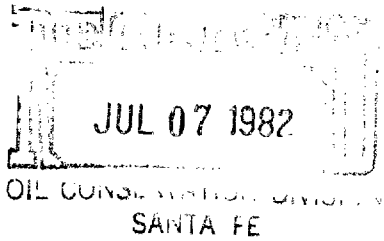
ARCO Oil and Gas Company
[illegible] District
[illegible] Box 16[illegible]
[illegible] Texas 7978[illegible]
[illegible] 915 684 [illegible]



July 1, 1982

Mr. M. Stogner
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Mr. Stogner:

ARCO Oil and Gas Company
Case No. 5762; Order No. R-5295
State Vacuum Unit - Waterflood Project
T17S, R34E, Lea County, New Mexico

Attached please find a copy of our proposal to increase the injection pressure on our State Vacuum Unit waterflood. Per your phone conversation with our secretary today, we understood that you never did receive the original sent May 4, 1982. Since production from the subject unit is decreasing more rapidly than anticipated, we would appreciate your most prompt consideration of this request.

Very truly yours,

J. A. Fraga

Juan A. Fraga
Engineer

JAF/MJB:dmm
Attachments

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0100

MAY 10 1982
CONSERVATION DIVISION
SANTA FE

May 4, 1982

Oil Conservation Division of the
New Mexico Dept. of Energy and Minerals
P. O. Box 2088
Santa Fe, New Mexico

Attention Mr. Ramey

Dear Mr. Ramey:

RE: Case No. 5762; Order No. R-5295
ARCO Oil and Gas Company
State Vacuum Unit - Waterflood Project
T17S, R34E, Lea County, New Mexico

Dear Mr. Ramey:

In the Order dated October 12, 1976, establishing the waterflood project, wellhead injection pressure was limited to 860 psi. Approval of a higher wellhead pressure could be obtained by showing that the increase in pressure would not fracture the confining strata. On April 14, 1980, evidence was offered to show that a wellhead injection pressure of 1422 psi would not fracture the formation. This proposal was approved administratively and the current limitation is 1422. As operator of the unit, ARCO Oil and Gas Company applies for administrative approval of a wellhead injection pressure of 1550 psi. The attached exhibits are offered as evidence that this pressure will not fracture the confining strata.

The exhibits are based on parting pressure tests run on April 19-26, 1982. Exhibit No. 1 is a map of the unit area showing the five injection wells which were tested. Four of the five wells were tested last time and provide reference for comparison purposes. The tests on these five wells indicate a range of surface parting pressures from 1600 to 2198 psi as shown in Exhibit No. 2. The necessary equipment and well data is included on Exhibit No. 3

The paper "Step-Rate Tests Determine Safe Injection Pressures in Floods"[1] was used as a reference to help determine proper testing procedures and analysis methods. The tests were run by Atlantic Richfield Company using a downhole pressure recorder, surface pressure recorder and a Halliburton turbine flowmeter. Individual well data and results are shown in Exhibits 4 through 8.

Some injection wells exhibit non-D'Arcy flow characteristics which prevents determination of the parting pressure by the normal rate vs. pressure graphical technique. Two of the wells tested exhibited this behavior. By using the technique outlined in the reference paper

Called Hobbs office 6-2-82 Fracture pressure raised up because of flood, problems in area [illegible] in [illegible] - thinks this application is ok.

($q = D'q^2$) parting pressures were determined for the two wells and are included as Exhibits 5A and 8A. Exhibits 9 and 10 are graphical solutions of the Williams and Hazen formula for determining the pressure drop due to friction in the injection tubing. Data for the individual wells is listed on Exhibit 2.

Some of the wells tested do not contain enough data points for a well-defined line after the formation parts. This is due to the limitation of the surface equipment during the tests. The wellheads have a 2000 psi working pressure limitation and this limited the injection rate during the test.

We feel that an increased wellhead injection pressure is necessary if we are to maintain adequate injection rates to promote the timely production of the secondary reserves in the unit. Our application for administrative approval of a wellhead injection pressure of 1550 psi should insure that we are not fracturing the formation strata but also allow us to increase our current injection rates. We will gladly forward any additional information which may be required and ask for your prompt consideration.

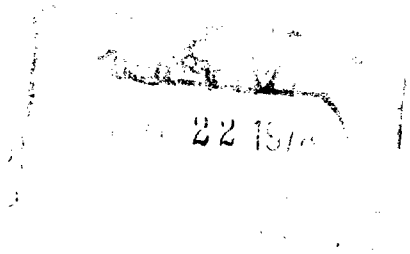
Very truly yours,

J. L. Tweed
District Engineer

JAF:JLT:cn

Attachments

AtlanticRichfieldCompany
North American Producing Division
Permian District
Post Office Box 1610
Midland, Texas 79701
Telephone 915 682 8631



May 19, 1978

Oil Conservation Division of the
New Mexico Department of
Energy and Minerals
P. O. Box 2088
Santa Fe, New Mexico

File

Attn: Mr. Ramey

Re: Case No. 5762; Order No. R-5295
Atlantic Richfield Company
State Vacuum Unit
Waterflood Project
T-17S, R-34E, Lea County, New Mexico

Dear Mr. Ramey:

In the Order establishing the waterflood project, wellhead injection pressure was limited to 860 psi. Approval of a higher wellhead pressure could be obtained by showing that the increase in pressure would not fracture the confining strata. As operator of the State Vacuum Unit, Atlantic Richfield Company applies for administrative approval of a wellhead injection pressure of 1134 psi. The attached exhibits are offered as evidence that this pressure will not fracture the confining strata.

The exhibits are based on pressure parting tests run on April 24-26, 1978. Exhibit 1 is a map of the unit area showing the seven injection wells which were tested. Insufficient pump capacity on Well No. 9 prevented the use of data from the test. The remaining six wells indicated a range of surface parting pressures from 1234 psi to 2101 psi as shown on Exhibit 2. Necessary equipment and well data is included on Exhibit 3.

The paper "Step-Rate Tests Determine Safe Injection Pressures in Floods" (Exhibit 10) was used as a reference to help determine proper testing procedures and analysis methods. The tests were run by Atlantic Richfield Company using a downhole pressure recorder and a Hallibruton turbine flowmeter. Individual well data and results are shown in Exhibits 4 through 9.

Some injection wells exhibit non-D'Arcy flow characteristics which prevents determination of the parting pressure by the normal rate vs. pressure graphical technique. Two of the wells

tested exhibited this behavior. By using the technique outlined in the reference paper ($q + Dq^2$) parting pressures were determined for the two wells and are included as Exhibits 4A and 5A. Exhibit 11 is a graphical solution of the Williams and Hazen formula for determining the pressure drop due to friction in the injection tubing. Data for the individual wells is listed on Exhibit 2.

At the current limiting pressure of 860 psi, injection rates in the unit have begun to decline. We feel that an increased wellhead injection pressure is necessary if we are to maintain adequate injection rates to promote the timely production of the secondary reserves in the unit. Our application for administrative approval of a wellhead injection pressure of 1134 psi should insure that we are not fracturing the formation strata but also allow us to increase our current injection rates. We will gladly forward any additional information which may be required and ask for your prompt consideration.

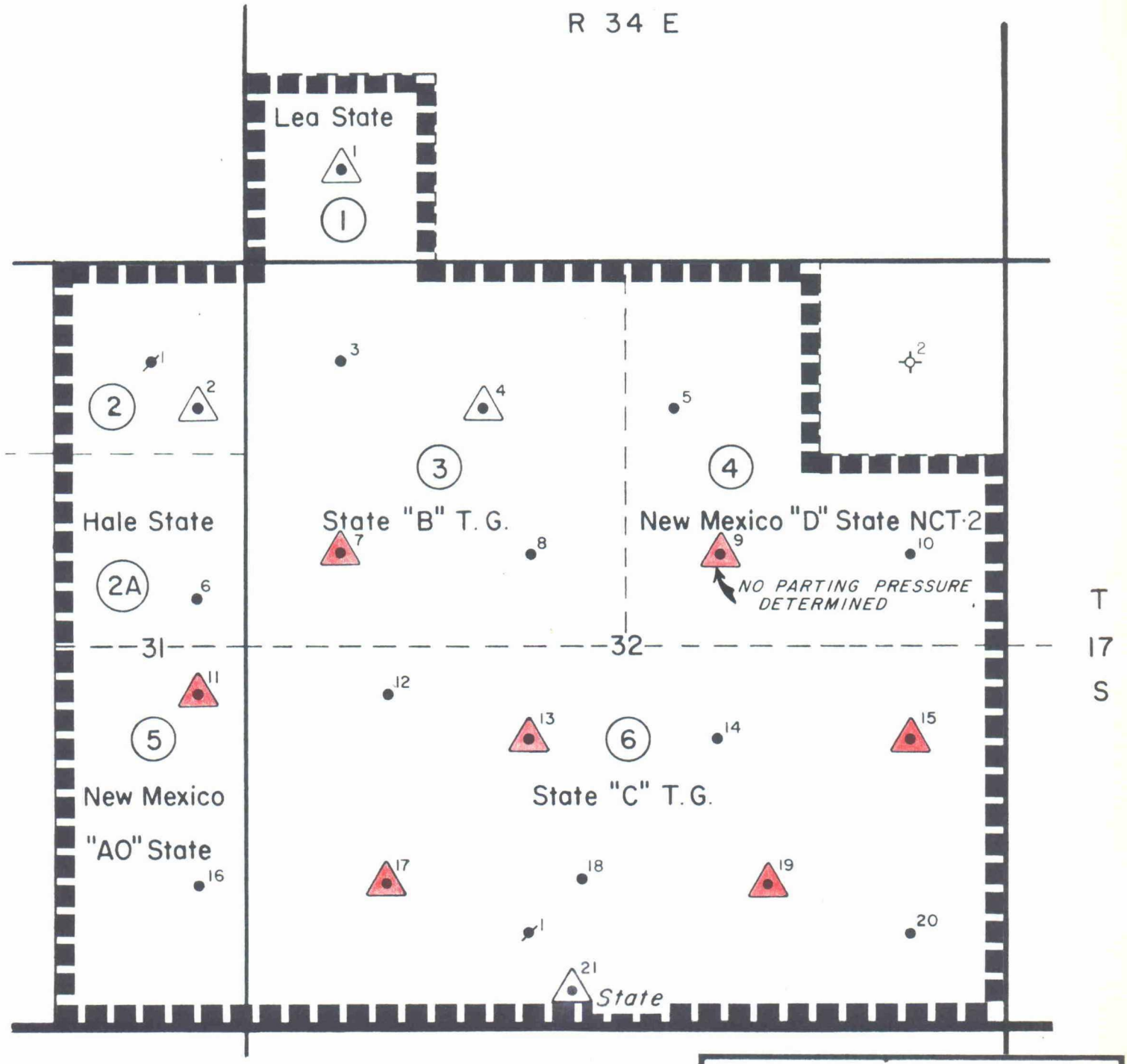
Very truly yours,

J. L. Tweed

J. L. Tweed

MG/agp

EXHIBIT I



UNIT BOUNDARY

(1) TRACT NUMBER

INJECTOR

PRODUCER

INJECTOR – TESTED

Atlantic Richfield Company

North American Producing Division
Permian District, Midland, Texas

STATE VACUUM UNIT
LEA COUNTY, NEW MEXICO

FORMATION
PARTING TESTS
INJECTION WELLS

Scale: 1"=1000'

MIKE GRIFFIN	J.L.	4-22-76
WEST AREA ENGR.		5-78

EXHIBIT 2

STATE VACUUM UNIT
PRESSURE PARTING TESTS

WELL NO.	CUM.INJ. 3/1/80 (MB)	PRESS.BOMB SETTING DEPTH (FT)	HYDRO-STATIC HEAD[1] (PSI)	INJ.RATE@ PTG.PRES. (BPD)	PRESS.DROP FRICTION[2] ΔP_f (PSI/100 FT)	ΔP_f TOTAL @ SETTING DEPTH(psi)	BTM HOLE PTG.PRES. (psi)	SURF.PTG.[3] PRESSURE (psi)	PTG.GRAD-IENT (psi/ft)
4	8.4	4609	1995.7	1000	1.63	75.1	Mn 3865	1944.4	.838
7	385.9	4574	1980.5	2800	6.0	274.4	Mn 3278	1571.9	.717
13	99.3	4685	2028.5	1900	2.95	138.2	Mn 3975	2084.7	.848
15	643.0	4661	2018.2	3800	10.5	489.4	Mn 3770	2241.2	.809
17	32.6	4741	2052.8	1145	1.15	54.5	3580	1581.7	.755

1. Injection water has specific gravity equal to 1.001; pressure gradient = .433 psi/ft.
2. Taken from Exhibit 10 (Williams and Hazen formula).
3. Surface parting pressure = bottom hole parting pressure - hydrostatic head + ΔP_f

EXHIBIT 3

STATE VACUUM UNIT
PRESSURE PARTING TESTS
INJECTION WELL DATA

WELL NO.	COMPLETION CASING SIZE (DEPTH)	TUBING SIZE* IN.	DEPTH SET	PERFORATIONS
4	3½" liner (3440-4700)	2-3/8" 2-1/16"	1153' 4550'	4594-4624'
7	3½" liner (4426-4728)	2-3/8"	4426'	4671-4718'
13	3½" liner (4241-4717)	2-3/8"	4241'	4660-4710'
15	3½" liner (4249-4708)	2-3/8"	4249'	4636-4686'
17	3½" liner (4416-4750)	2-3/8"	4416'	4692-4742'

* All tubing is internally plastic coated.

Exhibit 4

STEP RATE TEST REPORT

LEASE: State Vacuum Unit

DATE OF TEST 4-26-82

WELL NUMBER: 4

ELEMENT: 36391

COUNTY: Lea

TEST DEPTH: 4609

TIME/ ~~AM~~ PM	APPROXIMATE RATE (BPD)	BHP @ TEST DEPTH (PSI)	SURFACE PRESSURE (PSI)
12:12	0	2823	833
12:32	350	3300	1050
12:49	650	3458	1458
1:04	1000	3878	1820
1:19	1200	4072	2030
1:34	1450	4174	2270

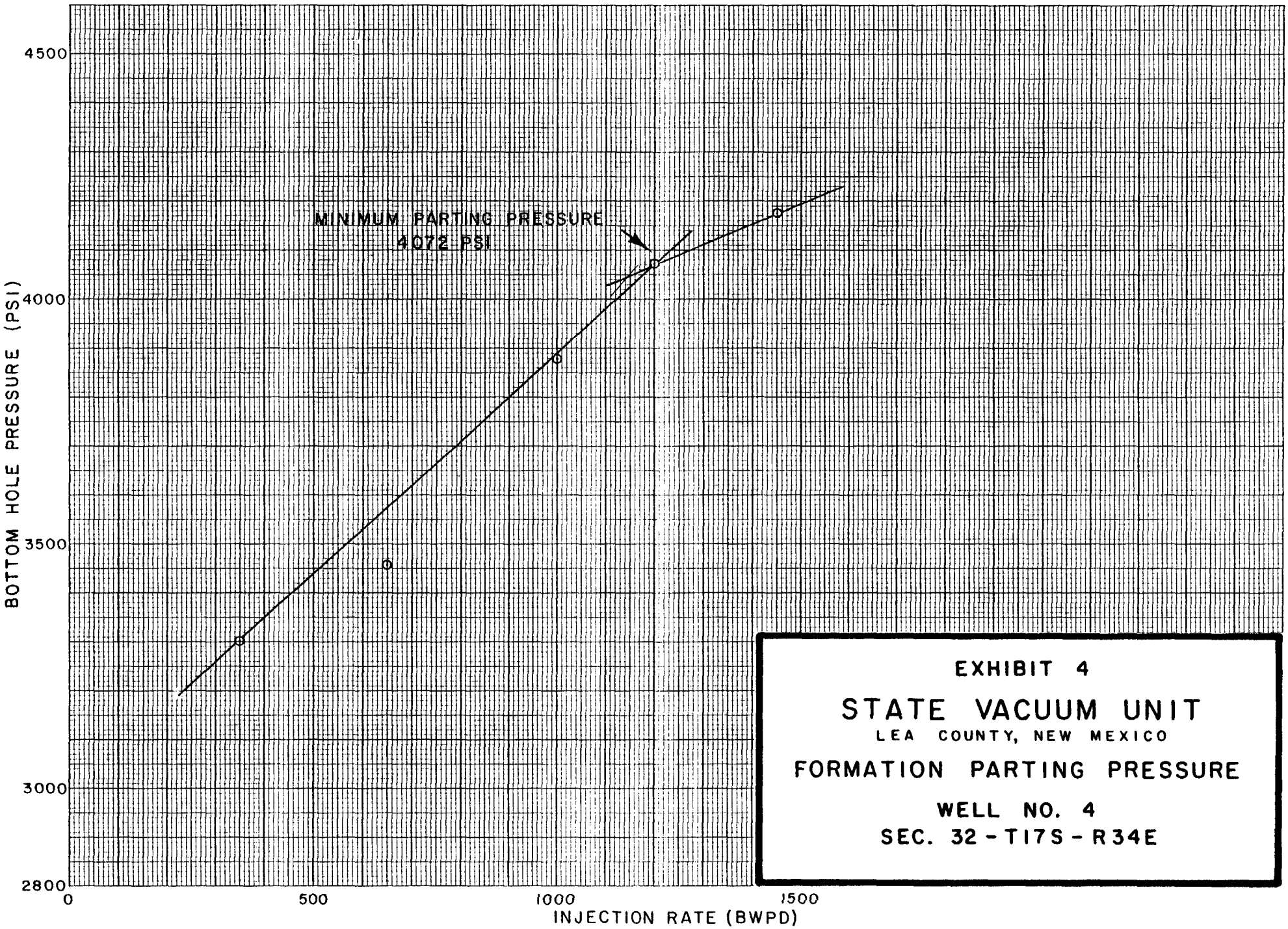


EXHIBIT 4

STATE VACUUM UNIT

LEA COUNTY, NEW MEXICO

FORMATION PARTING PRESSURE

WELL NO. 4

SEC. 32 - T17S - R34E

EXHIBIT 5

STEP RATE TEST REPORT

LEASE: State Vacuum

DATE OF TEST 3-17-80

WELL NUMBER: 7

ELEMENT: 5505

COUNTY: Lea

TEST DEPTH: 4574

AM TIME/PM	APPROX. RATE (BPD)	BHP @ TEST DEPTH (PSI)	SURFACE PRESSURE (PSI)
10:42	0	1839	Vacuum
12:16	400	1978	Vacuum
12:33	700	2079	130
12:48	1000	2191	280
1:03	1200	2299	390
1:20	1400	2392	500
1:34	1600	2507	620
1:49	1800	2600	730
2:05	2000	2692	850
2:20	2175	2836	1015
2:36	2450	2790	1240
2:51	2600	3107	1390
3:05	2800	3277	1650
3:20	3000	3397	1830

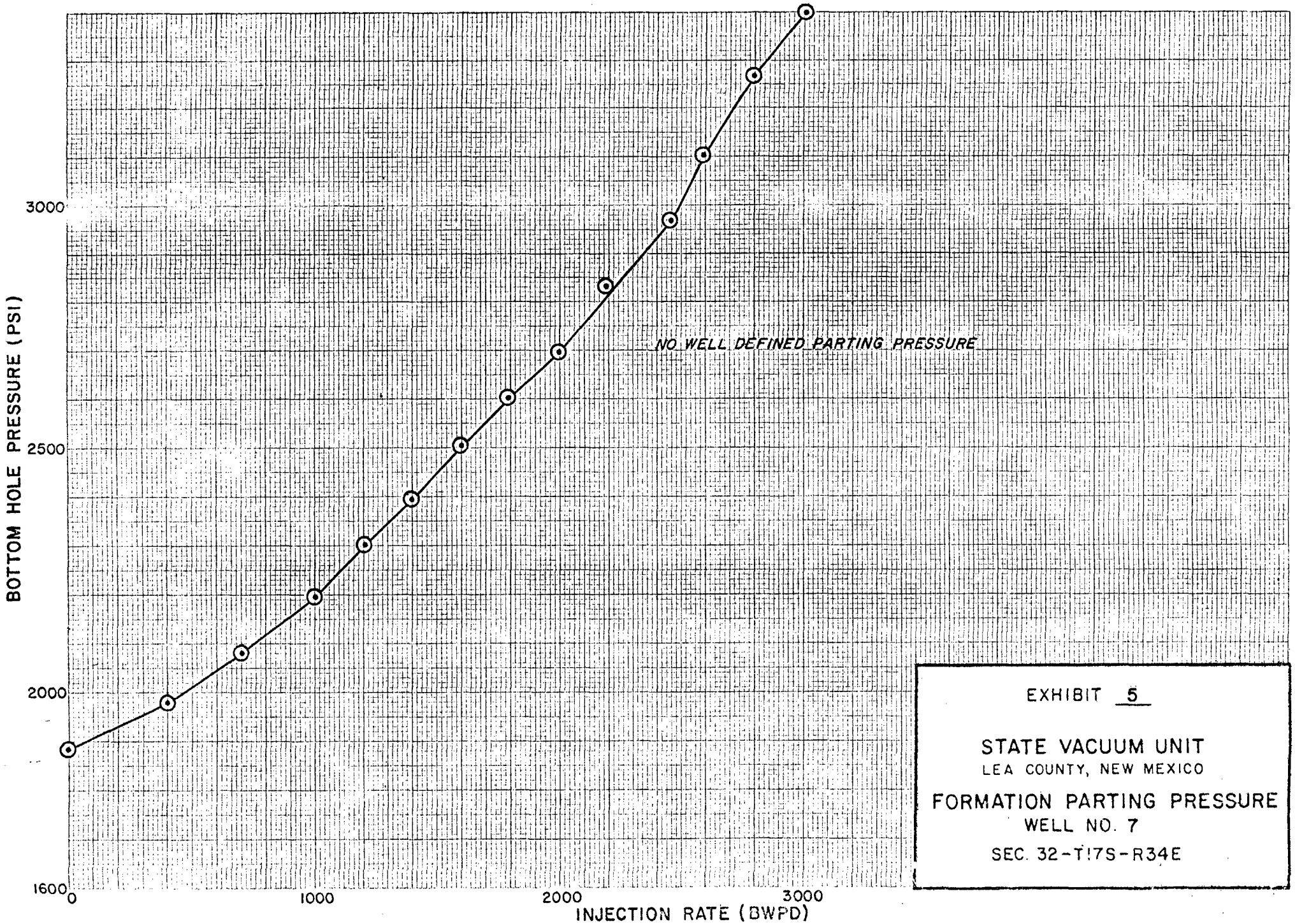

BOTTOM HOLE PRESSURE (PSI)
3000
2500
2000
1600
0
1000
2000
3000
INJECTION RATE (BWPD)
NO WELL DEFINED PARTING PRESSURE
EXHIBIT 5
STATE VACUUM UNIT
LEA COUNTY, NEW MEXICO
FORMATION PARTING PRESSURE
WELL NO. 7
SEC. 32-T17S-R34E

EXHIBIT 5A

STATE VACUUM UNIT
FORMANTION PARTING PRESSURE
NON D'ARFY FLOW TECHNIQUE
WELL NO. 7

From Exhibit 9:

$$D' = (q_2 \Delta P_1 - q_1 \Delta P_2) / (q_1^2 \Delta P_2 - q_2^2 \Delta P_1)$$

Substituting: $q_1 = 400$ BPD $P_1 = 1978$ $\Delta P_1 = 88$

$q_2 = 700$ BPD $P_2 = 2079$ $\Delta P_2 = 189$

Injection Rate BPD	$D'=.00109$ B/D^{-1} BHP @ TEST DEPTH (psi)	$q + D'q^2$ (BPD)
0	1839	
400	1978	573
700	2079	1233
1000	2191	2087
1200	2299	2765
1400	2392	3530
1600	2507	4383
1800	2600	5322
2000	2692	6348
2175	2836	7331
2450	2790	8974
2600	3107	9948
2800	3277	11321
3000	3397	12783

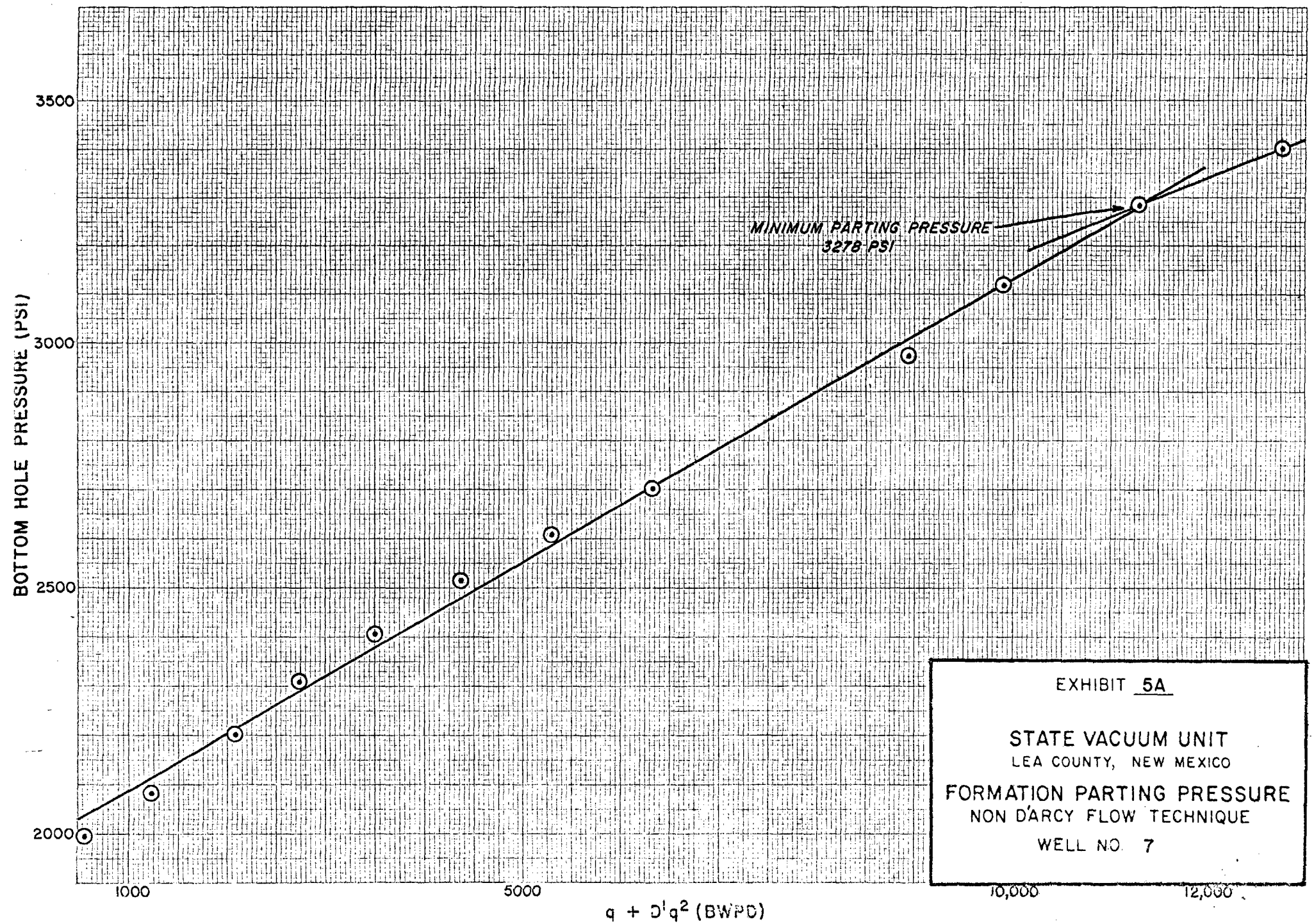


EXHIBIT 5A

STATE VACUUM UNIT
LEA COUNTY, NEW MEXICO

FORMATION PARTING PRESSURE
NON D'ARCY FLOW TECHNIQUE

WELL NO. 7

EXHIBIT 6

STEP RATE TEST REPORT

LEASE: State Vacuum

DATE OF TEST 3-11-80

WELL NUMBER: 13

ELEMENT: 7287

COUNTY: Lea

TEST DEPTH: 4685

AM TIME/PM	APPROX. RATE (BPD)	BHP @ TEST DEPTH (PSI)	SURFACE PRESSURE (PSI)
10:56	0	1844	Vacuum
11:22	400	2555	280
11:42	600	2788	640
12:03PM	800	2995	960
12:23	1000	3305	1300
12:44	1200	3618	1650
1:05	1400	3971	2160
1:21	1700	4198	2280

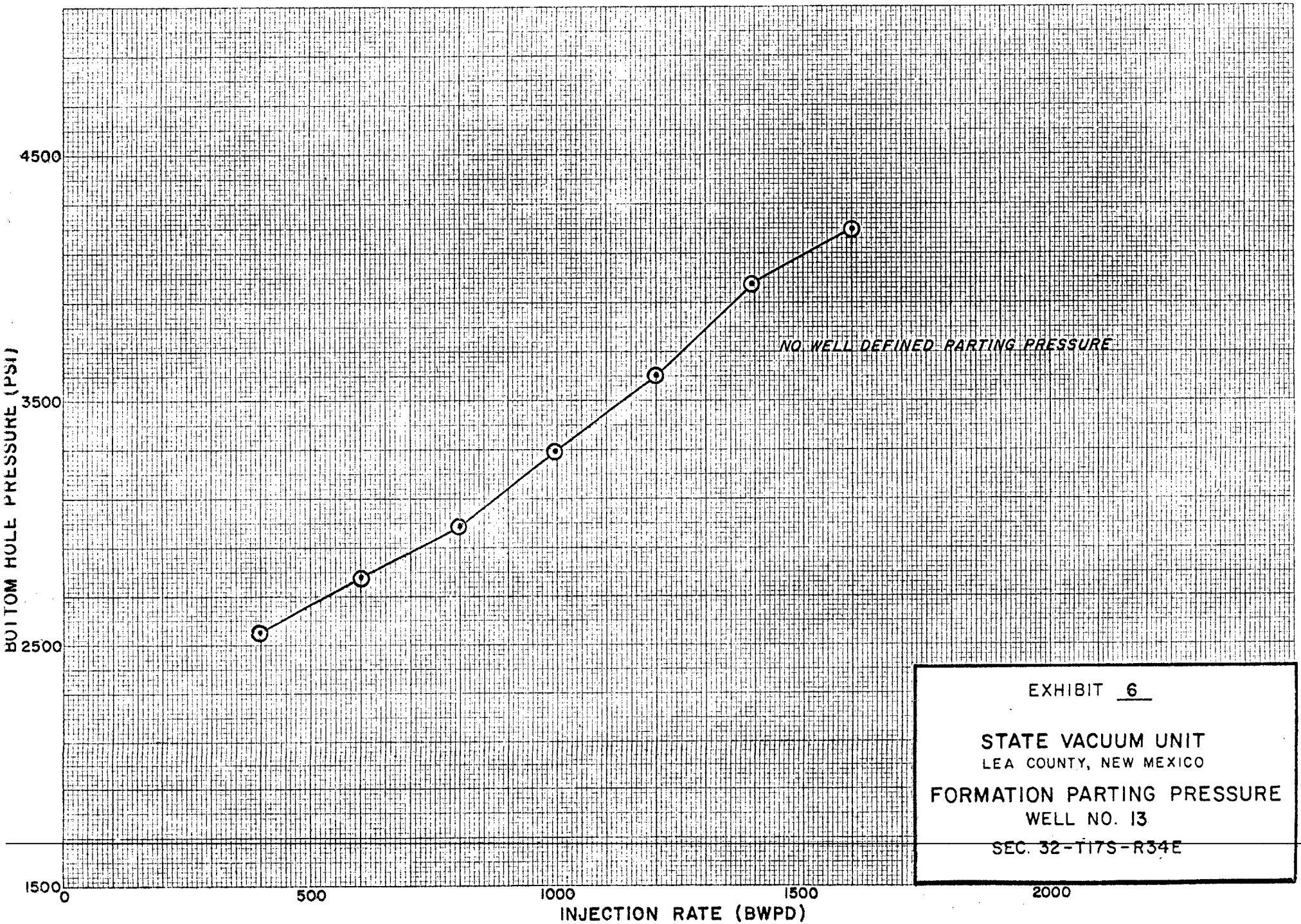


EXHIBIT 6

STATE VACUUM UNIT
LEA COUNTY, NEW MEXICO
FORMATION PARTING PRESSURE
WELL NO. 13
SEC. 32-T17S-R34E

EXHIBIT 6A

STATE VACUUM UNIT
FORMATION PARTING PRESSURE
NON D'ARCY FLOW TECHNIQUE
WELL NO. 13

From Exhibit 9 :

$$D' = (q_2\Delta P_1 - q_1\Delta P_2)/ (q_1^2\Delta P_2 - q_2^2 \Delta P_1)$$

Substituting: $q_1 = 600$ $P_1 = 2788$ $\Delta P_1 = 528$
$q_2 = 800$ $P_2 = 2995$ $\Delta P_2 = 735$
$D' = .00254$

Injection Rate (BPD)	BHP @ TEST DEPTH (PSI)	$q+D'q^2$ (BPD)
0	1844	
400	2555	441
600	2788	691
800	2995	962
1000	3305	1254
1200	3618	1566
1400	3971	1898
1700	4198	2434

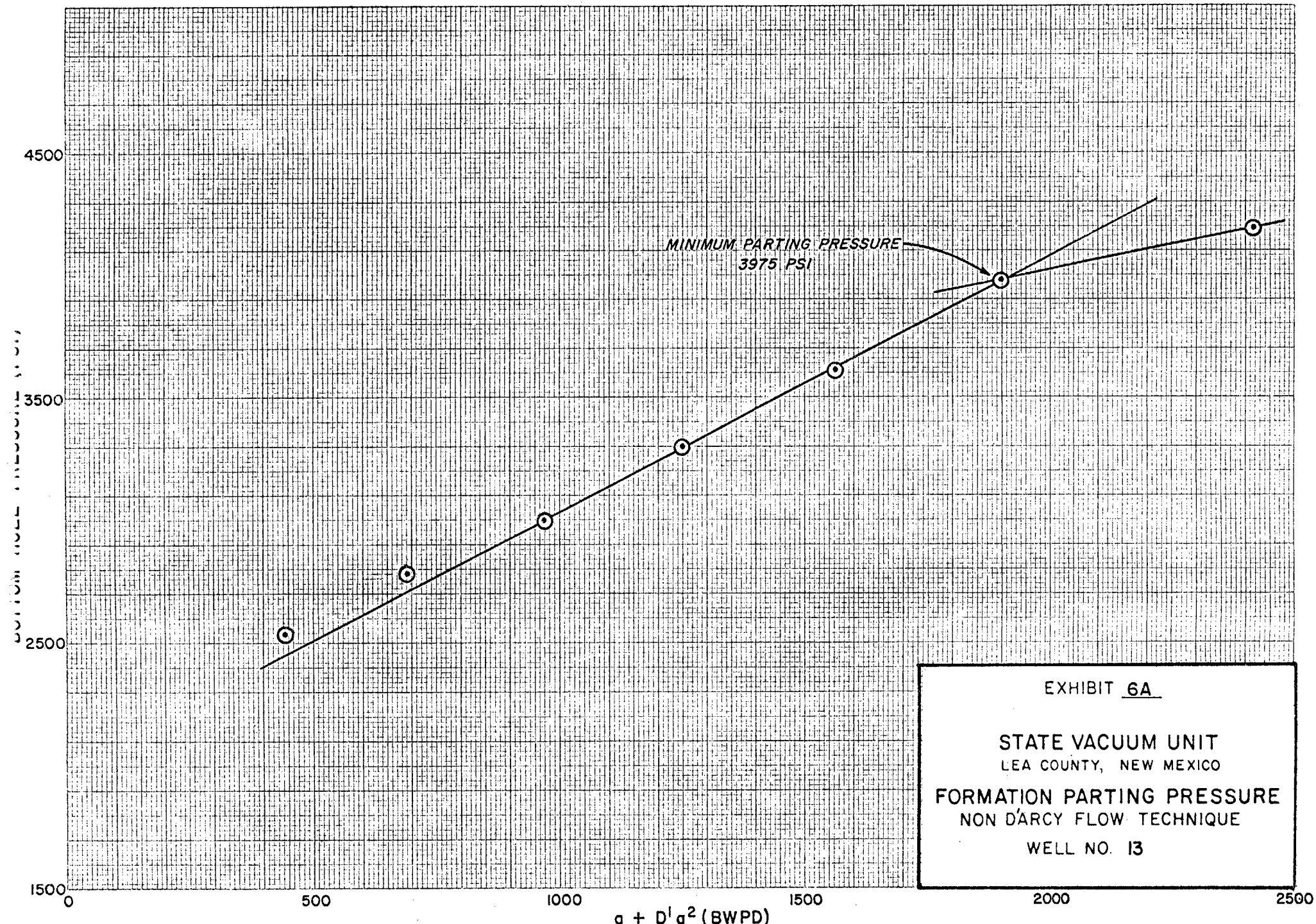


EXHIBIT 6A

STATE VACUUM UNIT
LEA COUNTY, NEW MEXICO

FORMATION PARTING PRESSURE
NON D'ARCY FLOW TECHNIQUE

WELL NO. 13

EXHIBIT 7

STEP RATE TEST REPORT

LEASE: State Vacuum

DATE OF TEST 3-10-80

WELL NUMBER: 15

ELEMENT: 5505

COUNTY: Lea

TEST DEPTH: 4661

AM TIME/PM	APPROX. RATE (BPD)	BHP @ TEST DEPTH (PSI)	SURFACE PRESSURE (PSI)
10:55	0	1727	Vacuum
1:25 PM	600	2155	150
1:41	1000	2312	340
2:02	1475	2508	560
2:23	1800	2687	775
2:42	2250	2919	1080
3:02	2600	3129	1340
3:22	3000	3359	1650
3:42	3350	3540	1900
4:01	3600	3645	2010
4:15	3800	3776	2225

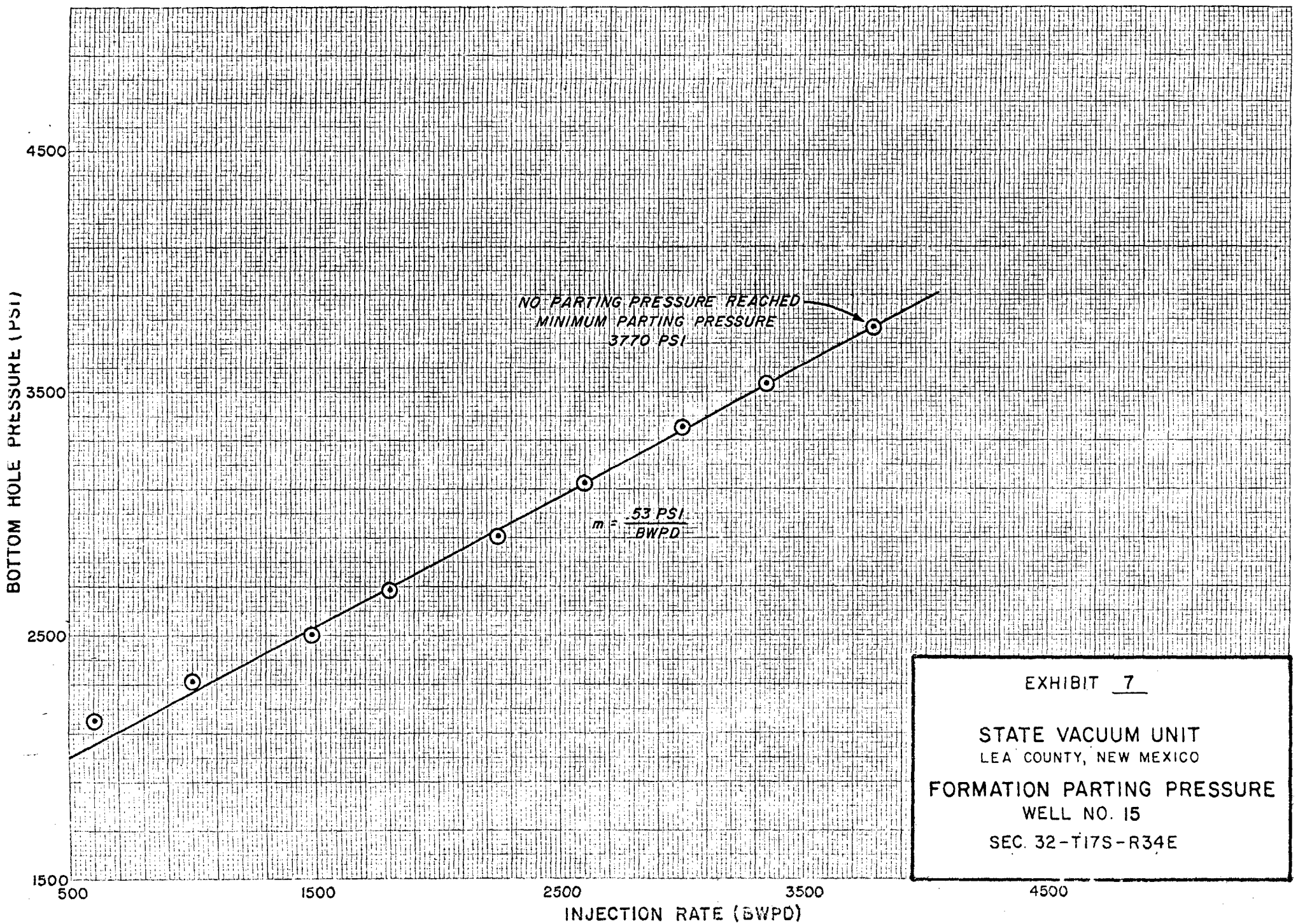


EXHIBIT 7

STATE VACUUM UNIT
LEA COUNTY, NEW MEXICO

FORMATION PARTING PRESSURE
WELL NO. 15
SEC. 32-T17S-R34E

EXHIBIT 8

STEP RATE TEST REPORT

LEASE: State Vacuum

DATE OF TEST 3-4-80

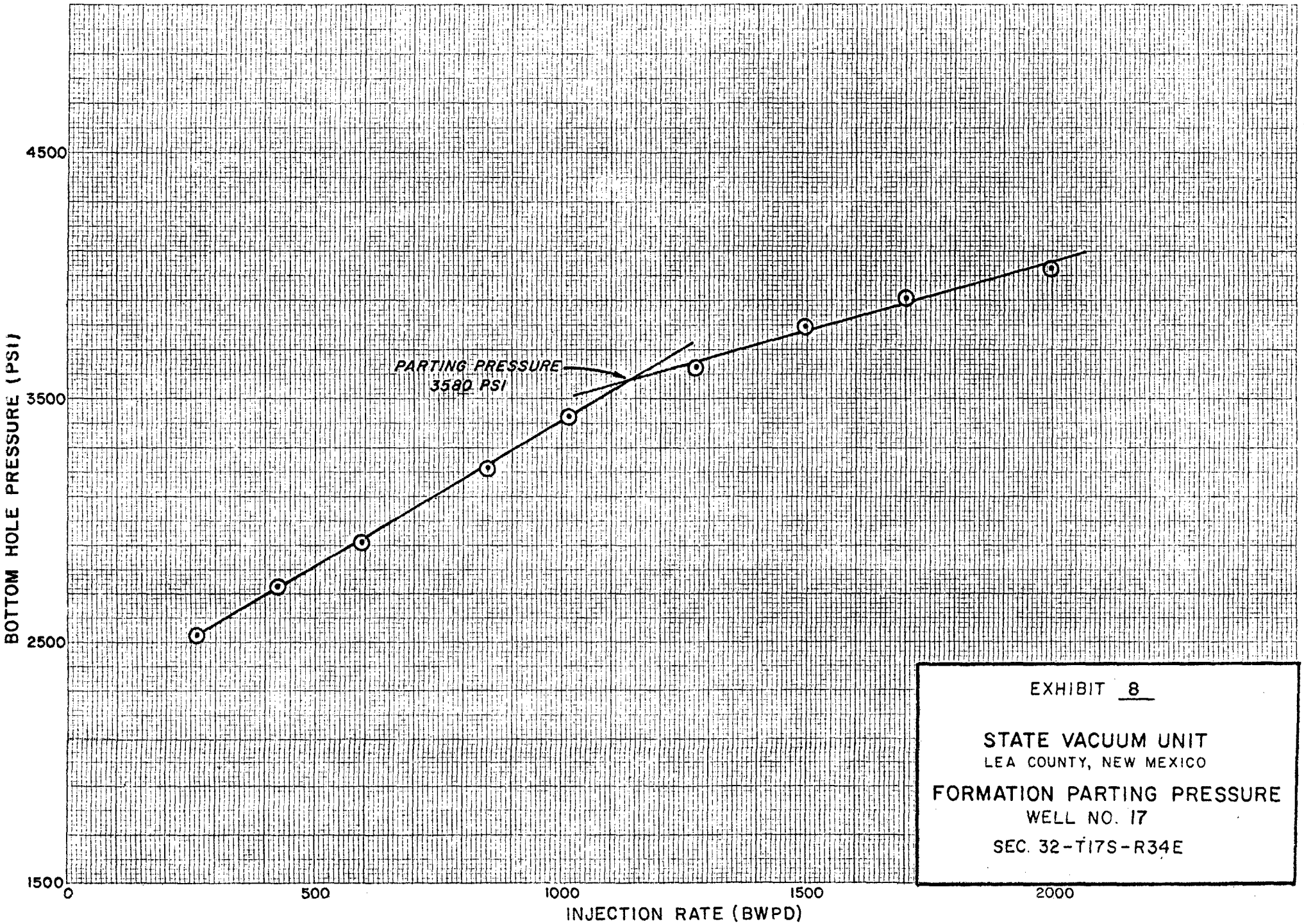
WELL NUMBER: 17

ELEMENT: 5505

COUNTY: Lea

TEST DEPTH: 4741

AM TIME/PM	APPROX. RATE (BPD)	BHP @ TEST DEPTH (PSI)	SURFACE PRESSURE (PSI)
10:51	0	2335	220
11:08	260	2539	360
11:24	425	2713	537
11:39	590	2918	750
11:56	850	3221	1090
12:11 PM	1015	3427	1300
12:26	1275	3635	1540
12:42	1500	3796	1750
12:57	1700	3913	1900
1:12	2000	4039	2075


4500
3500
2500
1500
BOTTOM HOLE PRESSURE (PSI)
PARTING PRESSURE
3580 PSI
0
500
1000
1500
2000
INJECTION RATE (BWPD)
EXHIBIT 8
STATE VACUUM UNIT
LEA COUNTY, NEW MEXICO
FORMATION PARTING PRESSURE
WELL NO. 17
SEC. 32-T17S-R34E