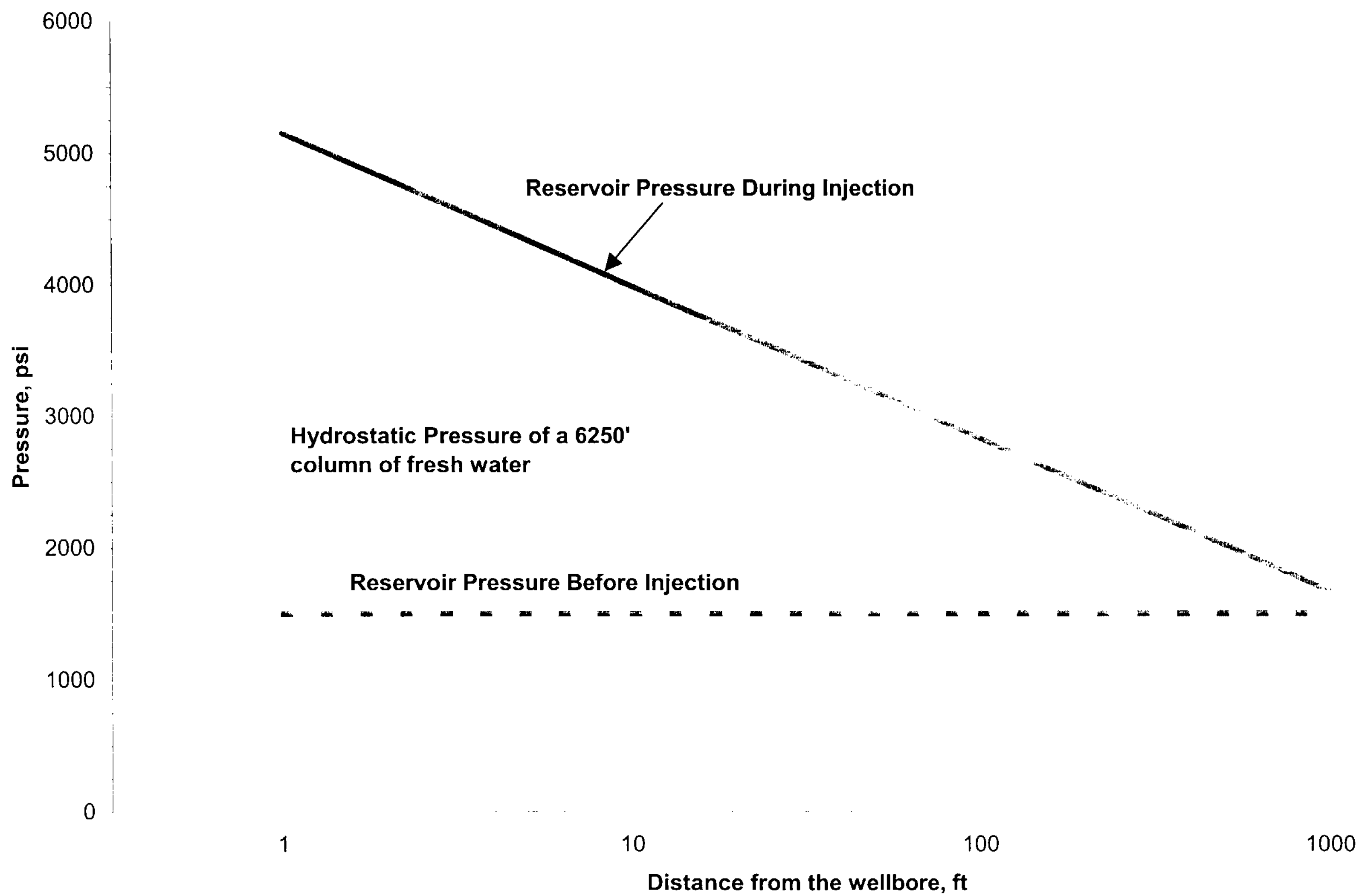
Pressure Profile in Government AB-9 AOR Area



CALCULATIONS

Assumptions						Shown on Graph
Injection Rate, BPD	**192**	**192**	**192**	**192**	**192**	
Viscosity, cps	1	1	1	1	1	
Permeability, md	0.5	0.5	0.5	0.5	0.5	
Net Pay Thickness, ft.	107.2	107.2	107.2	107.2	107.2	
Injection Time, days	365	365	365	365	365	
Porosity	0.18	0.18	0.18	0.18	0.18	
Compressibility	7.50E-06	7.50E-06	7.50E-06	7.50E-06	7.50E-06	
Distance from wellbore, ft.	**1**	**10**	**100**	**1000**	**1867**	
Reservoir Pressure, psi	1500	1500	1500	1500	1500	X
Calculations						
Fresh Water Hydrostatic Pressure @ 6250 feet, psi	2706	2706	2706	2706	2706	X
Delta P due to injection, psi.	3651	2489	1327	165	0	
Pore Pressure during injection, psi.	5151	3989	2827	1665	1500	X

Notes:
Column 1 is used to calculate the maximum injection rate associated with a maximum surface injection pressure permitted by the NMOCD

Maximum injection pressure at the perfs on the Government AB-9 is 5151 psi. Adjusting for reservoir pressure, Delta P = 5151 -1500 = 3651 psi.

OXY

JAN 2 4 2000

OIL CONSERVATION DIVISION

OXY USA Inc.
5 Greenway Plaza, Suite 2400
P.O. Box 27570, Houston, TX 77227-7570

January 20, 2000

Mr. Mark Ashley, Hearing Examiner
New Mexico Oil Conservation Division
P. O. Box 6429
Santa Fe, NM 87505

Re: **Case 12265, Application of OXY USA Inc. for Salt Water Disposal, Government AB Lease, Well No. 9, Old Millman Ranch (Bone Springs) Associated Pool, Eddy County, NM.**

Dear Mark:

Per your request I have investigated Oklahoma's approach to "Area of Review" calculations and the Matthews & Russell pressure buildup equations contained in a technical report obtained from the Texas Railroad Commission. The attached graph illustrates the results of my calculations, and shows the pore pressure increases resulting from injection rates that correspond to maximum surface injection pressures to be negligible in the vicinity of the two problem wells. Consequently, it does not appear that our proposed injection into the Government AB-9 well will create conditions necessary for behind-pipe flow into other formations at the two problem well locations. This analysis is conservative not only because of the assumptions used in the calculations, but also because production is occurring from the same interval. This ongoing depletion will cause the actual pore pressure less than the values resulting from the Matthews & Russell equation. Following is a discussion of the method I used to apply this analysis to our proposed injection into the Government AB-9 well.

The Matthews & Russell equation for pressure buildup resulting from a constant injection rate is the same equation used by Oklahoma in their "Radius of Endangerment" calculations for injection well applications, so my analysis of our situation mirrors Oklahoma's approach. Prior to using a particular equation for a given situation, I like to examine the underlying assumptions of such calculations to get a handle of the quality of the results. The critical assumptions are detailed in the technical report from the Texas Railroad Commission. Among other things, the equation assumes that the reservoir is already filled with a fluid of small compressibility when injection begins. When the first barrel is injected, the pressure effects are then transmitted immediately throughout the reservoir. That will not be the case when we start injecting into the Government AB #9 wellbore because production has depleted the drainage area of this well and allowed the pore space to become partially filled with gas, a highly compressible fluid. When the injected fluid fills up this gas saturated pore space (i.e., fillup is achieved), then this assumption will be more valid. Until then, higher injection rates and/or lower surface pressures are to be expected.

Oklahoma uses these calculations to identify the appropriate size of the AOR (Area of Review) for UIC applications on injection or disposal wells. Their analysis begins with reservoir parameters and results in the pressures caused by injection. For this analysis, I started with a maximum surface injection pressure at the Government AB-9 injection well and used the Matthews & Russell equation to determine the corresponding injection rate. Using this rate, I then calculated the pressure increases in the reservoir at certain distances from the injection well. This allows us to compare the effects of injection into the AB-9 with the hydrostatic pressure of a column of water at the same depth at the same horizontal distance as our problem wells to determine if conditions are such that flow behind pipe might occur in the problem wells. The pressure resulting from column of fresh water is a good assumption for the "static" condition that exists behind the long string pipe in the two problem wells

(Government S-2 & Government AB-2). The results of my calculations are depicted on the attached graph and spreadsheets.

As mentioned above, reducing the radius to near-wellbore in the Matthews & Russell equation allows us to calculate an injection rate associated with such pressure. I estimated that a normal maximum injection pressure for our AB-9 well would be 0.2 psi/ft X depth, or 1260 psi. The hydrostatic pressure of a column of injection fluid is .494 psi/ft X 6378 feet (top perf in the Government AB-9), or 3151 psi. To cover all the bases, let us assume that the maximum injection pressure on the AB-9 is increased to 2000 psi due to step-rate testing. So the total injection pressure at the Bone Spring perfs in the AB-9 will be 2000 psi + 3151 psi, or 5151 psi. This near-wellbore pressure equates to an injection rate of 192 BPD after one year. At 1867 feet from the wellbore (the distance to the nearest problem well), the pore pressure increase from this low-rate injection is negligible, so flow behind the long string pipe on either the Government S-2 or the Government AB-2 wellbores is not likely.

For completeness I have included a diskette with the EXCEL spreadsheet used to generate the plot. I am also attaching a sheet entitled "Variables" to further explain the values used in the equation. Regarding your other request for more specifics about our proposal, I elected to use Exhibit #11 from the hearing to expand on the details. Behind that is a proposed form that we can use to record and report our observations. Thank you for your time and consideration of our request, and if I can provide any additional information please let me know.

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

Sincerely,

Rick

Richard E. Foppiano, P.E.
Senior Advisor - Regulatory Affairs

REF:ref

CC: Gary Womack, Joe Gibson, David Stewart (OXY, Midland) & Tom Kellahin

Variables

Injection Rate:	Self-explanatory.
Viscosity:	The value of 1 cps is used because the injection fluid is water.
Permeability:	As stated in the hearing, this is a very tight reservoir. Permeability is a very important number in these calculations, so I reviewed the technical data offered by OXY and CHI Energy in the NMOCD Examiner hearing held on 3/2/95 (Case # 10556, Order No. R-5353-M-1) as well as internal reservoir data. Based on this, I feel that the average permeability is somewhere between 0.5 md to 1.0 md., and probably closer to the lower number in the area of the Government AB9 because of the lower porosity in that area of the reservoir. As the permeability value decreases, the slope of the pressure profile line becomes steeper.
Net Pay Thickness:	Exhibits 2 and 3 from the recent hearing revealed that the product of porosity and new feet of pay (Phi-H) for the Government AB-9 well was 19.3. The assumptions for porosity and net pay thickness in these calculations honor that testimony.
Compressibility:	This is the total compressibility constant for water, 7.5 X 10-6
Distance from wellbore:	Self-explanatory.
Injection fluid Specific Gravity:	Taken from water analysis data in the C-108 filed for the Government AB-9, exhibit 5.
Current Reservoir Pressure:	In the aforementioned NMOCD hearing on this field on 3/2/95, it was testified that the original reservoir pressure in this solution gas-drive reservoir was 2345 psi. To date, this reservoir has produced 1,147,279 BO and 25,534,873 CFG. The oil wells in this field are all on pump and many have declined in productivity and are not far from being commercially depleted. Therefore, I used an optimistic assumption of current reservoir pressure of 1500 psi.
Delta P:	This is the pressure (in psi) resulting from the Matthews & Russell calculation and is the pressure increase in the formation created by the injection at specified distances from the injection well.
Pore Pressure during injection:	This is the calculated pressure (in psi) that exists in the reservoir as a result of injection. It is equal to the existing reservoir pressure plus the delta P.

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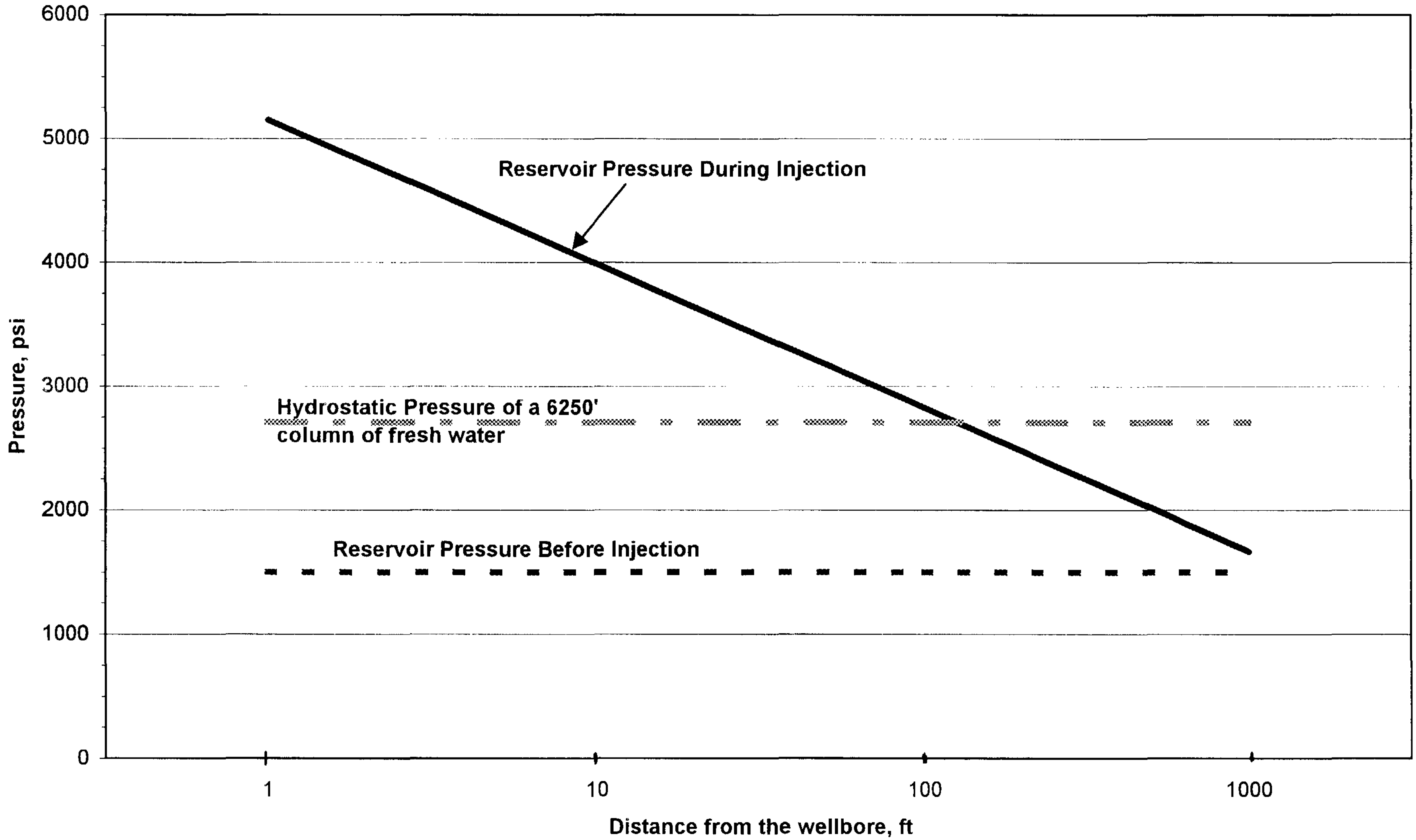

OXY PROPOSAL

Cease disposal into the Bone Springs pool in the Government AB-9 well when any of the following occurs:

1. Water breakthrough in any offset Bone Springs producer located within ½ mile of the well (Government AB-7, AB-8, S-3 or S-7); or

[Production volumes (oil, water gas) on these wells will be monitored by running well tests each month and gauging the tanks frequently at the AB battery and the S battery. The monthly well test data will be reported at the same time as the pressure monitoring data. When water volumes from the well test data on the AB-7, AB-8, S-3 or S-7 wells show +100 BWPD, indicating water breakthrough, injection into the AB-9 will be immediately stopped.]

2. Detection of a significant pressure increase between intermediate and production casings on the Government S-2 or the Government AB-2.

[Install 0-1000# pressure gauges before injection commences, to get baseline readings. Observe and record injection (tubing) and casing/casing annulus pressure once a week. Observe and record injection pressures and injection rate on Government AB-9 once a week. By the 15th of the month following the month in which the pressures are recorded, report all observations to the NMOCD District Office in Artesia. When the casing/casing annulus pressure has increased by at least 250# above baseline on the S-2 or the AB-2, immediately cease all injection into the AB-9.

When injection has been stopped due to any of the above conditions, OXY shall notify the NMOCD District Office in writing.]

AOR Monitoring Report

Old Millman Ranch (Bone Springs) Associated Pool
Eddy County, New Mexico
Re: Order No. ______________

Well Tests:

Well Name & Number	Test Date	Oil, BPD	Water, BPD*	Gas, MCFPD
Government AB 7				
Government AB 8				
Government S 3				
Government S 7				

Note: Government AB 9 injection well must be shut-in if this value exceeds 100

Pressure Readings:

Well Name & Number	Date Readings Taken	Pressure between 5 1/2" and Intermediate Casing**
Government S 2		
Government AB 2		

****Note: Government AB 9 injection well must be shut-in if this value exceeds 250# above baseline***

Injection Well Status:

	Date Readings Taken	Tubing Pressure, psi	Injection Rate, BPD
Government AB 9			

I hereby certify that the above information is true and correct to the best of my knowledge and belief.

____
Signature

____
Printed Name

____
Title

____
Date & Telephone Number

Send to NMOCD District Office in Artesia before the 15th of the following month. Copy to Rick Foppiano in Houston.