rim block contains a substantial gas cap and, of course, as a result there will not be as much oil in place. It also has a broader area of separation between the rim block and the basin block and so the rim block is not quite as large as we estimated a year ago. Nevertheless, the relative recoverable reserves for the rim block will be about the same as we have shown here, which is roughly, we think, 25 to 30 per cent under competitive operations up to perhaps 70 per cent on wide spacing and under unitized operations.

MR. NUTTER: Mr. Greer, how did you establish that there is a gas cap on the rim block?

THE WITNESS: By drilling a well into it, and it's the N-31, it penetrated the gas cap --

MR. NUTTER: The N-31 did --

THE WITNESS: The N-31.

MR. NUTTER: But it was completed as an oil well, wasn't it?

THE WITNESS: Actually we haven't completed it yet, we just produced part of the load oil back and the gas reached such a high point that we shut the well in rather than continuing producing it.

MR. NUTTER: Structurally, it's about what, a hundred feet higher than the Taylor well?

THE WITNESS: Yes, only about a hundred feet higher, and if I might add to that, I don't have the figures with me, but we determined the bottom hole pressure in the N-31 at the time we finished the sand frack treatment and from that pressure it was, I believe, about 20 pounds higher than we felt it should be. And, of course, this gave us concern, because one reason for that would be that the oil column extended only half-way between the Taylor well and the N-31 and, of course, in producing the well we did find the high gas-oil ratio and it's in the gas cap. And from those pressures, then, we would estimate that the gas-oil contact is about half-way between those two wells.

MR. NUTTER: I see. Which would probably be at about, well, one is 3836 and the other is 3718?

THE WITNESS: Yes, sir.

MR. NUTTER: So that's 118 feet difference between about half of that difference you would expect to be the location of the gas-oil contact?

THE WITNESS: Yes, sir, which would be roughly 60 feet above the Taylor well.

Q (By Mr. Cooley) Mr. Greer, does there occur any vertical separation within the productive member of the Niobrara?

A Yes, sir. I would like to refer back to Figure 3, if you might, for just a moment.

Q This is under Section B?

A Under Section B of Exhibit 1. We anticipate from this field most of the production will come from the zones between the D and E marker, primarily the zone colored in brown, although we believe that there might be production possible from the zone colored in yellow, particularly if it could be connected with vertical fractures to the zone colored in brown.

Now, there are some other zones which show continuity across this area. And there are three zones between the B and C markers, which one can follow. We have not colored them in but it's apparent that they are rather continuous. Our experience, however, in the Porto-Chiquita Pools with zones in about that part of the Niobrara, they have had high gas-oil ratios, they have not been good reservoirs and even where the gas-oil ratio was good, they did not have as much horizontal communication as other zones, and a well completed in one of them would produce just a short while and then be depleted.

We have not, however, found vertical communication all the way from, say, the B-C interval down to the D-E interval, which is a separation of maybe a hundred to 200 feet. The shales between those intervals are perhaps more plastic and if they were fractured at the time that the other zones were fractured, well, the fractures have since healed, and we have found no vertical communication between those zones. And this means, then, a number of things; we cannot determine communication, for instance, from a well completed in the B-C interval with one in the D-E interval, but primarily it means we have an expensive completion in that we have to isolate these zones which are not good producers, in order to confine our sand fracture treatment to the productive interval. If we attempt to fracture several hundred feet of open hole, we believe it's possible, if not probable, that the fracture, the sand frack treatment will not enter the right zone. And if it doesn't enter the right zone, and not being in vertical communication, then we have not, we do not have a commercial well.

Q Looking now, Mr. Greer, to Section D of Exhibit 1.

A Yes, sir.

Q This has to do with the pressure production data. As you pointed out in your earlier discussion, this deals only with the basin block, is this correct? The pressure, actual pressure production history deals largely with the basin block, does it not?

A Yes, sir. We do have a pressure buildup on the one well, on the Taylor well in the rim block, which is covered in here, but no production data to work with.

Q I'm interested in shortening this hearing as much as possible. Could we turn to Figure 12 and try to summarize the information that's contained in Section D of Exhibit 1?

A Yes, sir.

Q That appears immediately after page 9 of that section.

A Pages 1 to 9 contain primarily the statistical data which goes into the figures which follow. On Figure 12 is shown the bottom hole pressure buildup on the N-5 well taken in April of 1968. From this we have determined two things, primarily, an estimate of permeability in the area of this well. And what its pressure might be at the time or this day it was taken in April.

The Figure 12 shows on one scale most of the information which was taken up to about two days after the oil was shut in. The details of the information from that point on is shown in Figure 13. And primarily what we determined from this is that the permeability at some distance from the well bore is substantially better than that near the well bore.

On Figure 12, for the first part of the buildup curve we determined the permeability to be something like four to five hundredths of a darcy foot. As shown on Figure 13, a permeability of ten times that amount is indicated at some distance from the well bore. Now, we believe that at this time, of course, the pressure was substantially less than it had been originally, and the permeability to oil is less than it originally was. And I would estimate that the initial permeability, then, when the oil was at a pressure in the reservoir, that it was substantially oil and very little free gas, would probably have been about three times that amount.

If so, the main fracture system within the area of this M-5 well would have a transmissibility on the order of one and a half darcy feet.

Figure 14 is a plot of pressures taken in the M-5 well, plotted against a cumulative production. By April of '68 the well produced approximately 300,000 barrels of oil, and as can be seen on the graph, shut in 48 hours and shut in twelve days, the pressure was still increasing. And our interpretation of the maximum pressure at which this well might build up, which would reflect the true reservoir pressure at this time, would be something between 1100 and 1200 pounds. If the pressure, stabilized pressure in the reservoir were size 1200 pounds last April, it would indicate a pressure production coefficient of 1,050 barrels per pound. We know that it was at least 1100 pounds, which would be a pressure production coefficient of 800 barrels per pound.

Using those two coefficients, we can calculate that the oil in place, that there were no free gas in the reservoir, would originally have been on the order of two to three million barrels of oil. Now, at this point I estimated two and a half million barrels of oil. Now, this means, then, that if this well is in communication, or was at the time it was first drilled for two and a half million barrels of oil, and we have, as we believe, something like 1200 barrels per acre in place, the well then must be draining an area on the order of 2,000 acres. It is only happenstance that that is approximately the size of the area shown in brown on Figure 9, which from our geologic interpretations would be the size of the basin block reservoir which geologically we would expect to have.

Now, the fact that we determined 2,000 acres from our pressure production data, of course, does not necessarily confirm that that is the area, but it would be an area of about that size. It may not be located as shown on Figure 9, but it would be an area of about that size.

Now, of course, if there were substantial, if there were a substantial gas cap in this reservoir, then the amount of oil would be less and the area would be less. We think that there is very little room for substantial gas cap here, because it is so close to the point which we believe separates the basin block from the rim block. The bottom hole location of the well is indicated on Figure 9, is very close to the zero contour and we feel that there can be very little productive acreage updip from that point. Even so, if there were a substantial gas cap or free gas in this reservoir, which tended to hold the pressure up, we still have the fact that the well has actually produced 300,000 barrels of oil, and if the recovery in this instance, almost has to be solution gas drive, there's hardly enough dip here for gravity drainage. We must be looking at only 400 to 500 barrels per acre, so this means, then, that the well has actually produced amount of oil equivalent to complete depletion of six to seven hundred acres.

MR. NUTTER: Whatever dip there is, is down from the well anyway?

THE WITNESS: Yes, sir. So this, then, gives us additional evidence, we believe, of widespread drainage possibilities in this pool.

Q (By Mr. Cooley) Moving now, hurriedly, Mr. Greer, to Figure 15, for a brief summary of the pressure buildup survey on the Lloyd B. Taylor No. 1 Walker --

A We determined, again, two things from the pressure buildup of this well; as shown on Figure 15, this is a plot which is often used for a well, a new well in a reservoir, the familiar Delta "T" divided by "T" plus Delta "T", time ratios against either pressure or fluid level. And, of course, from this we can tell permeability in the vicinity of the well, which is indicated to be two and a half darcy feet. And also an extrapolation which would indicate a minimum height of fluid level to which the well might build up.

The important thing we gather from that is that it is apparent that the fluid level will raise at least to a point 1300 acre feet from the surface, and, as a matter of fact, it actually rates higher than that. But that gives us a minimum pressure in Mr. Taylor's well, the E marker datum, of around 330 pounds. And when we convert that back to a datum comparable to that of which the M-5 well was completed, or which the pressures were measured in the M-5 well, we find a comparable pressure, then, of 1500 pounds, which is about the pressure the M-5 had originally.

This means to me that we are dealing, then, with virgin pressure in the rim block reservoir. And that the M-5 well has not depleted this reservoir.

MR. NUTTER: The rim block?

THE WITNESS: The rim block, yes, sir.

A So we have, then, pressure difference data which then adds to our belief that there are two, at least two fault blocks.

Q (By Mr. Cooley) Section E, Mr. Greer, deals with drilling and completion methods and costs. It is self-explanatory, and I suggest that we move on to Section F, which deals with the economics under competitive operations.

A All right, sir. I suggest we look --

Q On page 3 of that section you have a tabulation which I think best explains it; would you direct your attention to that?

A Yes, sir. On page 3 of Section F of Exhibit 1, we have a schedule which shows my estimate of drilling costs based upon the depth wells will be drilled and also on the spacing, and the reason it varies in this instance with spacing is that it would be my thought that on close spacings, say, 40 acres or 80 acres, that operators would not take the, go to the expense of large sand frack treatments, they would hope by drilling enough wells that they could get into the fracture system with the additional number of wells, and perhaps could drill them somewhat cheaper than on wide spacing. On wide spacing we feel we have to go to large frack treatments to be sure we get into the fracture system. And, of course, on the close spacing, if care is not taken to drill a well with air, if they are drilled with mud, of course, they will ruin some of the wells.

This is not a material thing from the standpoint of recovery because on 40-acre spacing they would probably only need a fraction of the total number of wells drilled to recover the oil, so that's not the fact that they would ruin some of the wells doesn't mean they wouldn't recover all of the oil; and by "all of the oil", I mean all the oil that is recoverable by solution gas drive methods and under competitive operations it probably would make very little difference in recoverable oil on the various spacings other than we might recover a little more on wide spacing than on close spacing.

The reason for that is that competitively the wells, the reservoir would be produced so fast, depleted so fast there would be very little gravity drainage.

Now, with these figures of costs of wells, we can then determine the economics under the various spacing patterns that might exist under competitive operations.

Q Would you proceed, then, to the 40-acre spacing pattern and discuss the economics under that?

A This is shown under the tab numbered 40 and here we have just taken a sample reservoir of the sizes indicated earlier, postulated a few dry holes and calculated the total cost depending upon the depth and for the 40-acre spacing column as we reviewed on the previous schedule.

In this instance we would anticipate a recovery of a million one hundred and seventy thousand barrels of oil at a cost of seven dollars a barrel, which, of course, would be uneconomic.

Q Would you proceed to the 80-acre spacing postulation?

A With the same principles on 80-acre spacing, we come up with a cost of five dollars and eight cents per barrel.

Q And for 160-acre spacing?

A 160-acre spacing we get down to a cost of three dollars and eighty-three cents per barrel for the over-all average.

Q And for 320-acre spacing?

A 320-acre spacing we have gone to a little bit more detail, broken the cost down as to the different blocks, the basin block and the rim block, but primarily what we would like to show here under the colored plat, under the 320-acre tab, is the fact that on any spacing pattern it is difficult to realize the full spacing recovery for any -- on an over-all average, and that is because that somewhere under the spacing unit of the outside or edge wells the reservoir will probably cease to be productive or you'll reach the edge of the reservoir, and for the example shown on this plat, although the spacing is 320 acres per well, the true average area of drainage, which each well would result in having, is only 200 to 220 acres. So even under wide spacing we find that we really could not anticipate a full drainage tract for each well equal to the spacing unit.

Now, these costs are shown, figuring costs in terms of dollars per barrel recovered, is shown, too, for the basin block, which is still quite high, $6.50 a barrel. The rim block, however, begins to reach economic proportions, $1.72 per barrel on 320-acre spacing.

Q Mr. Greer, from your testimony with respect to the various possible spacing patterns, it would appear that in your opinion that none of the spacing patterns, either 40, 80, 160 or 320 would be an economical method by which to develop this pool.

A This is true.

Q Then, as far as, in fact, development, in view of the unitization of this pool, would you proceed to Section G and demonstrate to the Examiner how you would propose to actually develop this pool?

A Yes, sir. It is our thought that this pool can only be economically developed under unitized operation and, of course, concurrently with that, to have some type of wider spacing pattern than the 40 acres. One type of development pattern is shown under Section G of Exhibit 1, which would probably recover the maximum amount of oil for the minimum cost. And the reason for this is that the gravity drainage mechanism could be realized in the rim block and additional oil recovered in that fashion. And it would take only a few wells to do it.

The basin block, it makes no difference, I believe, what spacing is drilled on, it's recovery will be about the same, being solution gas drive.

Q Well, Mr. Greer, in view of this fact, why have you proposed that the Oil Conservation Commission space this pool on 160-acre spacing?

A Well, sir, it's very difficult, of course, to get 100 per cent commitment of the working interest owners to a unit agreement and if some of the operators have not joined the unit agreement, then they, of course, must be permitted to develop their own properties in their own way. And so it's necessary that we have some type of spacing pattern. And it certainly needs to be wider than 40 acres.

We believe, in this instance, that with the commitments we have to the unit agreement, although part of the acreage is still not committed, that the unitized lands could be properly protected with the 160-acre spacing pattern. I believe we could meet any offsets which would be drilled by any of the non-unitized parties, and protect the lands without a dense drilling program being resulting.

Q Would this be true in the case of either 80-acre spacing or 40-acre spacing?

A If we get down to 80-acre spacing and 40-acre spacing I feel we could not protect the unitized lands without drilling too many wells.

Q Would this, in your opinion, result in the drilling of useless and unnecessary wells in the pool?

A Yes, sir.

Q Would failure to drill on a closer pattern result in any less recovery from the pool?

A No, sir. In fact, I anticipate higher recovery on the wider pattern.

Q And this, again, is because of the efficient utilization of the gravity drainage mechanism?

A Yes, sir.

Q Now, so that we have no misunderstanding with respect to the particular type of spacing order that the Applicant is here requesting, it is true, is it not, that you propose that the order prohibit the drilling of more than one well on 160-acre quarter section?

A Yes, sir, we are concurned with not only proration units but actual spacing units.

Q In your opinion, is this particular provision absolutely essential in order to prevent waste in this pool?

A Yes, sir, it's absolutely essential.

Q In your opinion, will the pools, or pool or pools, the area requested here to be spaced, be efficiently and economically drained under the patterns which you propose?

A Yes, sir.

Q In your opinion will the correlative rights of any operator in the pool be adversely affected thereby?

A No, sir.

MR. COOLEY: Mr. Examiner, this concludes the direct testimony that we have with respect to the spacing facets of our case and we would move admission of Exhibits A through E at this time.

THE WITNESS: Could we have a word?

MR. NUTTER: Sure.

(Whereupon, a discussion was held off the record.)

MR. COOLEY: I would like to move the admission of these exhibits and then inquire of the Examiner his pleasure with respect to procedure. Do you want to cross examine with respect to this?

MR. NUTTER: We have got Exhibits A through E?

MR. COOLEY: Yes, sir. We have Exhibits A, B and C in the form of the booklets.

MR. NUTTER: Those are 1, 2 and 3.

MR. COOLEY: Excuse me, Exhibits 1, 2, 3, 4, 5.

THE WITNESS: We have got some misnumbered here.

MR. COOLEY: I will redesignate the exhibits, but they are 1, 2, 3, 4, 5.

MR. NUTTER: Now we have three books here, that's 1, 2 and 3, and you have got three rocks there?

MR. COOLEY: No, they are all marked as 4.

MR. NUTTER: 4-A, 4-B and 4-C?

MR. COOLEY: Correct.

MR. NUTTER: And you have got Exhibit 5 here, which is the film that you want withdrawn later?

MR. COOLEY: Correct.

MR. NUTTER: Applicant's Exhibits 1, 2, 3, 4-A, 4-B, 4-C and Exhibit 5 will be admitted in evidence provided that Exhibit 5 may be withdrawn at a later date.

(Whereupon, Applicant's Exhibits 1 - 5 were offered and admitted in evidence.)

MR. NUTTER: How much longer will your direct examination last, Mr. Cooley?

MR. COOLEY: I would think possibly another fifteen minutes with respect to the pressure maintenance and the amendment of the unit rules.

MR. NUTTER: I think we'll recess the hearing at this time until 1:30, then.

MR. COOLEY: In order to clarify the record with respect to Applicant's Exhibits, that portion of the record which refers to Exhibits D-1, D-2 and D-3 should be changed to read 4-A, 4-B and 4-C respectively. And the exhibit identified as Exhibit E should now be identified as Exhibit 5.

(Whereupon, the noon recess was taken.)

MR. NUTTER: The hearing will come to order.

Mr. Cooley, I believe just prior to lunch you had finished your direct testimony on Case 4067, is that correct?

MR. COOLEY: I said I was, but I have one more question with respect to that case.

DIRECT EXAMINATION (CONTINUED)

BY MR. COOLEY:

Q With respect to Case 4067, Mr. Greer, due to the extreme angle of dipping in the La Plata-Gallup Pool, is there a possibility that within the same fault block, wells could be completed that were in different depth factors as established by the Commission's rules and regulations?

A Yes, sir.

Q As a result of this possibility, do you have any recommendation with respect to what allowables should be assigned 160-acre spacing and proration units in that pool?

A Yes, sir, would suggest four times the normal unit allowable for all wells, all depths throughout this spaced area.

MR. COOLEY: With that, we have no further direct testimony to present in connection with Case 4067.

CROSS EXAMINATION

BY MR. KUTTER:

Q Mr. Greer, in your direct testimony you mentioned that the rules that you would propose for this pool would prohibit the drilling of a second well on a 160-acre tract if such unit were approved by the Commission. Now, I presume then that you would also object to the formation of a nonstandard unit comprising less than 160 acres?

A Yes, sir, unless, of course, it was the result of a partial section. You know, there are some lots, as I recall, along the township line; some are larger than standard, and some are smaller. But with that exception, we would oppose it.

Q Now, you also mentioned that there were some tracts in this unit area that had not been committed to the unit agreement?

A Yes, sir.

Q For the purpose of protecting the unitized line by drainage from those tracts outside of the participation, you felt that 160-acre spacing would be adequate. Now, what tracts are not committed to the unit, could you tell me, and what is the size and shape of those tracts?

A I believe somewhere in the Commission's records, you have a copy of Exhibits A and B to the unit agreement. If I had that, I could probably identify them more quickly and simply. So you suppose we could have someone look that up in the unit files? I don't have a copy of Exhibit A or B with me.

Q Yes, I think we probably can. Has the status changed since the unit agreement was signed, or do you know offhand which tracts are not committed, so if you had a copy of the Exhibit A--

A I would have to look at Exhibit A or B in order to tell which tracts we feel will not come in. In general, though, they are tracts, if you might refer back to--

Q Refer to figure 2, that shows all of the tracts, and you can probably identify them.

A You are looking at figure 2?

Q Exhibit 1.

A They are primarily in Sections 27, 28, 34, I believe a 40-acre tract in Section 8, the northeast of the southeast. That would be most of it.

Q Now, up here in Section 27, which would the acreage be which was not committed?

A In the south part of Section 27.

Q That little narrow strip that runs across the south part there?

A I believe it is either the narrow strip or the small tracts, the north halves of those 40-acre tracts.

Q And then in Section 28, which is the acreage that is not committed?

A I believe it is the acreage shown through the center of the--

Q Is that the odd-shaped configuration?

A The odd-shaped configuration, yes.

Q And did you mention Section 29?

A I didn't mention Section 29, and I certainly can't tell.

Q And in Section 34, that would be--

A Probably the little tract, 80 acres in the west half of the northwest quarter.

Q Mr. Greer, in the event we adopted 180-acre spacing rules, and you don't approve of nonstandard units, what opportunity is given to the owners of this acreage to develop their property?

A Well--

Q Without coming into the unit.

A They can drill in on 160-acre tracts and, of course, if they don't have a full 160, then, of course, they can communitize with unit lands in the 160. Of course, if we refuse to join, they could force pool the unit lands. This is our interpretation of the forced pooling law or rule.

Q But you would still object to the formation of a nonstandard unit and suggest--

A Well, I'm sorry, sir, I thought you were talking about standard 160-acre tracts in which they didn't have the full 160 acres.

Q Well, you would object to either the formation of a nonstandard 160, excluding the unitized lands, and you would suggest they would force pool?

A Oh, yes, sir.

Q Take the southwest quarter of Section 28 there, 40 acres presumably is unitized, and 120 acres is not committed to the unit?

A Yes, sir.

Q So you would suggest if they wanted to develop that quarter section, that they would have to force pool the 40 acres that belongs to the unit in with their 120?

A Yes, sir, they would always have that right. I doubt that we would refuse to join. We would probably work out some kind of agreement where they could have our 40 acres and drill it. But certainly, we would not prevent them from drilling their 120 acres and force pooling our 40.

Q Now, what is your primary objection to the establishment of nonstandard units, say two 80-acre units in a quarter section, assuming that each of those wells would receive half of an allowable? The withdrawals from those two wells would be limited to one single allowable, and wouldn't result in dropping the reservoir pressure below the bubble point with an increase in viscosity, would it?

A I have no particular objection to two 80-acre tracts forming a 160. The nonstandard units that I would oppose would be, say, two 40-acre tracts and, say, two lots of five acres each. That would really give you only 90 acres. In this instance, we would suggest that they go to 240 acres.

Q You would rather see an oversized unit than an undersized unit?

A Then they could have the unitized allowable with it.

Q Along the west side of this township, there are some undersized sections which, I presume, do have some small lots under them?

A Yes, sir, you can see it is dotted out, I believe in Section 7. In the south part of the plat, you can see the size of those small lots.

Q Referring to your Exhibit Number--or Figure No. 8 in Exhibit 1 in which you have--correction, we will make that Figure 9, in which we have the rim block and the basin block. Now, this is probably the limits of the development as far as commercial production is concerned, as you know it now, is that allowable? The withdrawals from those two wells would be limited to one single allowable, and wouldn't result in dropping the reservoir pressure below the bubble point with an increase in viscosity, would it?

A I have no particular objection to two 80-acre tracts forming a 160. The nonstandard units that I would oppose would be, say, two 40-acre tracts and, say, two lots of five acres each. That would really give you only 90 acres. In this instance, we would suggest that they go to 240 acres.

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A Yes, sir, you can see it is dotted out, I believe in Section 7. In the south part of the plat, you can see the size of those small lots.

Q Referring to your Exhibit Number--or Figure No. 8 in Exhibit 1 in which you have--correction, we will make that Figure 9, in which we have the rim block and the basin block. Now, this is probably the limits of the development as far as commercial production is concerned, as you know it now, is that correct?

A It could extend into the area a little bit north of that, as shown on Figure 8, colored--the areas colored on Figure 9 would be the area primary possibility. Figure 8 there colored in brown, in my opinion, might offer production or might permit production, but I really doubt that it would be commercial. Somewhere in the brown shaded area, I think we will find the end of the commercial production.

Q Now, actually, what you have done, if you take the colored area on Figure 9 which is bounded by the dotted line, you have extended that on the north with the dashed line by just about a belt, a belt of just about a mile width, is that correct?

A Yes, sir, that's correct.

Q And then down on the southwest side of the colored area, you have extended that area by a belt exactly one mile wide around on the southwest side?

A Yes, sir. If I might continue on that, we shorten it on a due south side because of the poor development shown in the No. 1 Elliott, the southernmost well on the plat along the range line between 13 and 14 west.

Q What are the pool boundaries as established by the Commission at the present time?

A The present designated La Plata-Gallup Pool, I believe, covers the south half of Section 5, and then, of course, as I understand it, the rules applying to this pool then would also cover wells drilled within one mile of that boundary, which just about fits this southern boundary. Of course, it would be slightly east of this boundary.

Q The pool has never been extended over to the Taylor Walker Well yet?

A I think that the Taylor Walker Well has just been operated under the same rules, since it is within about a mile of the present designation.

Q And then you have two wells in Section 31 which aren't shown on this exhibit, and the pool hasn't been extended to take them in either, also?

A No, sir.

Q Now, your request here for the 160-acre spacing is that these rules would be applicable to the entire area of the La Plata-Mancos Unit, the way I understand it?

A Yes, sir.

Q Which would be beyond the commercial productive limits, as you estimated them, they would be well beyond the present pool boundaries, and they would even be past the commercial limits? Take up in the north end there of the unit, you have a belt there that is beyond the one mile belt, which is at least a half a mile wide, so you would be making these rules applicable for beyond the present pool boundaries and beyond the expected boundaries of commercial production?

A Yes, sir. The reason for that is it is so difficult to tell for sure where the production will start and where it will end.

Q I realize when you have a fracture system this way, it could extend a good distance.

A Yes, sir. And we felt it is absolutely necessary to cover the area, and we feel that on one will be harmed if we have a little larger area than actually covers these pools.

And, of course, as we understand it, there is nothing at some future date to prevent an operator from asking a hearing to shrink the pool boundaries, if through development of additional information they have found a separate reservoir which requires different treatment, as for instance a sand bar.

Q Is it your present contemplation to drill any additional wells?

A Yes, sir, there is a well in Section 32 of Unit G, which is currently being drilled; and further drilling to the north of that would probably depend on the outcome of that well.

Q And there is nothing going on at the present time in the Brown area?

A Yes, sir, we are preparing to work over the well in the southeast quarter of Section 5, indicated on Figure 9 as the J-5.

Q That is shown with the gas well symbol?

A Yes, sir, that well was originally completed in the Dakota. We have just recently plugged the Dakota off and are preparing to treat the Gallup formation.

Q Is that the Hoss well that we had considerable correspondence on last year?

A No, sir, the Hoss well is the old Standard of Texas 5-1 well which Hoss purchased from Standard of Texas, and we purchased then from Hoss, and it is designated on here as the M-5.

MR. NUTTER: I believe that is all the questions I have. Are there any other questions that anyone wants to ask of Mr. Greer? Go ahead, proceed with your next direct testimony.

(Whereupon, Applicant's Exhibits Numbers 1, 2, 3, 4, 5, inclusive, Case No. 4074, were marked for identification.)

DIRECT EXAMINATION

BY MR. COOLEY:

Q Mr. Greer, Benson-Montin-Greer has made application to the Commission in Case No. 4074, for the institution of a pressure maintenance project in the La Plata-Gallup Oil Pool, and the surrounding area, the area covered by the La Plata-Mancos Unit Agreement. Have you prepared a plat which shows thereon the proposed injection water wells?

A Yes, sir.

Q I hand you what has been marked as Exhibit 1 in Case 4074, and ask you if that is the plat to which you refer?

A Yes, sir.

Q Does Exhibit 1 show thereon the proposed water injection well?

A Yes, sir.

Q Would you identify that please?

A It is in Unit B of Section 31, and is identified on the plat.

Q For what purpose do you propose, what specific purpose do you propose to inject water into this pool at this time, Mr. Greer?

A In order to maintain pressure and keep the characteristics of the reservoir oil as favorable as possible. We believe by this sort of flotation water flooding process, we can realize the same ultimate recovery, high ultimate recovery as we can by gravity drainage. It is just a reverse process of moving the oil uphill rather than downhill. The important thing is to keep the gas in solution, and prevent a deterioration of the relative permeability characteristics.

Q Does the success of this water injection pressure maintenance concept depend upon the concept that the water will, because of its weight, sink to the bottom of the reservoir or below the oil, at least?

A Yes, sir, the area right around the proposed injection well is fairly tight, low permeability. We believe the water will course in all directions as we inject the water into this well, but when it reaches the permeability indicated for the reservoir found in the No. 1 Walker and in the M-31, this will be high enough permeability to allow the water and oil to separate by gravity segregation. We feel then that the oil will float to the top, in a sense, the water will tend to move to the bottom; and if we can keep the oil undersaturated, we think we should have a high recovery of oil in place.

Q Do you have any evidence through the producing history of this pool of the amenability of the pool to gravity segregation? Have you had occasion to observe gravity segregation in the pool?

A All we can do is calculate on the basis of transmissibility the rates of gravity segregation, gravity drainage, which we have done, and we think would be adequate for a successful flood. Our only problem here is that the reservoir appears to be quite small.

Q Have you prepared a diagrammatic sketch of the proposed water injection well?

A Yes, sir.

Q I hand you what has been marked as Exhibit Number 2 in Case No. 4074, and ask you if that is the diagrammatic sketch to which you refer?

A Yes, sir.

Q Will you explain to the Examiner the information set forth thereon?

A Well, this plat simply shows the casing in the well, the proposed setting point of the packer. It was our intention to load the annulus with oil behind the packer, and we will then inject water into the perforations through which the well now produces.

Q Do you also propose to simultaneously inject gas into the reservoir at a different point.

A Yes, sir. In Exhibit 1, we show the location of the proposed gas injection well. It is in Unit N of Section 31, and is marked on the plat.

Q What is the purpose of injecting gas, what would be your purpose of injecting gas into this reservoir?

A Our purpose in injecting gas is again to help maintain reservoir pressure high enough to keep the oil at a pressure above the bubble point. We have anticipated by the time we can get water started into the ground that the pressure will have dropped somewhat in the reservoir, and it will be necessary then to raise the pressure in order to keep the oil pressure above the bubble point.

We can do it two ways. One would be to inject an excess amount of water and compress the gas cap, but if we do we are apt to lose oil into the dry gas cap. So our plan is to inject enough water to raise the level around the No. 1 Walker. At that time, we will inject enough gas to raise the pressure in the reservoir to a point that we can plug the well and a draw down in the well bore, while leaving the working pressure at or near the bubble point. In this fashion, we can produce with a minimum draw down any given volume of oil, and with a minimum draw down in pressure we will have a maximum potential for successful water flood.

Q Has the gas oil ratio in the Taylor Walker well shown any increase since its completion?

A It produced from about three months from the end of November to the end of February at about solution gas oil ratio, and at this point it started--it has recently started a slight increase in gas oil ratio, which is just about the same we calculated would happen.

Q Isn't it also further evidence of the amenability of the reservoir to gravity segregation?

A I believe it indicates that some gravity segregation was taking place in the production of this well, inasmuch as the gas oil contact is only 60 feet above the datum at which this well produces. And horizontally from the well bore, it would have to be within 200 or 300 feet, and there is enough oil being produced that had we had complete gravity segregation, the gas would have been approximately to the well bore now. So this means there has been very little coning, and with very little coning we can only assume that we have had good gravity segregation.

Q Have you prepared a diagrammatic sketch of the proposed gas injection well, N-31?

A Yes, sir.

Q I hand you what has been marked as Exhibit Number 3 in Case 4074, and I ask you if this is that diagrammatic sketch?

A Yes, sir.

Q Would you please point out the significant features of this?

A This also shows the strings of casing in the hole where they were cemented, and how much cement. This is an open hole completion, approximately 80 feet of open hole below the casing.

It is our intention to inject gas in this well in the casing without either tubing or packer. I understand this is an unusual procedure, but in this instance we feel that it is a completely safe operation.

The casing is seven and five-eighths inch N-80 casing, will stand several thousand pounds pressure, and we anticipate our highest injection pressure to be on the order of 300 or 400 pounds.

Q Mr. Greer, what will be the respective sources of the injected water and injected gas in the event this application is approved?

A As to water, one of the local ranchers has a water well within a few hundred feet of the proposed water injection well. We have an agreement with the rancher to purchase water from him.

As to the source of gas, Southern Union Gas Company has a pipeline within a few hundred feet of the well, and the line carries pressures ranging from 300 to 500 pounds. It is our plan to purchase gas from Southern Union and inject it into the well without compressor, just simply use line pressure. The injection rates will be quite small. We anticipate injecting probably not more than 100,000 feet a day, and probably injection would be required for a period of time less than a year in order to raise the reservoir pressure to the point desired.

Q Then with respect to the water sources, it would be fresh water that you would be injecting?

A Yes, sir.

Q Mr. Greer, in your opinion, will the approval of the proposed pressure maintenance project increase the ultimate recovery from the La Plata-Gallup Oil Pool?

A Yes, sir, in the circumstances which we have found, the wells which we have drilled in this area so far, it appears that we cannot utilize gravity drainage in the normal fashion, which we would have preferred in this particular fault block, for the simple reason that the highest productivity wells are updip, and the lower productivity wells are downdip. Accordingly, in order to reduce the reservoir to a reasonable rate of production, it is more practical to inject water downdip than to produce the updip wells, rather than, say, inject gas updip and produce the downdip wells. Of course, we are going to inject gas, but only for the purpose of raising the pressure, and not for the purpose of moving the oil downdip.

Q In your opinion, can the correlative rights of any operator in the entire area of the pool be adversely effected by the approval of this proposed project?

A No, sir, all of the owners of working interest rights within the area of the proposed pressure maintenance project have committed their interests to the unit agreement, and we can see no difficulty with uncommitted owners.

Q It is your proposal, however, that the entire unit area be considered as the pressure maintenance project area?

A Well, sir, I believe the practice of the Commission has been, even inside a unit, to designate pressure maintenance projects which do not cover the entire land, and I should think we can be guided by the same principles that the Commission has used in the past for designating a pressure maintenance project.

Q Do you have any recommendations with respect to the area to be covered by the proposed pressure maintenance project?

A Well, I have not given thoughts to that, but I guess we can do it right now.

I would suggest all of Section 31, the east half of Section 36, the east half of Section 1, the north half and the southwest quarter of Section 6.

Q Does that include all of the presently completed wells in that particular fault block?

A Yes, sir, so far as we know at this time.

Q If any additional wells were completed within that particular fault block, would it be your recommendation that the project area be enlarged to include them?

A Yes, sir.

MR. COOLEY: I have no further questions on direct.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Greer, referring to Exhibit Number 2 first, I note that your surface pipe is set at 276 feet. Is this adequate to protect the surface water in this area, the shallow fresh water?

A Yes, sir.

Q Do you know what the depth of the rancher's well is that you will be buying water from?

A I don't recall that. I believe it is from--I believe we checked into this one time, and decided it is producing from the Cliff House, and, of course, the formation dips in that area. The Cliff House is exposed on the west part of the unit, and it is several thousand feet deep on the east side of the unit. The surface or near surface water sands are not related, I don't believe, I believe are not related to any of the other formations.

Q Now, what volume of water do you anticipate you will be injecting into this well?

A It is my thought that we would inject just enough water to maintain reservoir pressure, once we have raised the reservoir pressure by injecting gas in the N-31. It is my thought that we will shut the well in, use it as an observation well to measure reservoir pressure, and then we will adjust our injection, water injection volumes to maintain that pressure, neither increase or decrease it.

Q In other words, you would be putting in what you take out?

A Putting in what we take out. Nearly always there is a loss of water injected, and it varies from perhaps 10 to 30 per cent. I don't know whether it is absorbed in the shale, or what happens to it. But I would think that that would be something on the order of what we would inject, from 100 to 130 per cent of the oil produced.

Q Do you have any idea what the injection pressure will be for that water?

A No, sir, we have not run any calculation. I have just assumed we would have no difficulty in putting the water away. We have a tentative order for a pump which will go up to several thousand pounds, if we need it. And, of course, we are certain that we can put the water away if we have to go to fracking the pressure, which will be 1,500 to 2,000 pounds.

Q Now, the perforated interval in this N-31 is 2,943 to

2,975. Would that be with reference to the cross section that you have in this Exhibit Number 1 with the brown, the yellow, and the green? Would that be in the brown area?

A It is only in the brown area, yes, sir.

Q And then referring to Exhibit Number 3 on the gas well, you mentioned the source and the volume, and the pressure. It is this open hole interval from 2,219 to 2,234 in the brown only?

A No, it is in both. It is in both the yellow and the brown.

Q That is the well that we were discussing before lunch that is partially completed above the gas oil contact, isn't it?

A Yes, sir.

Q Is the surface casing here adequate to protect the shallow fresh water from being contaminated by gas in the event you should have a breakthrough somehow? You have 176 feet.

A Yes, sir. I believe at that point we don't really have fresh waters. That is usually characterized by water that is not fresh. I believe at this particular point, we don't have surface fresh water problems.

Q No shallow fresh waters here?

A No, sir.

Q Now, in your D-21 well, you will use plastic lined tubing, and you are going to load the annulus with oil. Can that be equipped with a pressure gauge at the surface so you can detect a pressure leak?

A Yes, sir.

Q And you suggest for the project area that we include all of 31, the east half of 36, east half of 1, and the north half and southwest quarter of 6?

A Yes, sir.

Q Now, you mentioned that the G-32 is drilling in the northeast quarter of Section 32?

A Yes, sir.

Q Presumably upon completion of that well as a producer, you would extend the project area. And what is the status of this I-6 in the southeast quarter of Section 6?

A Sir, if I might make a comment on the possibility of adding the G-32. If, of course, we find that the G-32 on completion to be a commercial well, and in the same fault block as these others, we would ask for it to be extended.

Now, we are in the real steeply dipping part of the formation at that point, and it is our present thinking that this well, if it develops to be a commercial producer, will probably be in a different fault block than either of the others.

Q There is a transitional zone between the rim block and the basin block?

A Yes, sir. I believe this for the reason that as we examine the pressure coefficient of the wells in the rim block now, and the fact that we have found a substantial gas cap, we can then back up our calculations to a total volume of oil and total area, and that point I feel it unlikely the area will be large enough to include the G-32. We don't know this, but this is our thought.

Q What is the status of the I-6?

A I-6 is about to be plugged. We have drilled the well, set pipe, fracked it, and produced part of the fracked oil back. I doubt we will recover all of the fracked oil before we plug it. I-6 is definitely in the area of noncommunication with either the rim block or the basin block.

Q That is where those rocks are bent and very tight, I guess?

A Yes, sir, probably faulted.

MR. NUTTER: I believe that is all I have. Does anyone have any questions of Mr. Greer in this case?

MR. COOLEY: I have something additional.

REDIRECT EXAMINATION

BY MR. COOLEY:

Q Mr. Greer, you have submitted to the Commission logs on both proposed injection wells, have you not?

A Yes, sir.

Q I hand you what has been marked as Exhibit Number 4 in Case 4074, and ask you to identify this, please?

A Yes, sir, this is the well in which we propose to inject gas.

Q That being--

A The N-31.

Q I hand you what has been marked as Exhibit Number 5 in Case 4074, and ask you to identify it, please?

A It is a log of the P-31 well, which we propose to inject water in.

MR. COOLEY: Mr. Examiner, Applicant offers into evidence Exhibits 1 through 5, inclusive.

MR. NUTTER: Applicant's Exhibits 1 through 5, in Case No. 4074 will be admitted in evidence.

(Whereupon, Applicant's Exhibits Numbers 1, 2, 3, 4, 5, inclusive, Case 4074, were admitted in evidence.)

Does anyone have any further questions of Mr. Greer in this case? Do you have anything further in this case, Mr. Cooley?

MR. COOLEY: No, sir.

MR. NUTTER: We will proceed with Case 4075.

DIRECT EXAMINATION

BY MR. COOLEY:

Q Mr. Greer, has the Oil Conservation Commission already approved as to form the La Plata-Mancos Unit Agreement?

A Yes, sir.

Q Has the operator of that unit been Benson-Montin-Greer?

A Yes, sir.

Q Have you had occasion, Mr. Greer, to consider minor changes as to the form of that agreement?

A Yes, sir.

Q What particular portions of the La Plata-Mancos Unit Agreement do you propose now to amend?

A We would like to amend pages 15, 16, 17, and 18 for the purpose of permitting lands to be added to a participating area which are necessary for unit operations, lands which not necessarily are established to be commercially productive.

Q For what reason would it be justifiable to include such lands within a participating area?

A For the reason, as we just reviewed in the preceding case, we would like to add a gas well to the participating area in order to inject gas into it. As a gas well, it is a noncommercial well. It is also a noncommercial well as an oil producer. According to the terms of the unit agreement as originally approved, only lands which are commercially productive can be added to a participating area. This would permit lands to be added to a participating area which are necessary to unit operations.

Q For further production of that well as a gas well, it would have an extremely adverse effect on the oil recovery from the pool?

A Yes, sir. Wells producing from a structural position, the same as the N-31, would probably produce a little bit of oil, but the amount of gas to be produced with it would so deplete the reservoir pressure as to seriously affect the ultimate recovery, so these wells are wells in that category and should not be produced. Accordingly, lands of this category should not have wells drilled on them, but there are some gas and some oil that can be recovered from them from the downdip wells. Accordingly, they need to be added a participating area, given some fair equity, and handled in this fashion.

Q I hand you what has been marked as Exhibit Number 1 in this case, and ask you to explain the significance of this exhibit?

A This exhibit shows pages 15, 16, 17, and 18 as they appeared in the original unit agreement which the Commission has already ruled on. Shown in red on these pages are the changes necessary to put the unit agreement in the form which we require in order that lands necessary for unit operations can be added to participating areas.

The United States Geological Survey has approved as to form these changes as shown here. The State Land Office has also approved them.

Q In your opinion, Mr. Greer, will the proposed changes in this unit agreement tend to prevent waste and protect correlative rights within the unit?

A Yes, sir.

MR. COOLEY: No further questions.

(Whereupon, Applicant's Exhibit Number 1, Case 4075, was marked for identification.)

MR. NUTTER: Does anyone have any questions regarding this case? Mr. Greer may be excused.

Mr. Cooley, do you have anything to say with respect to the three cases?

MR. COOLEY: Thank you for the offer, Mr. Examiner. I think we have taken quite enough time of the Commission, and the transcript will speak for itself.

MR. NUTTER: Does anyone have anything they wish to offer in these three cases? We will take the cases under advisement, and call Case No. 4065.

INDEX

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

We, ADA DEARNLEY and SAMUEL MORTELETTE, Court Reporters in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by us, and that the same is a true and correct record of the said proceedings, to the best of our knowledge, skill and ability.

[signature]
ADA DEARNLEY - COURT REPORTER

[signature]
SAMUEL MORTELETTE - COURT REPORTER

I do hereby [illegible] is
a [illegible] in
the [illegible] 4067-74-75
[illegible] 3/5 69
[signature] [illegible]man
[illegible] Oil Conservation Commission

OIL CONSERVATION COMMISSION
STATE OF NEW MEXICO
P. O. BOX 2088 · SANTA FE
87501

April 1, 1969

Mr. Jack Cooley
Burr & Cooley
Attorneys at Law
152 Petroleum Center Building
Farmington, New Mexico

Re: Case No. 4067
Order No. R-3720
Applicant:
Benson-Montin-Greer

Dear Sir:

Enclosed herewith are two copies of the above-referenced Commission order recently entered in the subject case.

Very truly yours,

A. L. Porter, Jr.

A. L. PORTER, Jr.
Secretary-Director

ALP/ir

Copy of order also sent to:

Hobbs OCC x
Artesia OCC
Aztec OCC x

Other

Docket No. 6-69

DOCKET: EXAMINER HEARING - WEDNESDAY - FEBRUARY 26, 1969

9 A.M. - OIL CONSERVATION COMMISSION CONFERENCE ROOM
STATE LAND OFFICE BUILDING - SANTA FE, NEW MEXICO

The following cases will be heard before Elvis A. Utz, Examiner, or Daniel S. Nutter, Alternate Examiner:

CASE 4052: Application of Mobil Oil Corporation for a pool creation and discovery allowable, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks the creation of the Lightcap-Pennsylvanian Pool in Chaves County, New Mexico, comprising the NE/4 NE/4 of Section 7, Township 8 South, Range 30 East, and for the assignment of approximately 35,650 barrels of oil discovery allowable to the discovery well, its C. L. O'Brien Well No. 1 located in Unit A of said Section 7.

CASE 4036: (Continued from the February 5, 1969, Examiner Hearing) Application of Mobil Oil Corporation for a dual completion, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion (conventional) of its C. L. O'Brien Well No. 1 located in Unit A of Section 7, Township 8 South, Range 30 East, Chaves County, New Mexico, to produce oil from an undesignated Pennsylvanian oil pool and the Lightcap [illegible] Pool through parallel strings of tubing.

CASE 4053: Application of El Paso Products Company for special pool rules, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks the promulgation of special rules for the Gallegos-Gallup Pool, San Juan County, New Mexico, including provisions for the classification of oil and gas wells, 80-acre spacing for oil wells, and 320-acre spacing for gas wells.

CASE 4054: Application of Amerada Petroleum Corporation for an unorthodox oil well location and amendment to Order No. R-2[illegible], Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to drill a producing oil well at an unorthodox location 1250 feet from the West line and 2220 feet from the South line of Section 18, Township 24 South, Range [illegible] East, in its Langlie Mattix Woolworth Unit Waterflood Project, Langlie-Mattix Pool, Lea County, New Mexico. Applicant also seeks the amendment of Order No. R-2197, which order authorized said waterflood project, to establish an administrative procedure whereby said project could be expanded to include additional lands and injection wells and producing wells at orthodox and unorthodox locations as may be necessary to complete an efficient injection and producing pattern without the necessity of showing well response.

<u>CASE 4055:</u> Application of Albert Gackle for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Seven Rivers formation in the open-hole interval from approximately 3290 feet to 3620 feet in his George Etz Well No. 3 located in Unit N of Section 27, Township 23 South, Range 36 East, Jalmat Pool, Lea County, New Mexico.

<u>CASE 4056:</u> Application of Albert Gackle for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Lower Queen formation in the perforated interval from approximately 3642 feet to 3699 feet in his Sinclair "A" State Well No. 5 located in Unit I of Section 23, Township 23 South, Range 36 East, Langlie-Mattix Pool, Lea County, New Mexico.

<u>CASE 4057:</u> Application of Charles B. Read for special pool rules, Lea County, New Mexico, Applicant, in the above-styled cause, seeks the promulgation of special rules for the Quail-Queen Pool, Lea County, New Mexico, including a provision for 80-acre spacing and proration units.

<u>CASE 4058:</u> Application of Hiram W. Keith and Dalton Haines for salt water disposal, Lea County, New Mexico. Applicants, in the above-styled cause, seek authority to dispose of produced salt water into the Seven Rivers formation in the open-hole interval from approximately 3874 feet to 3951 feet in their State Well No. 2 located in Unit K of Section 16, Townhship 21 South, Range 34 East, West Wilson Pool, Lea County, New Mexico.

<u>CASE 4059:</u> Application of Hiram W. Keith and Dalton Haines for salt water disposal, Eddy County, New Mexico. Applicants, in the above-styled cause, seek authority to dispose of produced salt water into the Delaware formation in the open-hole interval from approximately 4030 feet to 4158 feet in their Eddy "AGA" State Well No. 2 located 660 feet from the North line and 1650 feet from the West line of Section 36, Township 26 South, Range 31 East, North Mason-Delaware Pool, Eddy County, New Mexico.

<u>CASE 4060:</u> Application of Sidney Lanier for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Yates-Seven Rivers formations in the open-hole interval from approximately 3402 feet to 3650 feet in his I. B. Ogg "A" Well No. 5 located in Unit [illegible] of Section 35, Township 24 South,

(Case 4060 continued)

Range 36 East, Jalmat Yates-Seven Rivers Pool, Lea County, New Mexico.

CASE 4061: Application of Millard Deck Oil Company for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Seven Rivers and Queen formations in the open-hole interval from approximately 3752 feet to 3872 feet in its Atha Well No. 1 located in Unit M of Section 31, Township 21 South, Range 36 East, South Eunice Pool, Lea County, New Mexico.

CASE 4062: Application of Kersey & Company for salt water disposal, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Queen formation in the perforated interval from approximately 1835 feet to 1870 feet in the Bass Well No. 3 located in Unit F of Section 12, Township 19 South, Range 28 East, East Millman Queen-Grayburg Pool, Eddy County, New Mexico.

CASE 4063: Application of Kerr-McGee Corporation for the creation of a new gas pool and special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new pool for the production of gas from the Morrow formation by its Nix Well No. 1 located in Unit L of Section 11, Township 19 South, Range 26 East, Eddy County, New Mexico, and for the promulgation of special pool rules therefor, including a provision for 640-acre spacing.

CASE 4064: Application of Atlantic Richfield Company for salt water disposal, Roosevelt County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the San Andres formation in the perforated interval from approximaely 4207 feet to 42?? feet in its Tucker Well No. 4 located in Unit O of Section 23, Township 7 South, Range 32 East, Chaveroo-San Andres Pool, Roosevelt County, New Mexico.

CASE 4065: Application of Humble Oil & Refining Company for an unorthodox oil well location and reclassification of a water well to an oil well, Lea County, New Mexico. Applicant, in the above-styled cause, seeks to have its New Mexico State "S" Water Source Well No. 4 (CP-427), located at an unorthodox oil well location 650 feet from the West line and 175 feet from the

South line of Section 2, Township 22 South, Range 37 East, Lea County, New Mexico, reclassified as an oil well for the production of oil an undesignated San Andres Oil Pool and authority to produce same as an oil well.

CASE 4066: Application of Humble Oil & Refining Company for the consolidation of two non-standard gas proration units, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the consolidation of two existing non-standard 320-acre gas proration units into one standard 640-acre unit comprising all of Section 26, Township 21 South, Range 36 East, Eumont Gas Pool, Lea County, New Mexico, to be dedicated to its New Mexico State "G" Wells Nos. 2 and 4 located in Units P and G, respectively, of said Section 26. Applicant further seeks authority to produce the allowable assigned to said unit from either of said wells in any proportion.

CASE 4067: Application of Benson-Montin-Greer Drilling Corporation for special pool rules, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks the promulgation of special pool rules for the La Plata-Gallup Pool, San Juan County, New Mexico, including a provision for 160-acre spacing and proration units. Applicant further requests that said special rules provide that the unit allowable for a 160-acre unit in said pool be allocated on the basis of four times the normal unit allowable for Northwest New Mexico, and that no credit be given for depth factors. Applicant further requests that said special rules be limited in their application to the exterior boundaries of the La Plata-Mancos Unit Area.

CASE 4068: Application of Martin Yates III for salt water disposal, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Delaware formation in its Yates & Hanson McCord Well No. 1 located in Unit E of Section 22, Township 23 South, Range 26 East, Dark Canyon Field, Eddy County, New Mexico. Applicant further seeks a procedure whereby its Cordie King Well No. 2 located in Unit K of said Section 22 may be approved for the disposal of salt water without the requirement of notice and hearing.

CASE 4045: (Continued from the February 5, 1969 Examiner Hearing)
Application of H & S Oil Company for an amendment to Order No. R-3357, as amended by Order No. R-3357-A, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the amendment of Order No. R-3357, as amended by Order No. R-3357-A, which order authorized the H & S West Artesia Unit Unit Waterflood Project. Applicant proposes to substitute the Roach Drilling Company-Leonard Well No. 18 located in Unit D of Section 17 as a water injection well in said project in lieu of the Cities Service-Mell Well No. 17 located in Unit M of Section 8, both in Township 18 South, Range 28 East, Artesia Pool, Eddy County, New Mexico.

CASE 4069: Application of Union Oil Company of California for the creation of a new pool, assignment of discovery allowable, and the promulgation of special pool rules, Lea County, New Mexico.

Applicant, in the above-styled cause, seeks the creation of a new Devonian oil pool for its Midway State Well No. 1 located in Unit F of Section 12, Township 17 South, Range 36 East, Lea County, New Mexico, and for the assignment of an oil discovery allowable in the amount of approximately 57,380 barrells to said well. Applicant further seeis the promulgation of special pool rules for said pool, including a provision for 80-acre proration units.

CASE 4070: Application of C. E. LaRue and B. N. Muncy, Jr., for salt water disposal, Lea County, New Mexico. Applicants, in the above-styled cause, seek authority to dispose of produced salt water into the salt and Yates formations in the open-hole interval from approximately 1254 feet to 3000feet in the La Rue-Muncy John "B" Well No. 2 located in Unit A of Section 35, Township 17, South, Range 32, East, Maljamar Grayburg-San Andres Pool, Lea County, New Mexico.

BENSON-MONTIN-GREER DRILLING CORP.

EXHIBITS IN CASE NO. 4067
BEFORE THE
NEW MEXICO OIL CONSERVATION
COMMISSION

March 5, 1969

INDEX

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company BENSON-MONTIN-GREER   Formation GALLUP   File RP-3-2306
Well LA PLATA MANCOS UNIT NO. 1(P-31)   Core Type DIAMOND 4"   Date Report 7-31-68
Field LA PLATA (GALLUP)   Drilling Fluid CRUDE OIL   Analysts GALLOP
County SAN JUAN   State NEW MEX.   Elev. 6062'GL   Location 660'FSL 990'FEL SEC 31-T32N-R13W

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	CHALK-CHK	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

NOTE: Add 6' to below listed core depths to correlate with Schlum. IES Log Run 7-31-68

(CONVENTIONAL ANALYSIS)

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS KA	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
1	2868.0-69.0	0.06	8.5	52.0	42.3	Sh, Bl, V/Fn Grn, Sl/Slty
2	73.0-74.0	0.03	6.8	48.4	36.7	Sh, Bl, V/Fn Grn, Sl/Slty
3	78.0-79.0	0.01	9.1	46.2	37.3	Sh, Bl, V/Fn Grn, Sl/Slty
4	83.0-84.0	0.13	8.4	45.2	42.8	Sh, Bl, V/Fn Grn, Sl/Slty
5	88.0-89.0	0.04	8.6	41.8	46.5	Sh, Bl, V/Fn Grn, Sl/Slty
6	93.0-94.0	0.33	9.2	42.8	43.6	Sh, Bl, V/Fn Grn, Sl/Slty
7	98.0-99.0	0.03	8.9	43.8	46.1	Sh, Bl, V/Fn Grn, Sl/Slty
8	2903.0-04.0	0.33	9.0	41.1	48.7	Sh, Bl, V/Fn Grn, W/Strks of Lmy Slt
9	08.0-09.0	0.01	9.2	52.1	36.9	Sh, Bl, V/Fn Grn, W/Strks of Lmy Slt
10	13.0-14.0	0.01	5.8	44.9	36.2	Sd, Wh, Fn Grn, W/Sh Strks
11	14.0-15.0	0.01	8.0	47.5	40.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
12	18.0-19.0	0.02	8.0	41.2	41.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
13	23.0-24.0	0.02	8.0	45.0	40.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
14	27.0-28.0	0.01	7.9	35.4	53.1	Sh, Bl, V/Fn Grn
15	33.0-34.0	0.01	8.2	45.2	45.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
16	38.0-39.0	0.12	9.7	48.5	44.3	Sh, Bl, V/Fn Grn
17	43.0-44.0	0.02	8.4	38.1	54.8	Sh, Bl, V/Fn Grn
18	48.0-49.0	0.02	7.3	38.4	54.7	Sh, Bl, V/Fn Grn
19	50.0-51.0	0.86	5.8	48.2	41.3	Sd, Wh, Fn Grn, Lmy, W/Sh Strks
20	55.0-56.0	0.02	7.0	44.3	41.4	Sd, Wh, Fn Grn, Lmy, W/Sh Strks
21	60.0-61.0	0.08	7.8	51.2	41.0	Sh, Bl, V/Fn Grn
22	65.0-66.0	0.12	6.4	14.1	75.0	Sh, Bl, V/Fn Grn
23	70.0-71.0	<0.01	5.9	11.9	74.5	Sh, Bl, V/Fn Grn, Slty
24	75.0-76.0	0.34	6.4	10.9	81.3	Sh, Bl, V/Fn Grn, Slty
25	80.0-81.0	0.81	6.8	10.3	79.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
26	84.0-85.0	0.07	8.9	7.9	61.8	Sh, Bl, V/Fn Grn
27	90.0-91.0	0.33	6.6	13.6	77.2	Sh, Bl, Fn Grn, Sndy
28	95.0-96.0	0.01	7.8	6.4	77.0	Sh, Bl, Fn Grn, Sndy
29	3000.0-01.0	0.33	7.3	6.8	76.6	Sh, Bl, Fn Grn, Sndy
30	05.0-06.0	0.08	6.9	7.3	81.2	Sh, Bl, Fn Grn, Slty
31	10.0-11.0	0.01	5.9	8.5	78.1	Sh, Bl, Fn Grn, Slty
32	15.0-16.0	0.33	6.4	7.8	79.7	Sh, Bl, Fn Grn, Sndy
33	20.0-21.0	0.33	6.4	7.8	75.0	Sh, Bl, Fn Grn, Sndy
34	25.0-26.0	0.13	6.5	7.7	80.0	Sh, Bl, Fn Grn, Slty
35	30.0-31.0	0.06	7.0	7.1	80.0	Sh, Bl, Fn Grn, Slty
36	35.0-36.0	0.05	6.4	10.9	81.2	Sh, Bl, Fn Grn, Slty

Service #5-A

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company: BENSON-MONTIN-GREER — Formation: GALLUP — File: RP-3-2312
Well: LA PLATA MANCOS UNIT "I" NO. 6 — Core Type: DIAMOND 3.5" — Date Report: 8-24-68
Field: LA PLATA (GALLUP) — Drilling Fluid: CRUDE OIL — Analysts: GALLOP
County: SAN JUAN — State: NEW MEX. — Elev. 6015' KB — Location: SEC 6-T32N-R13W

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	GRAIN-GRN	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

(Note: Add 9' to below listed core depths to correspond to depths on Schlumberger log run 8-29-68.)

(CONVENTIONAL ANALYSIS)

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS Ka	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE: OIL	RESIDUAL SATURATION PER CENT PORE: TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
1	3995.0-96.0	0.29	8.3	42.2	46.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
2	97.0-98.0	0.11	9.0	41.1	42.2	Sh, Bl, Slty, V/Fn Grn, Frac
3	99.0-00.0	0.10	9.6	38.5	48.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
4	4001.0-02.0	0.32	8.7	41.3	43.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
5	03.0-04.0	0.22	9.2	38.0	46.7	Sh, Bl, V/Fn Grn, Slty, Frac
6	05.0-06.0	0.07	8.6	39.5	51.2	Sh, Bl, V/Fn Grn, Slty, Frac
7	07.0-08.0	0.16	9.1	37.4	50.6	Sh, Bl, V/Fn Grn, Slty, Frac
8	09.0-10.0	0.06	9.1	39.5	52.7	Sh, Bl, V/Fn Grn, Slty, Frac
9	11.0-12.0	0.32	9.4	42.6	48.9	Sh, Bl, V/Fn Grn, Slty, Frac
10	13.0-14.0	0.99	8.5	37.7	54.1	Sh, Bl, V/Fn Grn, Slty, Frac
11	15.0-16.0	0.02	8.0	48.7	41.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
12	17.0-18.0	0.02	7.5	52.0	36.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
13	19.0-20.0	0.06	7.5	41.3	49.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
14	21.0-22.0	0.19	7.7	48.2	41.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
15	23.0-24.0	0.11	7.9	44.2	44.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
16	25.0-26.0	0.08	7.5	38.6	49.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
17	27.0-28.0	0.02	7.9	37.9	50.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
18	29.0-30.0	0.11	8.6	33.7	54.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
19	31.0-32.0	1.70	8.9	39.3	52.7	Sh, Bl, V/Fn Grn, Slty, Frac
20	33.0-34.0	0.07	7.9	36.7	57.0	Sh, Bl, V/Fn Grn, Slty, Frac
21	35.0-36.0	0.14	6.6	49.3	37.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
22	37.0-38.0	0.10	7.9	51.8	39.2	Sh, Bl, V/Fn Grn, Slty, Frac
23	39.0-40.0	0.07	7.0	44.3	47.2	Sh, Bl, V/Fn Grn, Slty, Frac
24	41.0-42.0	0.06	7.4	41.8	52.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
25	43.0-44.0	0.01	7.3	39.7	50.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
26	45.0-46.0	0.13	7.0	44.2	47.2	Sh, Bl, V/Fn Grn, Slty, Frac
27	47.0-48.0	0.02	7.0	40.0	45.7	Sh, Bl, V/Fn Grn, Slty, Frac
28	49.0-50.0	0.03	7.0	41.4	47.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
29	51.0-52.0	0.01	7.4	40.6	51.3	Sh, Bl, V/Fn Grn, Slty, Frac
30	53.0-54.0	0.03	8.1	38.3	35.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
31	55.0-56.0	0.06	6.8	30.9	61.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
32	57.0-58.0	0.09	6.3	31.8	55.6	Sh, Bl, V/Fn Grn, Slty, Frac
33	59.0-60.0	0.01	6.5	27.2	61.5	Sh, Bl, V/Fn Grn, Slty, Frac
34	61.0-62.0	2.0	7.2	40.2	48.5	Sh, Bl, V/Fn Grn, Slty, Frac
35	63.0-64.0	4.8	6.7	31.3	61.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
36	65.0-66.0	0.83	7.2	27.7	63.8	Sh, Bl, V/Fn Grn, Slty, Frac

Service #1-A

CA-1

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company BENSON-MONTIN-GREER Formation GALLUP File RP-3-2312
Well LA PLATA MANCOS UNIT "I" NO. 6 Core Type DIAMOND 3.5" Date Report 8-24-63
Field LA PLATA (GALLUP) Drilling Fluid CRUDE OIL Analysts GALLOP
County SAN JUAN State NEW MEX. Elev. 6015' KB Location SEC 6-T32N-R13W

Lithological Abbreviations

SAND-SD, SHALE-SH, LIME-LM, DOLOMITE-DOL, CHERT-CH, GYPSUM-GYP, ANHYDRITE-ANHY, CONGLOMERATE-CONG, FOSSILIFEROUS-FOSS, SANDY-SDY, SHALY-SHY, LIMY-LMY, FINE-FN, MEDIUM-MED, COARSE-CSE, CRYSTALLINE-XLN, GRAIN-GRN, GRANULAR-GRNL, BROWN-BRN, GRAY-GY, VUGGY-VGY, FRACTURED-FRAC, LAMINATION-LAM, STYLOLITIC-STY, SLIGHTLY-SL/, VERY-V/, WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS KA	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
		(CONVENTIONAL ANALYSIS)				
37	4067.0-68.0	0.13	6.0	36.6	48.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
38	69.0-70.0	0.37	4.8	41.7	43.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
39	71.0-72.0	0.10	5.1	43.1	45.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
40	73.0-74.0	0.66	6.1	42.6	40.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
41	75.0-76.0	0.07	7.1	39.4	45.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
42	77.0-78.0	0.40	7.2	40.2	48.6	Sh, Bl, V/Fn Grn, Slty, Frac
43	79.0-80.0	0.13	7.6	32.9	56.5	Sh, Bl, V/Fn Grn, Slty, Frac
44	4150.0-51.0	0.83	5.5	25.4	63.6	Sh, Bl, V/Fn Grn, W/Lmy Slty Strks, Frac
45	52.0-53.0	1.30	5.0	30.0	58.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
46	54.0-55.0	0.83	5.8	27.5	56.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
47	56.0-57.0	5.3	5.1	33.4	52.9	Sh, Bl, V/Fn Grn, S/Lmy Slt Strks, Frac
48	58.0-59.0	0.06	5.7	29.0	54.3	Sh, Bl, V/Fn Grn, S/Lmy Slt Strks, Frac
49	60.0-61.0	<0.01	4.7	25.5	57.4	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
50	62.0-63.0	0.21	5.9	27.2	57.6	Sh, Bl, V/Fn Grn, Slty, Frac
51	64.0-65.0	0.06	5.8	32.8	56.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
52	66.0-67.0	0.83	6.1	41.0	49.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
53	68.0-69.0	0.04	6.7	38.8	49.3	Sh, Bl, V/Fn Grn, Slty, Frac
54	70.0-71.0	0.03	6.5	32.3	58.5	Sh, Bl, V/Fn Grn, Slty, Frac
55	72.0-73.0	0.02	6.6	30.3	57.5	Sh, Bl, V/Fn Grn, Slty, Frac
56	74.0-75.0	0.11	6.5	44.6	41.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
57	76.0-77.0	0.01	5.9	35.6	52.5	Sh, Bl, V/Fn Grn, Slty, Frac
58	78.0-79.0	5.5	5.9	37.3	42.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
59	80.0-81.0	1.50	7.3	38.3	52.0	Sh, Bl, V/Fn Grn, W/Lmy Slty Strks, Frac
60	82.0-83.0	0.06	8.1	42.0	46.8	Sh, Bl, V/Fn Grn, Slty, Frac
61	84.0-85.0	2.2	7.9	39.2	54.4	Sh, Bl, V/Fn Grn, Slty, Frac
62	86.0-87.0	1.50	5.4	53.6	33.4	Sh, Bl, V/Fn Grn, W/Lm Slty, Strks, Frac
63	88.0-89.0	0.03	7.0	42.8	40.0	Sh, Bl, V/Fn Grn, Slty, Frac
64	90.0-91.0	1.12	5.8	56.9	34.5	Sh, Bl, V/Fn Grn, Slty, Frac
65	92.0-93.0	0.33	6.7	52.2	40.3	Sh, Bl, V/Fn Grn, Slty, Frac
66	94.0-95.0	0.04	7.5	44.0	46.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
67	96.0-97.0	0.33	6.7	49.1	40.3	Sh, Bl, V/Fn Grn, Slty, Frac
68	98.0-99.0	0.83	7.3	43.8	46.5	Sh, Bl, V/Fn Grn, W/Lmy Slty Strks, Frac
69	4200.0-01.0	0.09	6.9	50.7	42.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
70	02.0-03.0	0.50	9.4	41.4	52.0	Sh, Bl, V/Fn Grn, Slty, Frac
71	04.0-05.0	0.08	8.5	43.5	43.5	Sh, Bl, V/Fn Grn, Slty, Frac
72	06.0-07.0	1.30	7.5	49.2	44.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
73	08.0-09.0	0.01	8.2	51.2	34.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company BENSON-MONTIN-GREER — Formation GALLUP — File RP-3-2312
Well LA PLATA MANCOS UNIT "I" NO. 6 — Core Type DIAMOND 3.5" — Date Report 8-24-68
Field LA PLATA (GALLUP) — Drilling Fluid CRUDE OIL — Analysts GALLO2
County SAN JUAN — State NEW MEX. — Elev. 6015' KB — Location SEC 6-T32N-R13W

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	GRAIN-GRN	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS Ka	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
	(CONVENTIONAL ANALYSIS)					
74	4210.0-11.0	0.09	8.5	48.2	41.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
75	12.0-13.0	<0.01	6.9	50.7	42.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
76	14.0-15.0	0.06	8.1	40.7	48.0	Sh, Bl, V/Fn Grn, Slty, Frac
77	16.0-17.0	0.02	8.3	45.7	45.7	Sh, Bl, V/Fn Grn, Slty, Frac
78	18.0-19.0	2.5	7.9	39.2	44.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
79	20.0-21.0	1.80	8.0	41.3	51.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
80	22.0-23.0	0.17	7.3	46.6	41.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
81	24.0-25.0	0.10	6.5	49.1	40.0	Sh, Bl, V/Fn Grn, Slty, Frac
82	26.0-27.0	0.10	7.0	55.8	31.4	Sh, Bl, V/Fn Grn, Slty, Frac
83	28.0-29.0	0.02	7.5	50.7	37.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
84	30.0-31.0	8.3	6.6	45.4	39.4	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
85	32.0-33.0	0.37	6.5	47.7	41.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
86	34.0-35.0	0.10	7.3	35.6	45.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
87	36.0-37.0	0.06	6.3	33.3	49.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
88	38.0-39.0	0.02	6.0	35.0	45.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
89	40.0-41.0	0.02	7.9	35.4	42.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
90	42.0-43.0	0.04	7.0	40.0	48.6	Sh, Bl, V/Fn Grn, Slty, Frac
91	44.0-45.0	<0.01	6.8	17.6	66.2	Sh, Bl, V/Fn Grn, Slty, Frac
92	46.0-47.0	0.83	8.2	36.5	46.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
93	48.0-49.0	0.19	6.2	33.8	48.3	Sh, Bl, V/Fn Grn, Slty, Frac
94	50.0-51.0	0.02	6.6	42.3	39.4	Sh, Bl, V/Fn Grn, Slty, Frac
95	52.0-53.0	0.20	6.2	50.0	35.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
96	54.0-55.0	0.06	7.1	43.6	43.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
97	56.0-57.0	0.33	7.0	41.4	41.4	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
98	58.0-59.0	0.17	6.7	43.3	40.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
99	60.0-61.0	0.01	7.6	38.2	40.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
100	62.0-63.0	0.01	6.7	49.2	32.8	Sh, Bl, V/Fn Grn, Slty, Frac
101	64.0-65.0	2.3	5.7	49.1	35.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
102	66.0-67.0	0.17	7.4	44.6	44.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
103	68.0-69.0	0.07	6.2	50.0	35.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
104	70.0-71.0	0.19	6.3	52.3	34.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
105	72.0-73.0	12	6.6	45.4	42.4	Sh, Bl, V/Fn Grn, Slty, Frac
106	74.0-75.0	0.21	6.0	49.3	35.7	Sh, Bl, V/Fn Grn, Slty, Frac
107	76.0-77.0	0.14	6.1	50.8	39.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
108	78.0-79.0	0.66	5.8	46.5	37.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
109	80.0-81.0	0.01	7.0	57.1	31.4	Sh, Bl, V/Fn Grn, Slty, Frac
110	82.0-83.0	<0.01	5.6	39.2	48.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
111	84.0-85.0	3.0	6.3	39.7	46.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS TEXAS

CORE ANALYSIS RESULTS

Company [illegible] Formation GALLUP File RP-3-2312
Well LA PLATA MANCOS UNIT "I" NO. 6 Core Type DIAMOND 3.5" Date Report 8-24-68
Field LA PLATA (GALLUP) Drilling Fluid CRUDE OIL Analysts GALLUP
County SAN JUAN State NEW MEX. Elev. 6015'KB Location SEC 6-T32N-R13W

Lithological Abbreviations

SAND-SD, SHALE-SH, LIME-LM, DOLOMITE-DOL, CHERT-CH, GYPSUM-GYP, ANHYDRITE-ANHY, CONGLOMERATE-CONG, FOSSILIFEROUS-FOSS, SANDY-SDY, SHALY-SHY, LIMY-LMY, FINE-FN, MEDIUM-MED, COARSE-CSE, CRYSTALLINE-XLN, GRAIN-GRN, GRANULAR-GRNL, BROWN-BRN, GRAY-GY, VUGGY-VGY, FRACTURED-FRAC, LAMINATION-LAM, STYLOLITIC-STY, SLIGHTLY-SL/, VERY-V/, WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS Ka	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE: OIL	RESIDUAL SATURATION PER CENT PORE: TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
	(CONVENTIONAL ANALYSIS)					
112	4286.0-87.0	0.02	6.6	43.9	46.9	Sh, Bl, V/Fn Grn, Slty, Frac
113	88.0-89.0	0.33	6.9	45.9	47.8	Sh, Bl, V/Fn Grn, Slty, Frac
114	90.0-91.0	<0.01	8.2	40.2	47.5	Sh, Bl, V/Fn Grn, Slty, Frac
115	92.0-93.0	<0.01	8.3	42.2	47.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
116	94.0-95.0	0.50	5.1	17.6	68.5	Sh, Bl, V/Fn Grn, V/Slty
117	96.0-97.0	3.3	5.2	13.5	76.8	Sh, Bl, V/Fn Grn, V/Slty
118	98.0-99.0	0.02	7.2	6.9	79.2	Sh, Bl, V/Fn Grn, V/Slty
119	4300.0-01.0	0.01	5.2	13.4	69.2	Sh, Bl, V/Fn Grn, V/Slty
120	02.0-03.0	<0.01	4.2	16.6	76.2	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
121	04.0-05.0	0.50	5.0	10.0	84.0	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
122	06.0-07.0	<0.01	5.0	10.0	76.0	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
123	08.0-09.0	0.22	5.4	9.2	77.8	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
124	10.0-11.0	0.09	6.0	8.3	73.3	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
125	12.0-13.0	3.0	6.3	7.9	76.2	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
126	14.0-15.0	<0.01	5.4	9.3	81.5	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
127	16.0-17.0	0.05	6.0	8.3	76.6	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
128	18.0-19.0	0.01	6.3	7.9	69.9	Sh, Bl, V/Fn Grn, V/Slty
129	20.0-21.0	0.07	5.4	9.3	74.0	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
130	22.0-23.0	0.18	5.7	8.7	70.1	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
131	24.0-25.0	<0.01	4.6	10.9	71.7	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
132	26.0-27.0	0.08	5.8	8.6	74.1	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
133	28.0-29.0	0.09	6.2	8.1	77.3	Sh, Bl, V/Fn Grn, V/Slty, W/Lmy Slt Strks
134	30.0-31.0	0.07	6.8	7.3	82.4	Sh, Bl, V/Fn Grn, V/Slty

C

CA-24

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company BENSON-MONTIN-GREER Formation GALLUP File RP-3-2318
Well LA PLATA MANCOS UNIT NO. 3(C-32) Core Type DIAMOND 3.5" Date Report 9-30-68
Field LA PLATA (GALLUP) Drilling Fluid CRUDE OIL Analysts GALLOP
County SAN JUAN State NEW MEX. Elev. 5988'GL Location 1650'FN&EL SEC 32-T32N-R13W

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	GRAIN-GRN	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

NOTE: DEDUCT 20' FROM BELOW LISTED DEPTHS TO CORRELATE WITH SCHLUM. IES LOG RUN 10-2-68

(CONVENTIONAL ANALYSIS)

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS K_A	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE: OIL	RESIDUAL SATURATION PER CENT PORE: TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
1	5075.0-76.0	0.03	5.8	12.1	75.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
2	77.0-78.0	0.30	5.4	13.0	64.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
3	79.0-80.0	0.38	5.9	8.5	67.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
4	81.0-82.0	0.66	4.5	11.1	75.5	Sh, Bl, V/Fn Grn, Slty, Frac
5	83.0-84.0	0.17	5.6	8.9	71.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
6	85.0-86.0	0.01	5.3	3.8	75.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
7	87.0-88.0	0.17	5.5	3.6	80.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
8	89.0-90.0	0.02	4.8	4.2	83.4	Sh, Bl, V/Fn Grn, Slty, Frac
9	91.0-92.0	0.01	5.1	9.8	68.6	Sh, Bl, V/Fn Grn, Slty, Frac
10	93.0-94.0	0.01	5.3	13.2	71.7	Sh, Bl, V/Fn Grn, Slty, Frac
11	95.0-96.0	0.04	5.7	8.8	70.7	Sh, Bl, V/Fn Grn, Slty, Frac
12	97.0-98.0	0.02	7.2	29.8	59.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
13	5099.0-00.0	1.12	6.6	39.4	46.9	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
14	5101.0-02.0	0.09	6.2	46.7	43.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
15	03.0-04.0	0.02	6.9	43.5	37.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
16	05.0-06.0	0.01	7.3	46.5	41.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
17	07.0-08.0	0.03	6.7	41.8	44.7	Sh, Bl, V/Fn Grn, Slty, Frac
18	09.0-10.0	0.03	7.8	51.2	35.9	Sh, Bl, V/Fn Grn, Slty, Frac
19	11.0-12.0	0.17	6.7	49.2	40.3	Sh, Bl, V/Fn Grn, Slty, Frac
20	13.0-14.0	0.01	7.5	41.3	44.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
21	15.0-16.0	0.03	6.6	53.0	30.3	Sh, Bl, V/Fn Grn, Slty, Frac
22	17.0-18.0	0.03	6.6	48.5	36.4	Sh, Bl, V/Fn Grn, Slty, Frac
23	19.0-20.0	0.24	6.7	49.2	37.3	Sh, Bl, V/Fn Grn, Slty, Frac
24	21.0-22.0	0.22	5.2	40.3	46.2	Sh, Bl, V/Fn Grn, Slty, Frac
25	23.0-24.0	0.27	5.9	28.8	55.9	Sh, Bl, V/Fn Grn, Slty, Frac
26	25.0-26.0	0.50	4.5	20.0	59.9	Sh, Bl, V/Fn Grn, Slty, Frac
27	27.0-28.0	0.03	6.1	27.8	57.3	Sh, Bl, V/Fn Grn, Slty, Frac
28	29.0-30.0	0.66	6.7	32.8	49.2	Sh, Bl, V/Fn Grn, Slty, Frac
29	31.0-32.0	0.03	6.8	27.9	57.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
30	33.0-34.0	0.04	6.2	27.4	56.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
31	35.0-36.0	0.17	5.2	32.7	44.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
32	37.0-38.0	0.17	5.5	25.5	56.3	Sh, Bl, V/Fn Grn, Slty, Frac
33	39.0-40.0	0.17	5.9	27.1	64.3	Sh, Bl, V/Fn Grn, Slty, Frac
34	41.0-42.0	0.13	5.4	38.9	48.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
35	43.0-44.0	0.09	5.6	35.7	44.6	Sh, Bl, V/Fn Grn, Slty, Frac
36	45.0-46.0	0.02	5.3	39.6	51.0	Sh, Bl, V/Fn Grn, Slty, Frac

(Service #1-A)

CA-23

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

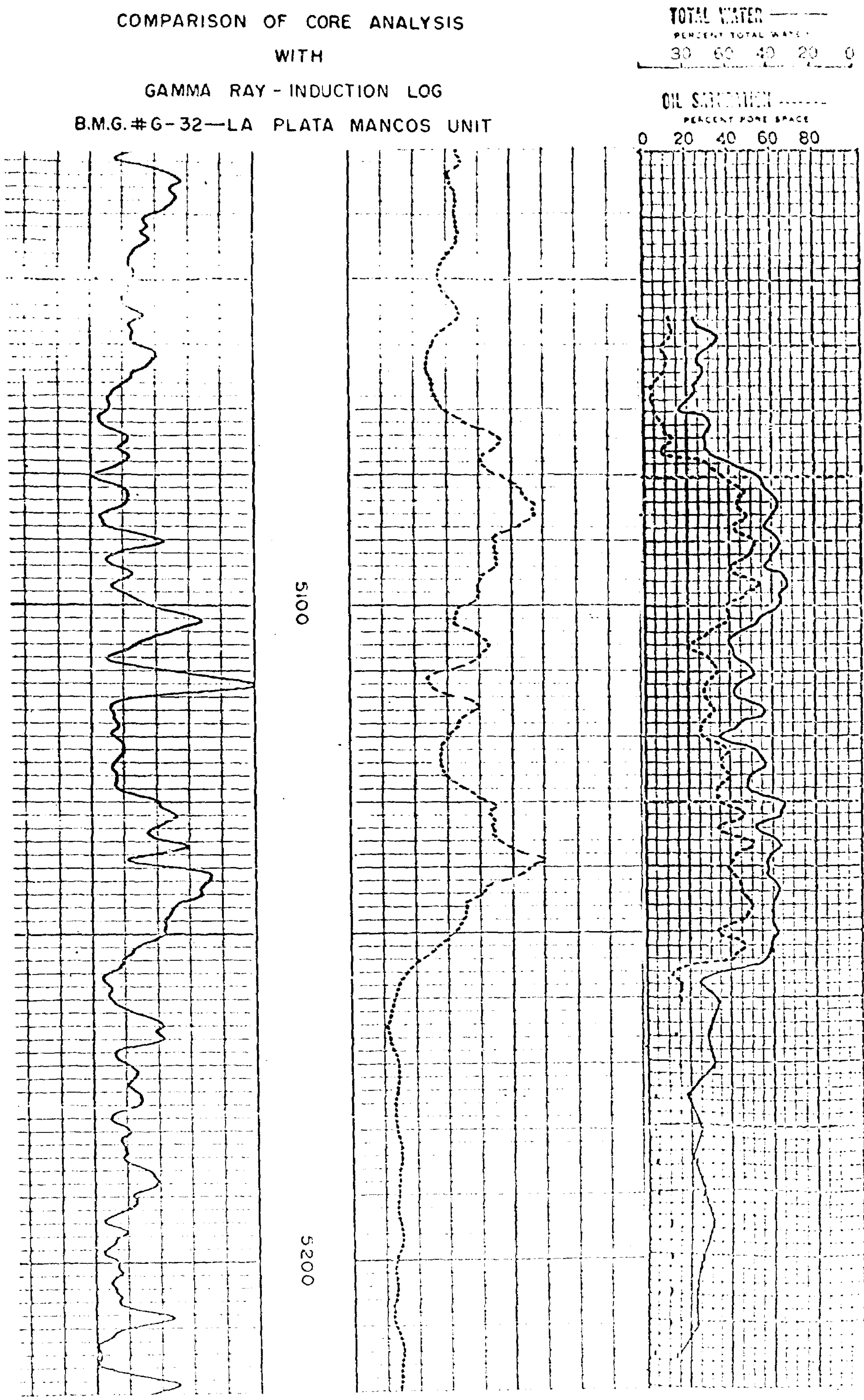
Company BENSON-MONTIN-GREER Formation GALLUP File RP-3-2318
Well LA PLATA MANCOS UNIT NO. 3(G-32) Core Type DIAMOND 3.5" Date Report 9-30-68
Field LA PLATA (GALLUP) Drilling Fluid CRUDE OIL Analysts GALLOP
County SAN JUAN State NEW MEX. Elev. 5988'GL Location 1650'FNSEL SEC 32-T32N-R13W

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	GRAIN-GRN	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS KA	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE: OIL	RESIDUAL SATURATION PER CENT PORE: TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
	(CONVENTIONAL ANALYSIS)					
37	5147.0-48.0	2.80	6.3	33.3	50.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
38	49.0-50.0	0.04	6.2	45.1	35.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
39	51.0-52.0	0.02	6.3	46.0	34.9	Sh, Bl, V/Fn Grn, Slty, Frac
40	53.0-54.0	0.10	5.6	33.9	48.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
41	55.0-56.0	0.30	6.9	50.7	39.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
42	57.0-58.0	1.30	5.9	42.4	40.7	Sh, Bl, V/Fn Grn, Slty, Frac
43	59.0-60.0	0.33	6.3	39.7	42.8	Sh, Bl, V/Fn Grn, Slty, Frac
44	61.0-62.0	2.60	6.6	43.9	40.8	Sh, Bl, V/Fn Grn, Slty, Frac
45	63.0-64.0	0.09	5.6	46.1	37.5	Sh, Bl, V/Fn Grn, Slty, Frac
46	65.0-66.0	1.30	6.2	50.0	40.3	Sh, Bl, V/Fn Grn, Slty, Frac
47	67.0-68.0	0.33	6.3	46.0	39.7	Sh, Bl, V/Fn Grn, Slty, Frac
48	69.0-70.0	0.50	4.7	34.0	38.3	Sh, Bl, V/Fn Grn, Slty, Frac
49	71.0-72.0	0.04	6.0	46.7	40.0	Sh, Bl, V/Fn Grn, Slty, Frac
50	73.0-74.0	0.17	7.6	40.8	40.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
51	75.0-76.0	0.19	5.3	13.2	71.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
52	77.0-78.0	0.31	5.7	15.8	73.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
53	5180.0-81.0	0.21	5.9	15.2	67.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
54	85.0-86.0	0.02	6.4	14.1	71.9	Sh, Bl, V/Fn Grn, Slty, Frac
55	90.0-91.0	0.01	6.2	14.5	74.2	Sh, Bl, Fn Grn, Slty, Frac
56	95.0-96.0	0.01	5.2	3.8	80.8	Sh, Bl, Fn Grn, Slty, Frac
57	5200.0-01.0	0.01	4.7	4.3	74.4	Sh, Bl, V/Fn Grn, Slty, Frac
58	05.0-06.0	0.02	5.2	3.8	77.0	Sh, Bl, V/Fn Grn, Slty, Frac
59	10.0-11.0	0.01	4.0	5.0	75.0	Sh, Bl, V/Fn Grn, Slty, Frac
60	15.0-16.0	0.04	4.8	10.4	68.8	Sh, Bl, V/Fn Grn, Slty, Frac
61	20.0-21.0	0.32	4.8	10.4	73.0	Sh, Bl, V/Fn Grn, Slty, Frac
62	25.0-26.0	0.09	4.4	11.4	77.2	Sh, Bl, V/Fn Grn, Slty, Frac
63	30.0-31.0	0.01	4.2	11.9	76.2	Sh, Bl, V/Fn Grn, Slty, Frac
64	35.0-36.0	0.01	5.7	3.5	87.8	Sh, Bl, V/Fn Grn, Slty, Frac

COMPARISON OF CORE ANALYSIS
WITH
GAMMA RAY - INDUCTION LOG
B.M.G. #G-32—LA PLATA MANCOS UNIT



CA 2a

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

Page No. 2

CORE ANALYSIS RESULTS

Company BENSON-MONTIN-GREER Formation GALLUP File RP-3-2326
Well LA PLATA MANCOS UNIT NO. 4(N-31) Core Type DIAMOND 3.5" Date Report 10-25-68
Field LA PLATA (GALLUP) Drilling Fluid CRUDE OIL Analysts GALLOP
County SAN JUAN State NEW MEX. Elev. 6113' GL Location 756' FSL 1208' FWL SEC 31-T32N-R13W

Lithological Abbreviations

SAND-SD, SHALE-SH, LIME-LM; DOLOMITE-DOL, CHERT-CH, GYPSUM-GYP; ANHYDRITE-ANHY, CONGLOMERATE-CONG, FOSSILIFEROUS-FOSS; SANDY-SDY, SHALY-SHY, LIMY-LMY; FINE-FN, MEDIUM-MED, COARSE-CSE; CRYSTALLINE-XLN, GRAIN-GRN, GRANULAR-GRNL; BROWN-BRN, GRAY-GY, VUGGY-VGY; FRACTURED-FRAC, LAMINATION-LAM, STYLOLITIC-STY; SLIGHTLY-SL/, VERY-V/, WITH-W/

NOTE: SEE DEPTH CORRELATIONS IN NARRATION ON PAGE 2

(CONVENTIONAL ANALYSIS)

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS K_A	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE: OIL	RESIDUAL SATURATION PER CENT PORE: TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
1	2220.0-21.0	0.20	6.5	44.6	50.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
2	22.0-23.0	0.41	8.3	39.7	56.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
3	24.0-25.0	0.20	7.8	41.1	53.8	Sh, Bl, V/Fn Grn, Slty, Frac
4	26.0-27.0	0.20	8.4	48.8	46.4	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
5	28.0-29.0	0.31	8.8	49.8	45.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
6	30.0-31.0	0.08	9.6	45.8	50.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
7	32.0-33.0	0.20	6.8	51.4	42.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
8	34.0-35.0	0.10	8.6	47.7	50.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
9	36.0-37.0	0.01	8.3	54.2	42.2	Sh, Bl, V/Fn Grn, Slty, Frac
10	38.0-39.0	0.02	8.3	49.4	47.0	Sh, Bl, V/Fn Grn, Slty, Frac
11	40.0-41.0	0.05	7.0	47.1	47.1	Sh, Bl, V/Fn Grn, Slty, Frac
12	42.0-43.0	0.01	8.1	50.7	43.1	Sh, Bl, V/Fn Grn, Slty, Frac
13	44.0-45.0	0.01	8.9	43.9	50.5	Sh, Bl, V/Fn Grn, Slty, Frac
14	46.0-47.0	0.02	8.4	34.5	58.5	Sh, Bl, V/Fn Grn, Slty, Frac
15	48.0-49.0	0.01	8.3	45.7	45.7	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
16	50.0-51.0	0.20	8.9	50.6	41.6	Sh, Bl, V/Fn Grn, Slty, Frac
17	52.0-53.0	0.01	8.1	54.3	35.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
18	54.0-55.0	0.01	7.8	42.3	47.5	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
19	56.0-57.0	0.04	7.7	45.3	48.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
20	58.0-59.0	0.01	8.2	42.7	47.6	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
21	60.0-61.0	0.62	9.6	40.5	51.0	Sh, Bl, V/Fn Grn, Slty, Frac
22	62.0-63.0	1.20	9.6	41.7	50.0	Sh, Bl, V/Fn Grn, Slty, Frac
23	64.0-65.0	0.04	7.8	37.2	56.4	Sh, Bl, V/Fn Grn, Slty, Frac
24	66.0-67.0	0.08	7.8	37.2	53.8	Sh, Bl, V/Fn Grn, Slty, Frac
25	67.0-68.0	2.10	8.8	29.8	47.7	Sd, Gy, V/Fn Grn, Lmy, W/Shale Strks, Frac
26	68.0-69.0	0.03	4.8	41.6	48.0	Sd, Gy, V/Fn Grn, Lmy, W/Sh Strks, Frac
27	69.0-70.0	0.36	7.7	29.0	41.6	Sd, Gy, V/Fn Grn, Lmy, W/Sh Strks, Frac
28	70.0-71.0	1.60	9.6	44.8	42.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
29	2272.0-73.0	0.17	9.2	48.8	40.2	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks, Frac
30	74.0-75.0	0.08	10.3	63.1	32.0	Sh, Bl, V/Fn Grn, Slty, Frac

Service #1-A

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company BENSON-MONTIN-GREER Formation GALLUP File RP-3-2326
Well LA PLATA MANCOS UNIT NO. 4 Core Type DIAMOND 3.5" Date Report 10-25-68
Field LA PLATA (GALLUP) (N-31) Drilling Fluid CRUDE OIL Analysts GALLOP
County SAN JUAN State NEW MEX. Elev 6113'GL Location 756'FSL 1208'FWL SEC 31-T32N-R13W

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	GRAIN-GRN	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS K_A	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE: OIL	RESIDUAL SATURATION PER CENT PORE: TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
31	2276.0-77.0	0.60	8.9	50.5	37.1	Sh, Bl, V/Fn Grn, Slty, Frac
32	78.0-79.0	0.07	9.2	56.5	36.9	Sh, Bl, V/Fn Grn, Slty, Frac
33	80.0-81.0	0.02	8.5	52.8	41.1	Sh, Bl, V/Fn Grn, Slty, Frac
34	82.0-83.0	0.03	8.4	44.1	46.4	Sh, Bl, V/Fn Grn, Slty, Frac
35	84.0-85.0	0.57	7.2	18.1	69.5	Sh, Bl, V/Fn Grn, Slty, Frac
36	86.0-87.0	0.14	7.3	9.6	75.3	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
37	88.0-89.0	0.01	5.8	8.6	74.1	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
38	90.0-91.0	0.02	7.4	6.7	81.0	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
39	92.0-93.0	0.03	6.8	3.0	77.8	Sh, Bl, V/Fn Grn, W/Lmy Slt Strks
40	94.0-95.0	0.11	6.1	3.3	78.7	Sh, Bl, V/Fn Grn, Slty
41	96.0-97.0	0.08	5.7	3.5	82.4	Sh, Bl, V/Fn Grn, Slty

Note: To correspond with Schlumberger log depths:
Add 9' to interval 2220 to 2245 feet
Add 8' to interval 2245 to 2270 feet
Add 7' to interval 2270 to 2297 feet

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE No. 4067
Order No. R-3720
NOMENCLATURE

APPLICATION OF BENSON-MONTIN-GREER
DRILLING CORPORATION FOR SPECIAL
POOL RULES, SAN JUAN COUNTY, NEW
MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on March 5, 1969, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this 1st day of April, 1969, the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Benson-Montin-Greer Drilling Corporation, seeks the promulgation of special rules and regulations for the La Plata-Gallup Oil Pool, San Juan County, New Mexico, including a provision for 160-acre spacing and proration units.

(3) That the applicant requests that said special rules provide that the unit allowable for a 160-acre unit in said pool be allocated on the basis of four times the normal unit allowable for Northwest New Mexico, and that no credit be given for depth factors.

(4) That the applicant further requests that said special rules and regulations apply to all lands within the boundaries

of the La Plata Mancos Unit Area, but the evidence presently available indicates that the productive limits of the pool may be considerably less than the unitized area.

(5) That the subject reservoir is composed of a highly fractured shale.

(6) That the producing formation in the subject pool is both less than and more than 5000 feet below the surface.

(7) That the evidence indicates that one well in the subject pool can efficiently and economically drain and develop 160 acres.

(8) That in order to prevent the economic loss caused by the drilling of unnecessary wells, to avoid the augmentation of risk arising from the drilling of an excessive number of wells, to prevent reduced recovery which might result from the drilling of too few wells, and to otherwise prevent waste and protect correlative rights, special rules and regulations providing for 160-acre spacing units and the establishment of a 160-acre proportional factor of 4.00 for allowable purposes should be promulgated for the La Plata-Gallup Oil Pool.

(9) That the special rules and regulations should apply only to those wells completed or recompleted in the La Plata-Gallup Oil Pool or in the Gallup formation within one mile thereof, and not nearer to or within the limits of another designated Gallup oil pool.

IT IS THEREFORE ORDERED:

(1) That the horizontal limits of the La Plata-Gallup Oil Pool in San Juan County, New Mexico, are hereby extended to include the following-described area:

TOWNSHIP 3[illegible] NORTH, RANGE 13 WEST, NMPM
Section [illegible]: NW/4 and S/2
Section [illegible]: N/2

TOWNSHIP 32 NORTH, RANGE 13 WEST, NMPM
Section 3[illegible]: S/2

(2) That Special Rules and Regulations for the La Plata-Gallup Oil Pool, San Juan County, New Mexico, are hereby

promulgated as follows:

**SPECIAL RULES AND REGULATIONS
FOR THE
LA PLATA-GALLUP OIL POOL**

RULE 1. Each well completed or recompleted in the La Plata-Gallup Oil Pool or in the Gallup formation within one mile thereof, and not nearer to or within the limits of another designated Gallup oil pool, shall be spaced, drilled, operated, and produced in accordance with the Special Rules and Regulations hereinafter set forth.

RULE 2. Each well shall be located on a standard unit containing 160 acres, more or less, substantially in the form of a square, which is a quarter section being a legal subdivision of the United States Public Land Surveys.

RULE 3. The Secretary-Director of the Commission may grant an exception to the requirements of Rule 2 without notice and hearing when an application has been filed for a non-standard unit consisting of less than 160 acres or the unorthodox size or shape of the tract is due to a variation in the legal subdivision of the United States Public Land Surveys. All operators offsetting the proposed non-standard unit shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Secretary-Director may approve the application upon receipt of written waivers from all offset operators or if no offset operator has entered an objection to the formation of the non-standard unit within 30 days after the Secretary-Director has received the application.

RULE 4. Each well shall be located within 150 feet of the center of a governmental quarter-quarter section or lot.

RULE 5. The Secretary-Director may grant an exception to the requirements of Rule 4 without notice and hearing when an application has been filed for an unorthodox location necessitated by topographical conditions or the recompletion of a well previously drilled to another horizon. All operators offsetting the proposed location shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Secretary-Director may approve the application upon receipt of written waivers from all operators offsetting the proposed location or if no objection to the unorthodox location has been entered within 20 days after the Secretary-Director has received the application.

RULE 6. A standard proration unit (158 through 162 acres) shall be assigned a proportional factor of 4.00 for allowable purposes, and in the event there is more than one well on a 160-acre proration unit, the operator may produce the allowable assigned to the unit from the wells on the unit in any proportion.

The allowable assigned to a non-standard proration unit shall bear the same ratio to a standard allowable as the acreage in such non-standard unit bears to 160 acres.

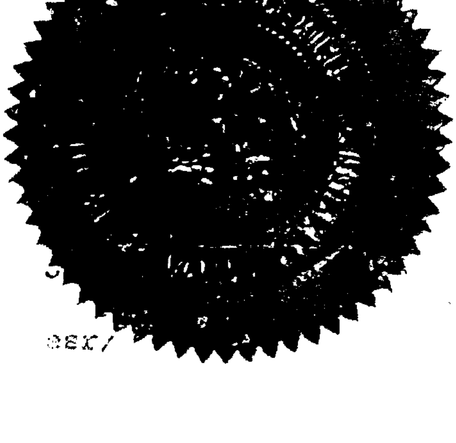
IT IS FURTHER ORDERED:

(1) That the locations of all wells presently drilling to or completed in the La Plata-Gallup Oil Pool or in the Gallup formation within one mile thereof are hereby approved; that the operator of any well having an unorthodox location shall notify the Aztec District Office of the Commission in writing of the name and location of the well on or before April 15, 1969.

(2) That each well presently drilling to or completed in the La Plata-Gallup Oil Pool or in the Gallup formation within one mile thereof shall, after April 15, 1969, receive an allowable in the same proportion to a standard 160-acre allowable for the pool as the acreage presently dedicated to the well bears to 160 acres, until Form C-102 dedicating 160 acres to the well has been filed with the Commission, or until a non-standard unit containing less than 160 acres has been approved.

(3) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.



STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

DAVID F. CARGO, Chairman

ALEX J. ARMIJO, Member

A. L. PORTER, Jr., Member & Secretary

esr/

BURR & COOLEY
ATTORNEYS AND COUNSELORS AT LAW
SUITE 152 PETROLEUM CENTER BUILDING
FARMINGTON, NEW MEXICO
87401

JOEL B. BURR, JR.
WM. J. COOLEY

TELEPHONE 325-1702
AREA CODE 505

'69 JAN 13 AM 10 13

Case ~~4059~~ 4067

January 10, 1969

Mr. A. L. Porter
New Mexico Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico

Dear Pete:

Forwarded herewith is the Application of Benson-Montin-Greer Drilling Corporation for 160-acre spacing in the La Plata-Gallup Oil Pool. If it is at all possible, we would appreciate your setting this case for the last week in January. If this is not possible, please set the case in February, bearing in mind that Mr. Greer will not be available for the period from February 1-8, 1969.

Very truly yours,

BURR & COOLEY

By William J. Cooley jjh
William J. Cooley

WJC:jjh
Enclosures

DOCKET MAILED
Date 2-13-69
2-20-69

BEFORE THE OIL CONSERVATION COMMISSION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION

OF

BENSON-MONTIN-GREER DRILLING CORPORATION

for 160-acre spacing in the La Plata-Gallup Oil Pool.

Case 4067 4057

APPLICATION

COMES NOW BENSON-MONTIN-GREER DRILLING COMPORATION and respectfully makes application to the Oil Conservation Commission of the State of New Mexico for an Order establishing 160-acre spacing in the La Plata-Gallup Oil Pool in San Juan County, New Mexico, as the same is presently defined by the Commission, together with all acreage included in the La Plata-Mancos Unit Area, which Unit Agreement has been heretofore approved by the Commission.

Applicant requests that the unit allowable for a 160-acre unit in the La Plata-Gallup Oil Pool be allocated on the basis of four times the normal unit allowable for the Northwestern New Mexico District, and that no credit be given for any depth factors for the reason that Applicant expects that production will occur in said pool from depths both above and below the 5000 foot level.

Applicant further requests that the 160-acre spacing Order be limited to the exterior boundaries of the La Plata-Mancos Unit Area and that the usual provisions with respect to areas within one mile of the La Plata-Gallup Pool limits be disregarded.

Applicant contends and will submit persuasive evidence to the effect that one well will economically and efficiently drain an area in excess of 160 acres in the La Plata-Gallup Oil Pool and the lands covered by the La Plata-Mancos Unit Agreement.

Applicant further contends that the approval of the subject Application will prevent waste and protect relative rights in the area involved.

Respectfully submitted,

BURR & COOLEY

By ______________________
William J. Cooley
Attorneys for Applicant
152 Petroleum Center Building
Farmington, New Mexico 87401

Set for Feb. 26
examination

<u>DRAFT</u>

GMH/esr
March 28, 1969

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION COMMISSION OF NEW MEXICO FOR THE PURPOSE OF CONSIDERING:

RECORDS CENTER & LAW LIBRARY

CASE No. 4067

Order No. R-3720

NOMENCLATURE

APPLICATION OF BENSON-MONTIN-GREER DRILLING CORPORATION FOR SPECIAL POOL RULES, SAN JUAN COUNTY, NEW MEXICO.

<u>ORDER OF THE COMMISSION</u>

<u>BY THE COMMISSION</u>:

This cause came on for hearing at 9 a.m. on March 5, 1969, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this ______ day of April, 1969, the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

<u>FINDS</u>:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Benson-Montin-Greer Drilling Corporation, seeks the promulgation of special rules and regulations for the La Plata-Gallup Oil Pool, San Juan County, New Mexico, including a provision for 160-acre spacing and proration units.

(3) That the applicant requests that said special rules provide that the unit allowable for a 160-acre unit in said pool be allocated on the basis of four times the normal unit allowable for Northwest New Mexico, and that no credit be given for depth factors.

(4) That the applicant further requests that said special rules and regulations apply to all lands within the boundaries of the La Plata Mancos Unit Area, but the evidence presently available indicates that the producing limits of the pool may be considerably less than the unitized area.

(5) That the subject reservoir is composed of a highly fractured shale.

(6) That the producing formation in the subject pool is both less than and more than 5000 feet below the surface.

(7) That the evidence indicates that one well in the subject pool can efficiently and economically drain and develop 160 acres.

(8) That in order to prevent the economic loss caused by the drilling of unnecessary wells, to avoid the augmentation of risk arising from the drilling of an excessive number of wells, to prevent reduced recovery which might result from the drilling of too few wells, and to otherwise prevent waste and protect correlative rights, special rules and regulations providing for 160-acre spacing units and the establishment of a 160-acre proportional factor of 4.00 for allowable purposes should be promulgated for the La Plata-Gallup Oil Pool.

(9) That the special rules and regulations should apply only to those wells completed or recompleted in the La Plata-Gallup Oil Pool or in the Gallup formation within one mile thereof, and not nearer to or within the limits of another designated Gallup oil pool.

IT IS THEREFORE ORDERED:

(1) That the horizontal limits of the La Plata-Gallup Oil Pool in San Juan County, New Mexico, are hereby extended to include the following-described area:

TOWNSHIP 31 NORTH, RANGE 13 WEST, NMPM
Section 5: NW/4 and S/2
Section 6: N/2

TOWNSHIP 32 NORTH, RANGE 13 WEST, NMPM
Section 31: S/2

(2) That Special Rules and Regulations for the La Plata-Gallup Oil Pool, San Juan County, New Mexico, are hereby

promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE La Plata - Gallup Oil Pool
~~VADA-PENNSYLVANIAN POOL~~

RULE 1. Each well completed or recompleted in the ~~Vada-Pennsylvanian Pool~~ ~~[illegible]~~ or in ~~the Bough "C" zone of the Pennsylvanian~~ La Plata - Gallup Oil Pool Gallup formation within one mile thereof, and not nearer to or within the limits of another designated ~~Pennsylvanian~~ Gallup oil pool, shall be spaced, drilled, operated, and produced in accordance with the Special Rules and Regulations hereinafter set forth.

RULE 2. Each well shall be located on a standard unit containing 160 acres, more or less, substantially in the form of a square, which is a quarter section being a legal subdivision of the United States Public Land Surveys.

RULE 3. The Secretary-Director of the Commission may grant an exception to the requirements of Rule 2 without notice and hearing when an application has been filed for a non-standard unit consisting of less than 160 acres or the unorthodox size or shape of the tract is due to a variation in the legal subdivision of the United States Public Land Surveys. All operators offsetting the proposed non-standard unit shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Secretary-Director may approve the application upon receipt of written waivers from all offset operators or if no offset operator has entered an objection to the formation of the non-standard unit within 30 days after the Secretary-Director has received the application.

RULE 4. Each well shall be located within 150 feet of the center of a governmental quarter-quarter section or lot.

RULE 5. The Secretary-Director may grant an exception to the requirements of Rule 4 without notice and hearing when an application has been filed for an unorthodox location necessitated by topographical conditions or the recompletion of a well previously drilled to another horizon. All operators offsetting the proposed location shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Secretary-Director may approve the application upon receipt of written waivers from all operators offsetting the proposed location or if no objection to the unorthodox location has been entered within 20 days after the Secretary-Director has received the application.

RULE 6. A standard proration unit (158 through 162 acres) shall be assigned a proportional factor of 4.[illegible] for allowable purposes, and in the event there is more than one well on a 160-acre proration unit, the operator may produce the allowable assigned to the unit from the wells on the unit in any proportion.

The allowable assigned to a non-standard proration unit shall bear the same ratio to a standard allowable as the acreage in such non-standard unit bears to 160 acres.

IT IS FURTHER ORDERED:

(1) That the locations of all wells presently drilling to or completed in the La Plata - Gallup Oil Pool ~~Vada Pennsylvanian Pool~~ or in the ~~Bough "C" zone of the Pennsylvanian~~ Gallup formation within one mile thereof are hereby approved; that the operator of any well having an unorthodox location shall notify the ~~Hobbs~~ Aztec District Office of the Commission in writing of the name and location of the well on or before ~~October~~ April 15, ~~1967~~ 1969.

(2) That each well presently drilling to or completed in the La Plata - Gallup Oil Pool ~~Vada Pennsylvanian Pool~~ or in the ~~Bough "C" zone of the Pennsylvanian~~ Gallup formation within one mile thereof shall, after ~~October~~ April 15, ~~1967~~ 1969, receive an allowable in the same proportion to a standard 160-acre allowable for the pool as the acreage presently dedicated to the well bears to 160 acres, until Form C-102 dedicating 160 acres to the well has been filed with the Commission, or until a non-standard unit containing less than 160 acres has been approved.

~~(3) That this case shall be reopened at an examiner hearing in September, 1968, at which time the operators in the subject pool may present the results of interference tests and other pertinent evidence to show cause why the subject pool should not be developed on less than 160-acre spacing units and to show cause why the 160-acre proportional factor of 4.77 assigned to the subject pool should or should not be retained.~~

~~(4) That Order No. R-3179 entered by the Commission on January 18, 1967, is hereby superseded.~~

(3) ~~(5)~~ That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

DAVID F. CARGO, Chairman

GUYTON B. HAYS, Member

A. L. [illegible]

S E A L

esr/

CASE 4067: Application of BENSON-
MONTIN-GREER DRLG. CORP. FOR
SPECIAL RULES FOR LA PLATA-GALLUP