STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

APPLICATION OF BIRD CREEK RESOURCES FOR SPECIAL POOL RULES, EDDY COUNTY, NEW MEXICO

CASE NO. 10226

REPORTER'S TRANSCRIPT OF PROCEEDINGS

EXAMINER HEARING

BEFORE: DAVID R. CATANACH, Hearing Examiner

February 21, 1991
3:15 p.m.
Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Division on February 21, 1991, at 3:15 p.m. at Oil Conservation Division Conference Room, State Land Office Building, 310 Old Santa Fe Trail, Santa Fe, New Mexico, before Paula Wegeforth, Certified Court Reporter No. 264, for the State of New Mexico.

FOR: OIL CONSERVATION DIVISION

BY: PAULA WEGEFORTH
Certified Court Reporter
CSR No. 264

I N D E X

February 21, 1991
Examiner Hearing

CASE NO. 10226

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E X H I B I T S

A P P E A R A N C E S

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FOR FLARE OIL, INC.: MONTGOMERY & ANDREWS
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BY: W. PERRY PEARCE, ESQ.
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FOR R.C. BENNETT, R.C. BENNETT COMPANY, RB OPERATING COMPANY, RAMCONYL 1987 LIMITED PARTNERS AND POGO PRODUCING COMPANY: HINKLE, COX, EATON, COFFIELD & HENSLEY
Attorneys At Law
BY: JAMES BRUCE, ESQ.
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EXAMINER CATANACH: Let's call the hearing back to order and at this time call Case 10226.

MR. STOVALL: This is a simple and uncontroversial case called the application of Bird Creek Resources for special pool rules in Eddy County, New Mexico.

EXAMINER CATANACH: Are there appearances in this case?

MR. CARR: May it please the Examiner, my name is William F. Carr with the law firm Campbell & Black, P.A., in Santa Fe. I represent Bird Creek Resources, and I have one witness.

EXAMINER CATANACH: No other appearances?

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe law firm of Kellahin, Kellahin & Aubrey, appearing on behalf of Oryx Energy, Inc., and Parker and Parsley Petroleum Company.

MR. PEARCE: Mr. Examiner, I am W. Perry Pearce of the Santa Fe office of the law firm of Montgomery & Andrews. I'm appearing in this matter on behalf of Flare Oil, Inc.

EXAMINER CATANACH: Flare?

MR. PEARCE: Flare, F-l-a-r-e. Flare.

MR. BRUCE: Mr. Examiner, my name is Jim Bruce from the Hinkle law firm, and I am representing Mr. R.C. Bennett, R.C. Bennett Company, RB Operating Company, Ramco NYL 1987 Limited Partnerships.

EXAMINER CATANACH: I'm sorry, again.

MR. BRUCE: Ramco, R-a-m-c-o. And, finally, Pogo Producing Company.

EXAMINER CATANACH: Any other appearances?

MR. KELLAHIN: I potentially have three witnesses, Mr. Examiner.

EXAMINER CATANACH: Okay. Can I get all witnesses and potential witnesses to stand up and be sworn in?

(At this time the witnesses were sworn in.)

BRAD BURKS,

the Witness herein, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CARR:

Q. Will you state your full name for the record, please?

A. My name is Brad Burks.

Q. Where do you reside, Mr. Burks?

A. I'm from Tulsa, Oklahoma.

Q. Mr. Burks, by whom are you employed and in what capacity?

A. I'm employed by BK Energy Company in Tulsa, Oklahoma. We serve on a retaining basis to Bird Creek and provide engineering and geological services in New Mexico.

Q. Are you a private consulting firm?

A. Yes, I am.

Q. Have you previously testified before this commission?

A. Yes, I have.

Q. How long ago was that?

A. Three years ago.

Q. Why don't you briefly summarize your educational background for the examiner?

A. I graduated from the University of Tulsa in 1983 with a bachelor of science. Petroleum engineering was my major. Geology was my minor.

At that time, I went to work for Texaco in Hobbs. I handled their Delaware wells in Lea County and Eddy County. My tasks with Texaco were providing engineering or reservoir engineering, production engineering and geological work in the Delaware Basin.

Q. Are you a registered petroleum engineer?

A. Yes, I am.

Q. In what state are you registered?

A. Oklahoma.

Q. Are you familiar with the application filed in this case on behalf of Bird Creek Resources?

A. Yes, I am.

Q. Are you familiar with the East Loving-Delaware Pool and the wells located therein?

A. Yes, I am.

I need to go back and clarify something. I worked for Texaco for six years, until 1989. Since that time, I have been working for BK Energy.

Q. And in that capacity you have been working for Bird Creek as a consulting engineer and geologist?

A. Yes.

MR. CARR: We tender Mr. Burks as an expert witness and petroleum engineer.

EXAMINER CATANACH: He is so qualified.

Q. (By Mr. Carr) Mr. Burks, would you briefly state what Bird Creek Resources seeks with this application?

A. Bird Creek Resources seeks a GOR limitation of 5000 to one above the present 2000 to one.

Q. And what would that result in in terms of a gas rate?

A. It would result in a 710-MCF-per-day ceiling on gas rate in this pool.

Q. And are you asking for these rules on a permanent basis or for a temporary period of time?

A. We are seeking a 12-month trial basis.

Q. Why are you selecting 12 months as the time period for these rules?

A. We feel that 12 months is required to see the results of the GOR 5000. Anything less than that is not sufficient time.

Q. And a six-month period of time, in your opinion, would not be adequate?

A. No.

Q. Have you prepared certain exhibits for presentation in this hearing?

A. Yes, I have.

Q. Would you refer to what has been marked for identification as Bird Creek Exhibit No. 1?

A. Okay.

Q. Identify this and then review this for Mr. Catanach.

A. Exhibit 1 is a copy of a Midland map, regional map, and it's 23 South, 28 East is primarily the township shown. The boundary of the pool as of January 15th of this year is shown with a dark line highlighted with yellow within those lines -- within the boundary.

There is also another line highlighted orange on the map, which is the one-mile radius required under the commission rules of notification.

Q. Mr. Burks, what is Bird Creek's interest in this field?

A. Bird Creek operates wells in the west half of 14, primarily the center of the field -- west half of 14, east half of 15, with the exception of 40 acres, which is operated by Bennett, most of the north half of 22 and various working interests from north to south throughout the field.

Q. In this area you have identified, has Bird Creek been the company that's actually drilled and developed the pool in this area?

A. Bird Creek's drilled 19 of the wells in the area, four of which have been handed over to other operators after completion.

Q. And then you have other working interests throughout the pool?

A. Yes, we do.

Q. When was this pool actually discovered?

A. Reading & Bates Operating Company discovered the pool in 1987 in Section 23, a well called the Brantley well.

Q. And since that time, who have been the primary operators and where are their interests located?

A. The primary operators at this time, starting up in the north end: Pogo in the west half of Section 10. They have one well. Oryx in the east half of 10. BTA in the west half of 11. RB, or reading and Bates, primarily the east half of the field. As you move south, Bird Creek, and then down to Parker and Parsley in the south.

Q. Okay.
A. Flare -- a small company called Flare also operates a lease to the south and west of Bird Creek's interest.
Q. Are they actually in the pool?
A. Flare is not.
Q. Are they currently completed in this particular sand?
A. Flare is not. Everybody else is.
Q. Generally speaking, where was the initial development in the reservoir?
A. The initial development in the reservoir was in Section 23 moving up into Section 14.
Q. What portion of this field was developed first?
A. Primarily the south central portion was developed first.
Q. Why don't we go to Exhibit No. 2 and I'd have you first identify that for Mr. Catanach and then explain what this exhibit shows.
A. Okay. This is the East Loving-Delaware Pool, all wells reported as of 2-15-91 with the commission as far as being in existence. It includes the well name; the operator or current operator of that well; the location in that unit, in the unit itself; the section -- all of these are in Township 23, South 28 East -- the completion date as

reported to the commission; the initial potential again is reported to the commission; and current production.

Current production here is a three-month average based on that reported to the commission on Form C-115, the months October '90 through December '90. If those were not available, it was the most recent production test available.

Q. Why did you use a three-month average instead of just the most recent figure?

A. The three month tended to smooth out irregularities in the reported production to the commission.

Q. What does this table show you about the reservoir?

A. About the reservoir itself is the fact that GORs on many wells tend to be higher than what you would expect out of a normal-solution gas reservoir. It also indicates the current -- based on current production that GORs have increased on almost all wells since initial completion.

There is also a column called "API Gravity," which is just to show that the oil that's being yielded out of the Delaware here is of the same grade, all greater than 43 API.

Q. What is the current average production rate per well in this pool?

A. The average -- all of these wells averaged out current production rate 96 barrels of oil per day, 197 MCF per day. That is a GOR of 2100. I did not average water.

Q. Would you briefly explain to Mr. Catanach why it is that Bird Creek is seeking a higher gas-oil ratio in this pool?

A. Bird Creek is seeking a higher GOR because we have a number of wells that are being curtailed. They are capable of top allowable rates, which is 142 barrels of oil per day. They are being curtailed at this time -- approximately eight wells, as I speak -- being curtailed because they are capable of producing over 284 MCF per day, which correlates to the 2000 GOR limitation.

Q. Are there a number of wells in the pool that are not being effectively restricted by the gas-oil ratio?

A. Yes, there are. There are a number of wells, especially in the southern portion, which are not capable of allowable rates and therefore are not hindered by the GOR limitation, yet they do possess high GOR.

Q. What are the current allowable limitations for this pool?

A. For this pool, oil allowable: 142 a day, based on the depth bracket of 6100 feet; gas, 284 MCF per day.

Q. All right. Mr. Burks, let's now go to Bird Creek Exhibit No. 3. Would you identify this and review it for the examiner?

A. Exhibit No. 3 is a structure map on top of what Bird Creek calls Zone C, and we'll go into that later, as far as what the top of Zone C looks like.

Q. Could you first, I think, review the color coding on this exhibit?

A. Yes, I will. This is a structure map, basically, structure increases from east to west, coming up structure towards the mountains. I have color-coded several ovals on this map. Within the oval is the current GOR based on a three-month averaging reported to the commission. It's the same GOR as on Exhibit 2. I have color-coded to indicate whether the GOR was less than 2000 or greater than 2000 -- orange being greater than 2000, yellow being less than 2000.

My purpose in doing this is to establish that there is no significant trend in GOR in this field.

A third color, pink, is shown on wells that have reportedly vented their gas and are not currently selling, and this is as of February 15.

Q. Apparently, from this exhibit, it appears that the there are a number of wells with high GORs in the southern portion of the field; is that correct?

A. Yes, there are. There are a number of wells.

Q. Is that where the primary problem in the reservoir is occurring?

A. Yes.

Q. And are these wells being effectively restricted by the GOR?

A. The wells in the south, which tend to be RB and Parker and Parsley, are not restricted since their oil rates are less than 142 barrels per day.

Q. The wells with the high gas-oil ratios in the northern portion of the pool are, then, the ones that are really the problem wells in terms of gas-oil ratio restriction?

A. That's become the problem well because the wells in the north part of the field tend to be capable of greater than 142 barrels of oil per day, which is based on porosity.

Q. What kind of a decline or drop in the oil rate are you seeing in the wells in the northern portion of the field?

A. In our wells and offset wells, we are seeing no decline. We are at 142 barrels of oil per day. Our oldest well is a year and a half old, still capable of 142 barrels of oil per day.

Q. What generally is the nature of the geology that we're talking about here?

~~A. In engineering, talking geology, these are~~

basically turbidity currents or hyper-saline density currents coming off a reef to either the west or north or probably northwest, coming down in events. As each event comes down, as the turbidity current slows, it fans out, forms a small fan, and that sand is laid down.

The fines within that turbidity current then are usually deposited on top of the higher permeability sand. Sediment also then rains down from the water above, forming a shale -- a shale coating on top of each sand.

The geology of this basically, then, is just a series of particulate sands being deposited over each other, overlapping.

Q. What role, actually, does structure play in terms of as it relates to the gas-oil ratio in there? Is it significant?

A. It does not appear to be significant. It does not appear to play a role. I point out that wells off structure, whether they be in the south or the north, tend to have high GORs. We have wells up structure that Bird Creek operates that have low GORs offset by high GORs. So I don't think any sensible trend can be made of this.

Q. Let's go to No. 4 now and I'd ask you to identify that.

A. Exhibit 4 is the same structure map on top of Zone C, which tends to be the pay in the area. On it are traces of the cross sections which I will present as Exhibit 5. They are Trace A through A', and there's a correction to be made there.

The first well at A I've designated as one of Oryx's wells. It is actually the well to the west of it, which is a Pogo well.

Q. So you haven't included the well that has the circle around it after the letter "A." In fact, your cross section starts with the well west of that with the number minus 2999 feet above it?

A. That is correct. The well presently circled there is not included on this cross section.

Q. Now, using this as your index map, would you go to the cross sections and review those for the examiner?

A. The cross sections are on Exhibit 5. I have both A-A' and B-B' on the cross section.

On the cross section itself there's a correction to be made on A-A' between the second well and the third well. The top BS, meaning top of Bone Spring, that should be placed on the line underneath that. The line that it is on is a minus 3100 feet sea level data.

All wells on this cross section are hung off of the minus 3100-foot data.

Q. Okay, Mr. Burks, what's this show you?

A. Cross section A through A' is an east-west cut of this north-south -- typically north-to-south-running field. It shows -- production is included under every log where logs were available.

Curves in most instances were available and are marked on the logs. The logs are gamma ray, density neutron with lateral logs, and MSFL logs alongside when available.

It shows basically, again, that structure plays no part or little part in what the GOR of the well -- of what the well has. It also shows that every well or every log is vastly different from the next one to it, indicating to us that it's a highly discontinuous sand.

What is continuous through the area are the shale markers, which were predominantly deposited during quiet times in between sand deposition. But within the sands themselves, we have a hard time trying to correlate or even correlating any of the sands.

Q. What particular portion of these logs do you look at in making that statement?

A. I typically look at the MSFL curve on the resistivity log, which is the solid line of the three curves on the resistivity logs. The MSFL, having high-resolution capabilities, can pick out approximate thicknesses and the shape of the sand itself -- or vertical shape or thickness within the group itself.

Q. When you look at that, you can't correlate well to well?

A. I cannot correlate from well to well with the logs here or with any logs in the field.

Q. When you say that, you're talking about the sand stringers, not the gross interval?

A. That's correct. Again, I might just point out that I can correlate the gross interval because there are shale markers above and below. We are on top of the Bone Spring, and that's also very easy to pick out. But within the individual sands themselves, they are too discontinuous to pick up from well to well.

On A to A' I have three or four wells here that are one location apart. Just by looking at the MSFL curve you can tell that they are vastly different as far as that profile is concerned.

Q. Mr. Burks, how thick is the Delaware itself?

A. The Delaware in this area is a little over 3,000 feet thick.

Q. How much of the Delaware are you showing on these cross sections?

A. Basically, the pay opened is 100 feet thick. I'm showing approximately 200 feet on these cross sections, which is the basal Delaware on top of the Bone Spring line.

Q. And this is the bottom portion of the 3,000-foot

Delaware interval?

A. That's correct. The Brushy Canyon tends to be the lower third, or that's what the Brushy Canyon is, is the lower third of the Delaware formation, and we are basal Brushy Canyon.

Q. Is it fair to say from this that you can't see that all the wells are at least completed of the same age sands?

A. Yes. I can see that they are in the same age sands.

Q. So basically you you can see the sands are there, but you can't correlate them well to well?

A. That's true.

Cross Section B through B' serves the same purpose. Based on the MSFL curves, it is very difficult to correlate from well to well. B through B' is also a north-to-south cross section from the northernmost well to the southermost well in this pool.

Q. Let's go now to what has been marked as Bird Creek Exhibit No. 6. I'd ask you to identify that, please.

A. Exhibit No. 6 is a resistivity log run on one of our more recent wells marked No. 1 in Section 22. We ran a high-resolution MSFL curve on this interval. I have perforations marked. I have perforations marked where we have shot.

What this demonstrates again is high-resolution MSFL curve, which you cannot see on a conventional MSFL curve run in this field.

Q. Let's go to the second page of this exhibit, and I'd ask you, Mr. Burks, how accurate is this log?

A. This log is very accurate as long as you're not trying to pick out bed definitions less than three to four inches.

Q. So you could pick up a six-foot interval with this log?

A. Oh, very easily. I can pick up one-foot intervals, even half-foot intervals with this log.

Q. What does the yellow dot on the second page indicate?

A. The yellow dot indicates the presence of a sand member, one of these turbidity currents or density currents that come down off of the reef and are deposited as a pod in this area. This -- for example, the divisions on this log are two feet, each division being two feet. So the sand that I've highlighted is a little more than one foot thick.

The red arrow off to the side of that sand member points to a shaley dolomite, which are the deposits laid on top of each sand in between the sand-dumping events. Those shales are an impermeable barrier to vertical migration of any fluids. Therefore, each sand is separate from the one overlying and underlying it.

Q. So you have separate sand stringers across the field; is that what you're saying?

A. Yes, we do.

And it is these sand stringers that cannot be correlated from well to well just because of their thinness.

Q. Because of that, do you have any opinion as to their aerial extent, or can you determine that from this information?

A. Our estimation is the aerial extent of any one of these pods is dependent upon the thickness of the sand, but it's roughly somewhere between ten and 60 acres, is the aerial extent of any one given sand.

Q. Let's move down to Exhibit No. 7. Would you identify that, please?

A. Exhibit 7 is a core analysis report performed for us at my direction by Core Lab in Midland. We bored a well in Section 14 across the entire pay interval to Zone C sand. Page 2 of this exhibit shows a gamma-ray strip to allow correlating with open-hole logs. It shows porosity, also has a track which is horizontal permeability, two different values of horizontal permeability, and of course, then oil saturation and water saturation within that core.

Q. What does this show you?

A. This shows us that throughout the pay from top to bottom -- and when I say "pay," I mean the entire gross interval of 100 feet -- that permeability has a wide range, anywhere from less and -- or zero all the way up to over a hundred millidarcies.

Q. When you're talking about permeability, you're talking about in the sand stringers?

A. Yes, I am. Each sand stringer will contribute a given value of permeability. The one above will be drastically different. Therefore, we see the same thing on this log, a spiking of the permeability. It does not appear to be consistent, makes the sand appear as if it were individual sand stringers, each heterogenous to the other.

Q. Does this tell you anything about the shale in the reservoir?

A. It goes to further there are a couple of gamma ray kicks in the middle of the strip and near the base which are corresponding shales being dumped on top of each individual sand. They -- Core Lab found that they have no permeability whatsoever and very little porosity.

Q. Is there any evidence of any vertical fracturing in this reservoir?

A. Not in our core and not in sonic logs that we've run in the field.

Q. Let's go to Exhibit No. 8. Would you identify that, please?

A. Exhibit 8 is a collection of production plots versus time for three Bird Creek wells and two RB wells. The left axis is production in barrels. The bottom axis, time, of course.

The Bird Creek wells -- the three examples that I have here -- are wells that are still flowing at the allowable of 142 barrels of oil per day, which is approximately 4,300 barrels of oil per month. That tends to be the top -- the top line on the Bird Creek graphs.

The bottom plot on the Bird Creek graphs is GOR, showing GOR increasing with time. Most wells are currently around 2000 to 3000. These three wells are 2000 to 3000 GOR. Based on the present trend, we should be at 5000 on these wells -- assuming that the wells are still allowable, we should be at 5000 in nine months.

Q. Okay.

A. I might point out that the two RB wells that I've chosen here are the oldest wells in the field. The BCB-23 No. 1 was completed in spring of '88. The Brantley No. 1, which is the last page of the exhibit, is the first well in the field. It was completed in September of '87. I did not have the fall of '87 production at the time I plotted these.

The point I'd like to make out on these is, these are approximately four -- three and a half, four years old, not quite four years old. We are seeing a decline on these wells which we are not seeing in our own wells. We also see in these two wells and in many of R.B.'s other wells that GOR has increased over time.

On both of these wells RB ran into GORs exceeding the 2000. The SCB-23-1 was the only one adversely affected by that increased GOR. How much they were overproduced at a given time back in '88, I do not know. Since then their oil has dropped and so has their gas rates. So if there was any overproduction of gas, it's been settled down with the commission on these wells.

Q. Mr. Burks, as to an increasing gas-oil ratio, isn't that normal as a reservoir use -- as you continue to produce a reservoir?

A. In this type of reservoir, yes. We're seeing GOR on the older wells having increased over time and then trying to level out. As you can see these two plots seem somewhat erratic. Typically, a solution-gas reservoir should have a GOR that remains fairly constant throughout the life of the well with gas rates declining along with the oil rates.

Q. In the case of the RB wells, the gas rate was increasing along with the oil; is that what you were saying?

A. Yes, it was. Over a period in the SCB-23-1, which is the fourth page -- this well is in section 23 -- it took about nine months for it to peak and then started to decline at the end as the oil rate started declining off the 142 barrels of oil per day.

Q. Let's go to Exhibit No. 9 and I'd ask you to identify those and then explain to the examiner what that shows.

A. Exhibit 9?

Q. Exhibit No. 9, the rate sensitivity test.

A. Exhibit No. 9 are four rate sensitivity tests, three on Bird Creek wells, one on Pogo's only well in the field at this time. The rate sensitivity tests shown here has GOR on the left margin, increasing as you go up, and barrels of oil per day on the bottom margin, increasing as you go to the right.

How these were performed, the wells were flowed every other day or the chokes were changed on the wells every other day. An accurate gas and oil rate was measured on each well and then these were plotted.

The purpose of this plot is to see if there's any trend -- to see if there's any trend for GOR to increase as production goes up. From these four plots, GOR remains constant whether you flow the well at less than 100 barrels of oil per day or greater than 250 barrels of oil per day.

Now, in this application we're not seeking an increased oil allowable. What this corresponds to is the fact that gas was also increased -- the gas rates were also increased as oil rates were increased.

Q. In your opinion, would the reservoir be damaged by increasing these gas-oil ratios?

A. Based on the rate sensitivity tests and the other data I've shown, no.

Q. What percent of current producing capacity are the wells in the pool currently producing at?

A. Pardon me?

Q. At what percent of their capacity are the wells in the pool producing?

A. I can only -- I can only state Bird Creek wells. None of Bird Creek wells have been drawn down, according to Vogel's relationship, more than 35 percent of maximum oil capacity. In other words, say, 35 percent -- if our well's making an 150 barrels of oil per day, the maximum that that well could make is roughly somewhere somewhere between 500 and 600 barrels per day. We therefore have kept our wells at around a 35 percent of the maximum.

Also on the rate sensitivity test, I'd like to point out that where pressure -- bottom-hole pressure data is available it's so marked. The Pogo well bottom hole -- initial bottom-hole pressure was measured. On the Bird Creek Carrasco No. 1, which is the second page, bottom-hole pressure has been measured on three different occasions.

We feel these are very accurate numbers. On the Carrasco No. 1, which was our first well in the field, we have seen a 700-pound drop in a year and a half and have produced 8000 barrels with that draw.

Q. Mr. Burks, let's go to Exhibit No. 10. Would you identify that?

A. Exhibit No. 10 is a Core Lab report for the Carrasco No. 1, again, our first well in the field. We took a sample of the oil and also a sample of the gas, measured them accurately -- this was on initial completion -- and sent those to Midland to be analyzed.

One of the tests that they performed is the test here as Exhibit 10, this differential vaporization data. In this test they took a sample of oil at the original bottom-hole pressure as we measured. What they felt was the bubble point was 2850, which was less than our initial pressure. They took this oil, started reducing the pressure on it in 250-pound increments and started measuring the amount of gas liberated from that oil.

I'd like to point out that what is important in my point here is the first column and the second column of Exhibit 10. The first column, of course, is the pressure being drawn down on the sample of oil. The second column is the GOR or the gas liberated at each stage through the draw down.

To summarize this report, I would say that 1039 would be the maximum gas-oil ratio that could be liberated from this 42-degree-gravity oil from bottom-hole pressure to surface conditions. In other words, one MCF per barrel of oil is the maximum that that barrel of oil -- stock tank barrel will hold.

Q. From this study, what conclusions can you reach?

A. The conclusions from this study indicate -- indicate to Bird Creek that the oil can only hold, again, one MCF of gas. Yet on initial completion of many wells in the field, GORs have been higher than 1000. GORs now currently in the field range from, again, 100 to well over 10,000. That is indicative that there is something else down there giving up gas. It is not gas liberated out of oil.

Q. And do you have an opinion as to what that would be?

A. Yes, I do. It is not a gas cap, per se. They are just individual -- our feeling is individual gas stringers are present in between the oil stringers and are giving up this gas production.

Q. Why do you think this is not a gas cap?

A. This is not a gas cap in the classical sense, first, because throughout the 100-foot pay there is no vertical communication between each sand member. That was exhibited in the core study. That was also exhibited on the logs -- just too many shale stringers in between sand stringers to allow a vertical continuity or a gas cap to form. On a -- that would be a vertical basis.

On a horizontal basis, the sands are too limited and too thin to form a gas cap in each individual sand stringer.

Q. And you have these high gas-oil ratios in wells that are off structures as well, do you not?

A. Yes, we do. I can point out on the structure map where there are GORs off structure much higher than what we have up structure. An argument can be thrown out, then, that, well, those wells aren't capable of producing allowable. We do, though, have on the GOR map -- and going back to Exhibit No. 2, it can be seen RB has wells off structure that are capable of 142 barrels of oil per day and have GORs in excess of 2000. And those are typically anywhere from 50 to 75 feet below the highest structure wells in the field.

Q. Mr. Burks, how does the oil sample that was analyzed by Core Lab compare to other oil produced from the pool?

A. This is the same oil throughout the field. Table 2 showed the API gravity reported to the commission on every well completed in the zone. All are roughly in the range of 40 to 45 degrees temperature, at which the gravity -- or at which the oil was measured can affect the gravity value somewhat.

But my conclusion is that it is the same oil in every well.

Q. In your opinion, would the conclusions reached by Core Lab be applicable to other wells in the field?

A. Oh, yes.

Q. From your opinion, will approval of a higher gas-oil ratio, the 5000-to-one-gas-oil ratio you recommend, result in the dissipation of reservoir energy?

A. No, it will not.

Q. Why is that?

A. Again, going back to what we feel we have, we have primarily oil field stringers down there which are driven to the surface by solution gas draws. We also have intermingled in there separate gas stringers. You can see those gas stringers, we feel, on the porosity log where we have significant crossover of density and neutron curves.

Q. In your opinion, will approval of this application result in a waste of oil?

A. No, it will not. Because of the rates that we've been flowing at, which are far below the maximum that the well is capable of, in asking for the 5000 GOR limitation, we do not feel that any damage would occur, nor would there be any waste.

Q. Will the correlative rights of any interest owner be impaired by the approval of this application?

A. No. We feel that the wells drain less than 40 acres in this field. That was presented at our hearing with BTA before the commission about a year ago. We still feel strongly about that, that these wells cannot produce any more than 35 to 40 acres in aerial extent. So therefore there would be no -- no problem.

Q. Mr. Burks, would you identify what has been marked as Bird Creek Exhibit No. 11?

A. Exhibit No. 11 are letters of approval from operators in the pool and within the one-mile radius.

Q. Who are they?

A. I have BTA; Harken; Hallwood, which is the old Conoco Companies; and Ray Westall.

Q. Is Exhibit No. 12 an affidavit with attached letter and return receipts confirming that notice of this hearing has been provided as required by OCD rules?

A. Yes, it is.

Q. Were Exhibits 1 through 12 either prepared by you directly or at your direction?

A. Yes.

MR. CARR: At this time, Mr. Catanach, we would move the admission of Bird Creek Exhibits 1 through 12.

EXAMINER CATANACH: Exhibits 1 through 12 will be admitted as evidence.

(Whereupon Exhibits 1 through 12 were admitted into evidence.

MR. CARR: That concludes my direct examination of Mr. Burks.

EXAMINER CATANACH: Mr. Kellahin.

MR. KELLAHIN: Thank you, Mr. Examiner.

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Burks, let me have you direct your attention to your Exhibits 3 and No. 2.

A. Exhibit 2 is the table of most the recent reported production averaged out, and Exhibit 3 is a structure map with GOR plotted.

Q. Right. When I look at Exhibit 3, am I correct in understanding that the gas-oil ratio values shown on that display have been taken from the second-to-last column on Exhibit 2, which shows the average gas-oil ratio?

A. That is correct.

Q. When we look at Exhibit No. 2, the initial potential information for each of the wells, as you reported, was obtained by you from what source?

A. It was obtained by me from the New Mexico Oil Conservation Division office in Artesia, New Mexico.

Q. And you get it from what type of reports or information at the Artesia office?

A. I believe it's C-101 or C-104, is the initial completion form. The values are on there.

Q. Those values, as reported by the various operators for the wells that are on the commission form, and you've taken this -- I think there is C-104s.

MR. STOVALL: 105.

THE WITNESS: C-105.

Q. (By Mr. Kellahin) The completion report?

A. 104 is request for allowables, where some of the data comes off, also.

Q. When we get to the column that says "Current Production Barrels of Water" --

A. Yes.

Q. -- what does "current" mean? Current as of what date?

A. Current production three-month average. Three-month average was according -- where I had data available at the commission, meaning if the operator filed

C-115s for any month or all three months in October, November, December, and December is the latest month that the commission has in Artesia.

Q. October, November, December --

A. December.

Q. -- of 1991 --

A. That's right.

Q. -- is the three-month interval? And it's during that period of time, then, you looked at the Artesia district office's reports to see during that period of time what the total number of barrels of oil produced?

A. Yes. That is a three-month average.

Q. All right. You get the total for the three months and then you divide it by three?

A. Or the number of days reported having produced on the C-115.

Q. Let's look specifically at the Teledyne No. 2 well, which is the Bird Creek well in the middle of page 2.

A. Okay.

Q. The initial reported gas-oil ratio was 3364 to one --

A. That's correct.

Q. -- barrels of oil?

Can you give us information other than this averaging of current production to tell us what the total cumulative production has been for the Teledyne well? Do you have other information on the production on that well?

A. No, I do not. That reported to the state has only been updated through 1/1 of '90. I have not gotten a cumulative for that well at this time.

Q. Do you have other information available with you that you could tell me what the gas-oil ratio was for the well for the month of, say, September, 1991?

A. I don't have that. During the months last summer, the Teledyne was overproduced on gas. The commission came to us in roughly August of 1991 and requested that we shut the well in. We reached an agreement with the commission that we could still produce the oil, but we just had to keep the gas rates at roughly half the allowable rate and -- until we made up the overproduction. The --

Q. Half of the gas allowable rate?

A. Half of the gas allowable.

Q. So you would have had half of -- what was -- the 384 number?

A. That's correct. So basically what we do is, we flow the well for half a month every month and then shut it in. And we -- during that half month that it is productive, we keep it choked back to as close as we can to 384 MCF per day rate, meaning during that month we have only produced half of our allowable.

And we will continue to do that for a time period sometime into later this year until that overproduction is made up.

Q. So the Teledyne No. 2 well is being restricted because it exceeds the gas withdrawal maximum limit allowed for the well at this point?

A. Yes. I believe, yes.

Q. Do you have an accurate producing gas-oil ratio that we can utilize to tell what the true gas-oil ratio is? Because I'm confused.

A. In what well?

Q. Well, because you've restricted the well.

A. Yes.

Q. How am I going to relate this average on a gas-oil ratio to what would be the true gas-oil ratio for the well?

A. It would make no difference. This is the true gas-oil ratio when we produce the well for the 15-day period.

Q. Okay. And then you simply stop producing when you reach the maximum oil-- gas volume allowed for the well for that period?

A. Yes.

Q. If we went through the reports for each of the months for this well --

A. Yes.

Q. -- and found out what the gas-oil ratio was for that well and then averaged October, November and December, we should get the 5986 average?

A. Yes.

Q. One of your arguments is that there is not a structural explanation to the high gas-oil ratios of the wells. In other words, you see the gas breaking out of solution indiscriminate of structural position, and therefore you're not concerned that we're forming a gas cap, if you will, by withdrawing the gas too fast from the reservoir.

A. So what's your question?

Q. My question is that, one of your points is there is not a relationship between the gas-oil ratios and structure?

A. There is not a logical correlation between structure and GOR here.

Q. If we're depleting a depletion or a solution gas-drive reservoir too fast and breaking out too much of the gas and leaving it to be produced preferentially to the oil, we would expect to see higher gas-oil ratios in wells in higher structural positions?

A. In a solution gas -- in a classic solution gas reservoir?

Q. Yes. Right.

A. Not necessarily, unless there was horizontal and vertical permeability in that given sand member.

Q. Let's assume that. One of the concerns about producing an oil reservoir is that you don't want to waste the gas drive by producing the gas too high, right?

A. Right.

Q. And if you've got good permeability in the reservoir, if you're pooling the reservoir too fast, then you would see a secondary gas cap being formed higher in the structural position of the reservoir?

A. In our classic example, yes.

Q. With regard to these Delaware wells, are they mechanically communicating the reservoir so that these various lenses or stringers are actually being communicated in the near well bore condition?

A. They are in the near well bore. Yes, they are.

Q. When we look at your gas-oil ratio map and your structure on Exhibit No. 3, and I look at the Teledyne well in the northwest of the northwest of 14, and I look at the well to the southwest of that in the southeast of the northeast of 15 -- I guess I need some nomenclature. That is the Bird Creek Siebert No. 1 well in 15?

A. Siebert -- it's the northeast northeast, which is unit letter "A." It's the Siebert, yes.

Q. Siebert. You've got the Siebert well and I've got the Teledyne No. 2 well. Gas-oil ratios of both of those -- one is about 6000 to one. The other is 8300 to one. They are high in the structural position. I look to the west offsetting that down structure and I got the wells at substantially less gas-oil ratio.

Is that not an example?

A. That is a very isolated example of where you move up structure and you have a high GOR. I can pick out rather quickly for you where there are examples of moving up structure and lower GORs.

Q. Even within that isolated portion of the structure shouldn't we then control the gas withdrawal rates from those two Bird Creek wells so that we don't waste the drive mechanism in the reservoir?

A. If it were the classic-type reservoir with great vertical and horizontal permeability?

Q. Yes.

A. Yes, you would want to restrict that. In this case, we feel that we have discontinuous sands, no vertical permeability, no horizontal -- or when I say no vertical permeability, that is between individual sand members -- limited horizontal permeability due to the size of the sand pods or the sand stringers. And, again, going back, we should not drain and cannot drain anything greater either than 40 acres, so I do not feel that we can make that parallel in this case.

Q. Is there available data from which you as an engineer could plot the effects of increasing the gas-oil ratio on ultimate recovery?

A. There are -- there is some engineering that can be done to determine with increased GO -- with GOR data what ultimate recovery would be or the percentage of oil in place.

Q. Have you done that here?

A. I have not. We do not have time. We have not had enough production history on our wells to perform that type of study.

Q. When you look at your anticipated maximum recovery percentages for this Delaware oil production, what is your estimate as an engineer of what that maximum might be?

A. We are assuming 20 to 25 percent, no more than 25 percent, original oil in place.

Q. For this reservoir?

A. For this reservoir in Section 14.

That figure is based somewhat on production in other Brushy Canyon wells of which I played a part of at Texaco for a number of years.

Q. Your fluid data, the PVT data on Exhibit No. 10 -- one of the things that this shows us is that very quickly in the life of the reservoir we were producing below the bubble point of the reservoir, wasn't it?

A. No. No. The bubble point here was 2858 of this oil sample. If I may point you to Exhibit No. 9, page 2, our initial reservoir pressure two days after having opened the well up was 2906. That was a 72-hour shut-in.

It's in small script above the average GOR line.

Q. You're looking at Exhibit No. 9?

A. I'm looking at Exhibit No. 9, page 2, rate sensitivity test.

Q. Yes.

A. Bird Creek Carrasco 14 No. 1, initial reservoir pressure 2906.

Q. I got it.

A. Which is approximately 50 pounds higher than the bubble point as measured by Core Lab.

Q. The bubble point was 2892, if I remember right.

A. 2858.

Q. 2858?

A. That is on Exhibit 10.

Q. At what point in the reservoir have the -- did the wells cross through the bubble point and start proceeding at a pressure below the bubble point?

A. The Carrasco -- and this is an estimate based on the pressures here again on the rate sensitivity test on the Carrasco No. 1 -- it took 14 months for the pressure to drop from 2900 to roughly 2440 which is a difference of about 450 pounds. So 450 divided by 15 months is roughly three -- oh, what am I trying to say?

It's a roughly 30-pounds pressure drop per month, so about somewhere around two and a half, three months after this well was completed, this well crossed into the bubble point, went below the bubble point pressure.

Q. Are there any wells that are currently producing above the bubble point of the reservoir?

A. Our most recent completions are above the bubble point just because they are recent completions. If there are others that other operators have, I'm not aware of it.

Q. Let's take, for example, the Teledyne No. 2 well. If that well is allowed to produce gas at the increased 5000 to one, it gives it a 710 ceiling per day?

A. That's correct.

Q. What would be its comparable oil rate?

A. Its comparable oil rate would be approximately 90 to 100 barrels of oil per day, still below the --

Q. 142?

A. -- the 142.

Q. The top allowable?

A. This is one of the two or three wells that we have that we do not want to go over the GOR of 5000 for the -- for the conservation of energy past that rate. These two or three wells would never make the 142 a day unless we flowed them in excess of a million MCF or a million gas cubic feet per day.

Q. Help me find on Exhibit No. 2, Mr. Burks, which of your wells, meaning the Bird Creek wells, that are currently curtailed because of the gas ceiling under the current GOR rate.

A. Okay. Currently curtailed wells.

Q. Because of the gas component.

A. Right. That would be pages 2 and 3, Sections 14 and 15 and also in Section 22, unit letter "A" of 22.

Q. I'm confused. Can you do it by well name?

A. I'm sorry. Those currently curtailed are in Section 14, Teledyne No. 1.

Q. All right, sir.

A. Teledyne No. 2, the Trachta No. 2, Carrasco No. 1, RGA No. 1, and I believe that would be all in Section 14.

Again, the gas allowable rate is 284 MCF per day.

In Section 15, we have a problem that is just started on the Siebert No. 1.

Q. Okay.

A. Then the Caviness-Paine No. 1, then in Unit Letter A of Section 22 that would be the Queen No. 1.

Q. Okay.

A. Those are wells that we currently operate. Now, we again have drilled and completed other wells for -- and have handed those operations over.

Q. If the gas component is increased to the 710 MCF a day, will any of those eight wells still be gas-allowable curtailed?

A. Some of those eight will be, naming the Teledyne No. 2 as we discussed a while ago. But the majority of them would be able to get back up to the 142-barrels-of-oil-per-day allowable.

Q. You said a while ago you didn't want to exceed the 5000 to one. What's the distinction between five and, say, 4000 or 6000? Why five?

A. We just feel that we'll be at 5000 on approximately every well within the next 12 to 14 months, and we feel that that's sufficient time period to evaluate this increase in GOR. And so at this time we feel comfortable with the 5000; no more, no less.

Q. That would be 5000 on the wells that you operate, then? Within a 12-month period you would expect all of those to bump against the 5000 ceiling?

A. I expect the wells that I just listed to, again, bump the 5000 ceiling on the current trend they have. I hope they don't do that, but we will need 12 months to determine that.

Q. Did you run rate sensitivity tests on any wells other than the four that are shown in Exhibit No. 9?

A. Yes, I did, but I did not include those.

Q. Why not?

A. They were -- they were indicative of what I have here, and I -- these were a -- I felt, a good average of our wells in the field.

Q. You didn't run any rate sensitivity tests where the well showed that with increased withdrawals the gas-oil ratio climbed?

A. Everything that we ran indicated a flat line.

Q. Explain to me again the rate sensitivity test. You said that -- let's start at the first one, the Pogo --

A. That's correct.

Q. -- operated well. What are we controlling here in terms of establishing the rate sensitivity?

Are we controlling the gas rate or are we controlling the oil rate?

A. Well, since the -- since the GOR is

approximately constant, if you control the oil rate, you therefore control the gas rate by the same factor.

Q. For example, the first point on here is, oh, it looks like about 80 barrels a day.

A. That's correct. And GOR of approximately 3400.

Q. So flowing in at 80 barrels a day gave us that gas-oil ratio number?

A. Yes.

Q. How long did you flow it at that rate?

A. This was Pogo, and according to Pogo, those were 48-hour rates.

Q. How long did you flow your wells?

A. 48 hours.

Q. So you flow it for 48 hours and then do --

A. That was minimum. Minimum of 48 hours.

Q. All right. Is there some stabilization period such as you would run in a gas well in terms of pressure analysis?

A. That's why we did the 48-hour test. We felt like 24 was not sufficient time to get a good, stabilized rate.

Q. So you run it for 48 hours. You get a stabilized -- what you think is a stabilized rate, and then you change it and run it at a high --

A. Then we change the choke size after that 48-hour period to a higher choke, say from a 1064 to a 1464.

Q. And then you produced at about 130 barrels a day?

A. In this Pogo example, yes, it started producing at about 130 barrels a day. The GOR went down for the 48-hour period, down to roughly 3100.

Q. And then it's flowed for another 48-hour period, it looks like, just above 150 barrels a day, and the gas-oil ratio goes back up to what? 4000 to one?

A. No, that's -- that line would be 3400.

Q. What is that line?

3400 -- 3400 to one.

A. The best thing that can be done with these points is to average the area between the two points and draw a straight line in whatever direction. The indication here was that the GOR even dropped at higher oil rates. The other tests also demonstrate that, that they may drop. They may come up slightly. And that would just be the -- area or error involved with the flowing of the well.

Q. Well, when you look at the Pogo well and you compare the first step rate to the last step rate, it's taken you more gas energy to recover a barrel of oil at the higher rate?

A. I don't think that conclusion can be made from these just two points. You're only talking about going from a gas-oil ratio of approximately 3330 up to 3400, which is quite minute, in my opinion.

Q. What's the percentage range of difference off your average line for those points?

A. The percentage difference?

Q. Yes.

A. Which graph?

Q. Oh, for the first one, the Pogo graph.

A. The first one?

Q. Yes.

A. Average line is 3250. The highest or the -- either the lowest point or the highest point plotted there -- I'll pick the lowest. The lowest point is approximately at 3100. That's a difference of 140 divided by 3100.

Q. Let's turn to the --

A. That's approximately four percent.

Q. When you look at the Bird Creek RGA well -- it's the third page over --

A. Yes.

Q. -- you flow the well at, oh, I guess a little over almost 170 barrels a day and you get a gas-oil ratio of slightly over 1500 to one. And then you go over and you produce it at 210 a day, and your gas-oil ratio goes up to 3450 to one?

A. But then we go to 225 a day and it comes back down to 2250.

You're not --

Q. How do you draw any sense out of the points that are that far apart?

A. Again, I point out that you split the points and draw the best-fit line on those points. Nothing is perfect in this world, and as most engineers know, it is hard to get all your points to line up when attempting to do a best-fit straight line.

Q. Wouldn't the scattering of points make you, as an engineer, suspect that the 48-hour flow rate really is not long enough to tell you what effect you're having on the reservoir?

A. I would not say that. Some of our flow rates were 72-hour on our wells.

Q. Even 72 hours is going to be too short to tell you?

A. I would not say that.

I can make these points look closer together by scrunching the numbers on the level margin and make my line easier to plot.

MR. KELLAHIN: Thank you, Mr. Examiner. I have no further questions.

EXAMINER CATANACH: Any re-direct?

MR. CARR: No.

MR. KELLAHIN: You've got a couple more lawyers here that want to ask engineering questions.

EXAMINER CATANACH: Mr. Pearce.

CROSS-EXAMINATION

BY MR. PEARCE:

Q. Mr. Burks, I'll bite. I want to go back to your Exhibit 9 with the plots that you've been looking at with Mr. Kellahin for a minute and I want to understand what the line labeled "Average GOR" is.

A. Okay.

Q. That's not any kind of least squares fit; that's just a simple mathematical number that you derived and you drew a straight line from it?

A. That's correct. That's taking the points, looking at them on the same plane and drawing the best-fit line.

Q. That is the best-fit line?

A. In my engineering opinion, yes.

Q. And in each of these four examples the best-fit line came out to be an absolutely flat line?

A. Yes.

Q. Absolutely horizontal?

A. I tried to split all points evenly. If there are many points far off the line, I've got to take them into consideration. In my engineering opinion, these are the best-fit lines -- in my opinion.

Q. And what I'm trying to determine is how you derived that best engineering opinion. Is that a mathematical function or is that a sighting-down-the-points function like you just did?

A. That's a sighting-down-the-points function.

Q. Did you do a least-squares fit on any of these points?

A. No, I did not.

MR. PEARCE: Thank you.

EXAMINER CATANACH: Mr. Bruce.

CROSS-EXAMINATION

BY MR. BRUCE:

Q. Going back to your Exhibit No. 3, Mr. Burks, getting back to something Mr. Kellahin questioned you about, looking up, say, at the northwest quarter of Section 14 and the northeast quarter of Section 15 -- I don't know the well names -- but the well with the GOR of 5986 and then the other one with the GOR of 8325 --

A. Yes.

Q. -- are those both Bird Creek wells?

A. The 5,986 is operated by Bird Creek at this time. The 8,325 well, which is the southeast of northeast of 15, is operated by a company called Harken.

Q. Did Bird Creek drill that well?
A. We drilled that well.
Q. And the well immediately to the west of the Harken well, that would be a GOR of 8888. That's the R.C. Bennett well?
A. That's the R.C. Bennett well. That is at a legal location, although it has crowded Bird Creek and Harken acreage -- 330 and 330.
Q. Getting back to your comment about these -- you're talking about individual gas stringers in the Delaware. How extensive could these be?
A. Again, I'll go back to my testimony. We feel that they averaged -- depending upon the thickness, they average an aerial coverage of ten to 60 acres.
Q. So it's conceivable, looking at that R.C. Bennett well, assuming your theory of gas stringers is correct, that a gas stringer could be reaching from the Bennett well to that Harken well?
A. It could, conceivably, yes. Correlating the two logs there, I don't think you could pick out what individual sand might be the actual one again.
Q. But it is possible?
A. I won't rule it out.
Q. And the Harken well is completed higher structurally than the Bennett well; is that correct?

A. I'd better not answer that because I don't have those logs in front of me at this time. Structurally, the Bennett well was -- from my recollection, was completed in the lower two-thirds of the 100-foot interval. The Harken well is completed in the entire 100-foot interval, so I think one could deduce that, yes, they are probably completed at a lower structural level.

Q. The Bennett well?

A. The Bennett well is -- to the Harken well.

Q. And therefore it's conceivable that the Harken well could be, if it's producing at that higher GOR, drawing off the gas from that individual gas stringer that's in the bad well?

A. I can't make that conclusion in the Bennett well for basically one reason. The Bennett well has not even been completed for 30 days. They are still within their 30-day -- they are still flaring their gas at this time. They are hoping to get hooked up by the end of this month, so they have no production history.

Our opinion is -- and we visited with them about this -- that we feel that even though their GOR is at 1000, approximately, that given a few months, their GOR will increase over 1000, based on R.B.'s experience, based on Bird Creek's experience, based on Parker and Parsley's experience down south.

Q. But it is conceivable that the Harken well is drawing off gas from the Bennett well?

A. If you believe the theory that there might be a gas -- a gas stringer extending -- or any sand stringer extending from one well to the other, if it were that continuous.

You're talking 990 feet distance, a little over that there.

Q. Now, if the GOR is not increased, would Bird Creek be losing any of its oil or would it just take longer to produce it?

A. It would just take longer to produce it. The only way that we would lose any of our oil is occasions like R.C. Bennett where they have crowded the line 330 and 330. If they drain an ideal 40 acres, they will drain our oil and our gas.

Q. But, for instance, are there any unorthodox locations?

A. There is one unorthodox location. It was approved by the commission, a BTA well.

Q. All the others are orthodox?

A. All the others are orthodox.

Q. According to the standard rules of this commission?

A. That's correct; 330 off the 40-acre line.

Q. I'm going back here to the two for Mr. Kellahin. You listed what you considered -- I don't know what the right term is -- but problem wells, but you want a GOR of 5000 to one. Are there any of these wells that a lower GOR would suffice?

A. They would suffice for a period of about -- depending upon the GOR, for a period of from one month to six months from now. I pointed out on Exhibit 8, which are the production plots showing our GORs increasing with time, we have some wells that are over the GOR of 3000 at this time. Other wells in the field we have gone over 2000, the ones that I listed previously.

If you pick a GOR of 4000, we'll be there in, say, six months on the average. If you pick a GOR of 5000, which we'd like to see, we'll be there in nine to 12 months.

Q. Looking at your Exhibit 8, you did complete a couple of RB Operating Company wells on that chart or on that exhibit and -- for instance, the SCB 23 No. 1 well, although it fluctuated, the GOR has not really increased, has it?

A. It did in the first year. If I were to attempt to draw a straight line in the first year on that GOR, it increased from an average of 4500 a day, which on an initial completion was -- it's initial completion GOR --

SCB 23 No. 1 was 1406.

I'm on the wrong plot.

On the SCB 23 No. 1, original GOR on completion was 1406. Within nine months GOR had increased to well over 4300.

Q. But since then it's declined, hasn't it?

A. I think it's drawn roughly a straight line through there because, again, here in August of 1991 they were at a GOR of 4000.

Q. Sure. But excluding, say, 1988, it's more or less been -- if you draw a straight line through there, it might be more like 2500; is that correct?

A. That's not unreasonable to draw that line.

Q. And that could indicate that after a year or so of production there might be less of a problem with GOR than Bird Creek is having right now?

A. Could you restate that, please?

Q. Could that indicate that after a year or so of production there might be less of a problem with production than Bird Creek is seeing right now?

A. It depends how long you can sustain your allowable flow rate. RB here could only sustain it for a few months.

We feel that we can sustain it for anywhere from six to 12 months on our problem wells. We feel 12 months from now we ought to be coming off of the allowable oil rate of 142 a day, and that's why we're requesting the 12-month trial period.

Q. Getting back to Exhibit 3 and the wells you were discussing on that exhibit -- the Bird Creek well, the Harken well and the R.C. Bennett well.

A. Correct.

Q. Now, you said the -- I believe -- and correct me if I'm wrong -- that the Bennett well was completed in the lower two-thirds of the sand and the other two wells were completed in the full interval; is that correct?

A. The Bennett versus what wells? The Harken?

Q. The Bennett -- looking at the Bennett, the Harken, which has the GOR of 8325, and the Bird Creek with a GOR of 5986.

A. 5,986. That is, from my recollection, an approximate value of where they are open at.

Q. But, I mean, just looking at the completion, I believe you said that the Harken well was completed in two-thirds of that interval that you've been looking at.

A. Yes.

Q. On your cross section.

A. Yes.

Q. And that the Harken well and the Bird Creek well were completed in the full interval.

A. In the full interval, yes.

Q. Did you do a similar analysis of any of the other completions?

A. Yes, I did. R.B.'s first well -- let me step back and have you restate your question again.

Q. Have you done a similar analysis of the other wells in the pool of what portion of the interval they were completed in, whether the full -- I think you were talking about 100 feet or two-thirds of that or half, or whatever?

A. Yes. Yes, I have. I've looked at RB wells. I can point out that the two production plots on RB wells I currently have, which are SCB 23 No. 1 and the Brantley No. 1, have been completed in the lower one-fourth of the 100-foot interval. That and other wells that they have shot just a lower interval and still have a high GOR and/or allowable gas problems indicated to us that you can be -- you can be just perforated in the lower zones, the lower one-fourth, and still have your gas problems; that it was not just something that occurred when you were perforated in the upper one-fourth of the zone. We could not develop a trend where you were open.

I could further point out on the cross section, which would be Exhibit 5, I believe Pogo's well is completed in the lower one-third of the zone in their attempt to stay away from the upper one-third of the zone, and yet they still have a GOR problem, a GOR approaching 3000 approximately 30 days after completion.

Q. I don't know if you stated it earlier, but what is the drive mechanism in this pool?

A. In our opinion, there's two different kinds of sand: a gas sand and an oil sand, and the mechanism in the oil sand appears to be solution gas draw.

The idea has been thrown around that there is partial water drive. That theory can be disproved by saying there's no vertical permeability from lower zones bringing water up. There's not -- the horizontal extent of each individual sand is not sufficient to allow water drive.

The other proofs, then, are the production plots of the SCB 23 1 and the Brantley No. 1, showing water rates declining along with oil rates. A water drive would indicate continued increases or static water volumes.

MR. BRUCE: I have nothing further, Mr. Examiner.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Burks, it's my understanding that you cannot isolate the -- or you cannot tell where these individual gas-containing sand stringers are?

A. At times I feel we can pick them out based on the cross-over on the density neutron log. Now, a portion of the cross-over on the density neutron log is due to a clean sand effect seen often in the Delaware. But there are cases in the field and in our wells where we feel like we've got sufficient cross-over. When you plot them on log interpretation charts, they indicate to be gas field sand.

We have investigated the possibility of running surveys to try to find gas entry, but we've discounted using that due to the rates involved here. We've got so much gas and oil and water that the water line companies we've talked to say they would have a hard time pinpointing down to, say, the foot where that gas is coming from just because of the turbulence in that well bore. You would have to flow the well while you're running the log.

Q. Do you show any correlation between the wells that are producing at a higher GOR, and would these wells be producing from gas sands? Have you looked into that? Or are they producing from what you think are gas sands?

A. I feel that the areas of high GORs just have a larger amount of gas sands or a larger frequency of the little individual sand stringers in that given well bore. My cross section A through A' goes from the well highest on structure in the field to one of the lowest wells on structure in the field and shows how discontinuous the sands are, and also the porosities are greater where we tend to have gas problems. And when I say porosities are greater, the cross plot between the density neutron curve.

So we feel that's just indicative that there are more gas sands in that given well bore than there are even up structure in wells that don't have a GOR problem.

Q. If you've in fact got some gas sands, why would the GOR go up in time and why wouldn't this problem have shown up when you first completed the well? Why wouldn't it have had a higher GOR at that time?

A. We feel we did have the problem at that time. When we measured that oil sample, Core Lab came back and said, "You can't put more than a MCF in this oil." But before we have even drawn the reservoir down below bubble point we were seeing GORs higher than the 1000, upwards to 1500.

For example, the Harken well was drilled some months ago, could not have had any offset drainage, therefore should have been at or above -- well above the bubble point. Yet their initial GOR -- Harken well would be in Unit Letter H of 15. Their initial GOR was 11,000. And that would be page -- from page 3 of Exhibit No. 2 -- page 3, Exhibit No. 2, Unit Letter H, Section 15.

So we feel we have had that GOR problem. The increase in GOR is due to the liberation, additional liberation, of gas in the solution gas zones. There's -- I should say, the oil sands, which are solution-gas drive.

The gas sands that we report to see should be having the same gas rate now as they were a year ago -- or about the same, probably a little bit more as we've drawn the pressure of the well bore down.

EXAMINER CATANACH: I believe that's all I have.

Anything further of this witness?

MR. CARR: Nothing further.

EXAMINER CATANACH: The witness may be excused. Let's take a short break here.

(At this time a recess was taken.)

EXAMINER CATANACH: This is continuation of the Bird Creek case, testimony of Bonnie S. Wilson coming up.

BONNIE S. WILSON,

the Witness herein, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Ms. Wilson, for the record, would you please state your name and occupation?

A. Bonnie Wilson. I'm a reservoir engineer for Oryx Energy.

Q. Ms. Wilson, on prior occasions have you testified before the division as a petroleum engineer?

A. Yes, I have.

Q. Pursuant to your employment, have you made a reservoir study of the Delaware wells involved in this particular pool?

A. Yes.

Q. Based upon that study, were you able to come to certain conclusions with regard to the Bird Creek application today?

A. Yes, I have.

Q. And you've heard Mr. Burks' testimony this afternoon and listened through his presentation and reviewed with him his explanations and his exhibits?

A. Yes.

Q. What is your conclusion about the necessity at this time to increase the gas-oil ratio for the pool?

A. At this time, I think it's still too early in the life of the field. The operators are still actively drilling in this field and it's just too early to be changing field rules.

Q. Mr. Burks explains that he is not concerned about the gas-oil ratios that he has seen well to well and from area to area in the pool and believes that we can, without wasting the drive mechanism in the reservoir, increase that gas-oil ratio to 5000 to one.

Do you share that conclusion with him?

A. No. We see varying GORs across this field ranging from 1000 up to 10,000, and this large variance in GOR from well to well is what concerns me. I'm worried that the high GOR wells will deplete reservoir energy and result in waste or a loss of actual recoverable reserves.

Q. Have you made available to you PVT data to examine for wells in the field?

A. Yes.

Q. And you've seen Mr. Burks' PVT data before, have you not?

A. Yes.

Q. What's your conclusion about the PVT data?

A. The PVT data shows that the reservoir was either below bubble point or at bubble point when it was originally discovered and that, yes, a free gas saturation has formed in the reservoir and the reservoir is now below bubble point.

Q. One of Mr. Burks' conclusions was that he felt that there was good horizontal and vertical separation of the various hydrocarbon lenses in the Delaware and that we need not be concerned about forming a gas cap with increasing withdrawals in the reservoir. He said he attributed a significant portion of the gas to gas stringers in the reservoir.

Do you agree with that conclusion?

A. No, I don't. I believe that there are secondary gas cap or caps forming within the reservoir and that originally these zones were all oil productive.

Q. What is your recommendation to the examiner with regard to this application, Ms. Wilson?

A. I would recommend that we would leave the field rules or the GOR allowable set as it is at 2000 to one.

Q. If the allowable, gas allowable, is increased to 5000 to one, in your estimate as an engineer, will it reduce the ultimate recovery for the pool?

A. It will reduce the ultimate recovery by about 12 percent.

Q. 12 percent, and relate that in volume for us.

A. If a well was to make 100,000 barrels of oil, then that well would make 100,000 minus 12,000, or 88,000 barrels of oil if we would change the GOR limit.

Q. As an engineer assigned to examine the reservoir and to formulate an opinion concerning increasing the gas-oil ratio, what were the kinds of things that you wanted to look at and what types of information did you want to assimilate before you could begin your study?

A. The first thing that I looked at was the GOR in the field and then the oil rates that coincided with the GOR. That's Exhibit No. 1, which shows a bubble map of the GORs, and then Exhibit No. 2 shows the production data for each well at that well's location.

Exhibit 2 shows along the top line barrels of oil per day, MCF per day and barrels of water per day and then along the bottom line accumulative oil, gas and water.

MR. KELLAHIN: At this time, Mr. Examiner -- I neglected to do it a while ago -- I'll tender Ms. Wilson as an expert petroleum engineer.

EXAMINER CATANACH: She's so qualified.

Q. (By Mr. Kellahin) When your looking at gas-oil ratios, I assume you've got to start with some data base of information?

A. Yes.

Q. Where did you go to obtain what you considered to be reliable information concerning the production of oil and gas from each of the wells in the pool?

A. I pooled some data from Dwights. Then I came here to the state office a week ago and pulled the data that I could from the state office.

Q. Does your tabulation of information agree with the tabulation of information that Mr. Burks presented in his Exhibit No. 2?

A. No. I haven't examined all the wells. I can't address one well.

Q. Let's take, for example, one specific well and let me find the display here.

All right. I'm going to hand you the Bird Creek

Exhibit No. 2 and you direct us to that portion of the display that has the well in question that you would like to discuss.

A. It's on the second page. It's the Teledyne No. 2.

Q. Just a moment. Let's make sure we all have a copy of that.

A. Since this well produces at high GORs and is close to our property, it is one of the wells that I was most explicitly interested in and that's why I was able to catch the difference in the data.

Q. What does your information tell you about that well?

A. My data shows that the Teledyne No. 2 in the month of August produced at a GOR of 9821. In the month of September it produced at a GOR of 7040. In the month of October it produced at a GOR of 5047, and then that GOR went back up. In the month of November it produced at 9544.

It's these high GORs in wells like this that I'm worried about.

Q. What is your understanding of the status of that well in terms of whether or not it's overproduced in its gas volumes currently?

A. It's currently overproduced.

Q. Let's go back to your GOR bubble map and the data map that is the companion display to it, Exhibits 1 and 2. Tell us what you tabulated on Exhibit 2, first of all, in terms of the information.

A. Exhibit 2 shows the current oil production barrels of oil and -- MCF and barrels of water along the top line and then cumulative oil, gas and water along the bottom line for the individual wells that I was able to find data for in the field.

Q. Taking that information, then, and formulating a display that would give you a visual reference of the various magnitudes of gas-oil ratios per well, did you then prepare Exhibit No. 1?

A. Yes. I prepared Exhibit No. 1 from that data. The bubbles -- this is called a bubble map. The bubbles, the size and the color, represent the relative size of the GOR in the well, and it's a very visual comparison of wells that have 1000 GOR compared to wells that have a 10,000 GOR.

Q. And this is the current status of the reservoir using the current 2000-to-one-gas-oil ratio limitation?

A. Yes.

Q. And even with that limitation, what is occurring in the reservoir?

A. Wells are able to produce at GORs up to 10,000, and you will be able to produce at GORs even higher as their oil rates fall off.

Q. What impact is that going to have to wells immediately adjacent to the high gas-oil ratios?

A. Well, it will deplete the reservoir energy, or it will use up the energy of the other wells next to it.

Another way to look at this is to think of the bubble as the amount of reservoir energy that that well is using per barrel of oil to produce its oil.

Q. Let me direct your attention to what is marked as Exhibit No. 3, Ms. Wilson. Would you identify and describe that display?

A. Exhibit No. 3 contains two of the PVT samples that were gathered in this field. The top sheet is the comparison of those two PVT samples. It shows the Carrasco 14 in October of '89, the sample taken there, and then the Oryx-collected sample from the Pardue taken in September of '90, roughly a year later.

You can see that reservoir pressure has dropped roughly 500 pounds. You can see that the solution GOR has changed from 1108 down to 983. This gas has been produced and it has formed a free-gas saturation in the reservoir. So you can see that the reservoir is definitely below its bubble point.

I would also like to talk a little bit about the

PVT from the Carrasco 14 No. 1. If you turn to the first page following the cover sheet and read the last paragraph, it says:

"We were initially requested to recombine the separator products to a ratio of 1000...per barrel of stock tank oil at 60 degrees F. The physical recombination was performed and the resulting fluid was placed into a high pressure windowed cell and thermally expanded to the reservoir temperature of 106 degrees. This fluid was found to have a bubble point pressure of 3270."

Now, whether or not this was right or wrong or the well was recombined at the correct GOR or not, it does show the sensitivity of a small change in GOR, causing a large change in the bubble point pressure, and that's why I believe it was actually possible for this reservoir to have had a small original gas cap that no one found.

It may not have had an original gas cap. It may have been at its bubble point pressure, but I don't feel that it was above its bubble point pressure.

Q. Mr. Burks and you disagree on that point, then, don't you?

A. Yes.

Q. Turn now to Exhibit No. 4. Having satisfied yourself that there was a concern about the gas withdrawal from the reservoir, did you go about formulating a method to try to quantify the magnitude of the change in the gas-oil ratio?

A. Yes.

Q. How did you analyze that?

A. The first calculation that I made was a material balance calculation, and that's shown in Exhibit No. 4. And basically what this calculation does is it uses PVT data to describe the relationship between the recovery factor and the cumulative GOR of the reservoir, the cumulative producing GOR.

And you can see from the equations that the recovery factor is a function only of your cumulative GOR production. If the reservoir is produced at a high GOR, then you result in lower recovery factors. And then --

Q. The PVT data you selected to use for the material balance calculation is derived from what source?

A. The Carrasco 14 No. 1. Even though it was not at original pressure, it's the closest I had to original pressure.

Q. Having performed that calculation, have you displayed the information in the form of a curve?

A. I have the graphical solution to this material balance equation shown as Exhibit No. 5.

Q. Before we discuss the conclusions you can draw as an engineer, let's make certain that we all can understand your form.

A. Okay.

Q. Identify and explain the format.

A. On the Y axis I have plotted the recovery factor as a function of zero to a hundred percent, and then on the X axis I have plotted the cumulative final GOR that a well would be produced at. This assumes an abandonment pressure of three 350 psi for the reservoir.

Q. If we use the 2000-to-one-gas-oil ratio as the ceiling for the gas withdrawal from the reservoir --

A. Yes.

Q. -- what might we expect to be the maximum range of recovery from the reservoir in terms of a percentage?

A. Somewhere in the 8000 range cumulative GOR.

Q. The recovery factor on the Y axis -- that tells us what?

A. The amount -- the percent of the oil in place that you'll recover. If we have a cumulative producing GOR in this field of 8000, then we'll recover roughly 10 percent of the oil in place.

Q. Mr. Burks was using an estimate of somewhere between 20, perhaps 20 plus, maybe 25, as an expectation of the maximum recovery factor for the Delaware oil pool. If we use that as the maximum, can we relate that into this display in any way?

A. I would have to calculate what the cumulative -- well, this display is just saying we can't get there.

Q. Okay. All right. If we increase the gas-oil ratio now from 2000 to one to 5000 to one, or halfway between the 4000 and 6000 on the X axis --

A. Yes.

Q. -- what happens to the recovery factor in the reservoir?

A. The recovery factor would go down because your cumulative GOR would go up. You'd be up more in the 10,000 range, so your recovery factor is reduced.

Q. Describe for us the magnitudes of change in percentages of recovery.

A. Because of the assumptions used in material balance, I don't have that exact figure. Looking at this, it's roughly ten to 12 percent decrease in your recovery, which matches the more explicit calculations that I've done later.

Q. There is no doubt in your mind as a reservoir engineer that increasing the gas limit to 5000 to one is going to have at least a ten to 12 percent impact on ultimate recovery from the reservoir?

A. There is no doubt it will do that.

Q. Have you attempted to refine the calculation by adding in additional parameters, adding in additional data, to more explicitly demonstrate what would happen in the reservoir?

A. Yes. Material balance assumes a stirred tank model. It doesn't take into account permeability or pressure variances across your reservoir. It doesn't account for structure. It doesn't account for relative permeability. Once you forget saturation forms, your oil flow is limited. It doesn't take any of those things into account, and so to do an accurate measurement of the total deduction we could be seeing I went to a reservoir simulator to do that.

Q. Describe for us the type of simulator you used, Ms. Wilson.

A. I used the VIP Nolan Executive Simulator. It's a --

Q. Well, is it a standard numerical simulator used by reservoir --

A. It's a standard numerical simulator used by the industry.

Implicit. That's what I was trying to say.

Q. Has this been a reliable, accurate tool utilized by you and other reservoir engineers in the industry to model the performance of the reservoir?

A. It's been used by Oryx for ten to 15 years, and yes, it's a reliable tool that we use.

Q. Describe the format -- using Exhibit No. 6, describe what you have modeled there.

A. Exhibit No. 6, that's the model grid that I used. This is a process model so it doesn't encompass the entire field. All it shows is a cross section through the field. It shows four 40-acre locations, and the wells that are in there are shown by the dots. It's a quarter of a mile wide and a mile long, and I used a net thickness of 50 feet and the gross thickness was 100 feet. And I have the model dipping at one degree so that you have an upper well, an upper middle well, a lower middle well and a lower well.

Q. Are these typical of reservoir characteristics seen in the Delaware pool that we're discussing?

A. Yes.

Q. You have got four dots --

A. Yes.

Q. -- in the grid. What does that represent?

A. Those are the four wells that would be located at the center of each 40-acre location.

Q. This assumes 40-acre spacing for those wells and it shows their structural relationship?

A. Yes.

Q. All right. Turn to page 2 and give us the reservoir conditions and properties that you put into the model.

A. I initialized the reservoir at 2852 psia and a temperature of 115 degrees which I obtained from the PVT data, the temperature and the log data.

The porosity I used was 16 percent. The net pay was 50 feet. I used an irreducible water saturation of 17 percent, a residual saturation of 18 percent and a critical gas saturation of two percent, a rock compressibility of four microsips, a permeability of log average of 3.2 millidarcies within the reservoir. We do have a very tight reservoir.

And then the fluid properties for the oil: 2852 psia and a 1.59 information volume factor and an initial solution GOR of 1122, and then there's the water data.

Q. Are any of the fluid properties or reservoir properties you put into the model suspect?

A. No. This is taken from the data that we have in the field.

Q. What do you do then?

A. I turned the model on.

Q. Okay.

A. I built what I thought was a physical representation of the reservoir, and then I predicted what -- the way that the wells would react with different GOR allowables, and the four predictions for the four wells are shown on the next four seats.

Q. Is it necessary for these purposes to run some type of history match or sensitivity to fine-tune your model?

A. With such a short history, it's very difficult to obtain a good history match. I did try to history match the well index, for instance, the productivity of the well. I tried to match that a little bit.

Did I change the porosity or did I change the permeability? No, I didn't. I ran a little bit of sensitivity to see what changes there did, but I didn't make an attempt to -- a long attempt to history match.

I looked at my outputs and said, Does this appear to be what some of the wells are doing? But the wells appeared reasonable compared to the data that I had, and so I predicted.

Q. Of the parameters, then, that are in the model, as you change a component and rerun the model, the component that you're changing is the gas-oil ratio?

A. The limiting gas-oil ratios are in effect the maximum gas rate that a well can produce.

Q. When you did that, what did the model tell you on the lower well?

A. Let me first describe what we're looking at.

In the top left-hand corner I have oil

production for the three different curves. The red curve is for a 1000 GOR allowable. The green curve is for a 2000 GOR allowable, and the blue curve is for a 5000 GOR allowable.

In the lower right-hand corner the same colors apply. That's cumulative oil production. In the upper right-hand corner, I have gas production, and in the lower right-hand corner I have well reservoir pressure.

I would like to talk about the gas production rate first since that is what is controlling what happens in the reservoir.

Q. That's the upper right corner of the display?

A. That's the upper right corner of the display.

Q. All right.

A. The red curve shows that if we limit the GOR allowables to 1000, which is lower than what it's established at now, then we apply that to the 142 barrels of oil a day, and we get a maximum gas rate of 142 that can be produced from a well. And you can see that this well produces at that 142 up to 2006 and then it can no longer produce 142 MCF of gas a day.

You can see if you use a 2000 GOR, then your maximum gas-rate limit would be 284 MCF of gas, and you can see that the green curve limits on 284 up until about 1986, and then that rate falls off.

If you use a 5000 GOR, then your maximum gas rate is 710 MCF of gas per day. Well, this well was never actually able to make 710 MCF of gas per day. It peaked and then the rate began to fall.

Q. What is the basic conclusion from that portion of the display?

A. That shows what the gas production of this well is doing. It shows how the gas is being limited or the maximum gas rates that can be produced with the different allowables.

Q. All right. Next one?

A. The oil production in the top left-hand corner just shows the decreasing oil rate with time. I ran each model run in the shame economic limit, so there is a time differential here. If we had limited the reservoir to the 1000 GOR allowable, you roughly double your life or increase it by at least a third. So that is a large length of time that you increase it.

However, there's not a huge difference between the 2000 and the 5000 GOR cases as to the life of the reservoir. They hit their economic limit at roughly a similar time.

In the lower left-hand corner, which is probably the most significant curve on the graph, I have plotted cumulative oil production. You can see that this well, if you limit the GOR -- the maximum GOR in the reservoir to 1000, would produce about 117,000 barrels of oil.

If we limit the GOR to 2000 in this reservoir, you can see that the well would produce about 104,000 barrels of oil, and if we raise the GOR allowable to 5000 to one, that the production of this well will drop to 95,000 barrels of oil.

Q. For this well, being the lower well in the model, then it's a difference between 95,000 barrels of oil and 104,000?

A. Yes.

Q. And that is the direct result of changing the gas-oil ratio?

A. Yes.

Q. Let's go now to the difference in cumulative oil for the lower middle well, which is the next page, and look at the lower left display again.

What happens for the well in that position in the reservoir?

A. Again, at the 1000 GOR allowable it could produce about 120,000 barrels of oil. Currently my prediction is at the 2000 GOR allowable it will produce about 105,000 barrels of oil and this will drop to 91,000 barrels of oil if we raise the GOR limit to 5000.

Q. Those wells in the lower middle portion of the reservoir, then, they will benefit by keeping the gas-oil ratio lower?

A. Yes, definitely.

Q. It will increase their ultimate oil recovery?

A. Yes.

Q. Let's go to the upper middle well in the simulator and look at the effect on cumulative oil production with the change in gas-oil ratio.

A. Again you see a large difference in the cumulative production that a well will make. This well drops from 127,000 barrels of oil down to 110,000 barrels of oil and then down from that to 83,000 barrels of oil.

Q. A well in this position in the reservoir again also benefits with a smaller gas-oil ratio?

A. Yes, it does.

Q. The upper well, then, in the simulation.

A. The upper well actually decreases very slightly in its cumulative oil production. It drops -- or it actually -- I'm sorry -- increases. I said that backwards.

It increases -- between the 1000 and the 2000 it stays roughly constant at 50,000 barrels of oil recovery, and by raising to the 5000 GOR limit it increases up to about 52,000 barrels of oil.

Q. So there seems to be a small difference for those wells higher in the structure?

A. A well high in the structure would see a very slight benefit from the higher GOR.

Q. And you need to contrast that, then, with wells in the rest of the reservoir in terms of their structural position?

A. Right.

Q. The last display in this package under Exhibit 6 represents what, Ms. Wilson?

A. I've taken up the cumulative oil recovery from the four wells and divided that by the oil in place, and that gives me a recovery factor as a percent of oil in place recovery for each GOR case or each GOR allowable case.

So at a limiting GOR of 1000, my recovery average for those four wells is 10.8 percent of the oil in place. If the GOR allowable is 2000 -- and I've shown beneath that scale the maximum gas rate associated with that -- the maximum gas rate would be held at 284. Then the well -- or the recovery from the field would average 9.6 percent of the oil in the place.

And then if you move to the 5000 case, a maximum gas rate of 710 MCF of gas per day, then your recovery would drop to 8.4 percent of your oil in place.

I think it's important to note that the 8.4 divided by 9.6 is a 12 and a half percent decrease in your recovery. I think it's even more important to note that the 8.4 divided by 10.8, which is your recovery at 1000 GOR, is 22 percent. So we're already today losing reserves even at the current GOR allowable, and by increasing the GOR allowable we only do further damage.

Q. If we're dealing with an oil reservoir that over time demonstrates an increasing gas-oil ratio for the wells in the pool and a corresponding -- let's see -- an increasing gas-oil ratio and a corresponding decrease in oil production, you ought to be able to plot all those things and see if it followed in a particular form or curve on the display of field production?

A. Yes.

Q. Have you attempted to do that for this pool?

A. Yes. I've plotted GOR versus time and GOR versus cumulative oil for the wells.

Q. Let's look at Exhibit No. 7. You plotted gas-oil ratio as a function of time?

A. Yes. This is the life of the well in months, and this is the wells' current producing GOR. And by "current GOR," I mean the reported November GOR to the state.

You can see that some of the older wells, the ones -- there's one that's produced 30 months, and it's producing a 3000 GOR. You have wells that have produced five months and they are producing at 8000, 9000 GOR.

There doesn't seem to be necessarily a correlation between depletion and GOR. It's not a simple correlation.

Q. If you had a simple correlation where over time the gas-oil ratio was increasing, then you wouldn't necessarily have to be too concerned about the gas-oil ratio?

A. If the GOR in all the wells was increasing slightly the same, then I wouldn't be worried.

Q. Without regard to structural position?

A. Without regard to structural position.

Q. You would have an expansion drive or a depletion-drive reservoir that would not be rate sensitive, and regardless of the time component, your recovery is going to be the same regardless of how fast you pull it out?

A. Yes.

Q. Do you see those kind of characteristics displayed in this particular reservoir?

A. No.

Q. In fact, you see something different, don't you?

A. Yes.

Q. Let's go to Exhibit No. 8. Identify and describe that for us.

A. Exhibit No. 8, again, is GOR on the Y axis, and on the X axis, rather than time. Because time can be misleading, I wanted to go to something that was more indicative of the wells' actual reservoir characteristics, I used cumulative oil production.

And again you can see that your high cumulative oil wells 60, 70,000 barrels of oil, have GORs of around 2000, and again I have wells that have produced 10,000 barrels of oil and have GORs of eight and 9000.

Q. What does it tell you?

A. Again, that just because a well has produced a lot of oil, that its GOR may not be going up.

Q. Do you have examples that you have seen in the reservoir that over time with production the gas-oil ratios have either gone up or gone down in terms of some pattern?

A. I have well tests -- consistent well tests for two of our wells. I'll read those to you.

Q. Before you get to that, let me ask you a point.

Let me ask you to look at Bird Creek's Exhibit No. 9.

A. Yes.

Q. Mr. Burks was using this as an illustration by which he was demonstrating that certain wells using this test procedure were not rate sensitive, right?

A. Yes.

Q. What is your assessment of the method by which they have determined that fact utilizing this method?

A. I don't know if the wells were adequately -- what's the term I'm looking for?

Q. Condition stabilized?

A. Conditioned -- yes. I don't know if the wells were actually conditioned ahead of time, but when you take a PVT sample, you condition the well. You watch its GOR until its GOR has stabilized, and then you assume the well is conditioned. With permeability as tight as two millidarcies, I think -- I would be hesitant to believe that 48 hours was was a long enough flow period to stabilize the GOR.

So that is one question I have.

Q. How about 72 hours?

A. I would have -- I don't know the permeability in each individual well. You would have to watch the GOR. You would have to plot the GOR. When the GOR stabilized, then you could feel that the well was conditioned and you were measuring truly what was happening in the reservoir with the test data that you were getting from the well.

Q. When you look at the performance of any of your wells, can you see a relationship to gas withdrawal versus oil recovery?

A. In Oryx's wells?

Q. Yes.

A. I have adequate well tests from two of our wells. One of those wells -- and I'm not sure I can explain this -- actually shows a decreasing GOR with a decreasing rate, and that's probably due to the permeability of the reservoir. I can read the numbers to you.

At a rate of 650 barrels of oil it had produced at a GOR of 2600. At a rate of 474 barrels of oil it produced at a GOR of 2088, and then at the lower rate of 295 barrels of oil per day it produced at a rate of 1967.

So that's roughly a decreasing GOR with a decreasing rate, which would be due to permeability.

Q. Which well is that?

A. That's the Pardue Farms No. 1. Well test data for the Pardue Farms No. -- I'm sorry -- Lewis Estate No. 1 shows basically that the GOR stayed flat, but we had a very small change in rates.

You know, we're talking about rates of roughly around 200, and the GORs weren't changing. So that's sort of inconclusive, but those are the only two data points that I have to determine sensitivity to gas rate.

What's important here is not the fact that there is a sensitivity or isn't a sensitivity to the oil rate. What's important is that you have a 1000 GOR well over here and a 10,000 well GOR over here and you've got highly different amounts of reservoir energy being used by these two wells, and we need to conserve our reservoir energy and control the 10,000 GOR well.

Q. Can we do that if this application is granted?

A. No.

MR. KELLAHIN: That concludes my examination of Ms. Wilson. We move the introduction of her Exhibits 1 through 8.

EXAMINER CATANACH: Exhibits 1 through 8 will be admitted as evidence.

(Whereupon Exhibits 1 through 8 were admitted into evidence.)

EXAMINER CATANACH: Mr. Carr.

CROSS-EXAMINATION

BY MR. CARR:

Q. Ms. Wilson, have you been the engineer involved in the decisions to develop the four wells that Oryx has drilled from in this particular pool?

A. Yes, I have.

Q. And when did you actually start making your study that you've been presenting here today on this particular reservoir and the impact of GORs?

A. I started studying the reservoir and we've been watching GORs in the field since the day the first well was drilled.

Q. And then in preparing this, you said you got certain publicly available information and the information that Oryx had in its own files?

A. Yes. Yes.

Q. Now, your work is obviously based on some geologic interpretation; is that correct?

A. Portions of the work are based on a geologic interpretation.

Q. And will Oryx be calling a geologist to explain his interpretation?

A. Yes, we will.

Q. If we look at the presentations that you've made, you're concerned, if I understand it, about a 10,000 GOR well, as an example, offset by a 1000 GOR well?

A. Yes.

Q. And that the 10,000 GOR well is using a disproportionate amount of the energy?

A. Yes, that's correct.

Q. Is it fair to say that as you see this, there is pressure communication across the reservoir?

A. Yes.

Q. And your viewing this as being a reservoir that isn't segregated into a number of isolated stringers. Your study -- and I'm having to go with this with you because the geology hasn't been presented yet, but you're looking at a different kind of a reservoir than what Mr. Burks talked about?

A. We tracked all of the wells in the reservoir, and whether or not the sand lenses are communicated before fracturing, they are certainly communicated after fracturing. So all the sand lenses are in pressure communication.

Q. And in your part of the reservoir that would be true?

A. Yes.

Q. Is that done by everyone in the reservoir?

A. I'm not sure of the completion practice by everyone.

Q. If I understand your concern, your concern is based on these variances in GORs that occur across the reservoir; is that right?

A. The fact that the high GOR wells are producing high amount of gas energy.

Q. Do you have an explanation for why you have this great variance in gas-oil ratios well by well?

A. I think it's a combination of three factors. One factor is the formation of secondary gas caps.

Another factor is the permeability within the reservoir. There may be areas that have lower permeability. Therefore those wells will produce at higher GORs.

And the third factor is depletion -- whether or not this well was connected to another earlier well by a high permeability stringer so that its location was depleted, whereas another well may not have been as closely connected. I believe they are all in pressure communication, but there is a variance of time here that we're talking about for the different locations to be depleted.

Q. Some of the wells have come in with very high gas-oil ratios initially, correct?

A. Yes.

Q. And when that occurs, have you tried to refine your study to determine whether or not that is because there's been production in that area that would result in formation of secondary gas cap or not?

A. I've looked at that, yes.

Q. In this instance, that would be your opinion, that that is what is one of the factors causing this?

A. It is one, yes.

Q. And do you rule out separate stringers that could be producing higher volumes of gas into the reservoir, whether they are fractured or just individually opening into the well bore?

A. I don't believe that individually there were separate stringers that had gas in them. I believe originally all these were oil stringers.

Q. Do you believe there were a number of stringers in the reservoir?

A. I believe there are several families. The geologist can show you the sand lenses, and I believe in some areas they are communicated and in other areas they aren't. But in --

Q. Sorry. I didn't hear you.

In other areas, did you say, they were not communicated?

A. I believe in some areas that they were. You know, maybe 40 acres away they weren't. But, again, they are in pressure communication. If they are not in communication at one layer -- here they are separated, but you move over here and all of a sudden they are together. So they are in pressure communication.

Q. Somewhere in the reservoir?

A. Somewhere in the reservoir.

Q. And you assume that across wide areas in the reservoir there would be this pressure communication?

A. Yes. I believe the pressure data shows -- you know, you can see wells three locations away when they were drilled with lower pressure. There is pressure communication across the reservoir.

Q. And stringer to stringer, even in areas where they may not be in close proximity to a well bore or a fractured area that's been fractured by an oil company in developing the property to put them in communication?

A. Yes.

Q. When you developed a reservoir simulator, then, in your opinion, you didn't have to consider whether or not there were separate stringers; you treated it all just like one, homogeneous reservoir?

A. I treated it like a homogeneous reservoir.

Q. And we could argue with you on whether or not you -- where you got a 7 percent factor for this and what was interpretation and all of that, but basically when we look at your reservoir simulation, you've got a number of input factors that are reasonable for a reservoir of this type that is a homogeneous product?

A. Yes.

Q. And if it is not, you don't have a simulator that would without better input data than you have here be able to evaluate this reservoir; isn't that fair to say?

A. It's fair to say that to truly totally evaluate the reservoir you would need a full-field simulator that history matched each individual well, and the histories on these wells are so short that that would be impossible at this time.

Q. In the particular wells that you operate in this reservoir, in the Oryx wells, have you seen any change in the gas production in the volumes produced over the four months that some of them have been on?

A. Any change in the volumes?

Q. I'm sorry. I'm sorry. I mean, did you see any change in the gas-oil ratio?

A. Gas-oil ratios -- if -- I don't look at well tests. If I look at the monthly average, yes, gas-oil ratios are climbing. They initially IP at about 1000 GOR and then they climb to 23,000 or to 17,000.

Q. What data are you using to make those calculations that the gas-oil ratio is climbing in your wells? Do you have actual production information on the gas --

A. They take well test data. They allocate the measurement of the least production and they allocate based on what they stated back to the individual wells.

Q. You don't have actual production data on the gas on these wells, do you?

A. Actual --

Q. The wells you operate.

A. -- daily production gas from individual wells, I don't have that data with me.

Q. Do you have that data somewhere?
A. We may.
Q. Have you been actually selling the gas from these wells?
A. Yes.
Q. Do you know what they are producing?
A. Yeah.
Q. You haven't been flaring this gas?
A. There was a period for about two weeks where our compressor was down where we flared the gas for about two weeks, and we're selling gas again.
Q. But you actually made gas sales during that period of time?
A. Yes.
Q. And if we looked at the C-115s, we could find those volumes, I suspect?
A. I would assume operation department filed it correctly.
Q. All right. But you are seeing an increase in the gas-oil ratio, that was the point, and not the rest of it?
A. Yes. Yes. Yes, gas-oil ratio is climbing.
MR. CARR: I think that's all I have.
EXAMINER CATANACH: Just one question, Ms. Wilson.
* * * * *

EXAMINATION

BY MR. CATANACH:

Q. On a temporary basis, say, for about a year or 12-month period of having a 5000 GOR in place, what would the effect be for just a temporary?

A. I think a year is enough to cause the problem in a reservoir. I think a year is too long.

You're going to -- your pressure -- if you look at your pressure curve, your pressure is just falling like a rock, and if you do it for a year, you've damaged your reservoir now.

I would rather wait two or three years down the road and then put in a higher GOR allowable. At that point, after we've already produced the majority of our oil -- once we've produced the majority of our oil out of the reservoir, then you don't hurt your oil production to the degree that we will right now. We're right in the critical stage.

EXAMINER CATANACH: Nothing further. Witness may be excused.

MR. KELLAHIN: I call Mr. Bob Sidlowe at this time.

Mr. Examiner, I think everybody's package of exhibits may have an ownership plat in there. Mr. Burks had one, too, as well, I think.

MS. WILSON: It's Exhibit 13.

MR. KELLAHIN: I don't know how it's marked. There is a display in there. It's the last one on the left there, Mr. Examiner. I'm not going to refer to it. It's there as a point of information. You can see who operates what properties.

My next exhibit number, I believe, is No. 9, which is a structure map on the Bone Springs. If yours is not numbered 9, it needs to be corrected to show No. 9.

THE WITNESS: Top of Bone Springs.

MR. KELLAHIN: Top of Bone Springs. The net pay map is No. 12.

THE WITNESS: Right. The two cross sections are 10 and 11.

MR. KELLAHIN: So this net pay map which you have as No. 11 should be marked as 12.

EXAMINER CATANACH: Okay.

MR. KELLAHIN: We're going to have two cross sections. The B-B' cross section is Exhibit No. 10, and the A-A' is Exhibit No. 11. Okay?

THE WITNESS: Right.

EXAMINER CATANACH: All set.

ROBERT SIDLOWE,

the Witness herein, having been first duly sworn, was examined and testified as follows:

* * * * *

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Sidlowe, on prior occasions have you testified as a petroleum geologist before the division?

A. Yes, I have.

Q. Among your duties was the responsibility for continuing your studies on the Bone Springs reservoir and to map its geology?

A. The Delaware sands spread.

Q. I'm sorry.

A. Yes, I have.

Q. Wherever it is.

As part of that responsibility, have you reduced your interpretations to display, geologic displays of the information?

A. Yes.

Q. And you have prepared a structure map and an isopach map?

A. And two cross sections that will basically show what's going on in the field, I believe, geologically.

Q. I know there's lots of wonderful geologic things that you can tell us. I want to focus your attention on the question of the gas-oil ratio.

Do you have some geologic conclusions and opinions that help provide a geologic explanation to some of the production characteristics we're seeing in the field?

A. Yes, I do. I feel the Brushy Canyon sands in this field are continuous. They can be followed from lease to lease, from north to south, east to west.

Q. All right. Let's --

A. And I can show those in the later -- on the cross sections as we -- as we go on. And we also may have some possible explanations to some of the permeability problems we've been looking at and talking about here as far as GORs go.

MR. KELLAHIN: At this time, I'd tender Mr. Sidlowe as an expert petroleum geologist.

EXAMINER CATANACH: He is so qualified.

Q. (By Mr. Kellahin) Let's take a look at the structure first.

A. I have a structure map here on top of the Bone Spring formation which is the base of the Brushy Canyon formation, which is the pay zone. I also have two cross section lines depicted: A-A', basically a dip section, real similar to what was previously shown.

Q. Let's take a moment and make sure that you don't have a disagreement with Mr. Burks' Exhibit No. 3 which shows his structure on the top of the C zone.

A. Okay. Again, these are mapped on two slightly different horizons.

Q. I understand that, and that's why I want you to take a minute and explain to the examiner what the differences are.

A. Okay. The map that Mr. Burks presented previously is a map on the top of the actual sand, and the interval from the top of the sand to the top of the Bone Spring thickens to the east and also to the south. So you're going to see a slight -- slight differences in that respect.

And also the contour intervals are different between the two maps. Mine is on a 25-foot contour interval, and the one previously shown is on a 10-foot contour interval.

But basically the overall picture is basically the same.

Q. Why have you chosen to map on top of the Bone Springs for your structure?

A. It's a nice, easy correlateable point. Also, the top of the sand is also fairly easily correlateable across the field, but the Bone Springs is a nice, good, clean lime and it's easy to find and good to map, good to map on.

Q. Before we finish the conclusions about the structure, let me have you introduce the isopach map that's

Exhibit No. 12. Identify and describe that one to us.
A. Okay. This is -- this is an isopach map across the field area based on total net porosity of greater than equal to 14 percent on a neutron density cross button.
I'm showing a different geological model here than that what was previously expressed by Mr. Burks, and there's various thicks and thins training in a northeast to southwest direction, but I do agree with his source direction, which was the northwest, and I can get into this in more detail if we need to.
But the various trending, northeast-southeast trend thins and thicks, that you see here are reflective of the decreased porosity in the upper sand, which I'll show you in a cross section, and the discontinuous nature of the bottom sand that I'll show you in a cross section.
Q. So that we have a complete sense of your exhibits, let's go to the B-B' cross section.
A. I'd like to bring up both of these at once if I could. It might make things a little easier.
Q. All right, sir. Let's do that.
A. The colors ought to brighten up your eyes after a full day.
Q. Start with the B-B' cross section.
A. Okay. This is basically a strike section north-south through the field. The very northernmost well

is to the left, known as B, and the southernmost well is B'. The cross section extends through what I feel is the known field boundaries to this point, although field boundaries have yet to be fully determined.

But as you look overall on the general nature of the cross section and the top of the Brushy Canyon pay, the sand section does thicken to the south.

I've also divided the general pay section into four distinct sand members which I think are easily identifiable based on shale breaks, which are good time layers, time markers, good to use geologically to break up individual depositional events.

You could see from the uppermost sand -- this is the sand that ranges anywhere from 30 to 60-foot gross thicknesses -- is continuous across the field. And the next thickest sand member that I have mapped, colored here as blue, is also continuous across the field, and it's easily correlateable.

Q. When we look at the A-A' cross section --

A. Okay. The A-A' cross section is basically a dip section. It runs from the Pogo Nel Fed Comm No. 1, which is an Atoka completion, far to the west and up it. And A' is Amoco Teledyne Gas Comm No. 1, also Atoka completion, so again I've covered the full field boundaries, at least as known to this date.

The same four exact sand members are identifiable east, west, north and south. And you can also see the various thickening of the sands and the sands -- all the sands from from west to east. And, again, the main portion of the sand -- this is the green member, and again you can follow it all the way across.

You also note that the gross perforated sections are marked on the logs, and that for the most part everybody in the field is producing from the same sand members.

There's something I want to bring out here while I can, and I think it's relevant to the case. If you look at the B to B' cross section, the well far to the right, the RB operated Brantley Gas Comm No. 1, this was a discovery well for the field. Okay?

There's a very obvious thickening in the lower yellow sand, the very first deposit that's on top of the Bone Spring, which is what the Brantley Gas Comm was perforated in. On a north-to-south cross section, this to me indicates -- I've seen obvious pinch-out east and west from that well bore, and that to me indicates a more east-west nature of the trends of these sand boxes. And if you have a south to the northwest, I think we're looking at more of offshore-type bar deposits that are overlapping each other. And as the younger they get, the thicker they get, and the more widespread they get.

Q. Let me ask you to make a direct comparison geologically on Exhibit No. 11 -- it's the A-A' cross section -- with the Oryx Energy Pardue Farms No. 1 and the Bird Creek Teledyne No. 2 well. Do you see those?

A. Yes, sir. Well --

Q. In terms of sand continuity between the two wells, what's your correlation?

A. Again, the sand continuity is there. I see a decreased porosity in the Bird Creek Teledyne No. 2, especially in the main body of that upper sand. We're averaging 16 percent in ours versus 10 to 11 percent in the Teledyne well.

Q. If Bird Creek has a gas-oil ratio of 5900 or more to one and the Oryx well is down around 2000 to one --

A. I sure would hate to -- I think they would have a direct influence on our production.

Q. Ms. Wilson says she believes they are in pressure communication geologically. Can you support that conclusion?

A. I can support that, yes.

Q. Mr. Burks says -- he was explaining the gas in the reservoir as being in the small gas lenses, that they were both horizontally and laterally discontinuous. Do you see that?

A. No, I don't. For one thing --
Q. Did you identify gas zones in here?
A. No, I can't.
Q. Why not?
A. For one thing, none of the logs show us gas zones. On a neutron density log you are expected in a good clean sand to see anywhere from six to nine porosity units of cross-over. In a dirtier sand, a less permeable sand, you won't see as good a cross-over as you would in the very clean sand.
I don't see any zones here on a neutron density cross plot that indicate the gas zones.
Q. Would you as a geologist base increasing the gas-oil ratio in the field on this notion that they are separate gas stringers --
A. No.
Q. -- in the Delaware?
A. No. No, I wouldn't, especially based on a MSFL log alone.
Q. In summary, then, Mr. Sidlowe, what are your geologic conclusions with regard to the gas-oil ratio application of Bird Creek?
A. I feel that the sands are continuous across this reservoir. I feel a higher gas allowable will be using up too much energy. I think the obvious -- obvious thing here

from these cross sections shows that all said operator actions will directly affect our property.

And I also believe that the field is too young. The full boundaries have not been adequately established yet to be changing field rules at this time.

Q. Within the reservoir, geologically, do you see the opportunity for gas to migrate vertically to form a secondary gas cap either in the entire Delaware reservoir or within any of these sand components of the Delaware?

A. Sure, I do. What was previously talked about as far as, you know, half-foot thin, less permeable beds that are not mappable I cannot believe are seals across a reservoir. The wells are also frac'ed.

But, as I said previously, I think these things are overlapping offshore bars, and they also could be in communication vertically between well bores.

MR. KELLAHIN: That concludes my examination of Mr. Sidlowe. We move the introduction of his Exhibits 9 through 12.

EXAMINER CATANACH: Exhibits 9 through 12 will be admitted as evidence.

(Whereupon Exhibits 9 through 12 were admitted into evidence.)

Mr. Carr.

* * * * *

CROSS-EXAMINATION

BY MR. CARR:

Q. Mr. Sidlowe, if I understand your testimony, what your cross sections show, for example, the area shaded in green is a sand member that you can correlate across the reservoir?

A. Right.

Q. Is that what that is designed to show?

A. Right.

Q. You really can correlate this not because you can correlate the sand, but you can correlate the shale; isn't that right? That shows you where the sand would be?

A. That's correct.

Q. Now, if we go and just for an example look at on A-A', the Oryx Energy Pardue Farms No. 1 -- if we look at your porosity curve -- and I think that's the curve on the right --

A. Right.

Q. -- and you come down into the green-shaded area, as it pulls to the left, there are areas that appear to be shaded dark. Do you see what I'm talking about in the green band?

A. Yes, sir.

Q. Are those areas of higher porosity?

A. Yes, sir.

Q. And would those be the areas where you would expect to have your producing sands?

A. Yes, sir.

Q. And if you go, then, to, say --

A. Although, actually, that is one sand, I think you've got some variation within that sand, of course. But it's one depositional event.

Q. And those darker areas would be the higher porosity zone?

A. The higher porosity intervals, sure.

Q. And if we move over to the Bird Creek Teledyne No. 2 and we look at that porosity curve, we don't see the corresponding higher porosity areas that have been shaded dark; is that right?

A. Right. You do see it, but it's just not as high a porosity, not the quality.

Q. And some of these porosity zones may not correlate well by well, but the sand member does? Is that what you're saying?

A. Right.

I think the shale markers indicate one depositional event, and especially if you're talking about -- even if you use the previous geologist's opinion of what the depositional model was, that is one depositional event.

MR. CARR: That's all I have.

MR. KELLAHIN: A follow-up question, Mr. Examiner.

RE-DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Do you see a geologic pattern in terms of the reservoir thickening or thinning or reservoir quality to explain the high gas-oil ratio wells?

A. I think there is a possibility of looking at the logs here and the overall thinning and thickening of the general sand bodies from north, south, east and west. We're looking at a stratigraphic trap overall with some structural influence, of course.

But yeah, I think if you look at the isopach and refer to Exhibit 12 again, generally the higher GOR wells are mapped within a zone that has either one or two of the sand bodies missing and also decreased porosity in the main body of the sand, which is colored in green. This may be -- indicate decreased permeability and higher permeability to gas.

I don't have all the answers, but I think if the sands pinch out to the north and pinch out to the west, they can also individually fluctuate in permeability within the sand members. And that's what I think we're looking at here as far as GORs is concerned.

Q. Geologically, do you see how to accommodate Bird

Creek's desire to increase the gas-oil ratio without having a corresponding adverse effect on the other wells?

A. No, I don't.

MR. KELLAHIN: No further questions.

EXAMINER CATANACH: Are there any other questions of this witness?

He may be excused.

MR. KELLAHIN: Let me see if I have one more question.

(Discussion off the record.)

MR. KELLAHIN: Mr. Examiner, I'd like to call Mr. Mike Reeves for a few brief comments.

JAMES MICHAEL REEVES,

the Witness herein, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Reeves, would you please state your name and occupation?

A. James Michael Reeves, district operations manager for Parker and Parsley Petroleum Company.

Q. Where do you reside, sir?

A. Midland, Texas.

Q. And what is your professional background? Do you hold a degree?

A. I hold a degree in petroleum engineering from

Texas A&M University.

Q. You need to speak up a little bit so we can hear you. You speak too softly.

A. All right.

Q. What year, Mike, did you get your degree?

A. 1980.

Q. And what is your current function with Parker and Parsley?

A. I'm manager.

Q. What wells does Parker and Parsley currently operate in the pool?

A. They currently operate the -- most of the southern operated wells with the higher GORs, the Pardue Farms, specifically the Pardue Farms 26 No. 3, the 27 No. 4, 27 No. 6 and the 27 No. 7.

Q. When we look at Ms. Wilson's display, Exhibit No. 1, down in Section 27, some of those big purple bubbles, those are you?

A. Yeah, the purple bubbles and the yellow one in Section 26.

Q. All right, sir. Well, if the gas-oil ratio is to be increased in the reservoir, you might be a beneficiary of that, wouldn't you?

A. I wanted to comment on the reason that I feel that our GORs are higher in our -- those wells, and that is that each one of those wells has been completed in the Bone Springs, and the major production from the Bone Springs from those wells, while recompleting in the Brushy Canyon, was gas.

The top of the Bone Spring production or topmost perforations in the Bone Springs completions were ten to 15 feet from the bottom perforation in the Brushy Canyon. There's a good possibility that there is some type of communication between the Brushy Canyon and the Bone Springs gas production; therefore, a rise in the GOR.

I think if you look back on the Bone Springs production, you'll find the GORs have not changed between the Bone Springs production and the subsequent Brushy Canyon production.

Q. What's your company's position concerning increasing the gas-oil ratio for the Delaware pool?

A. I really have no position on it right now. I just came to try to be aware of the facts and contribute anything that could possibly help anybody in --

Q. But your concern is that we need to be very skeptical of relying upon your wells in the southern part of the pool as indicative of --

A. A high GOR.

Q. -- high GORs because you may have in fact been comingled with the Bone Springs?

A. That's correct. And as a matter of fact, the 27 4 is down-hole comingled with the Bone Springs.

MR. KELLAHIN: That concludes my examination of Mr. Reeves. I have no further questions.

EXAMINER CATANACH: Any cross, Mr. Carr?

MR. CARR: No, no questions.

EXAMINER CATANACH: I have no questions. The witness may be excused.

MR. KELLAHIN: That concludes my presentation, Mr. Examiner.

EXAMINER CATANACH: Would you like to make closing statements, brief closing statements, gentlemen?

MR. BRUCE: Sure, and the last shall be first.

EXAMINER CATANACH: Do you want to go first, Mr. Bruce?

MR. BRUCE: Yes.

If I could, I attached a letter from Pogo Producing Company to my prehearing statement, and I would just like to submit that, and that states Pogo's position.

As to R.C. Bennett and R.C. Bennett Company, they are opposed to the increase in GOR. I think it's been shown that they could be adversely affected by the increase in GOR due to the production from the offsetting Bird Creek wells. We are afraid that if the reservoir -- if the GOR is increased, the reservoir pressure and reservoir energy may be depleted to the harm of all parties.

As to R.C. Operating Company and Ramco, they are not especially in favor of the rules, and I'll leave it at that. I think if any rules are instituted, they really should be short, to the order of three to six months, like was done in the Stevens Operating case on the -- I forget which pool it was. But they are afraid of adversely affecting the reservoir by allowing a too long test period.

Thank you.

EXAMINER CATANACH: Okay. Mr. Pearce.

MR. PEARCE: Mr. Examiner, Flare Oil is one of the little guys in the vicinity of this pool. We're not even in the pool. We've gathered evidence in the record today that ultimate oil recovery may be threatened, and that the full extent of the pool may not yet be known.

Flare Oil is very concerned that waste will occur on its tract if this GOR is raised. We are persuaded by Ms. Wilson's study and Mr. Sidlowe's geology, and we are going to request that the application be denied.

EXAMINER CATANACH: Thank you. Mr. Kellahin.

MR. KELLAHIN: I don't think there is any question, reservation or concern you should have about denying this application in the outright, Mr. Examiner. This is one you can't tinker with. It's too early in the life of the ~~reservoir to start fussing with the gas-oil ratio.~~

I think Ms. Wilson spoke eloquently to her concerns about, even on a temporary nature, increasing the gas-oil ratio is going to have a direct detrimental effect on ultimate recovery. She mapped for you very carefully the fact that at 2000 to one we are not appropriately utilizing the gas reservoir energy in the reservoir and would be better at 1000 to one. But we're stuck with the statewide rule and we ought to leave it alone until later in the life the reservoir when a substantial majority of the wells in the pool are up against the gas-oil ratio limitation.

The fact that Bird Creek has got wells that are bumping up against the gas limitation does not have a detrimental effect on them because -- Mr. Burks said in response to Mr. Bruce's question, he said, "It will simply take us a little longer to get our share of the oil." He's not going to lose oil reserves if you increase the gas-oil ratio. You'd better leave it alone. If we increase it, we're going to risk and jeopardize the gas recovery in the reservoir.

There is simply no question that these well bores from well to well are in communication with each other. The only basis for justification is this hypothecated, convoluted notion that you can both vertically and horizontally separate out this reservoir into these neat little gas lenses. I'll defy you to take those little teeny gas stringers and put back in the humongous amount of gas that's getting produced out of this reservoir. It ain't coming from that place, and you don't need to be an engineer to figure that out.

What they are doing is pulling the reservoir too hard. We're forming a secondary gas cap. It's something we ought not to do. In order to protect waste and protect the correlative rights of all parties, we need to keep it right where it is, and it's absolutely premature and to be in here and solve this problem.

I'm concerned that the operators in the pool, certain of them, continue to produce in excess for some period of time the 2000 to one ceiling. We've got Mr. Burks telling us they are cutting back on their wells to get back in compliance with the current rules. His very own exhibit demonstrates the opposite result that he intended. The two key wells in this reservoir are in a high structural position, the Teledyne No. 2 -- you saw it on the display. It just jumps right out at you.

He wants to tell you it's not there, but the structural relationship is significant. The offsetting parties to that Teledyne No. 2 well are going to be adversely affected if you increase the gas-oil ratio. It's going to be a temporary fix to them and a permanent loss to us. We request that you deny the application.

MR. CARR: May it please the examiner, Bird Creek is before you seeking an increase in the gas-oil ratio in the East Loving-Delaware Pool. We're asking for an increase similar to what Yates received in the Avalon-Delaware Pool a month or two ago and was approved by division order R-6368-B.

In that case they got 5000 to one, and they came in and they showed you that there were separate gas stringers that were causing the high gas-oil ratio. We submit to you that today we have come before you and we have met our burden of proof. We have shown you there is no reservoir damage, that waste is not going to be caused and the correlative rights will not be impaired. But Oryx is opposes it.

And Oryx comes in here, and while Mr. Kellahin stands there and talks about hypothetical reservoir interpretation, I submit to you that the way Oryx has decided to fight this is to create a reservoir for purposes of modeling and developing their testimony which does not match the evidence that we have on this reservoir.

And when you look at the characteristics of this particular pool, you will see that the modeling doesn't match, that what we show about increased rates and higher gas-oil ratios that Ms. Wilson presents is very interesting from an academic point of view, but what she has given you is a homogeneous reservoir, treated it as such, modeled as such and given you a nice little textbook case. The problem is, it doesn't match the geology of the East Loving-Delaware Pool.

Look at their exhibit. Mr. Sidlowe comes in and he says, "Yes, I can correlate the shales, but I leave a big sand body. I can look at the porosity curve on the log on the Oryx Energy Pardue Farms No. 1, and I can see where the gas stringers are. They are the areas shaded dark where the porosity is higher."

Yes, he can correlate the body, but you can look at this and you can see you cannot correlate the porosity zones, the gas stringers within the overall sand bodies, and they don't correlate well to well. We've never argued that or asserted that these zones were communicated because of drilling activity. The question is: Where is the gas coming from? And we submit to you that when you take a look at their geology and compare it to ours, you will see that what we presented with logs that have substantially higher resolution than theirs, that what we have are a number of stringers and we have those stringers separated by shale zones, dolomitic intervals that will not permit vertical migration unless Ms. Wilson does it by fracturing when they complete the well.

We have come forward and we have shown you there will not be reservoir damage. Our rate sensitivity information shows that.

Now, Oryx may wonder, did we have a stable GOR before we ran the test? The problem is, they had a chance to ask and they didn't, and the record before you shows that we have rate sensitivity tests that show you can increase this -- the production rate and not damage the reservoir. We have presented the geology which matches what is actually happening in the reservoir. We've given you oil fluid analyses to show that the oil in this reservoir, when you break it out and analyze it, can't produce the amount of gas that is coming out of these wells.

And when you put all of this together, it is clear that Bird Creek has met its burden and that the only thing you can do on this record is grant the application for an increased gas-oil ratio and do just what this division did for Yates in the Avalon-Delaware Pool.

EXAMINER CATANACH: Is there anything further in this case?

If not, Case 10226 will be taken under advisement, and this hearing is adjourned.

(The foregoing hearing was concluded at the approximate hour of 5:45 p.m.)

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

REPORTER'S CERTIFICATE

I, PAULA WEGEFORTH, a Certified Court Reporter and Notary Public, DO HEREBY CERTIFY that I stenographically reported these proceedings before the Oil Conservation Division; and that the foregoing is a true, complete and accurate transcript of the proceedings of said hearing as appears from my stenographic notes so taken and transcribed under my personal supervision.

I FURTHER CERTIFY that I am not related to nor employed by any of the parties hereto, and have no interest in the outcome hereof.

DATED at Santa Fe, New Mexico, this 20th day of March, 1991.

Paula Wegeforth
PAULA WEGEFORTH
Certified Court Reporter
CSR No. 264, Notary Public

My Commission Expires:
September 27, 1993

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10226 heard by me on February 21 1991.

David R. Catanach, Examiner
Oil Conservation Division