PMx order copy

PHILLIPS PETROLEUM COMPANY
ODESSA, TEXAS 79762
4001 PENBROOK

EXPLORATION AND PRODUCTION GROUP
Permian Basin Region

January 3, 1982

East Vacuum Grayburg-San Andres Unit
NMOCD Order No. R-5897
INJECTION WELLHEAD PRESSURE LIMITATION
Lea County, New Mexico

New Mexico Dept. of Energy & Materials
Oil Conservation Division (3)
P. O. Box 2088
Santa Fe, New Mexico 87501

Attention: Mr. Joe Ramey

Gentlemen:

Phillips Petroleum Company, as operator of the subject unit, requests administrative approval of a unit injection wellhead pressure limitation of 1,350 psi. This is done in accordance with Special Rule No. 12 of the subject order, which states in part, "The Division Director may administratively authorize a pressure limitation ... upon showing by the unit operator that such higher pressure will not result in fracturing of the confining strata". The following exhibits substantiate the fact that the requested pressure limitation does not violate this rule.

In order to identify a minimum formation parting pressure, step rate tests were run on thirteen wells spread across the unit. These tests were conducted between September and November, 1982. Exhibit 1 is a plat of the unit showing the locations of the wells tested. Note that the unit is divided into six satellite areas of approximate equal geographic size. These "satellites" are actually six individual well testing and gas separation units located in the approximate center of each of these outlined areas. These satellites are connected to the central tank battery at the center of the unit. The satellite areas are used here merely to illustrate that the wells tested are spread over the entire unit. Note that each satellite area has at least two of the tested wells within it.

Exhibit 2 is a summary of the test results that are shown individually in Exhibits 3 through 15A. These tests were conducted with a pressure gauge at the surface and an Amerada pressure bomb set at the top perforation. In each case, a Halliburton turbine meter was used to measure the injection rate.

Note that in two cases (Exhibits 11 & 14), a plot of the surface pressure data could not adequately identify the parting pressure. However, the BHP data does identify it. This is most likely due to a masking effect caused by friction in the tubing. Since surface pressures were being recorded at the same time, it is very simple to correlate a surface injection pressure to the rate at which the parting pressure was identified downhole. This is identified in Exhibit 2 as

the surface parting pressure. In four other tests (Exhibits 4, 8, 13 & 15), neither the downhole or surface pressure plots identified the formation parting pressure. In one case (Exhibit 4), the permeability is very low and the surface wellhead equipment reached its limit (3,000 psi) at a relatively low injection rate (1.2 BPM). In the other three cases, porosity and permeability are very high, allowing extremely high injectivities. In all cases, it is believed that the parting pressure is higher than can be achieved with our present wellhead equipment limitation.

In five of the thirteen tests (Exhibits 6, 7, 9, 10 & 12), the BHP bomb failed to record. Fortunately, the parting pressure is easily identified on the surface pressure plot. However, in order to check the bottom hole pressure, it was calculated as follows:

$$BHPc = HH + SP - h$$

where;

BHPc - calculated bottom hole pressure (psi)
HH - hydrostatic head (psi) = (0.44) x (Depth of top perforation)
SP - surface pressure (psi)
h - pressure due to friction (psi)

The frictional pressure (h) is defined by Hazen & Williams according to the following formula:

$$h = L\left[\frac{94.92Q}{(CD^{2.63})}\right]^{1.852}$$

where;

L - depth of top perforation (ft.)
Q - injection rate (bbls./min.)
C - Hazen & Williams coefficient
D - inside diameter of pipe (inches)

According to the Tuboscope Coating Research and Engineering Department, the Hazen & Williams coefficient for plastic-coated pipe is 140, as compared to 100 for new steel pipe. (Tuboscope manufactures the coating used in the tubing on EVGSAU.) Therefore, the above equation becomes:

$$h \text{ (for 2-7/8" tubing)} = L\ (0.0649\ Q)^{1.852}$$

In each of these five tests, the injection rate at the parting pressure is very similar on both plots. Whereas these plots do provide supportive data, they all identify parting pressures above the requested wellhead injection pressure limitation.

At the present maximum pressure limitation of 920 psi, injection rates have begun to decline. In order to maintain sufficient injection, it is requested that the unit injection wellhead pressure limitation be increased to 1,350 psi. (This is slightly lower that the lowest recorded parting pressure [see Exhibit 2] so as to insure that the formation is not fractured.) This will enable the timely recovery of the secondary reserves in the unit. Any further information you require will gladly be forwarded. Your prompt attention is appreciated.

Sincerely,

G. R. Smith

G. R. Smith, Chairman
Working Interest Owners Committee

MHB:adk

Attachments

cc: New Mexico Dept. of Energy and Minerals
Oil Conservation Division
P. O. Box 1980
Hobbs, New Mexico
Attn: Mr. Jerry Sexton

EXHIBIT I

R-34-E

R-35-E

T 17 S

T 18 S

PHILLIPS EAST VACUUM UNIT

TEXACO CENTRAL VACUUM UNIT

1 2 3 4 5 6

EAST VACUUM GRAYBURG – SAN ANDRES UNIT
VACUUM GRAYBURG – SAN ANDRES FIELD
LEA COUNTY, NEW MEXICO

SCALE

0 2000' 4000' 6000'

SATELLITE AREAS

(3333) Tract Numbers

△ ------- Water Injection Well

⊡ -------- Water Supply Well

⊠ --------- Formation Parting Pressure Tests

December, 1982

EXHIBIT 2

SUMMARY OF FORMATION
PARTING PRESSURE TEST RESULTS

Tract-Well	Satellite No.	Depth of Top Perforation	Tubing Size	Surface Parting Pressure, psi	Inj. Rate at Parting Pressure, BPD
1952-W002	1	4606'	2-3/8"	1500	1080
2054-W003	1	4590'	2-3/8"	NIPP	1728+
2980-W003	2	4580'	2-3/8"	2035	2563
2801-W012*	2	4445'	2-7/8"	1985	5976
3202-W008*	3	4366'	2-7/8"	1725	8352
3202-W009	3	4395'	2-7/8"	NIPP	7488+
2738-W009*	4	4440'	2-7/8"	2000	2340
2721-W001*	4	4352'	2-7/8"	1710	4608
2717-W003	5	4394'	2-7/8"	1450**	6394
2622-W006*	5	4480'	2-7/8"	1550	5040
3456-W009	6	4446'	2-7/8"	NIPP	8640+
3333-W006	6	4387'	2-7/8"	1785**	7884
3315-W007	6	4505'	2-7/8"	NIPP	8640+

NIPP - No identifiable parting pressure.

* - The BHP bomb failed during these tests. Calculated bottom hole pressures are shown on the data sheets and graphs for these wells.

** - In these tests, the parting pressure was not evident from the surface pressure plots. However, the BHP plots did show the formation parting. The surface parting pressures shown here are read directly from the measured surface pressure curve at the rate at which the BHP plot shows the formation parting.

\+ - Where no identifiable parting pressure is shown, the maximum injection rate attained during the test is given.

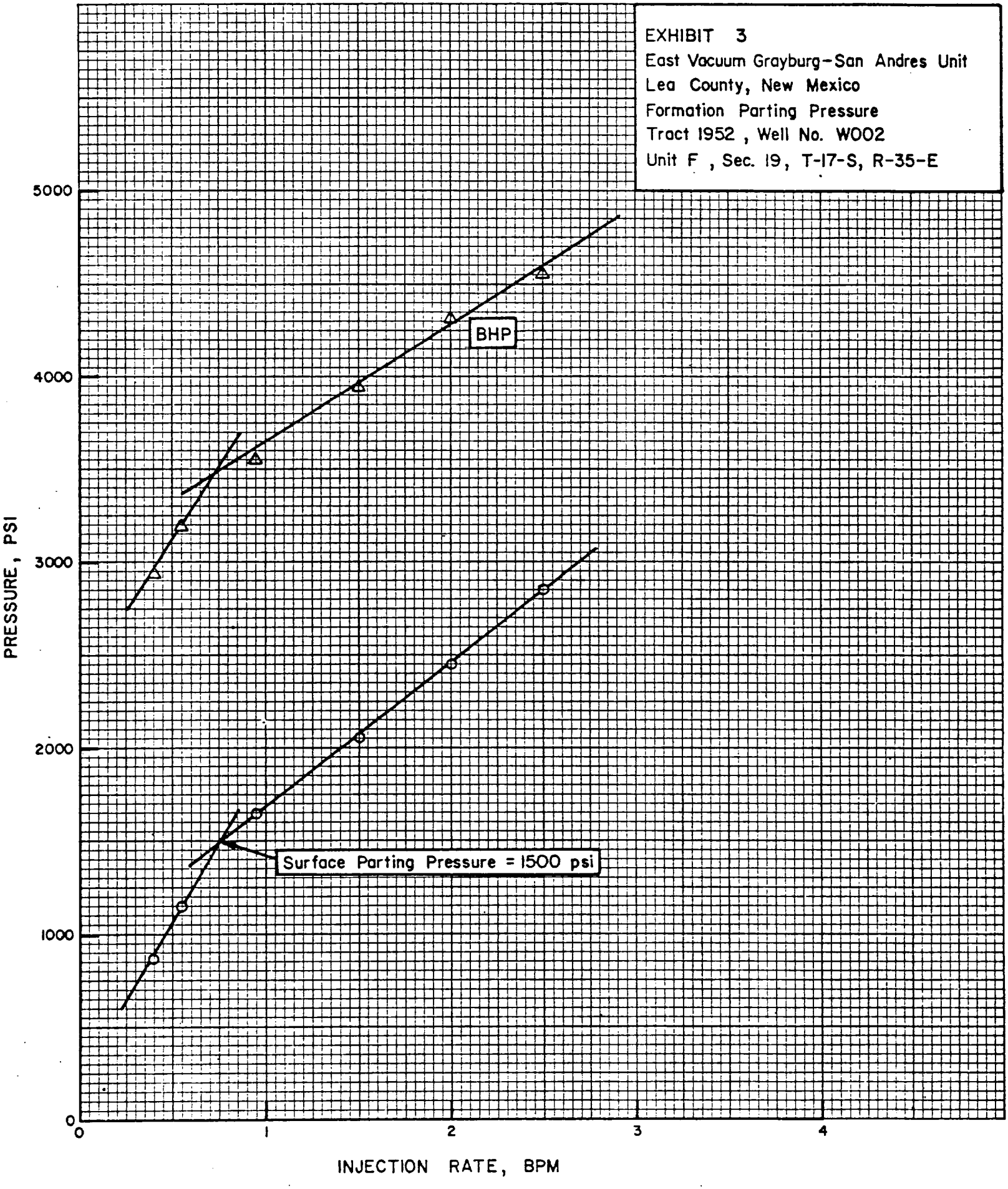
EXHIBIT 3
East Vacuum Grayburg-San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 1952 , Well No. W002
Unit F , Sec. 19, T-17-S, R-35-E
BHP
Surface Parting Pressure = 1500 psi
PRESSURE, PSI
INJECTION RATE, BPM
0
1000
2000
3000
4000
5000
0
1
2
3
4

EXHIBIT 3A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 1952, Well No. W002

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
0.4	576	875	2959
0.55	792	1150	3200
0.95	1368	1650	3564
1.5	2160	2050	3956
2.0	2880	2450	4329
2.5	3600	2850	4560

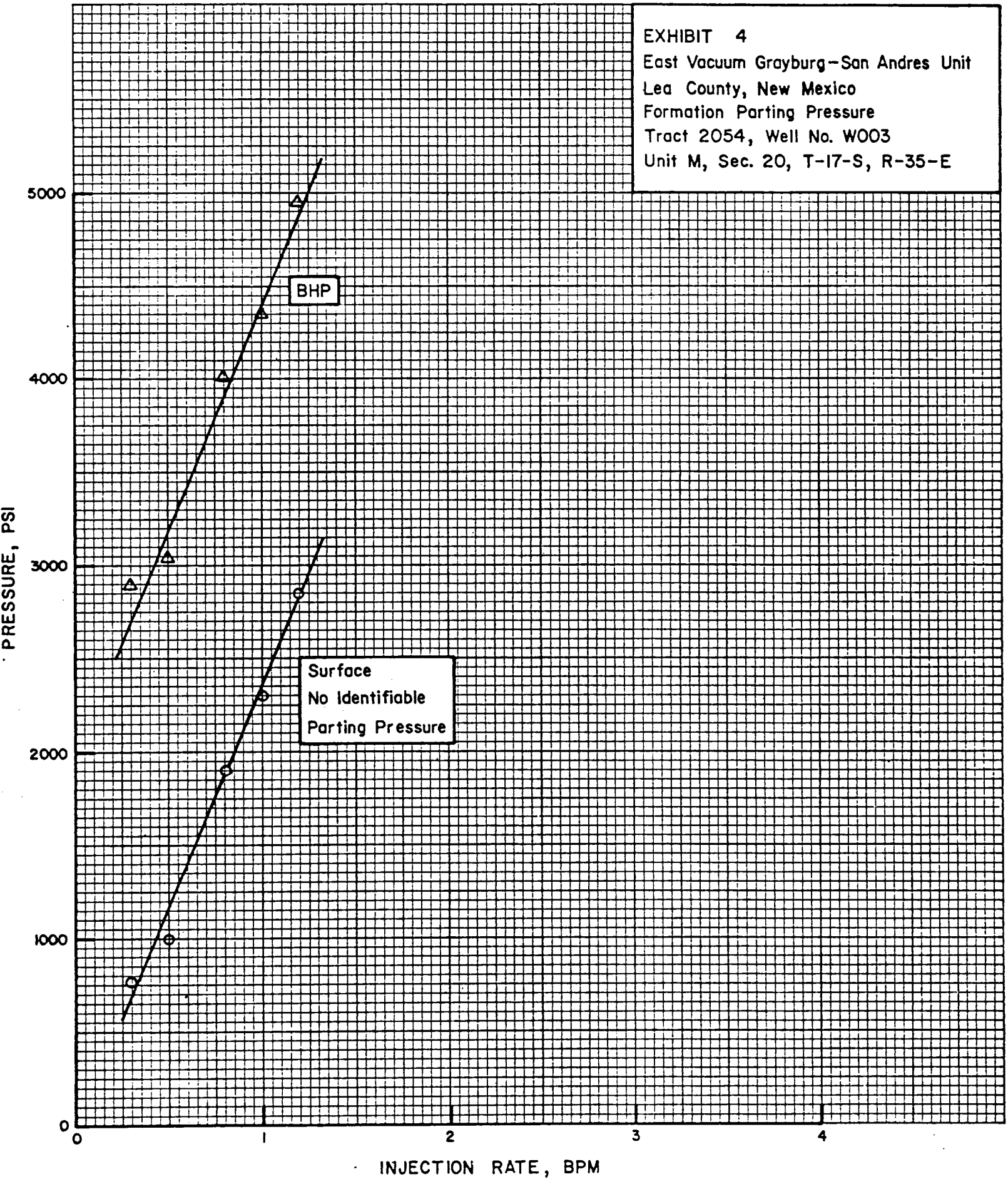
EXHIBIT 4
East Vacuum Grayburg-San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 2054, Well No. W003
Unit M, Sec. 20, T-17-S, R-35-E
BHP
Surface
No Identifiable
Parting Pressure
PRESSURE, PSI
INJECTION RATE, BPM
0
1000
2000
3000
4000
5000
0
1
2
3
4

EXHIBIT 4A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 2054, Well No. W003

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
0.3	432	775	2909
0.5	720	1000	3058
0.8	1152	1900	4011
1.0	1440	2300	4361
1.2	1728	2900	4959

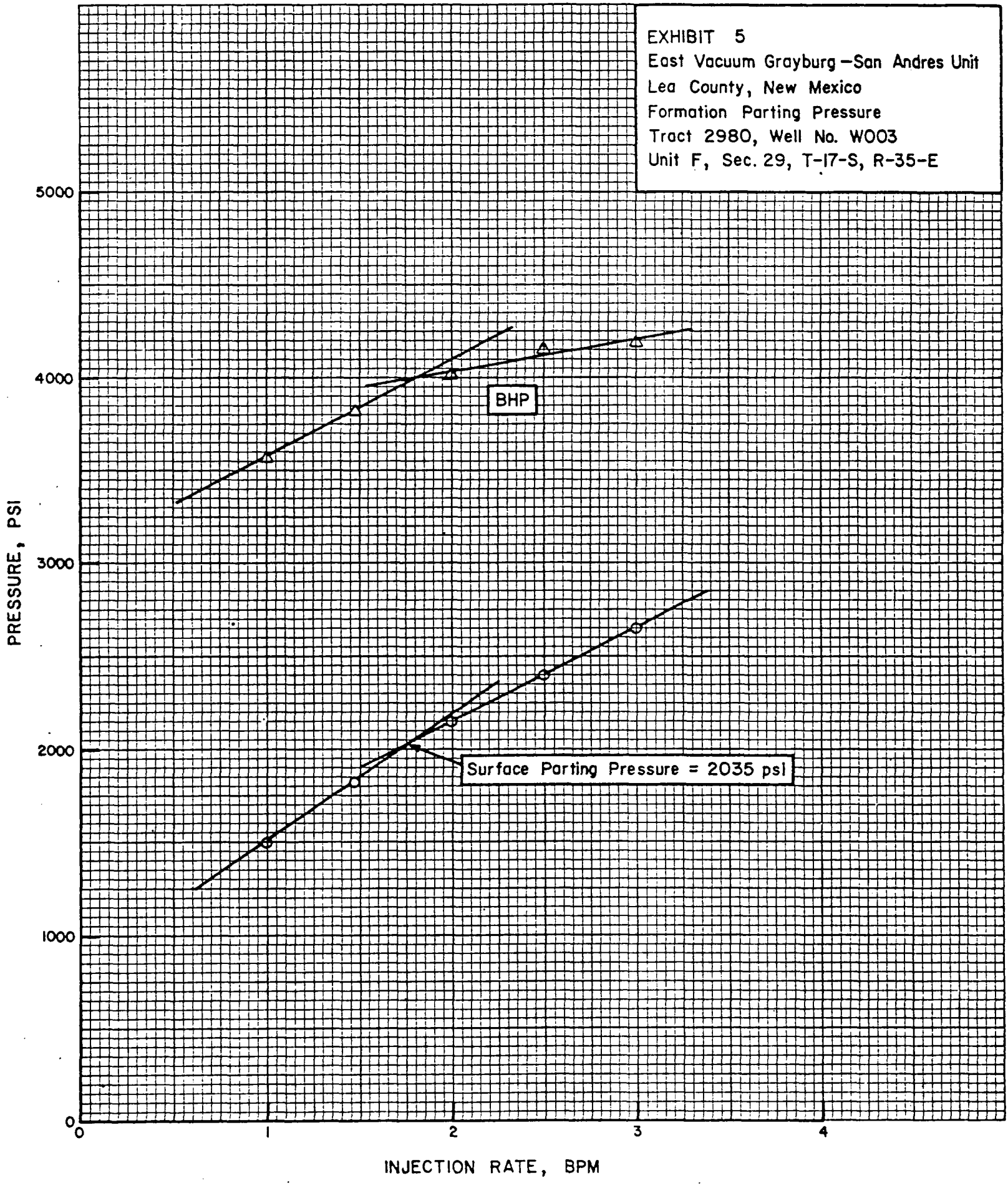
EXHIBIT 5
East Vacuum Grayburg – San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 2980, Well No. W003
Unit F, Sec. 29, T-17-S, R-35-E
BHP
Surface Parting Pressure = 2035 psi
PRESSURE, PSI
INJECTION RATE, BPM
0
1000
2000
3000
4000
5000
0
1
2
3
4

EXHIBIT 5A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 2980, Well No. W003

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
1.0	1440	1500	3573
1.45	2088	1825	3819
2.0	2880	2150	4019
2.5	3600	2400	4152
3.0	4320	2650	4193

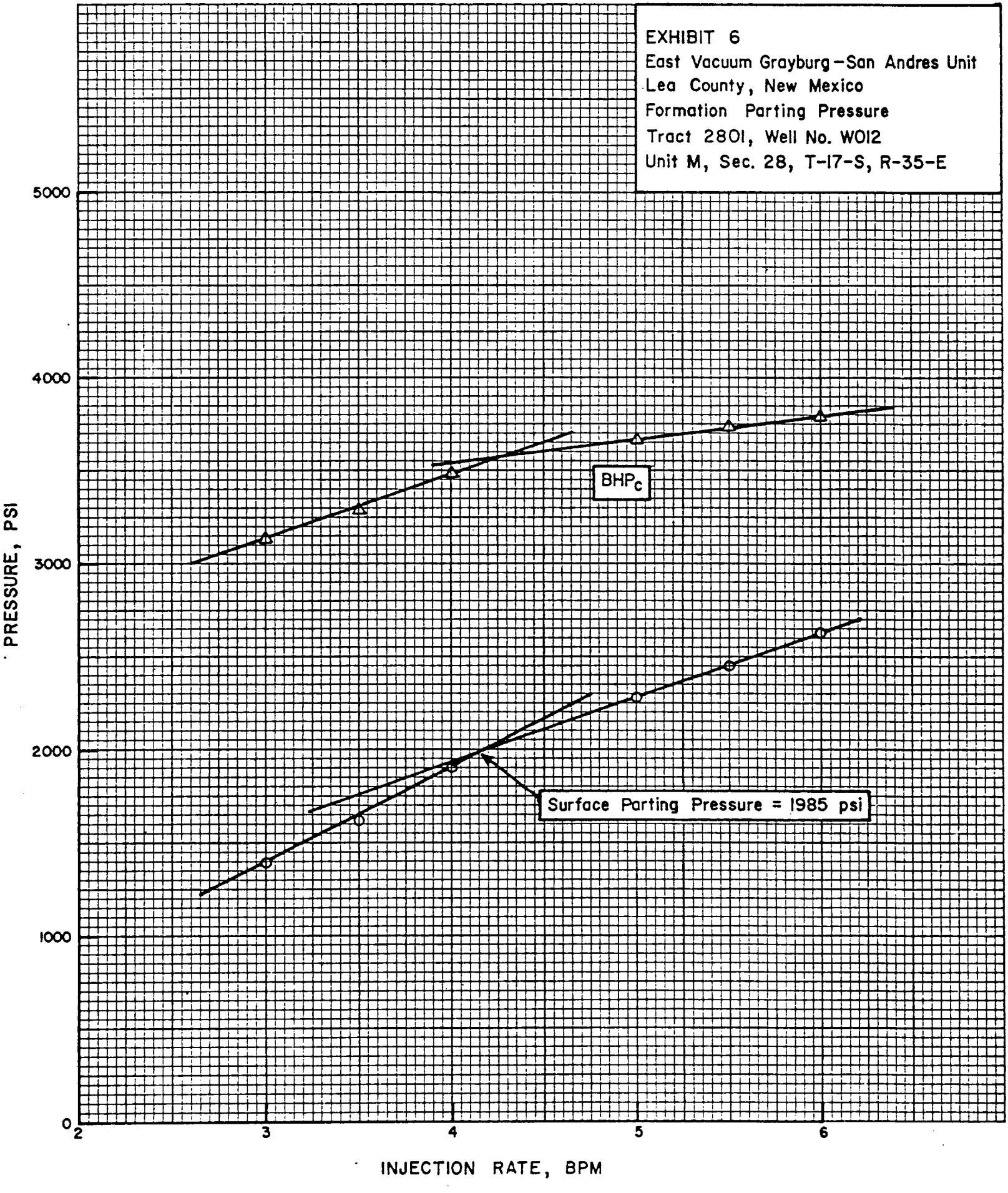
EXHIBIT 6
East Vacuum Grayburg-San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 2801, Well No. W012
Unit M, Sec. 28, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
BHPc
Surface Parting Pressure = 1985 psi
2
3
4
5
6
INJECTION RATE, BPM

EXHIBIT 6A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 2801, Well No. W012

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHPc
3.0	4320	1400	3141
3.5	5040	1625	3295
4.0	5760	1900	3490
5.0	7200	2275	3678
5.5	7920	2400	3746
6.0	8640	2625	3806

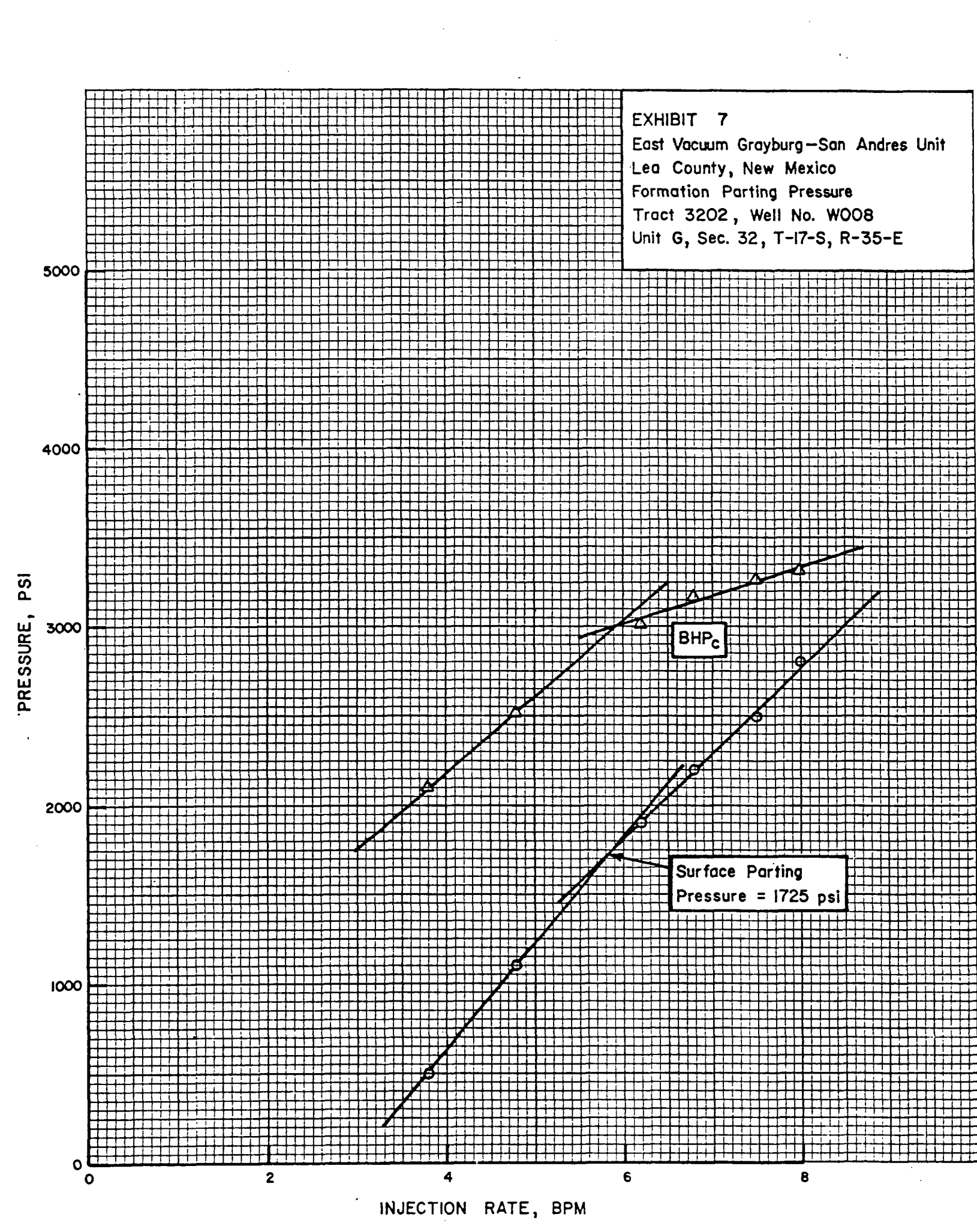
EXHIBIT 7
East Vacuum Grayburg–San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 3202, Well No. W008
Unit G, Sec. 32, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
0
2
4
6
8
INJECTION RATE, BPM
BHPc
Surface Parting
Pressure = 1725 psi

EXHIBIT 7A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 3202, Well No. W008

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHPc
3.8	5472	500	2094
4.8	6912	1100	2518
6.2	8928	1900	3012
6.8	9792	2200	3161
7.5	10800	2500	3270
8.0	11520	2750	3314

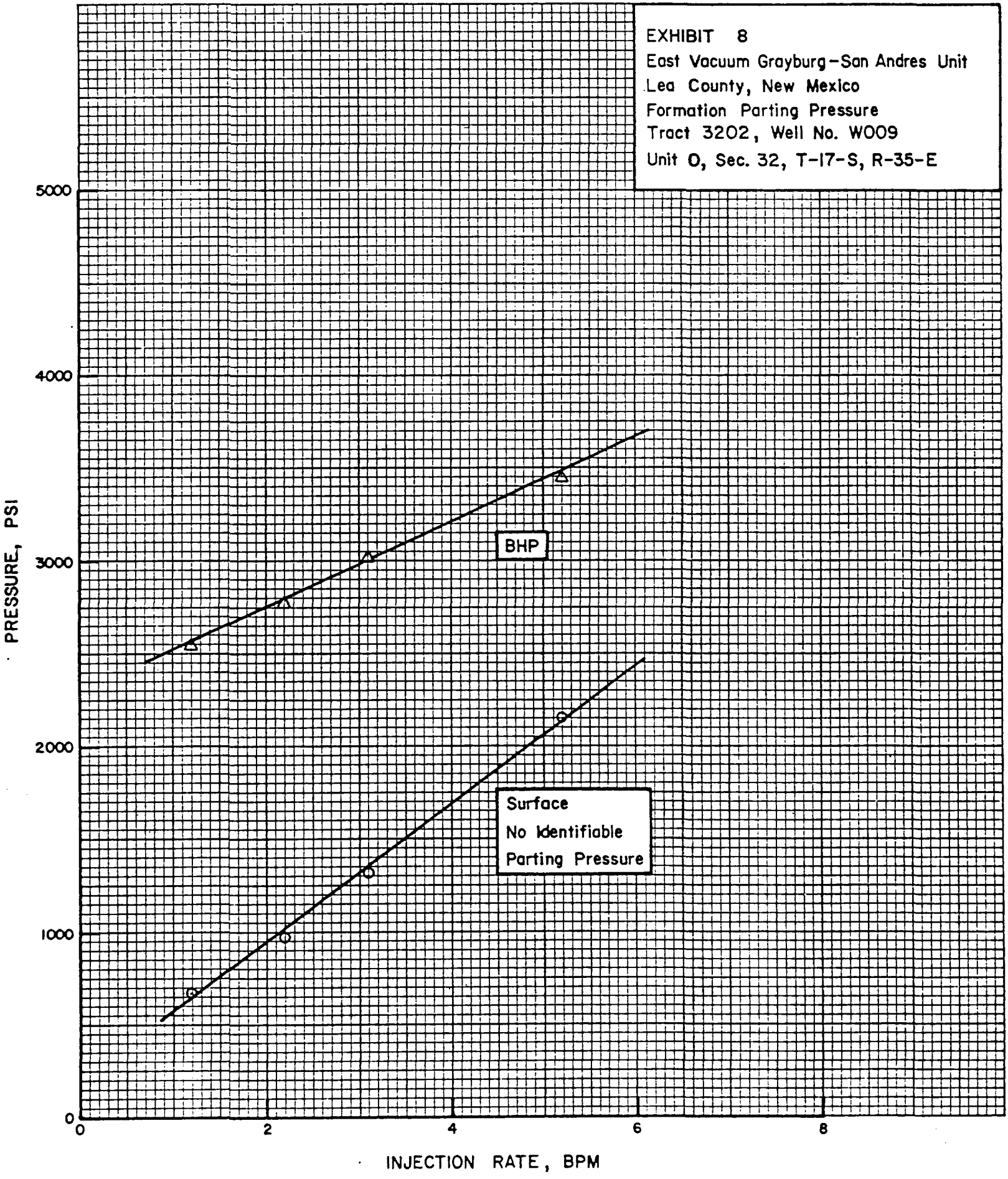
EXHIBIT 8
East Vacuum Grayburg-San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 3202, Well No. W009
Unit O, Sec. 32, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
BHP
Surface
No Identifiable
Parting Pressure
0
2
4
6
8
INJECTION RATE, BPM

EXHIBIT 8A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 3202, Well No. W009

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
1.2	1728	670	2565
2.2	3168	975	2782
3.1	4464	1320	3019
5.2	7488	2150	3449

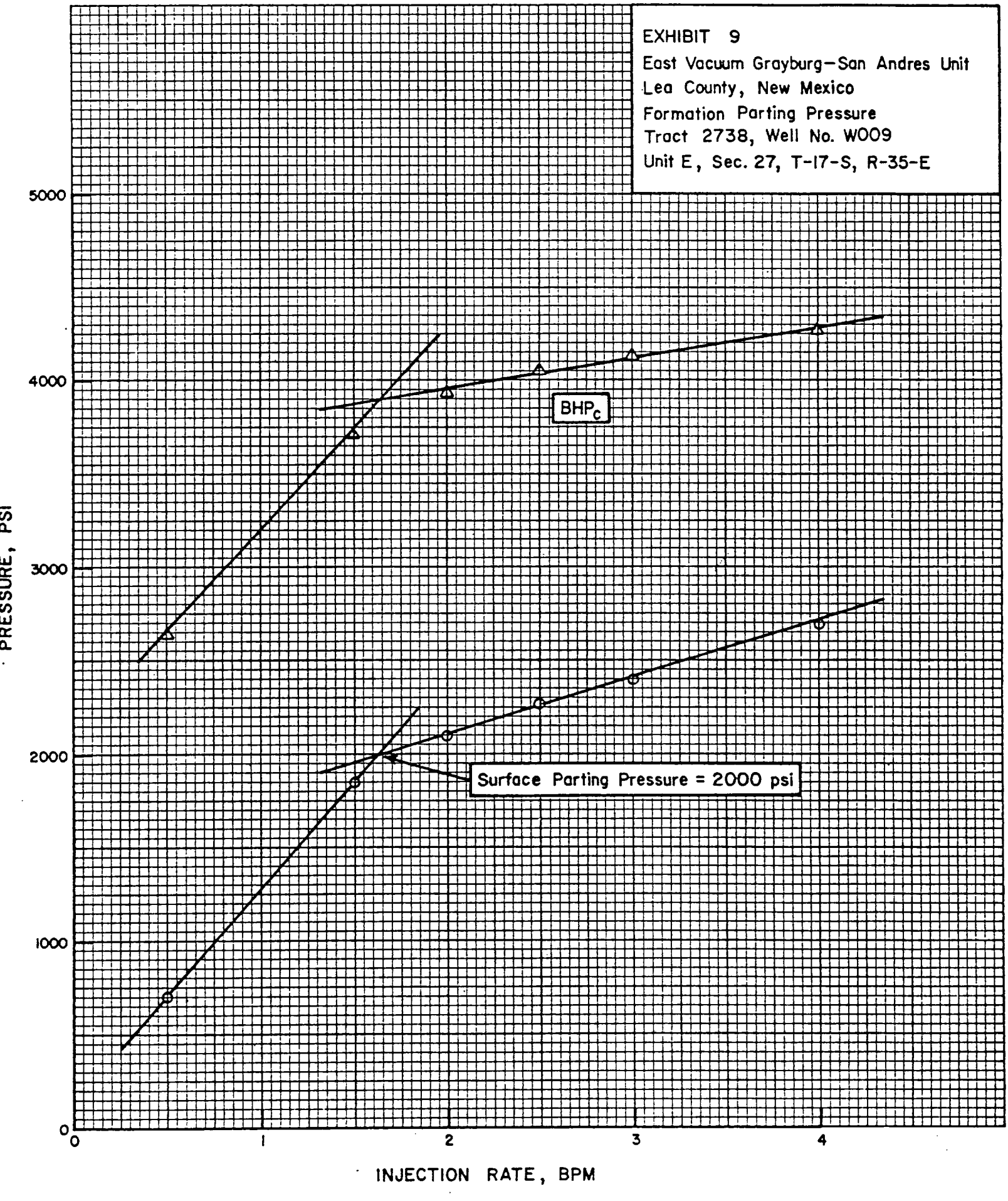
EXHIBIT 9
East Vacuum Grayburg–San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 2738, Well No. W009
Unit E, Sec. 27, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
BHPc
Surface Parting Pressure = 2000 psi
0
1
2
3
4
INJECTION RATE, BPM

EXHIBIT 9A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 2738, Well No. W009

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHPc
0.5	720	720	2666
1.5	2160	1850	3744
2.0	2880	2100	3952
2.5	3600	2275	4076
3.0	4320	2400	4139
4.0	5760	2700	4288

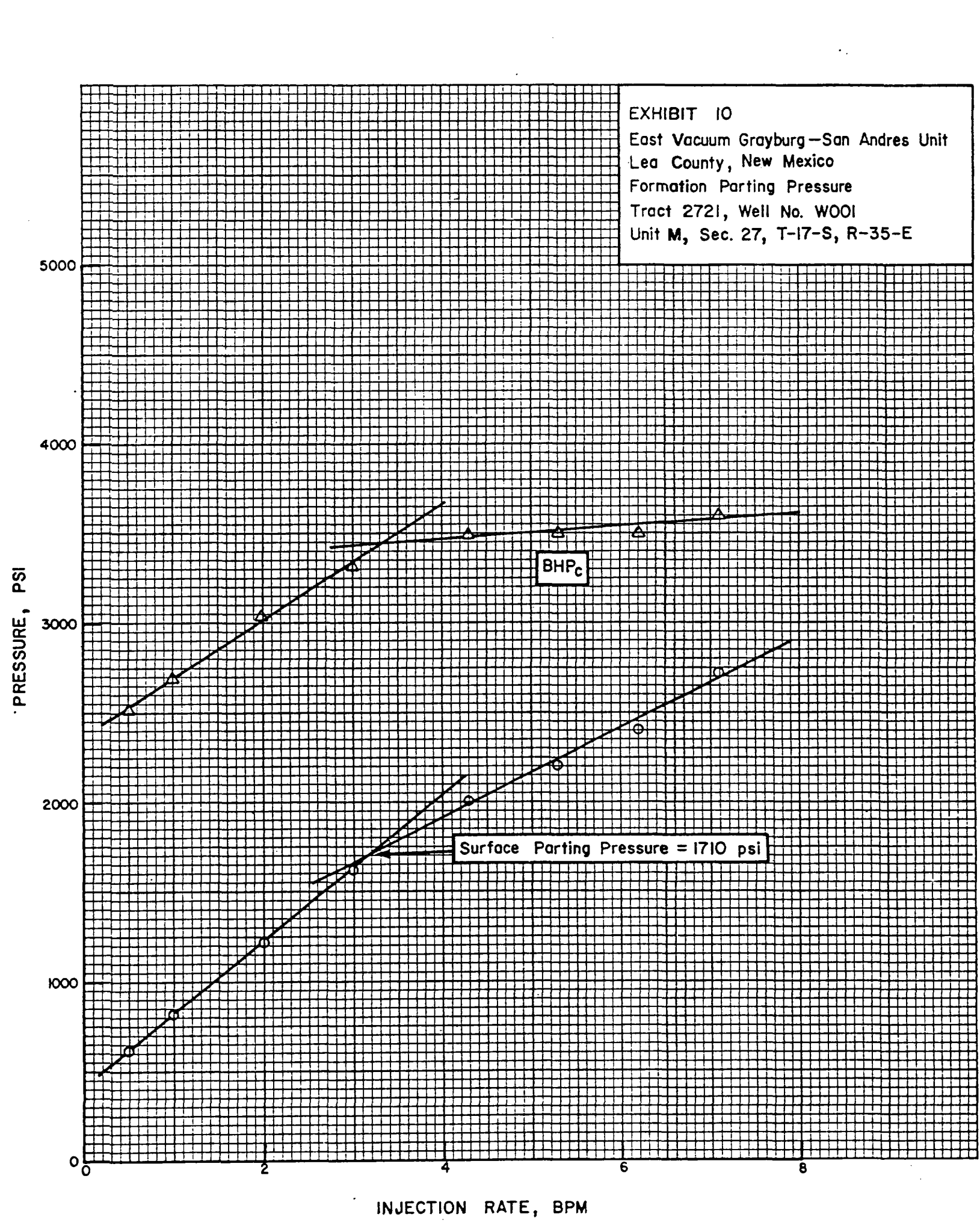
EXHIBIT 10
East Vacuum Grayburg—San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 2721, Well No. W001
Unit M, Sec. 27, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
0
2
4
6
8
INJECTION RATE, BPM
BHPc
Surface Parting Pressure = 1710 psi

EXHIBIT 10A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 2721, Well No. W001

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHPc
0.5	720	625	2532
1.0	1440	825	2712
2.0	2880	1225	3041
3.0	4320	1625	3330
4.3	6192	2000	3506
5.3	7632	2060	3512
6.2	8928	2400	3509
7.1	10224	2720	3599

EXHIBIT II
East Vacuum Grayburg-San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 2717, Well No. W003
Unit P, Sec. 27, T-17-S, R-35-E

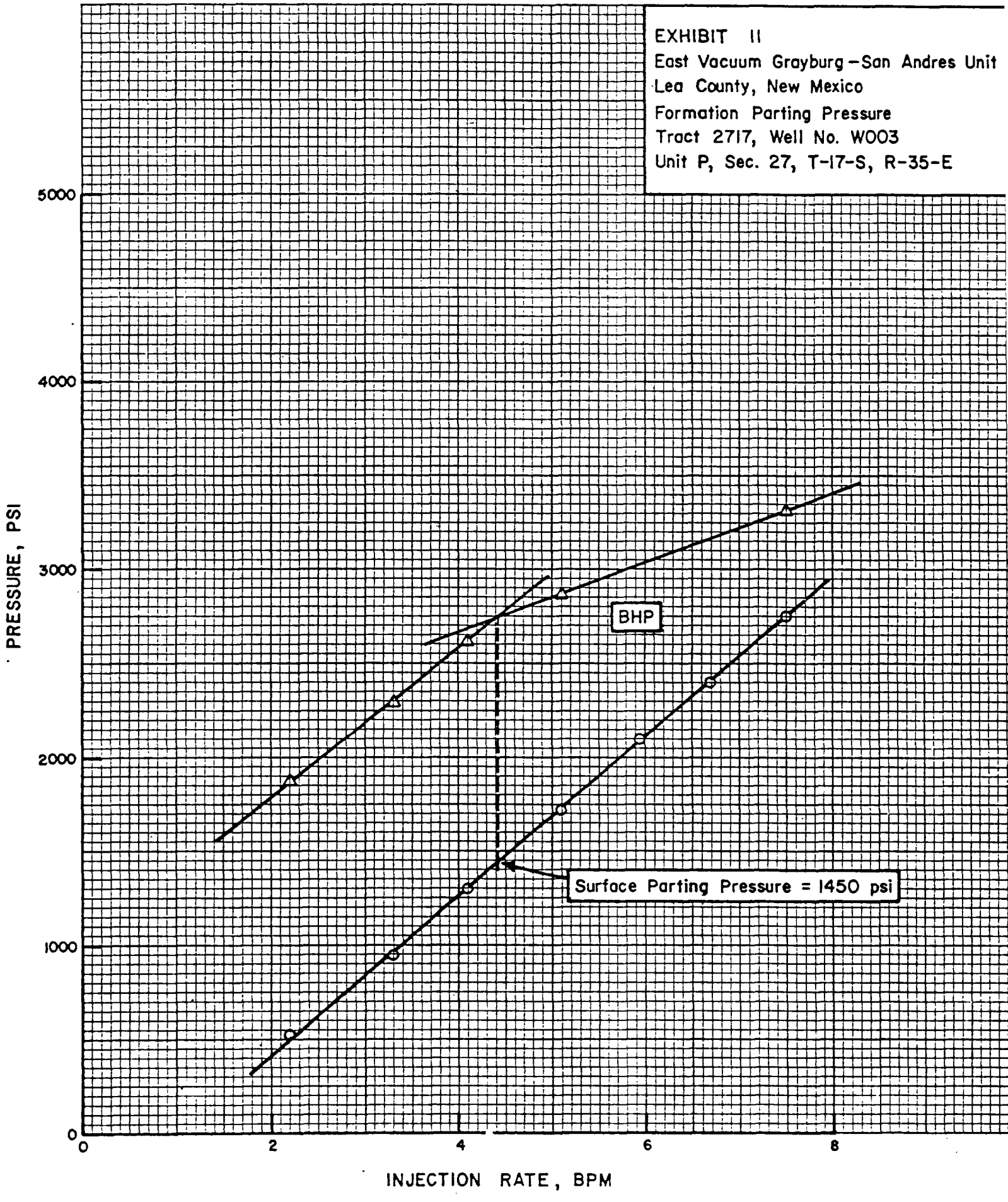

EXHIBIT 11A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 2717, Well No. W003

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
2.2	3168	525	1879
3.3	4752	950	2300
4.1	5904	1300	2631
5.1	7344	1725	2871
5.95	8568	2100	*
6.7	9648	2400	*
7.5	10800	2750	3321

*BHP bomb failure

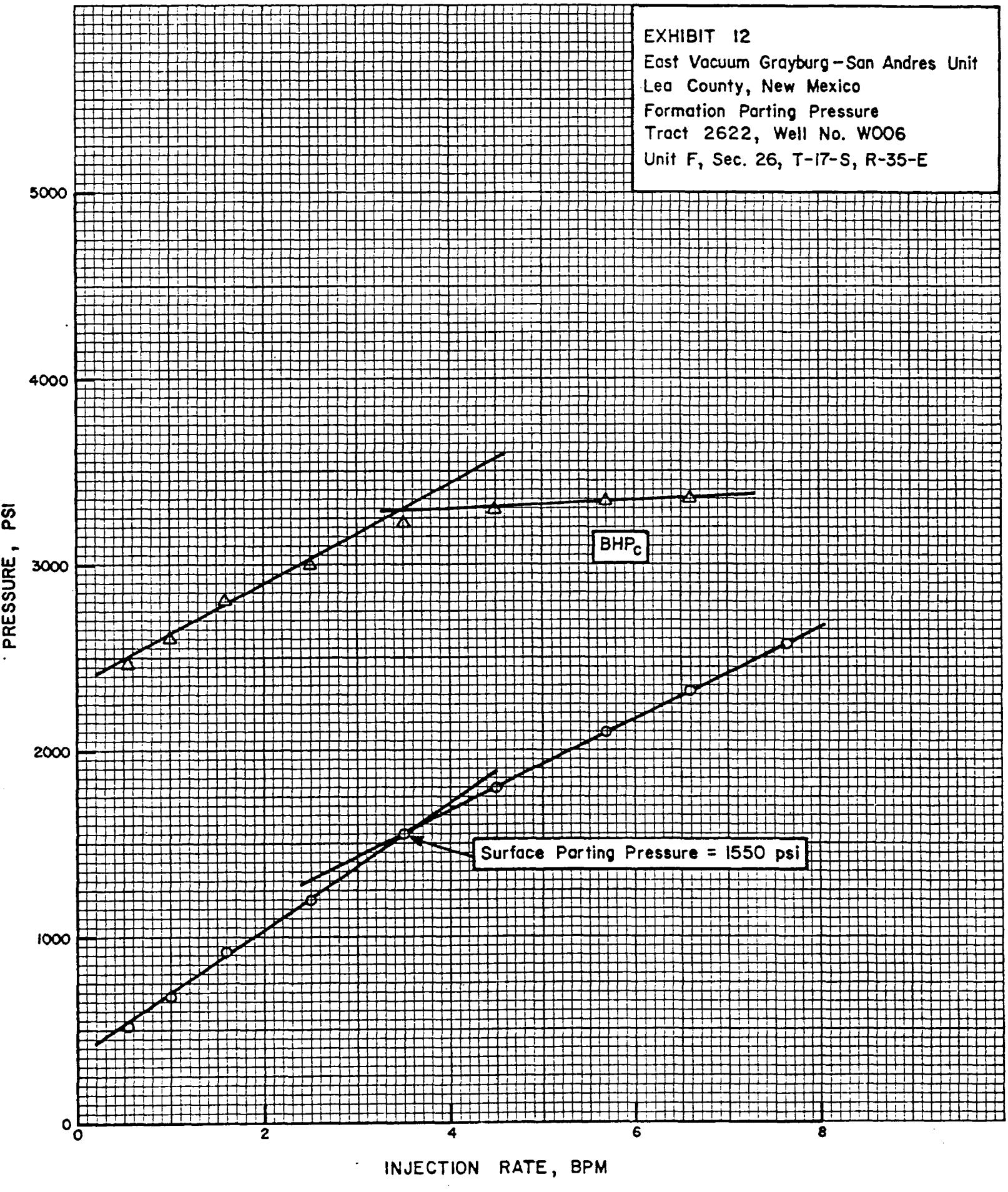
EXHIBIT 12
East Vacuum Grayburg-San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 2622, Well No. W006
Unit F, Sec. 26, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
0
2
4
6
8
INJECTION RATE, BPM
BHPc
Surface Parting Pressure = 1550 psi

EXHIBIT 12A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 2622, Well No. W006

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHPc
0.55	792	525	2487
1.0	1440	680	2623
1.6	2304	925	2829
2.5	3600	1200	3017
3.5	5040	1550	3233
4.5	6480	1800	3313
5.7	8208	2100	3361
6.6	9504	2325	3364
7.65	11016	2575	3321

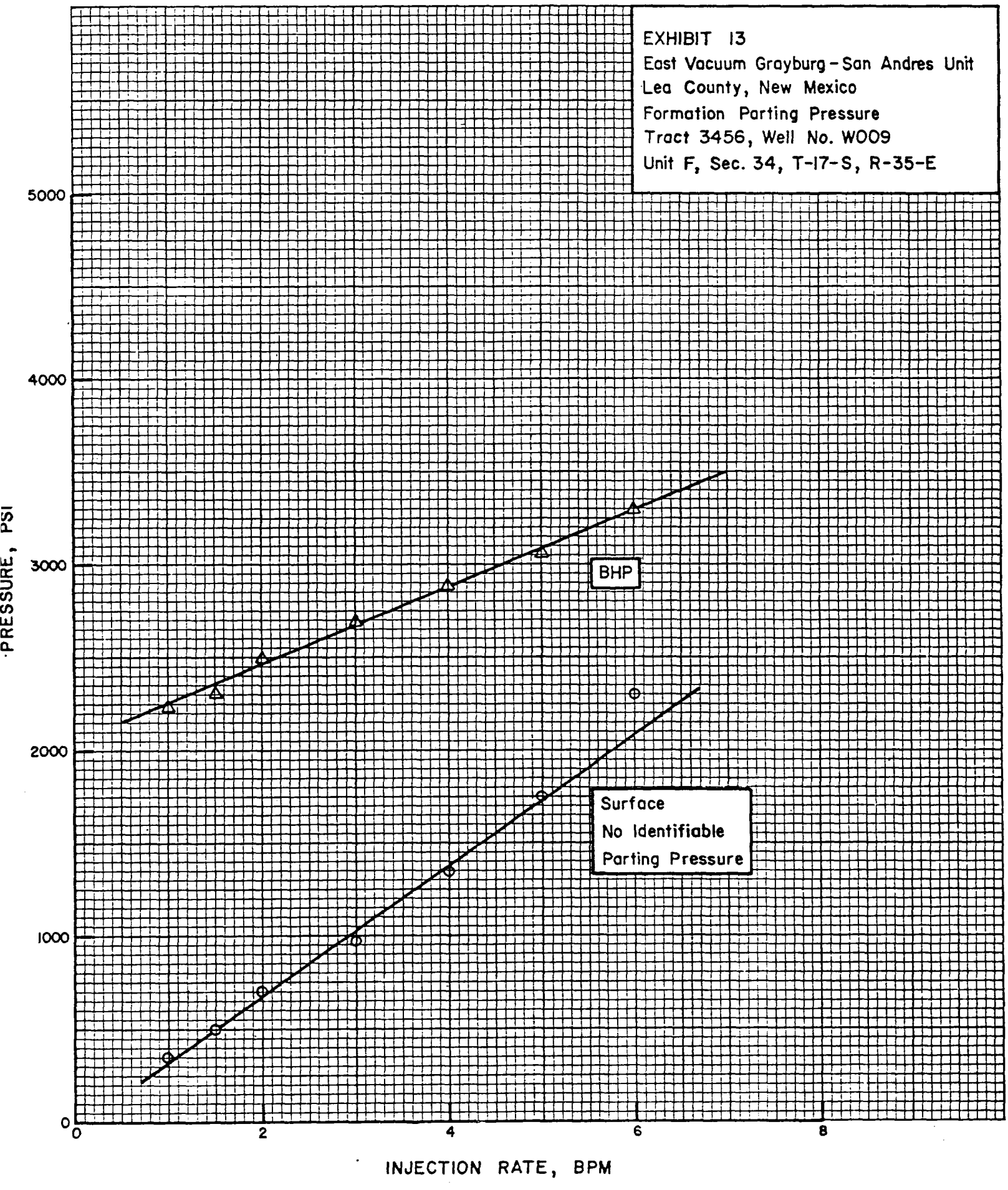
EXHIBIT 13
East Vacuum Grayburg - San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 3456, Well No. W009
Unit F, Sec. 34, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
0
2
4
6
8
INJECTION RATE, BPM
BHP
Surface
No Identifiable
Parting Pressure

EXHIBIT 13A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 3456, Well No. W009

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
1.0	1440	400	2298
1.5	2160	550	2375
2.0	2880	750	2565
3.0	4320	1020	2758
4.0	5760	1400	2945
5.0	7200	1800	3129
6.0	8640	2350	3362

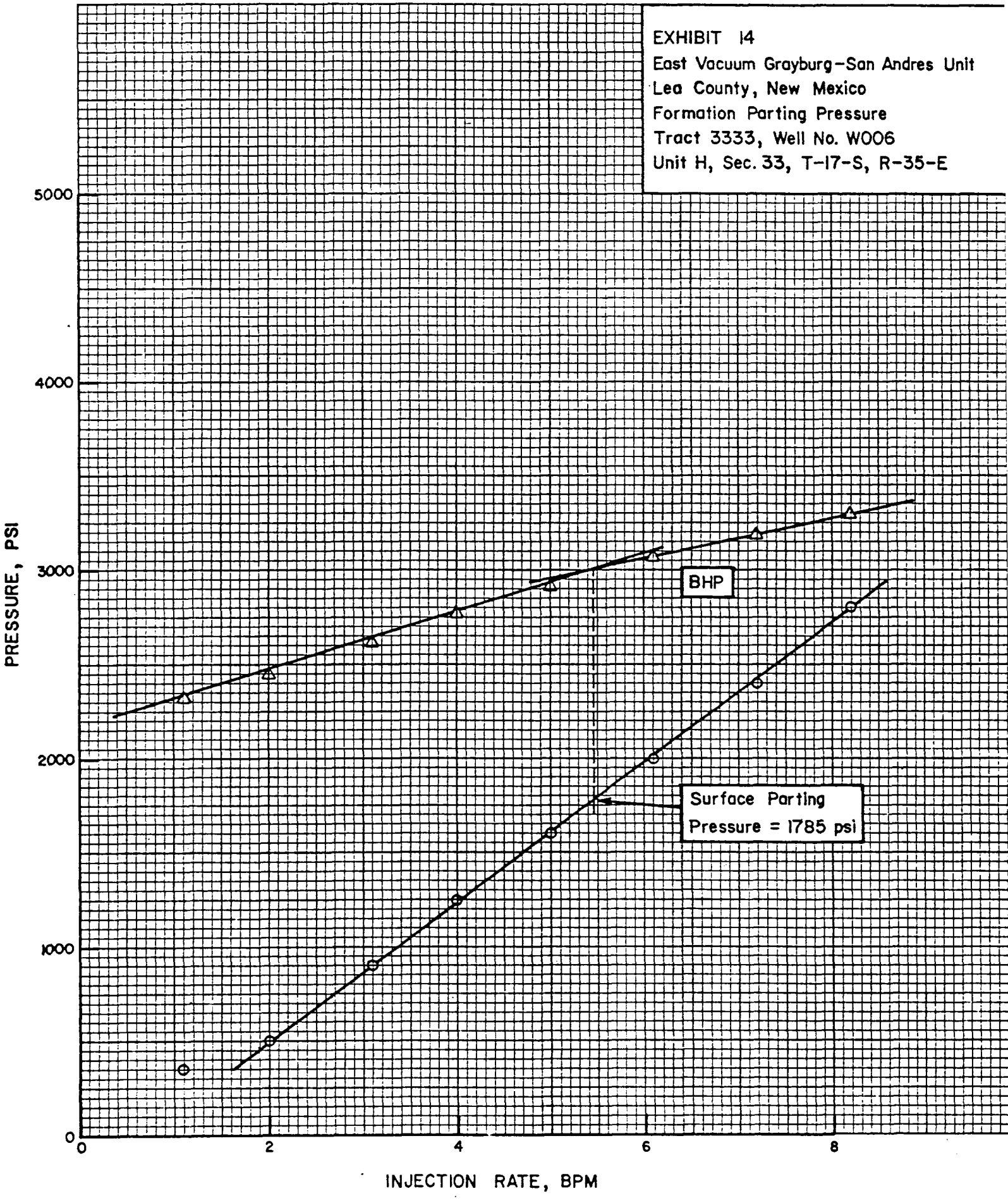
EXHIBIT 14
East Vacuum Grayburg-San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 3333, Well No. W006
Unit H, Sec. 33, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
0
2
4
6
8
INJECTION RATE, BPM
BHP
Surface Parting
Pressure = 1785 psi

EXHIBIT 14A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 3333, Well No. W006

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
1.1	1584	350	2333
2.0	2880	500	2457
3.1	4464	900	2628
4.0	5760	1250	2788
5.0	7200	1600	2915
6.1	8784	2000	3063
7.2	10368	2400	3189
8.2	11808	2800	3304

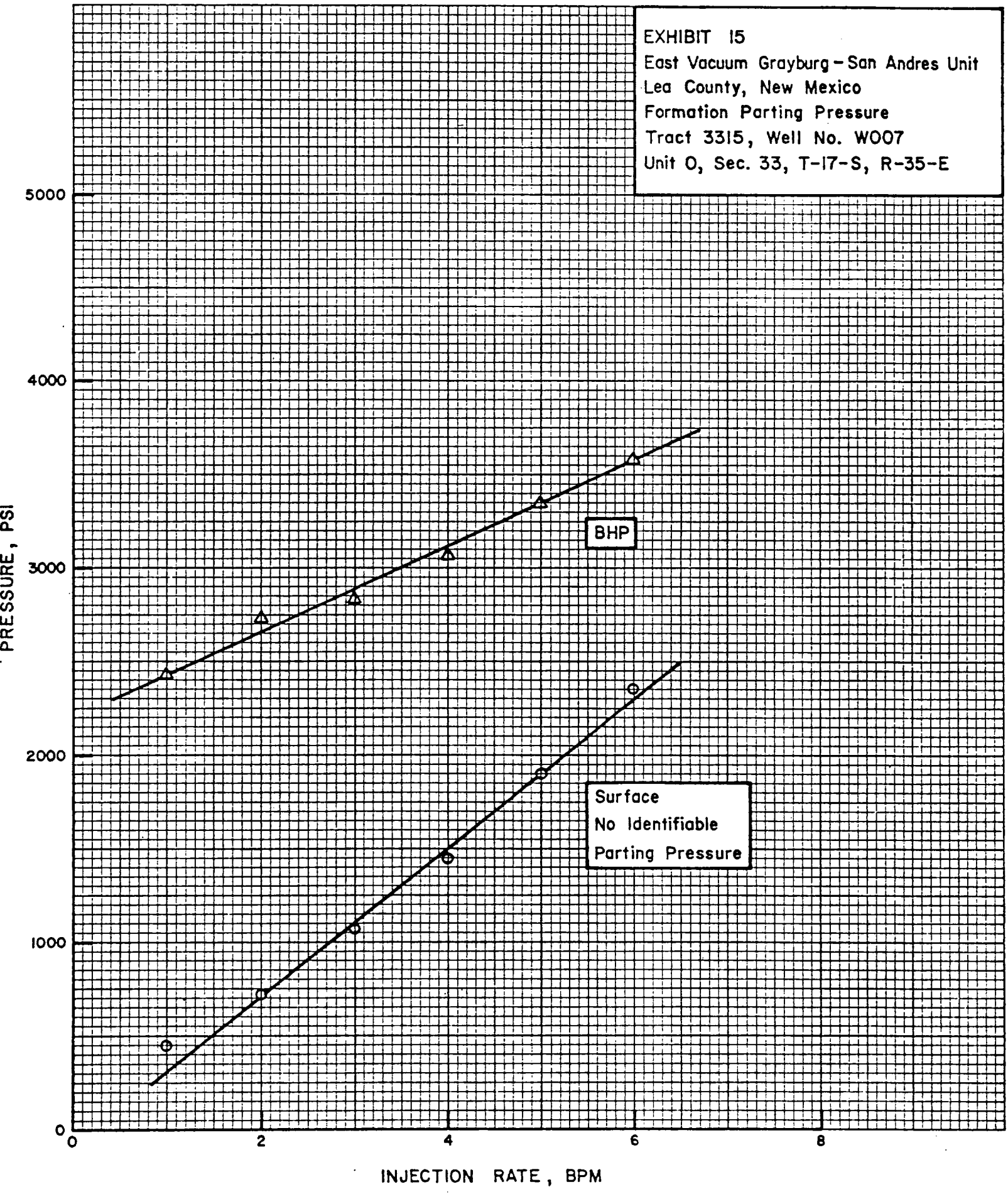
EXHIBIT 15
East Vacuum Grayburg - San Andres Unit
Lea County, New Mexico
Formation Parting Pressure
Tract 3315, Well No. W007
Unit O, Sec. 33, T-17-S, R-35-E
5000
4000
3000
2000
1000
0
PRESSURE, PSI
BHP
Surface
No Identifiable
Parting Pressure
0
2
4
6
8
INJECTION RATE, BPM

EXHIBIT 15A

EAST VACUUM GRAYBURG-SAN ANDRES UNIT
Tract 3315, Well No. W007

FORMATION PARTING PRESSURE
TEST DATA

Injection Rate		Pressure, PSI	
BPM	BPD	Surface	BHP
1.0	1440	450	2433
2.0	2880	725	2741
3.0	4320	1070	2837
4.0	5760	1460	3066
5.0	7200	1900	3353
6.0	8640	2350	3584

OIL CONSERVATION DIVISION
DISTRICT I

OIL CONSERVATION DIVISION
P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

DATE November 27, 1982

RE: Proposed MC
Proposed DHC
Proposed NSL
Proposed NSP
Proposed SWD
Proposed WFX
Proposed PMX X

Gentlemen:

I have examined the application for the:

Phillips Pet. Co. East Vacuum G/SA Unit Tr. 2622 #7, Tr. 2720 #8, Tr. 3202 #10
Operator Lease and Well No. Unit, S - T - R

and my recommendations are as follows:

O.K.----J.S.

Yours very truly,

jmc