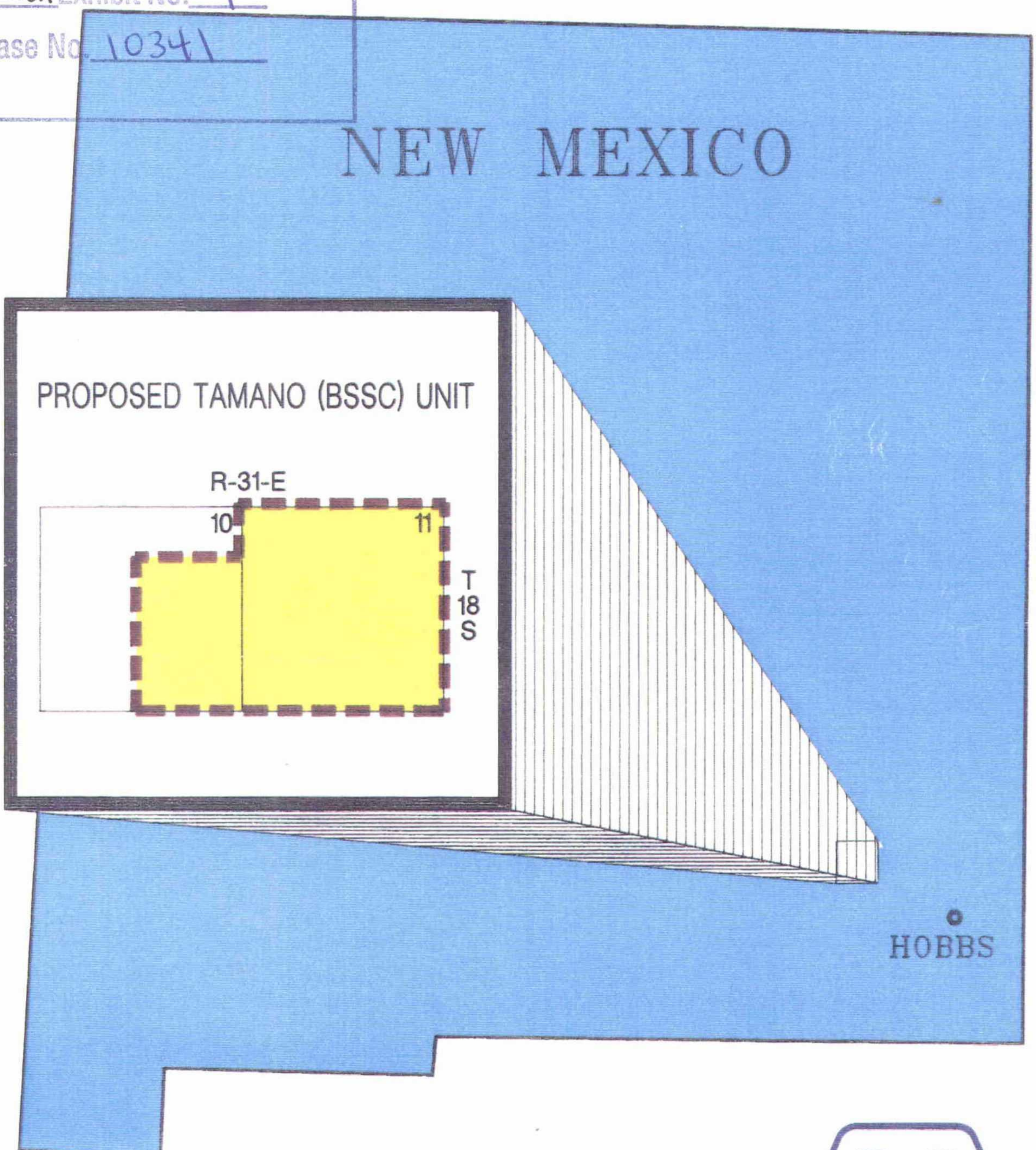
PROPOSED TAMANO (BSSC) UNIT
EDDY COUNTY, NEW MEXICO

WATERFLOOD FEASIBILITY STUDY
MARCH 1991



MARATHON OIL COMPANY

MARATHON

FEASIBILITY STUDY
PROPOSED BONE SPRING SECOND CARBONATE
WATERFLOOD UNIT
TAMANO FIELD
EDDY COUNTY, NEW MEXICO

MARATHON OIL COMPANY
MID-CONTINENT REGION

MARCH 1991

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PROPOSED BONE SPRING SECOND CARBONATE UNIT

TAMANO FIELD

EDDY COUNTY, NEW MEXICO

INTRODUCTION

The Bone Spring Second Carbonate (BSSC) reservoir was discovered in the Tamano Field by Marathon Oil Company in 1987. Ensuing development by Marathon, et. al. and Harvey E. Yates Company, HEYCO, et. al. found the BSSC to be productive under acreage contained within Section 10 and Section 11 of Township 18 South, Range 31 East, Eddy County, New Mexico. This acreage (Figure 1) is located halfway between the towns of Maljamar and Loco Hills, and is roughly 50 miles northwest of Hobbs, New Mexico.

Marathon has undertaken a study of the BSSC in order to determine the feasibility of implementing a secondary recovery project. Results of this study indicate that a profitable waterflood is possible under the present economic conditions.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. The Tamano BSSC has been reasonably delineated.

2. The BSSC reservoir in the Tamano Field has an original oil-in-place (OOIP) of 15,000,000 STBO.

3. Gross ultimate primary recovery is estimated to be 2,250,000 STBO, which represents 15 percent of the OOIP.

4. A peripheral waterflood yields the optimum results, from both a recovery and economic standpoint.

5. Incremental secondary gross reserves, if the waterflood is initiated on January 1, 1992, are estimated to be 2,250,000 STBO which yields a secondary-to-primary ratio of 1.0. Total ultimate recovery of 4,500,000 STBO represents 30 percent of the OOIP.

6. Deferment of water injection will result in the loss of secondary reserves. Model predictions show a loss of 900,000 STBO gross if injection begins on January 1, 1994.

7. An initial gross investment of $1,125,000 would be required to implement the flood. Unescalated ultimate gross investments of $1,513,000 are estimated.

8. Based on projected reserves and investments, this project would generate (assuming uninflated economics) an undiscounted net profit BFIT of $26,284,000 at an annual rate-of-return of 60.1 percent BFIT assuming a 100 percent working interest and 87.5 percent net revenue interest.

RECOMMENDATIONS

1. Marathon Oil Company commence formal unitization efforts of the BSSC.

2. A plan to develop a peripheral waterflood be ratified by Working Interest Owners on or before April 30, 1991.

3. A unit participation formula be ratified by Working Interest Owners on or before May 28, 1991. Ratification will allow for the filing of an application with the NMOCD to instigate a waterflood.

4. Marathon Oil Company represent the Working Interest Owners at all related New Mexico Oil Conservation Division proceedings.

5. Cumulative oil production from the BSSC through December, 1990 be used as the first basis for all voting procedures prior to ratification of a unit participation formula.

PURPOSE AND SCOPE

The purpose of this report is to document Marathon's evaluation of the BSSC of the Tamano Field in Eddy County, New Mexico. It is submitted to Working Interest Owners in the Tamano (Bone Spring) Field to highlight Marathon's recommendations. Results show that oil recovery can be increased in a profitable fashion by implementing a waterflood project and that delay of a pressure maintenance scheme could result in a loss of secondary reserves. Contained within the report are estimates of primary reserves, estimates of secondary reserves, a waterflood operation plan and an economic analysis of the waterflood project. Marathon believes that sufficient information has been provided to initiate unitization proceedings.

TRACT DESIGNATION AND UNITIZED AREA

The proposed Tamano (BSSC) Unit (Figure 2) encompasses 880 acres, of which 640 acres are in Section 11 and 240 acres are in Section 10, T-18-S, R-31-E, Eddy County, New Mexico. This area is felt to best represent the extent of the BSSC which will be impacted by the proposed waterflood scheme. Eight (8) tracts were divided based on existing knowledge of working and net revenue interests within the proposed unit area. Verification of each leasehold and division of interest will be requested from Marathon's Land Department after the initial meeting of the Working Interest Owners.

The proposed unit area was based on the known productive limits of the Second Bone Spring Carbonate. The Tamano (Bone Spring) Field has been delineated to the North, South and East by dry holes and marginal producing wells which clearly support the proposed unit boundary in these directions. The reservoir has been reasonably delineated to the West, which is consistent with material balance results. Three undeveloped 40 acre locations have been included within the proposed unit boundary. Future performance may support the development of these locations as the flood progresses.

VERTICAL INTERVAL TO BE UNITIZED

The vertical interval to be unitized in the proposed Tamano (BSSC) Unit is the Bone Spring Second Carbonate. This interval is correlative to the interval shown in the type log (Figure 3) from the Marathon Johnson "B" Federal No. 4, Section 11, T-18-S, R-31-E, Eddy County, New Mexico. This interval is 7,908 feet below KB (-4,156 feet subsea) to 8,190 feet below KB (-4,438 feet subsea). The BSSC is overlain by the Bone Spring First Sand, and underlain by the Bone Spring Second Sand.

GEOLOGICAL SUMMARY

Geological Summary

The reservoir for the proposed Tamano waterflood unit is the Second Carbonate of the Bone Spring formation. The Bone Spring formation is a basin and slope deposit consisting of shelf derived turbidite sandstones, slump and debris flow carbonates and basinal shales. Production commonly occurs from dolomitized toe-of-slope carbonate debris flow deposits such as the reservoir in the proposed unit (Figure 4), or from fine-grained, low permeability sands in submarine turbidite fan deposits.

REGIONAL STRUCTURE

Structure in the proposed unit area on the Bone Spring formation and specifically on the Second Carbonate reservoir dips generally down to the south-southeast at about 200 feet per mile, with some local variations in direction or amount of dip (Figure 5). This is consistent with the regional slope into the Delaware basin and reflects the depositional slope of the Bone Spring formation. Hydrocarbon trapping in this reservoir is stratigraphic in nature (Figures 6 and 7).

LITHOLOGY

The Bone Spring Second Carbonate in the proposed unit area is a tan to dark gray, very fine to medium crystalline dolomite with minor amounts of shale, limestone, pyrite, silt or fine-grained sand and anhydrite. Textures vary from finely laminated mudstones to grainstones to coarse rudstones. Interclasts range in size from a few millimeters to several inches or larger and are most commonly mud supported. Bioclastic material is common, consisting mainly of crinoid debris with lesser amounts of sponges, bryozoans and mollusks.

Porosity is entirely secondary consisting mainly of intercrystalline matrix porosity, solution vugs and fractures which are commonly solution enlarged. Fractures are irregular and frequently occur at high angles. Most fracturing is probably related to local depositional and early burial slope rather than to tectonic processes. Based on core analysis, formation micro-scanner data, and borehole televiewer surveys, fracturing appears to be local and random, which should not create a preferred direction of flow within the reservoir.

PETROPHYSICAL SUMMARY

Core data are available in four wells from the main pay interval of the Bone Spring Second Carbonate (BSSC). The average core permeability is 11.7 md and ranges from <.1 md to about 800 md. The average core porosity in this same interval is 4% ranging from <1% to >20%.

A typical log suite consists of density, neutron, natural gamma ray, and resistivity logs. Most wells have photoelectric factor measurements. Additional information such as sonic transit time, borehole imaging, dielectric and mechanical properties data are also available on selected wells.

The producing interval in the Bone Spring Carbonate typically runs about 130 to 140 feet with average log porosity ranging from 3% to 6%. This interval is located in the basal portion of the BSSC. Fluid transmissibility is enhanced via localized fracturing of the formation and solution enhancement of these fractures forming channel networks.

PRIMARY PRODUCTION PERFORMANCE

The first completion in the Bone Spring Second Carbonate was the Johnson "B" Federal A/C 1 Well No. 3 (Marathon Oil Company) on April 30, 1987. Initial production was 8 BOPD. For practical purposes, discovery is considered to be December 7, 1987 when the Johnson "B" Federal Well No. 4 (Marathon Oil Company, et. al.) flowed 40 BO in 2-1/2 hours to a frac tank during a drillstem test of the interval from 7,986 feet to 8,119 feet. Well No. 4 was eventually perforated from 8,060 feet to 8,150 feet in what is now referred to as the Bone Spring Second Carbonate main pay. It was completed on January 15, 1988 as a top allowable oil well at the rate of 230 BOPD.

Development of the BSSC main pay has continued through January, 1991. The reservoir was found to be productive in Section 10 and Section 11, Township 18 South, Range 31 East, Eddy County, New Mexico. The Johnson "B" Federal Well No. 4 is located in Section 11. Most of Section 11 was developed on 40-acre spacing in 1988. Field wide gross production reached 1,417 BOPD in January, 1989 from eight wells.

Further development of the field resumed in the Spring of 1990. All remaining available 40-acre locations in Section 11 were drilled. The reservoir was delineated by dry holes and marginal producers on three sides: North into Section 2, East into Section 12 and South into Section 14. The western extent of the reservoir was tested in August, 1990 when Marathon, et. al. drilled the Stetco "10" Federal Well No. 1 in the NE/4 SE/4 of Section 10. This well was capable of producing the allowable rate of 230 BOPD. Development of the Stetco "10" Federal lease progressed with the completion of Well No. 2 in December, 1990 and Well No. 3 in January, 1991. Field wide gross production continued to increase with development, peaking at 2,015 BOPD from 18 wells in December, 1990. Cumulative gross production through December, 1990 was 1,280,000 STBO. Figure 8 shows the production history of the field.

Production was increased not only by drilling, but by an increase in the depth-bracket allowable. By order of the New Mexico Oil Conservation Division, allowables for the Tamano BSSC were raised to 460 BOPD per well on November 15, 1990. This ruling affected four existing wells which had the capability of producing in excess of 230 BOPD, as well as the Stetco "10" Federal Well No. 3 upon its completion.

Current production is constrained by the maximum allowable gas rate of 920 MSCFGPD per well, which is derived from the oil allowable rate and a GOR limit of 2,000 SCFG per STBO.

Production performance from the BSSC is indicative of a solution gas drive reservoir. The reservoir was undersaturated with an initial pressure of 3,000 psia. Bubble point was determined to be 2,500 psia. Bottom water exists, however, the pressure history indicates that the aquifer is not lending pressure support to the reservoir. Average reservoir pressure was estimated to be 1,400 psia in December, 1990.

Marathon utilized a computer model as part of the evaluation of the BSSC main pay reservoir. Results from the computer model are considered to be the best estimate of reserves. An OOIP value of 15,000,000 STBO generates the best match of production and reservoir pressure. Ultimate gross primary reserves of 2,250,000 STBO are projected from the model (Figure 9). Gross remaining primary reserves as of January 1, 1991 would be 970,000 STBO.

RESERVOIR MODEL

Marathon utilized a black oil simulator, ECLIPSE™, as part of the evaluation of remaining primary reserves and feasibility study of a secondary recovery project. Input data for each well includes depths to layer tops for each of the 11 geologic layers, net pay and porosity by layer. Virgin reservoir pressure was 3,000 psia. A bubble point of 2,500 psia was determined from laboratory experiments using a downhole fluid sample from the Johnson "B" Federal Well No. 4. Production from May, 1987 through December, 1990 was used to history match the model. Reservoir pressures estimated from pressure transient tests were also incorporated into the history match.

An OOIP of 15,000,000 STBO was determined from a match of production and pressure. Ultimate primary production is projected to be 2,250,000 STBO for a primary recovery factor of 15 percent.

SECONDARY RECOVERY PLAN

Two secondary recovery methods examined were waterflooding and gas injection. Waterflooding was concluded to be more economically attractive than gas injection based on net present value projections. Hampering the economics associated with gas injection were the investment required to purchase make-up gas and high lease expenses resulting from compression. No additional work was performed on a gas injection process, and the evaluation focused on a waterflood scheme.

Two waterflood plans have been evaluated. One is a downdip waterflood in which three wells low on structure are converted to water injection initially. As offset producing wells water out, they are converted to injection wells. The other plan is a peripheral waterflood. Five perimeter wells are converted to water injection initially. Subsequent conversions occur as wells water out. Gross ultimate reserves are estimated from the ECLIPSE™ model to be as follows:

	DOWNDIP	PERIPHERAL
Primary Reserves, MSTBO	2,250	2,250
Secondary Reserves, MSTBO	1,350	2,250
Total Reserves, MSTBO	3,600	4,500
Secondary-to-Primary Ratio	0.60	1.00
Total, Unescalated Investments, M$	1,338	1,511
Total, Unescalated Expenses, M$	9,993	10,500

Figure 10 shows the projected net present value BFIT of each case using various discount factors. As the figure shows, the peripheral waterflood is economically superior and is the recommended plan of development. Table 1 is a summary of the two economic cases.

In the peripheral waterflood plan, five wells are converted to water injection initially. The five wells are: the A. J. "11" Federal Well No. 1 (HEYCO, et. al.), the Hudson "11" Federal Well No. 4 (HEYCO, et. al.), the Johnson "B" Federal A/C 1 Well No. 10 (Marathon, et. al.), the Marathon-Shugart "B" Well No. 1 (Marathon, et. al.) and the Stetco "10" Federal Well No. 3 (Marathon, et. al.). This injection pattern is shown on Figure 11. The wells were limited to an injection rate of 1,000 BWPD per well for a total field injection limit of 5,000 BWPD. Water injection begins on January 1, 1992. Water injection averages 3,500 BWPD for the first two years. In 1994, Johnson "B" Federal Wells No. 6 and 8 are converted to injection wells due to high producing water cuts. The five initial injection wells remain active. Water injection in 1994 averages approximately 5,000 BPD and is relatively constant for the remainder of the flood.

Gross production from the proposed Tamano (BSSC) Unit is estimated to be 932 BOPD on January 1, 1992. Decline is arrested as a result of the waterflood operations, although production falls off to approximately 400 BOPD in 1994 before peaking at 876 BOPD in 1996. Projections were made for several years, with ultimate reserves being estimated from economic limits. Figure 12 shows oil, gas and water production for both historical data and model projections. Figure 13 shows injected water rates, produced water rates and average reservoir pressure throughout the life of the proposed unit. Table 2 contains production estimates by year for the flood.

Injection water requirements were based on model predictions. Due to very limited water production rates from the BSSC reservoir, make-up water will be required throughout the life of the flood. Figure 14 shows produced and injection volumes. Make-up water requirements would be the difference between the two sets of volumes. Based on model predictions, a total of 25.8

MMBW will be injected throughout the life of the flood. Approximately 8.1 MMBBLS of make-up water will be required for the flood. Total make-up water expense is estimated to be $1,200,000 (uninflated) over the project life. The maximum make-up water requirement is projected to occur in 1994 at an average daily rate of 4,700 BWPD. Possible sources for make-up water are still being investigated.

Incentive to commence waterflood pressure maintenance is supported by Figure 15. This figure shows that if the waterflood is delayed for two years, ultimate recovery could be reduced by an estimated 900,000 STBO.

CAPITAL INVESTMENT

The initial, uninflated capital investment required to initiate the proposed peripheral waterflood is estimated to be $1,125,000. Included in this estimate are $748,000 for construction of an injection system, minor facility upgrades and consolidation. The remainder of the initial capital investment ($377,000) consists of five producer-to-injector conversions and two workovers to isolate the Bone Spring Second Sand. Future uninflated investments of $386,000 have been included to purchase additional lift equipment and well conversions. A summary of the required investments is shown in Table 3. All cost estimates cited herein, although believed to be representative for project evaluation purposes, will be refined and presented in final form through normal AFE procedures.

WELL CONVERSIONS, WORKOVERS AND ADDITIONAL LIFT EQUIPMENT

Initially, five wells are scheduled for conversion to water injection. Total costs to convert the five wells are estimated to be $362,000. Additional well work, in the form of Bone Spring

Second Sand isolation, is also required. Both the Johnson "B" Federal A/C 1 No. 3 and the Hudson "11" Federal No. 3 are downhole commingled in the Second Sand and Carbonate. Because only the Second Carbonate is to be included in the proposed unit, it is recommended the Second Sand be isolated with a cast iron bridge plug. Workover costs in the total amount of $15,000 are required to complete this work.

Based on model predictions, the existing producers will initially require no additional lift equipment. All the Marathon-operated wells which are slated as producers are capable of producing approximately 400 BFPD. In the future, the Johnson "B" Federal No. 4 and the A/C 1 No. 9 and No. 7 will require submersible pumping equipment. Well Nos. 4 and 9 will require pumps capable of approximately 600 BFPD. A future investment of $73,000 per installation is anticipated and has been included in the economics. A submersible pump capable of 2,000 BFPD will be required for Well No. 7. This will require an investment of $100,000 and has also been included in the economics.

OPERATING COSTS

Table 4 summarizes the projected yearly operating costs (uninflated) for primary depletion and waterflooding operations.

Figure 18 shows these expenses in graphical form. Based on 1990 data, the yearly operating expense was roughly $36,000/year/well on Marathon-operated leases. Because of extensive data collection (pressure buildups, crude sampling, PVT, etc.) during 1990, expenses will probably be less than the aforementioned amount as the field continues on depletion. However, due to the relatively short life of the field and limited lease expense history, $36,000/year/well was used to generate primary depletion economics.

Producing well expenses for secondary operations were estimated by increasing current expenses by 25%. Under this premise, expenses are estimated to be $45,000/year/well. Operating costs per injector were estimated to be $10,000/year/well. Additional expenses in the form of make-up water charges and costs to inject 5,000 BWPD are also required. Make up water charges are assumed to be $0.15/BW. Table 4 shows yearly makeup water expense. Figure 14 shows make-up water and reinjected water rates throughout the life of the flood. Costs to inject 5,000 BWPD at 2,500 psi are estimated to be $100,000/year.

SURFACE FACILITIES

Upgrade and consolidation of production facilities and construction of injection facilities will require an investment of $748,000 in the fourth quarter of 1991. A main battery consisting of both the production and injection facilities is proposed where the Johnson "B" Federal battery is presently located. Such a location would position the battery in the center of the unit area. Using production and injection rates from the reservoir model, the facility has been designed such that no future upgrades, with the exception of future injection well tie-ins, will be necessary. Because of the Tamano (Bone Spring) Field's recent development, most of the surface equipment is in excellent shape and almost the entire main battery, with the exception of the injection system, can be constructed using equipment already in place. Figure 16 shows the location of both the satellite and main battery locations as well as the injection system.

Production Facilities

Oil, gas and water from each producer will be directed to one of two test facilities. Wells in the north half of the unit will be directed to a satellite test facility. Wells in the north half are the Johnson "B" Federal A/C 1 Nos. 3, 7 and 9, Hudson "11" Federal Nos. 2, 3 and 5 and Stetco "10" Federal No. 2. The Johnson "B" Federal Nos. 5, 6 and 8, A. J. Federal No. 2 and Stetco "10" Federal No. 1 will be directed to the main battery.

The central battery (Figure 17) will provide facilities for oil, gas and water separation. To aid in gas separation, two 4' x 15' vertical gas separators will be set upstream of the free water knockout (FWKO). Both are currently set at the proposed main battery site and can be incorporated into the proposed facilities at minimal cost. Water production rates will require the purchase of a 8' x 20' two-phase FWKO downstream of the gas separators. Water derived by the FWKO will be directed to the adjacent water injection facility. Oil will be treated prior to transfer to stock tanks by an 8' x 20' and a 6' x 20' vertical heater treater. Both vessels are currently being used in the Tamano (Bone Spring) Field and are capable of handling the maximum oil production rates of approximately 900 BOPD. Gas production will be directed into Conoco's Maljamar Gas Plant at a line pressure of approximately 40 psig.

Injection Facilities

Injection facilities will be constructed at the main battery, and will be designed to handle a maximum of 6,000 BWPD at 2,500 psig. Produced water will be utilized, however, its initial contribution (<200 BPD) will be negligible. By requirement, the injection facility must have storage capacity of one half day's make-up water requirement. Water will be distributed to the injection wells via buried 2-3/8" injection line.

WATERFLOOD ECONOMICS

Uninflated incremental waterflood economics were run using an initial investment of $1,125,000. A future investment of $386,000 was also included. Table 2 shows primary depletion and secondary recovery production forecasts. To simplify the results, economics were run based on a 100% WI and 87.5% NRI. Initial 1992 oil and gas prices of $20.96/BBL (gravity adjusted) and $2.01/MCF, respectively, were used to evaluate waterflooding economics.

Table 1 provides a summary of pertinent economic parameters. Results of the incremental economics indicate a 3.6 year BFIT payout from an initial investment of $1,125,000. The project has a BFIT DCF/ROR of 60.1% and a profit-to-investment of 11.5. In addition, the project has an incremental BFIT cumulative cash flow of $26,284,000. Figure 19 shows this graphically. Table 1 shows that the payout and rate of return are better for the downdip case. However, reserves, NPV and cumulative cash flow are all significantly greater for a peripheral flood and have guided the recommendation of a peripheral flood.

Net oil reserves of 1,979 MBBLS (87.5% NRI) are expected due to waterflooding. A loss of 1.098 BCFG is predicted. This loss can be attributed to retaining gas in the reservoir as part of the residual hydrocarbon saturation due to waterflooding. Based on the oil recovery predictions, development costs are $0.84/NEB. Table 5 shows the incremental economic summary of the proposed waterflood.

RECOMMENDED PARTICIPATION PARAMETERS

Based on Marathon's experience in the Tamano (BSSC) Field, the use of parameters such as cumulative oil production, current oil rate, remaining primary reserves and estimated ultimate primary recovery should be used in establishing participation parameters. Marathon believes the use of parameters based on production are the most equitable. Table 6 is a preliminary unitization parameter table which includes cumulative oil production thru March, 1991, six-month oil rate, remaining primary reserves as of April 1, 1991 and estimated ultimate primary oil recovery. Oil rates and produced volumes from January 1, 1991 through March 31, 1991 were estimated using either traditional decline curve analysis or the reservoir model. Decline analysis was utilized on wells with established declines. Performance of top allowable producers and wells with limited production history were evaluated using the reservoir model. When production data is available for the first quarter of 1991, this table will be updated and compiled on both a well and tract basis. As unitization proceeds, the deletion of these parameters and/or the addition of other parameters can be adopted by the working interest owners.

Table 7 was constructed to show each working interest owner the range of interest based on these parameters.

Marathon recommends cumulative oil production through December, 1990 serve as the basis for initial voting procedures prior to ratification of a unit participation formula. Cumulative oil production is summarized in Table 8. Production figures are tabulated on a tract basis. Where possible, production figures have been tabulated by Working Interest Owner as shown in Table 9. The source of production data is from the State of New Mexico's Form C-115 monthly production reports submitted by the operators in the Tamano (Bone Spring) Field. After the initial Working Interest Owner's meeting, complete ownership information will be obtained for each tract.

TABLE 1

ECONOMIC SUMMARY
PERIPHERAL VERSUS DOWNDIP WATERFLOOD

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

	DOWNDIP WATERFLOOD	PERIPHERAL WATERFLOOD
Gross Investment, M$		
Current Year	985	1,125
Future	353	386
Incremental Payout, Years	2.94	3.47
DCF/ROR (BFIT), %	62.05	60.11
Net Present Value (@15% BFIT)	5,087	9,394
Profit/Investment (BFIT), $/$	11.13	17.39
Incremental Cumulative BFIT Cashflow, M$	14,901	26,284
Incremental Investment/NBOE, $/NBOE	1.12	0.84
Incremental Reserves, MBO	1,324	1,979
MMCF	-780	-1,098
MNBOE (6:1)	1,194	1,795

TABLE 2

PROJECTION OF GROSS PRODUCTION
PERIPHERAL WATERFLOOD
PROPOSED TAMANO (BSSC) UNIT

	PRIMARY DEPLETION			PERIPHERAL WATERFLOOD		
YEAR	BOPD	MSCFGPD	BWPD	BOPD	MSCFGPD	BWPD
1987	8	6	0	8	6	0
1988	673	514	5	673	514	5
1989	1308	1004	56	1308	1004	56
1990	1482	2636	76	1482	2636	76
1991	1407	8238	102	1407	8418	102
1992	706	8505	104	705	6636	226
1993	360	4434	104	589	3264	453
1994	137	1471	31	435	1023	229
1995	52	577	10	533	266	836
1996	22	204	4	868	137	2595
1997	14	102	2	815	118	3230
1998	9	59	1	751	123	4180
1999	8	52	0	691	104	4246
2000	7	45	0	516	79	4359
2001				395	62	4469
2002				323	52	4563
2003				271	44	4634
2004				233	38	4662
2005				204	34	4679
2006				181	30	4733

TABLE 3

WATERFLOOD INVESTMENT SCHEDULE

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

YEAR	ITEM	TANGIBLE (M$)	INTANGIBLE (M$)	TOTAL (M$)
1991 (4th Qtr)	Main Battery Consolidation & Injection Facility Construction	433	315	748
	Convert 5 wells to Injection	159	203	362
	Isolate Second Sand in 2 wells	—	15	15
Subtotal 1991 (4th Qtr)		592	533	1,125
1994	Convert 2 wells to Injection	63	77	140
1997	Larger Lift Equipment	53	20	73
1998	Larger Lift Equipment	80	20	100
2002	Larger Lift Equipment	53	20	73
Grand Total		841	670	1,511

TABLE 4

PRIMARY DEPLETION AND WATERFLOOD
OPERATING EXPENSES

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

		PERIPHERAL WATERFLOOD		
YEAR	PRIMARY DEPLETION EXPENSES ($)	INCREMENTAL DIRECT LEASE EXPENSE ($)	MAKE-UP WATER EXPENSE ($)	TOTAL OPERATING EXPENSE ($)
1992	663,000	99,000	177,000	939,000
1993	582,000	132,000	166,000	880,000
1994	441,000	161,000	260,000	862,000
1995	312,000	253,000	246,000	811,000
1996	90,000	439,000	130,000	659,000
1997	72,000	464,000	59,000	595,000
1998	36,000	587,000	43,000	666,000
1999	36,000	587,000	28,000	651,000
2000	36,000	587,000	28,000	651,000
2001	--	623,000	23,000	646,000
2002	--	637,000	19,000	656,000
2003	--	637,000	16,000	653,000
2004	--	626,000	15,000	641,000
2005	--	592,000	13,000	605,000
2006	--	592,000	11,000	603,000

TABLE 5

INCREMENTAL ECONOMIC ANALYSIS
TAMANO UNIT (INCR) PERIPHERAL H_2O FLOOD
VS.
TAMANO UNIT (BASE) DEPLETION
AS OF JANUARY, 1992

YEAR	DAILY NET LIQUIDS (BBLS/D)	DAILY NET GAS (MCF/D)	TOTAL OPERATING REVENUE (M$)	TOTAL OPERATING EXPENSE (M$)	TOTAL INVESTMENT (M$)	BFIT CASH FLOW (M$)
0					1,125	-1,125
1992	-1	-1,635	-1,206	159	0	-1,365
1993	200	-1,024	782	362	0	419
1994	261	-392	1,707	562	140	1,005
1995	421	-272	3,020	748	0	2,272
1996	740	-59	5,620	1,032	0	4,588
1997	701	14	5,372	966	73	4,334
1998	649	56	5,008	1,043	100	3,865
1999	598	46	4,605	994	0	3,611
2000	445	30	3,429	898	0	2,532
2001	346	54	2,684	867	0	1,817
2002	283	46	2,196	837	73	1,286
2003	237	39	1,842	805	0	1,038
2004	204	33	1,584	772	0	813
2005	179	30	1,387	719	0	668
2006	158	26	1,231	704	0	526
TOTAL	1,978,528	-1,098,331	39,262	11,467	1,511	26,284

INCREMENTAL NET RESERVES (1000'S)

OIL	(BBLS)	1979
GAS	(MCF)	-1098
COND.	(BBLS)	0
PL. LIQ.	(BBLS)	0
SULFUR	(LT)	0
TOTAL EQUIV. BBLS		1,873
TOTAL EQUIV 6:1 BBLS		1,795

INCR. LIQUID REVENUE (M$)	41,470
INCR. GAS REVENUE	-2,208
INCR. LIQUID PRICE ($/BBL)	20.96
INCR. GAS PRICE ($/MCF)	2.01

	BFIT (M$)
NPV AT 5%	18,279
NPV AT 10%	13,001
NPV AT 13%	10,682
NPV AT 15%	9,394
NPV AT 20%	6,851
NPV AT 25%	5,010
NPV AT 30%	3,646
NPV AT 35%	2,616
NPV AT 40%	1,823
NPV AT 45%	1,204
NPV AT 50%	715

	BFIT
PROFIT/INVESTMENT	17.39
PAYOUT, YEARS	3.67
DCF-ROR, %	60.11
INCR. INV/EQ BBL	0.84
AFIT PROFIT/EQ BBL	9.66
OPER EXP/EQ BBL	6.39

TABLE 6

PRELIMINARY UNITIZATION PARAMETER TABLE

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

(PRODUCTION DATA ESTIMATED FROM 1/91 THRU 3/91)

WELL	CUMULATIVE OIL THRU 3/91	%	OIL RATE 10/90-3/91	%	REM PRIM OIL AS OF 4/91	%	ESTIMATED ULTIMATE PRIM OIL	%
JBF #3	12,490	0.85	947	0.27	3,664	0.52	16,154	0.75
JBF #4	237,811	16.21	19,851	5.69	24,197	3.45	262,008	12.09
JBF #5	48,466	3.30	2,384	0.68	10,749	1.53	59,215	2.73
JBF #6	245,647	16.74	61,931	17.75	89,422	12.77	335,069	15.46
JBF #7	215,312	14.68	23,454	6.72	145,504	20.77	360,816	16.65
JBF #8	174,569	11.90	18,930	5.43	37,759	5.39	212,328	9.80
JBF #9	73,516	5.01	52,230	14.97	65,178	9.31	138,694	6.40
JBF #10	4,049	0.28	4,049	1.16	7,055	1.01	11,104	0.51
SHUG B1	32,966	2.25	1,923	0.55	11,663	1.67	44,629	2.06
SHUG B2	89,655	6.11	52,594	15.07	76,419	10.91	166,074	7.66
STETCO #1	66,734	4.55	57,604	16.51	75,599	10.79	142,333	6.57
STETCO #2	1,620	0.11	1,620	0.46	12,775	1.82	14,395	0.66
STETCO #3	27,637	1.88	27,637	7.92	85,396	12.19	113,033	5.21
STETCO #4	0	0.00	0	0.00	0	0.00	0	0.00
STETCO #5	0	0.00	0	0.00	0	0.00	0	0.00
STETCO #6	0	0.00	0	0.00	0	0.00	0	0.00
AJ 11 #1	37,289	2.54	4,272	1.22	14,070	2.01	51,359	2.37
AJ 11 #2	20,134	1.37	1,866	0.53	1,798	0.26	21,932	1.01
HUD 11 #2	13,159	0.90	1,208	0.35	7,102	1.01	20,261	0.93
HUD 11 #3	37,668	2.57	3,988	1.14	5,821	0.83	43,489	2.01
HUD 11 #4	123,281	8.40	9,223	2.64	17,503	2.50	140,784	6.50
HUD 11 #5	5,074	0.35	3,229	0.93	8,763	1.25	13,837	0.64
	1,467,077	100.00	348,940	100.00	700,437	100.00	2,167,514	100.00

TABLE 7

PARAMETER TABULATION
OWNER SUMMARY

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

(PRODUCTION DATA ESTIMATED FROM 1/91 THRU 3/91)

WORKING INTEREST OWNER	TRACT NOS.	CUMULATIVE OIL THRU 3/91 WI	OIL RATE 10/90-3/91 WI	REM PRIM OIL AS OF 4/91 WI	ESTIMATED ULTIMATE PRIM OIL WI
MARATHON	3,4,5,6,7	60.12687	59.45738	61.62574	60.61123
PENNZOIL	4,5	1.91113	7.27088	7.24634	3.63522
WAINOCO	4,5	1.36037	5.17553	5.15806	2.58760
F.H. HUDSON	4,5,6,7	8.35385	7.72139	6.37856	7.71553
HUDSON TRUSTEES	4,5	0.69519	2.64486	2.63593	1.32235
HUDSON TRUST	6,7	8.00625	6.39896	5.06060	7.05435
SHELTON & MOORE	4,5,6,7	3.07109	3.19193	2.71642	2.95648
DELMAR H. LEWIS	4,5	0.34760	1.32243	1.31797	0.66117
HARVEY E. YATES COMPANY	1,2,8	4.95777	2.02894	2.25859	4.08552
JAMES H. YATES, Inc.	1,2,8	0.00948	0.00371	0.00392	0.00769
COLKELAN CORPORATION	1,2,8	0.00948	0.00371	0.00392	0.00769
EXPLORERS PETROLEUM Corp.	1,2,8	0.58688	0.23342	0.25136	0.47845
EXBY, Ltd.	1,2,8	0.20160	0.08521	0.09825	0.16820
HEYCO EMPLOYEES Ltd.	1,2,8	0.34821	0.13624	0.14380	0.28216
SPIRAL, Inc.	1,2,8	0.74459	0.30349	0.33629	0.61265
YATES ENERGY CORPORATION	1,2,8	4.27761	1.67368	1.76644	3.46612
ATLANTIC RICHFIELD COMPANY	1,8	2.57846	1.51530	2.26523	2.47724
KERR MCGEE	2	2.19415	0.75721	0.66598	1.70032
LAURELIND CORPORATION	2	0.21941	0.07572	0.06660	0.17003
		100.00000	100.00000	100.00000	100.00000

TABLE 8
PAGE 1

CUMULATIVE OIL PRODUCTION
BY TRACT, OPERATOR AND WORKING
INTEREST OWNER
(REVISED 3/22/91)

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

TRACT #	OPERATOR	WIO'S	LEASE	CUMULATIVE OIL PROD. THRU 12/90 BO	% OF TOTAL UNIT
1	HEYCO		HUDSON "11" FEDERAL NOS. 2 & 5		
		HARVEY E. YATES COMPANY		4,159	0.32387
		JAMES H. YATES		6	0.00045
		COLKELAN CORPORATION		6	0.00045
		EXPLORERS PETROLEUM CORPORATION		404	0.03146
		EXBY, Ltd.		205	0.01593
		HEYCO EMPLOYEES Ltd.		210	0.01637
		SPIRAL, Inc.		608	0.04739
		YATES ENERGY CORPORATION		2,583	0.20111
		ATLANTIC RICHFIELD COMPANY		8,180	0.63702
		TRACT 1 SUBTOTAL		16,360	1.27403
2	HEYCO		HUDSON "11" FEDERAL NOS. 3 & 4		
		HARVEY E. YATES COMPANY		51,619	4.01986
		JAMES H. YATES		109	0.00847
		COLKELAN CORPORATION		109	0.00847
		EXPLORERS PETROLEUM CORPORATION		6,505	0.50654
		EXBY, Ltd.		1,941	0.15116
		HEYCO EMPLOYEES Ltd.		3,991	0.31079
		SPIRAL, Inc.		7,824	0.60933
		YATES ENERGY CORPORATION		49,025	3.81784
		KERR MCGEE		31,057	2.41857
		LAURELIND CORPORATION		3,106	0.24186
		TRACT 2 SUBTOTAL		155,286	12.09287
3	MARATHON		JOHNSON "B" FEDERAL A/C 1		
		MARATHON		266,294	20.73760
		TRACT 3 SUBTOTAL		266,294	20.73760
4	MARATHON		STETCO "10" FEDERAL NO. 2		
		SHELTON & MOORE		31	0.00238
		F. H. HUDSON		43	0.00337
		DELMAR LEWIS		43	0.00337
		HUDSON TRUSTEES		87	0.00674
		WAINOCO		169	0.01320
		MARATHON		204	0.01587
		PENNZOIL		238	0.01854
		TRACT 4 SUBTOTAL		815	0.06347

CUMULATIVE OIL PRODUCTION
BY TRACT, OPERATOR AND WORKING
INTEREST OWNER
(REVISED 3/22/91)

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

TRACT #	OPERATOR	WIO'S	LEASE	CUMULATIVE OIL PROD. THRU 12/90 BO	% OF TOTAL UNIT
5	MARATHON		STETCO "10" FEDERAL NOS. 1 & 3		
		SHELTON & MOORE		1,480	0.11526
		F. H. HUDSON		2,097	0.16329
		DELMAR LEWIS		2,097	0.16329
		HUDSON TRUSTEES		4,194	0.32658
		WAINOCO		8,206	0.63906
		MARATHON		9,868	0.76843
		PENNZOIL		11,529	0.89780
		TRACT 5 SUBTOTAL		39,470	3.07372
6	MARATHON		MOC-SHUGART "B"		
		SHELTON & MOORE		4,683	0.36470
		F. H. HUDSON		13,269	1.03333
		HUDSON TRUST		13,269	1.03333
		MARATHON		62,443	4.86271
		TRACT 6 SUBTOTAL		93,664	7.29407
7	MARATHON		JOHNSON "B" FEDERAL		
		SHELTON & MOORE		32,890	2.56131
		F. H. HUDSON		93,189	7.25706
		HUDSON TRUST		93,189	7.25706
		MARATHON		438,535	34.15086
		TRACT 7 SUBTOTAL		657,803	51.22629
8	HEYCO		AJ FEDERAL		
		HARVEY E. YATES COMPANY		13,834	1.07732
		JAMES H. YATES		19	0.00148
		COLKELAN CORPORATION		19	0.00148
		EXPLORERS PETROLEUM CORPORATION		1,344	0.10465
		EXBY, Ltd.		680	0.05297
		HEYCO EMPLOYEES Ltd.		699	0.05446
		SPIRAL, Inc.		2,024	0.15763
		YATES ENERGY CORPORATION		8,590	0.66898
		ATLANTIC RICHFIELD COMPANY		27,210	2.11897
		TRACT 8 SUBTOTAL		54,420	4.23795
GRAND TOTAL				1,284,112	100.00000

TABLE 9
PAGE 1

OWNER SUMMARY
CUMULATIVE OIL PRODUCTION
BY WORKING INTEREST OWNER
(REVISED 3/22/91)

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

WIO	TRACT #	LEASE	CUMULATIVE OIL PROD. THRU 12/90 BO	% OF TOTAL UNIT
MARATHON	3	JOHNSON "B" FEDERAL A/C 1	266,294	20.73760
	4	STETCO "10" FEDERAL NO. 2	204	0.01587
	5	STETCO "10" FEDERAL NOS. 1 & 3	9,868	0.76843
	6	MOC-SHUGART "B"	62,443	4.86271
	7	JOHNSON "B" FEDERAL	438,535	34.15086
			777,343	60.53547
F. H. HUDSON	4	STETCO "10" FEDERAL NO. 2	43	0.00337
	5	STETCO "10" FEDERAL NOS. 1 & 3	2,097	0.16329
	6	MOC-SHUGART "B"	13,269	1.03333
	7	JOHNSON "B" FEDERAL	93,189	7.25706
			108,598	8.45705
HUDSON TRUST	6	MOC-SHUGART "B"	13,269	1.03333
	7	JOHNSON "B" FEDERAL	93,189	7.25706
			106,458	8.29039
HARVEY E. YATES COMPANY	1	HUDSON "11" FEDERAL NOS. 2 & 5	4,159	0.32387
	2	HUDSON "11" FEDERAL NOS. 3 & 4	51,619	4.01986
	8	AJ FEDERAL	13,834	1.07732
			69,612	5.42104
YATES ENERGY CORPORATION	1	HUDSON "11" FEDERAL NOS. 2 & 5	2,583	0.20111
	2	HUDSON "11" FEDERAL NOS. 3 & 4	49,025	3.81784
	8	AJ FEDERAL	8,590	0.66898
			60,198	4.68793
SHELTON & MOORE	4	STETCO "10" FEDERAL NO. 2	31	0.00238
	5	STETCO "10" FEDERAL NOS. 1 & 3	1,480	0.11526
	6	MOC-SHUGART "B"	4,683	0.36470
	7	JOHNSON "B" FEDERAL	32,890	2.56131
			39,084	3.04366
ATLANTIC RICHFIELD COMPANY	1	HUDSON "11" FEDERAL NOS. 2 & 5	8,180	0.63702
	8	AJ FEDERAL	27,210	2.11897
			35,390	2.75599
KERR MCGEE	2	HUDSON "11" FEDERAL NOS. 3 & 4	31,057	2.41857
			31,057	2.41857
PENNZOIL	4	STETCO "10" FEDERAL NO. 2	238	0.01854
	5	STETCO "10" FEDERAL NOS. 1 & 3	11,529	0.89780
			11,767	0.91633
SPIRAL, Inc.	1	HUDSON "11" FEDERAL NOS. 2 & 5	608	0.04739
	2	HUDSON "11" FEDERAL NOS. 3 & 4	7,824	0.60933
	8	AJ FEDERAL	2,024	0.15763
			10,457	0.81434

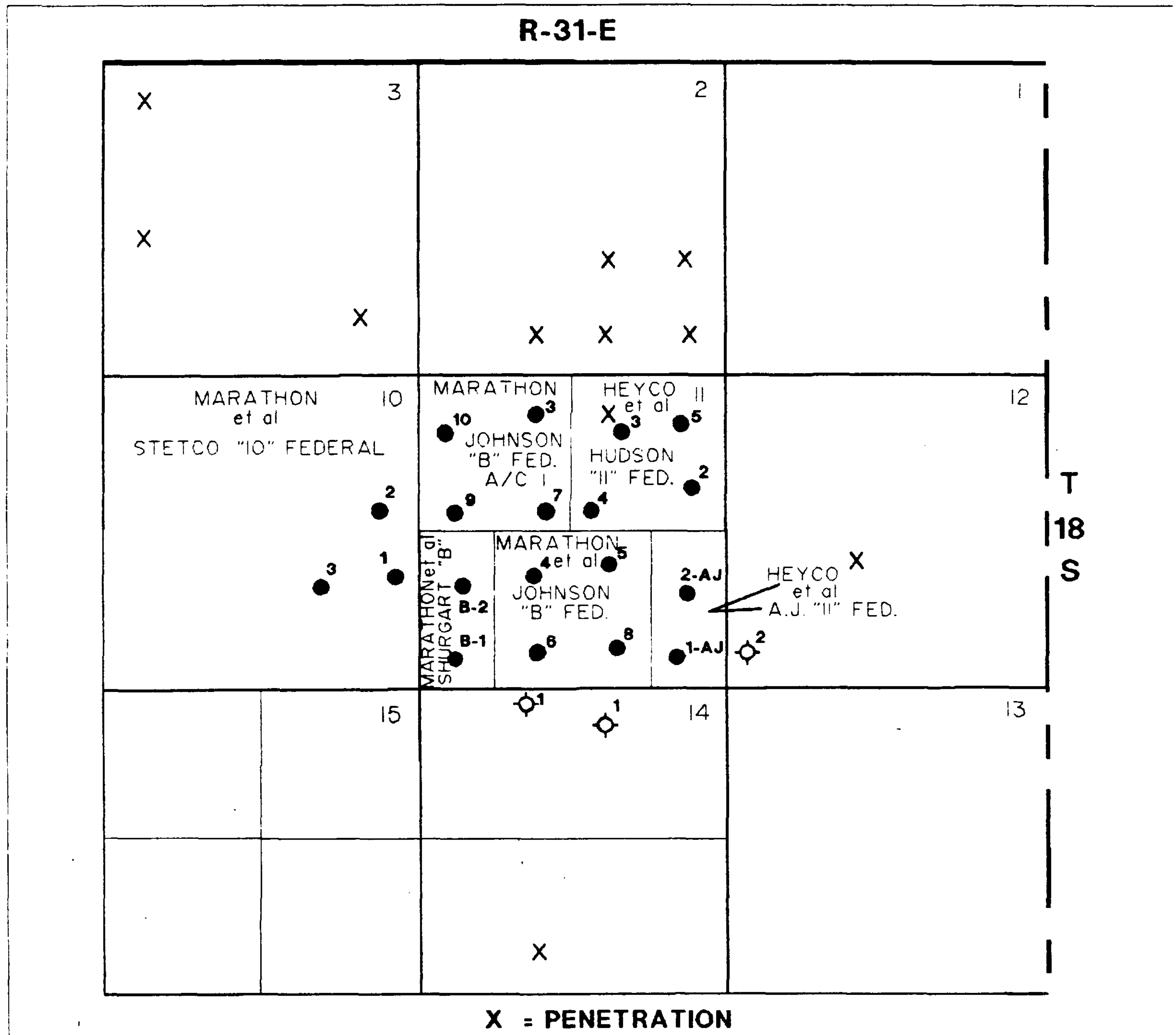
TABLE 9
PAGE 2

OWNER SUMMARY
CUMULATIVE OIL PRODUCTION
BY WORKING INTEREST OWNER
(REVISED 3/22/91)

PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

WIO	TRACT #	LEASE	CUMULATIVE OIL PROD. THRU 12/90 BO	% OF TOTAL UNIT
WAINOCO	4	STETCO "10" FEDERAL NO. 2	169	0.01320
	5	STETCO "10" FEDERAL NOS. 1 & 3	8,206	0.63906
			8,376	0.65226
EXPLORERS PETROLEUM CORPORATION	1	HUDSON "11" FEDERAL NOS. 2 & 5	404	0.03146
	2	HUDSON "11" FEDERAL NOS. 3 & 4	6,505	0.50654
	8	AJ FEDERAL	1,344	0.10465
			8,252	0.64265
HEYCO EMPLOYEES Ltd.	1	HUDSON "11" FEDERAL NOS. 2 & 5	210	0.01637
	2	HUDSON "11" FEDERAL NOS. 3 & 4	3,991	0.31079
	8	AJ FEDERAL	699	0.05446
			4,900	0.38162
HUDSON TRUSTEES	4	STETCO "10" FEDERAL NO. 2	87	0.00674
	5	STETCO "10" FEDERAL NOS. 1 & 3	4,194	0.32658
			4,280	0.33333
LAURELIND CORPORATION	2	HUDSON "11" FEDERAL NOS. 3 & 4	3,106	0.24186
			3,106	0.24186
EXBY, Ltd.	1	HUDSON "11" FEDERAL NOS. 2 & 5	205	0.01593
	2	HUDSON "11" FEDERAL NOS. 3 & 4	1,941	0.15116
	8	AJ FEDERAL	680	0.05297
			2,826	0.22006
DELMAR LEWIS	4	STETCO "10" FEDERAL NO. 2	43	0.00337
	5	STETCO "10" FEDERAL NOS. 1 & 3	2,097	0.16329
			2,140	0.16666
JAMES H. YATES	1	HUDSON "11" FEDERAL NOS. 2 & 5	6	0.00045
	2	HUDSON "11" FEDERAL NOS. 3 & 4	109	0.00847
	8	AJ FEDERAL	19	0.00148
			133	0.01039
COLKELAN CORPORATION	1	HUDSON "11" FEDERAL NOS. 2 & 5	6	0.00045
	2	HUDSON "11" FEDERAL NOS. 3 & 4	109	0.00847
	8	AJ FEDERAL	19	0.00148
			133	0.01039
GRAND TOTAL			1,284,112	100.00000

FIGURE 1



● BONE SPRING SECOND CARBONATE PRODUCER

MARATHON OIL COMPANY
MID-CONTINENT REGION

TAMANO (BSSC) FIELD

EDDY COUNTY, NEW MEXICO

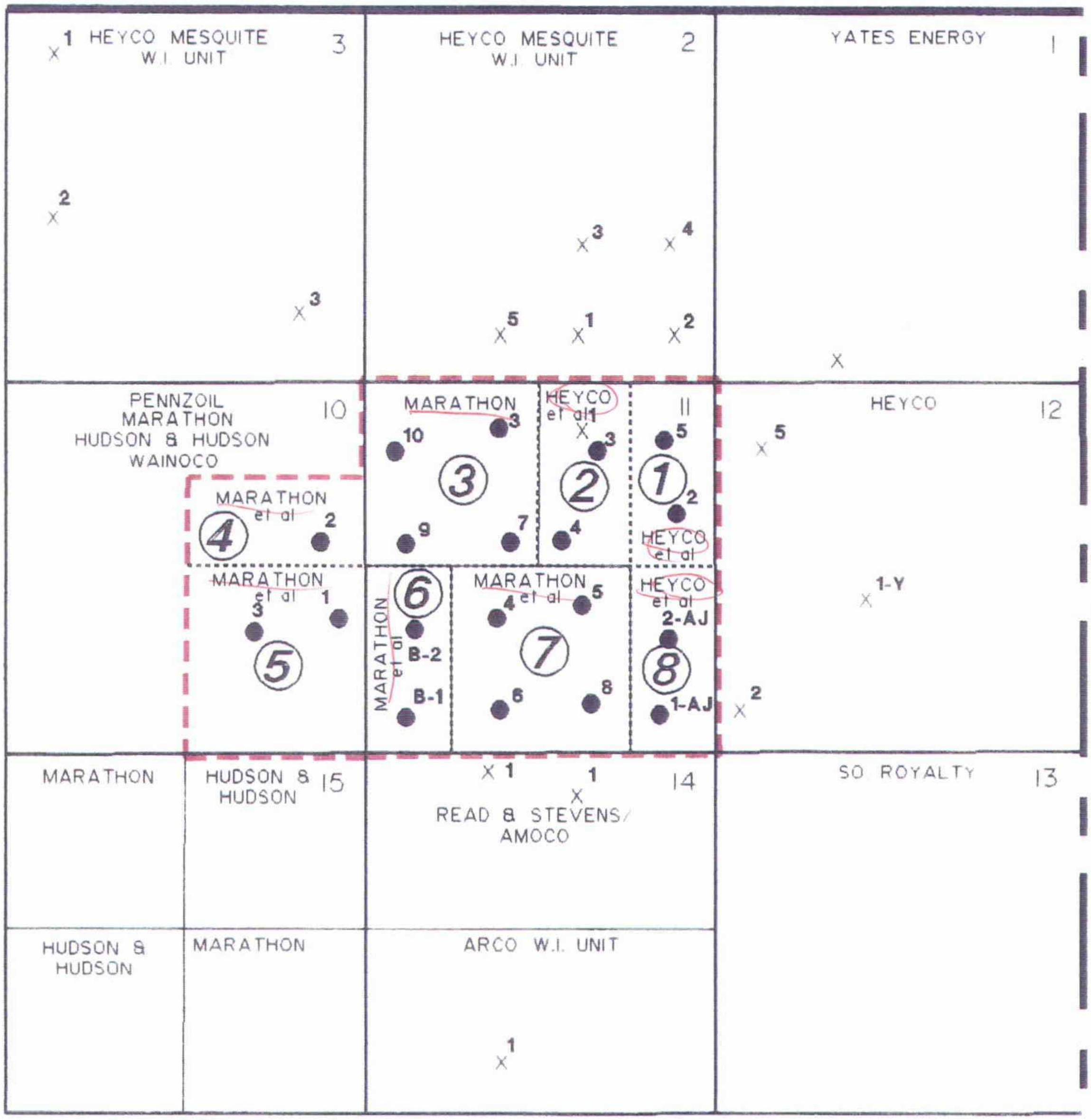
LEASE PLAT

0 1/2 1
MILE

MARCH 1991

FIGURE 2

R-31-E



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

(1) TRACT NUMBER

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

TRACT MAP SHOWING OPERATORS WITHIN PROPOSED UNIT BOUNDARIES

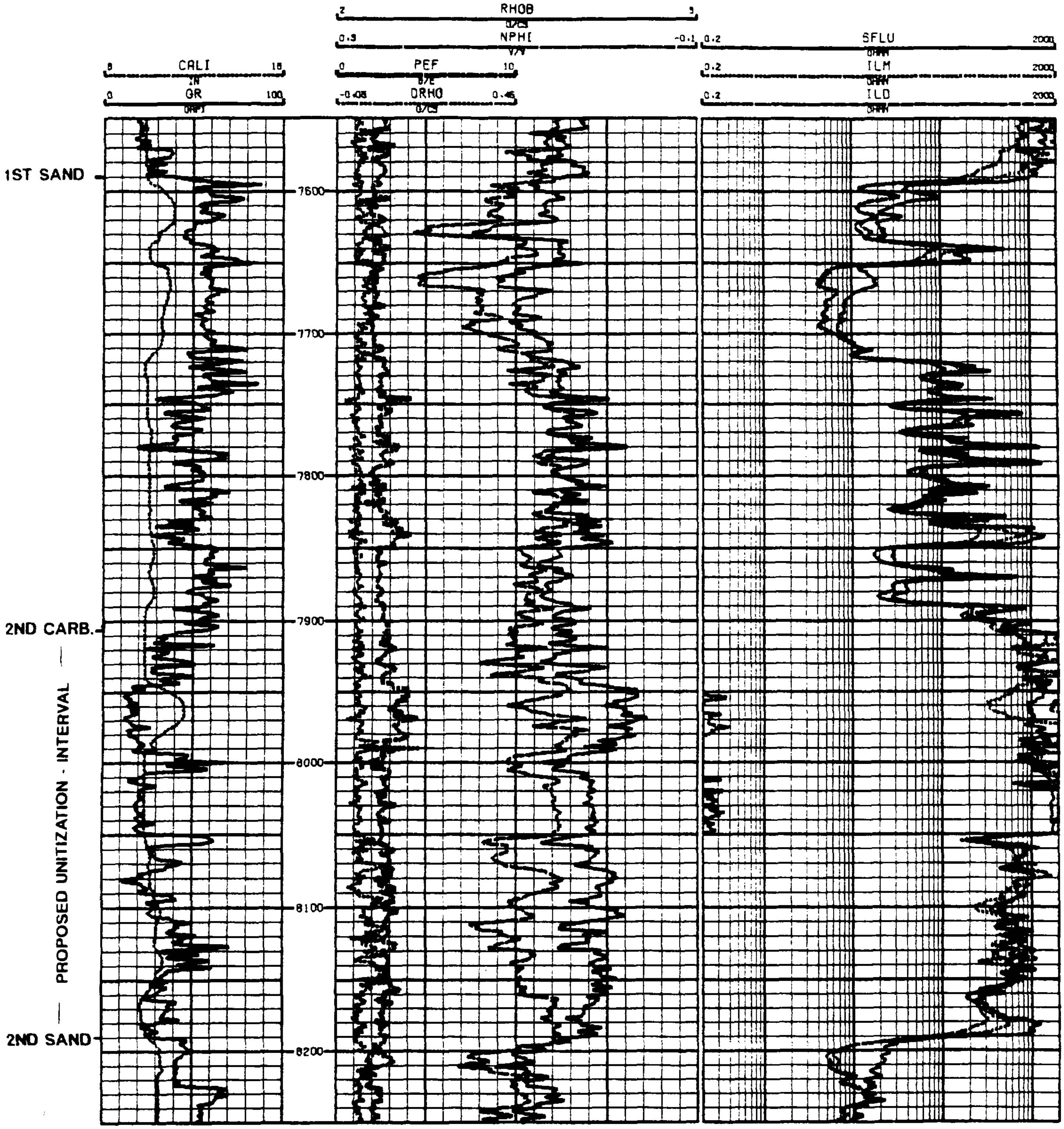
0 1/4 1/2

MILE

1-91

7854 AFE

FIGURE 3



K.B. 3752'
G.L. 3736'

MARATHON OIL COMPANY
MID-CONTINENT REGION

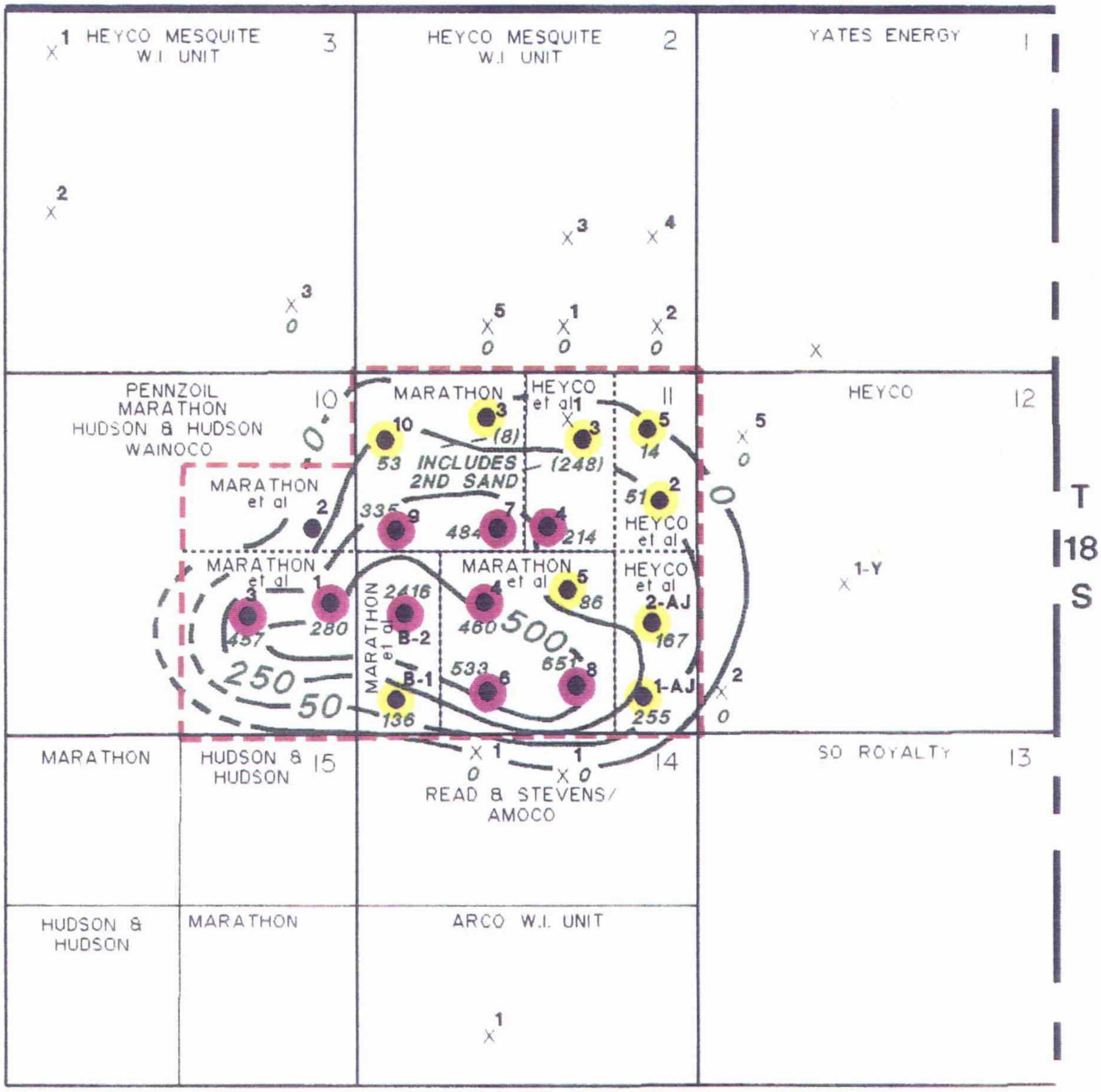
TAMANO (BSSC) UNIT

EDDY COUNTY, NEW MEXICO

TYPE LOG
JOHNSON "B" FEDERAL #4

FIGURE 4

R-31-E



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED
UNIT BOUNDARY

PUMP

FLOW

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED
TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

INITIAL POTENTIAL
IN BOPD

0 1/4 1/2

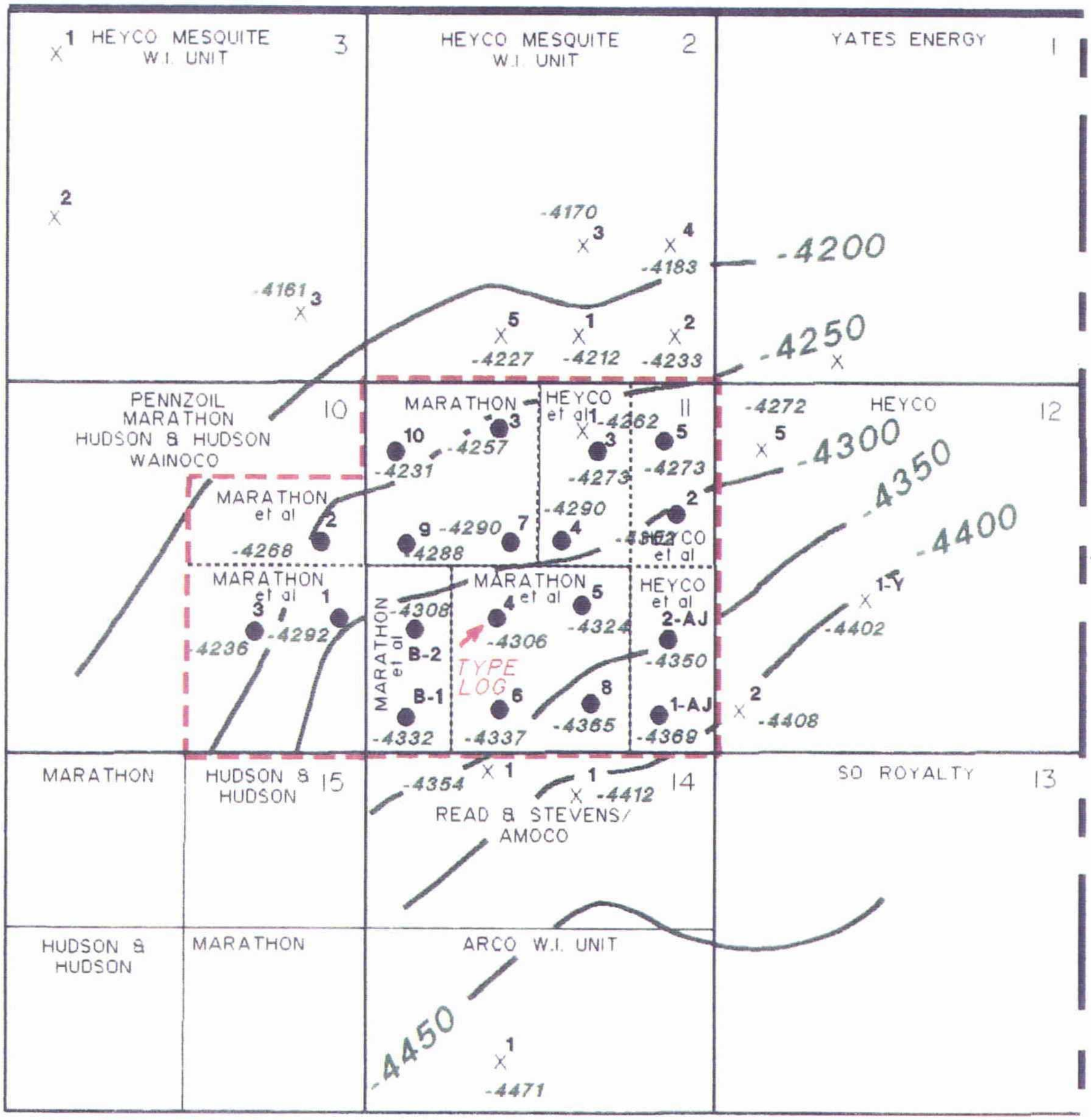
MILE

1-91

TBS4 AFE

FIGURE 5

R-31-E



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

SUBSURFACE STRUCTURE MAP
TOP OF MAIN PAY
2nd CARBONATE
C.I.: 50'

0 1/4 1/2

MILE

1-91

TB54.AFE

FIGURE 6

TAMANO BSSC UNIT
BONE SPRING DEPOSITIONAL MODEL

SCHEMATIC

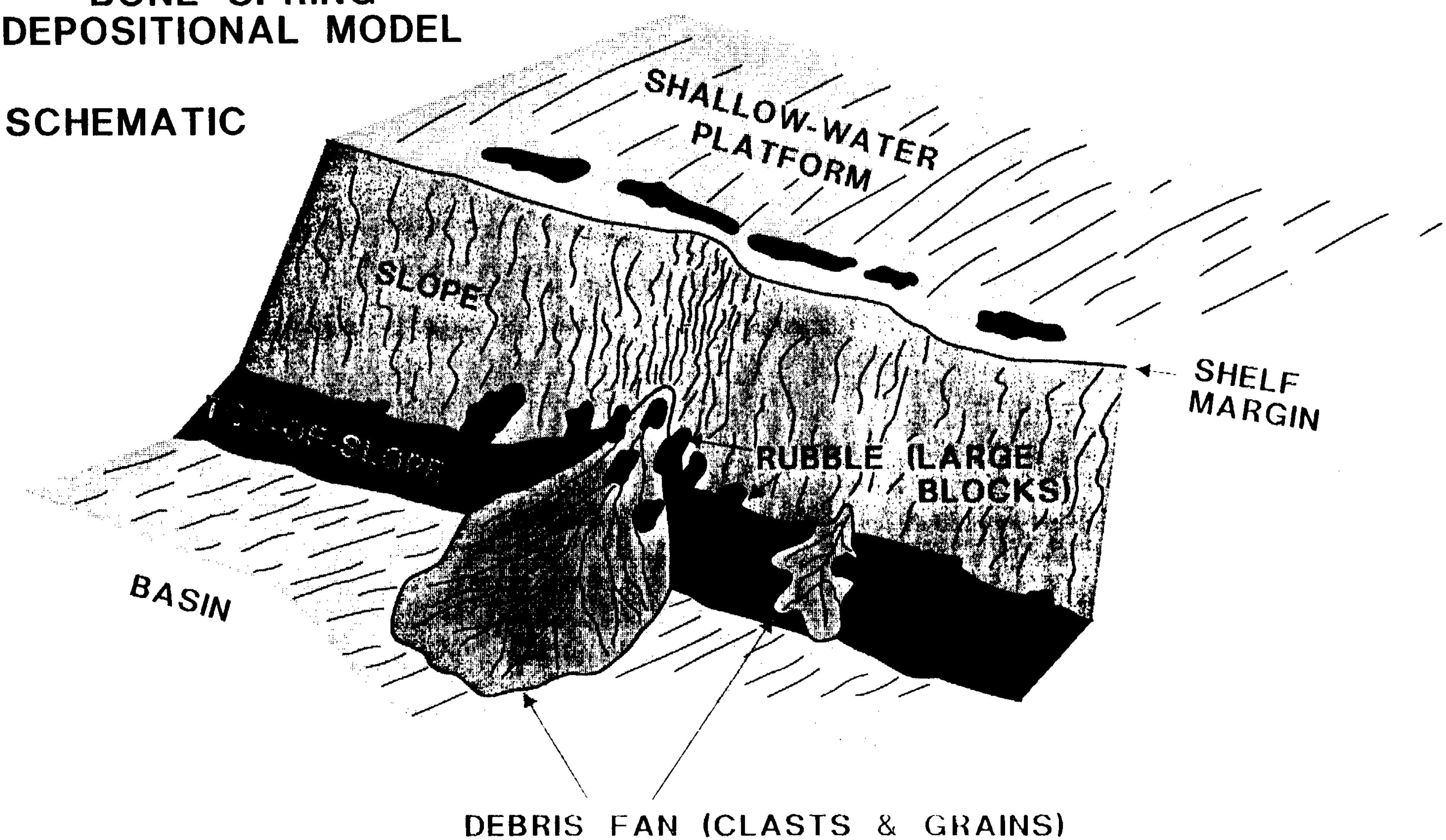
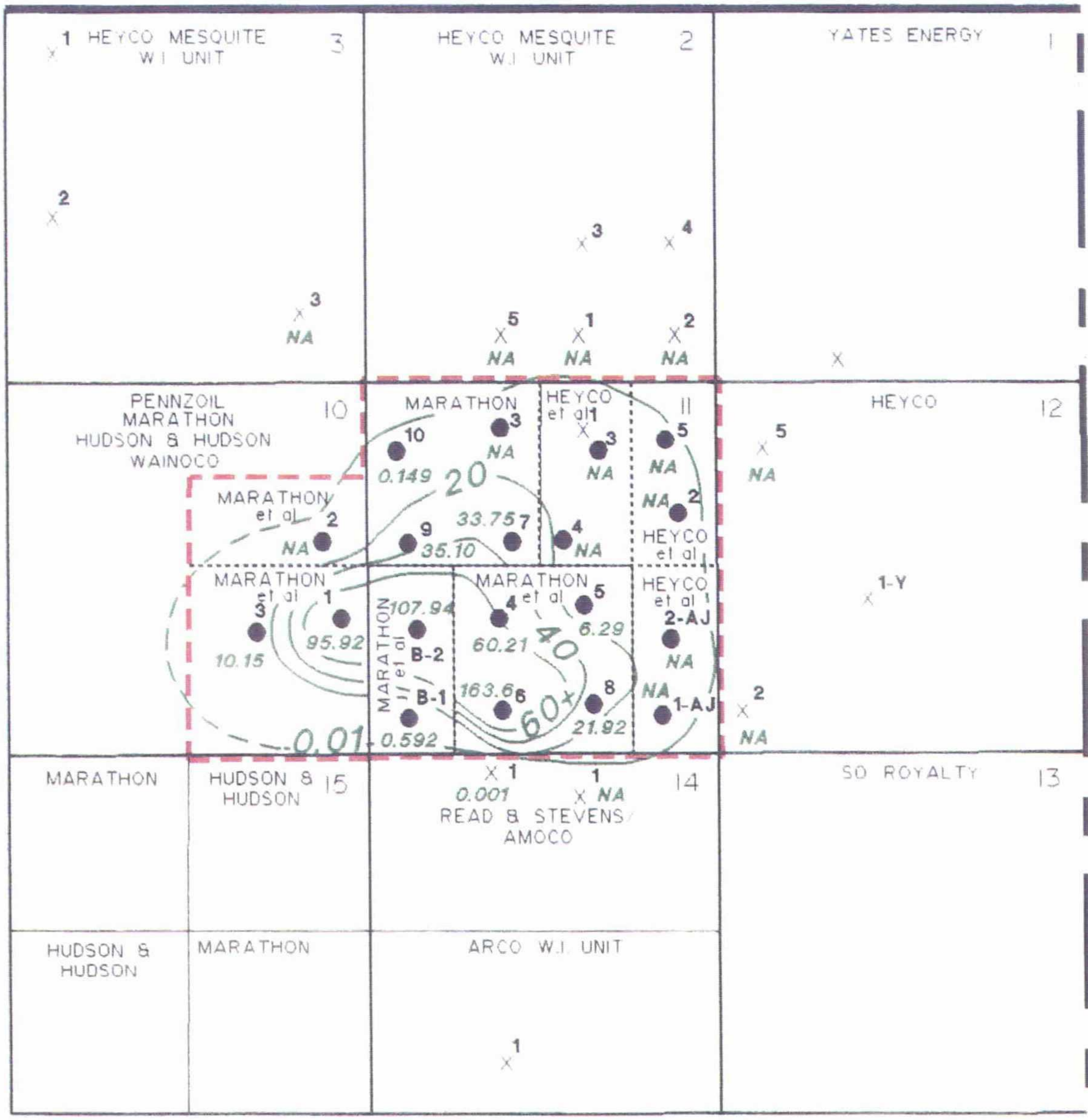


FIGURE 7

R-31-E



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

Ø CUTOFF = 4%

Ko MEASURED AS Koh DIVIDED BY h GIVING AVERAGE md/jt OVER INTERVAL h

$$ØKoh = \frac{(Koh)(Øh)}{h}$$

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

Ø-K_o-h

0 1/4 1/2

MILE

1-91

T954.AFE

FIGURE 8

TAMANO (BSSC) FIELD

Gross Production History

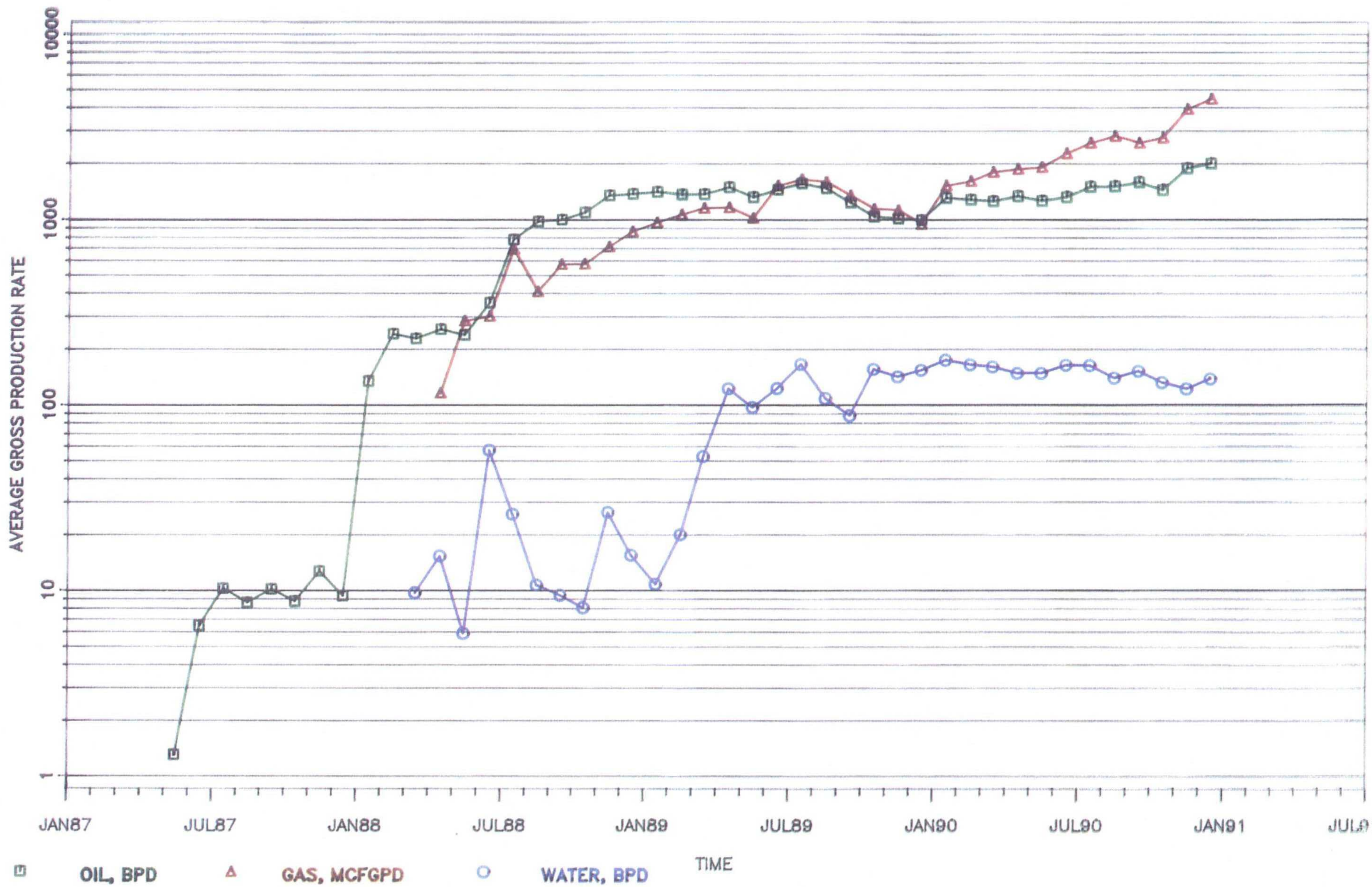


FIGURE 9

PROPOSED TAMANO (BSSC) UNIT

Primary Production History and Forecast

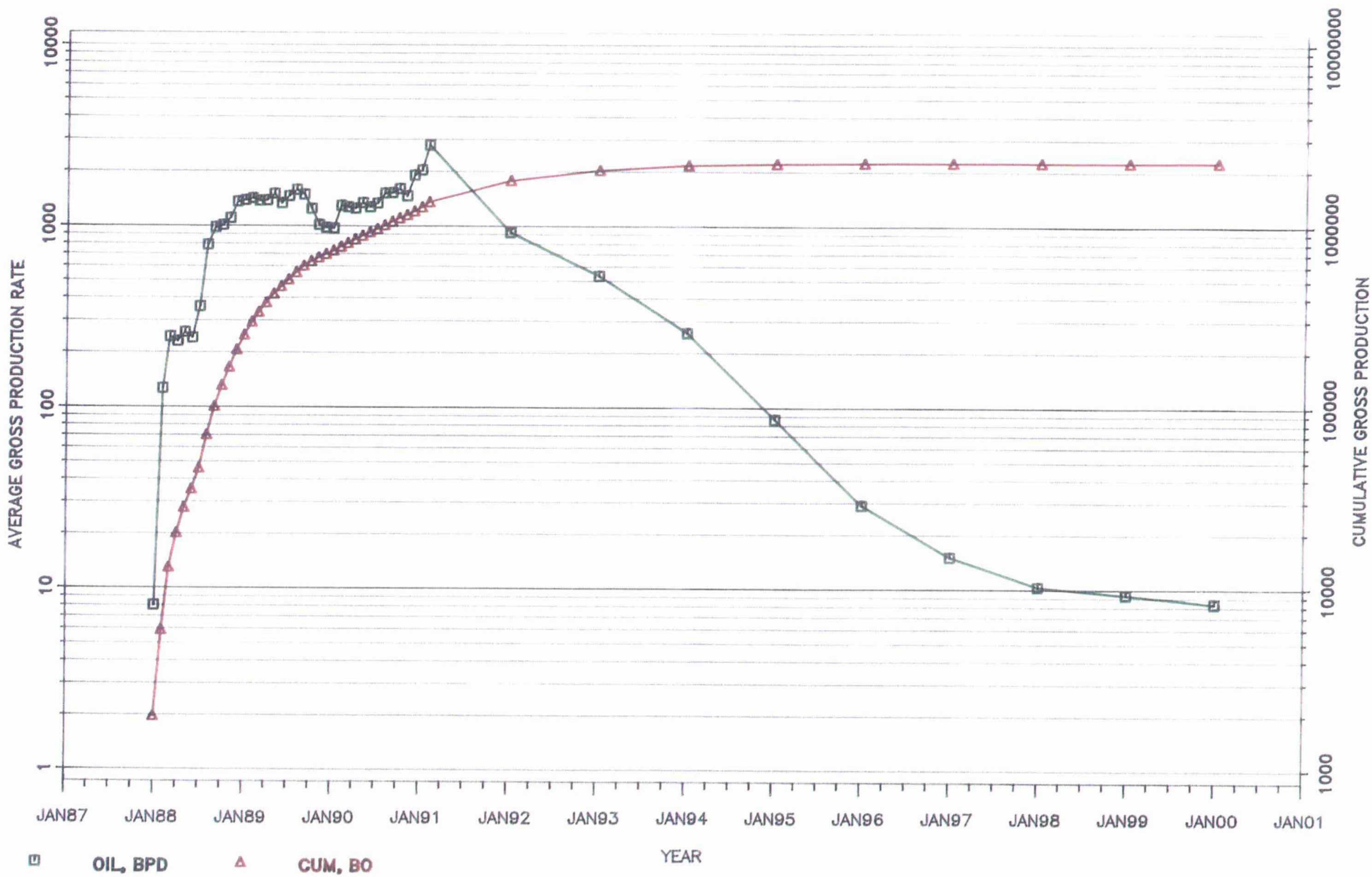


FIGURE 10

NET PRESENT VALUE PROFILE

WATERFLOOD SENSITIVITY

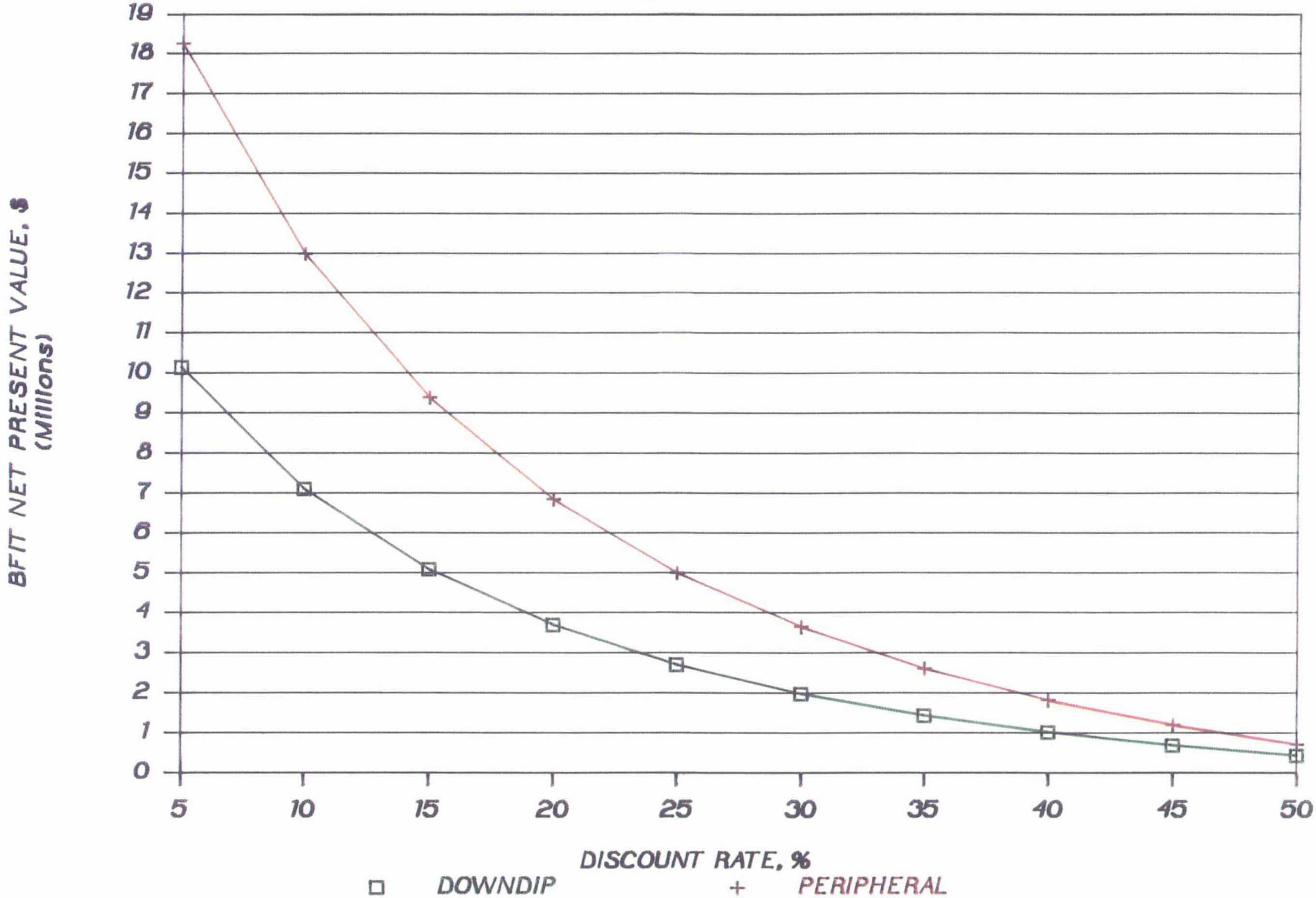
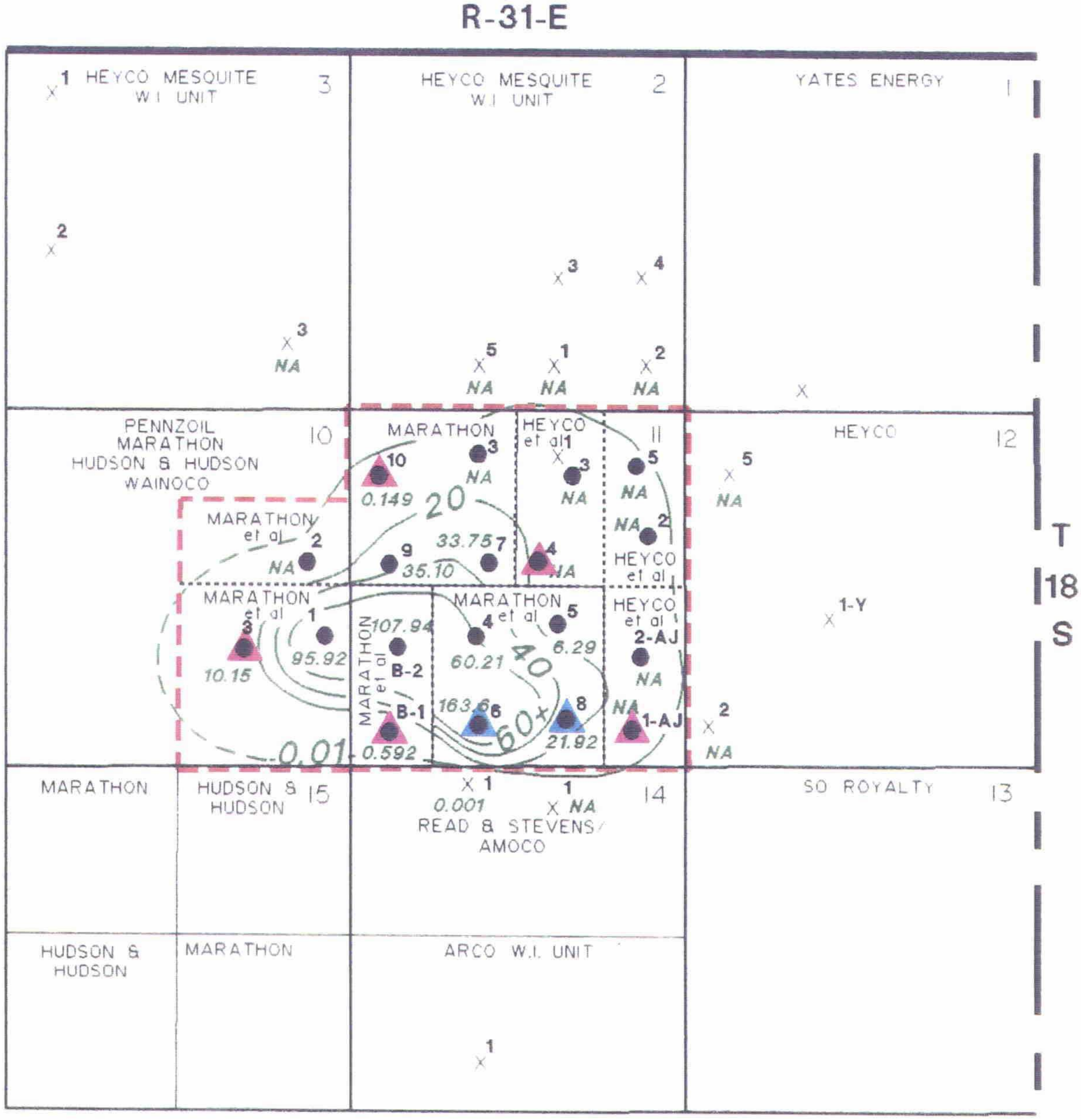


FIGURE 11



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

$\emptyset$-K_o-h

1992

PROPOSED CONVERSION TO WATER INJECTION

1994

0 1/4 1/2
MILE

1-91

7854 AFE

FIGURE 12

PROPOSED TAMANO (BSSC) UNIT

Peripheral Waterflood - Projected Performance

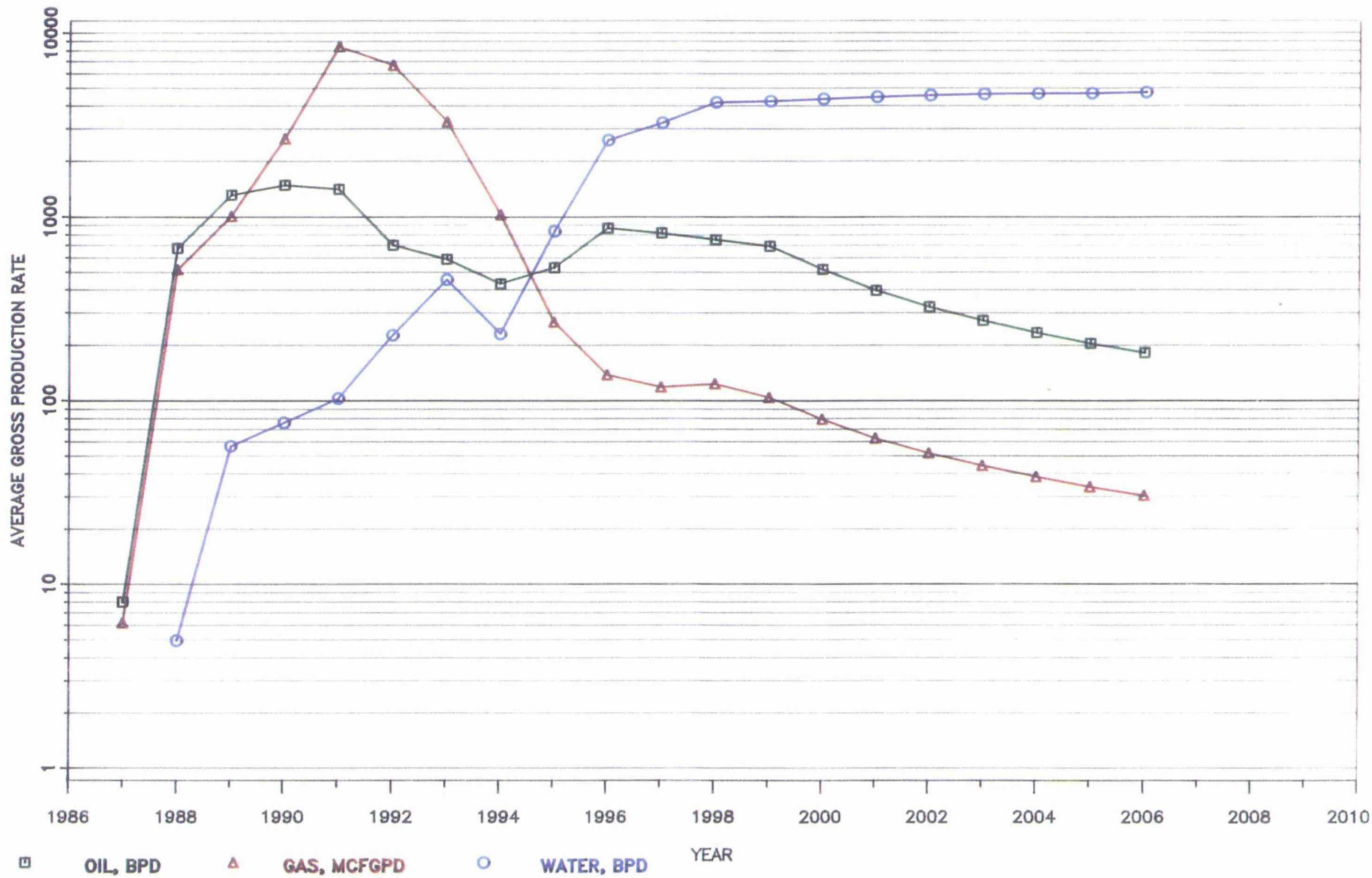


FIGURE 13

PROPOSED TAMANO (BSSC) UNIT

Peripheral Waterflood - Performance

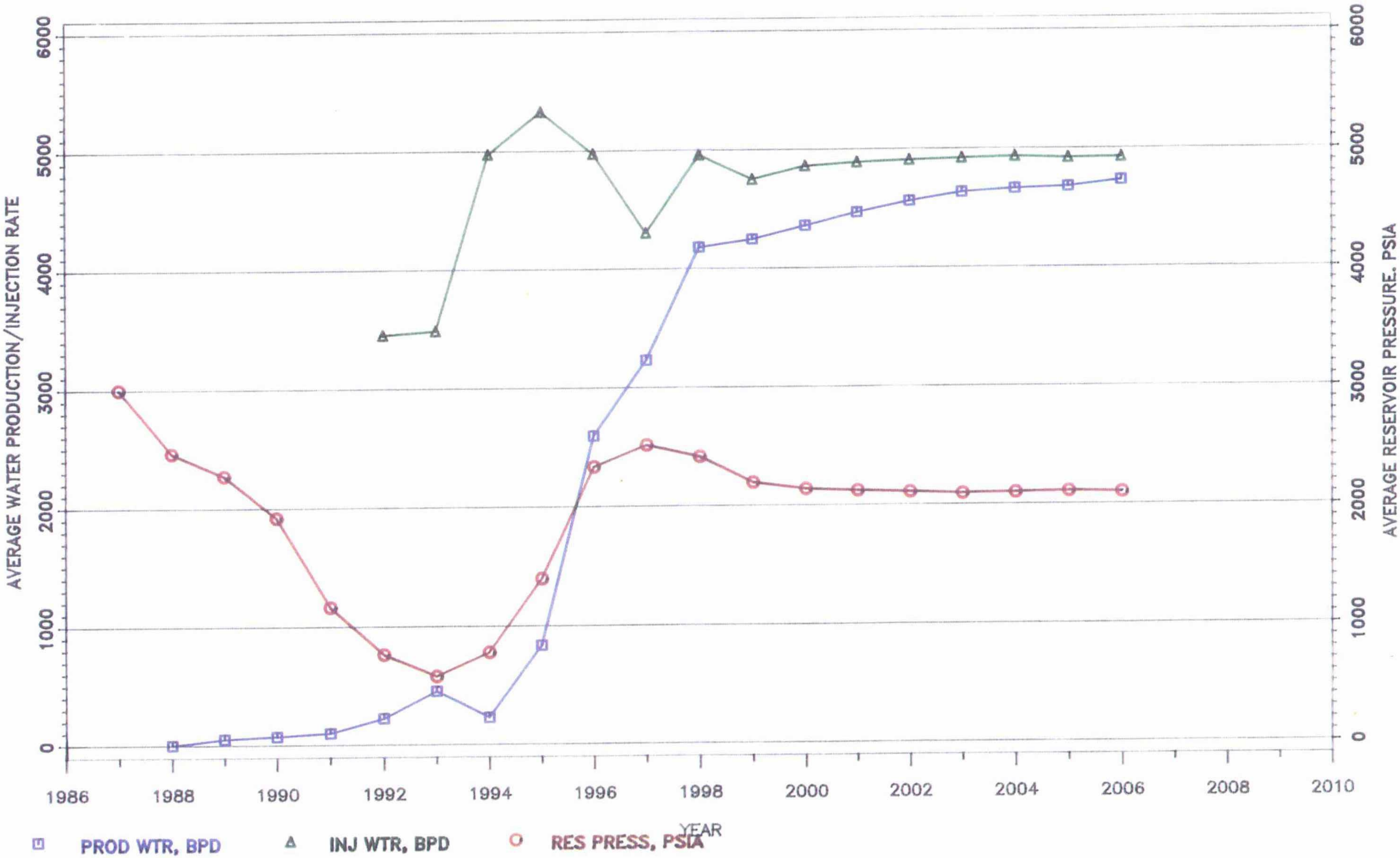


FIGURE 14

TAMANO (BSSC) UNIT

Injection Rate vs Time

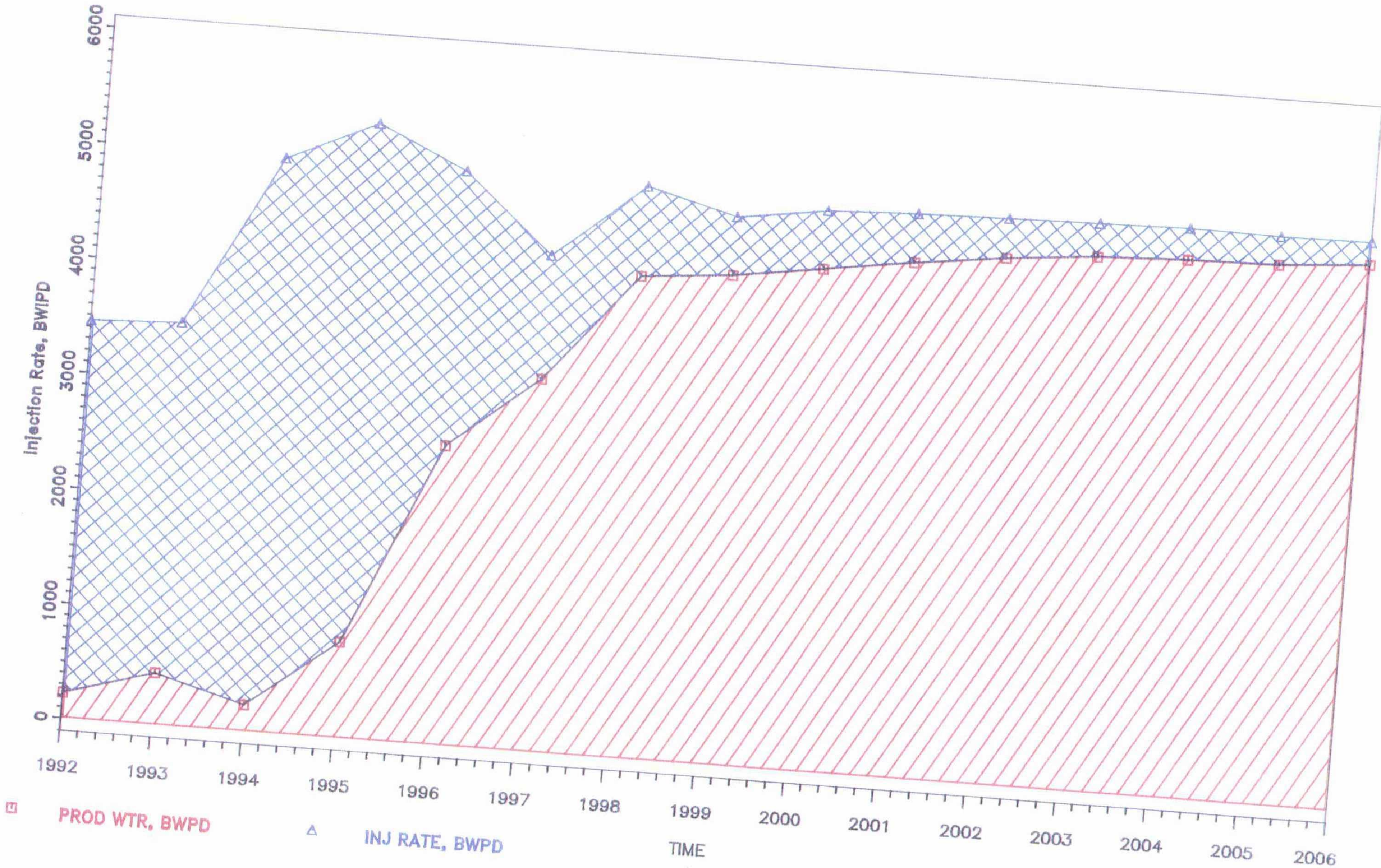


FIGURE 15

PROPOSED TAMANO (BSSC) UNIT

Cumulative Gross Oil Production

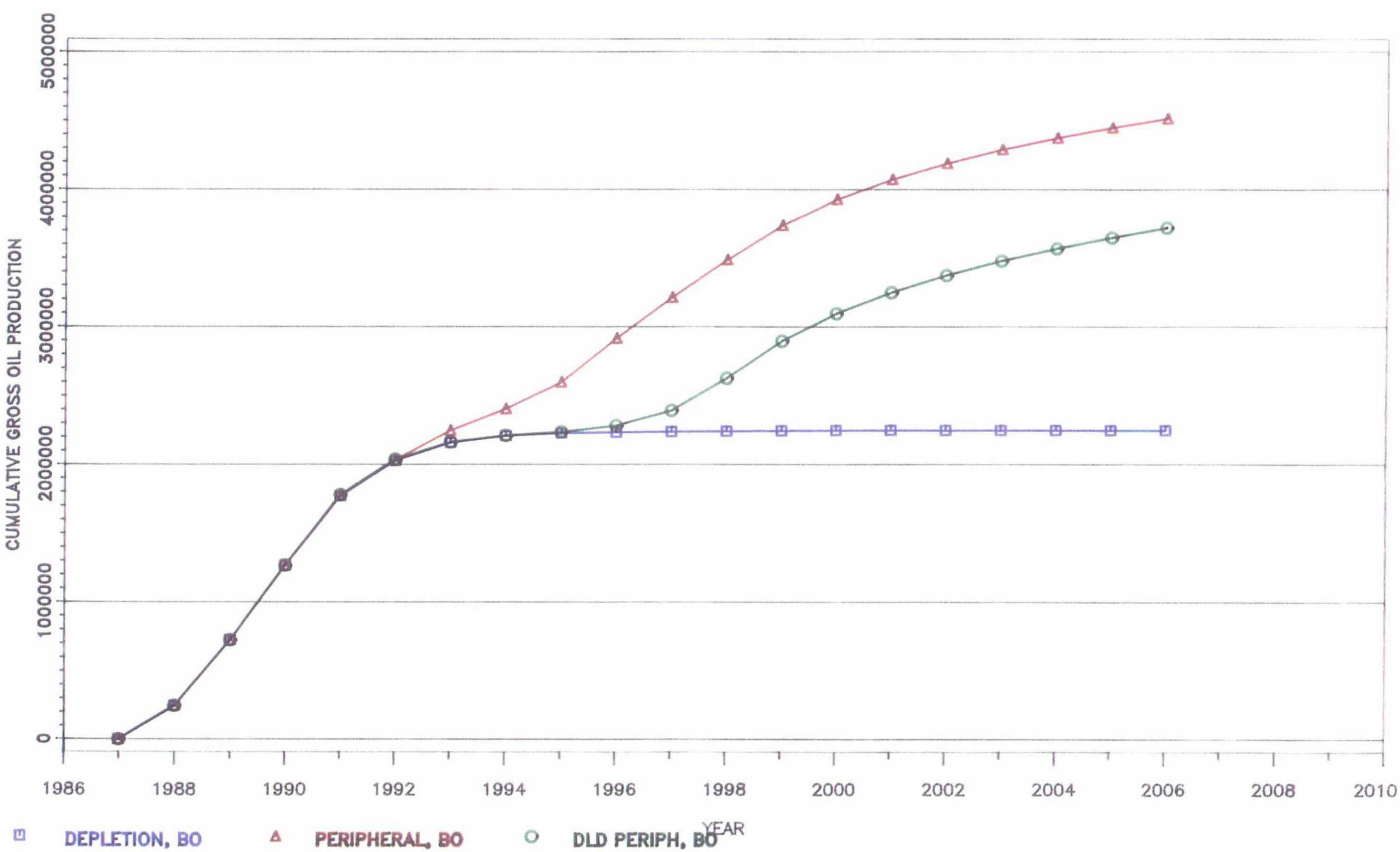
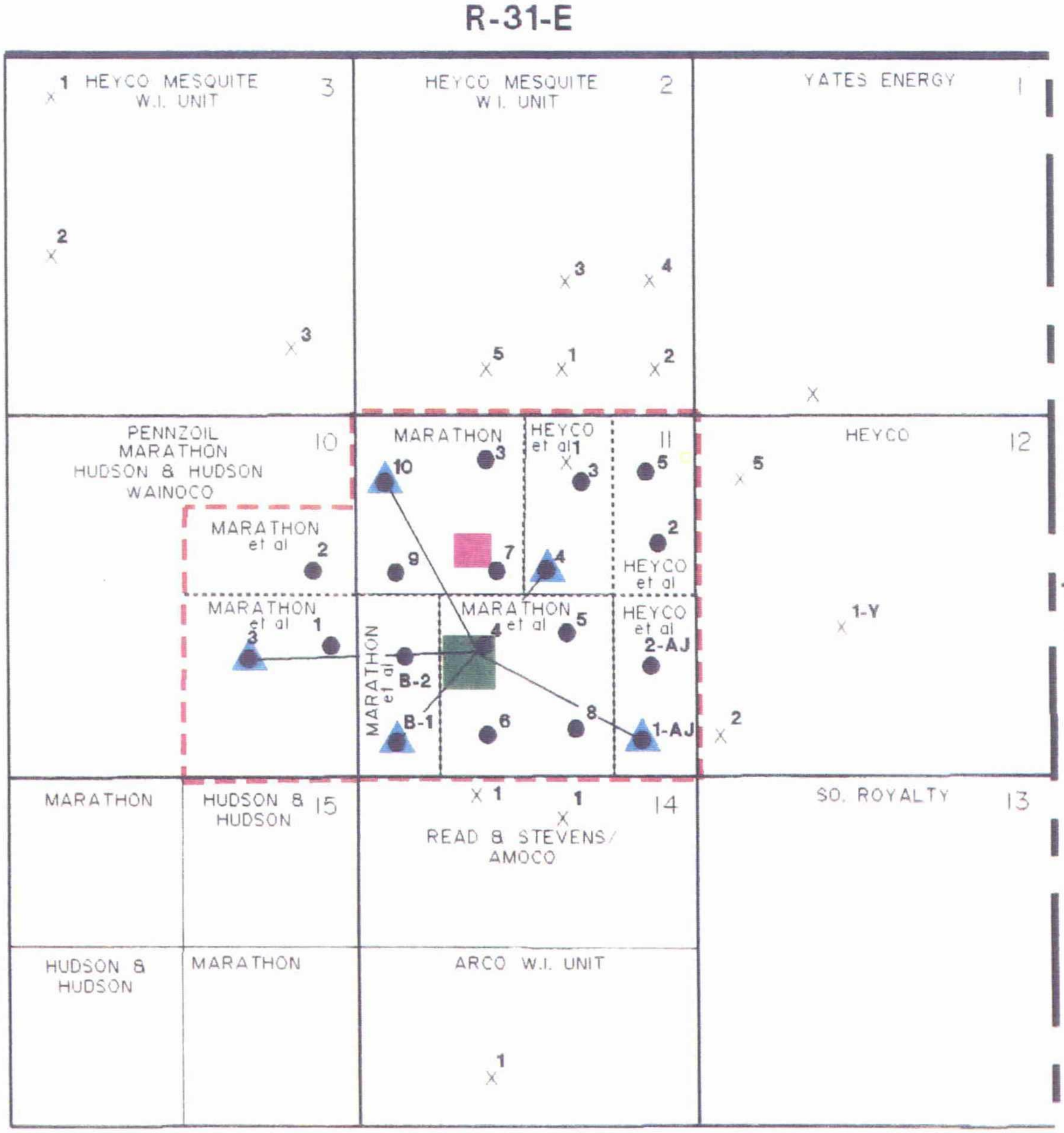
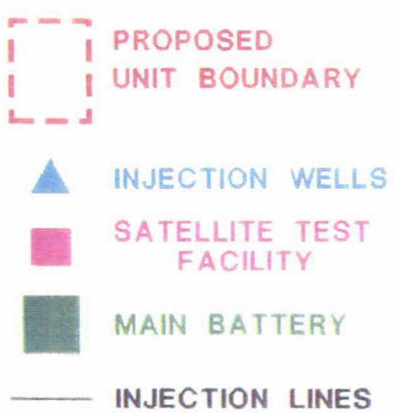


FIGURE 16



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

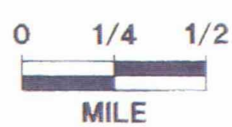


MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

PROPOSED 1992 INJECTION PATTERN & FACILITY LOCATIONS



1-91

FIGURE 17

MAIN BATTERY AND INJECTION FACILITY FLOW SCHEMATIC
PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

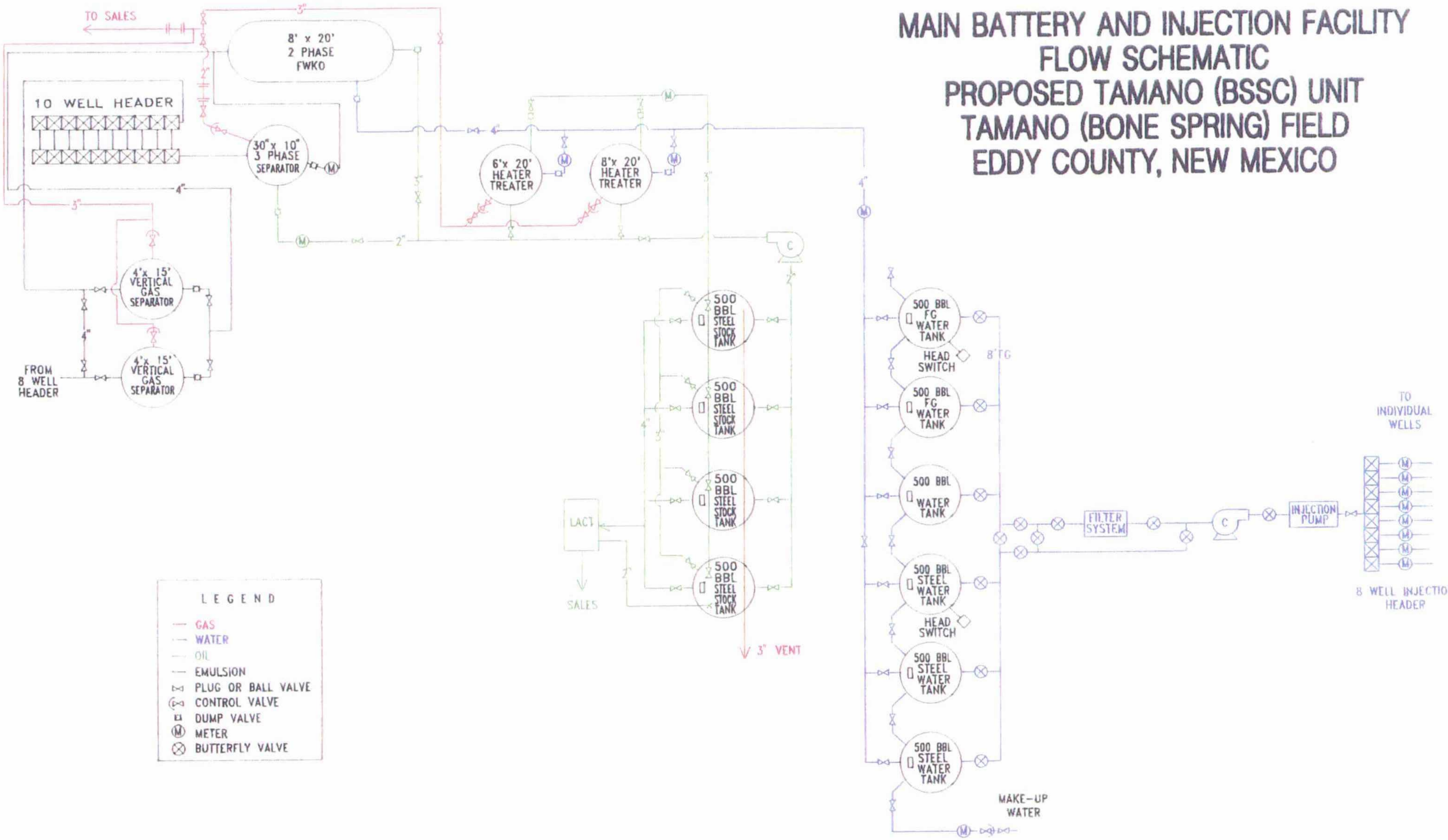


FIGURE 18

TAMANO (BSSC) UNIT

Peripheral Waterflood Expense Forecast

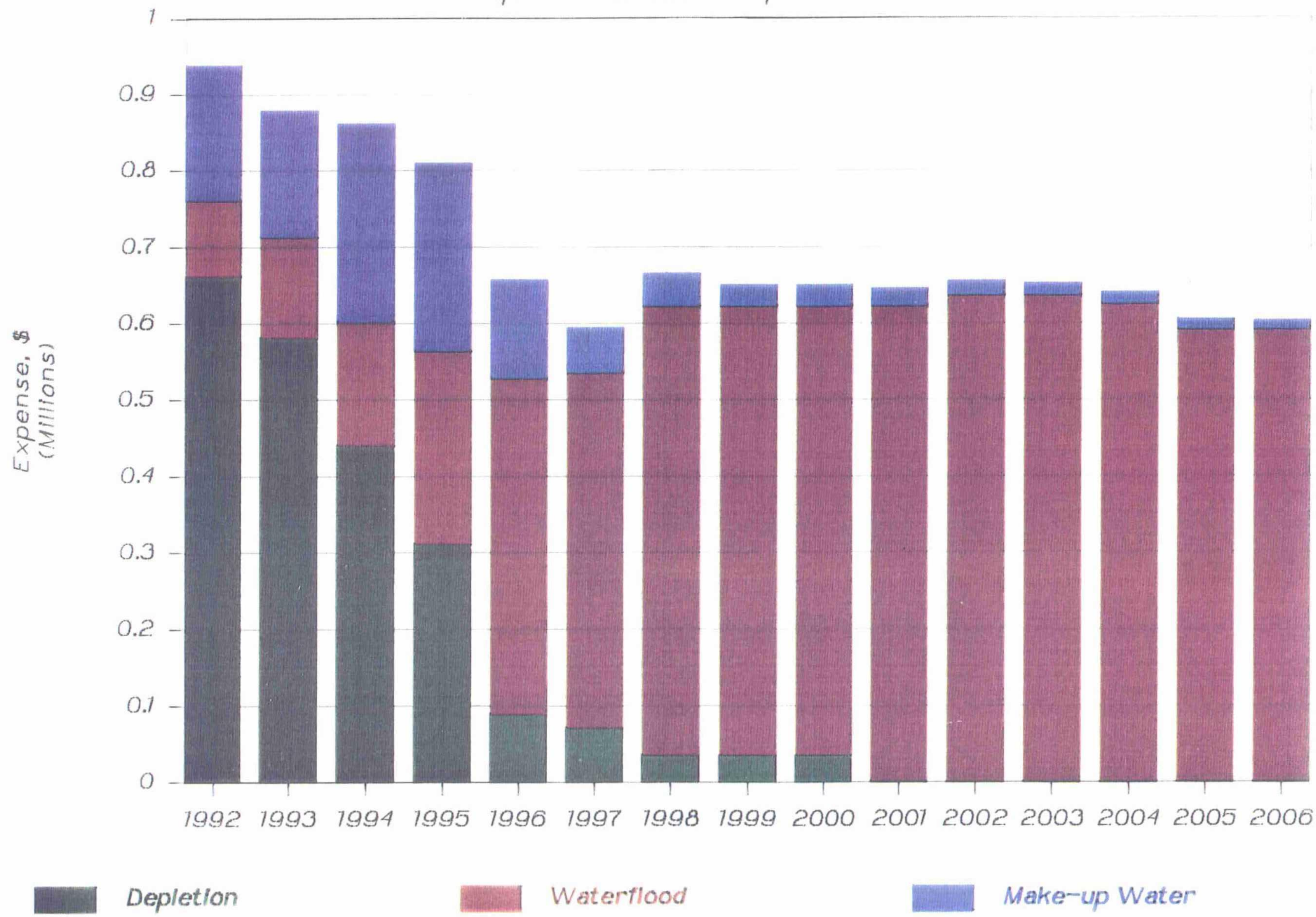
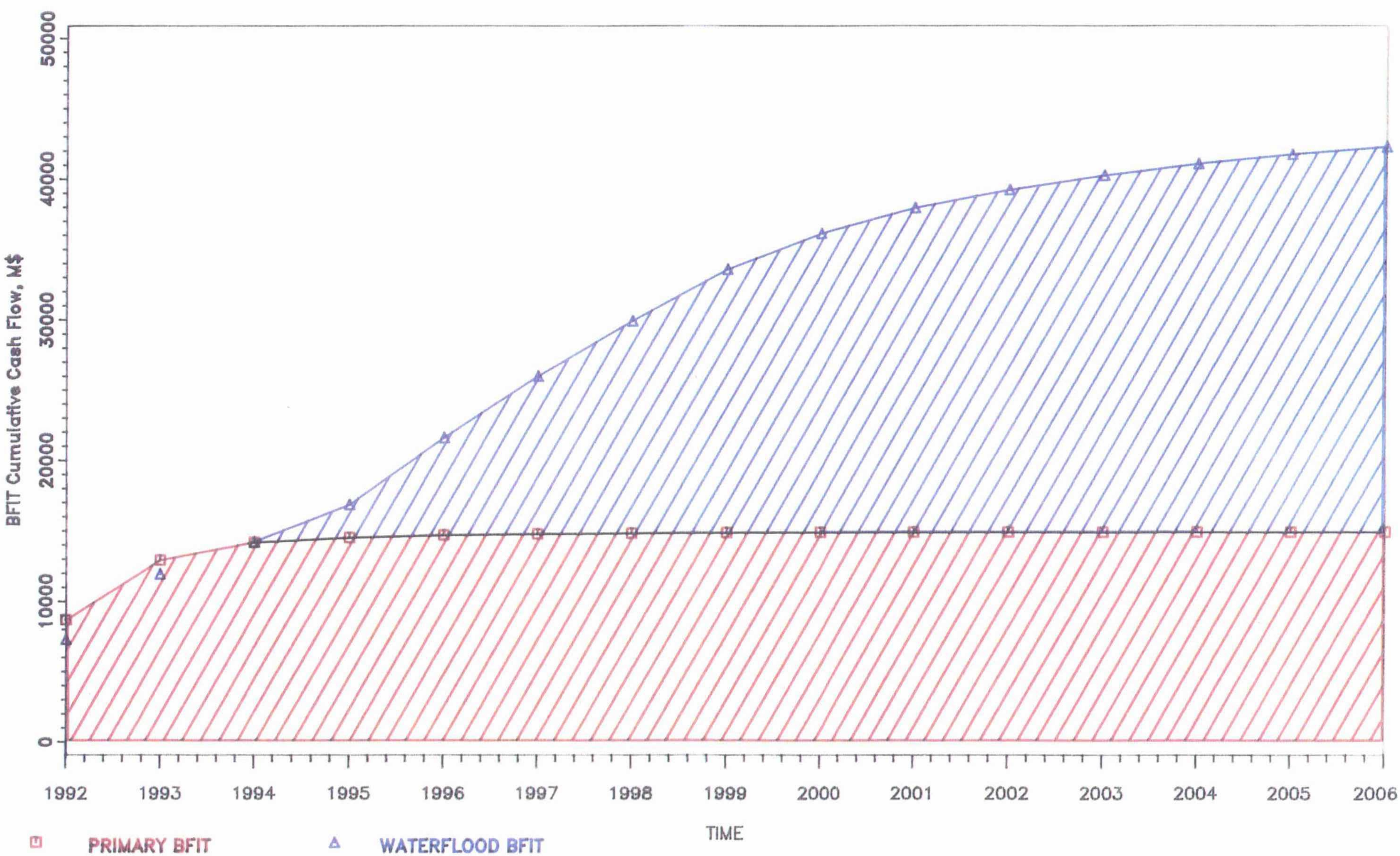


FIGURE 19

TAMANO (BSSC) UNIT

Primary vs Peripheral Waterflood Cash Flow
(Unescalated Economics)



BEFORE EXAMINER STOGNER
Oil Conservation Division
Marathon Exhibit No. 2
Case No. 10341

ENGINEERING STUDY OF
ENHANCED RECOVERY POSSIBILITIES

TAMANO (BONE SPRING SECOND CARBONATE) UNIT
EDDY COUNTY, NEW MEXICO

JUNE 1991

MARATHON OIL COMPANY, ET. AL.

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TAMANO (BSSC) UNIT

INTRODUCTION

Waterflood operations are projected to increase oil recovery in the Tamano (Bone Spring) Field by approximately 2,261,000 stock tank barrels of oil, STBO. This projection was based on the evaluation of 19 wells currently producing from the Bone Spring Second Carbonate, BSSC, formation in the field. An economic evaluation indicates that the project will generate a BFIT profit of $13,001,000 using a discount factor of 10 percent.

All 19 wells are operated either by Marathon Oil Company or the Harvey E. Yates Company, HEYCO. The wells are located in Section 10 or 11 of Township 18 South, Range 31 East, Eddy County, New Mexico. Marathon Oil Company proposes to initiate waterflood operations by forming a unit containing the 19 wells and 880 acres. The proposed unit is referred to as the Tamano (BSSC) Unit and would consist of the entire 640 acres of Section 11 and 240 acres of Section 10 described as the southeast quarter and the south half of the northeast quarter (see Figure 1).

Based on available leasehold information, the unit has been divided into the nine tracts shown on Figure 1. Table 1 shows the 19 wells by tract, estimated remaining gross primary production per well, estimated gross secondary reserves per tract based on the proposed final participation formula, and associated economics. As Table 1 shows, each tract benefits from the projected waterflood performance by an increase in reserves and by an increase in net profit.

The purpose of this report is to document the technical and economic data that was used during the evaluation of the BSSC formation with respect to enhanced recovery operations. Discussion of that data is also provided.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. The Tamano BSSC reservoir has been **reasonably delineated**.

2. The Tamano BSSC reservoir has an original oil-in-place, OOIP, of 15,000,000 STB.

3. Gross ultimate primary recovery is estimated to be 2,167,000 STBO which represents 14.4 percent of the OOIP.

4. A peripheral waterflood yields the optimum results, from both a recovery and economic standpoint.

5. Incremental gross secondary reserves, if the peripheral waterflood is initiated on January 1, 1992, are estimated to be approximately 2,261,000 STBO for a secondary to primary ratio of 1.0. Total ultimate recovery of 4,428,000 STBO represents 29.5 percent of the OOIP.

6. Deferment of water injection may result in the loss of secondary reserves.

7. An initial gross investment of $1,125,000 is required to implement a peripheral waterflood. Unescalated ultimate gross investments of $1,513,000 are estimated.

8. The incremental profit BFIT, using a discount factor of 10 percent, is $13,001,000.

Recommendations

1. A peripheral waterflood should be implemented in the Tamano (Bone Spring) Field of Eddy County, New Mexico.

2. The acreage outlined in Figure 1 should comprise the proposed waterflood unit.

3. Formal unitization efforts should commence with the New Mexico Oil Conservation Division, NMOCD, with the objective of initiating water injection by January 1, 1992.

HISTORY

The first completion in the BSSC was the Johnson "B" Federal A/C 1 Well No. 3 (Marathon Oil Company) on April 30, 1987. Initial production was 8 BOPD. For practical purposes, discovery is considered to be December 7, 1987 when the Johnson "B" Federal Well No. 4 (Marathon Oil Company, et. al.) flowed 40 BO in 2-1/2 hours to a frac tank during a drillstem test of the interval from 7,986 feet to 8,119 feet. Well No. 4 was eventually perforated from 8,060 feet to 8,150 feet in what is now referred to as the BSSC main pay. It was completed on January 15, 1988 as a top allowable oil well at the rate of 230 BOPD.

Following completion of Well No. 4, development of the BSSC took place in two stages. The first stage occurred in 1988, when most of Section 11 was developed on 40-acre spacing. Field wide gross production reached 1,429 BOPD and 970 MSCFGPD in January 1989 from eight wells. Development resumed in the Spring of 1990. All remaining 40-acre locations in Section 11 were drilled. Activity progressed west into Section 10 with the drilling and completion of three wells. The most recent well drilled in Section 10, the Stetco "10" Federal Well No. 3, was completed in January 1991. Production peaked in January 1991 at an average 2,339 STBOPD and 5,858 MSCFGPD from 19 wells.

Current production is constrained by the maximum allowable gas rate of 920 MSCFGPD, which is derived from the current oil allowable rate of 460 STBOPD and a GOR limit of 2,000 SCFG per STBO. March 1991 production averaged 1,850 STBOPD and 5,821 MSCFGPD from 19 wells. During March 1991, oil production from five wells was restricted due to the gas allowable. Figure 2 is a graph of the gross production history of BSSC completions in the Tamano Field. Table 2 is a copy of the production data in tabular form.

UNITIZED INTERVAL

Description

The vertical interval to be unitized is the BSSC. This interval is correlative to the interval shown on the type log (see Figure 3) from the Johnson "B" Federal Well No. 4 (Marathon Oil Company, et. al.) located in Section 11, Township 18 South, Range 31 East, Eddy County, New Mexico. This interval is 7,908 feet below KB (-4,156 feet subsea) to 8,190 feet below KB (-4,438 feet subsea). The BSSC is overlain by the Bone Spring First Sand and underlain by the Bone Spring Second Sand, BSSS.

Geology

The reservoir for the proposed Tamano waterflood unit is the Second Carbonate of the Bone Spring formation. The Bone Spring formation is a basin and slope deposit consisting of shelf-derived turbidite sandstones, slump and debris flow and basinal carbonates, and basinal shales. Production commonly occurs from dolomitized toe-of-slope carbonate debris flow deposits, such as the BSSC in the Tamano Field, or from fine-grained, low permeability sands in submarine turbidite fan deposits. Figure 4 characterizes the geologic model.

Structure in the proposed unit area, and specifically on the BSSC reservoir, dips generally to the south-southwest at about 200 feet per mile (see Figure 5). Some local variations in direction or amount of dip exist. The BSSC structure is consistent with the regional slope into the Delaware Basin and reflects the depositional slope of the Bone Spring formation. Hydrocarbon trapping is stratigraphic in nature.

The BSSC in the proposed unit area is a tan to dark gray, very fine to medium crystalline dolomite with minor amounts of shale, limestone, pyrite, silt or fine-grained sand and anhydrite. Textures vary from finely laminated mudstones to grainstones to coarse rudstones. Interclasts range in size from a few millimeters to several inches or larger and are most commonly mud supported. Bioclastic material is common, consisting mainly of crinoid debris with lesser amounts of sponges, bryozoans and mollusks.

The producing interval in the BSSC is typically about 130 to 140 feet thick with average log porosity ranging from 3 percent to 6 percent. This interval is located in the lower half of the BSSC. Porosity is almost entirely secondary consisting mainly of intercrystalline matrix porosity, solution vugs and fractures which are commonly solution enlarged. Intervals with matrix porosity, but lacking vug and fracture porosity, are typically very low in permeability. Fractures are irregular and frequently occur at high angles. Most fracturing is probably related to local depositional and early burial slope rather than to tectonic processes. Based on core analysis, formation micro-scanner data, and borehole televiewer surveys, fracturing appears to be local and random, which should not create a preferred direction of flow within the reservoir.

The BSSC "Main Pay" interval was divided into eleven "layers" numbered in ascending order, which are interpreted to be either "high flow" zones (even numbers) or less porous and permeable "low flow" zones (odd numbers). These zones were defined using core porosity and permeability measurements as well as production surveys to determine where the greatest flow into the borehole was occurring. These intervals were then identified on the neutron/density logs where core and production data was available, in order to correlate these zones to wellbores where no core data was available. These zones are shown on cross section A-A', along with core intervals, perforations and initial potential production rates.

Core permeability varies throughout the BSSC. Average core permeability is 11.7 millidarcies, (md), and ranges from less than 0.1 md to 800 md. Low permeabilities were measured in samples that represented matrix or intercrystalline porosity. Samples that had measured permeability of a few hundred md normally contained vugs and fractures.

UNITIZED AREA

The proposed Tamano (BSSC) Unit (see Figure 1) encompasses 880 acres of which 640 acres are located in Section 11 and 240 acres in Section 10, Township 18 South, Range 31 East, Eddy County, New Mexico. The 240 acres in Section 10 are described as the southeast quarter and the south half of the northeast quarter. This area best represents the extent of the BSSC which will be impacted by the proposed waterflood scheme. Nine (9) tracts were created based on existing knowledge of working and net revenue interests within the proposed area.

The proposed unit area contains the known productive limits of the BSSC in the Tamano (Bone Spring) Field. Delineation to the north is defined by marginal production in the north half of the north half of Section 11 and the absence of BSSC production in Section 2. From west to east along the northern row of producers in Section 11, production is as follows:

OPERATOR	WELL NAME AND NUMBER	MARCH '91 STBOPD	CUM STBO TO 4-1-91
Marathon	Johnson "B" Federal A/C 1 No. 10	7	4,002
Marathon	Johnson "B" Federal A/C 1 No. 3	6	10,317
HEYCO	Hudson "11" Federal No. 3	18	37,461
HEYCO	Hudson "11" Federal No. 5	19	5,282

The Johnson "B" Federal A/C 1 Well No. 3 (Marathon) and the Hudson "11" Federal Well No. 3 (HEYCO) are both commingled in the BSSC and the BSSS whereas all of the other wells in the proposed unit area are completed solely in the BSSC. Five wells in Section 11 to the south and west have already produced more than 120,000 STBO to date and four additional wells drilled in 1990 are also estimated to produce in excess of 100,000 STBO. Because the four most northerly producing wells in Section 11 are marginal producers and no BSSC production exists north of Section 11 into Section 2, the proposed northern boundary of the unit is believed to define the productive limits in this direction.

Productive limits to the east are defined in the same manner. South of the Hudson "11" Federal Well No. 5, which has already been defined as a marginal producer, are the Hudson "11" Federal Well No. 2 and the A. J. "11" Federal Well Nos. 2 and 1, respectively. All three wells are operated by HEYCO. The Hudson "11" Federal Well No. 2 is not completed in the basal portion of BSSC that is the main pay within the BSSC, but is completed in the upper portion of the BSSC, which is a dense dolomite and not continuous across the field. Well No. 2 has only produced 13,484 STBO as of April 1, 1991 and averaged 9 STBOPD in March 1991. The two A. J. "11" Federal wells appear to be on the edge of the reservoir despite good reservoir properties. First-month averages for Well Nos. 1 and 2 were 178 STBOPD and 87 STBOPD, respectively. However, production rapidly declined to 20 STBOPD and 6 STBOPD, respectively. Also, the A. J. "11" Federal Well No. 1 is directly offset to the east by the Taylor Deep "12" Federal Well No. 2 (HEYCO) located 660' FSL and 330' FWL of Section 12, T-18-S, R-31-E. This well was spudded on June 26, 1989 and plugged and abandoned on July 25, 1989 after the BSSC tested dry during a drillstem test. Another dry hole, the Taylor Deep "12" Federal Well No. 5 (HEYCO) located 990' FNL and 660' FWL of Section 12, T-18-S, R-31-E, directly offsets the Hudson "11" Federal Well No. 5. The Taylor Deep "12" Well No. 5 was plugged and abandoned on July 14, 1990. Marginal production and dry holes clearly define the eastern boundary of the unit.

A point regarding the character of the BSSC reservoir should be made at this time. The two A. J. "11" Federal wells, in addition to the Johnson "B" Federal Well No. 8 (Marathon), produce the only appreciable water in the field. March 1991 production averaged approximately 92 BWPD from these 3 wells and only 53 BWPD from the remaining 13 wells. However, the Taylor Deep "12" Federal Well No. 2, a direct offset, had limited fluid entry during the drillstem test indicating poor porosity and permeability. This further illustrates the stratigraphic nature of the reservoir. The three wells making water are the lowest on structure in the proposed unit area. Therefore, it has been concluded that the BSSC reservoir has a bottom water leg, but its volume is not significant.

Two dry holes in Section 14, T-18-S, R-31-E clearly define the southern boundary of the unit. Read and Stevens spudded both wells in 1989: the Marion Federal Well No.1 located 660′ FNL and 2,100′ FEL; and the Jamie Federal Well No. 1 located 330′ FNL and 1,920′ FWL. Both wells tested dry in the BSSC.

The western boundary of the proposed unit area is partially defined by marginal production and dry holes. Production from the BSSC extended west into Section 10 in 1990 with the completion of the Stetco "10" Federal Well Nos. 1 and 2 (Marathon, et. al.), and further west with completion of the Stetco "10" Federal Well No. 3 (Marathon, et. al.) in January 1991. Production from Well No. 2 is marginal. However, Well Nos. 1 and 3 are both capable of producing at the top allowable rate of 460 BOPD. Well No. 3 is believed to be on the edge of the reservoir because it required a greater stimulation than the wells to the east and its measured permeability was substantially lower. Declining pressures and increasing GOR throughout the field indicate that a sufficient number of wells exist to recover the primary reserves. However, because Well Nos. 1 and 3 are allowable wells offset by open acreage, three undeveloped 40-acre tracts have been included in the proposed unit area. Future evaluation may support the drilling of some or all of these undeveloped tracts in order to improve waterflood sweep efficiency.

The complex nature of the BSSC reservoir has made the use of conventional mapping, such as of gross pay-porosity, invalid. The dry holes that have been discussed in this text have gross pay-porosity values comparable to or greater than wells that produce at the top allowable rate. For this reason, fluid transmissibility must be predominantly influenced by the presence of vugs and fractures. Quantifying the amount of porosity represented by vugs and fractures (secondary porosity) cannot be done on all wells due to the lack of wireline log data. However, by adding a permeability term to the gross pay-porosity value, the areas of greatest secondary porosity can be inferred. Figure 6 shows the results of this work. As Figure 6 shows, the projected reservoir limits are entirely contained within the proposed unit area. Figure 7 also supports the unit area. This figure maps the initial potential of each well and also codes the initial potential as to pumping or flowing. Flowing wells and the greatest potentials shown on Figure 7 directly correspond to the areas of greatest gross pay-porosity-permeability in Figure 6.

PRIMARY PRODUCTION PERFORMANCE

Primary production in the Tamano (Bone Spring) Field is typical of a solution-gas drive reservoir. The reservoir was slightly undersaturated initially. Virgin pressure was approximately 3,000 psia and the bubble point pressure was estimated to be 2,500 psia. Reservoir pressure as of May 1991 ranged from 741 to 1,201 psig. As of April 1, 1991, gross production totalled approximately 1,467,000 STBO, 2,018,000 MSCFG and 121,000 BW. Table 3 lists production by individual well.

The original oil-in-place, OOIP, is estimated to be 15,000,000 STBO based on modelling results. Primary recovery as of April 1, 1991 represents 9.8 percent of the OOIP. Remaining primary reserves as of April 1, 1991 are estimated to be approximately 700,000 STBO. Therefore, ultimate primary recovery is projected to be 2,167,000 STBO, which represents 14.4 percent of the OOIP.

Remaining primary reserves were estimated using two techniques: conventional decline analysis and modelling. Conventional decline analysis was applied to wells that had an established decline rate as of December 31, 1990. Because the decline analyses were performed in January and February of 1991, only actual data through December 1990 was used. Production was estimated for the months of January, February and March of 1991 and subtracted from the reserves estimated as of December 31, 1990. Remaining reserves as of April 1, 1991 were accepted as a parameter by the Working Interest Owners in the proposed unit area. Conventional decline analysis was applied to 12 of the 19 wells as indicated in Table 3.

Modelling results were used to estimate remaining primary reserves of the other 7 wells. The Johnson "B" Federal A/C 1 Well No. 10 (Marathon) was completed in October 1990 and the Stetco "10" Federal Well No. 2 (Marathon, et. al.) was completed in December 1990. Neither well had a sufficient production history from which to use conventional decline analysis. The other five wells, which are the Johnson "B" Federal Well No. 6, the Johnson "B" Federal A/C 1 Well No. 9, the Marathon-Shugart "B" Well No. 2, and the Stetco "10" Federal Well Nos. 1 and 3, were all producing at the top allowable rate at the time of the calculations. With no established decline, modelling was considered the best means to estimate reserves. Table 3 lists the results for these wells.

Figures 8 through 19 are the results of the conventional decline analysis for the 12 wells. Figures 20 through 26 are the model projections for the 7 remaining wells.

COMPUTER MODEL OF BONE SPRING SECOND CARBONATE

A black oil simulator, ECLIPSE™, was utilized as part of the evaluation of remaining primary reserves and feasibility study of an enhanced recovery project. Although the BSSC formation is recognized as vuggy and fractured, a single porosity version of ECLIPSE™ was used, as opposed to a dual porosity model, because the single porosity model was as efficient in matching the history. Vugs and fractures are believed to contain most of the storage capacity in the reservoir, and contribute most to fluid transmissibility. Matrix porosity contributes very little. It is for this reason that a single porosity model is as efficient.

[redacted]

[redacted]

Figure 27 is a three-dimensional profile of the model grid. The grid contains all 880 acres of the proposed unit area and is 25 x 20 x 11. The i component, 25, and the j component, 20, cover the areal extent of the unit. The k component, 11, represents the 11 layers within the BSSC main pay interval. Therefore, the model contains 5,500 nodes.

The modelling efforts were concentrated solely on the main pay interval, which was described earlier as the basal portion of the BSSC. Referring to Figure 3, the top of the main pay would be approximately 8,055 feet. Above that mark is a dolomite interval with very low porosity. The top of the main pay can easily be observed in the far right tract of Figure 3, which is the resistivity curve. Throughout the upper portion of the BSSC, the deep resistivity reading exceeds 2,000 ohm-m, or, is off-scale. A lower resistivity response is not observed until the lower portion of the BSSC interval, a result of better effective porosity. It has already been pointed out that the Hudson "11" Federal Well No. 2 did not produce from the main pay, but from the upper portion. Therefore, the nodes in the 40-acre tract containing this well were made inactive, as shown in Figure 27. Also, the 275 nodes representing the north half of the north east quarter are inactive. Hence, the model contains 4,950 active nodes and 550 inactive nodes.

The size of each Section 11 grid in the i and j directions are 264 feet by 264 feet. The k values vary and represent the gross thickness of each layer in each node. Section 10 i-j grids are 528 feet by 264 feet. Section 10 grids are somewhat larger to allow for more efficient use of computer time. This is a result of more control points in Section 11 than in Section 10. Nineteen control points, representing the 19 wells, are incorporated into the model. Thicknesses, or k components, in nodes without control points are extrapolated from values in nodes containing wells.

Porosity

Porosity values were derived from evaluation of compensated density-compensated neutron openhole wireline logs. The eleven geologic layers were identified (where present) in each well. Average porosity values over the eleven intervals were determined and put into the model as control points at the respective wells' locations. Values for nodes between control points were then extrapolated. Table 4 contains the porosity value for each layer in each well.

Permeability

Core data was used to derive permeability-porosity relationships from which to estimate permeabilities. Data from the four available cores (Johnson "B" Federal Well Nos. 4 and 5, and the Marathon-Shugart "B" Well Nos. 1 and 2) were used in the evaluation.

Three permeability-porosity relationships were observed from the data. They are:

Zones 1, 2, 3, 5, 7, 9, and 11 (Low flow units except for Zone 2)

$$\text{Log (Perm)} = 0.241 * \text{Porosity} - 0.648$$

Zones 4, 6, and 8 (high flow units)

$$\text{Log (Perm)} = 0.062 * \text{Porosity} + 1.134$$

Zone 10 (high flow unit)

$$\text{Log (Perm)} = 0.336 * \text{Porosity} - 2.668$$

Permeability values are in units of millidarcies and porosity values are in percent. Figures 28 through 30 are graphs of the actual data and the derived relationships. Table 4 also contains the permeability estimates using these relationships.

Pressure Data

Reservoir pressures, generally determined from 72-hour bottomhole pressure buildup surveys, were used in the evaluation. Table 5 lists all pressure data available during construction of the model.

Water Saturation

An average water saturation of 30 percent of the pore volume was used in the model. This value is derived from Figure 31, which shows the irreducible bulk volume water to be roughly at 1.5 percent porosity. Figure 31 shows that any pore space less than 1.5 percent of the bulk volume will be filled entirely by water. (The BSSC reservoir in Tamano is preferentially water-wet.) Any pore space with a value for porosity greater than 1.5 percent will have 1.5 percent filled with water and the remainder filled with oil, as long as the pore space is above any known free water contact. For instance, 2.0 percent porosity will have a bulk volume water value of 1.5 percent and a bulk oil value of 0.5 percent, or a water saturation of 75 percent. A porosity value of 10.0 percent will have a bulk volume water of 1.5 percent and a bulk volume oil of 8.5 percent, or a water saturation value of 15 percent. In both cases, the bulk volume water is 1.5 percent and irreducible. Average Tamano porosity is 5.0 percent, of which 1.5 percent is water-filled and 3.5 percent is oil-filled, for an average water saturation of 30 percent.

Capillary Pressure

Core from the Marathon-Shugart "B" Well No. 1 was used in laboratory experiments to obtain capillary pressure data. Core plugs were cut and trimmed to one inch lengths. After cleaning and drving the plugs, porosity and permeability were measured. The core was saturated in brine, and then run in a centrifuge to determine the primary drainage curve. The core was then soaked in crude for six weeks to restore the wetting character of the rock. Once the core was restored, imbibition and drainage measurements were obtained.

Results of the experiments are as follows:

CORE DEPTH	USBM WETTABILITY INDEX	IRREDUCIBLE BRINE SATURATION, %	INITIAL BRINE SATURATION, %
8122.4A	0.02	36.7	100
8122.4B	+ Large	63.0	100
8115.4A	+ Large	76.7	100
8115.4B	0.14	35.5	100
8100.9A	0.17	65.5	100
8100.9B	-0.19	23.9	100

The United States Bureau of Mines, USBM, Wettability Index is determined by computing the base ten log of the ratio of the drainage curve area to the imbibition curve area (see Figure 32). Values typically range from -1 to 1, where a positive index usually indicates a preferentially water-wet system. Tamano core is considered to be preferentially water-wet based on the experimental results. Table 6 contains the actual lab data that was used during the modelling work.

Relative Permeability

Gas-oil and oil-water relative permeability curves were measured in the laboratory using Marathon-Shugart "B" Well No. 2 core. Results of the experiments varied greatly, mainly due to the heterogeneity of the BSSC. Variations in the size and number of vugs and fractures from sample to sample affected the shape of the curves. Therefore, relative permeability curves were calculated using correlations for water-wet limestone/dolomite lithology. The correlations were published by Honarpour, et.al. [JPT, December,1982, pp. 2905-2908].

Relative permeabilities were a significant part of the history match of the model. The correlations are used to describe matrix porosity. Therefore, the curves were altered to reflect more of an anticipated shape of curves for vugs and fractures as opposed to a purely intercrystalline porosity. Figures 33 and 34 show the relative permeability curves from correlations and the adjusted curves for the gas-oil system and oil-water system, respectively, for the Tamano BSSC reservoir.

PVT Data

A downhole fluid sample was obtained from the Johnson "B" Federal Well No. 4. The sample was obtained immediately after the well was completed in January 1988, when the reservoir was still at the virgin pressure of 3,000 psia. A complete set of PVT experiments was run on the fluid sample in order to determine the reservoir fluid properties. The reservoir was found to be mildly undersaturated with a bubble point pressure of approximately 2,500 psia and an initial solution GOR of 880 SCFG per STBO. Some results of the laboratory experiments are as follows:

Bubble-Point Pressure	2,494 psia
Initial Solution GOR	880 SCFG/STBO
Reservoir Temperature	119°F at 8,016'
Oil Gravity	38.5° API @ 60°F
Gas Gravity	0.845 @ 67°F and 25 psig
FVF @ Bubble-Point	1.471 RBO/STBO
Oil viscosity at 2,250 psig	0.415 cp.
Gas viscosity at 2,250 psig	0.0189 cp.
GOR at Separator Conditions of 25 psig and 67°F	769 SCFG/STBO

The PVT results were also used a input data for the model.

Field data support the accuracy of the PVT results. On page 117 of Craft and Hawkins "Applied Petroleum Reservoir Engineering" book, a figure illustrates the behavior of an undersaturated reservoir in terms of reservoir pressure and oil recovery. Plotted on cartesian coordinates, reservoir pressure above the bubble point declines in a linear fashion with respect to the amount of oil recovered. When reservoir pressure falls below the bubble point, the decline in pressure with additional recovery is less severe, although still linear. The inflection point on the graph should occur at the bubble point. Figure 35 is a plot of reservoir pressure versus oil production for the Tamano Field. A regression line through the late data intersects the straight line formed by the first three data points at approximately 2,500 psia, which is the bubble-point pressure estimated from laboratory experiments.

Rock Compressibility

Rock compressibility is estimated to be 10×10^{-6} per psi. This value was determined from overburden pressure experiments performed on 10 whole core samples taken from the Marathon-Shugart "B" Well No. 2. Figure 36 shows the results of the experiments. Overburden pressure in Tamano is estimated to be 5,000 psia.

HISTORY MATCH

A history match of the model was performed once all available data was input. Model projections were compared to actual production and pressure data to determine the quality of the model projections. Production and pressure data through December 1990 were used in the match.

Few changes were needed to the initial input data to achieve a history match of field performance. In addition to adjusting the relative permeability curves as discussed previously, pore volumes in some of the edge tracts were reduced to match production data, and permeabilities were increased in some layers based on production log data and observed field performance. Figures 37 through 40 show the match of model projections to actual data for oil, gas, water and pressure, respectively. As the figures show, excellent matches were obtained for oil, gas and pressure. Some actual pressure data falls below the model prediction values. However, the model is projecting average pressure for the entire reservoir whereas actual pressure points are from individual wells. Actual water production is greater than the model projections. One reason is that, because water production is minor, even water from well stimulations affects the curve. Also, three wells completed in zones other than the main pay produce water that is booked. Model projections are from the BSSC main pay only. Two of the three wells, the Johnson "B" Federal A/C 1 Well No. 3 and the Hudson "11" Federal Well No. 3, are commingled in the BSSC and the BSSS. The third well is the Hudson "11" Federal Well No. 2 which produces from the upper portion of the BSSC.

The model is believed to be a good predictive tool based on the history match. This belief is supported by results from the Stetco "10" Federal Well No. 3. Well No. 3 was drilled as a stepout from existing BSSC and completed in January 1991. Figure 41 is a plot of pressure from the model node containing Well No. 3 with the lone actual data point being the pressure determined from a 72-hour buildup survey. Good agreement between model predictions and actual data is observed.

ENHANCED RECOVERY EVALUATION

Water injection and gas injection were evaluated as means of enhancing oil recovery from the BSSC reservoir in the Tamano Field. Four cases were investigated: a peripheral waterflood, a down-dip waterflood, gas injection in which 10 MMSCFGPD is injected, and gas injection in which 20 MMSCFGPD is injection. The ECLIPSE^{TM} model was used to predict the performance of all four cases. Figure 42 is a plot of ultimate oil recovery, including actual production to date and model projections of future performance, for the four scenarios. A fifth curve, titled "Depletion", is of model projections of primary recovery only, which would be the results if no enhanced recovery project is implemented.

In all four enhanced recovery projects, the start date was assumed to be January 1, 1992. As Figure 42 shows, a peripheral waterflood is projected to yield the greatest oil recovery. An economic analysis of all cases showed that a peripheral flood is also the most profitable scenario. Therefore, only the details of the peripheral flood will be discussed further.

Waterflood Plan

Five wells are converted to water injection initially. The five wells, highlighted on Figure 43, are the A. J. "11" Federal Well No. 1, the Hudson "11" Federal Well No. 4, the Johnson "B" Federal A/C 1 Well No. 10, the Stetco

"10" Federal Well No. 3, and the Marathon-Shugart "B" Well No. 1. Each well was limited to an injection rate of 1000 BWPD and a bottomhole pressure control of 5,760 psia. The pressure control was estimated from a frac gradient of 0.72 psi per foot and 8,000 feet of depth. The total field injection limit is 5,000 BWPD.

In addition to the five conversions, well work in the form of BSSS isolation is also required. Because only the BSSC will be unitized, the BSSS will be isolated in both the Johnson "B" Federal A/C 1 No. 3 and the Hudson "11" Federal Well No. 3 by setting a cast iron bridge plug between the two zones and dumping cement on top of the bridge plug. Plugging back in this manner should allow for easy reactivation of the BSSS upon termination of the Unit.

Model predictions show that no additional lift equipment will be required by producing wells initially. All Marathon-Operated wells are capable of producing approximately 400 BFPD, which is the maximum rate predicted by the model. HEYCO-Operated wells are assumed to have the same capability. In the future years, model predictions indicate submersible pumping equipment will be necessary for the Johnson "B" Federal Well No. 4, and the Johnson "B" Federal A/C 1 Well Nos. 7 and 9.

Future well work also exists in the form of additional conversions. The optimum waterflood plan involves conversion of the Johnson "B" Federal Well Nos. 6 and 8 in 1994. These two wells are also highlighted in Figure 43.

Waterflood Performance

Gross production from the proposed Tamano (BSSC) Unit is estimated to be 932 STBOPD on January 1, 1992. Decline is arrested as a result of waterflood operations, although production falls off to approximately 400 STBOPD in 1994 before peaking at 876 STBOPD in 1996. Projections were made for several years, with ultimate reserves being estimated from economic limits. Figure 44 depicts oil, gas and water production for both historical data and model projections. Figure 45 depicts injected water rates, produced water rates and average reservoir pressure throughout the life of the proposed unit. Table 7 contains production estimates by year for the flood.

Injection water requirements were based on model predictions. Due to limited water production rates from the BSSC reservoir, make-up water will be required throughout the life of the flood. Make-up water requirements would be the difference between the "produced water" curve and the "injected water" curve of Figure 45. A total of 25,800,000 BW will be injected throughout the life of the flood. Approximately 8,100,000 barrels of make-up water will be required. Maximum make-up water requirements are projected to occur in 1994 at an average rate of 4,700 BWPD.

Waterflood performance appears to be sensitive to depletion of the reservoir. If the initial date of water injection is delayed from January 1, 1992 until January 1, 1994, recovery of secondary reserves could be reduced. Figure 46 is a plot of primary production of oil, primary plus secondary oil production from the peripheral waterflood, and primary plus secondary oil production from a delayed peripheral waterflood. The delayed case assumes water injection begins on January 1, 1994 and is identical to the peripheral case in all other aspects. As Figure 46 shows, model projections of oil recovery are roughly 900,000 STB less if a two-year delay in water injection occurs.

Capital Investments

The initial, uninflated capital investment required to initiate the peripheral waterflood is estimated to be $1,125,000. Included in this estimate are $748,000 for construction of an injection system, minor facility upgrades and consolidation. The remaining $377,000 will be required for the five producer-to-injector conversions and two workovers to isolate the BSSS. Future uninflated investments of $386,000 are estimated for additional lift equipment and two more producer-to-injector conversions. Table 8 summarizes the investment schedule.

A main battery is proposed where Marathon's Johnson "B" Federal battery is presently located. Such a location would position the battery in the center of the Unit area. Based on model projections, the facility has been designed such that no future upgrades will be necessary, with the exception of the two future injection well tie-ins. Because of the Tamano (Bone Spring) Field's recent development, most of the surface equipment is in excellent shape and almost the entire main battery except for injection facilities will be constructed using equipment already in place. Figure 47 shows the location of the main battery, the injection system and a satellite battery.

The satellite battery will be used as a test facility for wells in the north half of the Unit. Oil, gas, and water from the Stetco "10" Federal Well No. 2 and each producing well on the Johnson "B" Federal A/C 1 Lease and Hudson "11" Federal Lease will be directed to this battery.

The central battery (Figure 48) will provide facilities for oil, gas, and water separation. To aid in gas separation, two 4' X 15' vertical gas separators will be set upstream of the free water knockout (FWKO). Both are currently set at the proposed main battery and can be incorporated into the proposed facilities at minimal cost. Water production rates will require the purchase of a 8' X 20' two-phase FWKO downstream of the gas separators. Water derived from the FWKO will be directed to the adjacent water injection facility. Oil will be treated prior to transfer to stock tanks by an 8' X 20' and a 6' X 20' vertical heater treater. The two heater treaters are currently in use in the Tamano Field and have the capacity to handle the maximum projected oil rates. Gas production will be directed to Conoco's Maljamar Gas Plant at a line pressure of approximately 40 psig.

Injection facilities will be constructed at the main battery and be designed to handle a maximum of 6,000 BWPD at 2,500 psig. Produced water will be utilized, however, its initial contribution (less than 200 BPD) will be negligible. By requirement, the injection facility must have storage capacity of one-half day's make up water requirement. Water will be distributed to the injection wells via buried 2-3/8" injection line.

Operating Expenses

Table 9 summarizes the projected yearly operating costs (uninflated) for primary depletion and waterflood operations. Yearly operating expenses were approximately $36,000 per well per year in 1990 on the Marathon-Operated leases. For secondary operations, these expenses are assumed to be 25 percent greater, or $45,000 per well per year, to handle the increase in water production. Make up water charges are assumed to be $0.15/BW. Costs to inject 5,000 BWPD are estimated to be $100,000 per year.

Waterflood Economics

Uninflated incremental waterflood economics were run using the investments, expenses, and production forecasts detailed in this report. Economics were based on a 100 percent working interest and 87.5 percent net revenue interest. Initial 1992 product prices of $20.96/BO and $2.01/MSCFG were assumed.

Table 10 provides a summary of pertinent economics. Results of the incremental economics indicate a 3.6 year payout BFIT, a DCF/ROR BFIT of 60.1 percent, and a profit-to-investment ratio BFIT of 11.5.

Net oil reserves of 1,979,000 STBO are estimated. A loss of 1.098 BCFG is predicted. This loss can be attributed to retaining gas in the reservoir as part of the residual hydrocarbon saturation due to waterflooding. Development costs based on these reserves are $0.84 per net equivalent barrel. Table 11 shows the incremental economic summary of the proposed peripheral waterflood.

SUMMARY

Peripheral waterflood operations are projected to economically develop BSSC secondary reserves. The BSSC is a dolomitized debris flow encountered at 8,000 feet in the Tamano Field. It is a solution gas drive reservoir with a virgin pressure of 3,000 psia and a bubble point pressure of 2,500 psia. The OOIP is estimated to be 15,000,000 STBO. Gross ultimate primary reserves are estimated to be 2,167,000 STBO, which represents 14.4 percent of the OOIP.

Evaluation of the BSSC reservoir determined that an incremental 2,261,000 STBO may be recovered by implementing a peripheral waterflood by January 1, 1992. Gross ultimate secondary reserves represent 15.1 percent of the OOIP. Ultimate recovery with secondary is therefore 29.5 percent of the OOIP. Secondary recovery appears to be sensitive to the initial start date of water injection. A two-year delay in the initial start date results in lower recovery of secondary reserves.

The results of this study are based on model predictious using the ECLIPSE™ black oil simulator. Also used in this study were all available openhole logs from the 19 wells within the proposed Unit area and direct offsets, cores from four BSSC wells, PVT data from the Johnson "B" Federal Well No. 4, and production data from the first date of production in May 1987 through December 1990.

NOMENCLATURE

BCFG - billion cubic feet of gas.

BFIT - before Federal Income Tax.

BFPD - barrels of fluid per day.

BSSC - Bone Spring Second Carbonate.

BSSS - Bone Spring Second Sand.

BWPD - barrels of water per day.

DCF - discounted cash flow.

FVF - formation volume factor, reservoir barrels per stock tank barrel.

GOR - gas-oil ratio, standard cubic feet of gas per stock tank barrel of oil.

HEYCO - Harvey E. Yates Company.

MBW - thousand barrels of water.

md - millidarcies.

MMSCFG - million standard cubic feet of gas.

MSCFGPD - thousand standard cubic feet of gas per day.

MSTBO - thousand stock tank barrels of oil.

NMOCD - New Mexico Oil Conservation Division.

NPV - net present value.

OOIP - original oil-in-place.

psia - pounds per square inch absolute.

psig - pounds per square inch gauge.

PVT - pressure-volume-temperature.

RBO - reservoir barrels of oil.

ROR - rate of return.

SCFG - standard cubic feet of gas.

STB - stock tank barrels.

STBO - stock tank barrels of oil.

STBOPD - stock tank barrels of oil per day.

TABLE 1

TAMANO (BSSC) UNIT
TRACT PRIMARY AND SECONDARY COMPARISON

TRACT NO.	LEASE	WELL NO.	REMAINING PRIMARY RESERVES AS OF 4-1-91, STBO	SECONDARY RESERVES BASED ON TRACT PARTICIPATION STBO	REMAINING PRIMARY NPV AS OF 1-1-92, BFIT @ 10%	SECONDARY NPV AS OF 1-1-92, BFIT @ 10%	INCREMENTAL SECONDARY NPV AS OF 1-1-92, BFIT @ 10%
1	Stetco "10" Federal	2	12,775				
	TRACT 1 TOTAL		12,775	39,560	$ 244,762	$ 472,217	$ 227,455
2	A. J. "11" Federal	1	14,070				
	A. J. "11" Federal	2	1,798				
	TRACT 2 TOTAL		15,868	60,813	$ 304,022	$ 653,678	$ 349,655
3	Stetco "10" Federal	1	75,599				
	Stetco "10" Federal	3	85,369				
	TRACT 3 TOTAL		160,995	699,011	$ 3,084,578	$ 7,103,658	$ 4,019,080
4	Johnson "B" Federal A/C 1	3	3,664				
	Johnson "B" Federal A/C 1	7	145,504				
	Johnson "B" Federal A/C 1	9	65,178				
	Johnson "B" Federal A/C 1	10	7,055				
	TRACT 4 TOTAL		221,401	508,756	$ 4,241,925	$ 7,167,102	$ 2,925,177
5	Johnson "B" Federal	4	24,197				
	Johnson "B" Federal	5	10,749				
	Johnson "B" Federal	6	89,422				
	Johnson "B" Federal	8	37,759				
	TRACT 5 TOTAL		162,127	521,336	$ 3,106,267	$ 6,103,776	$ 2,997,509
6	Marathon-Shugart "B"	1	11,663				
	Marathon-Shugart "B"	2	76,419				
	TRACT 6 TOTAL		88,082	283,285	$ 1,687,604	$ 3,316,396	$ 1,628,791
7	Hudson "11" Federal	3	5,821				
	Hudson "11" Federal	4	17,503				
	TRACT 7 TOTAL		23,324	91,173	$ 446,875	$ 971,089	$ 524,213
8	Hudson "11" Federal	5	8,763				
	TRACT 8 TOTAL		8,763	32,768	$ 167,894	$ 356,297	$ 188,403
9	Hudson "11" Federal	2	7,102				
	TRACT 9 TOTAL		7,102	24,474	$ 136,071	$ 276,787	$ 140,716
	TOTALS		700,437	2,261,176	$13,420,000	$26,421,000	$13,001,000

TABLE 2
TAMANO (BSSC) UNIT
GROSS PRODUCTION FROM TAMANO (BONE SPRING) FIELD

		FIELD TOTAL DAILY AVERAGE				MARATHON DAILY AVERAGE				HEYCO DAILY AVERAGE			
YEAR	MONTH	BOPD	MCFGPD	GOR	BWPD	BOPD	MCFGPD	GOR	BWPD	BOPD	MCFGPD	GOR	BWPD
1987	MAY	1	0	0	0	1	0	0	0				
	JUN	7	0	0	0	7	0	0	0				
	JUL	10	0	0	0	10	0	0	0				
	AUG	9	0	0	0	9	0	0	0				
	SEP	10	0	0	0	10	0	0	0				
	OCT	9	0	0	0	9	0	0	0				
	NOV	13	0	0	0	13	0	0	0				
	DEC	9	0	0	0	9	0	0	0				
1988	JAN	135	0	0	0	135	0	0	0				
	FEB	243	0	0	0	243	0	0	0				
	MAR	229	0	0	10	229	0	0	10				
	APR	257	117	454	15	257	117	454	15				
	MAY	239	285	1193	6	239	285	1193	6				
	JUN	357	301	845	57	357	301	845	57				
	JUL	807	696	863	52	624	597	956	22	183	100	545	30
	AUG	1,000	410	410	30	760	381	502	11	239	29	121	19
	SEP	1,021	578	566	25	783	388	495	9	239	190	798	16
	OCT	1,115	581	521	23	872	410	470	8	242	171	706	15
	NOV	1,371	717	523	37	1,123	560	499	26	248	157	632	10
	DEC	1,395	867	622	22	1,156	660	571	16	239	207	867	6
1989	JAN	1,429	970	678	16	1,198	737	615	11	231	232	1006	5
	FEB	1,383	1,071	775	26	1,158	859	742	20	225	212	944	6
	MAR	1,389	1,159	834	59	1,164	937	805	53	225	222	986	6
	APR	1,512	1,169	773	129	1,217	898	738	51	296	272	918	79
	MAY	1,337	1,022	765	104	1,041	701	674	40	296	321	1083	64
	JUN	1,469	1,532	1043	130	1,220	1,074	880	54	248	458	1841	76
	JUL	1,585	1,659	1047	173	1,183	1,168	987	90	402	491	1222	84
	AUG	1,491	1,604	1076	115	1,143	1,009	882	39	347	596	1715	76
	SEP	1,248	1,351	1083	94	924	810	877	60	324	541	1670	34
	OCT	1,047	1,145	1094	162	688	553	803	79	359	593	1651	83
	NOV	1,024	1,128	1101	149	665	548	824	70	359	580	1615	79
	DEC	1,006	949	943	161	691	502	727	78	315	447	1418	84
1990	JAN	1,323	1,534	1159	182	1,039	956	920	111	284	577	2031	71
	FEB	1,294	1,616	1249	172	1,031	1,019	989	105	262	597	2274	67
	MAR	1,271	1,807	1422	168	1,023	1,274	1245	102	248	533	2152	66
	APR	1,351	1,874	1387	155	1,141	1,257	1101	96	210	617	2944	59
	MAY	1,274	1,922	1508	155	1,086	1,326	1221	105	188	596	3170	50
	JUN	1,339	2,280	1703	172	1,163	1,702	1463	124	175	578	3297	48
	JUL	1,520	2,598	1710	171	1,338	1,998	1493	129	182	601	3298	42
	AUG	1,526	2,831	1855	144	1,363	2,269	1665	101	164	563	3438	43
	SEP	1,607	2,592	1613	162	1,454	2,074	1427	117	153	517	3382	46
	OCT	1,464	2,681	1831	150	1,315	2,282	1736	99	150	399	2670	50
	NOV	1,908	3,805	1994	131	1,770	3,501	1978	93	138	303	2201	38
	DEC	2,035	4,388	2157	133	1,899	4,166	2194	112	136	221	1631	21
1991	JAN	2,339	5,858	2505	115	2,219	5,614	2530	90	120	244	2031	25
	FEB	1,890	5,531	2927	141	1,767	5,097	2885	90	123	434	3538	52
	MAR	1,850	5,821	3146		1,733	5,355	3091		118	466	3958	55

TABLE 3
TAMANO (BSSC) UNIT
WELL-BY-WELL GROSS PRODUCTION

WELL NAME AND NUMBER	DECLINE METHOD	CUMULATIVE PRODUCTION THROUGH 3-31-91 STBO	MSCFG	BW	REMAINING PRIMARY STBO AS OF 4-1-91	ESTIMATED ULTIMATE STBO
A. J. "11" Federal No. 1	Conv.	37,517	56,911	4,842	14,070	51,587
A. J. "11" Federal No. 2	Conv.	19,634	40,086	10,775	1,798	21,432
Hudson "11" Federal No. 2	Conv.	13,484	2,150	12,441	7,102	20,586
Hudson "11" Federal No. 3	Conv.	37,461	98,323	21,076	5,821	43,282
Hudson "11" Federal No. 4	Conv.	123,490	191,601	1,071	17,503	140,993
Hudson "11" Federal No. 5	Conv.	5,282	8,356	580	8,763	14,045
Johnson "B" Federal No. 4	Conv.	235,214	265,720	2,788	24,197	259,411
Johnson "B" Federal No. 5	Conv.	47,969	44,939	3,036	10,749	58,718
Johnson "B" Federal No. 6	Model	239,804	352,898	3,254	89,422	329,226
Johnson "B" Federal No. 8	Conv.	176,690	144,133	45,899	37,759	214,449
Johnson "B" Federal A/C 1 No. 3	Conv.	12,285	10,557	9,760	3,664	15,949
Johnson "B" Federal A/C 1 No. 7	Conv.	205,931	221,918	1,741	145,504	351,435
Johnson "B" Federal A/C 1 No. 9	Model	73,026	198,214	207	65,178	138,204
Johnson "B" Federal A/C 1 No. 10	Model	4,002	13,935	0	7,055	11,057
Marathon-Shugart "B" No. 1	Conv.	32,604	29,484	2,392	11,663	44,267
Marathon-Shugart "B" No. 2	Model	87,583	161,794	414	76,419	164,002
Stetco "11" Federal No. 1	Model	84,102	175,000	90	75,599	159,701
Stetco "11" Federal No. 2	Model	1,527	2,223	186	12,775	14,302
Stetco "11" Federal No. 3	Model	29,273	-	-	85,396	114,669
TOTAL		1,466,878	2,018,242	120,552	700,437	2,167,315

TABLE 4
TAMANO (BSSC) UNIT
POROSITY AND PERMEABILITY ESTIMATES
PAGE 1

WELL NAME AND NUMBER	LAYER	THICKNESS, feet	POROSITY, decimal	PERMEABILITY, md
Johnson "B" Fed. A/C 1 No. 3	1	19	0.031	1.3
	2	0	0.000	0.0
	3	20	0.039	2.0
	4	4	0.054	29.4
	5	7	0.035	1.6
	6	0	0.000	0.0
	7	25	0.029	1.1
	8	0	0.000	0.0
	9	33	0.048	3.2
	10	0	0.000	0.0
	11	8	0.053	4.3
Johnson "B" Federal No. 4	1	0	0.000	0.0
	2	14	0.076	15.3
	3	20	0.040	2.1
	4	8	0.071	37.5
	5	8	0.043	2.5
	6	8	0.098	55.2
	7	8	0.072	12.2
	8	4	0.098	55.2
	9	56	0.054	4.5
	10	3	0.051	0.1
	11	3	0.049	3.4
Johnson "B" Federal No. 5	1	0	0.000	0.0
	2	12	0.065	8.3
	3	14	0.038	1.9
	4	3	0.051	28.2
	5	21	0.034	1.5
	6	6	0.031	21.2
	7	6	0.024	0.9
	8	0	0.000	0.0
	9	60	0.035	1.6
	10	5	0.059	0.2
	11	17	0.052	4.0
Johnson "B" Federal No. 6	1	8	0.064	7.8
	2	14	0.088	29.7
	3	21	0.042	2.3
	4	0	0.000	0.0
	5	11	0.065	8.3
	6	11	0.110	65.5
	7	5	0.069	10.4
	8	0	0.000	0.0
	9	54	0.059	5.9
	10	0	0.000	0.0
	11	20	0.052	4.0

TABLE 4
TAMANO (BSSC) UNIT
POROSITY AND PERMEABILITY ESTIMATES
PAGE 2

WELL NAME AND NUMBER	LAYER	THICKNESS, feet	POROSITY, decimal	PERMEABILITY, md
Johnson "B" Fed. A/C 1 No. 7	1	10	0.018	0.6
	2	0	0.000	0.0
	3	29	0.011	0.4
	4	7	0.028	20.3
	5	10	0.011	0.4
	6	0	0.000	0.0
	7	18	0.026	1.0
	8	0	0.000	0.0
	9	38	0.038	1.9
	10	0	0.000	0.0
	11	6	0.027	1.0
Johnson "B" Federal No. 8	1	0	0.000	0.0
	2	16	0.048	3.2
	3	8	0.041	2.2
	4	16	0.058	31.2
	5	8	0.035	1.6
	6	10	0.047	26.6
	7	7	0.032	1.3
	8	0	0.000	0.0
	9	48	0.036	1.7
	10	9	0.063	0.3
	11	32	0.052	4.0
Johnson "B" Fed. A/C 1 No. 9	1	4	0.055	4.8
	2	7	0.060	6.3
	3	17	0.067	9.3
	4	12	0.087	47.1
	5	9	0.077	16.1
	6	6	0.079	42.1
	7	11	0.090	33.2
	8	4	0.076	40.3
	9	48	0.063	7.4
	10	3	0.073	0.6
	11	9	0.069	10.4
Johnson "B" Fed. A/C 1 No.10	1	0	0.000	0.0
	2	2	0.071	11.6
	3	16	0.012	0.4
	4	8	0.023	18.9
	5	12	0.009	0.4
	6	0	0.000	0.0
	7	14	0.018	0.6
	8	6	0.044	25.5
	9	50	0.030	1.2
	10	2	0.034	0.0
	11	8	0.041	2.2

TABLE 4
TAMANO (BSSC) UNIT
POROSITY AND PERMEABILITY ESTIMATES
PAGE 3

WELL NAME AND NUMBER	LAYER	THICKNESS, feet	POROSITY, decimal	PERMEABILITY, md
Marathon-Shugart "B" No. 1	1	0	0.000	0.0
	2	6	0.063	7.4
	3	0	0.000	0.0
	4	30	0.051	28.2
	5	6	0.036	1.7
	6	12	0.039	23.8
	7	0	0.000	0.0
	8	16	0.040	24.1
	9	0	0.000	0.0
	10	75	0.027	0.0
	11	19	0.041	2.2
Marathon-Shugart "B" No. 2	1	0	0.000	0.0
	2	20	0.059	5.9
	3	12	0.048	3.2
	4	5	0.046	26.3
	5	15	0.038	1.9
	6	6	0.045	25.9
	7	6	0.030	1.2
	8	6	0.054	29.4
	9	45	0.058	5.6
	10	0	0.000	0.0
	11	33	0.042	2.3
Stetco "10" Federal No. 1	1	0	0.000	0.0
	2	20	0.087	28.1
	3	14	0.038	1.9
	4	6	0.051	28.2
	5	6	0.043	2.5
	6	4	0.072	38.1
	7	38	0.050	3.6
	8	4	0.081	43.3
	9	46	0.043	2.5
	10	2	0.056	0.2
	11	18	0.034	1.5
Stetco "10" Federal No. 2	1	0	0.097	48.9
	2	4	0.098	51.7
	3	26	0.032	1.3
	4	10	0.043	25.2
	5	10	0.066	8.8
	6	12	0.094	52.1
	7	14	0.037	1.8
	8	0	0.000	0.0
	9	37	0.026	1.0
	10	4	0.058	0.2
	11	7	0.054	4.5

TABLE 4
TAMANO (BSSC) UNIT
POROSITY AND PERMEABILITY ESTIMATES
PAGE 4

WELL NAME AND NUMBER	LAYER	THICKNESS, feet	POROSITY, decimal	PERMEABILITY, md
Stetco "10" Federal No. 3	1	12	0.035	1.6
	2	0	0.000	0.0
	3	24	0.025	0.9
	4	0	0.000	0.0
	5	35	0.021	0.7
	6	6	0.040	24.1
	7	15	0.019	0.7
	8	6	0.051	28.2
	9	49	0.029	1.1
	10	0	0.000	0.0
	11	29	0.041	2.2
Hudson "11" Federal No. 3	1	9	0.035	1.6
	2	0	0.000	0.0
	3	31	0.028	1.1
	4	0	0.000	0.0
	5	14	0.019	0.7
	6	0	0.000	0.0
	7	20	0.027	1.0
	8	4	0.080	42.7
	9	19	0.029	1.1
	10	0	0.000	0.0
	11	13	0.060	6.3
Hudson "11" Federal No. 4	1	10	0.048	3.2
	2	4	0.048	3.2
	3	24	0.049	3.4
	4	0	0.000	0.0
	5	20	0.046	2.9
	6	0	0.000	0.0
	7	18	0.043	2.5
	8	0	0.000	0.0
	9	24	0.047	3.1
	10	10	0.067	0.4
	11	10	0.056	5.0
Hudson "11" Federal No. 5	1	22	0.053	4.3
	2	0	0.000	0.0
	3	23	0.020	0.7
	4	0	0.000	0.0
	5	13	0.026	1.0
	6	4	0.044	25.5
	7	26	0.037	1.8
	8	0	0.000	0.0
	9	10	0.057	5.3
	10	6	0.049	0.1
	11	14	0.055	4.8

TABLE 4
TAMANO (BSSC) UNIT
POROSITY AND PERMEABILITY ESTIMATES
PAGE 5

WELL NAME AND NUMBER	LAYER	THICKNESS, feet	POROSITY, decimal	PERMEABILITY, md
A. J. "11" Federal No. 1	1	7	0.055	4.8
	2	0	0.000	0.0
	3	20	0.042	2.3
	4	10	0.061	32.5
	5	6	0.041	2.2
	6	3	0.051	28.2
	7	7	0.033	1.4
	8	0	0.000	0.0
	9	58	0.029	1.1
	10	8	0.048	0.1
	11	38	0.036	1.7
A. J. "11" Federal No. 2	1	10	0.040	2.1
	2	4	0.044	2.6
	3	15	0.028	1.1
	4	0	0.000	0.0
	5	10	0.027	1.0
	6	6	0.040	24.1
	7	10	0.031	1.3
	8	0	0.000	0.0
	9	57	0.037	1.8
	10	7	0.068	0.4
	11	18	0.049	3.4

TABLE 5
TAMANO (BSSC) UNIT
PRESSURE DATA

DATE	WELL NUMBER	BHP TEST METHOD	DATUM	BOTTOM-HOLE GRADIENT, psi/ft	EST. BHP, psia	PERM. to OIL, md	SKIN
12-07-87	B-4	DST	-4213'	N\A	2971	14.6	+16.0
01-15-88	B-4	BUILDUP	-4353'	0.308	2958	12.0	+15.0
04-12-88	B-4	BUILDUP	-4353'	0.305	2943	3.7	- 0.4
06-04-88	B-5	BUILDUP	-4331'	0.303	2714	4.4	+12.0
07-05-88	B-6	BUILDUP	-4385'	0.299	2687	25.0	+ 9.2
07-26-88	B-7	BUILDUP	-4345'	0.302	2503	12.5	- 0.9
09-02-88	B-1	BUILDUP	-4362'	0.448	2496	0.3	- 3.4
09-09-88	B-4	BUILDUP	-4353'	0.315	2613	2.6	+ 4.7
11-29-88	B-8	BUILDUP	-4409'	0.311	2472	6.8	+ 0.7
05-01-89	B-4	BUILDUP	-4353'	0.315	1936	2.6	+ 6.9
	B-6	BUILDUP	-4385'	0.312	2152	20.5	+11.9
	B-7	BUILDUP	-4345'	0.314	2151	13.3	- 0.8
	B-8	BUILDUP	-4409'	0.308	2302	7.4	- 1.7
	B-1	DSI BU	-4494'	N/A	2394	0.4	+ 1.5
08-08-89	B-4	BUILDUP	-4353'	0.038	1736	1.5	- 3.1
09-20-89	B-4	BUILDUP	-4353'	0.035	1702	1.3	- 3.7
	B-6	BUILDUP	-4385'	0.317	1939	9.6	+ 4.4
	B-7	BUILDUP	-4345'	0.313	1816	2.4	- 1.6
05-04-90	B-2	BUILDUP	-4263'	0.301	1917	18.6	- 2.1
07-13-90	B-9	BUILDUP	-4309'	0.052	1914	7.4	- 2.4
08-23-90	10-1	BUILDUP	-4340'	0.307	1813	12.7	- 1.9
08-23-90	B-10	DST	-4278'	N/A	2944	0.033	+ 4.9
12-12-90	B-2	BUILDUP	-4263'		1514	10.2	+ 1.0
	B-6	BUILDUP	-4385'		1286	20.8	- 0.6
	B-9	BUILDUP	-4309'		1564	9.9	- 1.7
	10-1	BUILDUP	-4340'		1523	9.3	- 0.2
01-11-91	10-3	BUILDUP	-4242'	0.054	2065	3.1	- 3.3

TABLE 6
TAMANO (BSSC) UNIT
CAPILLARY PRESSURE DATA

WATER SATURATION, %	CAPILLARY PRESSURE, psi
98.80	0.11
96.42	0.12
94.09	0.14
91.83	0.15
89.61	0.17
87.45	0.18
85.34	0.20
93.29	0.22
81.28	0.25
79.32	0.27
77.41	0.30
75.54	0.33
73.72	0.37
71.94	0.41
70.21	0.45
68.52	0.50
66.87	0.55
65.25	0.61
63.68	0.67
62.15	0.74
60.65	0.82
59.19	0.90
57.76	1.00
56.37	1.11
55.01	1.22
53.68	1.35
52.39	1.49

WATER SATURATION, %	CAPILLARY PRESSURE, psi
51.13	1.65
49.89	1.82
48.69	2.01
47.52	2.23
46.37	2.46
45.25	2.72
44.16	3.00
43.10	3.32
42.06	3.67
41.05	4.06
40.06	4.48
39.09	4.95
38.15	5.47
37.23	6.05
36.33	6.69
35.46	7.39
34.60	8.17
33.77	9.03
32.95	9.97
32.16	11.02
31.38	12.18
30.63	13.46
29.89	14.88
29.17	16.44
28.47	18.17
27.78	20.09

TABLE 7

TAMANO (BSSC) UNIT

PROJECTION OF GROSS PRODUCTION
PERIPHERAL WATERFLOOD

	PRIMARY DEPLETION			PERIHERAL WATERFLOOD		
YEAR	BOPD	MSCFGPD	BWPD	BOPD	MSCFGPD	BWPD
1987	8	6	0	8	6	0
1988	673	514	5	673	514	5
1989	1,308	1,004	56	1,308	1,004	56
1990	1,482	2,636	76	1,482	2,636	76
1991	1,407	8,238	102	1,407	8,418	102
1992	706	8,505	104	705	6,636	226
1993	360	4,434	104	589	3,264	453
1994	137	1,471	31	435	1,023	229
1995	52	577	10	533	266	836
1996	22	204	4	868	137	2,595
1997	14	102	2	815	118	3,230
1998	9	59	1	751	123	4,180
1999	8	52	0	691	104	4,246
2000	7	45	0	516	79	4,359
2001				395	62	4,469
2002				323	52	4,563
2003				271	44	4,634
2004				233	38	4,662
2005				204	34	4,679
2006				181	30	4,733

TABLE 8

TAMANO (BSSC) UNIT

WATERFLOOD INVESTMENT SCHEDULE

YEAR	ITEM	TANGIBLE (M$)	INTANGIBLE (M$)	TOTAL (M$)
1991(4th Qtr)	Main Battery Consolidation Injection Facility Construction	433	315	748
	Convert 5 wells to Injection	159	203	362
	Isolate Second Sand in 2 wells	---	15	15
Subtotal 1991(4th Qtr)		592	533	1,125
1994	Convert 2 wells to Injection	63	77	140
1997	Larger Lift Equipment	53	20	73
1998	Larger Lift Equipment	80	20	100
2002	Larger Lift Equipment	53	20	73
Grand Total		841	670	1,511

TABLE 9
TAMANO (BSSC) UNIT
PRIMARY DEPLETION AND WATERFLOOD
OPERATING EXPENSES

PERIPHERAL WATERFLOOD

YEAR	PRIMARY DEPLETION EXPENSE ($)	INCREMENTAL DIRECT LEASE EXPENSE ($)	MAKE-UP WATER EXPENSE ($)	TOTAL OPERATING EXPENSE ($)
1992	663,000	99,000	177,000	939,000
1993	582,000	132,000	166,000	880,000
1994	441,000	161,000	260,000	862,000
1995	312,000	253,000	246,000	811,000
1996	90,000	439,000	130,000	659,000
1997	72,000	464,000	59,000	595,000
1998	36,000	587,000	43,000	666,000
1999	36,000	587,000	28,000	651,000
2000	36,000	587,000	28,000	651,000
2001	---	623,000	23,000	646,000
2002	---	637,000	19,000	656,000
2003	---	637,000	16,000	653,000
2004	---	626,000	15,000	641,000
2005	---	592,000	13,000	605,000
2006	---	592,000	11,000	603,000

TABLE 10

TAMANO (BSSC) UNIT

ECONOMIC SUMMARY OF PERIPHERAL WATERFLOOD

	PERIPHERAL WATERFLOOD
Gross Investment, M$	
Current Year	1,125
Future	386
Incremental Payout, Years	3.47
DCF/ROR (BFIT), %	60.11
Net Present Value (@15% BFIT)	9,394
Profit/Investment (BFIT), $/$	17.39
Incremental Cumulative BFIT Cashflow, M$	26,284
Incremental Investment/NBOE, $/NBOE	0.84
Incremental Reserves, MBO	1,979
MMCF	-1,098
MNBOE (6:1)	1,795

TABLE 11
TAMANO (BSSC) UNIT
INCREMENTAL ECONOMIC ANALYSIS
PRIMARY DEPLETION VS. PERIPHERAL WATERFLOOD

YEAR	DAILY NET LIQUIDS (BBLS/D)	DAILY NET GAS (MCF/D)	TOTAL OPERATING REVENUE (M$)	TOTAL OPERATING EXPENSE (M$)	TOTAL INVESTMENT (M$)	BFIT CASH FLOW (M$)
0					1,125	-1,125
1992	-1	-1,635	-1,206	159	0	-1,365
1993	200	-1,024	782	362	0	419
1994	261	-392	1,707	562	140	1,005
1995	421	-272	3,020	748	0	2,272
1996	740	-59	5,620	1,032	0	4,588
1997	701	14	5,372	966	73	4,334
1998	649	56	5,008	1,043	100	3,865
1999	598	46	4,605	994	0	3,611
2000	445	30	3,429	898	0	2,532
2001	346	54	2,684	867	0	1,817
2002	283	46	2,196	837	73	1,286
2003	237	39	1,842	805	0	1,038
2004	204	33	1,584	772	0	813
2005	179	30	1,387	719	0	668
2006	158	26	1,231	704	0	526
TOTAL	1,978,528	-1,098,331	39,262	11,467	1,511	26,284

INCREMENTAL NET RESERVES (1000'S)

OIL	(BBLS)	1979
GAS	(MCF)	-1098
COND.	(BBLS)	0
PL. LIQ.	(BBLS)	0
SULFUR	(LT)	0
TOTAL EQUIV. BBLS		1,873
TOTAL EQUIV 6:1 BBLS		1,795

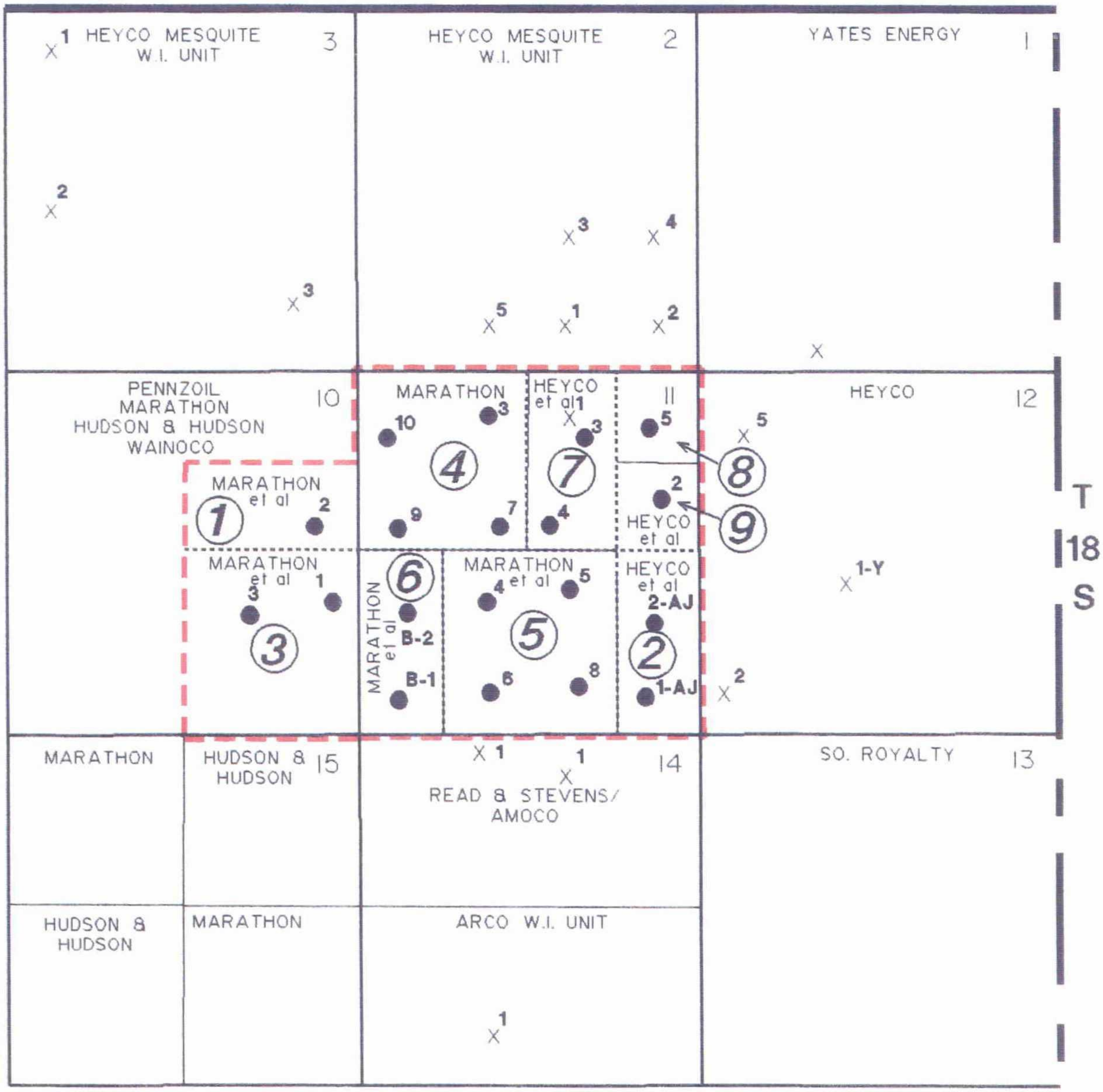
INCR. LIQUID REVENUE (M$)	41,470
INCR. GAS REVENUE	-2,208
INCR. LIQUID PRICE ($/BBL)	20.96
INCR. GAS PRICE ($/MCF)	2.01

	BFIT (M$)
NPV AT 5%	18,279
NPV AT 10%	13,001
NPV AT 13%	10,682
NPV AT 15%	9,394
NPV AT 20%	6,851
NPV AT 25%	5,010
NPV AT 30%	3,646
NPV AT 35%	2,616
NPV AT 40%	1,823
NPV AT 45%	1,204
NPV AT 50%	715

	BFIT
PROFIT/INVESTMENT	17.39
PAYOUT, YEARS	3.67
DCF-ROR, %	60.11
INCR. INV/EQ BBL	0.84
AFIT PROFIT/EQ BBL	9.66
OPER EXP/EQ BBL	6.39

FIGURE 1

R-31-E



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED
UNIT BOUNDARY

(1) TRACT NUMBER

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

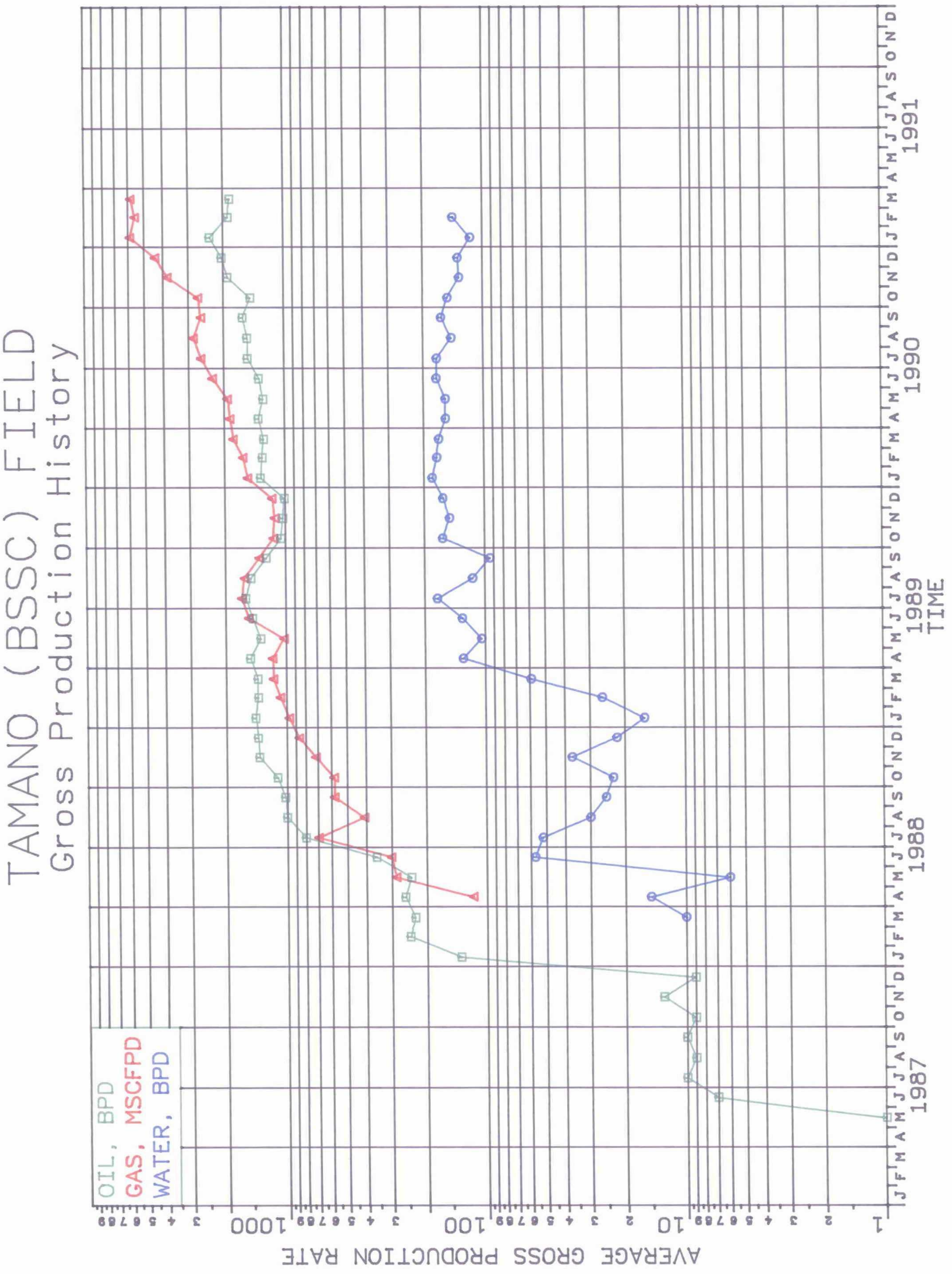
TRACT MAP SHOWING OPERATORS WITHIN PROPOSED UNIT BOUNDARIES

0 1/4 1/2
MILE

1-91

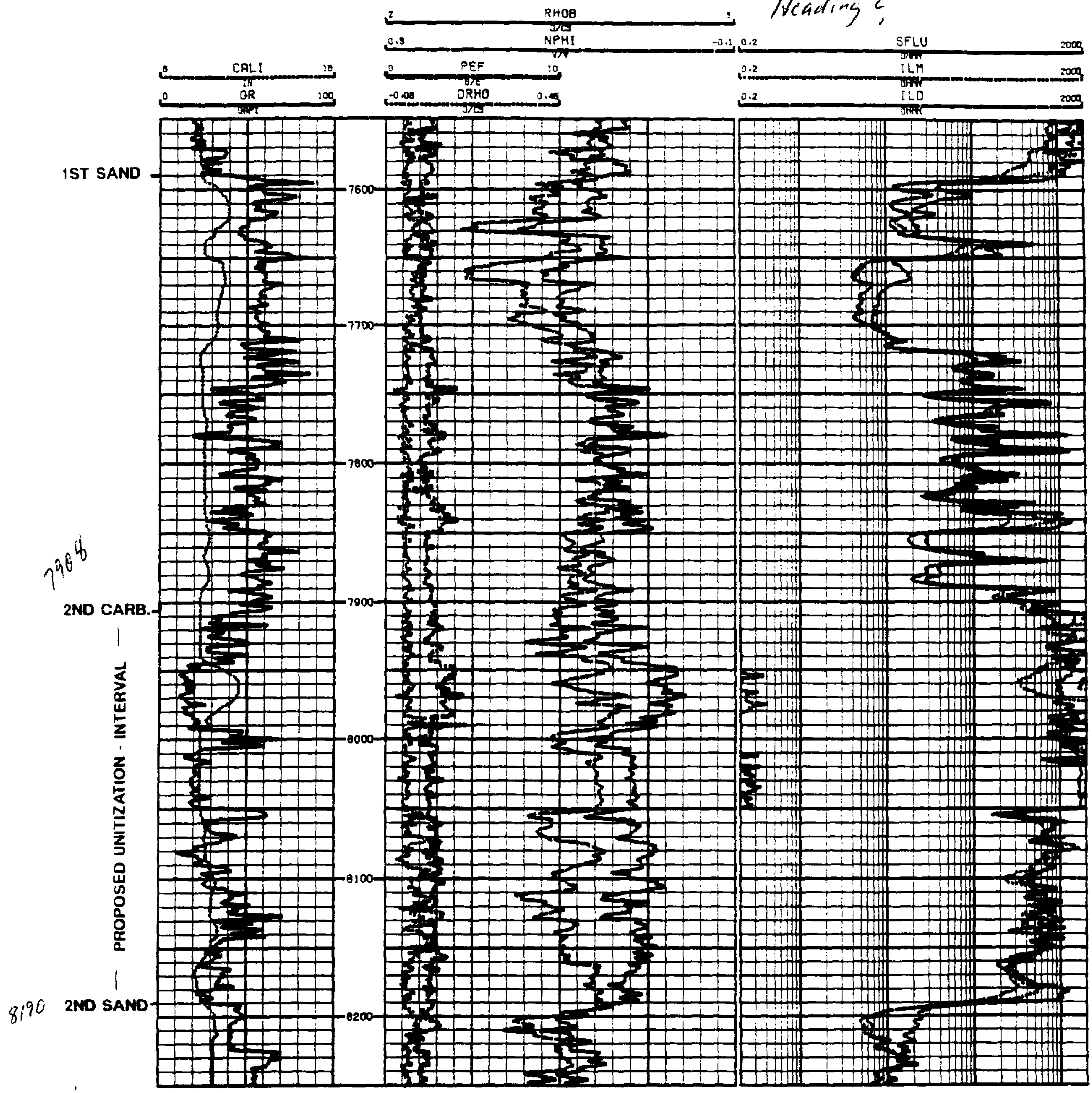
TBS4.AFE

FIGURE 2



TAMANO (BSSC) FIELD
Gross Production History
OIL, BPD
GAS, MSCFPD
WATER, BPD
AVERAGE GROSS PRODUCTION RATE
TIME
1987
1988
1989
1990
1991
1
10
100
1000

Heading ?

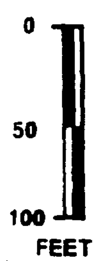


K.B. 3752'
G.L. 3736'

MARATHON OIL COMPANY
MID-CONTINENT REGION

TAMANO (BSSC) UNIT

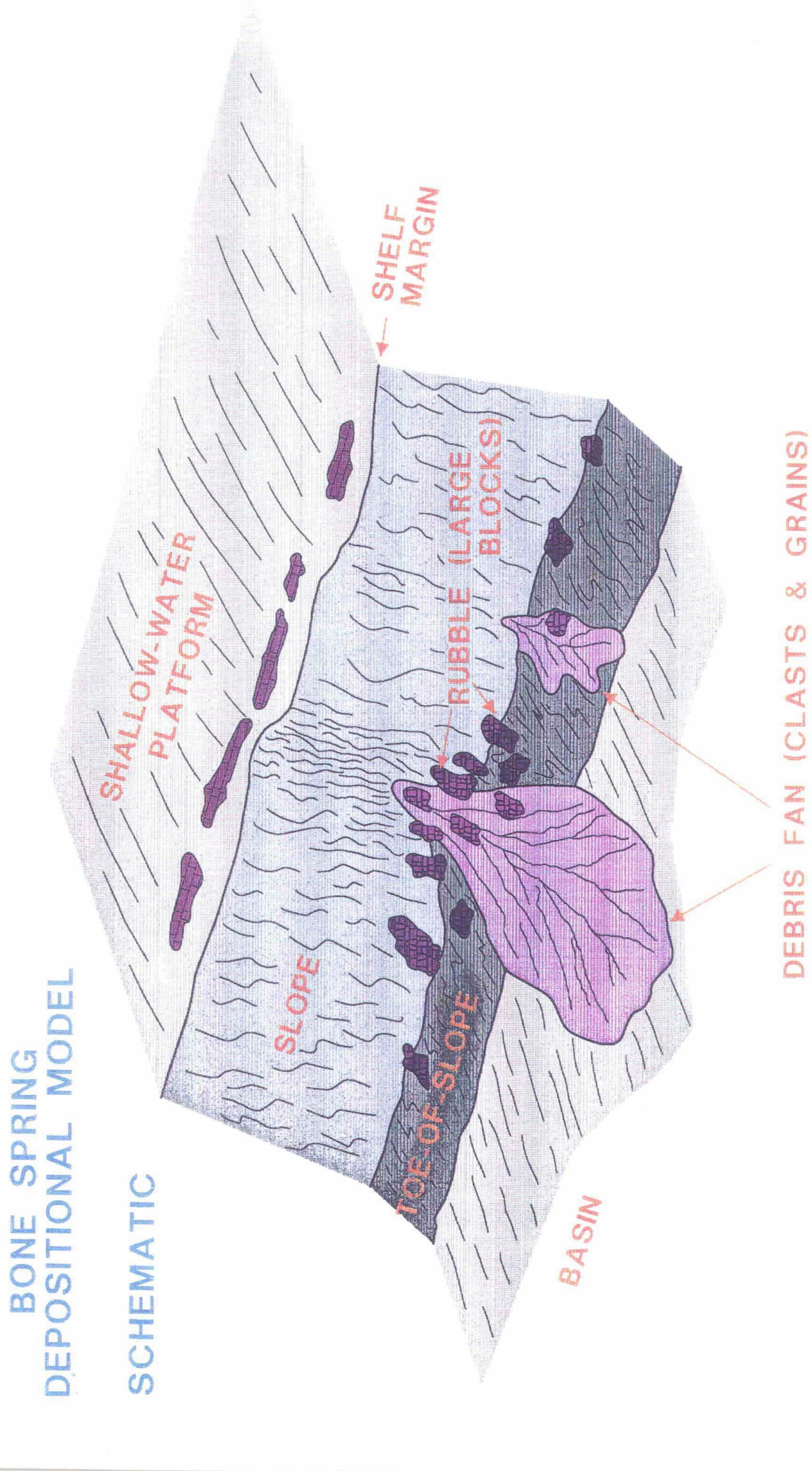
EDDY COUNTY, NEW MEXICO



TYPE LOG
JOHNSON "B" FEDERAL #4

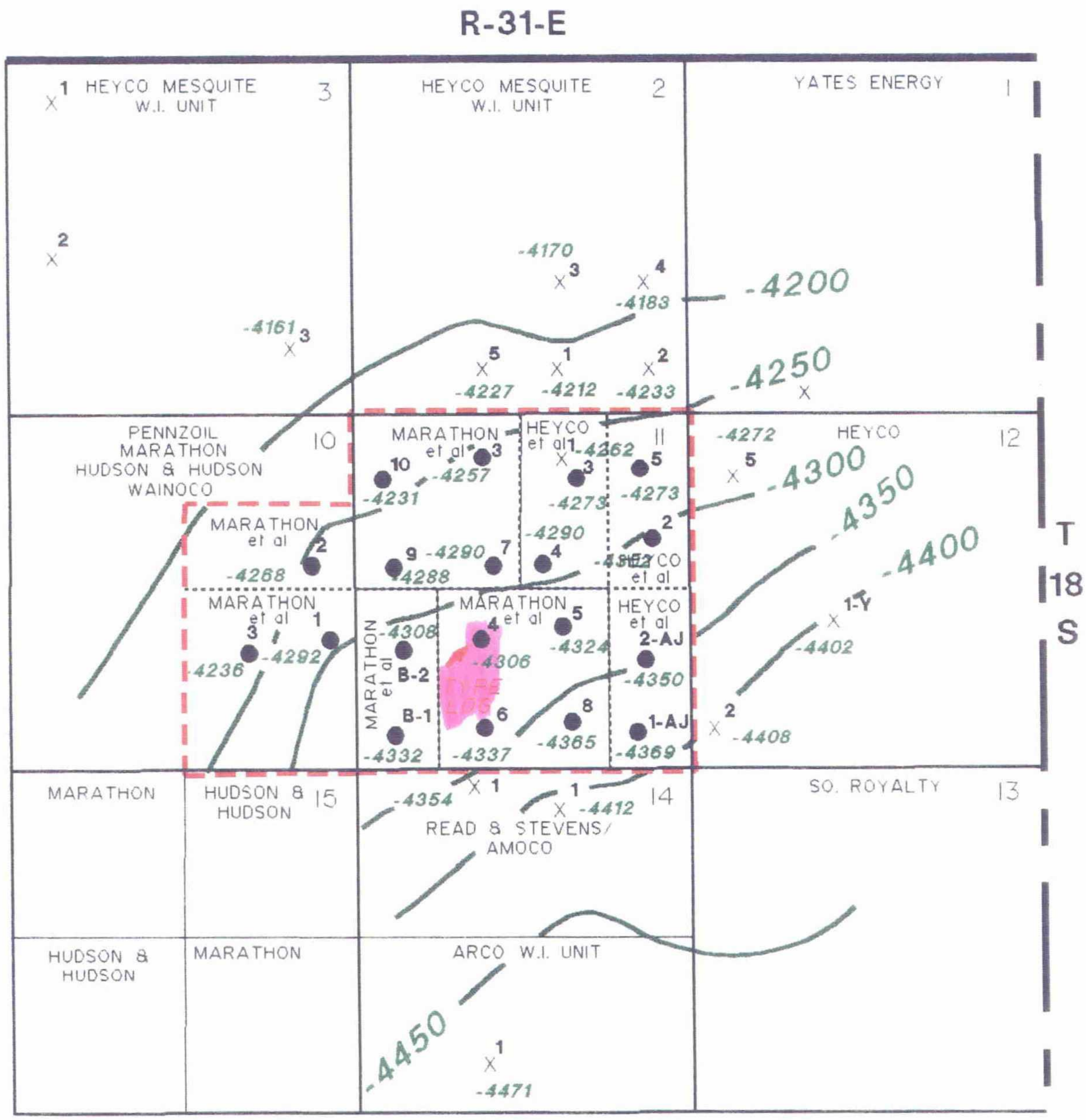
1-91

FIGURE 4



BONE SPRING
DEPOSITIONAL MODEL
SCHEMATIC
SHELF
MARGIN
SHALLOW-WATER
PLATFORM
SLOPE
TOE-OF-SLOPE
RUBBLE (LARGE
BLOCKS)
DEBRIS FAN (CLASTS & GRAINS)
BASIN

FIGURE 5



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

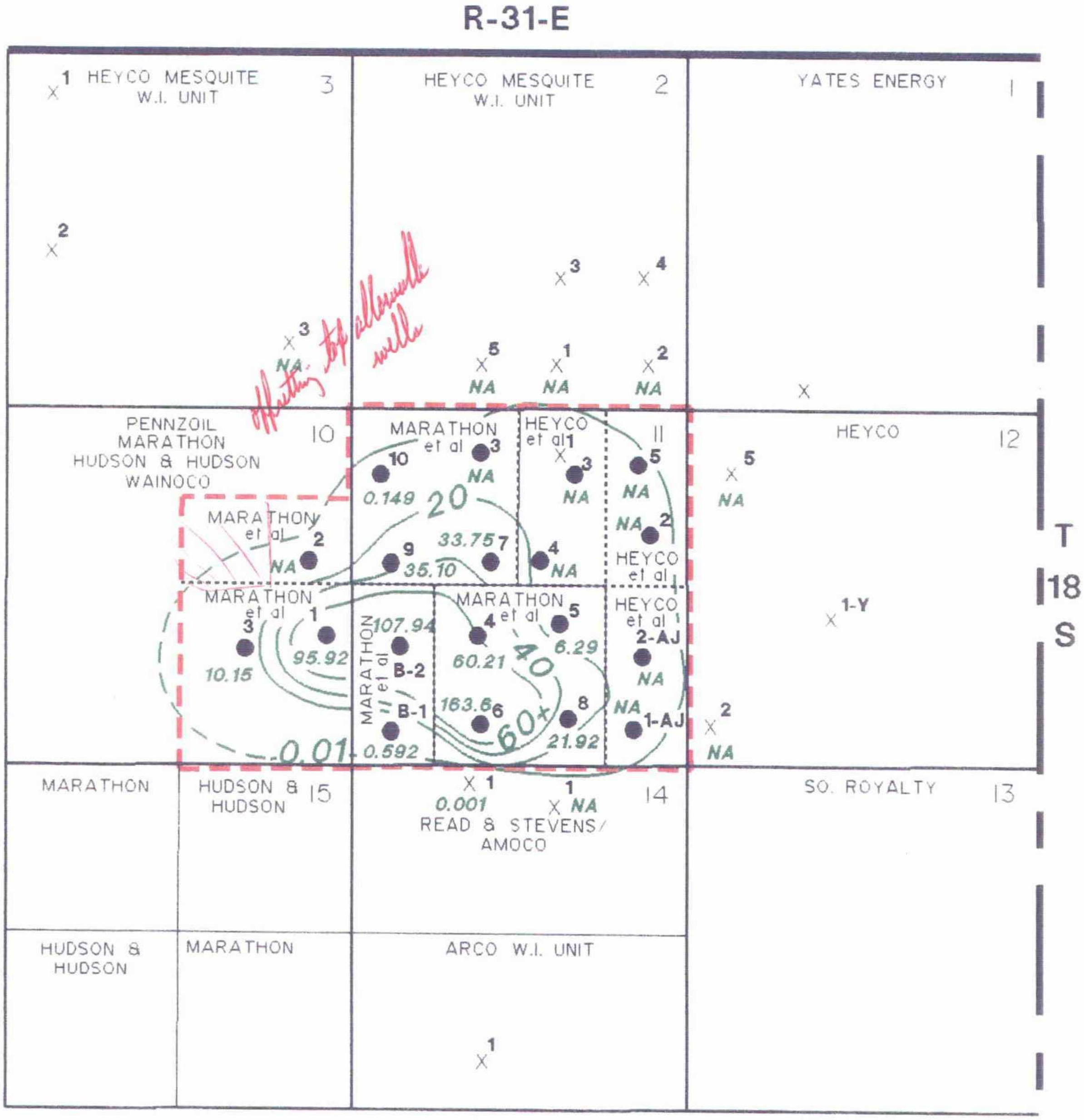
SUBSURFACE STRUCTURE MAP
TOP OF MAIN PAY
2nd CARBONATE
C.I.: 50'

0 1/4 1/2
MILE

1-91

TBS4.AFE

FIGURE 6



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

Ø CUTOFF = 4%

Ko MEASURED AS Koh DIVIDED BY h GIVING AVERAGE md/jt OVER INTERVAL h

$$ØKoh = \frac{(Koh)(Øh)}{h}$$

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

Ø-K_o-h

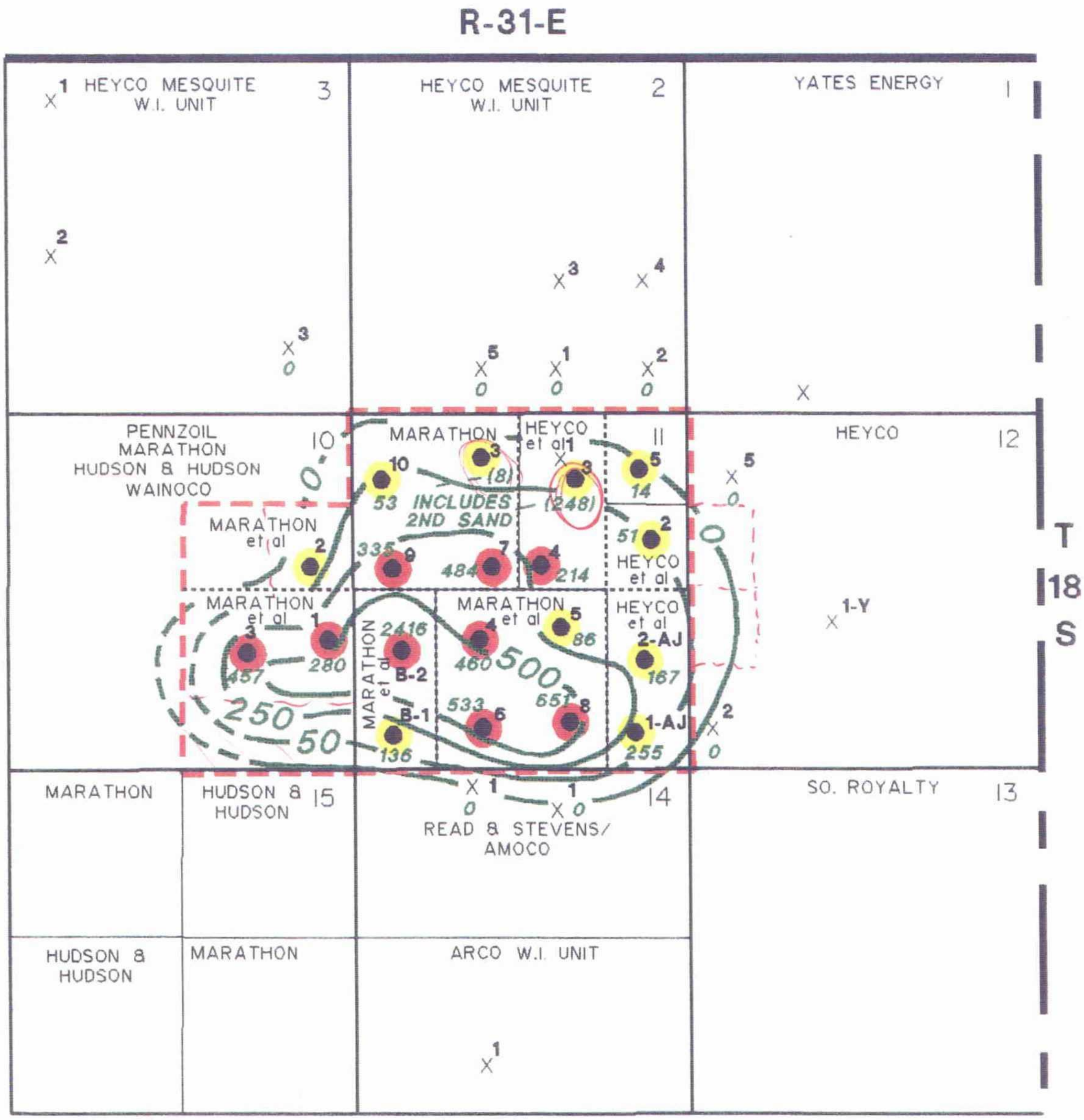
0 1/4 1/2

MILE

1-91

TBS4.AFE

FIGURE 7



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

PUMP

FLOW

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

INITIAL POTENTIAL IN BOPD

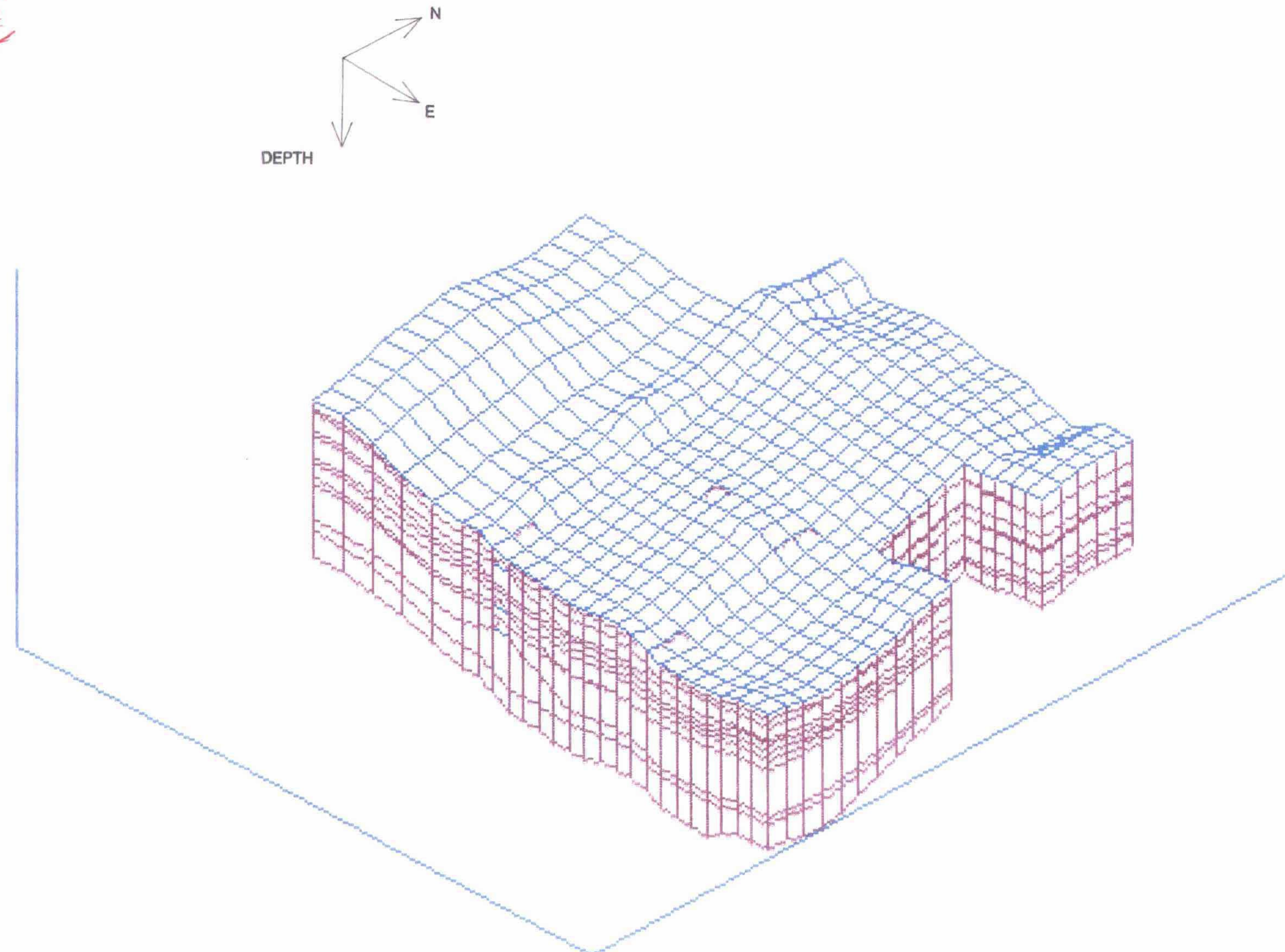
0 1/4 1/2
MILE

1-91

TBS4.AFE

FIGURE 27

3 fluid phase, single porosity model.



TAMANO (BSSC) UNIT COMPUTER GRID

FIGURE 8

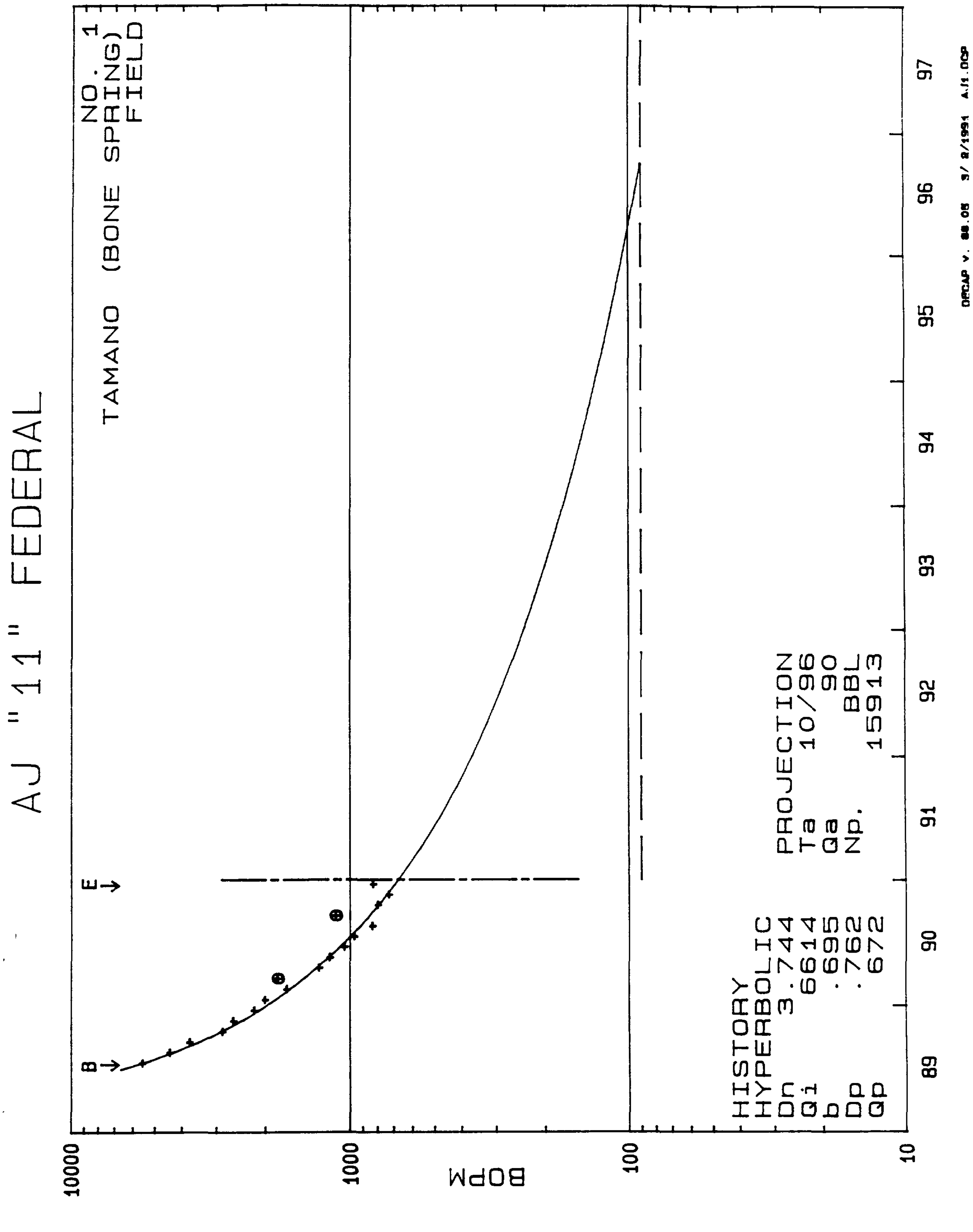
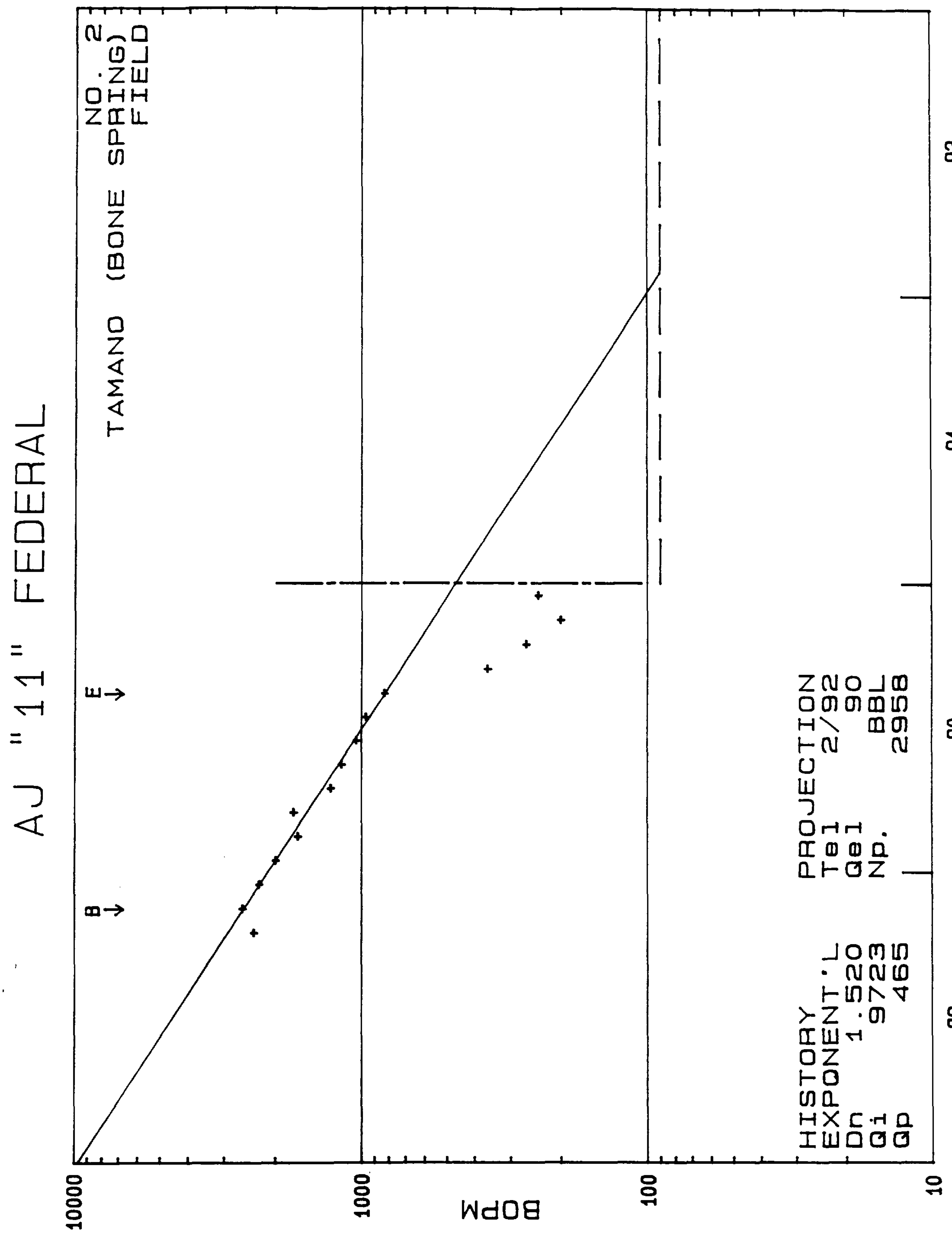

AJ "11" FEDERAL NO. 1
TAMANO (BONE SPRING) FIELD
BOPM
10000
1000
100
10
89
90
91
92
93
94
95
96
97
B
E
HISTORY
HYPERBOLIC
Dn 3.744
Qi 6614
b .695
Dp .762
Qp 672
PROJECTION
Ta 10/96
Qa 90
BBL
Np. 15913

FIGURE 9



AJ "11" FEDERAL
TAMANO (BONE SPRING) NO. 2
FIELD
B
E
PROJECTION
Tel 2/92
Qel 90
BBL
Np. 2958
HISTORY
EXPONENT'L
Dn 1.520
Qi 9723
Qp 465
BOPM
10000
1000
100
10
89
90
91
92

FIGURE 10

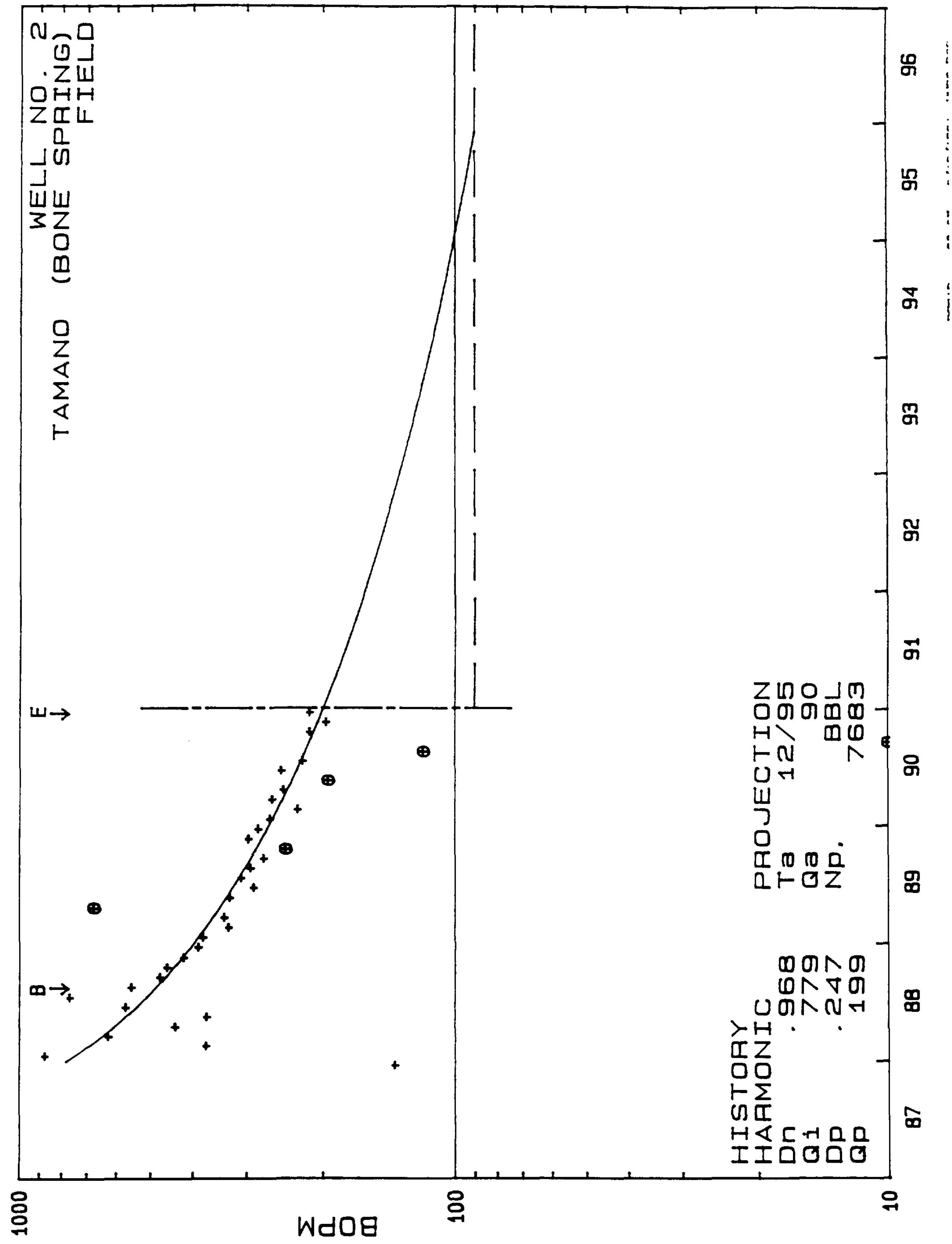
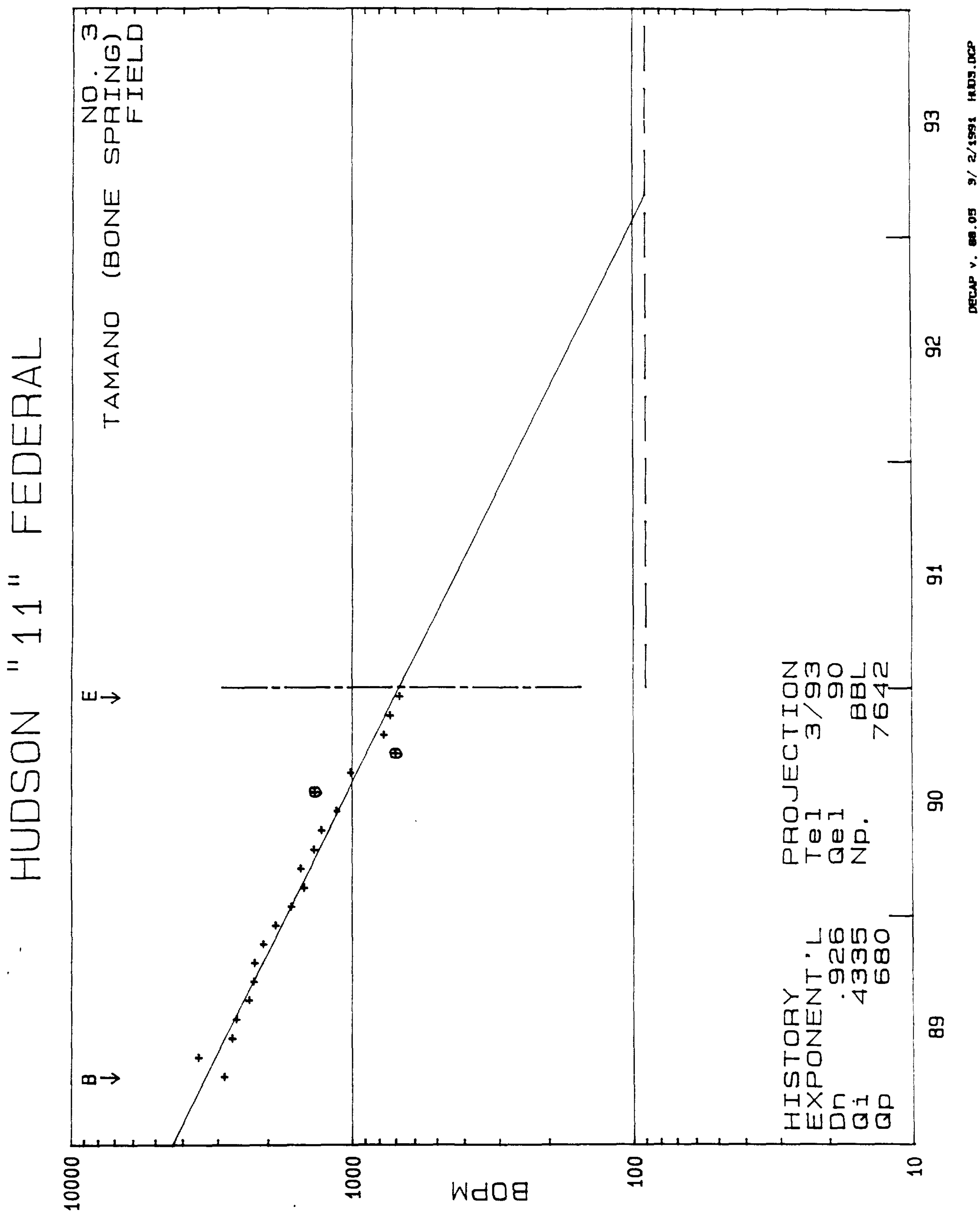
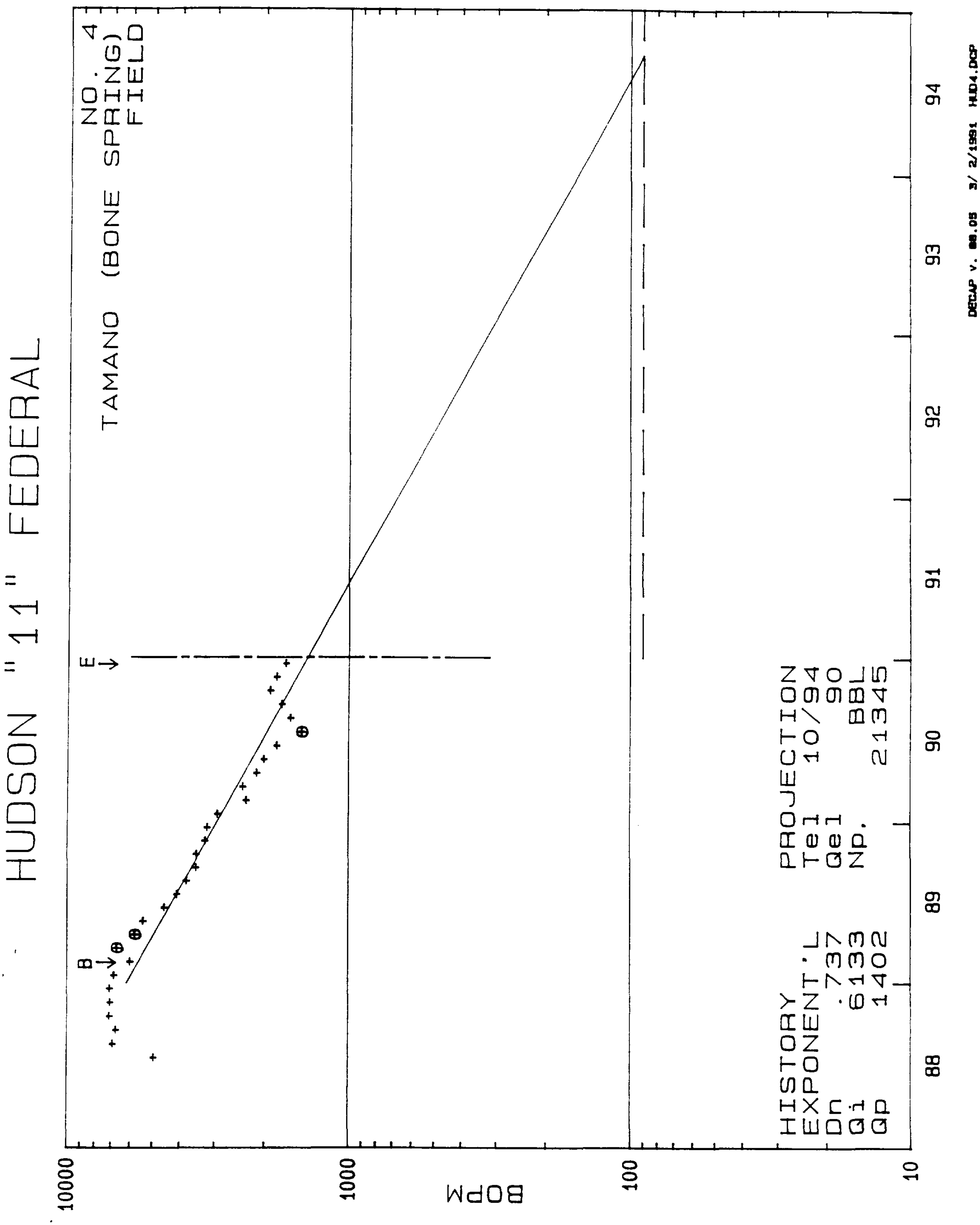

HUDSON "11" FEDERAL
TAMANO (BONE SPRING) FIELD
WELL NO. 2
B
E
BOPM
1000
100
10
87
88
89
90
91
92
93
94
95
96
HISTORY
HARMONIC
Dn .968
Qi .779
Dp .247
Qp .199
PROJECTION
Ta 12/95
Qa 90
BBL
Np. 7683

FIGURE 11



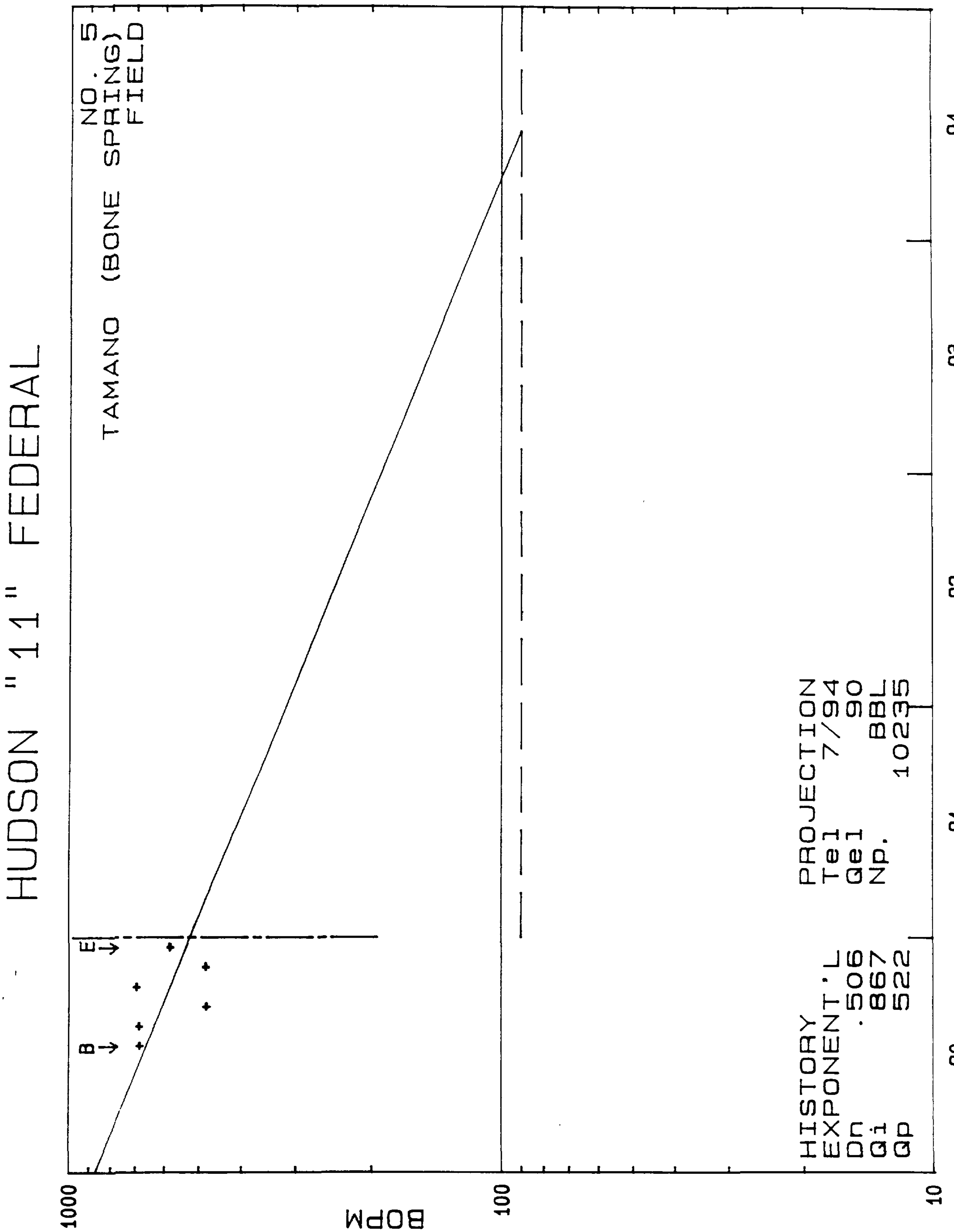
HUDSON "11" FEDERAL NO. 3
TAMANO (BONE SPRING) FIELD
B
E
HISTORY
EXPONENT'L
Dn .926
Qi 4335
Qp 680
PROJECTION
Tel 3/93
Qel 90
Np. BBL
7642
BOPM
10000
1000
100
10
89
90
91
92
93
DECAP v. 88.05 9/ 2/1991 HUD3.DCP

FIGURE 12



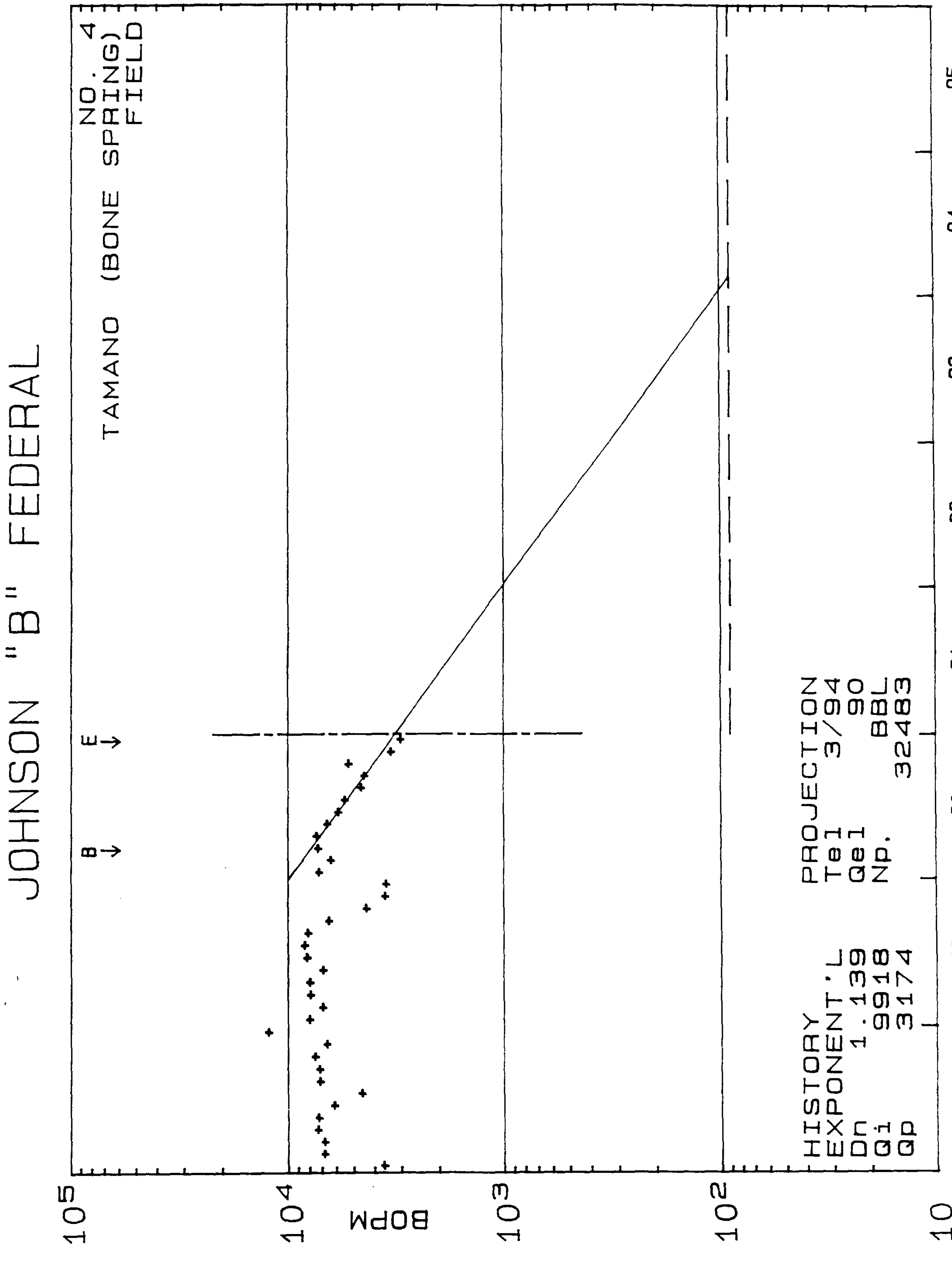
HUDSON "11" FEDERAL
NO. 4
TAMANO (BONE SPRING) FIELD
B
E
HISTORY
EXPONENT'L
Dn .737
Qi 6133
Qp 1402
PROJECTION
Tel 10/94
Qel 90
Np. 21345 BBL
BOPM
10000
1000
100
10
88
89
90
91
92
93
94
3/ 2/1991 HUD4.DCP

FIGURE 13



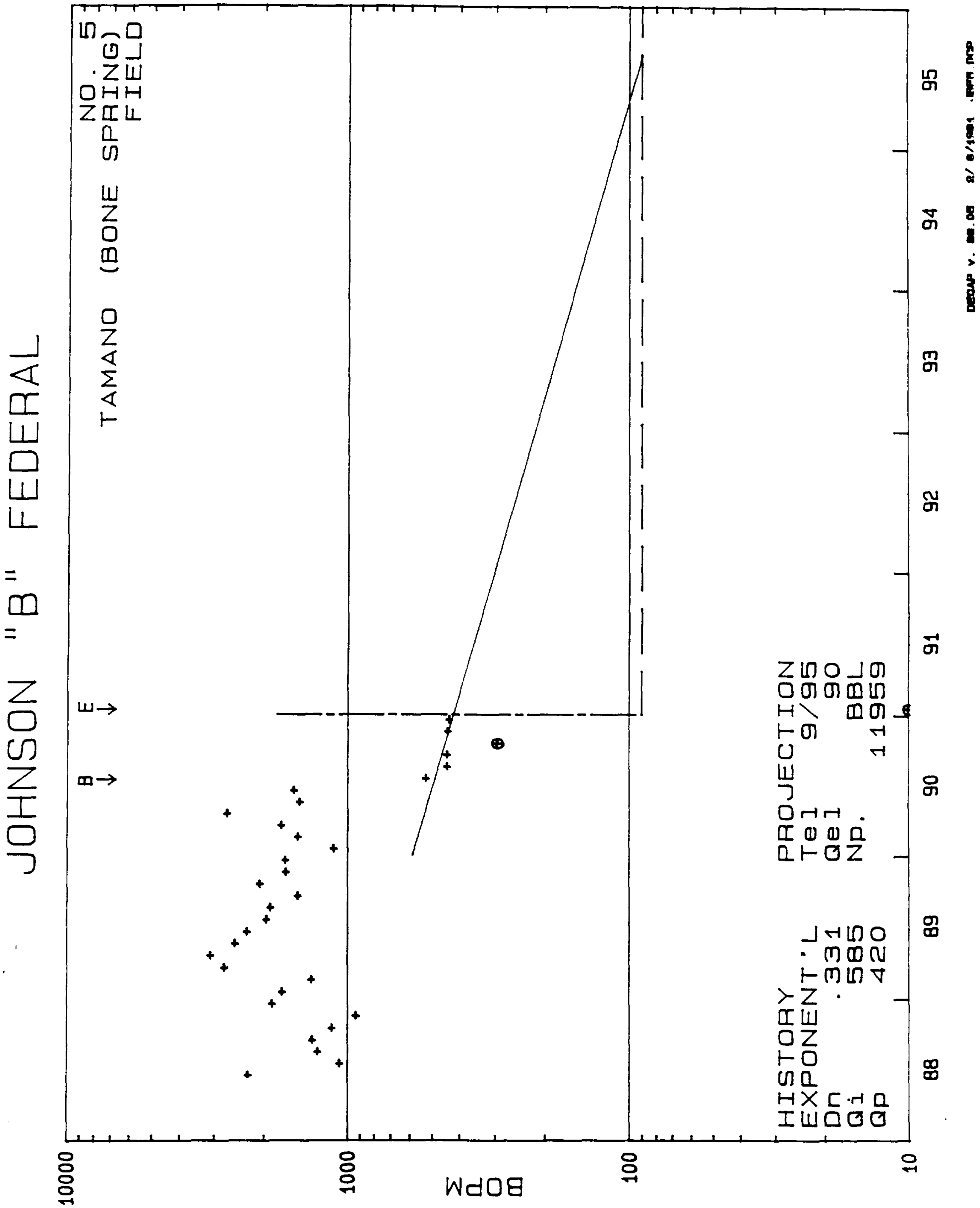
HUDSON "11" FEDERAL
NO. 5
TAMANO (BONE SPRING) FIELD
BOPM
1000
100
10
90
91
92
93
94
B
E
HISTORY
EXPONENT'L
Dn .506
Qi 867
Qp 522
PROJECTION
Tel 7/94
Qel 90
Np. 10235 BBL

FIGURE 14



JOHNSON "B" FEDERAL NO. 4
TAMANO (BONE SPRING) FIELD
B
E
BOPM
10^5
10^4
10^3
10^2
10
88
89
90
91
92
93
94
95
HISTORY
EXPONENT'L
Dn 1.139
Qi 9918
Qp 3174
PROJECTION
Tel 3/94
Qel 90
Np. 32483 BBL

FIGURE 15



JOHNSON "B" FEDERAL
TAMANO (BONE SPRING) NO. 5
FIELD
B
E
HISTORY
EXPONENT'L
Dn .331
Qi 585
Qp 420
PROJECTION
Tel 9/95
Qel 90
Np. 11959 BBL
BOPM
10000
1000
100
10
88
89
90
91
92
93
94
95

FIGURE 16

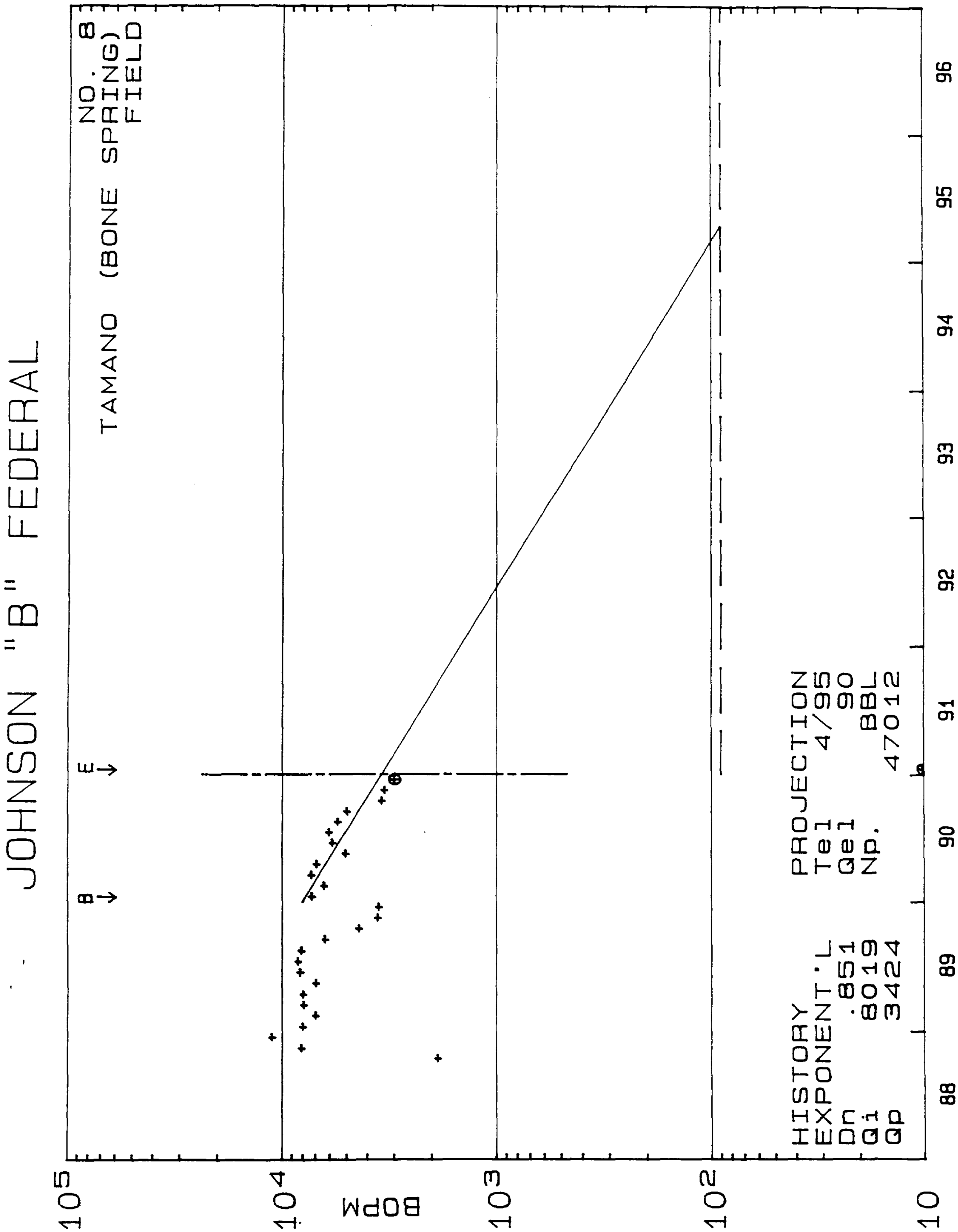
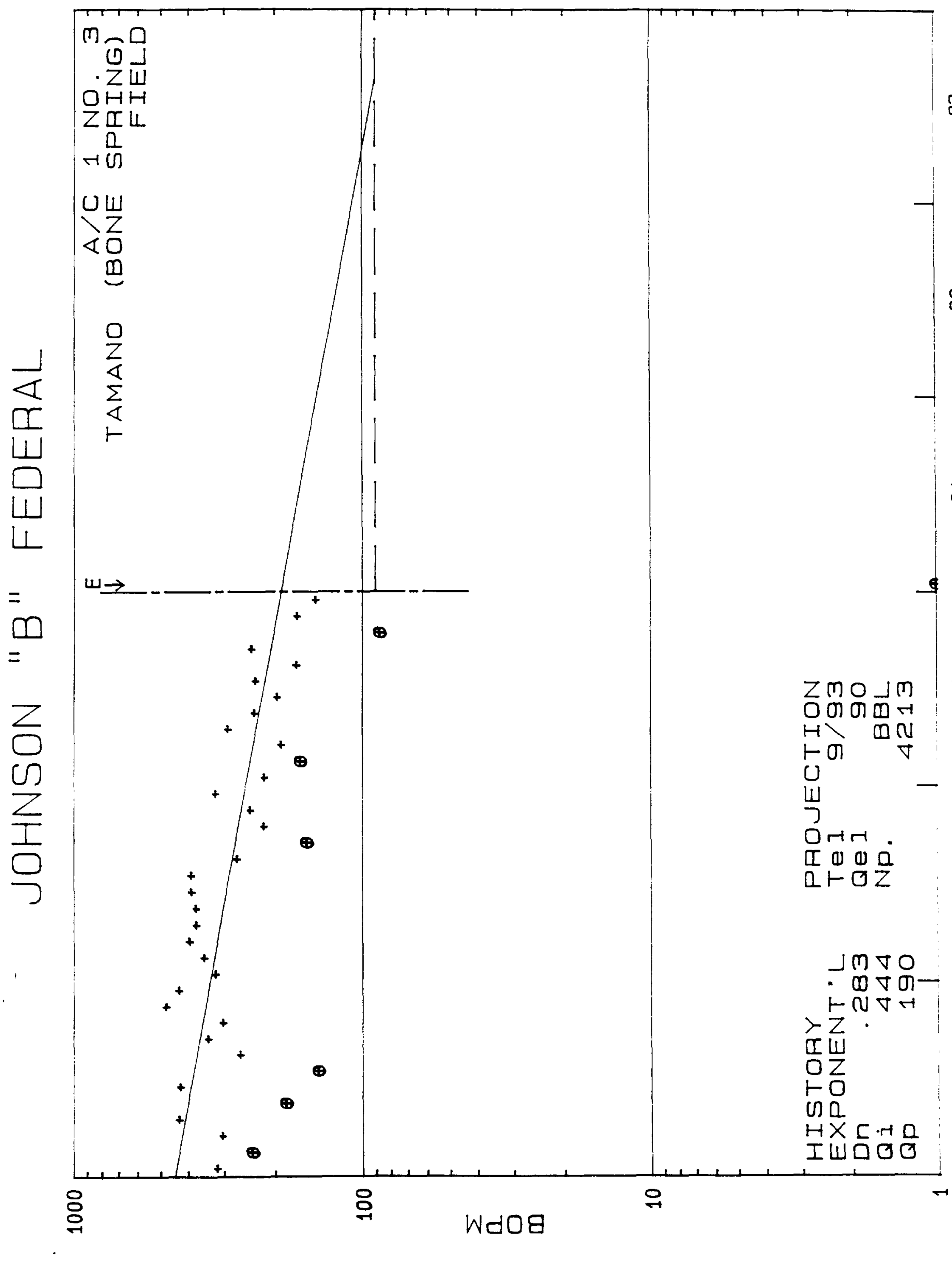
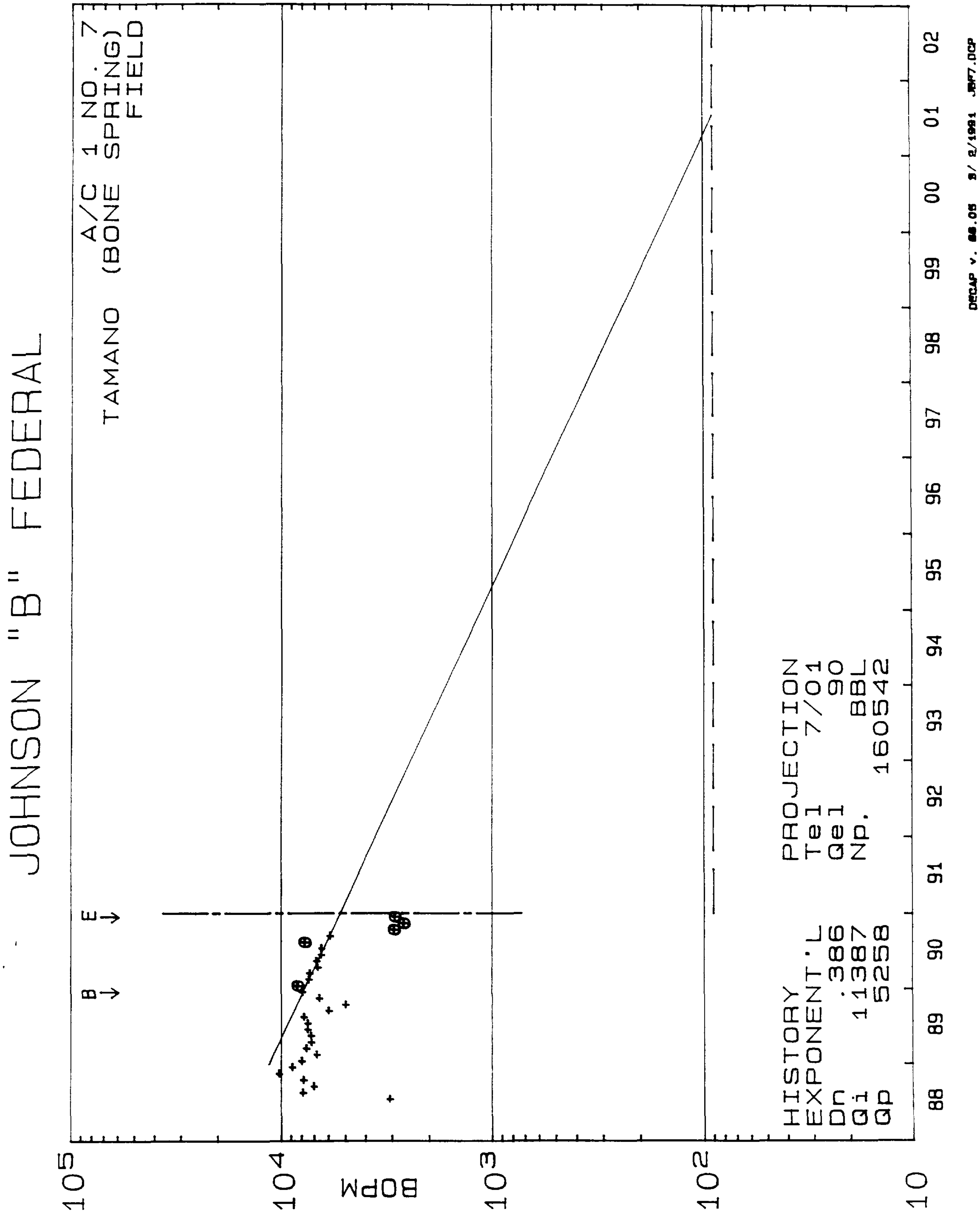

JOHNSON "B" FEDERAL
NO. 8
TAMANO (BONE SPRING) FIELD
BOPM
10^5
10^4
10^3
10^2
10
88
89
90
91
92
93
94
95
96
B
E
HISTORY
EXPONENT'L
Dn .851
Qi .8019
Qp 3424
PROJECTION
Tel 4/95
Qel 90
BBL
Np. 47012

FIGURE 17



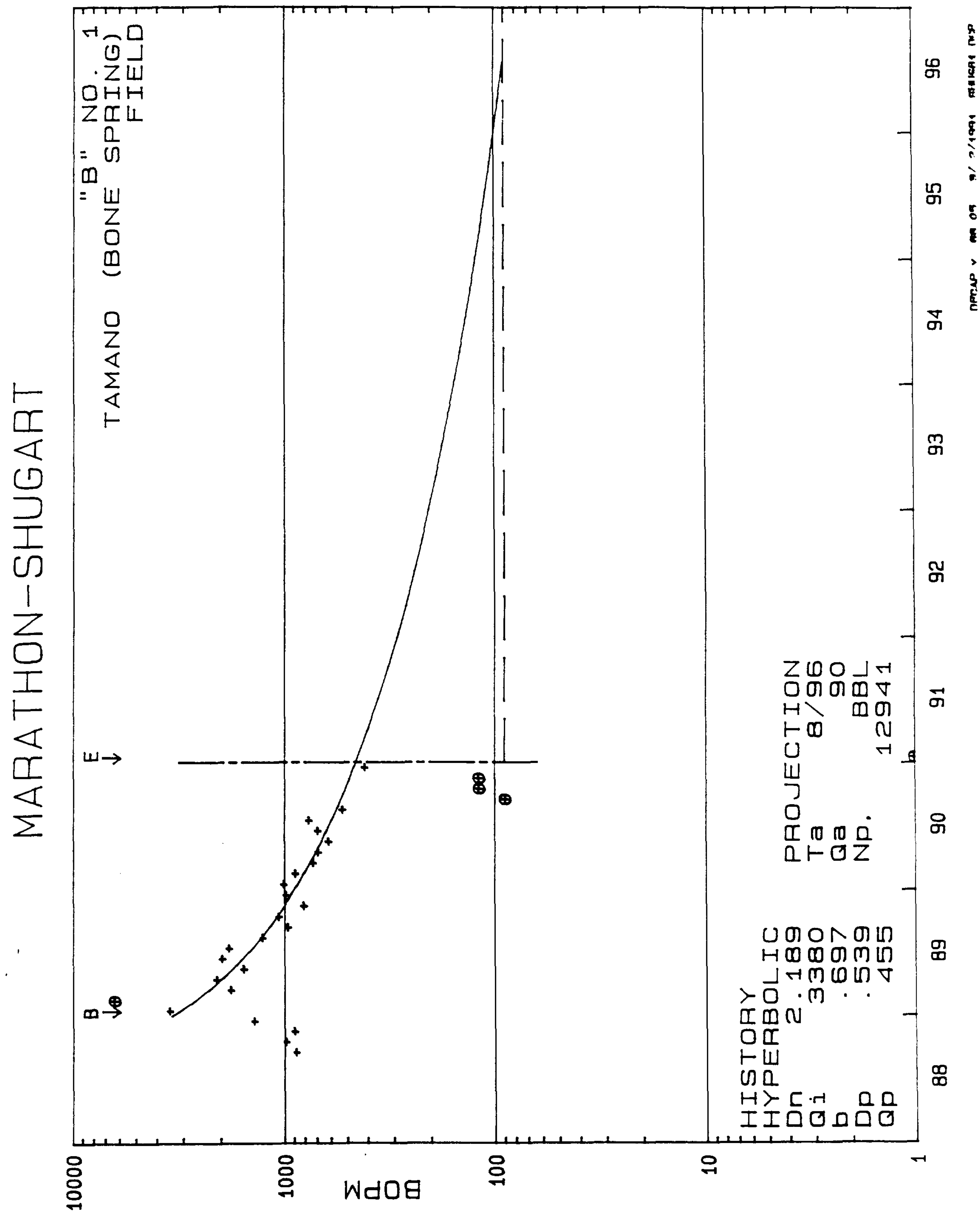
JOHNSON "B" FEDERAL
TAMANO
A/C 1 NO. 3
(BONE SPRING)
FIELD
E
HISTORY
EXPONENT'L
Dn .283
Qi 444
Qp 190
PROJECTION
Te1 9/93
Qe1 90
Np. BBL
4213
BOPM
1000
100
10
1
88
89
90
91
92
93

FIGURE 18



JOHNSON "B" FEDERAL
TAMANO (BONE SPRING) FIELD
A/C 1 NO. 7
BOPM
10^5
10^4
10^3
10^2
10
B
E
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
HISTORY
EXPONENT'L
Dn .386
Qi 11387
Qp 5258
PROJECTION
Tel 7/01
Qel 90
Np. 160542 BBL

FIGURE 19



MARATHON-SHUGART
TAMANO (BONE SPRING) FIELD
"B" NO. 1
BOPM
10000
1000
100
10
1
88
89
90
91
92
93
94
95
96
B
E
HISTORY
HYPERBOLIC
Dn 2.189
Qi 3380
b .697
Dp .539
Qp .455
PROJECTION
Ta 8/96
Qa 90
BBL
Np. 12941

FIGURE 20

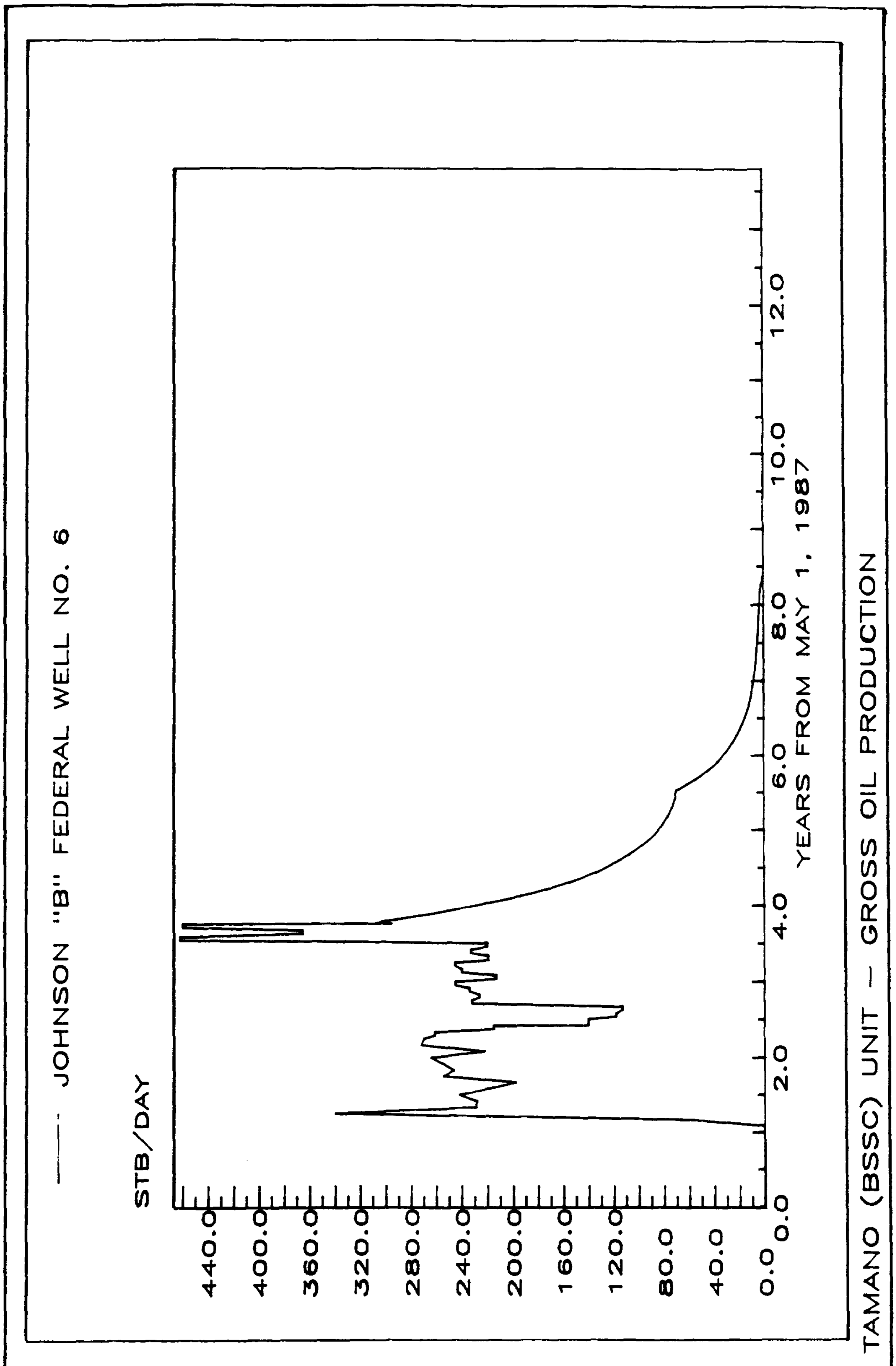
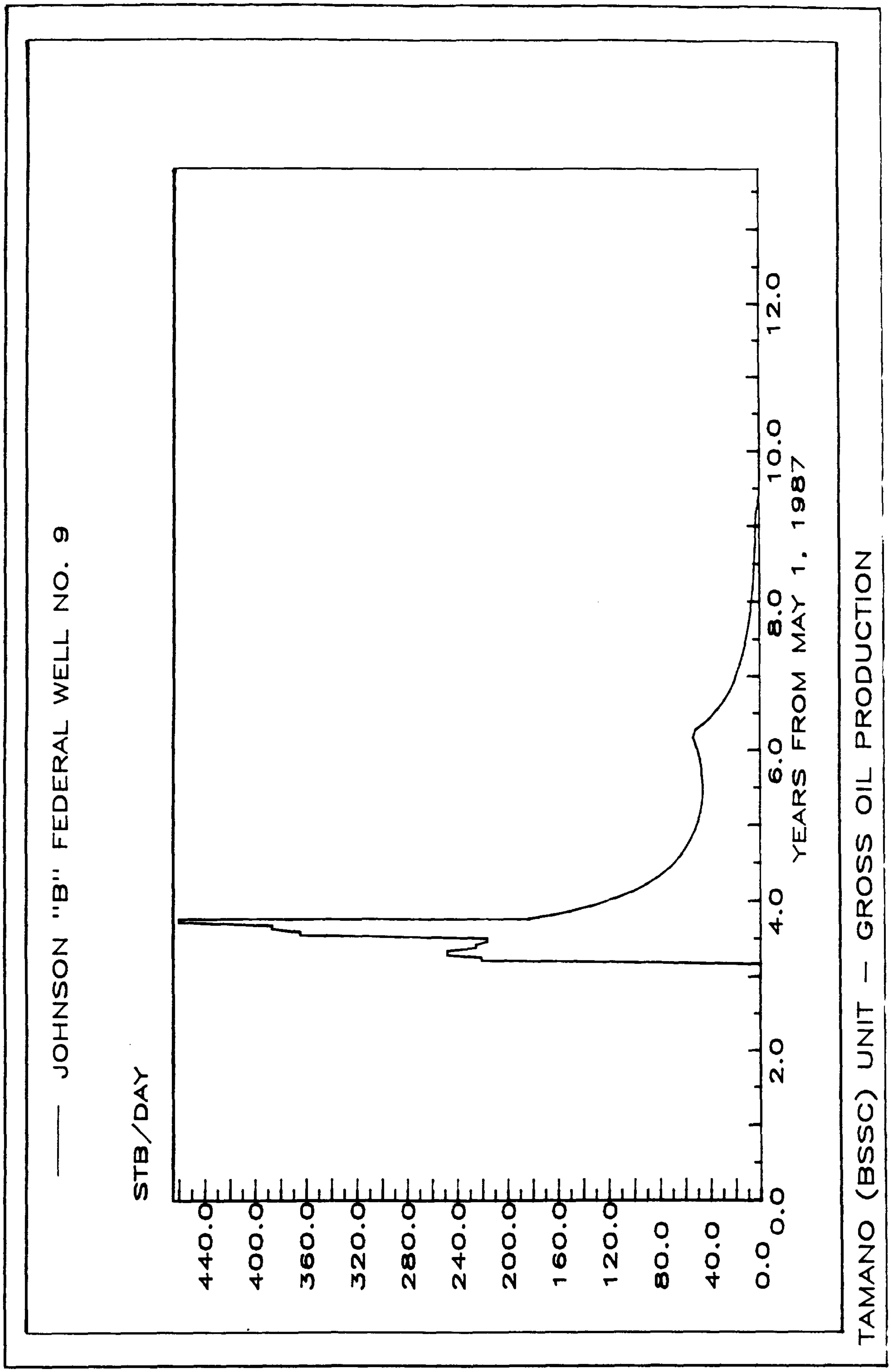
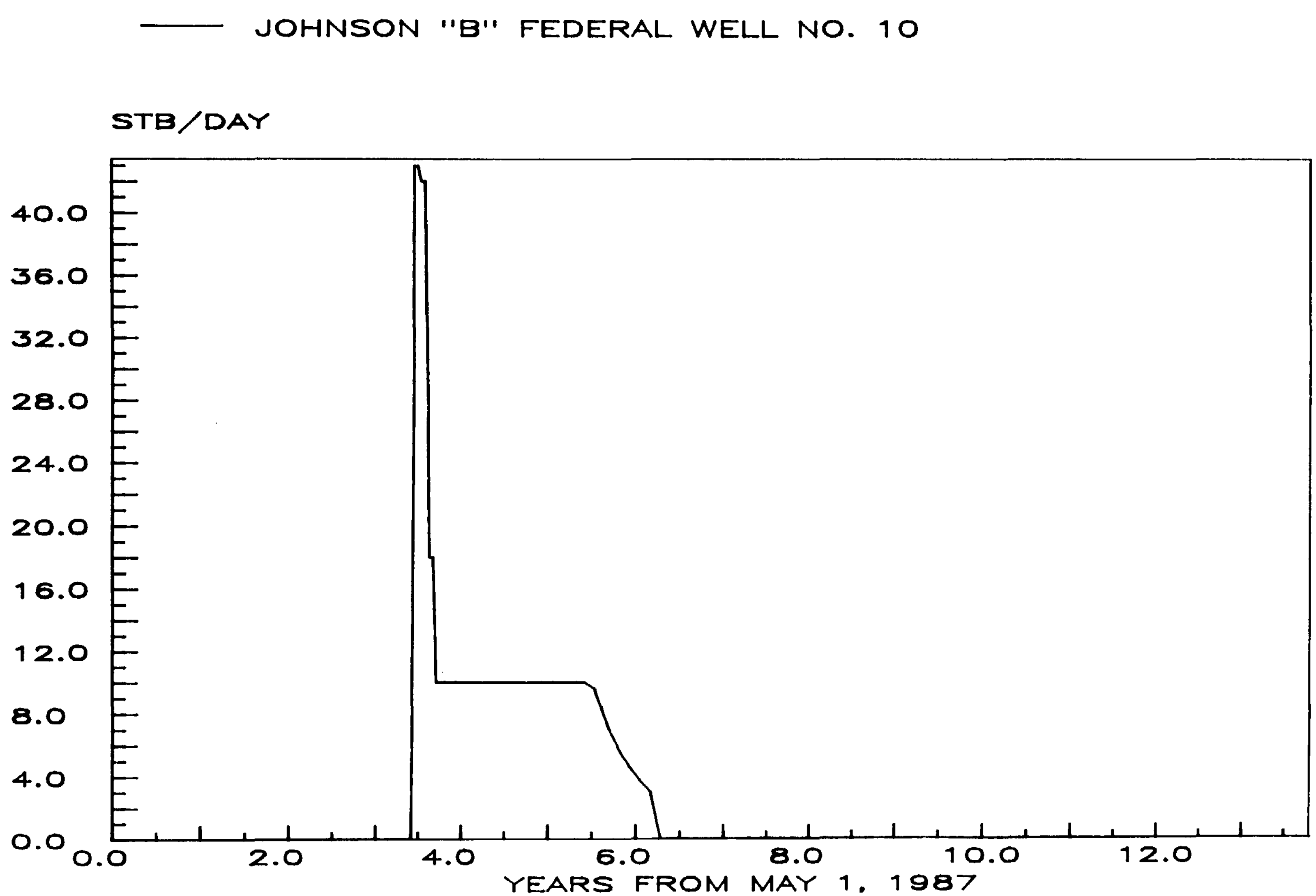

JOHNSON "B" FEDERAL WELL NO. 6
STB/DAY
440.0
400.0
360.0
320.0
280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
YEARS FROM MAY 1, 1987
TAMANO (BSSC) UNIT — GROSS OIL PRODUCTION

FIGURE 21



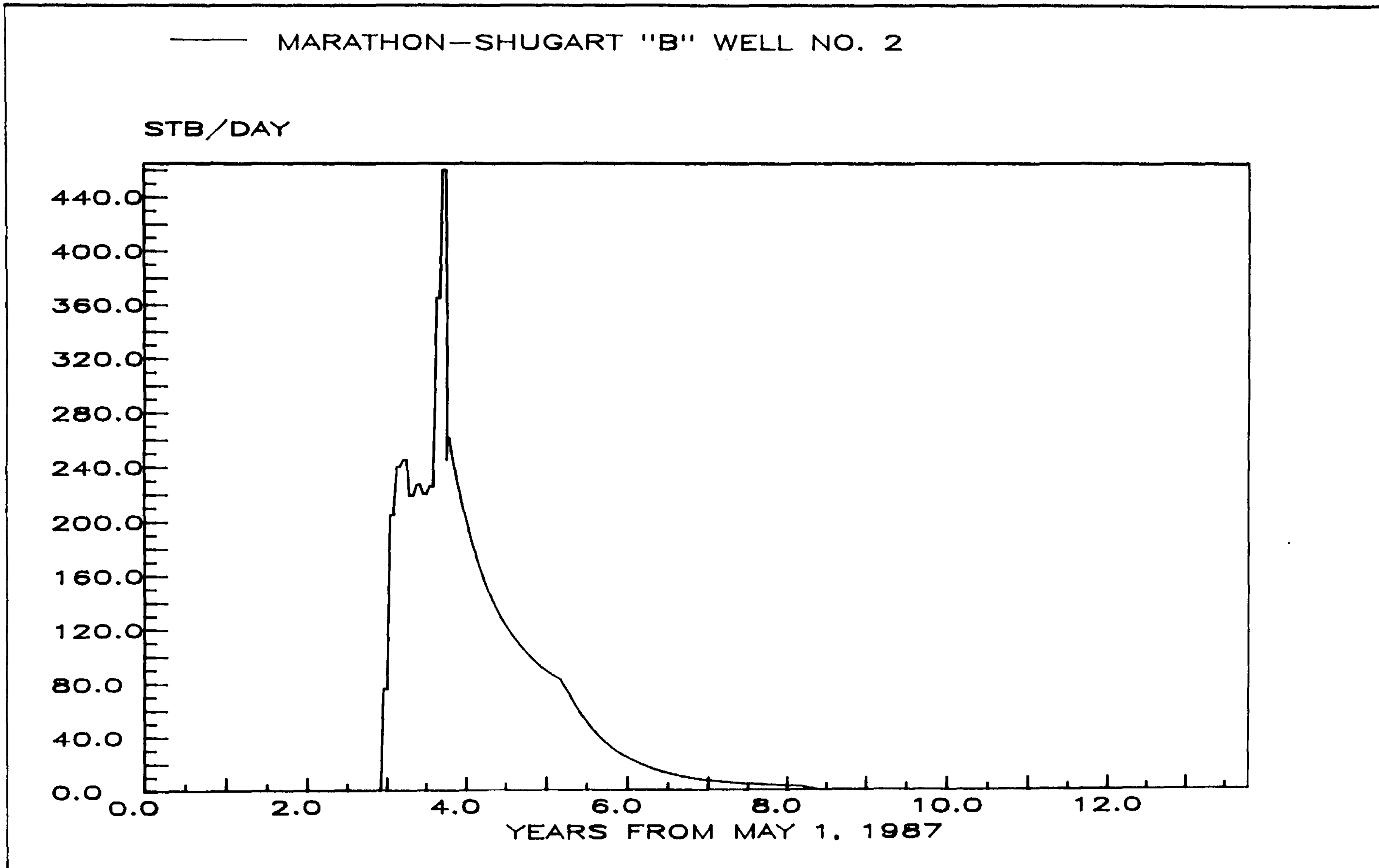
JOHNSON "B" FEDERAL WELL NO. 9
STB/DAY
440.0
400.0
360.0
320.0
280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
YEARS FROM MAY 1, 1987
TAMANO (BSSC) UNIT - GROSS OIL PRODUCTION

FIGURE 22



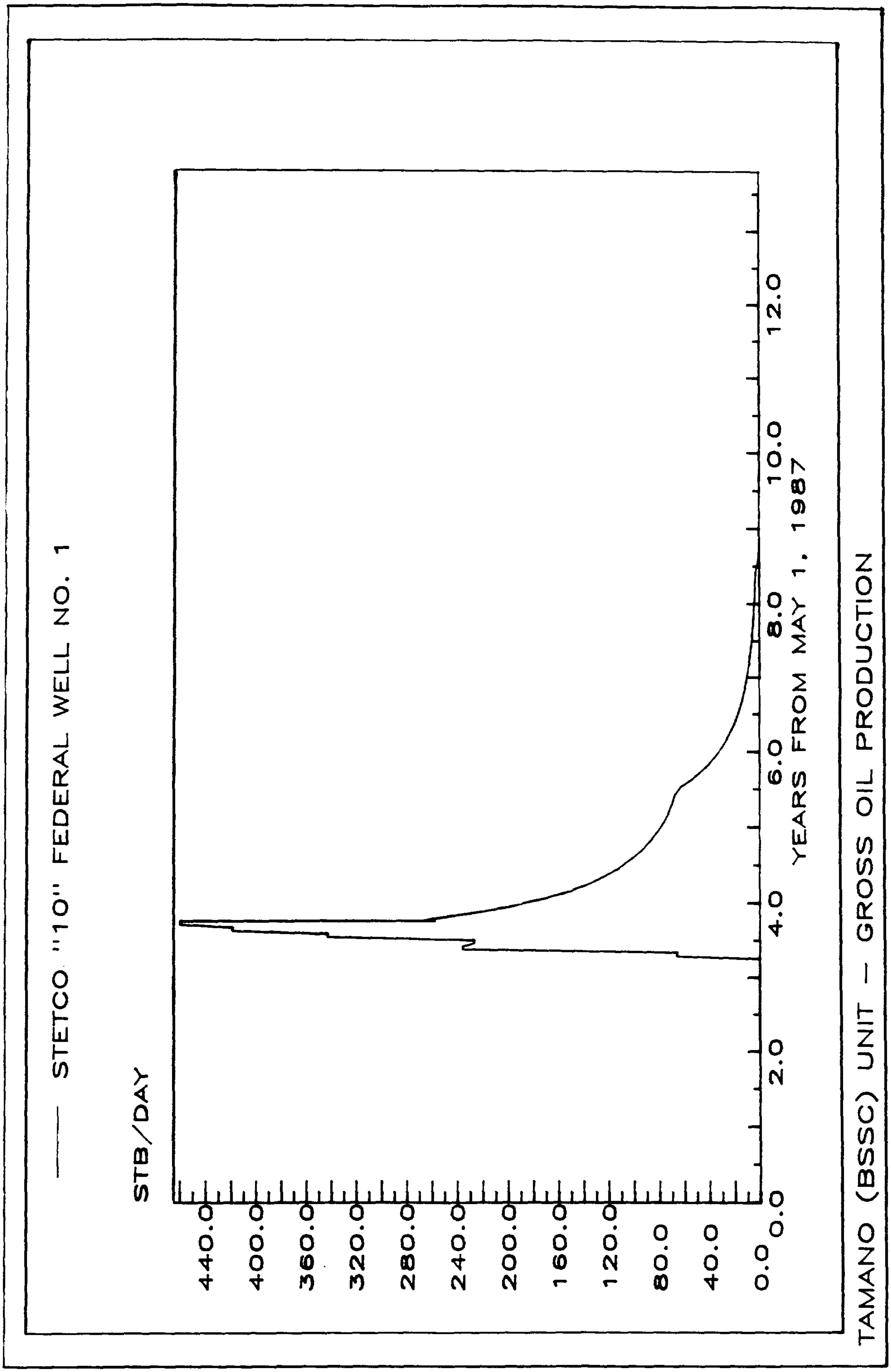
TAMANO (BSSC) UNIT — GROSS OIL PRODUCTION

FIGURE 23

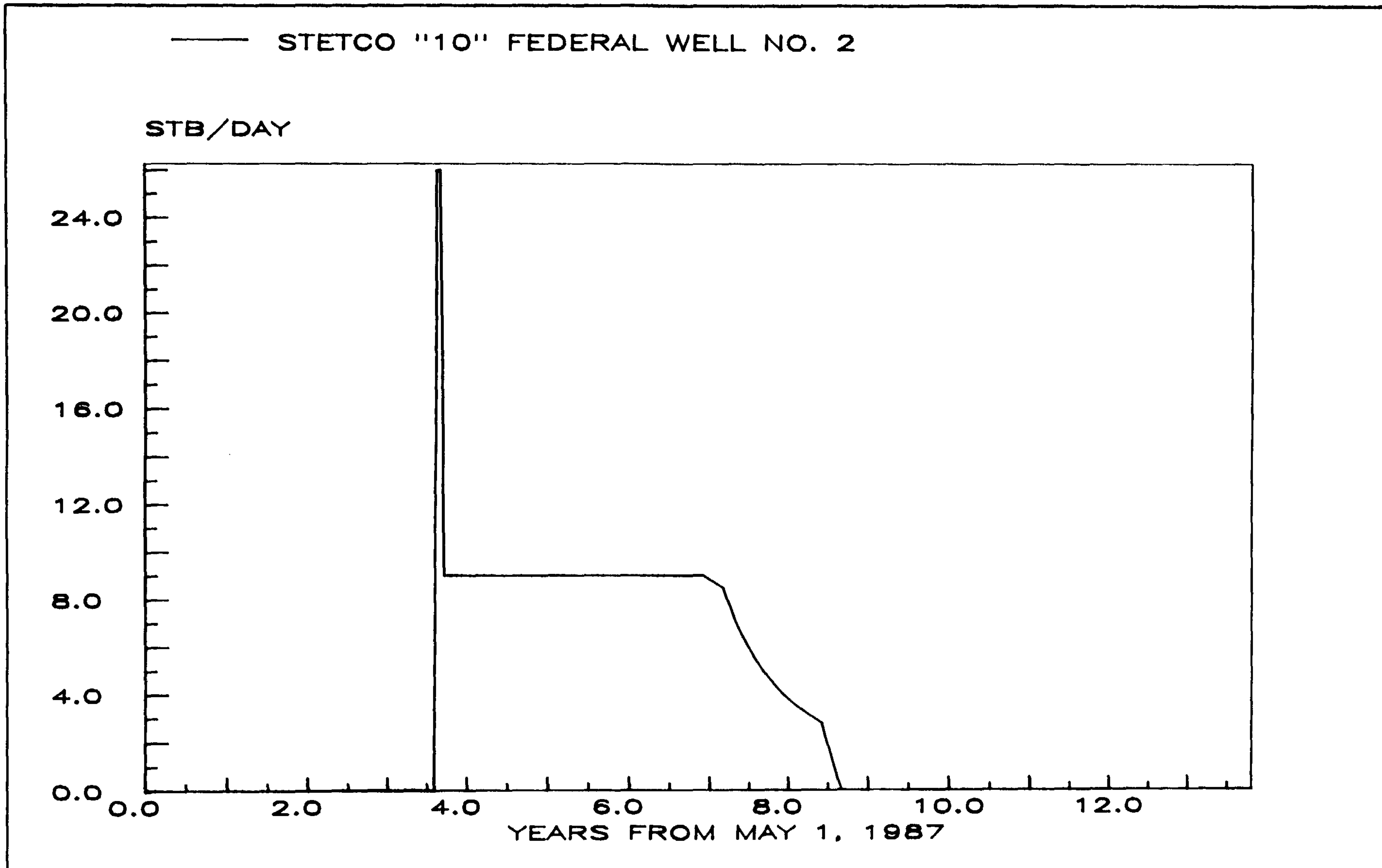


TAMANO (BSSC) UNIT — GROSS OIL PRODUCTION

FIGURE 24

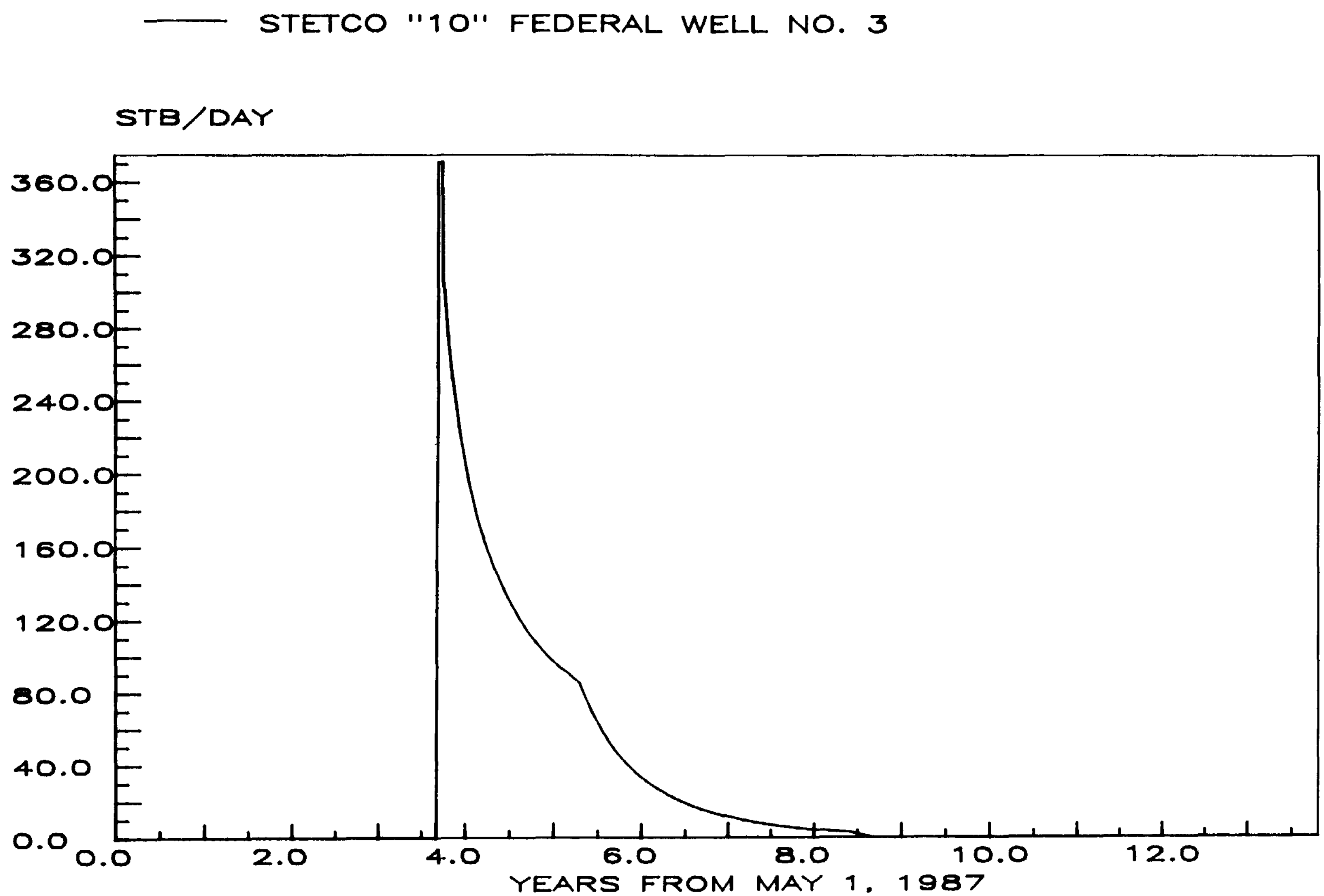


STETCO "10" FEDERAL WELL NO. 1
STB/DAY
440.0
400.0
360.0
320.0
280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
YEARS FROM MAY 1, 1987
TAMANO (BSSC) UNIT – GROSS OIL PRODUCTION



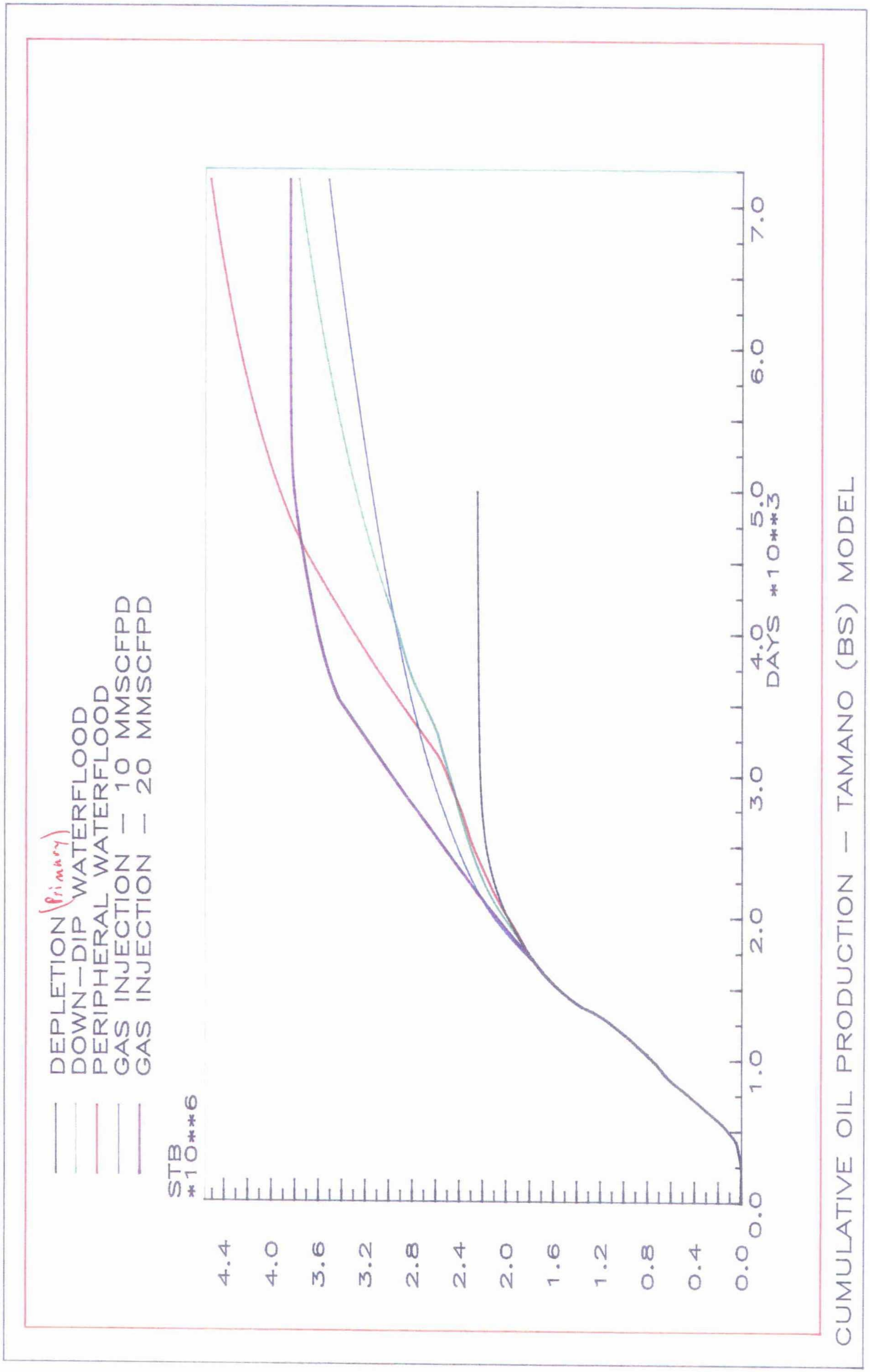
TAMANO (BSSC) UNIT — GROSS OIL PRODUCTION

FIGURE 26



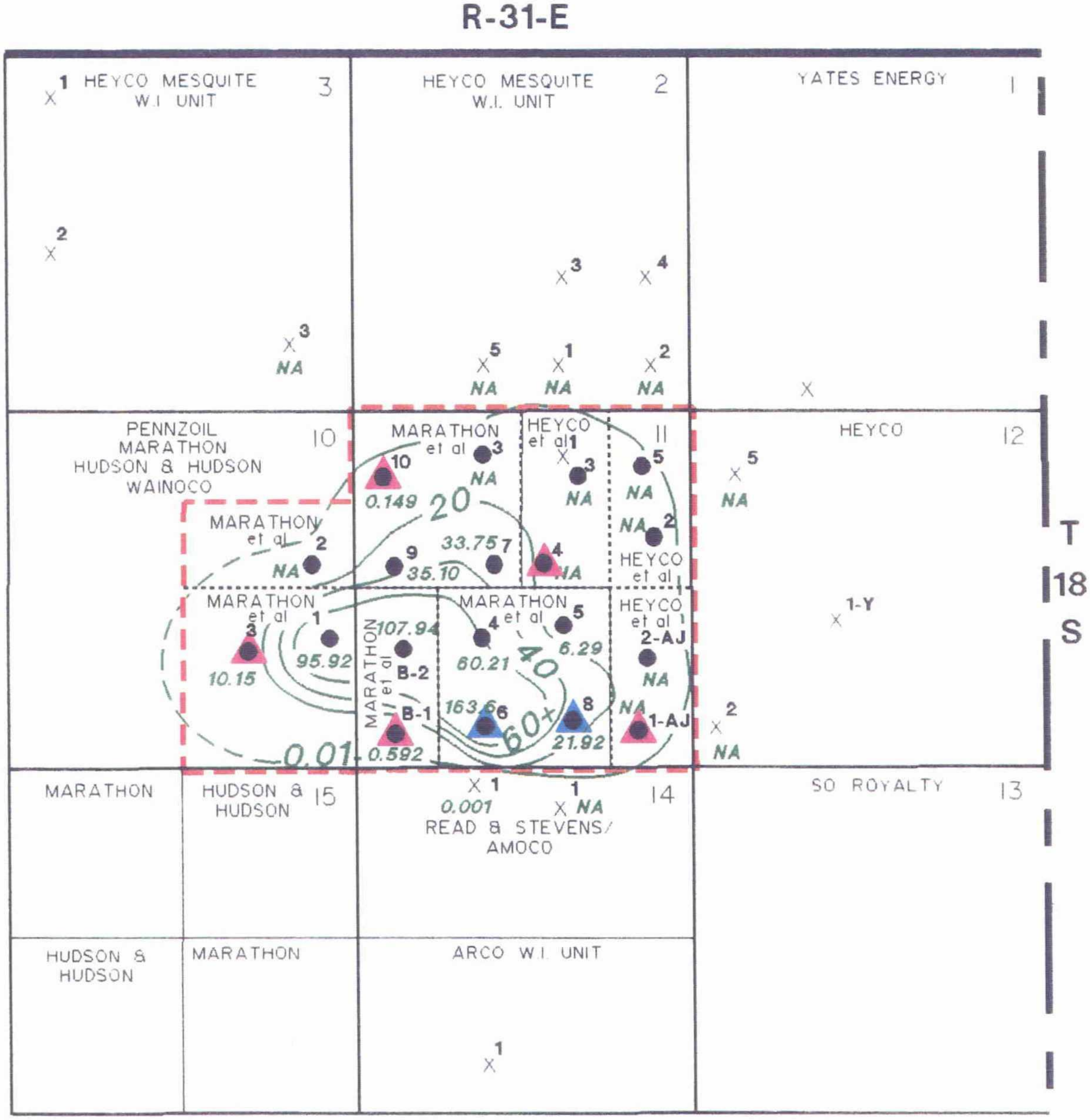
TAMANO (BSSC) UNIT — GROSS OIL PRODUCTION

FIGURE 42



DEPLETION (Primary)
DOWN-DIP WATERFLOOD
PERIPHERAL WATERFLOOD
GAS INJECTION — 10 MMSCFPD
GAS INJECTION — 20 MMSCFPD
STB *10**6
0.0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DAYS *10**3
CUMULATIVE OIL PRODUCTION — TAMANO (BS) MODEL

FIGURE 43



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

$\emptyset$-K_o-h

1992

1994

PROPOSED CONVERSION TO WATER INJECTION

0 1/4 1/2

MILE

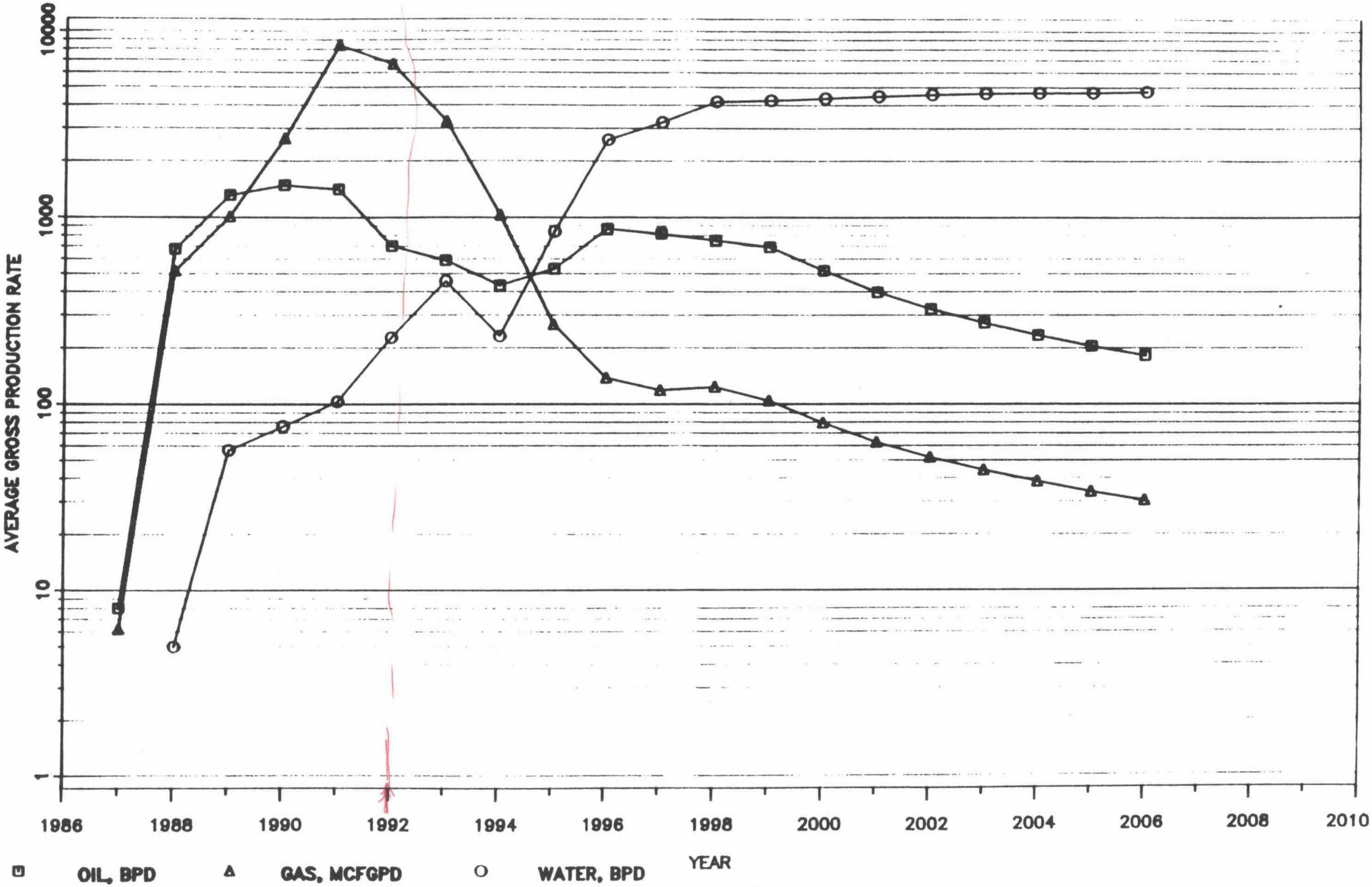
1-91

TB54.AFE

FIGURE 44

PROPOSED TAMANO (BSSC) UNIT

Peripheral Waterflood - Projected Performance



H_2O Inj. Commencing Jan. 1, 1992

FIGURE 45

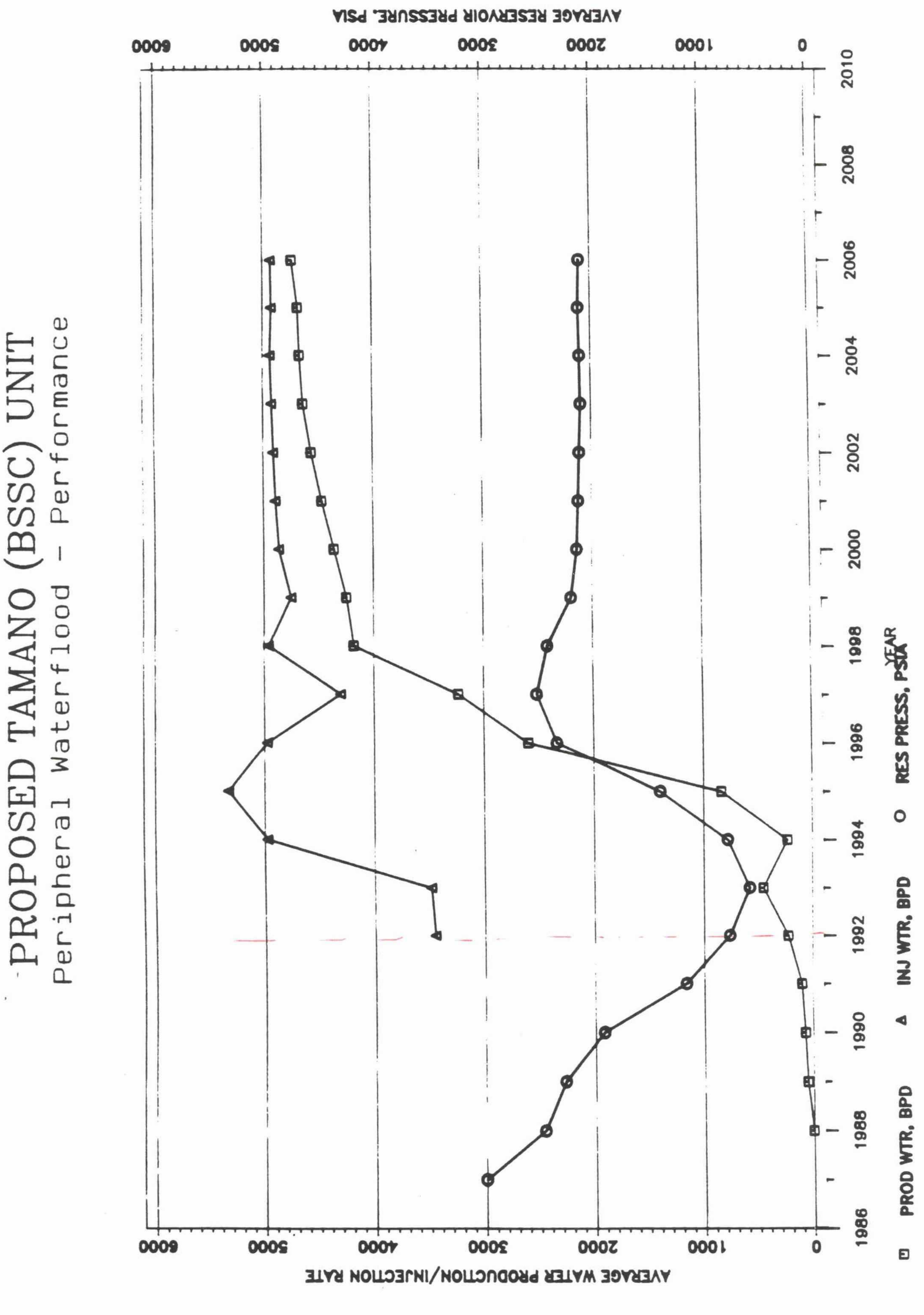

PROPOSED TAMANO (BSSC) UNIT
Peripheral Waterflood - Performance
AVERAGE RESERVOIR PRESSURE, PSIA
AVERAGE WATER PRODUCTION/INJECTION RATE
YEAR
PROD WTR, BPD
INJ WTR, BPD
RES PRESS, PSIA
0
1000
2000
3000
4000
5000
6000
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

FIGURE 28

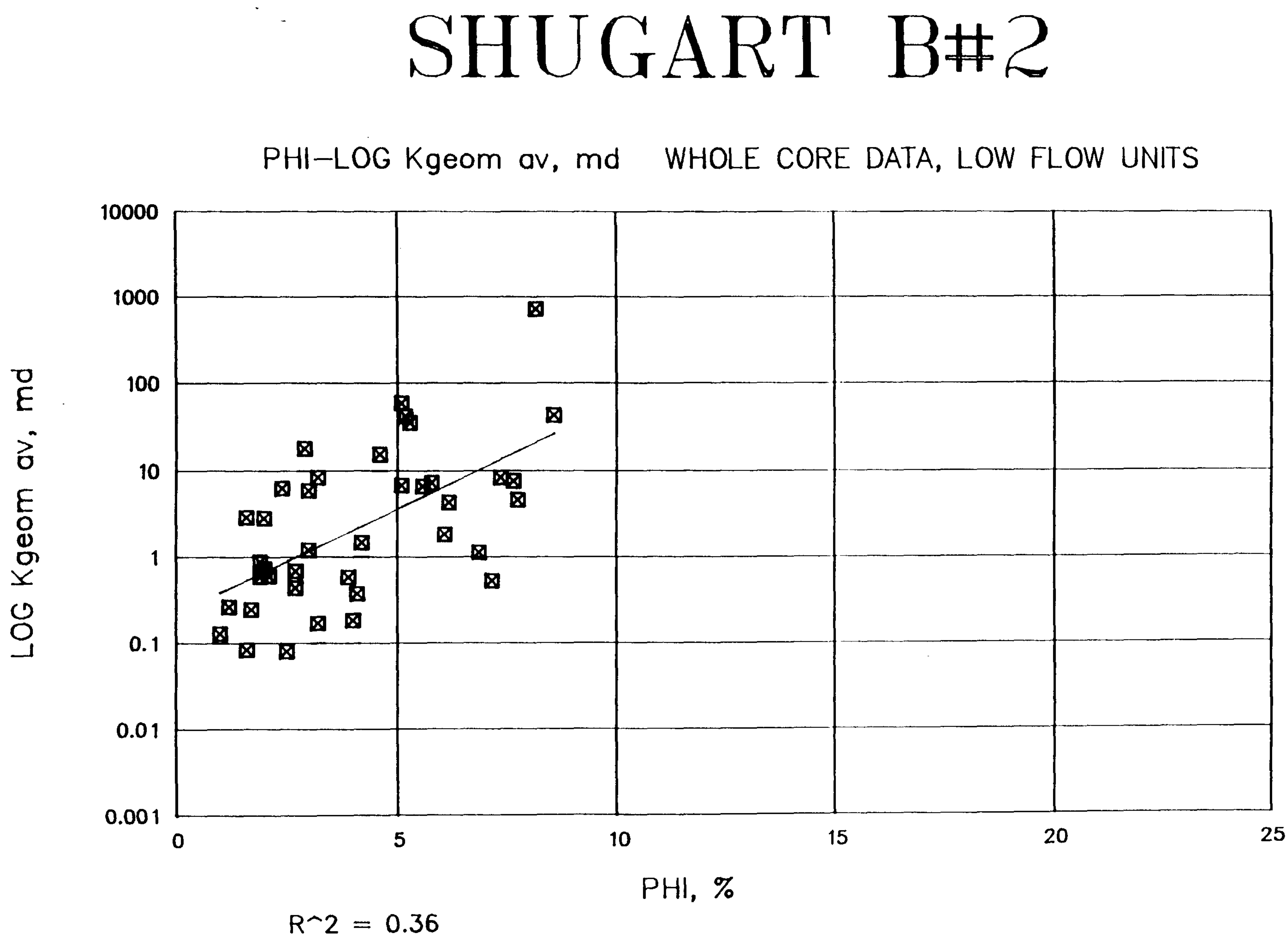

SHUGART B#2
PHI–LOG Kgeom av, md WHOLE CORE DATA, LOW FLOW UNITS
LOG Kgeom av, md
10000
1000
100
10
1
0.1
0.01
0.001
0
5
10
15
20
25
PHI, %
R^2 = 0.36

FIGURE 29

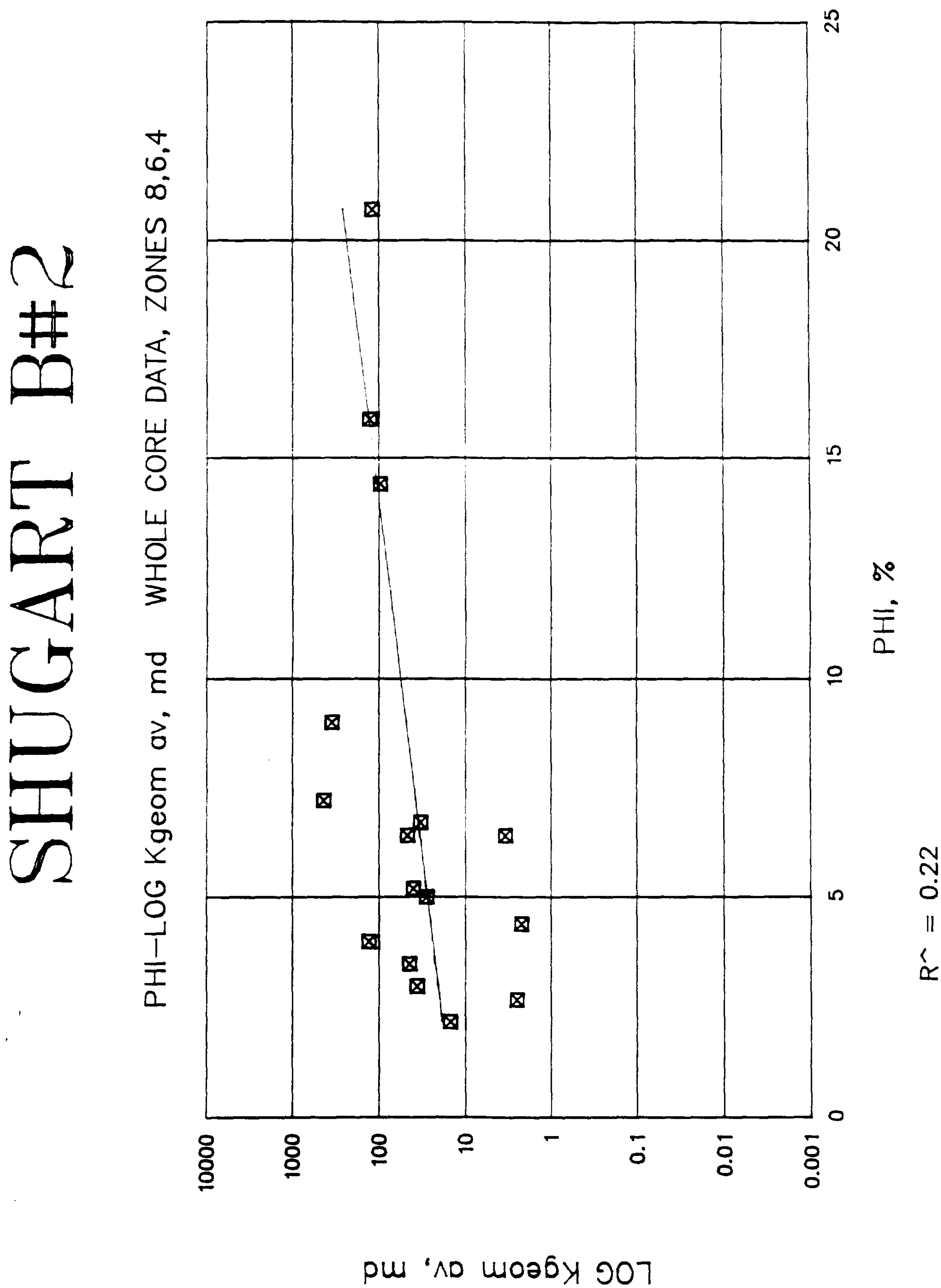
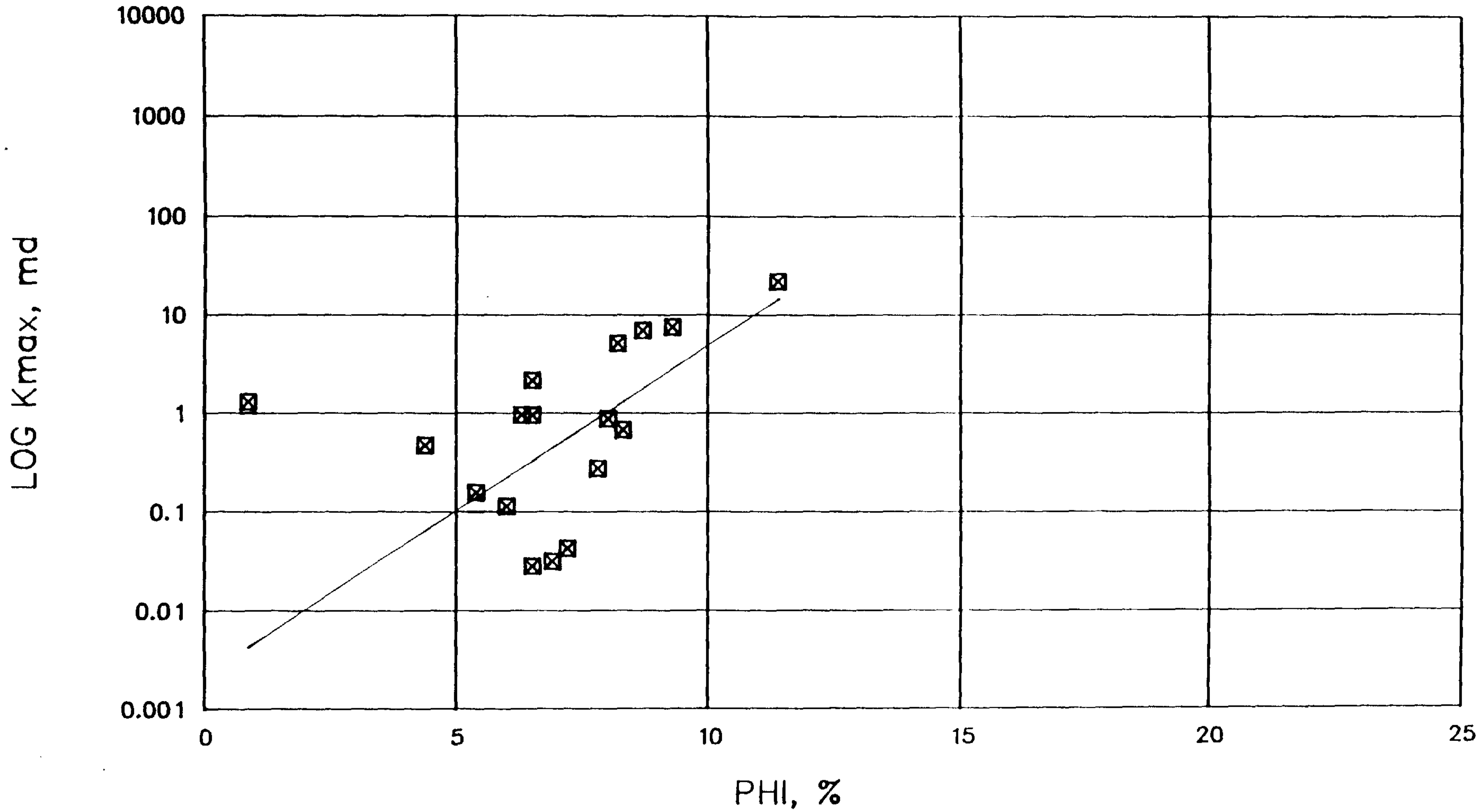

SHUGART B#2
PHI–LOG Kgeom av, md WHOLE CORE DATA, ZONES 8,6,4
10000
1000
100
10
1
0.1
0.01
0.001
0
5
10
15
20
25
PHI, %
LOG Kgeom av, md
R^ = 0.22

FIGURE 30

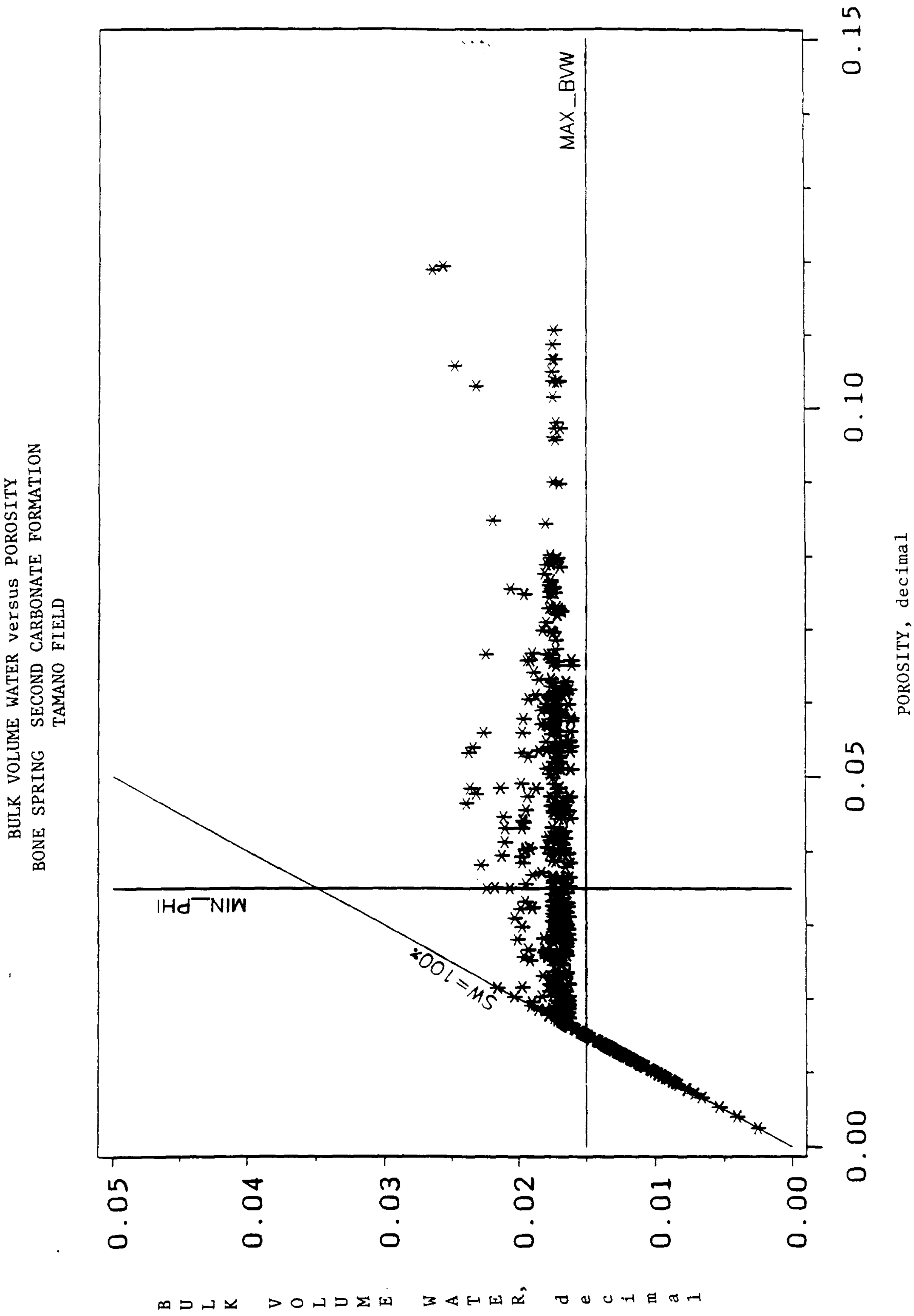
SHUGART B#2

PHI–LOG Kmax, WHOLE CORE DATA, ZONE 10



16 DATA POINTS USED (R^2 = 0.40)

FIGURE 31



BULK VOLUME WATER versus POROSITY
BONE SPRING SECOND CARBONATE FORMATION
TAMANO FIELD
MAX_BVW
MIN_PHI
SW=100%
0.00
0.05
0.10
0.15
POROSITY, decimal
0.00
0.01
0.02
0.03
0.04
0.05
BULK VOLUME WATER, decimal

FIGURE 32

WETTABILITY DETERMINATION WITH CAPILLARY PRESSURE CURVES

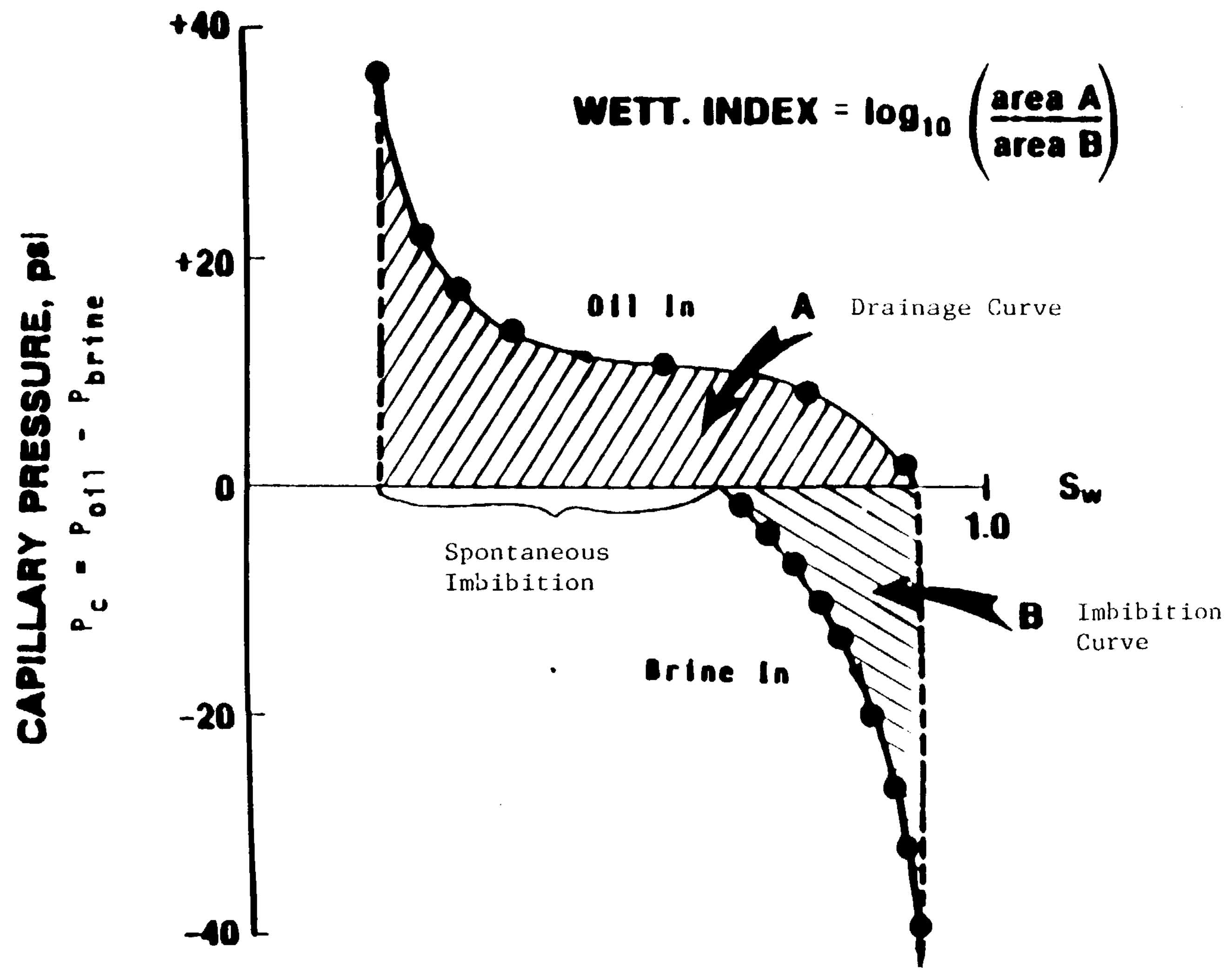


FIGURE 33

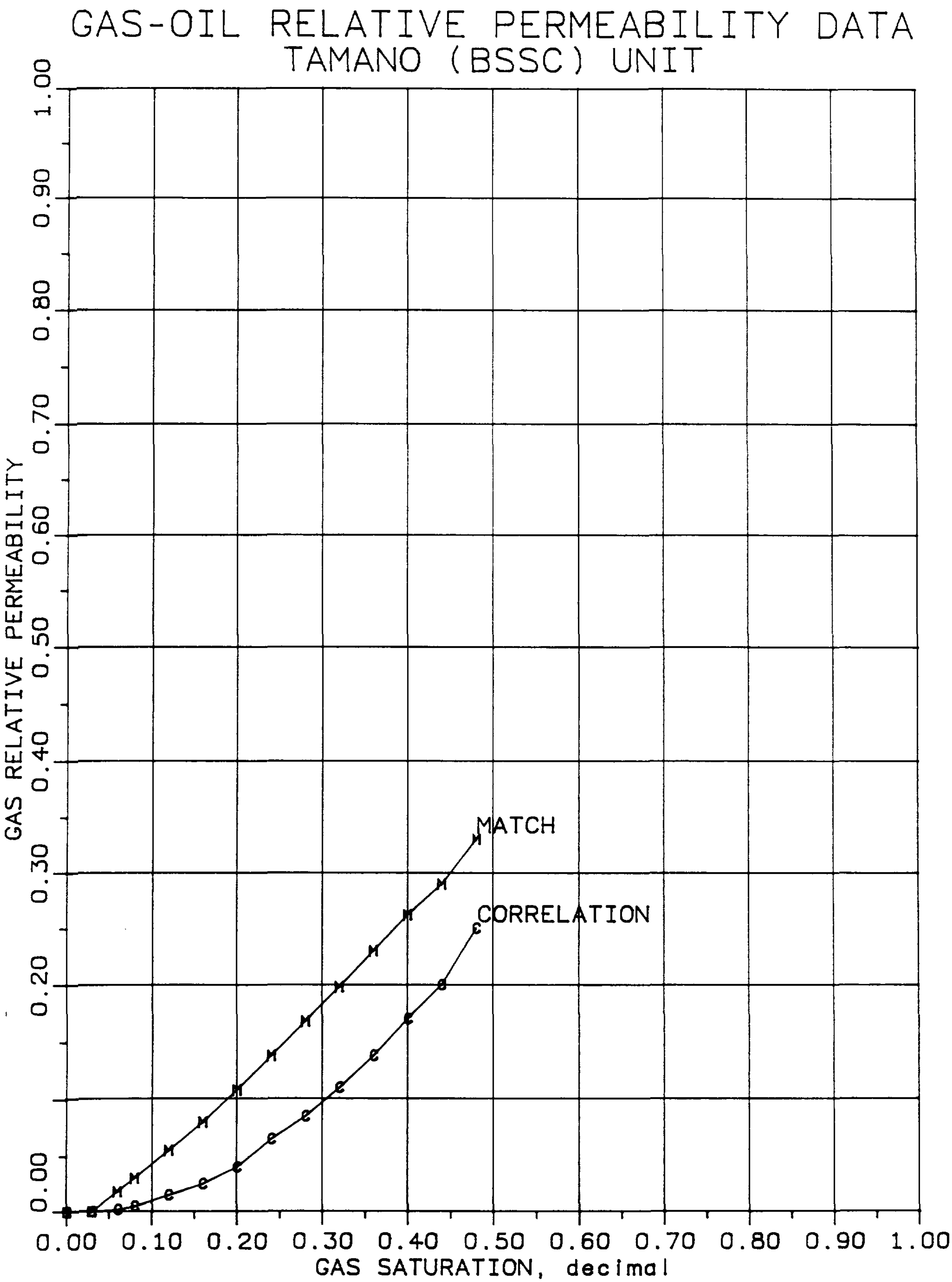
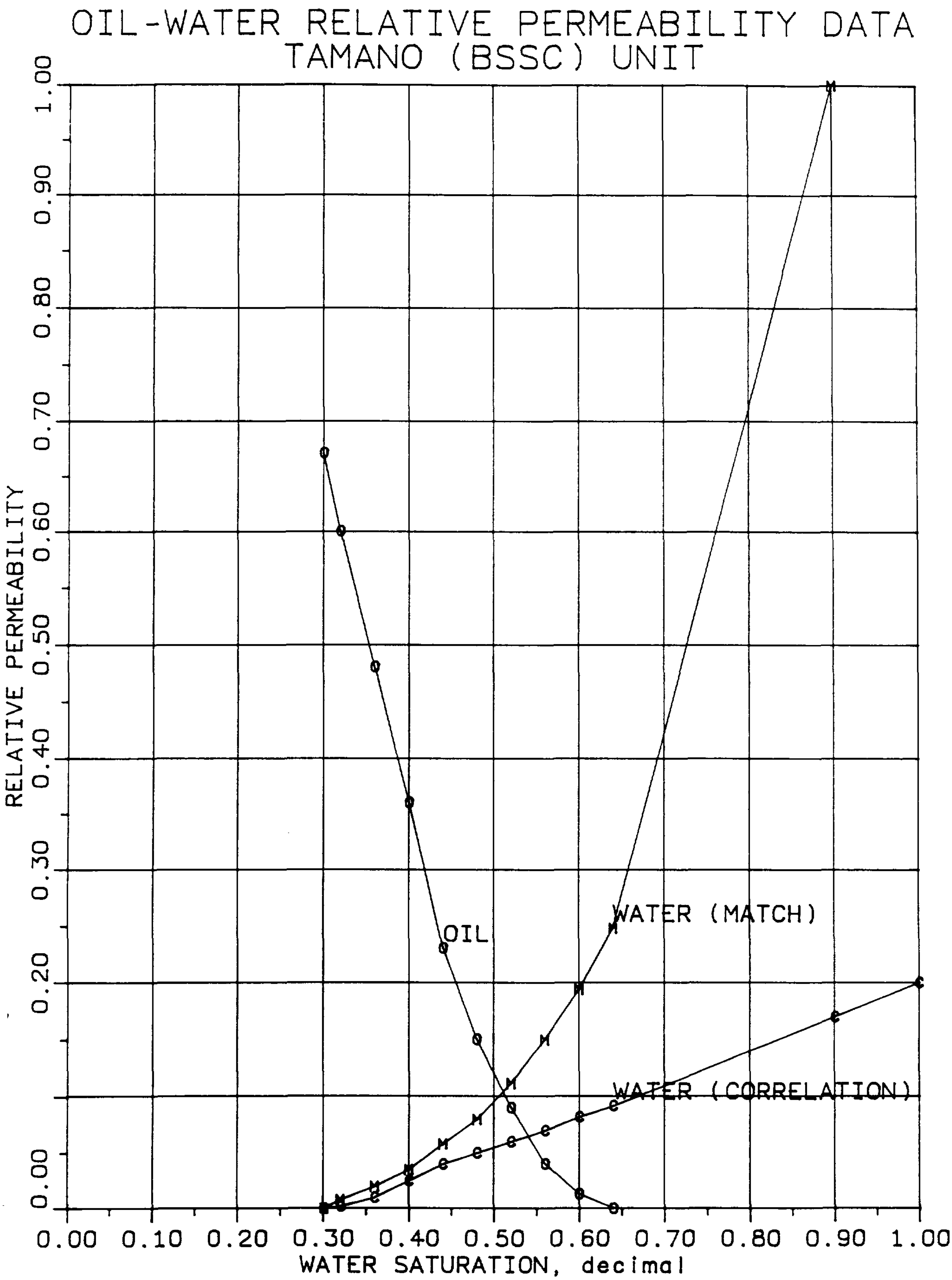
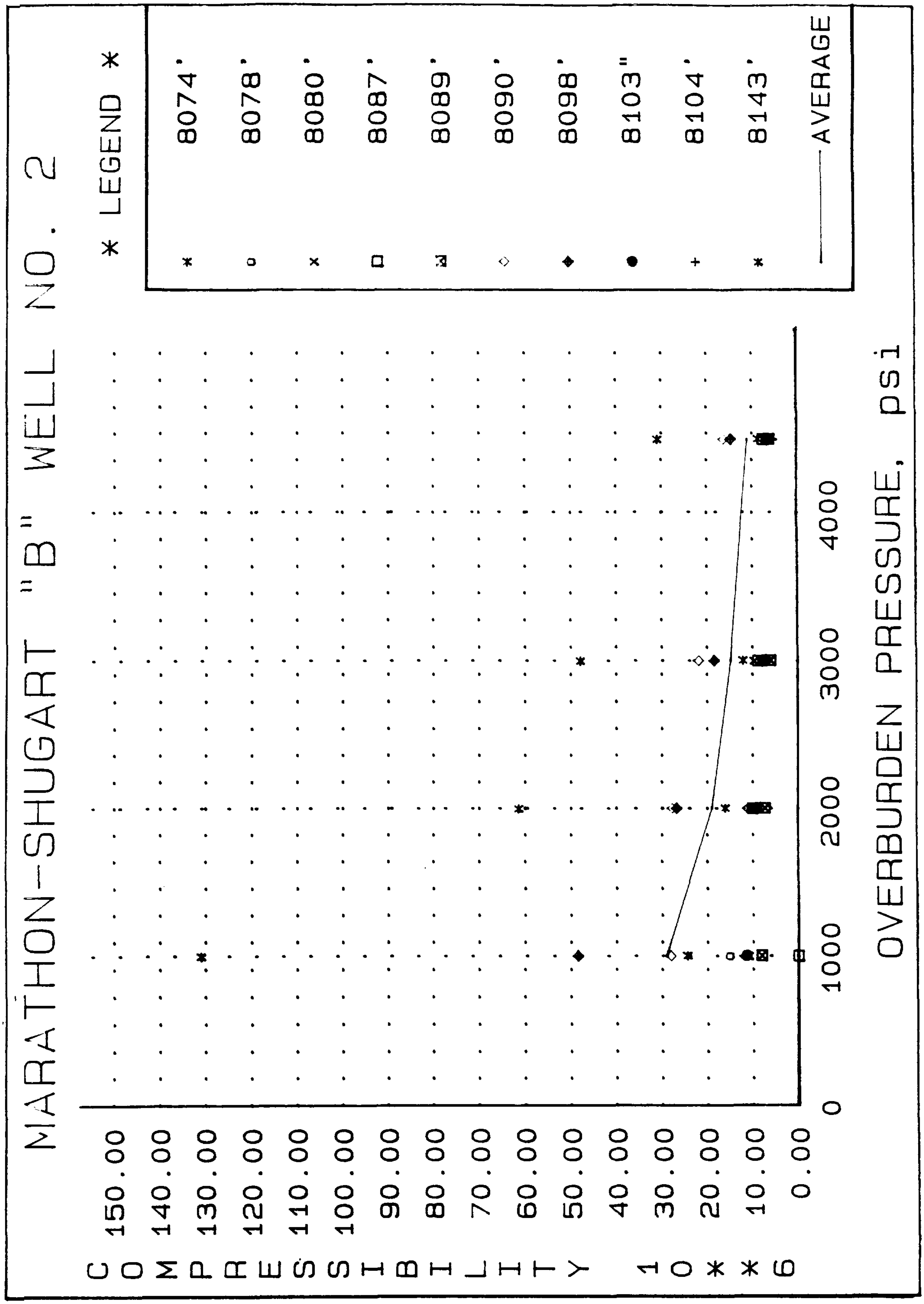

GAS-OIL RELATIVE PERMEABILITY DATA
TAMANO (BSSC) UNIT
GAS RELATIVE PERMEABILITY
0.00
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
MATCH
CORRELATION
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
GAS SATURATION, decimal

FIGURE 34



OIL-WATER RELATIVE PERMEABILITY DATA
TAMANO (BSSC) UNIT
RELATIVE PERMEABILITY
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.00
OIL
WATER (MATCH)
WATER (CORRELATION)
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
WATER SATURATION, decimal

FIGURE 35



MARATHON-SHUGART "B" WELL NO. 2
* LEGEND *
8074'
8078'
8080'
8087'
8089'
8090'
8098'
8103"
8104'
8143'
AVERAGE
COMPRESSIBILITY 10**6
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0
1000
2000
3000
4000
OVERBURDEN PRESSURE, psi

FIGURE 36

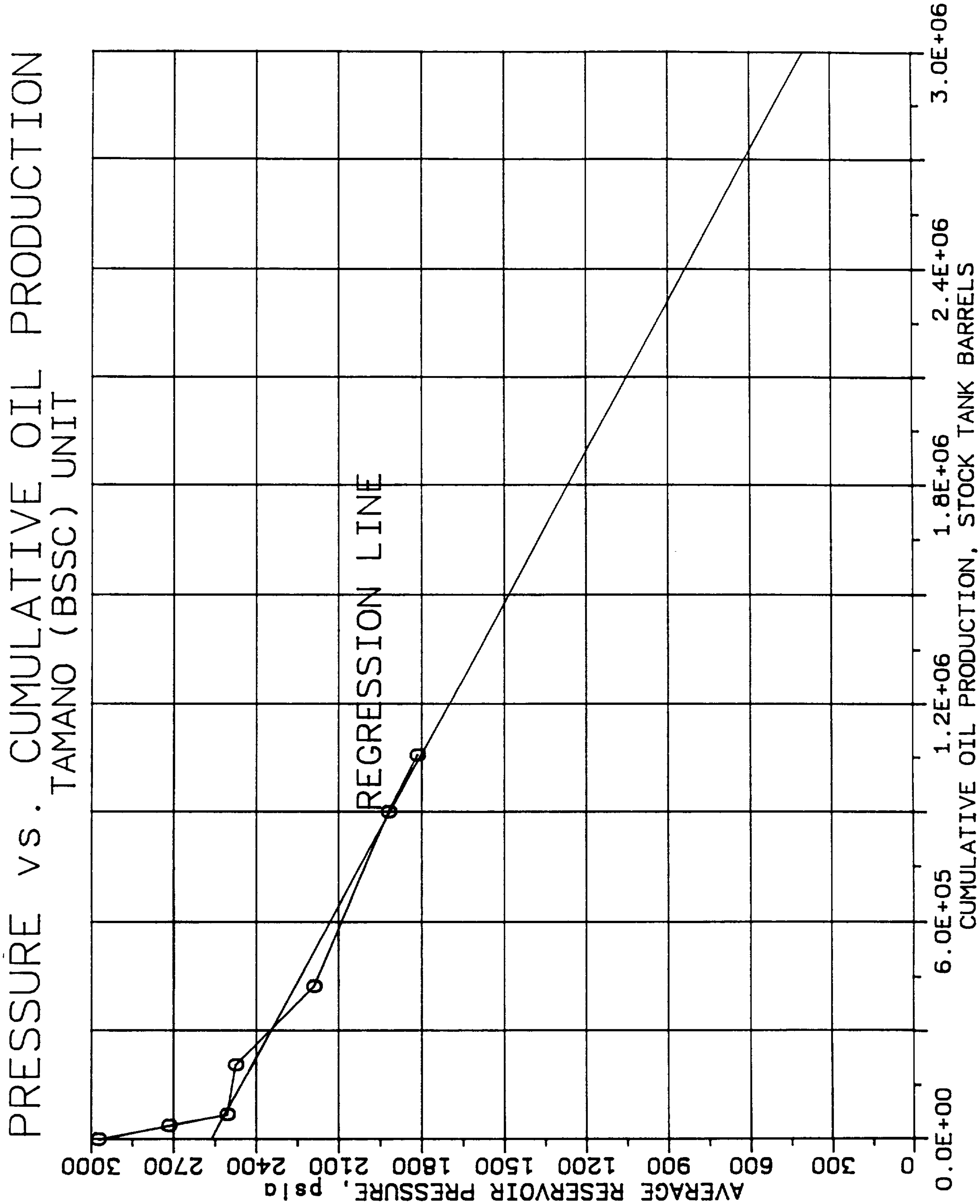
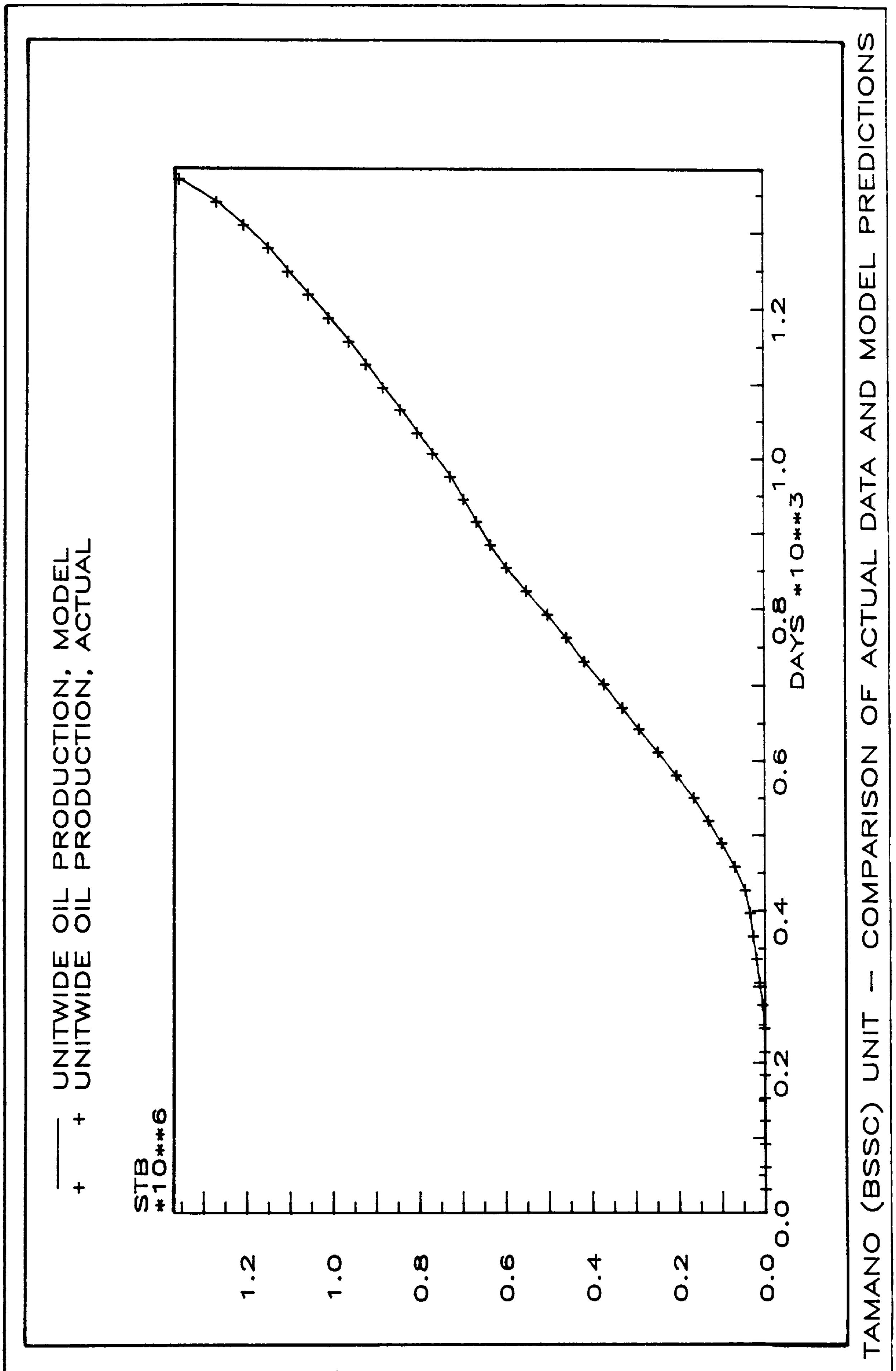
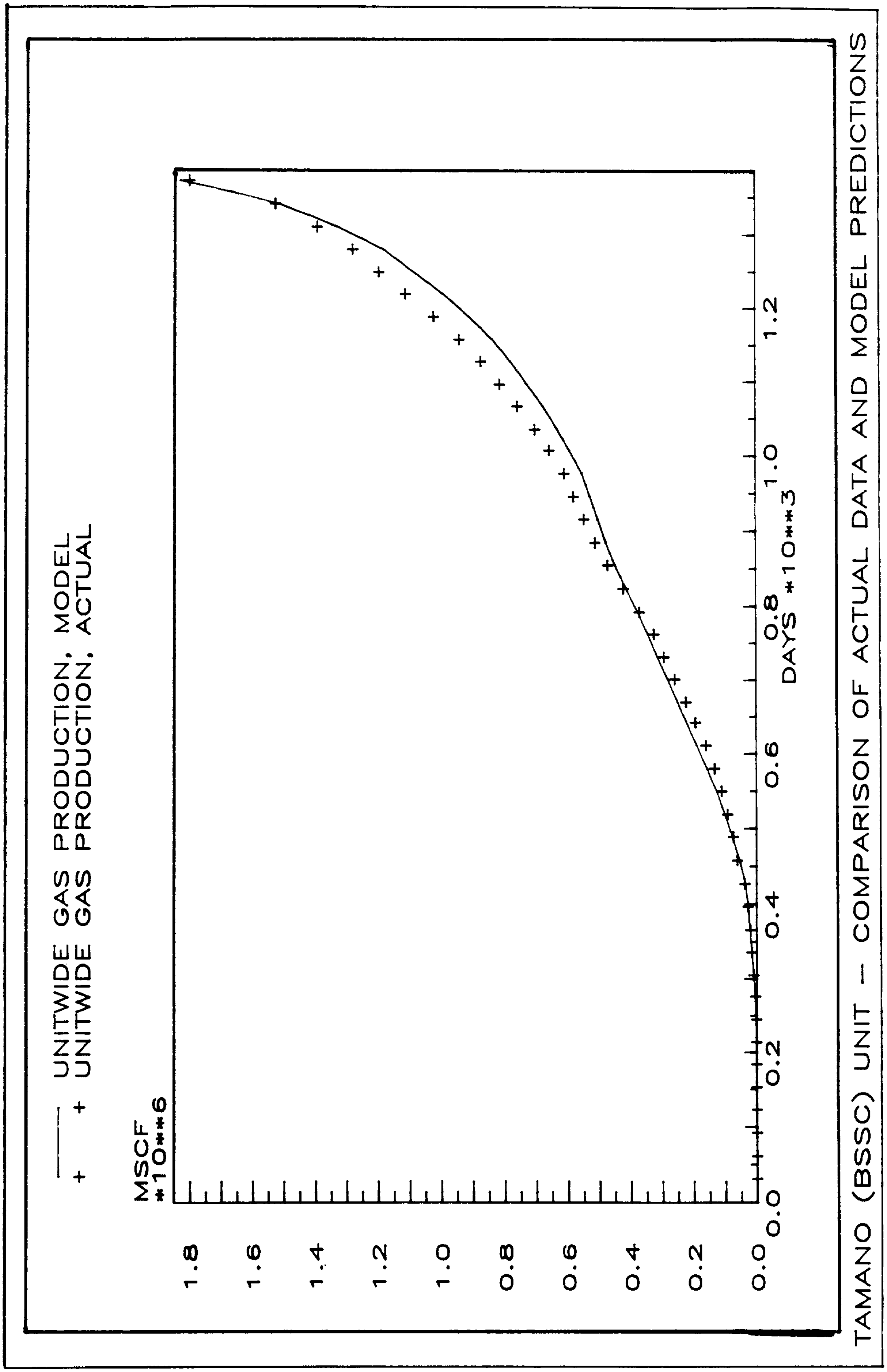

PRESSURE VS. CUMULATIVE OIL PRODUCTION
TAMANO (BSSC) UNIT
REGRESSION LINE
AVERAGE RESERVOIR PRESSURE, psia
3000
2700
2400
2100
1800
1500
1200
900
600
300
0
CUMULATIVE OIL PRODUCTION, STOCK TANK BARRELS
0.0E+00
6.0E+05
1.2E+06
1.8E+06
2.4E+06
3.0E+06

FIGURE 37



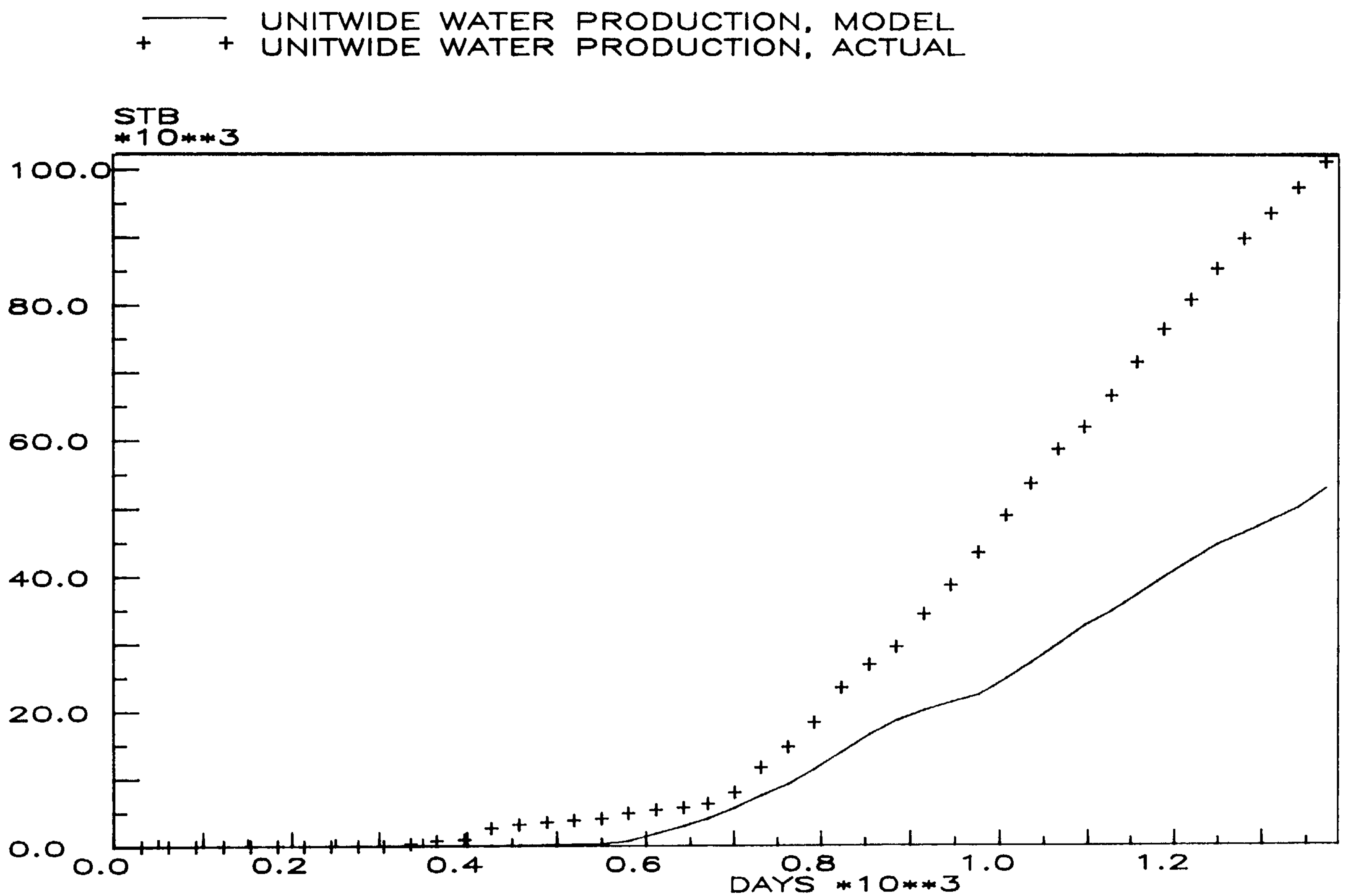
TAMANO (BSSC) UNIT — COMPARISON OF ACTUAL DATA AND MODEL PREDICTIONS

FIGURE 38

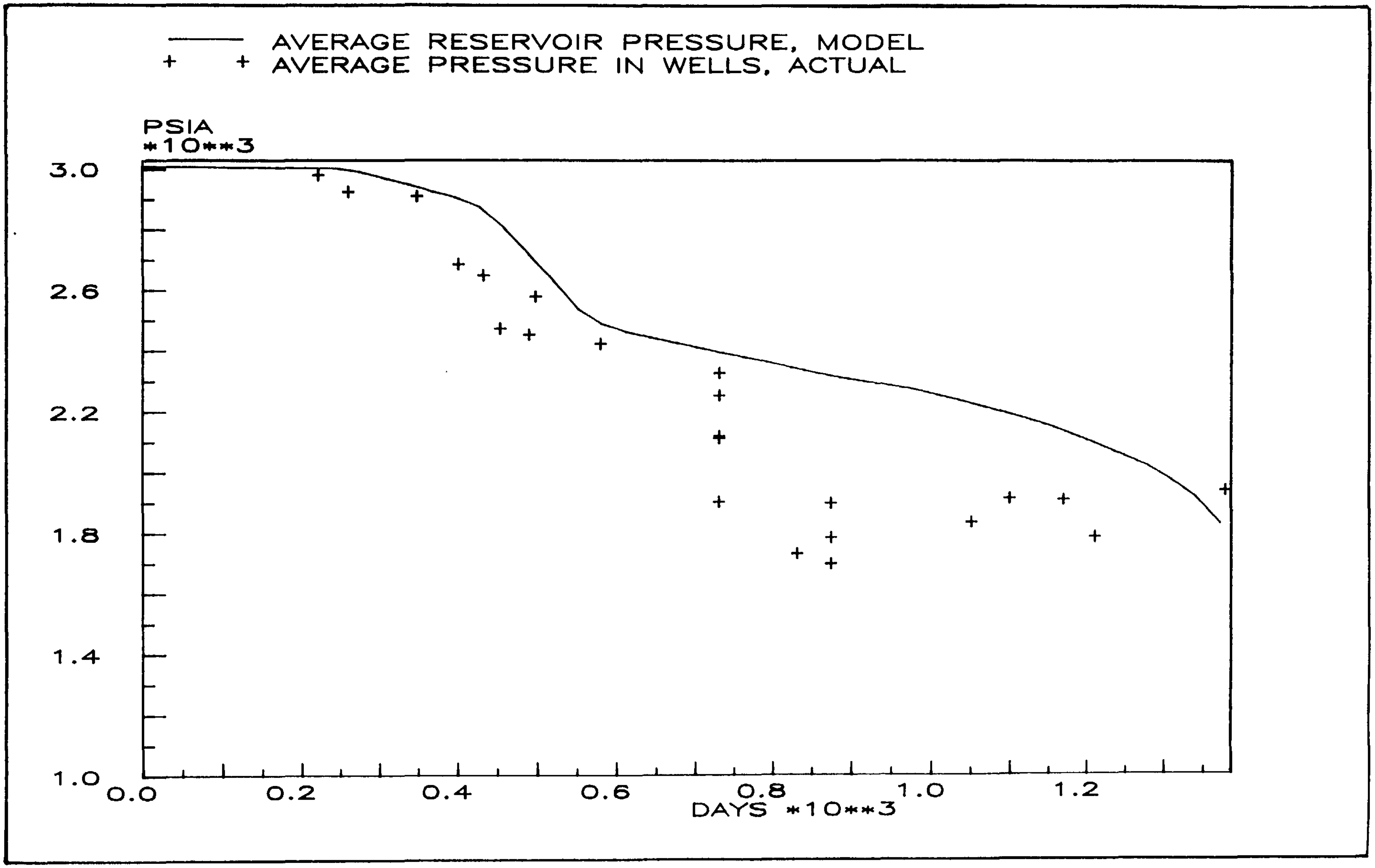


TAMANO (BSSC) UNIT – COMPARISON OF ACTUAL DATA AND MODEL PREDICTIONS

FIGURE 39

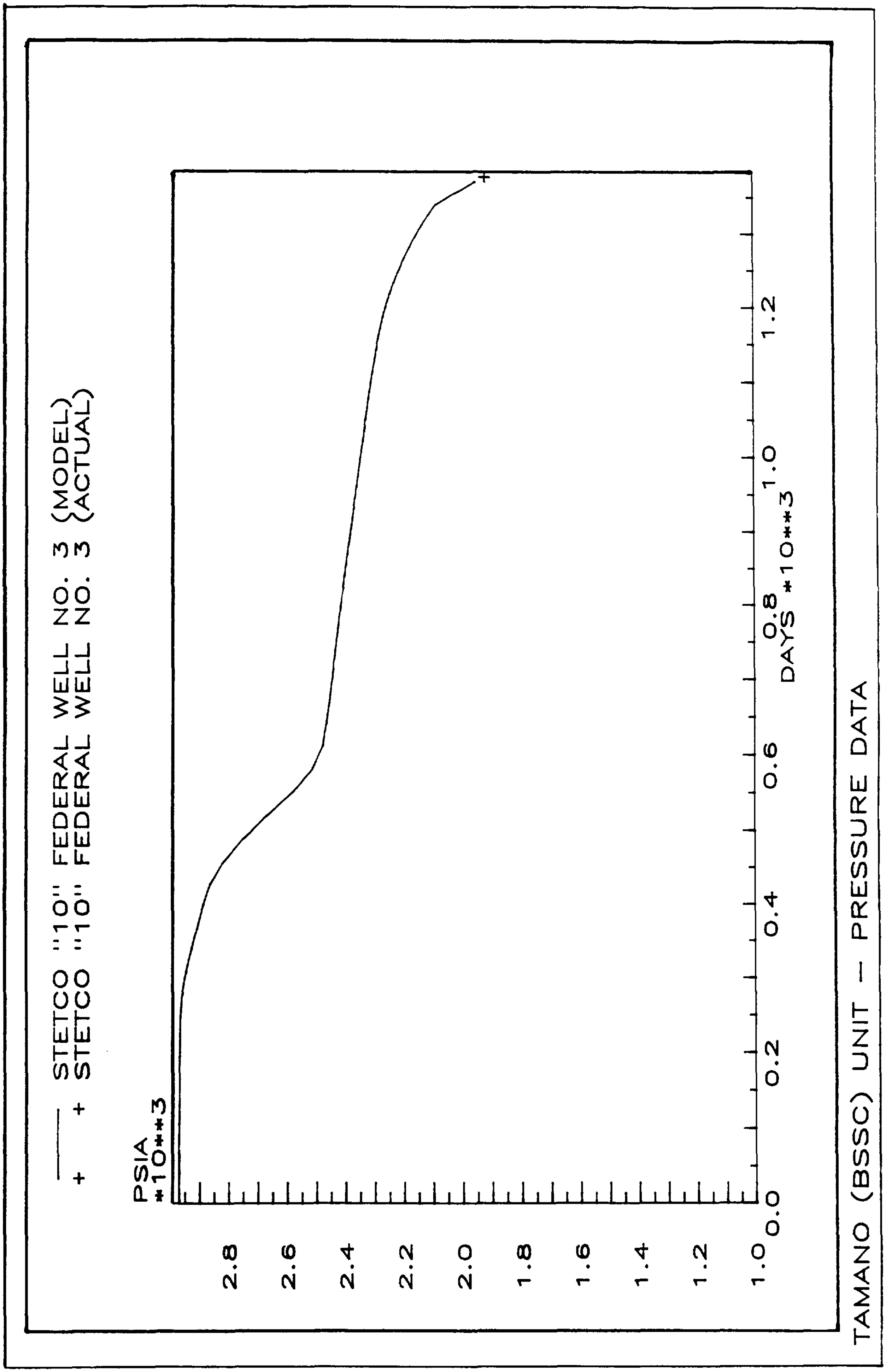


TAMANO (BSSC) UNIT — COMPARISON OF ACTUAL DATA AND MODEL PREDICTIONS

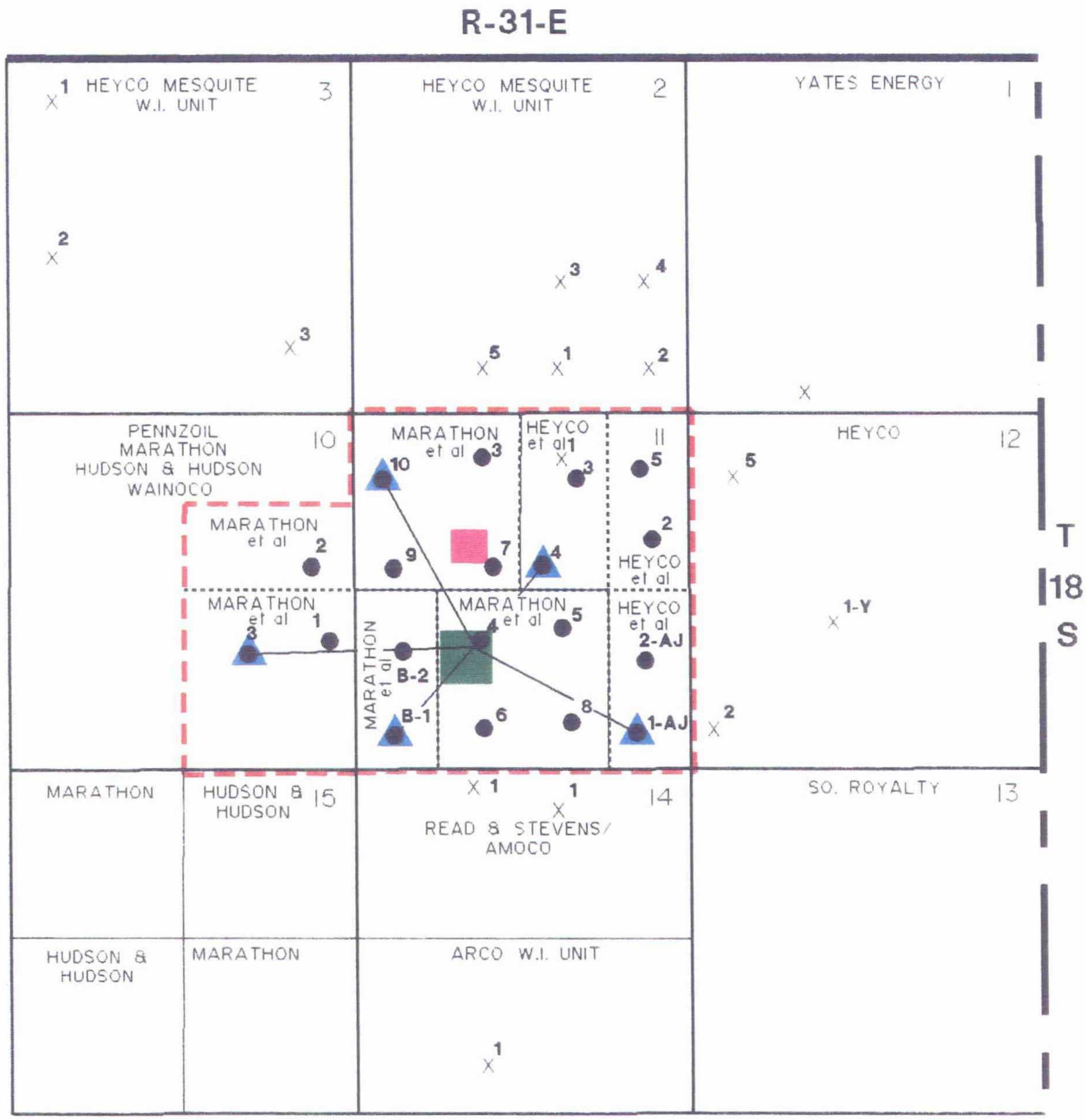


TAMANO (BSSC) UNIT – COMPARISON OF ACTUAL DATA AND MODEL PREDICTIONS

FIGURE 41



—— STETCO "10" FEDERAL WELL NO. 3 (MODEL)
+ + STETCO "10" FEDERAL WELL NO. 3 (ACTUAL)
PSIA
*10**3
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
DAYS *10**3
TAMANO (BSSC) UNIT — PRESSURE DATA



NOTE: ONLY BONE SPRING PENETRATIONS ARE SHOWN

PROPOSED UNIT BOUNDARY

INJECTION WELLS

SATELLITE TEST FACILITY

MAIN BATTERY

INJECTION LINES

MARATHON OIL COMPANY
MID-CONTINENT REGION

PROPOSED TAMANO (BSSC) UNIT

TAMANO (BONE SPRING) FIELD
EDDY CO., NEW MEXICO

PROPOSED 1992 INJECTION PATTERN & FACILITY LOCATIONS

0 1/4 1/2
MILE

1-91

T854.AFE

FIGURE 48

MAIN BATTERY AND INJECTION FACILITY
FLOW SCHEMATIC
PROPOSED TAMANO (BSSC) UNIT
TAMANO (BONE SPRING) FIELD
EDDY COUNTY, NEW MEXICO

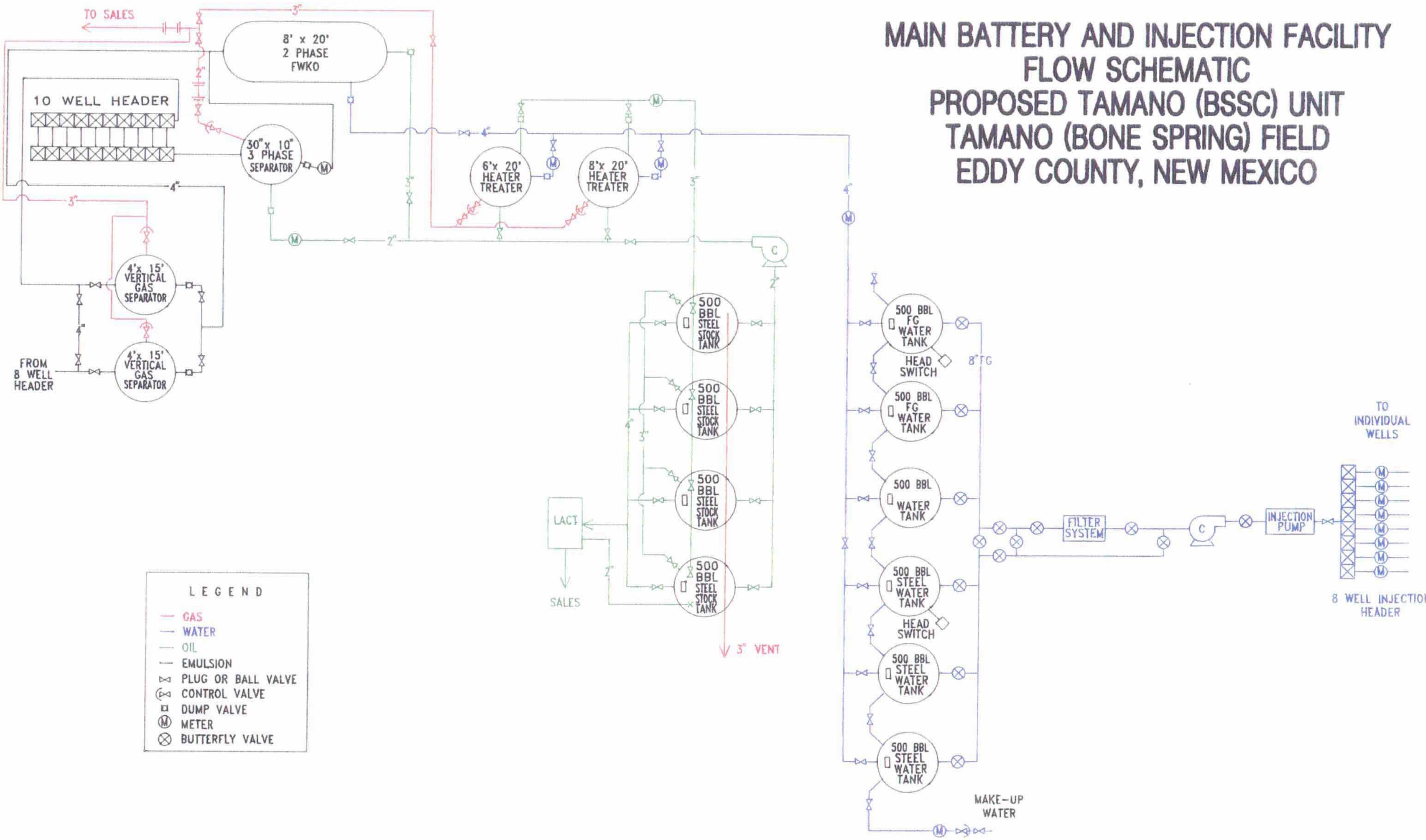
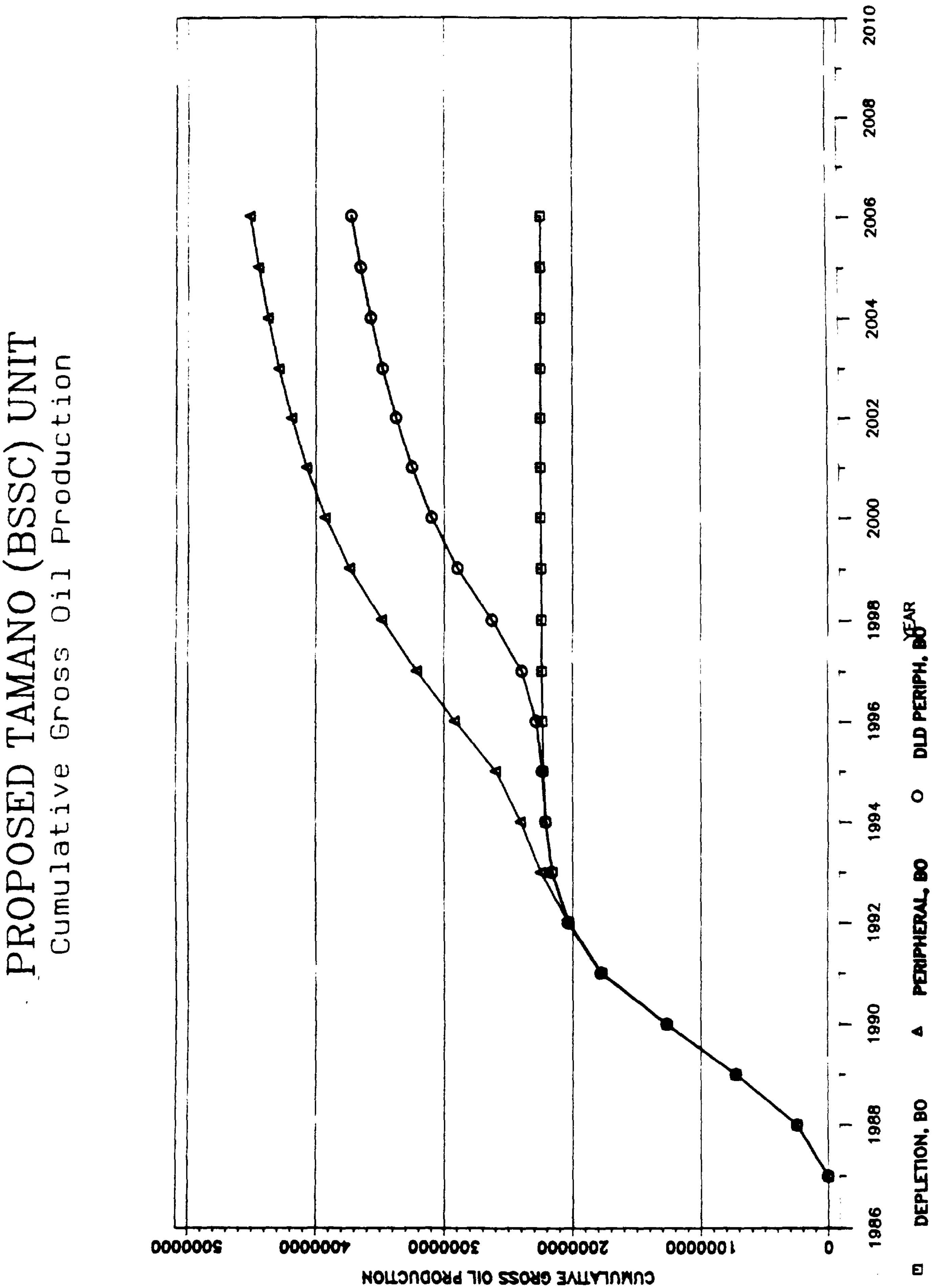


FIGURE 46



PROPOSED TAMANO (BSSC) UNIT
Cumulative Gross Oil Production
CUMULATIVE GROSS OIL PRODUCTION
0
1000000
2000000
3000000
4000000
5000000
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
YEAR
DEPLETION, BO
PERIPHERAL, BO
DLD PERIPH. BO