

# Home Oil Company Limited

1600 Home Oil Tower  
324 Eighth Avenue S.W.  
Calgary, Alberta T2P 2Z5  
Telephone (403) 232-7100  
Fax (403) 232-7678



Manitoba Energy and Mines  
Petroleum Branch  
1395 Ellice Avenue  
Suite 360  
Winnipeg, Manitoba  
R3G 0G3

1994-10-21

ATTENTION : Mr. L.R.Dubreuil  
Director, Petroleum Branch



**RE: Depletion Strategy - South Pierson Field**

In the past year, Home Oil has made several applications for reduced spacing in the South Pierson area. This was done as a result of our development drilling indicating a larger Mississippian oil reserve than previously anticipated. Outside the near Unit area wells have continued to be drilled on 32 ha spacing. Figure 1.0 shows the field development to date.

Home Oil intends to apply for expansion of the waterflood area to include L.S.D.'s 9 and 16-16-002-29 W1M, 12 and 13-15-002-29 W1M and the N.W. quarter of section 10. These areas will be developed in a similar manner to the existing waterflood area. The expansion will require the drilling of the L.S.D. at 13-15-002-29 W1M and possibly the L.S.D. at 11-10-002-29 W1M. The latter may not be drilled depending on the remedial completion that will be done on the horizontal well at 11-10-002-29 W1M. Currently it is planned to fracture stimulate this well. Technical considerations are being given to pattern sweep efficiencies as well as probable success of such a stimulation treatment.

Four wells will also be converted to injection, 16-16-002-29 W1M, 12-15-002-29 W1M, 14-10-002-29 W1M and 12-10-002-29 W1M. Depending on the results of the remedial completion at the horizontal well at 11-10, this well may also be converted to injection.

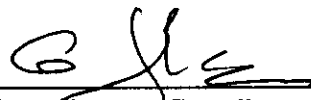
The remainder of the South Pierson field will continue to be developed (where possible) on 32 ha spacing. Wells in the non-waterflood area tend to be located in lower quality reservoir. Therefore there is not a large enough reserve associated with these wells to make them economically attractive. The two exceptions to drilling on 32 ha spacing in the non-waterflood area are first the application of future enhanced recovery schemes and secondly horizontal development.

In order for a new waterflood area to be economically viable, the Mississippian zone must be oil bearing. This is the case in most of the Unit area as it is presently defined. The waterflood expansion areas as outlined in Figure 1.0 contain regions where the Mississippian can be exploited. In areas surrounding the Unit, the Mississippian is largely wet and cannot be developed commercially. The anhydrite between the Lower Amaranth and the Mississippian is typically thin and therefore containing a frac to the Lower Amaranth is very difficult in these cases and usually results in the frac penetrating the Mississippian yielding unwanted water production.

In these areas, horizontal drilling is the best alternative for future development of the resource. However the 'C' sand in the Lower Amaranth must be thick enough to allow for enough oil volumes to make horizontal drilling profitable. Such areas where horizontal drilling may be applied are in the south half of section 10 and areas in sections 19 and 30.

Please contact me at (403) 232-7370 or E.L.Doherty at (403) 232-7376 if you have any questions.

Yours truly,  
HOME OIL COMPANY LIMITED



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G.C.K. Johnson, Coordinator  
Oil Division

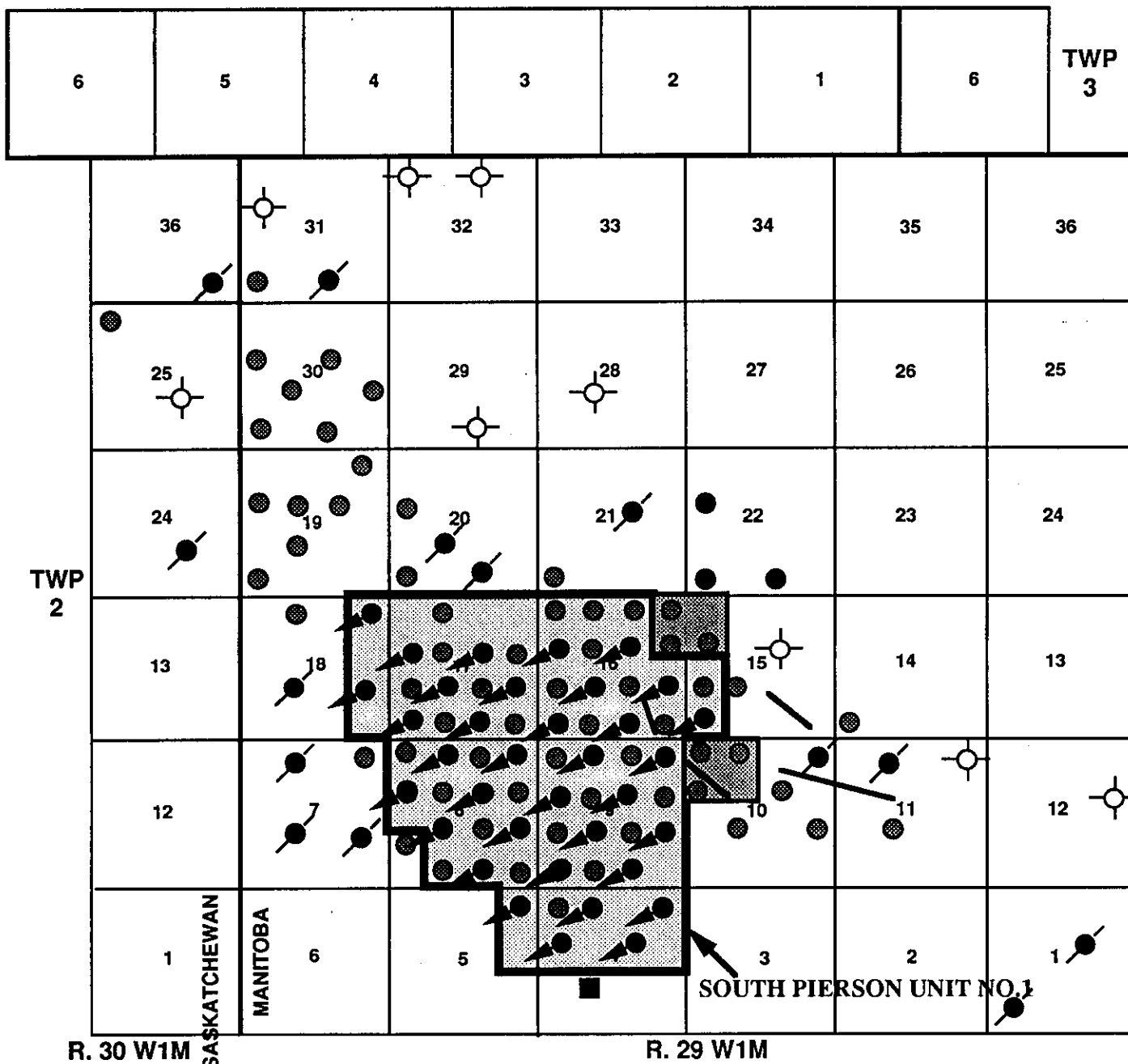
GCKJ/ed









cc: G.C.K. Johnson  
E.L.Doherty  
Pierson Corr.

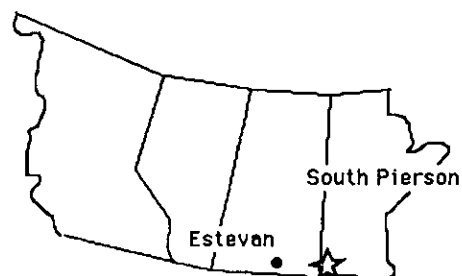
# FIGURE 1.0

## South Pierson Development

To October 21 1994



-  SUSPENDED WELL
-  WATER INJECTION WELL
-  NON-HOME OIL PRODUCING WELL
-  HOME OIL PRODUCING WELL
-  ABANDONED WELL
-  HORIZONTAL WELL LOCATIONS
-  WATER SOURCE WELL
-  WATERFLOOD EXPANSION AREAS



September 15, 1993

Mr. G.C.K. Johnson  
Home Oil Company Limited  
1600 Home Oil Tower  
324 8th Avenue SW  
Calgary, Alberta  
T2P 2Z5

Dear Mr. Johnson:

**Re: South Pierson Unit No. 1 WaterFlood Incentives**

The Petroleum Branch has completed its review of your request for royalty/tax incentives for the waterflood to be implemented in South Pierson Unit No.1.

A review of the EOR incentive program in place from 1987 to 1991 indicated that the program was ineffective in stimulating EOR projects. Marginal EOR projects benefitted little under the incentive program, and economic projects such as Home's, received an unnecessary and extremely costly (to the Crown) incentive. The Branch concluded EOR projects should be implemented in Manitoba based on technical merit and an EOR incentive was unnecessary.

In October 1991, following detailed consultation with industry, the EOR incentive program was terminated in favour of enhancements to the drilling incentive program. The revenue-neutral modifications to the incentive programs recognized Manitoba's fiscal limitations and need to encourage exploration.

The Branch has reviewed the project economics supplied by Home Oil and has the following observations:

- (1) The project has an rate of return of 25.7% (AIT), approximately 4.5 times the current cost of capital.
- (2) The Province's drilling incentive program provides a holiday oil volume of approximately 1300 m<sup>3</sup>/well for each infill well. The royalty/tax savings to Home is approximately \$1 MM and the savings occur early in the project.
- (3) Over the life of the project the Crown's royalty/tax share is only 10.9% of gross revenue. Typically

freehold oil and gas leases reserve a royalty of 15% to the royalty owner.

- (4) The selection of the discount factor has a substantial effect on the incremental NPV over the 40 year project life.

| <u>Discount Rate</u> | <u>NPV (AIT)</u> |
|----------------------|------------------|
| 8%                   | \$15.6 MM        |
| 10%                  | \$11.8 MM        |
| 12%                  | \$8.9 MM         |

- (5) The royalty/tax relief proposed by Home Oil, (\$3.2 MM discounted at 12%), is approximately 4 times the incentive the project would have earned under the EOR incentive program which expired in 1991.

One of the Department's roles is to facilitate the maximum economic recovery of the Province's oil and gas resources. To achieve this objective, the Department has provided what we believe is a stable, competitive fiscal environment for petroleum investment. Under the current fiscal constraints facing the Province, additional incentives for a conventional waterflood project are difficult to justify. It is the Petroleum Branch's position that the Crown's royalty/tax burden, 10.9% of gross revenue, is reasonable and the royalty/tax savings of \$1 MM upfront is an attractive incentive. From an external perspective, the project's rate of return of 25.7% (AIT) appears attractive in comparison to the current cost of capital.

For the above reasons the Branch is not prepared to recommend to the Minister that the project be given additional royalty/tax relief.

If you have any questions, please call the undersigned at (204) 945-6575.

Yours truly,

Original Signed By  
**L. R. DUBREUIL**

L. R. Dubreuil,  
Director

JNF/sb

**SUBJECT - REQUEST FOR WATERFLOOD  
INCENTIVES - HOME OIL**

**DATE:** September 13, 1993

**BACKGROUND**

- Home Oil Company Limited is in the process of implementing a waterflood project in the Pierson Field.
- From 1987 to 1992, projects of this type were eligible for an enhanced oil recovery incentive in the form of reduced royalties and production taxes.
- In the fall of 1991, Petroleum Branch staff met with key industry personnel to develop a new petroleum incentive program. Home Oil was invited but declined to participate.
- As a result of this meeting and in view of the lack of exploratory drilling, enhancements were incorporated in the drilling incentive program.
- It was also recognized at the meeting that the enhanced oil recovery incentive program was ineffective in encouraging marginal projects and provided an unnecessary and extremely costly (to the Crown) incentive for already economic projects. On this basis this incentive program was not renewed.
- The Petroleum Crown Royalty and Incentive Regulation provides authority to the Lieutenant Governor in Council to vary the Crown Royalty payable. The Oil and Gas Production Tax Act includes a similar provision with respect to freehold production taxes.

**CURRENT STATUS**

- Through correspondence with the Petroleum Branch, Home Oil has requested reductions in royalties/taxes for its waterflood project.
- Home Oil indicates that capital cost of the project is \$12.6 million. Under the current Royalty/Tax regime over the 40 year life of the project, Home Oil's undiscounted cash flow is \$53.4 million and undiscounted Crown revenue totals \$18.6 million. The project has a rate of return of 25.7 percent.
- Home has requested a reduction of about 50% in royalties/taxes. This would increase the rate of return to 30.3 percent.
- Home contends the incentive is necessary because:
  - project rate of return barely clears Home Oil's internal hurdle
  - other waterfloods received incentives
- Home has implied that if incentives are not granted for this project, it may not proceed with additional waterflood projects in the Pierson Field.
- The Branch has indicated to Home Oil that it does not support the need for incentives for this project because:
  - rate of return is about 4 times the current cost of capital
  - application for incentives may be made for additional projects as warranted
  - limitation of the Province's fiscal resources
- Under the current drilling incentive program, Home Oil has benefited by approximately \$1 million in foregone Crown revenue.

**RECOMMENDATIONS/CAUTIONARY NOTES**

- Home Oil may choose to approach the Minister to reiterate its request for incentives for this project.

**PREPARED BY:** L. R. Dubreuil

## Home Oil Company Limited

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324 Eighth Avenue S.W.  
Calgary, Alberta T2P 2Z5  
Telephone (403) 232-7100  
Fax (403) 232-7678



1993-07-23

Department of Energy and Mines  
Petroleum Branch  
555 - 330 Graham Avenue  
Winnipeg, Manitoba  
R3C 0V8



ATTENTION: Mr. J.N.Fox  
Chief Petroleum Engineer

### **RE: South Pierson Waterflood Economics - Incentives**

Further to our letter of June 22, 1993, Home Oil has developed a waterflood incentive proposal that we feel is fair to both the Unit and the Crown. Our proposal is to receive a reduced royalty rate on production volumes above the primary production forecast. This would guarantee the Crown of receiving the royalties that would have been received under primary depletion and rewards the Unit for implementing a technically successful waterflood. Thus the more successful the waterflood, the greater the benefit to the Crown as well as the Unit.

Past royalty schemes were based on production volumes or capped royalty rates based on the entire production. Under these types of incentive programs, there is no initiative to be technically successful. If the incentives are large enough, projects may have been economically viable without having to produce any incremental oil. Because of this, some waterfloods may have been implemented as cheaply as possible for the sole purpose of receiving the government incentives without having a lot of technical justification.

Home Oil has tried to demonstrate that the waterflood proposal for South Pierson will be technically successful and will have marginal economics due to lack of incentives. We feel our incentive proposal will reward the Unit for results. That is the Unit will receive a royalty break only if the waterflood is successful rather than receiving royalty breaks by just implementing the waterflood. Table 1.0 shows the difference in incremental NPV between the base case (no incentives) and the incentive case (capped royalty for incremental production) for the Unit and the Crown.


In running the economics it was assumed that the crown royalties and mineral taxes were calculated separately for the primary portion and the waterflood portion of the production. Therefore each component of the royalty calculation was based on the number of producing wells within the Unit. It was also assumed that the current incentives to drill a well of 1300 m<sup>3</sup>/well royalty free production remained in place.

Home Oil would like to reiterate our position that we are committed to this project. If we are successful in recovering the predicted incremental reserves, the waterflood will be both technically and economically successful. If the waterflood does not perform as predicted, then the waterflood may not prove to be economically successful from the Unit's viewpoint. With a substantial capital investment of 12.64 \$MM, the Unit should expect an NPV equal to the initial capital investment. This was the basis for the economic case for the royalty reduction.

Further waterflood development of the South Pierson pool may be limited due to marginal economics. Lack of Government incentives may force us to delay full implementation of this project and limit the area within the field that will be placed under any enhanced recovery scheme.

Please contact me at (403) 232-7370 or Eugene Doherty at (403) 232-7376 so that we may discuss the contents of this letter.

Sincerely,  
HOME OIL COMPANY LIMITED

  
for G.C.K. Johnson, P.Eng.  
Coordinator, Southern Production

G.C.K.J./ed  
attach:

cc: G.C.K. Johnson  
C.W. Labelle  
J.S. Murray  
D.R. Gateman  
E.L. Doherty  
Pier Corr



**Table 1.0**

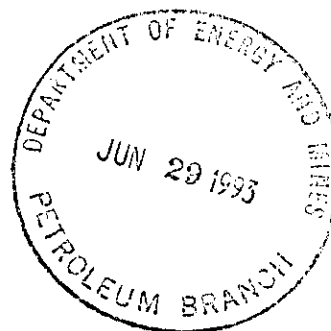
| <b>Case</b>                            | <b>Incremental<br/>Unit NPV<br/>(\$M)</b> | <b>ROR %</b> | <b>Payout (yrs)</b> | <b>Incremental<br/>Crown Royalty<br/>&amp; Mineral Tax<br/>NPV (\$M)</b> |
|--|---|--------------|---------------------|--|
| Base                                   | 8,933.90                                  | 25.74        | 5.13                | 6,551.60   |
| Incremental<br>Royalty Cap<br>of 12.2% | 12,106.20                                 | 30.35        | 4.48                | 3,379.30   |

Note: Capital investment of 12,640.0 \$M required to implement waterflood for the proposed Unit area.



1993-06-22

Department of Energy and Mines  
Petroleum Branch  
555 - 330 Graham Avenue  
Winnipeg, Manitoba  
R3C 0V8



ATTENTION: Mr. J.N.Fox  
Chief Petroleum Engineer

**RE: South Pierson Waterflood Economics**

Attached for your information are economic 'Pogo' runs for the planned waterflood in Pierson. Attachment A gives the results of the primary depletion case with no waterflood implementation. Attachment B shows the results of the waterflood 'go-forward' case and Attachment C gives the incremental case to implement the waterflood. Unrisked incremental economics indicate that the waterflood will have a NPV (12% DCF) of 8.93 \$MM with an after tax ROR of 25.74% and a payout of 5.13 years. The results of each case are given in Table 1.0.

Home Oil has several concerns with respect to these economics. Firstly, the economics on a corporate basis are marginal as they just clear our hurdle rate. Secondly, the return on a capital investment of 12.64 \$MM is only 8.93 \$MM. The cashflow stream of crown royalties and mineral taxes is approximately 18.59 \$MM. Home Oil feels that there may be room for the Manitoba Government to supply some royalty incentives to improve the return on capital. Another concern is that other waterfloods in Manitoba have received incentives. Many of these waterfloods have been technically, marginally successful. Home Oil feels that the design of the Pierson waterflood is superior to many of the earlier plans and that it will be successful in producing significant incremental reserves. However, because there are no waterflood incentives currently in place, we will not receive the same economic benefit as earlier waterfloods even though we have a superior design.

Home Oil would like to reiterate that we are committed to the implementation of the first phase of the Pierson waterflood. However, due to the marginal economics, further expansion in the area will be unlikely unless there are better government incentives in place.

Please note that each 'Pogo' run contains proprietary information and we would appreciate your discretion in not disclosing Home Oil's corporate price forecast.

Please contact me at (403) 232-7370 so that we may discuss the contents of this letter.

Sincerely,  
HOME OIL COMPANY LIMITED

G.C.K. Johnson, P.Eng.  
Coordinator, Southern Production

G.C.K.J./ed  
attach:

cc: without attach  
G.C.K.Johnson  
C.W.Labelle  
J.S.Murray  
E.L.Doherty  
Pier Corr

**Table 1.0**

| <u>Case</u>                 | <u>After Tax ROR</u> | <u>NPV (12% DCF)</u> | <u>Payout (yrs)</u> |
|-----------------------------|----------------------|----------------------|---------------------|
| 1) Primary Depletion        | 409.40%              | 6.70 \$MM            | 0.51                |
| 2) Secondary<br>Go-Forward  | 38.84%               | 15.63 \$MM           | 3.51                |
| 3) Incremental<br>Secondary | 25.74%               | 8.93 \$MM            | 5.13                |

oil & costs

① base no w.f.

③ subtract base case - waterflood case

# **Attachment A**

## **Pogo Run - Primary Depletion**

POGO is owned and supported by GARRETT COMPUTING CANADA  
The country default for this version is CNTRY=CAN  
Input units default to INPUNT=IMP  
Output units default to OUTUNT=IMP  
Version 811.4 September 30, 1992

FILE 3839 CASE 1 RUN TIME 22-JUN-1993 10:34

SLIST  
\*\* S. PIERSON MANITOBA \*\*  
LOWER AMARANTH PRIMARY ECONOMICS  
80 ACRE SPACING

1/3 CROWN, 2/3 FREEHOLD  
PRIMARY PROD WITHIN UNIT AREA  
\$DATA

CASE =3839  
@MAN SI BASE GENERAL DEFAULTS AS AT APRIL 27, 1993

CNTRY=CAN IEVVR=1993 WIDTH=WIDE MXPER=50 PRINT=20

REPORT = ANNL PROV

PVMTX=MIDP PVPC=0.08.10.12.15.20

WRTMX=YES DVMX=VES EXMX=VES DPRMX=VES

FTXPC=50\*.28 FCPTX=NO SURTPC=.03

@ INFLATION RATES

OPINF=0 49\*.02 CPIINF=0 .04 .03 47\*.02

OPRTIF=0 49\*.02

OPRQIF=0 .057 .025 .073 .067 .061 .038 .044 .043 .041 .04 39\*.03

@ ZEROING OUT JUMPING POUND CALCULATIONS

JPOQPC=6\*0 JPPQPC=0 JPLQPC=0 JPDQPC=0 JPCQPC=0

@ PROVINCIAL

CANROV=MAN PTXPC=50\*.17

@ HOME OIL APRIL 27, 1993 PRICE FORECAST

METRIC UNITS BASE PRICE FORECAST

@ IF YOU HAVE ANY QUESTIONS PLEASE CONTACT CORPORATE PLANNING

INPUT = SI

OUTUNT = SI

@ NOTE OIL PRICES ARE EDMONTON REFERENCE 40 API

PROIL=148.20 156.57 160.51 172.14 183.74 194.96 202.46 211.45

220.45 229.45 40\*238.70

PRCND=148.20 156.57 160.51 172.14 183.74 194.96 202.46 211.45

220.45 229.45 40\*238.70

PRBUT=89.99 98.60 107.49 118.83 132.25 144.19 151.86 160.87

167.85 174.82 40\*181.99

PRPRO=84.95 86.08 87.43 89.55 97.35 107.17 113.39 120.65 125.88

131.12 40\*136.49

PRETH=46.69 52.64 50.40 53.16 53.88 54.58 55.88 59.47 61.61

64.45 40\*67.35

PRSL=0 7.50 10 12.50 15 20 25 30 35 40 40\*50

@ GAS PRICES ARE BY GAS BUYER

PRINF=11\*0 39\*.03 @ PRICE INFLATION RATES

@ APRIL 27, 1993 FORECAST

@ CORPORATE AVERAGE METRIC BASE

PRRES = .05515 .06749 .07437 .07977 .07995 .08003 .08157

.08886 .09242 .09770 40\*.10308

PRSLN = .05515 .06749 .07437 .07977 .07995 .08003 .08157

.08886 .09242 .09770 40\*.10308

REPORT=DECL,ANLN,PROV,GOVT

-MXPER=40

OUTUNT=SI

IEVVR=1993 IEVMO=05

CNTRY=CAN

FEDTX=CAN

FTXPC=40\*.288

PTXPC=40\*.17

*capital inflation*

*corporate*

*Feb 27.96  
Feb 17.06  
mid-nid month*

*upside*

*Total effective tax*

ECPTX=40\*.00175  
ROYTYP=PROD=  
CANROY=MAN  
CANRYX=.76 .90 38\*1.0  
@ NO INCENTIVE OIL AT .6364 OF NEW  
@ 1300 M3 HOILDAY VOL PER WELL  
WIPC=40\*1.0  
ROY=40\*0.084015  
ORRPC=40\*0  
FRHPC=.5601  
MINRYX=.76 .90 38\*1.0  
NOILPC=40\*1  
PVOPPC=.12  
@ PRODUCTION RATES AND RESERVES  
PRDTIM=DAY  
OILWEL=35 16\*36 32 28 24 21 18 15 12 9 6 3 13\*0  
OIL=75.80 68.81 62.47 56.71 51.48 46.73 42.42 38.51 34.96 31.74  
28.81 26.15 23.74 21.55 19.57 17.76 16.12 14.64 13.29 12.06 10.95  
9.94 9.02 8.19 7.44 6.75 6.13 13\*0  
@ S. PIERSON WELLHEAD PRICE  
OPRTAJ=40\*9.0  
OPRQAJ=40\*13.0  
@ OPERATING COSTS  
OEDWM=40\*1300  
@ FIXED- \$1300/WELL/MON - PROD.  
CEDPU=40\*10  
@ VARIABLE- \$10/M3 OIL

*Production  
Quanti-  
ties*

*Cap. to Taxes*  
*discount*

@ CAPITAL COSTS  
TANGA=120 80 38\*0  
DVCST=600 400 38\*0  
CEXPOS=770.7  
@ DRILL AND COMPLETE \$240/WELL  
@ DRILL 3 WELLS IN 1993  
@ DRILL 2 WELLS IN 1994  
POSFAC=.6 .7 .8 .9  
POSMTH=PSCC  
\$END

*Quality & Timings*  
*perforability*

*7*

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING  
 1/3 CROWN, 2/3 FREEHOLD  
 PRIMARY PROD WITHIN UNIT AREA  
 PAGE 01

\*\*\*\*\* PRODUCT ROYALTY AND RESERVE SUMMARY \*\*\*\*\*  
 (OIL)

| DATE<br>BEGIN | GROSS PROD. |        | WORKING ROYALTY |       | CROWN ** |         | INDIAN  |         | FREEHOLD |         | NPI AND/OR |         | NET   |        |
|---------------|-------------|--------|-----------------|-------|----------|---------|---------|---------|----------|---------|------------|---------|-------|--------|
|               | PROD.       | PROD.  | PROD.           | PROD. | ROYALTY  | ROYALTY | ROYALTY | ROYALTY | ROYALTY  | ROYALTY | ROYALTY    | ROYALTY | PROD. | PROD.  |
|               | m3          | m3     | m3              | m3    | m3       | %       | m3      | %       | m3       | %       | m3         | %       | m3    | m3     |
| 1993          | 18445       | 18445  | 0               | 853   | 4.6      | 0       | 0       | 0       | 1550     | 8.4     | 0          | 0       | 0     | 16042  |
| 1994          | 25116       | 25116  | 0               | 1232  | 4.9      | 0       | 0       | 0       | 2110     | 8.4     | 0          | 0       | 0     | 21774  |
| 1995          | 22802       | 22802  | 0               | 1116  | 4.9      | 0       | 0       | 0       | 1916     | 8.4     | 0          | 0       | 0     | 19769  |
| 1996          | 20699       | 20699  | 0               | 906   | 4.4      | 0       | 0       | 0       | 1739     | 8.4     | 0          | 0       | 0     | 18055  |
| 1997          | 18790       | 18790  | 0               | 746   | 4.0      | 0       | 0       | 0       | 1579     | 8.4     | 0          | 0       | 0     | 16465  |
| 1998          | 17056       | 17056  | 0               | 615   | 3.6      | 0       | 0       | 0       | 1433     | 8.4     | 0          | 0       | 0     | 15009  |
| 1999          | 15483       | 15483  | 0               | 507   | 3.3      | 0       | 0       | 0       | 1301     | 8.4     | 0          | 0       | 0     | 13676  |
| 2000          | 14056       | 14056  | 0               | 418   | 3.0      | 0       | 0       | 0       | 1181     | 8.4     | 0          | 0       | 0     | 12458  |
| 2001          | 12760       | 12760  | 0               | 344   | 2.7      | 0       | 0       | 0       | 1072     | 8.4     | 0          | 0       | 0     | 11344  |
| 2002          | 11585       | 11585  | 0               | 284   | 2.4      | 0       | 0       | 0       | 973      | 8.4     | 0          | 0       | 0     | 10328  |
| 2003          | 10516       | 10516  | 0               | 234   | 2.2      | 0       | 0       | 0       | 883      | 8.4     | 0          | 0       | 0     | 9398   |
| 2004          | 9545        | 9545   | 0               | 193   | 2.0      | 0       | 0       | 0       | 802      | 8.4     | 0          | 0       | 0     | 8550   |
| 2005          | 8665        | 8665   | 0               | 159   | 1.8      | 0       | 0       | 0       | 728      | 8.4     | 0          | 0       | 0     | 7778   |
| 2006          | 7866        | 7866   | 0               | 131   | 1.7      | 0       | 0       | 0       | 661      | 8.4     | 0          | 0       | 0     | 7074   |
| 2007          | 7143        | 7143   | 0               | 108   | 1.5      | 0       | 0       | 0       | 600      | 8.4     | 0          | 0       | 0     | 6435   |
| 2008          | 6482        | 6482   | 0               | 89    | 1.4      | 0       | 0       | 0       | 545      | 8.4     | 0          | 0       | 0     | 5849   |
| 2009          | 5884        | 5884   | 0               | 73    | 1.2      | 0       | 0       | 0       | 494      | 8.4     | 0          | 0       | 0     | 5316   |
| 2010          | 5344        | 5344   | 0               | 68    | 1.3      | 0       | 0       | 0       | 449      | 8.4     | 0          | 0       | 0     | 4827   |
| 2011          | 4851        | 4851   | 0               | 64    | 1.3      | 0       | 0       | 0       | 408      | 8.4     | 0          | 0       | 0     | 4379   |
| 2012          | 4402        | 4402   | 0               | 61    | 1.4      | 0       | 0       | 0       | 370      | 8.4     | 0          | 0       | 0     | 3971   |
| SUBT.         | 247490      | 247490 | 0               | 8199  | 3.3      | 0       | 0       | 0       | 20793    | 8.4     | 0          | 0       | 0     | 218498 |
| REM.          | 21323       | 21323  | 0               | 494   | 2.3      | 0       | 0       | 0       | 1791     | 8.4     | 0          | 0       | 0     | 19038  |
| TOTAL         | 268813      | 268813 | 0               | 8693  | 3.2      | 0       | 0       | 0       | 22584    | 8.4     | 0          | 0       | 0     | 237536 |



PAGE 02

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING

## \*\*\*\*\* SUMMARY OF GOVERNMENT TAKE \*\*\*\*\*

| DATE  | REVENUE<br>BEFORE<br>DEDUCT. | CROWN<br>ROYALTY<br>BF. PEP | ALBERTA<br>PEP<br>ALLOW. | CROWN<br>ROYALTY<br>AF. PEP | MINERAL<br>TAXES | INCOME<br>TAXES | TOTAL<br>GOVERNMENT<br>BURDEN | REVENUE<br>AFTER<br>DEDUCT. |
|-------|------------------------------|-----------------------------|--------------------------|-----------------------------|------------------|-----------------|-------------------------------|-----------------------------|
| BEGIN | E3 \$                        | E3 \$                       | E3 \$                    | E3 \$                       | E3 \$            | E3 \$           | E3 \$ %                       | E3 \$                       |
| 1993  | 2328                         | 108                         | 0                        | 108                         | 65               | 465             | 638 27.4                      | 1690                        |
| 1994  | 3357                         | 165                         | 0                        | 165                         | 82               | 656             | 902 26.9                      | 2454                        |
| 1995  | 3125                         | 153                         | 0                        | 153                         | 65               | 619             | 837 26.8                      | 2288                        |
| 1996  | 3053                         | 134                         | 0                        | 134                         | 46               | 626             | 805 26.4                      | 2248                        |
| 1997  | 2966                         | 118                         | 0                        | 118                         | 29               | 619             | 766 25.8                      | 2200                        |
| 1998  | 2864                         | 103                         | 0                        | 103                         | 14               | 602             | 719 25.1                      | 2145                        |
| 1999  | 2703                         | 88                          | 0                        | 88                          | 0                | 560             | 649 24.0                      | 2054                        |
| 2000  | 2566                         | 76                          | 0                        | 76                          | 0                | 523             | 600 23.4                      | 1967                        |
| 2001  | 2432                         | 66                          | 0                        | 66                          | 0                | 485             | 551 22.6                      | 1881                        |
| 2002  | 2300                         | 56                          | 0                        | 56                          | 0                | 446             | 502 21.8                      | 1798                        |
| 2003  | 2175                         | 48                          | 0                        | 48                          | 0                | 407             | 455 20.9                      | 1720                        |
| 2004  | 2034                         | 41                          | 0                        | 41                          | 0                | 362             | 403 19.8                      | 1631                        |
| 2005  | 1903                         | 35                          | 0                        | 35                          | 0                | 319             | 354 18.6                      | 1549                        |
| 2006  | 1780                         | 30                          | 0                        | 30                          | 0                | 279             | 308 17.3                      | 1472                        |
| 2007  | 1666                         | 25                          | 0                        | 25                          | 0                | 240             | 265 15.9                      | 1401                        |
| 2008  | 1558                         | 21                          | 0                        | 21                          | 0                | 203             | 225 14.4                      | 1333                        |
| 2009  | 1457                         | 18                          | 0                        | 18                          | 0                | 168             | 186 12.8                      | 1271                        |
| 2010  | 1364                         | 17                          | 0                        | 17                          | 0                | 166             | 183 13.4                      | 1181                        |
| 2011  | 1276                         | 17                          | 0                        | 17                          | 0                | 166             | 183 14.3                      | 1093                        |
| 2012  | 1193                         | 17                          | 0                        | 17                          | 0                | 169             | 185 15.5                      | 1008                        |
| SUBT. | 44099                        | 1336                        | 0                        | 1336                        | 300              | 8080            | 9715 .0                       | 34384                       |
| REM.  | 6453                         | 154                         | 0                        | 154                         | 24               | 1242            | 1419 .0                       | 5034                        |
| TOTAL | 50552                        | 1489                        | 0                        | 1489                        | 323              | 9322            | 11135 22.0                    | 39418                       |

\*\*\*\*\* BEFORE INCOME TAX \*\*\*\*\*

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\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING

| DATE<br>BEGIN | TOTAL<br>PROD.<br>WELLS | GROSS<br>DAILY<br>OIL<br>m3 | GROSS<br>OIL<br>m3 | WORK-<br>INTRST<br>OIL<br>m3 | NET<br>OIL<br>m3 | OIL<br>SELLING<br>PRICE<br>\$/m3 |
|---------------|-------------------------|-----------------------------|--------------------|------------------------------|------------------|----------------------------------|
| 1993          | 35                      | 76                          | 18445              | 18445                        | 16042            | 126.20                           |
| 1994          | 36                      | 69                          | 25116              | 25116                        | 21774            | 133.65 3                         |
| 1995          | 36                      | 62                          | 22802              | 22802                        | 19769            | 137.06 7                         |
| 1996          | 36                      | 57                          | 20699              | 20699                        | 18055            | 147.48 7                         |
| 1997          | 36                      | 51                          | 18790              | 18790                        | 16465            | 157.87 6                         |
| 1998          | 36                      | 47                          | 17056              | 17056                        | 15009            | 167.91 4                         |
| 1999          | 36                      | 42                          | 15483              | 15483                        | 13676            | 174.57 5                         |
| 2000          | 36                      | 39                          | 14056              | 14056                        | 12458            | 182.57 4                         |
| 2001          | 36                      | 35                          | 12760              | 12760                        | 11344            | 190.57 4                         |
| 2002          | 36                      | 32                          | 11585              | 11585                        | 10328            | 198.56 4                         |
| 2003          | 36                      | 29                          | 10516              | 10516                        | 9398             | 206.79 4                         |
| 2004          | 36                      | 26                          | 9545               | 9545                         | 8550             | 213.11                           |
| 2005          | 36                      | 24                          | 8665               | 8665                         | 7778             | 219.61                           |
| 2006          | 36                      | 22                          | 7866               | 7866                         | 7074             | 226.31                           |
| 2007          | 36                      | 20                          | 7143               | 7143                         | 6435             | 233.22                           |
| 2008          | 36                      | 18                          | 6482               | 6482                         | 5849             | 240.34                           |
| 2009          | 36                      | 16                          | 5884               | 5884                         | 5316             | 247.67                           |
| 2010          | 32                      | 15                          | 5344               | 5344                         | 4827             | 255.22                           |
| 2011          | 28                      | 13                          | 4851               | 4851                         | 4379             | 263.00 3                         |
| 2012          | 24                      | 12                          | 4402               | 4402                         | 3971             | 271.02                           |
| SUBT.         | 24                      | 35                          | 247489             | 247489                       | 218498           | 178.76                           |
| REM.          | -21                     | 8                           | 21323              | 21323                        | 19038            | 302.41                           |
| TOTAL         | 3                       | 28                          | 268813             | 268813                       | 237536           | 188.67                           |

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\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING

| DATE<br>BEGIN | NET<br>REVENUE<br>BEFORE<br>ROYLTY<br>E3 \$ | NET<br>CROWN<br>ROYLTY<br>E3 \$ | FRHOLD<br>AND<br>ORR<br>ROYLTY<br>E3 \$ | NET<br>REVENUE<br>AFTER<br>ROYLTY<br>E3 \$ | OTHER<br>INCOME<br>E3 \$ | NET<br>OPER.<br>EXPENSE<br>E3 \$ | NET<br>G+A<br>OPER.<br>EXPENSE<br>E3 \$ | NET<br>MINRAL<br>TAX<br>E3 \$ | OTHER<br>EXPENSE<br>E3 \$ | NET<br>OPER.<br>INCOME<br>E3 \$ | ** CAPITAL INVESTMENTS ** |                |               | NET<br>CASH<br>FLOW<br>E3 \$ | CUM<br>CASH<br>FLOW<br>E3 \$ | DISC.<br>CASH<br>FLOW<br>E3 \$ |
|---------------|---|---------------------------------|---|--|--------------------------|----------------------------------|---|-------------------------------|---------------------------|---------------------------------|---------------------------|----------------|---------------|------------------------------|------------------------------|--------------------------------|
|               |   |                                 |   |  |                          |                                  |   |                               |                           |                                 | ***<br>DE<br>E3 \$        | PLANT<br>E3 \$ | TANG<br>E3 \$ | TOTAL<br>E3 \$               |                              |                                |
| 1993          | 2328  | 108                             | 196                                     | 2024                                       | 0                        | 548                              | 0                                       | 65                            | 0                         | 1411                            | 600                       | 0              | 120           | 720                          | 691                          | 639                            |
| 1994          | 3357  | 165                             | 282                                     | 2910                                       | 0                        | 829                              | 0                                       | 82                            | 0                         | 2000                            | 416                       | 0              | 83            | 499                          | 1500                         | 1314                           |
| 1995          | 3125  | 153                             | 263                                     | 2710                                       | 0                        | 822                              | 0                                       | 65                            | 0                         | 1824                            | 0                         | 0              | 0             | 0                            | 1824                         | 1426                           |
| 1996          | 3053  | 134                             | 256                                     | 2663                                       | 0                        | 816                              | 0                                       | 46                            | 0                         | 1801                            | 0                         | 0              | 0             | 0                            | 1801                         | 1258                           |
| 1997          | 2966  | 118                             | 249                                     | 2599                                       | 0                        | 811                              | 0                                       | 29                            | 0                         | 1759                            | 0                         | 0              | 0             | 0                            | 1759                         | 1097                           |
| 1998          | 2864  | 103                             | 241                                     | 2520                                       | 0                        | 808                              | 0                                       | 14                            | 0                         | 1698                            | 0                         | 0              | 0             | 0                            | 1698                         | 945                            |
| 1999          | 2703  | 88                              | 227                                     | 2387                                       | 0                        | 807                              | 0                                       | 0                             | 0                         | 1581                            | 0                         | 0              | 0             | 0                            | 1581                         | 786                            |
| 2000          | 2566  | 76                              | 216                                     | 2274                                       | 0                        | 807                              | 0                                       | 0                             | 0                         | 1468                            | 0                         | 0              | 0             | 0                            | 1468                         | 652                            |
| 2001          | 2432  | 66                              | 204                                     | 2162                                       | 0                        | 808                              | 0                                       | 0                             | 0                         | 1354                            | 0                         | 0              | 0             | 0                            | 1354                         | 537                            |
| 2002          | 2300  | 56                              | 193                                     | 2051                                       | 0                        | 810                              | 0                                       | 0                             | 0                         | 1241                            | 0                         | 0              | 0             | 0                            | 1241                         | 439                            |
| 2003          | 2175  | 48                              | 183                                     | 1944                                       | 0                        | 813                              | 0                                       | 0                             | 0                         | 1131                            | 0                         | 0              | 0             | 0                            | 1131                         | 357                            |
| 2004          | 2034  | 41                              | 171                                     | 1822                                       | 0                        | 817                              | 0                                       | 0                             | 0                         | 1005                            | 0                         | 0              | 0             | 0                            | 1005                         | 284                            |
| 2005          | 1903  | 35                              | 160                                     | 1708                                       | 0                        | 822                              | 0                                       | 0                             | 0                         | 886                             | 0                         | 0              | 0             | 0                            | 886                          | 223                            |
| 2006          | 1780  | 30                              | 150                                     | 1601                                       | 0                        | 828                              | 0                                       | 0                             | 0                         | 773                             | 0                         | 0              | 0             | 0                            | 773                          | 174                            |
| 2007          | 1666  | 25                              | 140                                     | 1501                                       | 0                        | 835                              | 0                                       | 0                             | 0                         | 666                             | 0                         | 0              | 0             | 0                            | 666                          | 134                            |
| 2008          | 1558  | 21                              | 131                                     | 1406                                       | 0                        | 843                              | 0                                       | 0                             | 0                         | 563                             | 0                         | 0              | 0             | 0                            | 563                          | 101                            |
| 2009          | 1457  | 18                              | 122                                     | 1317                                       | 0                        | 852                              | 0                                       | 0                             | 0                         | 465                             | 0                         | 0              | 0             | 0                            | 465                          | 74                             |
| 2010          | 1364  | 17                              | 115                                     | 1232                                       | 0                        | 774                              | 0                                       | 0                             | 0                         | 458                             | 0                         | 0              | 0             | 0                            | 458                          | 65                             |
| 2011          | 1276  | 17                              | 107                                     | 1152                                       | 0                        | 693                              | 0                                       | 0                             | 0                         | 459                             | 0                         | 0              | 0             | 0                            | 459                          | 59                             |
| 2012          | 1193  | 17                              | 100                                     | 1076                                       | 0                        | 610                              | 0                                       | 0                             | 0                         | 467                             | 0                         | 0              | 0             | 0                            | 467                          | 53                             |
| SUBT.         | 44099                                       | 1336                            | 3705                                    | 39059                                      | 0                        | 15751                            | 0                                       | 300                           | 0                         | 23007                           | 1016                      | 0              | 203           | 1219                         | 21788                        | 10618                          |
| REM.          | 6453  | 154                             | 542                                     | 5757                                       | 0                        | 2361                             | 0                                       | 24                            | 0                         | 3372                            | 0                         | 0              | 0             | 0                            | 3372                         | 248                            |
| TOTAL         | 50552                                       | 1489                            | 4247                                    | 44816                                      | 0                        | 18112                            | 0                                       | 323                           | 0                         | 26380                           | 1016                      | 0              | 203           | 1219                         | 25161                        | 10866                          |

\*\*\*\*\* AFTER INCOME TAX \*\*\*\*\*  
(NET)

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\*\* S. PIERSON MANITOBA \*\*  
LOWER AMARANTH PRIMARY ECONOMICS  
80 ACRE SPACING

| DATE  | TOTAL FIELD | GATHER  | PROD. | NET   | G+A   | FIELD  | FIELD | FIELD | DEPRECIATION | GATHERING | SYSTEM | DEPR   | TOTAL | INCOME | ALLOWD |
|-------|-------------|---------|-------|-------|-------|--------|-------|-------|--------------|-----------|--------|--------|-------|--------|--------|
| BEGIN | REVENUE     | REVENUE | ROVLT | OPR.  | OPR.  | PROCES | NET   | BAL.  | DEDUCT       | CAPITL    | BAL.   | DEDUCT | DEPR. | FOR    | RESOR. |
| E3 \$ | E3 \$       | E3 \$   | E3 \$ | E3 \$ | E3 \$ | E3 \$  | E3 \$ | E3 \$ | E3 \$        | E3 \$     | E3 \$  | E3 \$  | E3 \$ | E3 \$  | E3 \$  |
| 1993  | 2328        | 0       | 196   | 548   | 0     | 0      | 120   | 120   | 15           | 0         | 0      | 0      | 15    | 1569   | 392    |
| 1994  | 3357        | 0       | 282   | 829   | 0     | 0      | 83    | 188   | 37           | 0         | 0      | 0      | 37    | 2209   | 552    |
| 1995  | 3125        | 0       | 263   | 822   | 0     | 0      | 0     | 152   | 38           | 0         | 0      | 0      | 38    | 2003   | 501    |
| 1996  | 3053        | 0       | 256   | 816   | 0     | 0      | 0     | 114   | 28           | 0         | 0      | 0      | 28    | 1952   | 488    |
| 1997  | 2966        | 0       | 249   | 811   | 0     | 0      | 0     | 85    | 21           | 0         | 0      | 0      | 21    | 1885   | 471    |
| 1998  | 2864        | 0       | 241   | 808   | 0     | 0      | 0     | 64    | 16           | 0         | 0      | 0      | 16    | 1799   | 450    |
| 1999  | 2703        | 0       | 227   | 807   | 0     | 0      | 0     | 48    | 12           | 0         | 0      | 0      | 12    | 1657   | 414    |
| 2000  | 2566        | 0       | 216   | 807   | 0     | 0      | 0     | 36    | 9            | 0         | 0      | 0      | 9     | 1535   | 384    |
| 2001  | 2432        | 0       | 204   | 808   | 0     | 0      | 0     | 27    | 7            | 0         | 0      | 0      | 7     | 1413   | 353    |
| 2002  | 2300        | 0       | 193   | 810   | 0     | 0      | 0     | 20    | 5            | 0         | 0      | 0      | 5     | 1292   | 323    |
| 2003  | 2175        | 0       | 183   | 813   | 0     | 0      | 0     | 15    | 4            | 0         | 0      | 0      | 4     | 1175   | 294    |
| 2004  | 2034        | 0       | 171   | 817   | 0     | 0      | 0     | 11    | 3            | 0         | 0      | 0      | 3     | 1043   | 261    |
| 2005  | 1903        | 0       | 160   | 822   | 0     | 0      | 0     | 9     | 2            | 0         | 0      | 0      | 2     | 919    | 230    |
| 2006  | 1780        | 0       | 150   | 828   | 0     | 0      | 0     | 6     | 2            | 0         | 0      | 0      | 2     | 801    | 200    |
| 2007  | 1666        | 0       | 140   | 835   | 0     | 0      | 0     | 5     | 1            | 0         | 0      | 0      | 1     | 689    | 172    |
| 2008  | 1558        | 0       | 131   | 843   | 0     | 0      | 0     | 4     | 1            | 0         | 0      | 0      | 1     | 583    | 146    |
| 2009  | 1457        | 0       | 122   | 852   | 0     | 0      | 0     | 3     | 1            | 0         | 0      | 0      | 1     | 482    | 121    |
| 2010  | 1364        | 0       | 115   | 774   | 0     | 0      | 0     | 2     | 1            | 0         | 0      | 0      | 1     | 475    | 119    |
| 2011  | 1276        | 0       | 107   | 693   | 0     | 0      | 0     | 2     | 0            | 0         | 0      | 0      | 0     | 475    | 119    |
| 2012  | 1193        | 0       | 100   | 610   | 0     | 0      | 0     | 1     | 0            | 0         | 0      | 0      | 0     | 483    | 121    |
| SUBT. | 44099       | 0       | 3705  | 15751 | 0     | 0      | 203   | 1     | 202          | 0         | 0      | 0      | 202   | 24440  | 6110   |
| REM.  | 6453        | 0       | 542   | 2361  | 0     | 0      | 0     | -1    | 1            | 0         | -1     | 0      | 1     | 3549   | 887    |
| TOTAL | 50552       | 0       | 4247  | 18112 | 0     | 0      | 203   | 0     | 203          | 0         | 0      | 0      | 203   | 27990  | 6997   |

| DATE<br>BEGIN | DEVELOP |  | EXPLOR |  | EXPLOR COST |  | NET RESOR. |  | NET PROFIT |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX |  | FEDRAL TAX | 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PAGE 06

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING

## SUMMARY

## INTERESTS \*

|              |           |             |
|--------------|-----------|-------------|
| INTL ROYALTY | INT (PCT) | = 13.02770  |
| AVG. ROYALTY | INT (PCT) | = 11.34791  |
| INTL WORKING | INT (PCT) | = 100.00000 |
| INTL CAPITAL | INT (PCT) | = 100.00000 |

## RESERVES + PROJECT LIFE \*

LIFE (YRS) = 26.67  
PROJECT START MONTH = MAY

| 000000        | OIL<br>( E3 m3) | SOLN GAS<br>( E3 m3) | RESIDUE<br>( E3 m3) | ETHANE<br>( E3 m3) | COND.<br>( E3 m3) | PROPANE<br>( E3 m3) | BUTANE<br>( E3 m3) | SULPHUR<br>( E3 TNE) |
|---------------|-----------------|----------------------|---------------------|--------------------|-------------------|---------------------|--------------------|----------------------|
| GROSS REM RES | 268.8           | .0                   | .0                  | .0                 | .0                | .0                  | .0                 | .0                   |
| WI REM RES    | 268.8           | .0                   | .0                  | .0                 | .0                | .0                  | .0                 | .0                   |
| NET REM RES   | 237.5           | .0                   | .0                  | .0                 | .0                | .0                  | .0                 | .0                   |
| CUM HIST PROD | .0              | .0                   | .0                  | .0                 | .0                | .0                  | .0                 | .0                   |
| ULTIMATE RES  | 268.8           | .0                   | .0                  | .0                 | .0                | .0                  | .0                 | .0                   |

## NET PRESENT VALUE \*

## NET PROFIT INDICATORS \*

| DISC.<br>RATE | *** BEFORE INCOME TAX *** |                 | *** AFTER INCOME TAX *** |                 | RATE OF RETURN (PCT) | INFINITE |
|---------------|---------------------------|-----------------|--------------------------|-----------------|----------------------|----------|
|               | OP. INC<br>(E3 \$)        | INV.<br>(E3 \$) | OP. INC<br>(E3 \$)       | INV.<br>(E3 \$) |                      |          |
| .00           | 26380.0                   | 1219.2          | 17058.2                  | 1219.2          | 15839.0              | 409.40   |
| 8.00          | 14756.0                   | 1176.3          | 9614.8                   | 1176.3          | 8438.5               | .51      |
| 10.00         | 13249.9                   | 1166.7          | 8646.5                   | 1166.7          | 7479.8               | .53      |
| 12.00         | 12023.3                   | 1157.4          | 7856.9                   | 1157.4          | 6699.5               | .00      |
| 15.00         | 10563.7                   | 1144.1          | 6915.9                   | 1144.1          | 5771.8               | 12.99    |
| 20.00         | 8806.5                    | 1123.5          | 5780.8                   | 1123.5          | 4657.2               | 5.79     |
| 22.00         | 12023.3                   | 1157.4          | 7856.9                   | 1157.4          | 6699.5               | 5.49     |
|               |                           |                 |                          |                 |                      | 417.72   |
|               |                           |                 |                          |                 |                      | 770.70   |
|               |                           |                 |                          |                 |                      | 32.65    |
|               |                           |                 |                          |                 |                      | 14.10    |
|               |                           |                 |                          |                 |                      | 15.10    |
|               |                           |                 |                          |                 |                      | 3.24     |
|               |                           |                 |                          |                 |                      | 5.13     |
|               |                           |                 |                          |                 |                      | 237.54   |
|               |                           |                 |                          |                 |                      | 237.54   |

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING  
 1/3 CROWN, 2/3 FREEHOLD  
 PRIMARY PROD WITHIN UNIT AREA

## RISK ANALYSIS

## RISK ADJUSTED CASH FLOW

NET CAPITAL  
 EXPOSURE  
 (E3 \$)

770.7

| CASE | PROBABILITY<br>OF<br>SUCCESS<br>PCT | BIT<br>12%<br>PV<br>PROFIT<br>E3 \$ | BIT<br>PAYOUT<br>VRS | BIT<br>ROR<br>PCT | BIT<br>PVI | BIT<br>UNDIS<br>INV |
|------|-------------------------------------|-------------------------------------|----------------------|-------------------|------------|---------------------|
| 1    | .0                                  | -770.7                              | .00                  | .0                | .00        | -1.00               |
| 2    | 60.0                                | 6211.3                              | .58                  | 334.0             | 7.19       | 14.22               |
| 3    | 70.0                                | 7374.9                              | .49                  | 458.6             | 8.08       | 16.02               |
| 4    | 80.0                                | 8538.6                              | .43                  | 500.0             | 8.91       | 17.68               |
| 5    | 90.0                                | 9702.2                              | .38                  | 500.0             | 9.67       | 19.22               |
| 6    | 60.0                                | 6211.3                              | .58                  | 334.0             | 7.19       | 14.22               |
| 7    | 70.0                                | 7374.9                              | .49                  | 458.6             | 8.08       | 16.02               |
| 8    | 80.0                                | 8538.6                              | .43                  | 500.0             | 8.91       | 17.68               |
| 9    | 100.0                               | 10865.9                             | .34                  | 500.0             | 10.39      | 20.64               |

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING  
 1/3 CROWN, 2/3 FREEHOLD  
 PRIMARY PROD WITHIN UNIT AREA

RISK ANALYSIS

RISK ADJUSTED CASH FLOW

NET CAPITAL  
 EXPOSURE  
 (E3 \$)  
 -----

417.7

| CASE | PROBABILITY<br>OF<br>SUCCESS<br>PCT | AIT<br>12%<br>PV<br>PROFIT<br>E3 \$ | AIT<br>PAYOUT<br>VRS | AIT<br>ROR<br>PCT | AIT<br>PVI | AIT<br>UNDIS CF/<br>UNDIS INV |
|------|-------------------------------------|-------------------------------------|----------------------|-------------------|------------|-------------------------------|
| 1    | .0                                  | -417.7                              | .00                  | .0                | .00        | -1.00                         |
| 2    | 60.0                                | 3852.6                              | .73                  | 220.0             | 5.47       | 10.39                         |
| 3    | 70.0                                | 4564.3                              | .64                  | 265.7             | 5.88       | 11.20                         |
| 4    | 80.0                                | 5276.0                              | .59                  | 312.7             | 6.23       | 11.89                         |
| 5    | 90.0                                | 5987.8                              | .54                  | 360.8             | 6.53       | 12.48                         |
| 6    | 60.0                                | 3852.6                              | .73                  | 220.0             | 5.47       | 10.39                         |
| 7    | 70.0                                | 4564.3                              | .64                  | 265.7             | 5.88       | 11.20                         |
| 8    | 80.0                                | 5276.0                              | .59                  | 312.7             | 6.23       | 11.89                         |
| 9    | 100.0                               | 6699.5                              | .51                  | 409.4             | 6.79       | 12.99                         |



FILE 3839

RUN TIME 22-JUN-1993

10:34 GARRETT POGO V .

# **Attachment B**

## **Pogo Run - Go-forward Waterflood**

POGO is owned and supported by GARRETT COMPUTING CANADA  
The country default for this version is CNTRY=CAN  
Input units default to INPUT=IMP  
Output units default to OUTUNT=IMP  
Version 811.4 September 30, 1992

FILE 3842 CASE 1 RUN TIME 22-JUN-1993 10:34

\$LIST  
\*\* S. PIERSON MANITOBA \*\*  
LOWER AMARANTH WATERFLOOD ECONOMICS  
40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)  
1/3 CROWN, 2/3 FREEHOLD  
WATERFLOOD PROD WITHIN UNIT AREA  
\$DATA  
CASE =3842  
@MAN SI BASE GENERAL DEFAULTS AS AT APRIL 27, 1993  
CNTRY=CAN IEVVR=1993 WIDTH=WIDE MXPER=50 PRINT=20  
REPORT = ANNL PROV  
PVMT=MIDP PVPC=0,.08,.10,.12,.15,.20  
WRTMX=YES DVMX=YES EXMX=YES DPRMX=YES  
FTXPC=50\*.28 FCPTX=NO SURTPC=.03  
@ INFLATION RATES  
OPINF=0 49\*.02 CPINF=0 .04 .03 47\*.02  
OPRTIF=0 49\*.02  
OPRFIF=0 .057 .025 .073 .067 .061 .038 .044 .043 .041 .04 39\*.03  
@ ZEROING OUT JUMPING POUND CALCULATIONS  
JPOQPC=6\*0 JPPQPC=0 JPLQPC=0 JPDQPC=0 JPCQPC=0  
@ PROVINCIAL  
CANROY=MAN PTXPC=50\*.17  
@ HOME OIL APRIL 27, 1993 PRICE FORECAST  
@ METRIC UNITS BASE PRICE FORECAST  
@ IF YOU HAVE ANY QUESTIONS PLEASE CONTACT CORPORATE PLANNING  
INPUT = SI  
OUTUNT = SI  
@ NOTE OIL PRICES ARE EDMONTON REFERENCE 40 API  
PROIL=148.20 156.57 160.51 172.14 183.74 194.96 202.46 211.45  
220.45 229.45 40\*238.70  
PRCND=148.20 156.57 160.51 172.14 183.74 194.96 202.46 211.45  
220.45 229.45 40\*238.70  
PRBUT=89.99 98.60 107.49 118.83 132.25 144.19 151.86 160.87  
167.85 174.82 40\*181.99  
PRPRO=84.95 86.08 87.43 89.55 97.35 107.17 113.39 120.65 125.88  
131.12 40\*136.49  
PRETH=46.69 52.64 50.40 53.16 53.88 54.58 55.88 59.47 61.61  
64.45 40\*67.35  
PRUL=0 7.50 10 12.50 15 20 25 30 35 40 40\*50  
@ GAS PRICES ARE BY GAS BUYER  
PRINF=11\*0 39\*.03 @ PRICE INFLATION RATES  
@ APRIL 27, 1993 FORECAST  
@ CORPORATE AVERAGE METRIC BASE  
PRRES = .05515 .06749 .07437 .07977 .07995 .08003 .08157  
.08886 .09242 .09770 40\*.10308  
PRSLN = .05515 .06749 .07437 .07977 .07995 .08003 .08157  
.08886 .09242 .09770 40\*.10308  
REPORT=DECL,ANNL,PROV,GOVT  
OUTUNT=SI  
MXPER=40  
IEVVR=1993 IEVMO=05  
CNTRY=CAN  
FDTX=CAN  
FTXPC=40\*.288  
PTXPC=40\*.17

FCPTX=40\*.00175  
 ROYTVP=PROD  
 CANROY=MAN  
 CANRYX=.04 .70 38\*1.00  
 @ NO INCENTIVE OIL AT .6364 OF NEW  
 @ 1300 M3 HOILDAY VOL PER WELL  
 WIPC=40\*1.0  
 ROY=40\*.084015  
 ORRPC=40\*0  
 FRHPC=.5601  
 MINRYX=.04 .70 38\*1.00  
 NOILPC=40\*1  
 PVOPPC=.12  
 @ PRODUCTION RATES AND RESERVES  
 PRDTIM=DAY  
 OILWEL=47 29\*38 35 30 25 20 15 10 7 5 2\*3  
 @ 47 PROD / 12 INJ IN 1993  
 @ 38 PROD / 38 INJ IN 1994  
 @ NOTE INJ/PROD RATIO MAY NOT BE 1 TO 1 WITHIN WATEFLOOD AREA  
 @ DUE TO MORE INJECTORS AT PERIPHERY.  
 OIL=154.63 138.22 135.35 133.65 131.98 130.32 128.69 127.07 125.48  
 123.91 122.35 120.82 119.30 117.81 105.24 94.02 83.99 75.04 67.04  
 59.89 53.50 47.80 42.70 38.15 34.08 30.44 27.20 24.30 21.71 19.39  
 17.32 15.48 13.83 12.35 11.03 9.86 8.81 7.87 7.03 6.28  
 @ S. PIERSON WELLHEAD PRICE  
 OPRTAJ=40\*9.0  
 OPRQAJ=40\*13.0  
 @ OPERATING COSTS  
 OEDWM=1338 39\*1450  
 @ FIXED- \$1300/WELL/MON - PROD.  
 @ FIXED- \$150/WELL/MON - INJ  
 @ THEREFORE AVERAGE CHANGES  
 OEMD=40\*30  
 OEDPU=40\*10  
 @ CAPITAL COSTS  
 TANGA=1750 1410 38\*0  
 DVCST=5250 4230 38\*0  
 CEXPOS=8076.5  
 @ DRILL AND COMPLETE \$240/WELL  
 @ SEE PIERSON CAPITAL SUMMARY SHEET  
 @ DRILL 27 WELLS IN 1993, 16 WELLS IN 1994  
 @ TANG/INTANG FOR WTRFLD PROJECT = .75/.25  
 POSFAC=.7 .8 .9  
 POSMTH=PSCC  
 \$END

@ MANITOBA ROYALTY  
 @ ROYALTY HOLIDAY PRODUCED.  
 @ HOC/SRO W.I.=100%  
 @ FREEHOLD ROY @ 15% (OF .5601)  
 @ NO OVERRIDING ROY.  
 @ FREEHOLD PERCENT = 56.01%

@ OPERATING COSTS  
 @ FIXED - \$30,000/YR WTR INJ PLANT  
 @ VARIABLE- \$10/M3 OIL  
 @ DRILL-5M\$, COMP-20M\$ AL&EQUIP-20M\$  
 @ DRILL-150M\$, COMP-50M\$ TIE-IN-40M\$

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH WATERFLOOD ECONOMICS  
 40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)  
 1/3 CROWN, 2/3 FREEHOLD  
 WATERFLOOD PROD WITHIN UNIT AREA  
 PAGE 01

\*\*\*\*\* PRODUCT ROYALTY AND RESERVE SUMMARY \*\*\*\*\*  
 (OIL)

| DATE<br>BEGIN | WORKING ROYALTY    |                            | CROWN **      |       | INDIAN        |   | FREEHOLD      |       | NPI AND/OR    |   | NET          |        |
|---------------|--------------------|----------------------------|---------------|-------|---------------|---|---------------|-------|---------------|---|--------------|--------|
|               | GROSS<br>PRODN. m3 | INTERST<br>PRODN. RECD. m3 | ROYALTY<br>m3 | %     | ROYALTY<br>m3 | % | ROYALTY<br>m3 | %     | ROYALTY<br>m3 | % | PRODN.<br>m3 | %      |
| 1993          | 37627              | 37627                      | 0             | 116   | 0             | 0 | 0             | 3161  | 8.4           | 0 | 0            | 34349  |
| 1994          | 50450              | 50450                      | 0             | 2836  | 0             | 0 | 0             | 4239  | 8.4           | 0 | 0            | 43376  |
| 1995          | 49403              | 49403                      | 0             | 3937  | 0             | 0 | 0             | 4151  | 8.4           | 0 | 0            | 41315  |
| 1996          | 48782              | 48782                      | 0             | 3869  | 0             | 0 | 0             | 4098  | 8.4           | 0 | 0            | 40815  |
| 1997          | 48173              | 48173                      | 0             | 3803  | 0             | 0 | 0             | 4047  | 8.4           | 0 | 0            | 40323  |
| 1998          | 47567              | 47567                      | 0             | 3737  | 0             | 0 | 0             | 3996  | 8.4           | 0 | 0            | 39834  |
| 1999          | 46972              | 46972                      | 0             | 3672  | 0             | 0 | 0             | 3946  | 8.4           | 0 | 0            | 39353  |
| 2000          | 46381              | 46381                      | 0             | 3608  | 0             | 0 | 0             | 3897  | 8.4           | 0 | 0            | 38876  |
| 2001          | 45800              | 45800                      | 0             | 3545  | 0             | 0 | 0             | 3848  | 8.4           | 0 | 0            | 38408  |
| 2002          | 45227              | 45227                      | 0             | 3482  | 0             | 0 | 0             | 3800  | 8.4           | 0 | 0            | 37945  |
| 2003          | 44658              | 44658                      | 0             | 3420  | 0             | 0 | 0             | 3752  | 8.4           | 0 | 0            | 37486  |
| 2004          | 44099              | 44099                      | 0             | 3359  | 0             | 0 | 0             | 3705  | 8.4           | 0 | 0            | 37035  |
| 2005          | 43545              | 43545                      | 0             | 3299  | 0             | 0 | 0             | 3658  | 8.4           | 0 | 0            | 36587  |
| 2006          | 43001              | 43001                      | 0             | 3240  | 0             | 0 | 0             | 3613  | 8.4           | 0 | 0            | 36148  |
| 2007          | 38413              | 38413                      | 0             | 2740  | 0             | 0 | 0             | 3227  | 8.4           | 0 | 0            | 32445  |
| 2008          | 34317              | 34317                      | 0             | 2294  | 0             | 0 | 0             | 2883  | 8.4           | 0 | 0            | 29140  |
| 2009          | 30656              | 30656                      | 0             | 1896  | 0             | 0 | 0             | 2576  | 8.4           | 0 | 0            | 26185  |
| 2010          | 27390              | 27390                      | 0             | 1540  | 0             | 0 | 0             | 2301  | 8.4           | 0 | 0            | 23548  |
| 2011          | 24470              | 24470                      | 0             | 1222  | 0             | 0 | 0             | 2056  | 8.4           | 0 | 0            | 21192  |
| 2012          | 21860              | 21860                      | 0             | 957   | 0             | 0 | 0             | 1837  | 8.4           | 0 | 0            | 19067  |
| SUBT.         | 818789             | 818789                     | 0             | 56572 | 0             | 0 | 0             | 68791 | 8.4           | 0 | 0            | 693427 |
| REM.          | 163932             | 163932                     | 0             | 4428  | 0             | 0 | 0             | 13773 | 8.4           | 0 | 0            | 145732 |
| TOTAL         | 982721             | 982721                     | 0             | 61000 | 0             | 0 | 0             | 82563 | 8.4           | 0 | 0            | 839158 |

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\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH WATERFLOOD ECONOMICS  
 40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)

## \*\*\*\*\* SUMMARY OF GOVERNMENT TAKE \*\*\*\*\*

| DATE BEGIN | REVENUE BEFORE DEDUCT. E3 \$ | CROWN ROYALTY BF. E3 \$ | ALBERTA PEP ALLOW. E3 \$ | CROWN ROYALTY AF. PEP E3 \$ | MINERAL TAXES E3 \$ | INCOME TAXES E3 \$ | TOTAL GOVERNMENT BURDEN E3 \$ | %    | REVENUE AFTER DEDUCT. E3 \$ |
|------------|------------------------------|-------------------------|--------------------------|-----------------------------|---------------------|--------------------|-------------------------------|------|-----------------------------|
| 1993       | 4748                         | 15                      | 0                        | 15                          | 11                  | 392                | 418                           | 8.8  | 4330                        |
| 1994       | 6743                         | 379                     | 0                        | 379                         | 295                 | 406                | 1080                          | 16.0 | 5663                        |
| 1995       | 6771                         | 540                     | 0                        | 540                         | 418                 | 735                | 1692                          | 25.0 | 5079                        |
| 1996       | 7194                         | 571                     | 0                        | 571                         | 440                 | 1155               | 2166                          | 30.1 | 5028                        |
| 1997       | 7605                         | 600                     | 0                        | 600                         | 461                 | 1486               | 2548                          | 33.5 | 5057                        |
| 1998       | 7987                         | 627                     | 0                        | 627                         | 481                 | 1748               | 2857                          | 35.8 | 5131                        |
| 1999       | 8200                         | 641                     | 0                        | 641                         | 489                 | 1914               | 3044                          | 37.1 | 5156                        |
| 2000       | 8468                         | 659                     | 0                        | 659                         | 501                 | 2067               | 3226                          | 38.1 | 5242                        |
| 2001       | 8728                         | 675                     | 0                        | 675                         | 512                 | 2196               | 3383                          | 38.8 | 5345                        |
| 2002       | 8980                         | 691                     | 0                        | 691                         | 522                 | 2307               | 3520                          | 39.2 | 5460                        |
| 2003       | 9235                         | 707                     | 0                        | 707                         | 531                 | 2408               | 3647                          | 39.5 | 5588                        |
| 2004       | 9398                         | 716                     | 0                        | 716                         | 536                 | 2472               | 3724                          | 39.6 | 5674                        |
| 2005       | 9563                         | 724                     | 0                        | 724                         | 540                 | 2531               | 3796                          | 39.7 | 5767                        |
| 2006       | 9732                         | 733                     | 0                        | 733                         | 544                 | 2588               | 3865                          | 39.7 | 5867                        |
| 2007       | 8959                         | 639                     | 0                        | 639                         | 453                 | 2358               | 3450                          | 38.5 | 5509                        |
| 2008       | 8248                         | 551                     | 0                        | 551                         | 368                 | 2144               | 3063                          | 37.1 | 5184                        |
| 2009       | 7593                         | 470                     | 0                        | 470                         | 288                 | 1945               | 2703                          | 35.6 | 4890                        |
| 2010       | 6990                         | 393                     | 0                        | 393                         | 205                 | 1761               | 2359                          | 33.7 | 4631                        |
| 2011       | 6436                         | 321                     | 0                        | 321                         | 140                 | 1591               | 2052                          | 31.9 | 4384                        |
| 2012       | 5924                         | 259                     | 0                        | 259                         | 89                  | 1432               | 1780                          | 30.0 | 4145                        |
| SUBT.      | 157501                       | 10913                   | 0                        | 10913                       | 7822                | 35637              | 54372                         | .0   | 103129                      |
| REM.       | 55548                        | 1492                    | 0                        | 1492                        | 180                 | 10914              | 12586                         | .0   | 42962                       |
| TOTAL      | 213049                       | 12404                   | 0                        | 12404                       | 8002                | 46551              | 66958                         | 31.4 | 146091                      |

\*\*\*\*\* BEFORE INCOME TAX \*\*\*\*\*

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\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH WATERFLOOD ECONOMICS  
 40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)

| DATE<br>BEGIN | TOTAL<br>PROD.<br>WELLS | GROSS<br>DAILY<br>OIL<br>m3 | GROSS<br>OIL<br>m3 | WORK.<br>INTRST<br>OIL<br>m3 | NET<br>OIL<br>m3 | OIL<br>SELLING<br>PRICE<br>\$/m3 |
|---------------|-------------------------|-----------------------------|--------------------|------------------------------|------------------|----------------------------------|
| 1993          | 47                      | 155                         | 37627              | 37627                        | 34349            | 126.20                           |
| 1994          | 38                      | 138                         | 50450              | 50450                        | 43376            | 133.65                           |
| 1995          | 38                      | 135                         | 49403              | 49403                        | 41315            | 137.06                           |
| 1996          | 38                      | 134                         | 48782              | 48782                        | 40815            | 147.48                           |
| 1997          | 38                      | 132                         | 48173              | 48173                        | 40323            | 157.87                           |
| 1998          | 38                      | 130                         | 47567              | 47567                        | 39834            | 167.91                           |
| 1999          | 38                      | 129                         | 46972              | 46972                        | 39353            | 174.57                           |
| 2000          | 38                      | 127                         | 46381              | 46381                        | 38876            | 182.57                           |
| 2001          | 38                      | 125                         | 45800              | 45800                        | 38408            | 190.57                           |
| 2002          | 38                      | 124                         | 45227              | 45227                        | 37945            | 198.56                           |
| 2003          | 38                      | 122                         | 44658              | 44658                        | 37486            | 206.79                           |
| 2004          | 38                      | 121                         | 44099              | 44099                        | 37035            | 213.11                           |
| 2005          | 38                      | 119                         | 43545              | 43545                        | 36587            | 219.61                           |
| 2006          | 38                      | 118                         | 43001              | 43001                        | 36148            | 226.31                           |
| 2007          | 38                      | 105                         | 38413              | 38413                        | 32445            | 233.22                           |
| 2008          | 38                      | 94                          | 34317              | 34317                        | 29140            | 240.34                           |
| 2009          | 38                      | 84                          | 30656              | 30656                        | 26185            | 247.67                           |
| 2010          | 38                      | 75                          | 27390              | 27390                        | 23548            | 255.22                           |
| 2011          | 38                      | 67                          | 24470              | 24470                        | 21192            | 263.00                           |
| 2012          | 38                      | 60                          | 21860              | 21860                        | 19067            | 271.02                           |
| SUBT.         | 38                      | 115                         | 818789             | 818789                       | 693427           | 192.31                           |
| REM.          | -35                     | 22                          | 163932             | 163932                       | 145732           | 338.90                           |
| TOTAL         | 3                       | 69                          | 982721             | 982721                       | 839158           | 217.77                           |

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\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH WATERFLOOD ECONOMICS  
 40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)

| DATE<br>BEGIN | NET<br>REVENUE<br>BEFORE<br>ROYLTY<br>E3 \$ | NET<br>CROWN<br>ROYLTY<br>E3 \$ | FRHOLD<br>AND<br>ORR<br>ROYLTY<br>E3 \$ | NET<br>REVENUE<br>AFTER<br>ROYLTY<br>E3 \$ | OTHER<br>INCOME<br>E3 \$ | NET<br>OPER.<br>EXPENSE<br>E3 \$ | NET<br>OPER.<br>INCOME<br>E3 \$ | *** CAPITAL INVESTMENTS ***<br>D+E<br>E3 \$ | PLANT<br>E3 \$ | TANG<br>E3 \$ | NET<br>CASH<br>FLOW<br>E3 \$ | CUM<br>CASH<br>FLOW<br>E3 \$ | DISC.<br>CASH<br>FLOW<br>E3 \$ |
|---------------|---|---------------------------------|---|--|--------------------------|----------------------------------|---------------------------------|---|----------------|---------------|------------------------------|------------------------------|--------------------------------|
| 1993          | 4748  | 15                              | 399                                     | 4335                                       | 0                        | 909                              | 0                               | 3414  | 0              | 1750          | -3586                        | -3586                        | -3712                          |
| 1994          | 6743  | 379                             | 566                                     | 5797                                       | 0                        | 1220                             | 0                               | 4283  | 0              | 1466          | -1583                        | -5169                        | -1387                          |
| 1995          | 6771  | 540                             | 569                                     | 5663                                       | 0                        | 1233                             | 0                               | 4012  | 0              | 0             | 4012                         | -1156                        | 3139                           |
| 1996          | 7194  | 571                             | 604                                     | 6019                                       | 0                        | 1251                             | 0                               | 4328  | 0              | 0             | 4328                         | 3171                         | 3023                           |
| 1997          | 7605  | 600                             | 639                                     | 6366                                       | 0                        | 1270                             | 0                               | 4635  | 0              | 0             | 4635                         | 7806                         | 2890                           |
| 1998          | 7987  | 627                             | 671                                     | 6689                                       | 0                        | 1288                             | 0                               | 4920  | 0              | 0             | 4920                         | 12726                        | 2739                           |
| 1999          | 8200  | 641                             | 689                                     | 6870                                       | 0                        | 1307                             | 0                               | 5073  | 0              | 0             | 5073                         | 17799                        | 2522                           |
| 2000          | 8468  | 659                             | 711                                     | 7098                                       | 0                        | 1327                             | 0                               | 5270  | 0              | 0             | 5270                         | 23069                        | 2339                           |
| 2001          | 8728  | 675                             | 733                                     | 7319                                       | 0                        | 1346                             | 0                               | 5461  | 0              | 0             | 5461                         | 28530                        | 2164                           |
| 2002          | 8980  | 691                             | 754                                     | 7535                                       | 0                        | 1367                             | 0                               | 5646  | 0              | 0             | 5646                         | 34177                        | 1998                           |
| 2003          | 9235  | 707                             | 776                                     | 7752                                       | 0                        | 1387                             | 0                               | 5833  | 0              | 0             | 5833                         | 40010                        | 1843                           |
| 2004          | 9398  | 716                             | 790                                     | 7892                                       | 0                        | 1408                             | 0                               | 5949  | 0              | 0             | 5949                         | 45959                        | 1678                           |
| 2005          | 9563  | 724                             | 803                                     | 8035                                       | 0                        | 1429                             | 0                               | 6066  | 0              | 0             | 6066                         | 52025                        | 1528                           |
| 2006          | 9732  | 733                             | 818                                     | 8181                                       | 0                        | 1450                             | 0                               | 6187  | 0              | 0             | 6187                         | 58212                        | 1391                           |
| 2007          | 8959  | 639                             | 753                                     | 7567                                       | 0                        | 1419                             | 0                               | 5695  | 0              | 0             | 5695                         | 63907                        | 1144                           |
| 2008          | 8248  | 551                             | 693                                     | 7003                                       | 0                        | 1392                             | 0                               | 5243  | 0              | 0             | 5243                         | 69150                        | 940                            |
| 2009          | 7593  | 470                             | 638                                     | 6485                                       | 0                        | 1370                             | 0                               | 4827  | 0              | 0             | 4827                         | 73978                        | 773                            |
| 2010          | 6990  | 393                             | 587                                     | 6010                                       | 0                        | 1351                             | 0                               | 4454  | 0              | 0             | 4454                         | 78432                        | 637                            |
| 2011          | 6436  | 321                             | 541                                     | 5573                                       | 0                        | 1337                             | 0                               | 4097  | 0              | 0             | 4097                         | 82529                        | 523                            |
| 2012          | 5924  | 259                             | 498                                     | 5167                                       | 0                        | 1325                             | 0                               | 3753  | 0              | 0             | 3753                         | 86282                        | 428                            |
| SUBT.         | 157501                                      | 10913                           | 13232                                   | 133356                                     | 0                        | 26386                            | 0                               | 99148                                       | 9649           | 0             | 86282                        | 86282                        | 26600                          |
| REM.          | 55548                                       | 1492                            | 4667                                    | 49389                                      | 0                        | 19670                            | 0                               | 29538                                       | 0              | 0             | 29538                        | 29538                        | 1696                           |
| TOTAL         | 213049                                      | 12404                           | 17899                                   | 182745                                     | 0                        | 46057                            | 0                               | 128686                                      | 9649           | 0             | 115821                       | 115821                       | 28296                          |





| DATE  | DEVELOP<br>COST<br>BAL. | DEVELOP<br>WRITE<br>-OFF | EXPLOR<br>COST<br>BAL. | EXPLOR<br>WRITE<br>-OFF | NET<br>PROFIT | NET<br>PROFIT | FEDERAL<br>INCOME | FEDERAL<br>TAX | TAXBLE<br>CROWN RESOR. | NON-<br>DEDUCT | PROV.<br>TAXBLE<br>INCOME | PROV.<br>INCOME | PROCES<br>PROFIT | INVEST<br>-MENT | INCOME<br>TAX | CASH<br>FLOW | DISC.<br>CASH<br>FLOW |
|-------|-------------------------|--------------------------|------------------------|-------------------------|---------------|---------------|-------------------|----------------|------------------------|----------------|---------------------------|-----------------|------------------|-----------------|---------------|--------------|-----------------------|
| BEGIN | E3 \$                   | E3 \$                    | E3 \$                  | E3 \$                   | E3 \$         | E3 \$         | E3 \$             | E3 \$          | E3 \$                  | E3 \$          | E3 \$                     | E3 \$           | E3 \$            | E3 \$           | E3 \$         | E3 \$        | E3 \$                 |
| 1993  | 5250                    | 1575                     | 0                      | 0                       | 841           | 841           | 249               | 0              | 0                      | 0              | 841                       | 143             | 0                | 0               | 392           | -3978        | -4090                 |
| 1994  | 8074                    | 2422                     | 0                      | 0                       | 871           | 871           | 258               | 0              | 0                      | 0              | 871                       | 148             | 0                | 0               | 406           | -1989        | -1743                 |
| 1995  | 5652                    | 1696                     | 0                      | 0                       | 1575          | 1575          | 467               | 0              | 0                      | 0              | 1575                      | 268             | 0                | 0               | 735           | 3277         | 2563                  |
| 1996  | 3956                    | 1187                     | 0                      | 0                       | 2475          | 2475          | 734               | 0              | 0                      | 0              | 2475                      | 421             | 0                | 0               | 1155          | 3173         | 2216                  |
| 1997  | 2769                    | 831                      | 0                      | 0                       | 3185          | 3185          | 945               | 0              | 0                      | 0              | 3185                      | 541             | 0                | 0               | 1486          | 3148         | 1963                  |
| 1998  | 1939                    | 582                      | 0                      | 0                       | 3747          | 3747          | 1111              | 0              | 0                      | 0              | 3747                      | 637             | 0                | 0               | 1748          | 3171         | 1766                  |
| 1999  | 1357                    | 407                      | 0                      | 0                       | 4101          | 4101          | 1217              | 0              | 0                      | 0              | 4101                      | 697             | 0                | 0               | 1914          | 3159         | 1571                  |
| 2000  | 950                     | 285                      | 0                      | 0                       | 4429          | 4429          | 1314              | 0              | 0                      | 0              | 4429                      | 753             | 0                | 0               | 2067          | 3203         | 1422                  |
| 2001  | 665                     | 199                      | 0                      | 0                       | 4706          | 4706          | 1396              | 0              | 0                      | 0              | 4706                      | 800             | 0                | 0               | 2196          | 3265         | 1294                  |
| 2002  | 465                     | 140                      | 0                      | 0                       | 4944          | 4944          | 1467              | 0              | 0                      | 0              | 4944                      | 840             | 0                | 0               | 2307          | 3339         | 1182                  |
| 2003  | 326                     | 98                       | 0                      | 0                       | 5161          | 5161          | 1531              | 0              | 0                      | 0              | 5161                      | 877             | 0                | 0               | 2408          | 3425         | 1082                  |
| 2004  | 228                     | 68                       | 0                      | 0                       | 5298          | 5298          | 1572              | 0              | 0                      | 0              | 5298                      | 901             | 0                | 0               | 2472          | 3477         | 981                   |
| 2005  | 160                     | 48                       | 0                      | 0                       | 5424          | 5424          | 1609              | 0              | 0                      | 0              | 5424                      | 922             | 0                | 0               | 2531          | 3535         | 890                   |
| 2006  | 112                     | 34                       | 0                      | 0                       | 5545          | 5545          | 1645              | 0              | 0                      | 0              | 5545                      | 943             | 0                | 0               | 2588          | 3599         | 809                   |
| 2007  | 78                      | 23                       | 0                      | 0                       | 5052          | 5052          | 1499              | 0              | 0                      | 0              | 5052                      | 859             | 0                | 0               | 2358          | 3337         | 670                   |
| 2008  | 55                      | 16                       | 0                      | 0                       | 4595          | 4595          | 1363              | 0              | 0                      | 0              | 4595                      | 781             | 0                | 0               | 2144          | 3099         | 556                   |
| 2009  | 38                      | 11                       | 0                      | 0                       | 4169          | 4169          | 1237              | 0              | 0                      | 0              | 4169                      | 709             | 0                | 0               | 1945          | 2882         | 461                   |
| 2010  | 27                      | 8                        | 0                      | 0                       | 3775          | 3775          | 1120              | 0              | 0                      | 0              | 3775                      | 642             | 0                | 0               | 1761          | 2693         | 385                   |
| 2011  | 19                      | 6                        | 0                      | 0                       | 3408          | 3408          | 1011              | 0              | 0                      | 0              | 3408                      | 579             | 0                | 0               | 1591          | 2507         | 320                   |
| 2012  | 13                      | 4                        | 0                      | 0                       | 3069          | 3069          | 910               | 0              | 0                      | 0              | 3069                      | 522             | 0                | 0               | 1432          | 2321         | 264                   |
| SUBT. | 13                      | 9640                     | 0                      | 0                       | 76370         | 76370         | 22654             | 0              | 0                      | 0              | 76370                     | 12983           | 0                | 0               | 35637         | 50645        | 14563                 |
| REM.  | -13                     | 9                        | 0                      | 0                       | 23388         | 23388         | 6938              | 0              | 0                      | 0              | 23388                     | 3976            | 0                | 0               | 10914         | 18625        | 1070                  |
| TOTAL | 0                       | 9649                     | 0                      | 0                       | 99758         | 99758         | 29592             | 0              | 0                      | 0              | 99758                     | 16959           | 0                | 0               | 46551         | 69269        | 15633                 |

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\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH WATERFLOOD ECONOMICS  
 40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)

## \*\*\*\*\* SUMMARY \*\*\*\*\*

## INTERESTS \*

INTL ROYALTY INT (PCT) = 8.71061  
 AVG. ROYALTY INT (PCT) = 14.22384  
 INTL WORKING INT (PCT) = 100.00000  
 INTL CAPITAL INT (PCT) = 100.00000

## RESERVES + PROJECT LIFE \*

LIFE (YRS) = 39.67  
 PROJECT START MONTH = MAY

|               | OIL<br>(E3 m3) | SOLN GAS<br>(E3 m3) | RESIDUE<br>(E3 m3) | ETHANE<br>(E3 m3) | COND.<br>(E3 m3) | PROPANE<br>(E3 m3) | BUTANE<br>(E3 m3) | SULPHUR<br>(E3 TNE) |
|---------------|----------------|---------------------|--------------------|-------------------|------------------|--------------------|-------------------|---------------------|
| GROSS REM RES | 982.7          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| WT REM RES    | 982.7          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| NET REM RES   | 839.2          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| CUM HIST PROD | .0             | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| ULTIMATE RES  | 982.7          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |

## NET PRESENT VALUE \*

## NET PROFIT INDICATORS \*

## \* BIT \* \* AIT \*

| DISC. RATE | *** BEFORE INCOME TAX ***<br>OP. INC (E3 \$) | INV. (E3 \$) | *** AFTER INCOME TAX ***<br>OP. INC (E3 \$) | INV. (E3 \$) | C FLOW (E3 \$) | *** AFTER INCOME TAX ***<br>C FLOW (E3 \$) | NET PROFIT INDICATORS *  | * BIT * | * AIT * |
|------------|--|--------------|---|--------------|----------------|--|--------------------------|---------|---------|
| .00        | 128686.1                                     | 12865.6      | 82134.9                                     | 12865.6      | 69269.3        | 69269.3                                    | RATE OF RETURN (PCT)     | 54.27   | 38.84   |
| 8.00       | 54506.1                                      | 12361.9      | 36474.0                                     | 12361.9      | 24112.1        | 24112.1                                    | PAYOUT (YRS)             | 2.93    | 3.51    |
| 10.00      | 46564.7                                      | 12248.3      | 31569.9                                     | 12248.3      | 19321.6        | 19321.6                                    | DISCOUNTED PAYOUT (YRS)  | 3.32    | 4.20    |
| 12.00      | 40434.9                                      | 12139.2      | 27772.5                                     | 12139.2      | 15633.3        | 15633.3                                    | PRESENT WORTH INDEX      | 6.55    | 3.68    |
| 15.00      | 33568.9                                      | 11983.1      | 23497.4                                     | 11983.1      | 11514.3        | 11514.3                                    | UNDIS C FLOW/UNDIS INV   | 9.00    | 5.38    |
| 20.00      | 25981.6                                      | 11741.7      | 18724.9                                     | 11741.7      | 6983.2         | 6983.2                                     | DIS C FLOW/DIS INV       | 2.33    | 1.29    |
| 12.00      | 40434.9                                      | 12139.2      | 27772.5                                     | 12139.2      | 15633.3        | 15633.3                                    | DIS C FLOW/UNDIS INV     | 2.20    | 1.22    |
|            |  |              |   |              |                |  | CAPITAL EXPOSURE (E3 \$) | 8076.50 | 4377.46 |
|            |  |              |   |              |                |  | UNDIS C FLOW/CAP EXPOS   | 14.34   | 15.82   |
|            |  |              |   |              |                |  | DIS C FLOW/CAP EXPOS     | 3.50    | 3.57    |
|            |  |              |   |              |                |  | SUCCESS CAPACITY         | 4.50    | 4.57    |
|            |  |              |   |              |                |  | FINDING COST (\$/m3)     | 9.62    | 5.22    |
|            |  |              |   |              |                |  | FIND+DEV COST (\$/m3)    | 15.33   | 8.31    |
|            |  |              |   |              |                |  | OIL                      | 839.16  | 839.16  |

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH WATERFLOOD ECONOMICS  
 40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)  
 1/3 CROWN, 2/3 FREEHOLD  
 WATERFLOOD PROD WITHIN UNIT AREA

RISK ANALYSIS  
 RISK ADJUSTED CASH FLOW

NET CAPITAL  
 EXPOSURE  
 (E3 \$)  
 -----

8076.5

| CASE | PROBABILITY<br>OF<br>SUCCESS<br>PCT | BIT<br>12%<br>PV<br>PROFIT<br>E3 \$ | BIT<br>PAYOUT<br>VRS | BIT<br>ROR<br>PCT | BIT<br>PVI | BIT<br>UNDIS CF/<br>UNDIS INV |
|------|-------------------------------------|-------------------------------------|----------------------|-------------------|------------|-------------------------------|
| 1    | .0                                  | -8076.5                             | .00                  | .0                | .00        | -1.00                         |
| 2    | 70.0                                | 17384.1                             | 3.73                 | 37.7              | 2.59       | 6.88                          |
| 3    | 80.0                                | 21021.3                             | 3.40                 | 43.0              | 2.86       | 7.65                          |
| 4    | 90.0                                | 24658.5                             | 3.14                 | 48.5              | 3.10       | 8.35                          |
| 5    | 50.0                                | 10109.6                             | 4.72                 | 27.3              | 2.00       | 5.14                          |
| 6    | 60.0                                | 13746.8                             | 4.14                 | 32.5              | 2.31       | 6.05                          |
| 7    | 70.0                                | 17384.1                             | 3.73                 | 37.7              | 2.59       | 6.88                          |
| 8    | 80.0                                | 21021.3                             | 3.40                 | 43.0              | 2.86       | 7.65                          |
| 9    | 100.0                               | 28295.7                             | 2.93                 | 54.3              | 3.33       | 9.00                          |

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH WATERFLOOD ECONOMICS  
 40 ACRE SPACING - FIVE SPOT (WATERFLOOD FORECAST)  
 1/3 CROWN, 2/3 FREEHOLD  
 WATERFLOOD PROD WITHIN UNIT AREA

## RISK ANALYSIS

## RISK ADJUSTED CASH FLOW

NET CAPITAL  
 EXPOSURE  
 (E3 \$)

4377.5

| CASE | PROBABILITY<br>OF<br>SUCCESS<br>PCT | AIT<br>12%<br>PV<br>PROFIT<br>E3 \$ | AIT<br>PAYOUT<br>YRS | AIT<br>ROR<br>PCT | AIT<br>PVI | AIT<br>UNDIS CF/<br>UNDIS INV |
|------|-------------------------------------|-------------------------------------|----------------------|-------------------|------------|-------------------------------|
| 1    | .0                                  | -4377.5                             | .00                  | .0                | .00        | -1.00                         |
| 2    | 70.0                                | 9630.1                              | 4.11                 | 31.0              | 1.98       | 4.57                          |
| 3    | 80.0                                | 11631.2                             | 3.86                 | 33.8              | 2.10       | 4.88                          |
| 4    | 90.0                                | 13632.3                             | 3.67                 | 36.4              | 2.20       | 5.15                          |
| 5    | 50.0                                | 5627.9                              | 4.90                 | 24.4              | 1.68       | 3.76                          |
| 6    | 60.0                                | 7629.0                              | 4.44                 | 27.9              | 1.84       | 4.20                          |
| 7    | 70.0                                | 9630.1                              | 4.11                 | 31.0              | 1.98       | 4.57                          |
| 8    | 80.0                                | 11631.2                             | 3.86                 | 33.8              | 2.10       | 4.88                          |
| 9    | 100.0                               | 15633.3                             | 3.51                 | 38.8              | 2.29       | 5.38                          |

FILE 3842

RUN TIME 22-JUN-1993

10:34 GARRETT POGO V .

# **Attachment C**

## **Pogo Run - Incremental Waterflood**

POGO is owned and supported by GARRETT COMPUTING CANADA  
The country default for this version is CNTRY=CAN  
Input units default to INPUT=IMP  
Output units default to OUTUNT=IMP  
Version 811.4 September 30, 1992

FILE 3845 CASE 1 RUN TIME 22-JUN-1993 10:34

\$LIST  
\$DATA

CASE =3845  
@MAN SI BASE GENERAL DEFAULTS AS AT APRIL 27, 1993  
CNTRY=CAN IEVVR=1993 WIDTH=WIDE MXPER=50 PRINT=20  
REPORT = ANNL PROV  
PVMTH=MIDP PVPC=0.08.10.12.15.20  
WRINX=VES DVMX=YES EXMX=YES DPRMX=YES  
FTXPC=50\*.28 FCPTX=NO SURTPC=.03  
@ INFLATION RATES  
OPINF=0 49\*.02 CPINF=0 .04 .03 47\*.02  
OPRTIF=0 49\*.02  
OPROIF=0 .057 .025 .073 .067 .061 .038 .044 .043 .041 .04 39\*.03  
@ ZEROING OUT JUMPING POUND CALCULATIONS  
JPOQPC=6\*0 JPPQPC=0 JPLQPC=0 JPDQPC=0 JPCQPC=0  
@ PROVINCIAL  
CANROY=MAN PTXPC=50\*.17  
@ HOME OIL APRIL 27, 1993 PRICE FORECAST  
@ METRIC UNITS BASE PRICE FORECAST  
@ IF YOU HAVE ANY QUESTIONS PLEASE CONTACT CORPORATE PLANNING  
INPUT = SI  
OUTUNT = SI  
@ NOTE OIL PRICES ARE EDMONTON REFERENCE 40 API  
PROIL=148.20 156.57 160.51 172.14 183.74 194.96 202.46 211.45  
220.45 229.45 40\*238.70  
PRCND=148.20 156.57 160.51 172.14 183.74 194.96 202.46 211.45  
220.45 229.45 40\*238.70  
PRBUT=89.99 98.60 107.49 118.83 132.25 144.19 151.86 160.87  
167.85 174.82 40\*181.99  
PRPRO=84.95 86.08 87.43 89.55 97.35 107.17 113.39 120.65 125.88  
131.12 40\*136.49  
PRETH=46.69 52.64 50.40 53.16 53.88 54.58 55.88 59.47 61.61  
64.45 40\*67.35  
PRSQL=0 7.50 10 12.50 15 20 25 30 35 40 40\*50  
@ GAS PRICES ARE BY GAS BUYER  
PRINF=11\*0 39\*.03 @ PRICE INFLATION RATES  
@ APRIL 27, 1993 FORECAST  
@ CORPORATE AVERAGE METRIC BASE  
PRRES = .05515 .06749 .07437 .07977 .07995 .08003 .08157  
.08886 .09242 .09770 40\*.10308  
PRSLN = .05515 .06749 .07437 .07977 .07995 .08003 .08157  
.08886 .09242 .09770 40\*.10308  
REPORT=DECL ANNL PROV GOVT  
POSFAC=.6 .7 .8 .9  
POSMTH=PSCC  
PVOPPC=.12

CASENAME =  
3842 @ 3842 | BASE CASE WATERFLOOD WITHIN UNIT GO FORWRD 06/93  
3839 @ 3839 | BASE CASE PRIMARY WITHIN UNIT 06/93  
CASEFAC =  
1.0  
-1.0  
\$END



PAGE 01

\*\*\*\*\* PRODUCT ROYALTY AND RESERVE SUMMARY \*\*\*\*\*  
(OIL)

| DATE<br>BEGIN | GROSS PROD. |        | INTERST. PROD. |       | ROYALTY RECD. |   | ** CROWN ** |   | INDIAN ROYALTY |      | FREEHOLD ROYALTY |   | NPI AND/OR OVERRIDING ROYALTY |   | NET PROD. |    |
|---------------|-------------|--------|----------------|-------|---------------|---|-------------|---|----------------|------|------------------|---|-------------------------------|---|-----------|----|
|               | m3          | m3     | m3             | m3    | m3            | % | m3          | % | m3             | %    | m3               | % | m3                            | % | m3        | m3 |
| 1993          | 19182       | 19182  | -2848          | -737  | -3.8          |   | 0           | 0 | 1372           | 7.2  | 0                | 0 | 18307                         |   |           |    |
| 1994          | 25335       | 25335  | -3709          | 1604  | 6.3           |   | 0           | 0 | 1817           | 7.2  | 0                | 0 | 21602                         |   |           |    |
| 1995          | 26601       | 26601  | -3886          | 2820  | 10.6          |   | 0           | 0 | 1908           | 7.2  | 0                | 0 | 21546                         |   |           |    |
| 1996          | 28083       | 28083  | -4024          | 2964  | 10.6          |   | 0           | 0 | 2021           | 7.2  | 0                | 0 | 22760                         |   |           |    |
| 1997          | 29382       | 29382  | -4137          | 3057  | 10.4          |   | 0           | 0 | 2121           | 7.2  | 0                | 0 | 23857                         |   |           |    |
| 1998          | 30510       | 30510  | -4233          | 3122  | 10.2          |   | 0           | 0 | 2208           | 7.2  | 0                | 0 | 24825                         |   |           |    |
| 1999          | 31489       | 31489  | -4338          | 3165  | 10.1          |   | 0           | 0 | 2281           | 7.2  | 0                | 0 | 25678                         |   |           |    |
| 2000          | 32324       | 32324  | -4415          | 3190  | 9.9           |   | 0           | 0 | 2345           | 7.3  | 0                | 0 | 26419                         |   |           |    |
| 2001          | 33040       | 33040  | -4479          | 3200  | 9.7           |   | 0           | 0 | 2400           | 7.3  | 0                | 0 | 27064                         |   |           |    |
| 2002          | 33642       | 33642  | -4529          | 3198  | 9.5           |   | 0           | 0 | 2446           | 7.3  | 0                | 0 | 27617                         |   |           |    |
| 2003          | 34142       | 34142  | -4564          | 3186  | 9.3           |   | 0           | 0 | 2485           | 7.3  | 0                | 0 | 28087                         |   |           |    |
| 2004          | 34555       | 34555  | -3705          | 3167  | 9.2           |   | 0           | 0 | 2592           | 7.5  | 0                | 0 | 28485                         |   |           |    |
| 2005          | 34879       | 34879  | -2789          | 3140  | 9.0           |   | 0           | 0 | 2696           | 7.7  | 0                | 0 | 28809                         |   |           |    |
| 2006          | 35135       | 35135  | -1823          | 3109  | 8.8           |   | 0           | 0 | 2799           | 8.0  | 0                | 0 | 29074                         |   |           |    |
| 2007          | 31270       | 31270  | -718           | 2632  | 8.4           |   | 0           | 0 | 2567           | 8.2  | 0                | 0 | 26010                         |   |           |    |
| 2008          | 27835       | 27835  | 191            | 2206  | 7.9           |   | 0           | 0 | 2355           | 8.5  | 0                | 0 | 23291                         |   |           |    |
| 2009          | 24773       | 24773  | 931            | 1823  | 7.4           |   | 0           | 0 | 2159           | 8.7  | 0                | 0 | 20869                         |   |           |    |
| 2010          | 22046       | 22046  | 1526           | 1472  | 6.7           |   | 0           | 0 | 1980           | 9.0  | 0                | 0 | 18722                         |   |           |    |
| 2011          | 19619       | 19619  | 1997           | 1158  | 5.9           |   | 0           | 0 | 1816           | 9.3  | 0                | 0 | 16812                         |   |           |    |
| 2012          | 17458       | 17458  | 2364           | 895   | 5.1           |   | 0           | 0 | 1665           | 9.5  | 0                | 0 | 15096                         |   |           |    |
| SUBT.         | 571299      | 571299 | -47186         | 48373 | 8.5           |   | 0           | 0 | 44033          | 7.7  | 0                | 0 | 474929                        |   |           |    |
| REM.          | 142609      | 142609 | 63065          | 3934  | 2.8           |   | 0           | 0 | 17280          | 12.1 | 0                | 0 | 126694                        |   |           |    |
| TOTAL         | 713908      | 713908 | 15879          | 52307 | 7.3           |   | 0           | 0 | 61313          | 8.6  | 0                | 0 | 601623                        |   |           |    |

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## \*\*\*\*\* SUMMARY OF GOVERNMENT TAKE \*\*\*\*\*

| DATE<br>BEGIN | REVENUE<br>BEFORE<br>DEDUCT. E3 \$ | CROWN<br>ROYALTY<br>BF. PEP<br>E3 \$ | ALBERTA<br>PEP<br>ALLOW. E3 \$ | CROWN<br>ROYALTY<br>AF. PEP<br>E3 \$ | MINERAL<br>TAXES<br>E3 \$ | INCOME<br>TAXES<br>E3 \$ | TOTAL<br>GOVERNMENT<br>BURDEN E3 \$ | %    | REVENUE<br>AFTER<br>DEDUCT.<br>E3 \$ |
|---------------|------------------------------------|--------------------------------------|--------------------------------|--------------------------------------|---------------------------|--------------------------|-------------------------------------|------|--------------------------------------|
| 1993          | 2421                               | -93                                  | 0                              | -93                                  | -54                       | -73                      | -219                                | .0   | 2640                                 |
| 1994          | 3386                               | 214                                  | 0                              | 214                                  | 213                       | -250                     | 178                                 | 5.3  | 3208                                 |
| 1995          | 3646                               | 387                                  | 0                              | 387                                  | 353                       | 116                      | 856                                 | 23.5 | 2790                                 |
| 1996          | 4142                               | 437                                  | 0                              | 437                                  | 395                       | 529                      | 1361                                | 32.9 | 2781                                 |
| 1997          | 4639                               | 483                                  | 0                              | 483                                  | 433                       | 867                      | 1782                                | 38.4 | 2857                                 |
| 1998          | 5123                               | 524                                  | 0                              | 524                                  | 466                       | 1147                     | 2138                                | 41.7 | 2986                                 |
| 1999          | 5497                               | 553                                  | 0                              | 553                                  | 489                       | 1354                     | 2395                                | 43.6 | 3101                                 |
| 2000          | 5902                               | 582                                  | 0                              | 582                                  | 501                       | 1543                     | 2627                                | 44.5 | 3275                                 |
| 2001          | 6296                               | 610                                  | 0                              | 610                                  | 512                       | 1711                     | 2832                                | 45.0 | 3464                                 |
| 2002          | 6680                               | 635                                  | 0                              | 635                                  | 522                       | 1862                     | 3018                                | 45.2 | 3662                                 |
| 2003          | 7060                               | 659                                  | 0                              | 659                                  | 531                       | 2002                     | 3192                                | 45.2 | 3868                                 |
| 2004          | 7364                               | 675                                  | 0                              | 675                                  | 536                       | 2110                     | 3321                                | 45.1 | 4043                                 |
| 2005          | 7660                               | 690                                  | 0                              | 690                                  | 540                       | 2212                     | 3441                                | 44.9 | 4218                                 |
| 2006          | 7952                               | 704                                  | 0                              | 704                                  | 544                       | 2309                     | 3556                                | 44.7 | 4395                                 |
| 2007          | 7293                               | 614                                  | 0                              | 614                                  | 453                       | 2117                     | 3184                                | 43.7 | 4108                                 |
| 2008          | 6690                               | 530                                  | 0                              | 530                                  | 368                       | 1941                     | 2839                                | 42.4 | 3851                                 |
| 2009          | 6135                               | 451                                  | 0                              | 451                                  | 288                       | 1777                     | 2517                                | 41.0 | 3619                                 |
| 2010          | 5627                               | 376                                  | 0                              | 376                                  | 205                       | 1596                     | 2176                                | 38.7 | 3451                                 |
| 2011          | 5160                               | 305                                  | 0                              | 305                                  | 140                       | 1425                     | 1869                                | 36.2 | 3291                                 |
| 2012          | 4731                               | 243                                  | 0                              | 243                                  | 89                        | 1263                     | 1594                                | 33.7 | 3137                                 |
| SUBT.         | 113402                             | 9577                                 | 0                              | 9577                                 | 7522                      | 27557                    | 44657                               | .0   | 68745                                |
| REM.          | 49094                              | 1338                                 | 0                              | 1338                                 | 157                       | 9672                     | 11167                               | .0   | 37928                                |
| TOTAL         | 162496                             | 10915                                | 0                              | 10915                                | 7679                      | 37229                    | 55823                               | 34.4 | 106673                               |

\*\*\*\*\* BEFORE INCOME TAX \*\*\*\*\*

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| DATE<br>BEGIN | TOTAL<br>PROD.<br>WELLS | GROSS<br>DAILY<br>OIL<br>m3 | GROSS<br>OIL<br>m3 | WORK.<br>INTRST<br>OIL<br>m3 | NET<br>OIL<br>m3 | OIL<br>SELLING<br>PRICE<br>\$/m3 |
|---------------|-------------------------|-----------------------------|--------------------|------------------------------|------------------|----------------------------------|
| 1993          | 12                      | 79                          | 19182              | 19182                        | 18307            | 148.20                           |
| 1994          | 2                       | 69                          | 25335              | 25335                        | 21602            | 156.57                           |
| 1995          | 2                       | 73                          | 26601              | 26601                        | 21546            | 160.51                           |
| 1996          | 2                       | 77                          | 28083              | 28083                        | 22760            | 172.14                           |
| 1997          | 2                       | 80                          | 29382              | 29382                        | 23857            | 183.74                           |
| 1998          | 2                       | 84                          | 30510              | 30510                        | 24825            | 194.96                           |
| 1999          | 2                       | 86                          | 31489              | 31489                        | 25678            | 202.46                           |
| 2000          | 2                       | 89                          | 32324              | 32324                        | 26419            | 211.45                           |
| 2001          | 2                       | 91                          | 33040              | 33040                        | 27064            | 220.45                           |
| 2002          | 2                       | 92                          | 33642              | 33642                        | 27617            | 229.45                           |
| 2003          | 2                       | 94                          | 34142              | 34142                        | 28087            | 238.70                           |
| 2004          | 2                       | 95                          | 34555              | 34555                        | 28485            | 238.70                           |
| 2005          | 2                       | 96                          | 34879              | 34879                        | 28809            | 238.70                           |
| 2006          | 2                       | 96                          | 35135              | 35135                        | 29074            | 238.70                           |
| 2007          | 2                       | 86                          | 31270              | 31270                        | 26010            | 238.70                           |
| 2008          | 2                       | 76                          | 27835              | 27835                        | 23291            | 238.70                           |
| 2009          | 2                       | 68                          | 24773              | 24773                        | 20869            | 238.70                           |
| 2010          | 6                       | 60                          | 22046              | 22046                        | 18722            | 238.70                           |
| 2011          | 10                      | 54                          | 19619              | 19619                        | 16812            | 238.70                           |
| 2012          | 14                      | 48                          | 17458              | 17458                        | 15096            | 238.70                           |
| SUBT.         | 14                      | 80                          | 571299             | 571299                       | 474929           | 214.64                           |
| REM.          | -11                     | 20                          | 142609             | 142609                       | 126694           | 238.70                           |
| TOTAL         | 3                       | 50                          | 713908             | 713908                       | 601623           | 219.71                           |

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| DATE  | NET<br>BEFORE<br>ROYLTY<br>E3 \$ | NET<br>CROWN<br>ROYLTY<br>E3 \$ | FRHOLD<br>AND<br>ROYLTY<br>E3 \$ | NET<br>REVENUE<br>AFTER<br>ROYLTY<br>E3 \$ | OTHER<br>INCOME<br>E3 \$ | NET<br>OPER.<br>EXPENSE<br>E3 \$ | NET<br>MINRAL<br>TAX<br>E3 \$ | G+A<br>OPER.<br>EXPENSE<br>E3 \$ | OTHER<br>EXPENSE<br>E3 \$ | NET<br>OPER.<br>INCOME<br>E3 \$ | ***<br>D+E<br>E3 \$ | CAPITAL<br>PLANT<br>E3 \$ | INVESTMENTS<br>TANG<br>E3 \$ | ***<br>TOTAL<br>E3 \$ | NET<br>CASH<br>FLOW<br>E3 \$ | CUM<br>CASH<br>FLOW<br>E3 \$ | DISC.<br>CASH<br>FLOW<br>E3 \$ |
|-------|----------------------------------|---------------------------------|----------------------------------|--|--------------------------|----------------------------------|-------------------------------|----------------------------------|---------------------------|---------------------------------|---------------------|---------------------------|------------------------------|-----------------------|------------------------------|------------------------------|--------------------------------|
| 1993  | 2421                             | -93                             | 203                              | 2310                                       | 0                        | 361                              | -54                           | 0                                | 0                         | 2003                            | 4650                | 0                         | 1630                         | 6280                  | -4277                        | -4277                        | -4351                          |
| 1994  | 3386                             | 214                             | 284                              | 2887                                       | 0                        | 391                              | 213                           | 0                                | 0                         | 2283                            | 3983                | 0                         | 1383                         | 5366                  | -3083                        | -7360                        | -2701                          |
| 1995  | 3646                             | 387                             | 306                              | 2953                                       | 0                        | 412                              | 353                           | 0                                | 0                         | 2189                            | 0                   | 0                         | 0                            | 0                     | -2189                        | -5172                        | 1712                           |
| 1996  | 4142                             | 437                             | 348                              | 3357                                       | 0                        | 436                              | 395                           | 0                                | 0                         | 2526                            | 0                   | 0                         | 0                            | 0                     | 2526                         | -2645                        | 1765                           |
| 1997  | 4639                             | 483                             | 390                              | 3766                                       | 0                        | 458                              | 433                           | 0                                | 0                         | 2875                            | 0                   | 0                         | 0                            | 0                     | 2875                         | 230                          | 1793                           |
| 1998  | 5123                             | 524                             | 430                              | 4168                                       | 0                        | 480                              | 466                           | 0                                | 0                         | 3222                            | 0                   | 0                         | 0                            | 0                     | 3222                         | 3453                         | 1794                           |
| 1999  | 5497                             | 553                             | 462                              | 4482                                       | 0                        | 501                              | 489                           | 0                                | 0                         | 3493                            | 0                   | 0                         | 0                            | 0                     | 3493                         | 6945                         | 1736                           |
| 2000  | 5902                             | 582                             | 496                              | 4823                                       | 0                        | 520                              | 501                           | 0                                | 0                         | 3802                            | 0                   | 0                         | 0                            | 0                     | 3802                         | 10747                        | 1688                           |
| 2001  | 6296                             | 610                             | 529                              | 5157                                       | 0                        | 539                              | 512                           | 0                                | 0                         | 4107                            | 0                   | 0                         | 0                            | 0                     | 4107                         | 14854                        | 1628                           |
| 2002  | 6680                             | 635                             | 561                              | 5484                                       | 0                        | 557                              | 522                           | 0                                | 0                         | 4405                            | 0                   | 0                         | 0                            | 0                     | 4405                         | 19259                        | 1559                           |
| 2003  | 7060                             | 659                             | 593                              | 5808                                       | 0                        | 574                              | 531                           | 0                                | 0                         | 4703                            | 0                   | 0                         | 0                            | 0                     | 4703                         | 23962                        | 1486                           |
| 2004  | 7364                             | 675                             | 619                              | 6070                                       | 0                        | 591                              | 536                           | 0                                | 0                         | 4944                            | 0                   | 0                         | 0                            | 0                     | 4944                         | 28906                        | 1395                           |
| 2005  | 7660                             | 690                             | 644                              | 6327                                       | 0                        | 607                              | 540                           | 0                                | 0                         | 5180                            | 0                   | 0                         | 0                            | 0                     | 5180                         | 34086                        | 1305                           |
| 2006  | 7952                             | 704                             | 668                              | 6580                                       | 0                        | 622                              | 544                           | 0                                | 0                         | 5414                            | 0                   | 0                         | 0                            | 0                     | 5414                         | 39500                        | 1217                           |
| 2007  | 7293                             | 614                             | 613                              | 6066                                       | 0                        | 584                              | 453                           | 0                                | 0                         | 5029                            | 0                   | 0                         | 0                            | 0                     | 5029                         | 44529                        | 1010                           |
| 2008  | 6690                             | 530                             | 562                              | 5598                                       | 0                        | 549                              | 368                           | 0                                | 0                         | 4681                            | 0                   | 0                         | 0                            | 0                     | 4681                         | 49210                        | 839                            |
| 2009  | 6135                             | 451                             | 515                              | 5168                                       | 0                        | 518                              | 288                           | 0                                | 0                         | 4363                            | 0                   | 0                         | 0                            | 0                     | 4363                         | 53573                        | 698                            |
| 2010  | 5627                             | 376                             | 473                              | 4778                                       | 0                        | 578                              | 205                           | 0                                | 0                         | 3996                            | 0                   | 0                         | 0                            | 0                     | 3996                         | 57569                        | 571                            |
| 2011  | 5160                             | 305                             | 433                              | 4422                                       | 0                        | 644                              | 140                           | 0                                | 0                         | 3638                            | 0                   | 0                         | 0                            | 0                     | 3638                         | 61207                        | 464                            |
| 2012  | 4731                             | 243                             | 398                              | 4091                                       | 0                        | 716                              | 89                            | 0                                | 0                         | 3287                            | 0                   | 0                         | 0                            | 0                     | 3287                         | 64494                        | 374                            |
| SUBT. | 113402                           | 9577                            | 9527                             | 94297                                      | 0                        | 10635                            | 7522                          | 0                                | 0                         | 76140                           | 8633                | 0                         | 3013                         | 11646                 | 64494                        | 64494                        | 15982                          |
| REM.  | 49094                            | 1338                            | 4125                             | 43632                                      | 0                        | 17309                            | 157                           | 0                                | 0                         | 26166                           | 0                   | 0                         | 0                            | 0                     | 26166                        | 26166                        | 1448                           |
| TOTAL | 162496                           | 10915                           | 13652                            | 137929                                     | 0                        | 27944                            | 7679                          | 0                                | 0                         | 102306                          | 8633                | 0                         | 3013                         | 11646                 | 90660                        | 90660                        | 17430                          |

\*\*\*\*\* AFTER INCOME TAX \*\*\*\*\*  
(NET)

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| DATE  | TOTAL FIELD REVENUE | GATHER SYSTEM REVENUE | PROD. ROYLT DEDUCT | NET OPER. EXPENSE | G+A OPER. EXPENSE | FIELD PROCES FEE | FIELD NET CAPITL | FIELD DEPR. BAL. | DEDUCT BAL. | DEPR. DEDUCT | NET GATHERING SYSTEM | DEPR. BAL. | DEDUCT BAL. | TOTAL DEPR. | INCOME FOR RESOR. ALLOW. | RESOR. ALLOW. | ALLOW. DEDUCT | ALLOW. DEDUCT |
|-------|---------------------|-----------------------|--------------------|-------------------|-------------------|------------------|------------------|------------------|-------------|--------------|----------------------|------------|-------------|-------------|--------------------------|---------------|---------------|---------------|
| BEGIN | E3 \$               | E3 \$                 | E3 \$              | E3 \$             | E3 \$             | E3 \$            | E3 \$            | E3 \$            | E3 \$       | E3 \$        | E3 \$                | E3 \$      | E3 \$       | E3 \$       | E3 \$                    | E3 \$         | E3 \$         | E3 \$         |
| 1993  | 2421                | 0                     | 203                | 361               | 0                 | 0                | 1630             | 1630             | 204         | 0            | 0                    | 0          | 0           | 0           | 204                      | 1653          | 413           | 0             |
| 1994  | 3386                | 0                     | 284                | 391               | 0                 | 0                | 1383             | 2809             | 529         | 0            | 0                    | 0          | 0           | 0           | 529                      | 2181          | 545           | 0             |
| 1995  | 3646                | 0                     | 306                | 412               | 0                 | 0                | 0                | 2280             | 570         | 0            | 0                    | 0          | 0           | 0           | 570                      | 2358          | 590           | 0             |
| 1996  | 4142                | 0                     | 348                | 436               | 0                 | 0                | 0                | 1710             | 427         | 0            | 0                    | 0          | 0           | 0           | 427                      | 2931          | 733           | 0             |
| 1997  | 4639                | 0                     | 390                | 458               | 0                 | 0                | 0                | 1282             | 321         | 0            | 0                    | 0          | 0           | 0           | 321                      | 3470          | 868           | 0             |
| 1998  | 5123                | 0                     | 430                | 480               | 0                 | 0                | 0                | 962              | 240         | 0            | 0                    | 0          | 0           | 0           | 240                      | 3972          | 993           | 0             |
| 1999  | 5497                | 0                     | 462                | 501               | 0                 | 0                | 0                | 721              | 180         | 0            | 0                    | 0          | 0           | 0           | 180                      | 4354          | 1089          | 0             |
| 2000  | 5902                | 0                     | 496                | 520               | 0                 | 0                | 0                | 541              | 135         | 0            | 0                    | 0          | 0           | 0           | 135                      | 4750          | 1188          | 0             |
| 2001  | 6296                | 0                     | 529                | 539               | 0                 | 0                | 0                | 406              | 101         | 0            | 0                    | 0          | 0           | 0           | 101                      | 5127          | 1282          | 0             |
| 2002  | 6680                | 0                     | 561                | 557               | 0                 | 0                | 0                | 304              | 76          | 0            | 0                    | 0          | 0           | 0           | 76                       | 5486          | 1371          | 0             |
| 2003  | 7060                | 0                     | 593                | 574               | 0                 | 0                | 0                | 228              | 57          | 0            | 0                    | 0          | 0           | 0           | 57                       | 5836          | 1459          | 0             |
| 2004  | 7364                | 0                     | 619                | 591               | 0                 | 0                | 0                | 171              | 43          | 0            | 0                    | 0          | 0           | 0           | 43                       | 6112          | 1528          | 0             |
| 2005  | 7660                | 0                     | 644                | 607               | 0                 | 0                | 0                | 128              | 32          | 0            | 0                    | 0          | 0           | 0           | 32                       | 6378          | 1594          | 0             |
| 2006  | 7952                | 0                     | 668                | 622               | 0                 | 0                | 0                | 96               | 24          | 0            | 0                    | 0          | 0           | 0           | 24                       | 6637          | 1659          | 0             |
| 2007  | 7293                | 0                     | 613                | 584               | 0                 | 0                | 0                | 72               | 18          | 0            | 0                    | 0          | 0           | 0           | 18                       | 6078          | 1520          | 0             |
| 2008  | 6690                | 0                     | 562                | 549               | 0                 | 0                | 0                | 54               | 14          | 0            | 0                    | 0          | 0           | 0           | 14                       | 5565          | 1391          | 0             |
| 2009  | 6135                | 0                     | 515                | 518               | 0                 | 0                | 0                | 41               | 10          | 0            | 0                    | 0          | 0           | 0           | 10                       | 5092          | 1273          | 0             |
| 2010  | 5627                | 0                     | 473                | 578               | 0                 | 0                | 0                | 30               | 8           | 0            | 0                    | 0          | 0           | 0           | 8                        | 4569          | 1142          | 0             |
| 2011  | 5160                | 0                     | 433                | 644               | 0                 | 0                | 0                | 23               | 6           | 0            | 0                    | 0          | 0           | 0           | 6                        | 4077          | 1019          | 0             |
| 2012  | 4731                | 0                     | 398                | 716               | 0                 | 0                | 0                | 17               | 4           | 0            | 0                    | 0          | 0           | 0           | 4                        | 3614          | 903           | 0             |
| SUBT. | 113402              | 0                     | 9527               | 10635             | 0                 | 0                | 3013             | 17               | 3000        | 0            | 0                    | 0          | 0           | 0           | 3000                     | 90239         | 22560         | 0             |
| REM.  | 49094               | 0                     | 4125               | 17309             | 0                 | 0                | 0                | -17              | 13          | 0            | -17                  | 0          | 0           | 0           | 13                       | 27648         | 6912          | 0             |
| TOTAL | 162496              | 0                     | 13652              | 27944             | 0                 | 0                | 3013             | 0                | 3013        | 0            | 0                    | 0          | 0           | 0           | 3013                     | 117887        | 29472         | 0             |

| DATE  | DEVELOP   |           | EXPLORE   |                | NET RESOR.   |              | NET PROFIT           |                      | FEDRAL TAX |           | FEDRAL TAX |           | NON-DEDUCT.  |                      | PROV. INCOME |           | PROCES REBATE |           | INVEST -MENT |           | CASH FLOW   |             | DISC.       |  |
|-------|-----------|-----------|-----------|----------------|--------------|--------------|----------------------|----------------------|------------|-----------|------------|-----------|--------------|----------------------|--------------|-----------|---------------|-----------|--------------|-----------|-------------|-------------|-------------|--|
|       | COST BAL. | WRITE OFF | COST BAL. | COST WRITE OFF | PROFIT E3 \$ | PROFIT E3 \$ | TAXABLE INCOME E3 \$ | TAXABLE INCOME E3 \$ | TAX E3 \$  | TAX E3 \$ | TAX E3 \$  | TAX E3 \$ | ALLOW. E3 \$ | TAXABLE INCOME E3 \$ | TAX E3 \$    | TAX E3 \$ | TAX E3 \$     | TAX E3 \$ | TAX E3 \$    | TAX E3 \$ | A.TAX E3 \$ | A.TAX E3 \$ | A.TAX E3 \$ |  |
| BEGIN |           |           |           |                |              |              |                      |                      |            |           |            |           |              |                      |              |           |               |           |              |           |             |             |             |  |
| 1993  | 4650      | 1395      | 0         | 0              | -155         | 0            | -155                 | -46                  | -155       | 0         | -155       | -26       | 0            | 0                    | -155         | -26       | 0             | 0         | -73          | -4204     | -4281       | -4281       | -4281       |  |
| 1994  | 7238      | 2171      | 0         | 0              | -535         | 0            | -535                 | -159                 | -535       | 0         | -535       | -91       | 0            | 0                    | -535         | -91       | 0             | 0         | -250         | -2833     | -2482       | -2482       |             |  |
| 1995  | 5067      | 1520      | 0         | 0              | 249          | 0            | 249                  | 74                   | 249        | 0         | 249        | 42        | 0            | 0                    | 249          | 42        | 0             | 0         | 116          | 2073      | 1621        | 1621        |             |  |
| 1996  | 3547      | 1064      | 0         | 0              | 1134         | 0            | 1134                 | 336                  | 1134       | 0         | 1134       | 193       | 0            | 0                    | 1134         | 193       | 0             | 0         | 529          | 1997      | 1395        | 1395        |             |  |
| 1997  | 2483      | 745       | 0         | 0              | 1858         | 0            | 1858                 | 551                  | 1858       | 0         | 1858       | 316       | 0            | 0                    | 1858         | 316       | 0             | 0         | 867          | 2009      | 1253        | 1253        |             |  |
| 1998  | 1738      | 521       | 0         | 0              | 2458         | 0            | 2458                 | 729                  | 2458       | 0         | 2458       | 418       | 0            | 0                    | 2458         | 418       | 0             | 0         | 1147         | 2075      | 1156        | 1156        |             |  |
| 1999  | 1217      | 365       | 0         | 0              | 2901         | 0            | 2901                 | 860                  | 2901       | 0         | 2901       | 493       | 0            | 0                    | 2901         | 493       | 0             | 0         | 1354         | 2139      | 1063        | 1063        |             |  |
| 2000  | 852       | 255       | 0         | 0              | 3307         | 0            | 3307                 | 981                  | 3307       | 0         | 3307       | 562       | 0            | 0                    | 3307         | 562       | 0             | 0         | 1543         | 2259      | 1003        | 1003        |             |  |
| 2001  | 596       | 179       | 0         | 0              | 3666         | 0            | 3666                 | 1088                 | 3666       | 0         | 3666       | 623       | 0            | 0                    | 3666         | 623       | 0             | 0         | 1711         | 2396      | 950         | 950         |             |  |
| 2002  | 417       | 125       | 0         | 0              | 3989         | 0            | 3989                 | 1183                 | 3989       | 0         | 3989       | 678       | 0            | 0                    | 3989         | 678       | 0             | 0         | 1862         | 2544      | 900         | 900         |             |  |
| 2003  | 292       | 88        | 0         | 0              | 4289         | 0            | 4289                 | 1272                 | 4289       | 0         | 4289       | 729       | 0            | 0                    | 4289         | 729       | 0             | 0         | 2002         | 2701      | 853         | 853         |             |  |
| 2004  | 204       | 61        | 0         | 0              | 4522         | 0            | 4522                 | 1342                 | 4522       | 0         | 4522       | 769       | 0            | 0                    | 4522         | 769       | 0             | 0         | 2110         | 2833      | 799         | 799         |             |  |
| 2005  | 143       | 43        | 0         | 0              | 4740         | 0            | 4740                 | 1406                 | 4740       | 0         | 4740       | 806       | 0            | 0                    | 4740         | 806       | 0             | 0         | 2212         | 2968      | 748         | 748         |             |  |
| 2006  | 100       | 30        | 0         | 0              | 4948         | 0            | 4948                 | 1468                 | 4948       | 0         | 4948       | 841       | 0            | 0                    | 4948         | 841       | 0             | 0         | 2309         | 3105      | 698         | 698         |             |  |
| 2007  | 70        | 21        | 0         | 0              | 4538         | 0            | 4538                 | 1346                 | 4538       | 0         | 4538       | 771       | 0            | 0                    | 4538         | 771       | 0             | 0         | 2117         | 2912      | 585         | 585         |             |  |
| 2008  | 49        | 15        | 0         | 0              | 4159         | 0            | 4159                 | 1234                 | 4159       | 0         | 4159       | 707       | 0            | 0                    | 4159         | 707       | 0             | 0         | 1941         | 2740      | 491         | 491         |             |  |
| 2009  | 34        | 10        | 0         | 0              | 3808         | 0            | 3808                 | 1130                 | 3808       | 0         | 3808       | 647       | 0            | 0                    | 3808         | 647       | 0             | 0         | 1777         | 2585      | 414         | 414         |             |  |
| 2010  | 24        | 7         | 0         | 0              | 3419         | 0            | 3419                 | 1014                 | 3419       | 0         | 3419       | 581       | 0            | 0                    | 3419         | 581       | 0             | 0         | 1596         | 2400      | 343         | 343         |             |  |
| 2011  | 17        | 5         | 0         | 0              | 3053         | 0            | 3053                 | 906                  | 3053       | 0         | 3053       | 519       | 0            | 0                    | 3053         | 519       | 0             | 0         | 1425         | 2214      | 283         | 283         |             |  |
| 2012  | 12        | 4         | 0         | 0              | 2707         | 0            | 2707                 | 803                  | 2707       | 0         | 2707       | 460       | 0            | 0                    | 2707         | 460       | 0             | 0         | 1263         | 2024      | 231         | 231         |             |  |
| SUBT. | 12        | 8625      | 0         | 0              | 59055        | 0            | 59055                | 17518                | 59055      | 0         | 59055      | 10039     | 0            | 0                    | 59055        | 10039     | 0             | 0         | 27557        | 36937     | 8021        | 8021        |             |  |
| REM.  | -12       | 8         | 0         | 0              | 20727        | 0            | 20727                | 6149                 | 20727      | 0         | 20727      | 3524      | 0            | 0                    | 20727        | 3524      | 0             | 0         | 9672         | 16494     | 913         | 913         |             |  |
| TOTAL | 0         | 8633      | 0         | 0              | 79782        | 0            | 79782                | 23666                | 79782      | 0         | 79782      | 13563     | 0            | 0                    | 79782        | 13563     | 0             | 0         | 37229        | 53430     | 8934        | 8934        |             |  |

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## SUMMARY

| INTERESTS *              |        | RESERVES + PROJECT LIFE * |                      |                     |                   |                   |                    |                   |                     |  |
|--------------------------|--------|---------------------------|----------------------|---------------------|-------------------|-------------------|--------------------|-------------------|---------------------|--|
| INTL ROYALTY INT (PCT) = | 4.559  | LIFE (YRS) = 39.67        |                      |                     |                   |                   |                    |                   |                     |  |
| AVG. ROYALTY INT (PCT) = | 15.119 | PROJECT START MONTH = MAY |                      |                     |                   |                   |                    |                   |                     |  |
|                          |        | OIL<br>( E3 m3)           | SOLN GAS<br>( E3 m3) | RESIDUE<br>( E3 m3) | ETHANE<br>(E3 m3) | COND.<br>( E3 m3) | PROPANE<br>(E3 m3) | BUTANE<br>(E3 m3) | SULPHUR<br>(E3 TNE) |  |
| GROSS REM RES            |        | 713.9                     | .0                   | .0                  | .0                | .0                | .0                 | .0                | .0                  |  |
| WI REM RES               |        | 713.9                     | .0                   | .0                  | .0                | .0                | .0                 | .0                | .0                  |  |
| NET REM RES              |        | 601.6                     | .0                   | .0                  | .0                | .0                | .0                 | .0                | .0                  |  |
| CUM HIST PROD            |        | .0                        | .0                   | .0                  | .0                | .0                | .0                 | .0                | .0                  |  |
| ULTIMATE RES             |        | 713.9                     | .0                   | .0                  | .0                | .0                | .0                 | .0                | .0                  |  |

[illegible]

RISK ANALYSIS  
RISK ADJUSTED CASH FLOW

NET CAPITAL  
EXPOSURE  
(E3 \$)

7305.8

| CASE | PROBABILITY<br>OF<br>SUCCESS<br>PCT | BIT<br>12%<br>PV<br>PROFIT<br>E3 \$ | BIT<br>PAYOUT<br>VRS | BIT<br>ROR<br>PCT | BIT<br>PVI | BIT<br>UNDIS CF/<br>UNDIS INV |
|------|-------------------------------------|-------------------------------------|----------------------|-------------------|------------|-------------------------------|
| 1    | .0                                  | -7305.8                             | .00                  | .0                | .00        | -1.00                         |
| 2    | 60.0                                | 7535.6                              | 6.07                 | 22.2              | 1.79       | 5.19                          |
| 3    | 70.0                                | 10009.1                             | 5.57                 | 25.0              | 2.01       | 5.92                          |
| 4    | 80.0                                | 12482.7                             | 5.16                 | 27.8              | 2.22       | 6.59                          |
| 5    | 90.0                                | 14956.2                             | 4.85                 | 30.4              | 2.41       | 7.21                          |
| 6    | 60.0                                | 7535.6                              | 6.07                 | 22.2              | 1.79       | 5.19                          |
| 7    | 70.0                                | 10009.1                             | 5.57                 | 25.0              | 2.01       | 5.92                          |
| 8    | 80.0                                | 12482.7                             | 5.16                 | 27.8              | 2.22       | 6.59                          |
| 9    | 100.0                               | 17429.8                             | 4.59                 | 33.0              | 2.59       | 7.78                          |



RISK ANALYSIS

RISK ADJUSTED CASH FLOW

NET CAPITAL  
EXPOSURE  
(E3 \$)

4018.2

| CASE | PROBABILITY<br>OF<br>SUCCESS<br>PCT | AIT<br>12%<br>PV<br>PROFIT<br>E3 \$ | AIT<br>PAYOUT<br>YRS | AIT<br>ROR<br>PCT | AIT<br>PVI | AIT<br>UNDIS CF/<br>UNDIS INV |
|------|-------------------------------------|-------------------------------------|----------------------|-------------------|------------|-------------------------------|
| 1    | .0                                  | -4018.2                             | .00                  | .0                | .00        | -1.00                         |
| 2    | 60.0                                | 3753.0                              | 6.40                 | 19.3              | 1.46       | 3.54                          |
| 3    | 70.0                                | 5048.2                              | 5.95                 | 21.2              | 1.57       | 3.87                          |
| 4    | 80.0                                | 6343.5                              | 5.61                 | 22.9              | 1.66       | 4.14                          |
| 5    | 90.0                                | 7638.7                              | 5.34                 | 24.4              | 1.74       | 4.38                          |
| 6    | 60.0                                | 3753.0                              | 6.40                 | 19.3              | 1.46       | 3.54                          |
| 7    | 70.0                                | 5048.2                              | 5.95                 | 21.2              | 1.57       | 3.87                          |
| 8    | 80.0                                | 6343.5                              | 5.61                 | 22.9              | 1.66       | 4.14                          |
| 9    | 100.0                               | 8933.9                              | 5.13                 | 25.7              | 1.81       | 4.59                          |

FILE 3845

RUN TIME 22-JUN-1993

10:34 GARRETT POGO V .

INCREMENTAL WF ( GO FORWARD - BASE )

INCREMENTAL ROR - 25.7 %

NPV @ 12% DCF  
ALT \$ 11.77

→ OPTIONS TO INCREASE / ACCUMULATE  
REVENUE

- (a) reduced cost
- (b) higher than forecasted production
- (c) higher than forecasted oil prices
- (d) modify waterflood 9 spot vs 5 spot  
reduce conversion costs, less lost production  
accelerate pay-out & reduce ult. rec.

## PIERSON FIELD

| OIL<br>WATER                    | Cum. Prod.<br>Dec. 31/92<br>m <sup>3</sup> | Jan.   | Feb.   | Mar.   | Apr.   | May    | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | MAY<br>Daily<br>m <sup>3</sup> | 1993<br>Y.T.D.<br>m <sup>3</sup> | Cum.<br>Total<br>m <sup>3</sup> |
|---------------------------------|--|--------|--------|--------|--------|--------|------|------|------|------|------|------|------|--------------------------------|----------------------------------|---------------------------------|
| <b>LAm C POOL<br/>07 29C</b>    |  |        |        |        |        |        |      |      |      |      |      |      |      |                                |                                  |                                 |
| <b>HOME OIL COMPANY LIMITED</b> |  |        |        |        |        |        |      |      |      |      |      |      |      |                                |                                  |                                 |
| 14-04-02-29 -                   | 6432.0                                     | 80.4   | 74.5   | 83.8   | 81.2   | 78.2   |      |      |      |      |      |      |      |                                |                                  |                                 |
| Prov.                           | 1939.6                                     | 10.9   | 17.2   | 11.4   | 12.3   | 11.7   |      |      |      |      |      |      |      | 2.79                           | 398.1                            | 6830.1                          |
|                                 |  |        |        |        |        |        |      |      |      |      |      |      |      |                                | 63.5                             | 2003.1                          |
| 16-04-02-29 -                   | 2217.3                                     | 28.7   | 29.0   | 36.1   | 46.0   | 43.3   |      |      |      |      |      |      |      | 1.55                           | 183.1                            | 2400.4                          |
| Prov.                           | 736.5                                      | 0.7    | 2.2    | 7.0    | 16.7   | 16.2   |      |      |      |      |      |      |      |                                | 42.8                             | 779.3                           |
| 16-05-02-29 -                   | 10031.6                                    | 88.4   | 86.0   | 95.5   | 91.5   | 87.5   |      |      |      |      |      |      |      | 3.13                           | 448.9                            | 10480.5                         |
|                                 | 10698.8                                    | 123.8  | 133.9  | 129.1  | 112.6  | 106.2  |      |      |      |      |      |      |      |                                | 605.6                            | 11304.4                         |
| 06-07-02-29                     | 41.6                                       | —      | —      | —      | —      | —      |      |      |      |      |      |      |      |                                | —                                | 41.6                            |
|                                 | 699.8                                      | —      | —      | —      | —      | —      |      |      |      |      |      |      |      |                                | —                                | 699.8                           |
| 06-08-02-29 -                   | 1514.8                                     | 143.6  | 137.9  | 141.1  | 122.5  | 122.6  |      |      |      |      |      |      |      | 4.09                           | 667.7                            | 2182.5                          |
| Prov.                           | 561.4                                      | 28.4   | 29.8   | 30.4   | 28.0   | 27.4   |      |      |      |      |      |      |      |                                | 144.0                            | 705.4                           |
| 08-08-02-29 -                   | 11028.8                                    | 88.6   | 95.7   | 127.2  | 123.5  | 127.7  |      |      |      |      |      |      |      | 4.73                           | 562.7                            | 11591.5                         |
| Prov.                           | 21474.6                                    | 395.0  | 492.8  | 381.8  | 344.2  | 349.0  |      |      |      |      |      |      |      |                                | 1962.8                           | 23437.4                         |
| 10-08-02-29                     | 704.6                                      | 92.2   | 199.0  | 189.2  | 154.4  | 136.7  |      |      |      |      |      |      |      | 4.56                           | 771.5                            | 1476.1                          |
|                                 | 26.5                                       | 2.8    | 13.4   | 6.0    | 1.1    | 0.8    |      |      |      |      |      |      |      |                                | 24.1                             | 50.6                            |
| 12-08-02-29                     | 1794.2                                     | 63.3   | 64.8   | 82.2   | 67.4   | 62.7   |      |      |      |      |      |      |      | 2.24                           | 340.4                            | 2134.6                          |
|                                 | 468.5                                      | 6.9    | 4.9    | 8.8    | 9.6    | 9.4    |      |      |      |      |      |      |      |                                | 39.6                             | 508.1                           |
| 14-08-02-29                     | 451.3                                      | 107.4  | 76.7   | 70.4   | 58.8   | 56.6   |      |      |      |      |      |      |      | 2.02                           | 369.9                            | 821.2                           |
|                                 | 79.1                                       | 11.7   | 15.9   | 9.6    | 8.7    | 9.0    |      |      |      |      |      |      |      |                                | 54.9                             | 134.0                           |
| 16-08-02-29                     | 8772.0                                     | —      | —      | —      | —      | —      |      |      |      |      |      |      |      |                                | —                                | 8772.0                          |
|                                 | 1472.3                                     | —      | —      | —      | —      | —      |      |      |      |      |      |      |      |                                | —                                | 1472.3                          |
| 02-09-02-29                     | 600.4                                      | 146.7  | 133.7  | 144.8  | 125.8  | 114.7  |      |      |      |      |      |      |      | 4.10                           | 665.7                            | 1266.1                          |
|                                 | 112.1                                      | 14.1   | 11.0   | 19.2   | 22.6   | 22.1   |      |      |      |      |      |      |      |                                | 89.0                             | 201.1                           |
| 04-09-02-29                     | 5643.1                                     | 71.7   | 59.5   | 74.3   | 72.6   | 69.3   |      |      |      |      |      |      |      | 2.57                           | 347.4                            | 5990.5                          |
|                                 | 16575.4                                    | 153.4  | 189.9  | 167.2  | 156.1  | 164.7  |      |      |      |      |      |      |      |                                | 831.3                            | 17406.7                         |
| 06-09-02-29                     | 1065.8                                     | 272.0  | 270.8  | 244.6  | 217.4  | 216.9  |      |      |      |      |      |      |      | 7.23                           | 1221.7                           | 2287.5                          |
|                                 | 474.0                                      | 114.1  | 133.5  | 93.9   | 88.6   | 106.7  |      |      |      |      |      |      |      |                                | 536.8                            | 1010.8                          |
| 08-09-02-29                     | 1183.9                                     | 45.1   | 43.7   | 44.7   | 39.7   | 37.5   |      |      |      |      |      |      |      | 1.34                           | 210.7                            | 1394.6                          |
|                                 | 269.9                                      | 6.6    | 8.8    | 10.7   | 9.1    | 6.9    |      |      |      |      |      |      |      |                                | 42.1                             | 312.0                           |
| 10-09-02-29                     | 665.2                                      | 167.3  | 156.8  | 159.1  | 137.4  | 133.1  |      |      |      |      |      |      |      | 4.44                           | 753.7                            | 1418.9                          |
|                                 | 75.9                                       | 28.7   | 19.8   | 13.4   | 10.2   | 9.6    |      |      |      |      |      |      |      |                                | 81.7                             | 157.6                           |
| 12-09-02-29                     | 10324.9                                    | 136.5  | 134.4  | 146.2  | 133.5  | 135.6  |      |      |      |      |      |      |      | 4.52                           | 686.2                            | 11011.1                         |
|                                 | 1952.1                                     | 26.0   | 26.5   | 26.0   | 22.6   | 25.6   |      |      |      |      |      |      |      |                                | 126.7                            | 2078.8                          |
| 14-09-02-29                     | 7687.4                                     | 85.7   | 57.9   | 66.1   | 65.8   | 63.3   |      |      |      |      |      |      |      | 2.34                           | 338.8                            | 8026.2                          |
|                                 | 75458.0                                    | 1424.8 | 1539.7 | 1540.3 | 1440.2 | 1376.1 |      |      |      |      |      |      |      |                                | 7321.1                           | 82779.1                         |
| 16-09-02-29                     | 14507.2                                    | 200.6  | 140.9  | 179.0  | 187.7  | 196.1  |      |      |      |      |      |      |      | 6.54                           | 904.3                            | 15411.5                         |
|                                 | 1734.0                                     | 24.3   | 14.4   | 18.9   | 21.7   | 21.3   |      |      |      |      |      |      |      |                                | 100.6                            | 1834.6                          |
| 06-10-02-29                     | 6240.7                                     | 140.3  | 117.3  | 146.8  | 133.7  | 128.1  |      |      |      |      |      |      |      | 4.74                           | 666.2                            | 6906.9                          |
|                                 | 35898.0                                    | 750.8  | 2.5    | 794.7  | 765.5  | 732.9  |      |      |      |      |      |      |      |                                | 3046.4                           | 38944.4                         |
| 08-10-02-29                     | 4666.3                                     | 79.0   | 94.7   | 107.0  | 104.1  | 105.0  |      |      |      |      |      |      |      | 3.89                           | 489.8                            | 5156.1                          |
|                                 | 50134.9                                    | 862.6  | 880.1  | 826.6  | 837.8  | 857.9  |      |      |      |      |      |      |      |                                | 4265.0                           | 54399.9                         |
| 10-10-02-29                     | 1464.2                                     | 40.4   | 37.8   | 36.6   | 29.2   | 24.3   |      |      |      |      |      |      |      | 0.90                           | 168.3                            | 1632.5                          |
| Prov.                           | 8708.1                                     | 256.8  | 268.2  | 272.5  | 258.0  | 247.3  |      |      |      |      |      |      |      |                                | 1302.8                           | 10010.9                         |
| 14-10-02-29                     | 4947.1                                     | 104.5  | 97.5   | 105.1  | 96.7   | 93.6   |      |      |      |      |      |      |      | 3.47                           | 497.4                            | 5444.5                          |
|                                 | 9348.3                                     | 213.5  | 227.4  | 220.1  | 204.4  | 200.8  |      |      |      |      |      |      |      |                                | 1066.2                           | 10414.5                         |
| 16-10-02-29                     | —  | —      | —      | —      | —      | —      |      |      |      |      |      |      |      |                                | —                                | —                               |
| Prov.                           | 251.1                                      | —      | —      | —      | —      | —      |      |      |      |      |      |      |      |                                | —                                | 251.1                           |
| 06-11-02-29                     | 1483.0                                     | 12.4   | 56.9   | 38.3   | 39.2   | 25.9   |      |      |      |      |      |      |      | 0.84                           | 172.7                            | 1655.7                          |
| Prov.                           | 415.2                                      | 0.7    | 7.7    | 9.9    | 9.2    | 6.5    |      |      |      |      |      |      |      |                                | 34.0                             | 449.2                           |

CURRENT PROD

CR - 31.73

FH - 58.1

35%

65%

TOTAL 89.83%

**LAm C POOL  
07 29C**

**PIERSON FIELD**

| OIL<br>WATER                            | Cum. Prod.<br>Dec. 31/92<br>m <sup>3</sup> | Jan.  | Feb.  | Mar.  | Apr.  | May   | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | MAY<br>Daily<br>m <sup>3</sup> | 1993<br>Y.T.D.<br>m <sup>3</sup> | Cum.<br>Total<br>m <sup>3</sup> |
|---|--|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|--------------------------------|----------------------------------|---------------------------------|
| <b>HOME OIL COMPANY LIMITED (Cont.)</b> |  |       |       |       |       |       |      |      |      |      |      |      |      |                                |                                  |                                 |
| 14-11-02-29                             | 267.4                                      | —     | 0.7   | —     | —     | —     |      |      |      |      |      |      |      |                                | 0.7                              | 268.1                           |
| Prov                                    | 487.9                                      | —     | 5.8   | —     | —     | —     |      |      |      |      |      |      |      |                                | 5.8                              | 493.7                           |
| 04-14-02-29                             | 5 349.9                                    | 145.1 | 141.4 | 149.3 | 132.8 | 137.4 |      |      |      |      |      |      |      | 4.58                           | 706.0                            | 6 055.9                         |
| Prov.                                   | 460.4                                      | 4.2   | 4.2   | 4.3   | 4.1   | 2.5   |      |      |      |      |      |      |      |                                | 19.3                             | 479.7                           |
| 04-15-02-29                             | 12 655.3                                   | 90.7  | 80.7  | 86.5  | 146.7 | 146.0 |      |      |      |      |      |      |      | 4.87                           | 550.6                            | 13 205.9                        |
|   | 969.4                                      | 1.4   | 1.5   | 1.6   | 7.8   | 13.9  |      |      |      |      |      |      |      |                                | 26.2                             | 995.6                           |
| 02-16-02-29 ✓                           | 3 937.9                                    | 101.6 | 99.4  | 82.6  | 88.7  | 102.7 |      |      |      |      |      |      |      | 3.42                           | 475.0                            | 4 412.9                         |
| Prov.                                   | 111.8                                      | 0.6   | 0.6   | 0.7   | 0.6   | 0.6   |      |      |      |      |      |      |      |                                | 3.1                              | 114.9                           |
| 04-16-02-29 ✓                           | 5 302.3                                    | 121.0 | 108.8 | 132.4 | 97.2  | 91.0  |      |      |      |      |      |      |      | 3.03                           | 550.4                            | 5 852.7                         |
| Prov.                                   | 128.9                                      | 0.6   | 0.6   | 1.1   | 0.6   | 0.5   |      |      |      |      |      |      |      |                                | 3.4                              | 132.3                           |
| 06-16-02-29 ✓                           | 4 572.0                                    | 99.3  | 92.9  | 85.2  | 87.3  | 68.3  |      |      |      |      |      |      |      | 2.28                           | 433.0                            | 5 005.0                         |
| Prov.                                   | 346.5                                      | 2.2   | 1.9   | 0.8   | 2.3   | 1.3   |      |      |      |      |      |      |      |                                | 8.5                              | 355.0                           |
| 08-16-02-29 ✓                           | 1 507.2                                    | 37.6  | 36.4  | 36.6  | 40.2  | 40.2  |      |      |      |      |      |      |      | 1.44                           | 191.0                            | 1 698.2                         |
| Prov.                                   | 172.6                                      | 0.2   | 0.3   | 0.3   | 0.2   | 1.8   |      |      |      |      |      |      |      |                                | 2.8                              | 175.4                           |
| 10-16-02-29 ✓                           | 788.4                                      | 224.9 | 180.6 | 203.5 | 178.6 | 155.3 |      |      |      |      |      |      |      | 5.36                           | 942.9                            | 1 731.3                         |
| Prov.                                   | 93.7                                       | 16.4  | 12.5  | 9.1   | 6.0   | 3.5   |      |      |      |      |      |      |      |                                | 47.5                             | 141.2                           |
| 12-16-02-29 ✓                           | 1 921.9                                    | 42.3  | 44.7  | 53.5  | 48.3  | 46.4  |      |      |      |      |      |      |      | 1.66                           | 235.2                            | 2 157.1                         |
| Prov.                                   | 30.9                                       | 0.2   | 0.7   | 0.4   | —     | 0.1   |      |      |      |      |      |      |      |                                | 1.4                              | 32.3                            |
| 02-17-02-29                             | 3 618.6                                    | 81.1  | 74.5  | 82.2  | 74.5  | 73.1  |      |      |      |      |      |      |      | 2.44                           | 385.4                            | 4 004.0                         |
|   | 51.8                                       | 0.4   | 0.5   | 0.4   | 0.5   | 0.3   |      |      |      |      |      |      |      |                                | 2.1                              | 53.9                            |
| 04-17-02-29                             | 1 564.5                                    | 48.2  | 47.3  | 52.8  | 48.2  | 45.6  |      |      |      |      |      |      |      | 1.63                           | 242.1                            | 1 806.6                         |
|   | 315.5                                      | 0.5   | 0.5   | 2.2   | 2.4   | 4.1   |      |      |      |      |      |      |      |                                | 9.7                              | 325.2                           |
| 06-17-02-29                             | 1 668.3                                    | 14.7  | 16.9  | 20.9  | 19.1  | 17.7  |      |      |      |      |      |      |      | 0.66                           | 89.3                             | 1 757.6                         |
|   | 10 847.6                                   | 139.3 | 140.2 | 135.8 | 124.6 | 123.2 |      |      |      |      |      |      |      |                                | 663.1                            | 11 510.7                        |
| 08-17-02-29                             | 1 633.5                                    | 35.8  | 35.7  | 38.5  | 36.8  | 30.8  |      |      |      |      |      |      |      | 1.10                           | 177.6                            | 1 811.1                         |
|   | 54.5                                       | 0.5   | 0.2   | 0.3   | 0.2   | —     |      |      |      |      |      |      |      |                                | 1.2                              | 55.7                            |
| 10-17-02-29                             | 1 188.5                                    | 31.9  | 31.0  | 32.8  | 33.1  | 31.1  |      |      |      |      |      |      |      | 1.11                           | 159.9                            | 1 348.4                         |
|   | 150.4                                      | 0.2   | 0.2   | 0.7   | 0.3   | 0.3   |      |      |      |      |      |      |      |                                | 1.7                              | 152.1                           |
| 12-17-02-29                             | 1 158.3                                    | 41.7  | 40.3  | 43.4  | 36.0  | 37.8  |      |      |      |      |      |      |      | 1.35                           | 199.2                            | 1 357.5                         |
|   | 264.9                                      | 0.4   | 1.5   | 1.5   | 2.4   | 1.5   |      |      |      |      |      |      |      |                                | 7.3                              | 272.2                           |
| 06-18-02-29                             | 740.4                                      | 16.4  | 17.9  | 18.6  | 16.2  | 12.6  |      |      |      |      |      |      |      | 0.45                           | 81.7                             | 822.1                           |
|   | 741.1                                      | 11.0  | 10.3  | 9.1   | 10.1  | 12.3  |      |      |      |      |      |      |      |                                | 52.8                             | 793.9                           |
| 08-18-02-29 ✓                           | 2 010.0                                    | 44.3  | 43.0  | 56.9  | 46.5  | 38.5  |      |      |      |      |      |      |      | 1.38                           | 229.2                            | 2 239.2                         |
| Prov.                                   | 269.9                                      | 5.0   | 5.5   | 2.1   | 4.8   | 5.0   |      |      |      |      |      |      |      |                                | 22.4                             | 292.3                           |
| 14-18-02-29                             | 741.0                                      | 52.9  | 57.0  | 70.1  | 56.1  | 52.7  |      |      |      |      |      |      |      | 1.70                           | 288.8                            | 1 029.8                         |
| Prov.                                   | 178.7                                      | 11.6  | 7.6   | 9.5   | 8.6   | 11.4  |      |      |      |      |      |      |      |                                | 48.7                             | 227.4                           |
| 16-18-02-29                             | 8.8  | —     | —     | —     | —     | —     |      |      |      |      |      |      |      | —                              | —                                | 8.8                             |
|   | 38.8                                       | —     | —     | —     | —     | —     |      |      |      |      |      |      |      |                                | —                                | 38.8                            |
| 06-19-02-29                             | 8 289.8                                    | 95.5  | 88.3  | 78.2  | 70.2  | 98.2  |      |      |      |      |      |      |      | 3.27                           | 430.4                            | 8 720.2                         |
|   | 347.4                                      | 0.6   | 0.5   | 0.4   | 0.4   | 0.6   |      |      |      |      |      |      |      |                                | 2.5                              | 349.9                           |
| 10-19-02-29                             | 1 727.5                                    | 13.9  | 41.2  | 31.5  | 25.0  | 63.1  |      |      |      |      |      |      |      | 2.25                           | 174.7                            | 1 902.2                         |
|   | 1 321.3                                    | 21.1  | 70.1  | 35.5  | 26.7  | 65.7  |      |      |      |      |      |      |      |                                | 219.1                            | 1 540.4                         |
| 11-19-02-29                             | 6 527.3                                    | 89.2  | 72.3  | 92.6  | 88.3  | 105.5 |      |      |      |      |      |      |      | 3.52                           | 447.9                            | 6 975.2                         |
|   | 327.3                                      | 0.5   | 0.4   | 1.0   | 0.4   | 0.4   |      |      |      |      |      |      |      |                                | 2.7                              | 330.0                           |
| 12-19-02-29                             | 571.6                                      | 13.7  | 13.3  | 15.3  | 13.6  | 12.5  |      |      |      |      |      |      |      | 0.46                           | 68.4                             | 640.0                           |
|   | 8 562.5                                    | 316.7 | 332.9 | 326.6 | 308.9 | 302.3 |      |      |      |      |      |      |      |                                | 1 587.4                          | 10 149.9                        |
| 16-19-02-29                             | 1 965.7                                    | 45.3  | 41.0  | 59.2  | 57.5  | 44.6  |      |      |      |      |      |      |      | 1.65                           | 247.6                            | 2 213.3                         |
|   | 4 158.4                                    | 104.1 | 109.7 | 104.8 | 95.1  | 103.5 |      |      |      |      |      |      |      |                                | 517.2                            | 4 675.6                         |

**LAm C POOL  
07 29C**

**PIERSON FIELD**

| OIL<br>WATER                            | Cum. Prod.<br>Dec. 31/92<br>m <sup>3</sup> | Jan.    | Feb.    | Mar.    | Apr.    | May     | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | MAY<br>Daily<br>m <sup>3</sup> | 1993<br>Y.T.D.<br>m <sup>3</sup> | Cum.<br>Total<br>m <sup>3</sup> |
|---|--|---------|---------|---------|---------|---------|------|------|------|------|------|------|------|--------------------------------|----------------------------------|---------------------------------|
| <b>HOME OIL COMPANY LIMITED (Cont.)</b> |  |         |         |         |         |         |      |      |      |      |      |      |      |                                |                                  |                                 |
| 02-20-02-29                             | 122.6                                      | —       | —       | —       | —       | —       |      |      |      |      |      |      |      |                                | —                                | 122.6                           |
| Prov.                                   | 203.2                                      | —       | —       | —       | —       | —       |      |      |      |      |      |      |      |                                | —                                | 203.2                           |
| 04-20-02-29                             | 1 328.7                                    | 21.7    | 12.9    | 13.5    | 23.1    | 21.3    |      |      |      |      |      |      |      | 0.76                           | 92.5                             | 1 421.2                         |
| Prov.                                   | 306.3                                      | 3.8     | 1.4     | 1.4     | 2.5     | 1.9     |      |      |      |      |      |      |      |                                | 11.0                             | 317.3                           |
| 06-20-02-29                             | 463.0                                      | 8.0     | 7.8     | 6.5     | 4.2     | 7.3     |      |      |      |      |      |      |      | 0.26                           | 33.8                             | 496.8                           |
| Prov.                                   | 186.6                                      | 4.6     | 4.8     | 3.7     | 2.5     | 4.6     |      |      |      |      |      |      |      |                                | 20.2                             | 206.8                           |
| 12-20-02-29                             | 2 397.6                                    | 37.2    | 40.7    | 49.3    | 41.4    | 40.0    |      |      |      |      |      |      |      | 1.43                           | 208.6                            | 2 606.2                         |
| Prov.                                   | 331.0                                      | 0.2     | 2.0     | 3.3     | 2.7     | 2.6     |      |      |      |      |      |      |      |                                | 10.8                             | 341.8                           |
| 04-21-02-29                             | 345.1                                      | —       | —       | —       | —       | —       |      |      |      |      |      |      |      |                                | —                                | 345.1                           |
|   | 13 355.4                                   | —       | —       | —       | —       | —       |      |      |      |      |      |      |      |                                | —                                | 13 355.4                        |
| 02-30-02-29                             | 3 641.0                                    | 88.0    | 84.3    | 88.5    | 82.1    | 88.2    |      |      |      |      |      |      |      | 2.94                           | 431.1                            | 4 072.1                         |
|   | 163.2                                      | 0.4     | 0.5     | 0.4     | 3.4     | 1.9     |      |      |      |      |      |      |      |                                | 6.6                              | 169.8                           |
|   | 181 481.5                                  |         | 3 716.5 |         | 3 719.8 |         |      |      |      |      |      |      |      |                                |                                  | 200 419.7                       |
|   | 284 542.0                                  |         | 4 756.5 |         | 4 997.3 |         |      |      |      |      |      |      |      |                                |                                  | 309 627.5                       |
| TOTAL OIL                               |  | 3 836.8 |         | 3 998.5 |         | 3 666.6 |      |      |      |      |      |      |      |                                | 18 938.2                         |                                 |
| TOTAL WATER                             |  | 5 103.3 |         | 5 254.5 |         | 4 973.9 |      |      |      |      |      |      |      |                                | 25 085.5                         |                                 |

**T.D.L. PETROLEUMS INC.**

|  |           |         |         |         |         |         |  |  |  |  |  |  |  |      |          |           |
|--|-----------|---------|---------|---------|---------|---------|--|--|--|--|--|--|--|------|----------|-----------|
| 05-03-02-29                                | 112.0     | —       | —       | 10.0    | 7.4     | 8.4     |  |  |  |  |  |  |  | 0.27 | 25.8     | 137.8     |
|  | 694.6     | —       | —       | 55.6    | 40.5    | 33.9    |  |  |  |  |  |  |  |      | 130.0    | 824.6     |
| <b>TUNDRA OIL AND GAS LTD.</b>             |           |         |         |         |         |         |  |  |  |  |  |  |  |      |          |           |
| 14-17-02-29                                | 701.8     | 29.9    | 37.2    | 34.4    | 31.2    | 29.2    |  |  |  |  |  |  |  | 1.04 | 161.9    | 863.7     |
| c  | 764.4     | 54.7    | 49.0    | 47.4    | 44.1    | 38.2    |  |  |  |  |  |  |  |      | 233.4    | 997.8     |
| 02-22-02-29                                | 850.4     | 30.9    | 23.3    | 24.6    | 27.7    | 23.6    |  |  |  |  |  |  |  | 0.76 | 130.1    | 980.5     |
| Prov                                       | 445.1     | 11.8    | 12.3    | 14.5    | 9.4     | 14.0    |  |  |  |  |  |  |  |      | 62.0     | 507.1     |
| 04-22-02-29                                | 1 285.5   | 19.6    | 15.9    | 19.8    | 19.4    | 19.0    |  |  |  |  |  |  |  | 0.61 | 93.7     | 1 379.2   |
| Prov. c                                    | 467.2     | 17.2    | 16.8    | 12.4    | 11.5    | 13.7    |  |  |  |  |  |  |  |      | 71.6     | 538.8     |
| 12-22-02-29                                | 340.2     | —       | 16.2    | 19.4    | 13.1    | 10.6    |  |  |  |  |  |  |  | 0.34 | 59.3     | 399.5     |
| Prov                                       | 319.8     | —       | 20.9    | 8.4     | 10.4    | 10.9    |  |  |  |  |  |  |  |      | 50.6     | 370.4     |
|  | 3 177.9   |         | 92.6    |         | 91.4    |         |  |  |  |  |  |  |  |      |          | 3 622.9   |
|  | 1 996.5   |         | 99.0    |         | 75.4    |         |  |  |  |  |  |  |  |      |          | 2 414.1   |
| TOTAL OIL                                  |           | 80.4    |         | 98.2    |         | 82.4    |  |  |  |  |  |  |  |      | 445.0    |           |
| TOTAL WATER                                |           | 83.7    |         | 82.7    |         | 76.8    |  |  |  |  |  |  |  |      | 417.6    |           |
| <b>NON-UNIT<br/>PREVIOUS<br/>PRODUCERS</b> |           |         |         |         |         |         |  |  |  |  |  |  |  |      |          |           |
|  | 115.0     |         |         |         |         |         |  |  |  |  |  |  |  |      |          | 115.0     |
|  | 827.8     |         |         |         |         |         |  |  |  |  |  |  |  |      |          | 827.8     |
| LAm C                                      | 184 886.4 |         | 3 809.1 |         | 3 818.6 |         |  |  |  |  |  |  |  |      |          | 204 295.4 |
| POOL :                                     | 288 060.9 |         | 4 855.5 |         | 5 113.2 |         |  |  |  |  |  |  |  |      |          | 313 694.0 |
| TOTAL OIL                                  |           | 3 917.2 |         | 4 106.7 |         | 3 757.4 |  |  |  |  |  |  |  |      | 19 409.0 |           |
| TOTAL WATER                                |           | 5 187.0 |         | 5 392.8 |         | 5 084.6 |  |  |  |  |  |  |  |      | 25 633.1 |           |

**LAm E POOL  
07 29E**

**HOME OIL COMPANY LIMITED**

|             |         |   |   |   |   |   |  |  |  |  |  |  |  |  |   |         |
|-------------|---------|---|---|---|---|---|--|--|--|--|--|--|--|--|---|---------|
| 04-01-02-29 | 84.8    | — | — | — | — | — |  |  |  |  |  |  |  |  | — | 84.8    |
|             | 1 363.4 | — | — | — | — | — |  |  |  |  |  |  |  |  | — | 1 363.4 |
| 10-01-02-29 | 22.0    | — | — | — | — | — |  |  |  |  |  |  |  |  | — | 22.0    |
|             | 373.0   | — | — | — | — | — |  |  |  |  |  |  |  |  | — | 373.0   |

\*\* S. PIERSON MANITOBA \*\*  
 LOWER AMARANTH PRIMARY ECONOMICS  
 80 ACRE SPACING

## \*\*\*\*\* SUMMARY \*\*\*\*\*

## INTERESTS \*

INTL ROYALTY INT (PCT) = 13.02770  
 AVG. ROYALTY INT (PCT) = 11.34791  
 INTL WORKING INT (PCT) = 100.00000  
 INTL CAPITAL INT (PCT) = 100.00000

## RESERVES + PROJECT LIFE \*

LIFE (YRS) = 26.67  
 PROJECT START MONTH = MAY

|               | OIL<br>(E3 m3) | SOLN GAS<br>(E3 m3) | RESIDUE<br>(E3 m3) | ETHANE<br>(E3 m3) | COND.<br>(E3 m3) | PROPANE<br>(E3 m3) | BUTANE<br>(E3 m3) | SULPHUR<br>(E3 TNE) |
|---------------|----------------|---------------------|--------------------|-------------------|------------------|--------------------|-------------------|---------------------|
| GROSS REM RES | 268.8          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| WI REM RES    | 268.8          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| NET REM RES   | 237.5          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| CUM HIST PROD | .0             | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |
| ULTIMATE RES  | 268.8          | .0                  | .0                 | .0                | .0               | .0                 | .0                | .0                  |

## NET PRESENT VALUE \*

| NET PROFIT INDICATORS * |  |   |                | * BIT *  | * AIT * |
|-------------------------|--|---|----------------|----------|---------|
| DISC. RATE              | *** BEFORE INCOME TAX ***<br>OP. INC (E3 \$) | *** AFTER INCOME TAX ***<br>OP. INC (E3 \$) | C FLOW (E3 \$) | INFINITE |         |
| .00                     | 26380.0                                      | 17058.2                                     | 1219.2         | INFINITE | 409.40  |
| 8.00                    | 14756.0                                      | 9614.8                                      | 1176.3         | .34      | .51     |
| 10.00                   | 13249.9                                      | 8646.5                                      | 1166.7         | .35      | .53     |
| 12.00                   | 12023.3                                      | 7856.9                                      | 1157.4         | .00      | .00     |
| 15.00                   | 10563.7                                      | 6915.9                                      | 1144.1         | 20.64    | 12.99   |
| 20.00                   | 8806.5                                       | 5780.8                                      | 1123.5         | 9.39     | 5.79    |
| 12.00                   | 12023.3                                      | 7856.9                                      | 1157.4         | 8.91     | 5.49    |
|                         |  |   |                | 770.70   | 417.72  |
|                         |  |   |                | 32.65    | 37.92   |
|                         |  |   |                | 14.10    | 16.04   |
|                         |  |   |                | 15.10    | 17.04   |
|                         |  |   |                | 3.24     | 1.76    |
|                         |  |   |                | 5.13     | 2.78    |
|                         |  |   |                | 237.54   | 237.54  |

RATE OF RETURN (PCT)  
 PAYOUT (YRS)  
 DISCOUNTED PAYOUT (YRS)  
 PRESENT WORTH INDEX  
 UNDIS C FLOW/UNDIS INV  
 DIS C FLOW/DIS INV  
 DIS C FLOW/UNDIS INV  
 CAPITAL EXPOSURE (E3 \$)  
 UNDIS C FLOW/CAP EXPOS  
 DIS C FLOW/CAP EXPOS  
 SUCCESS CAPACITY  
 FINDING COST (\$/m3)  
 FIND+DEV COST (\$/m3)  
 OIL (E3 m3)

Home Oil 14-9-2-29

Value of Sales  
Before Truck Costs

Truck Costs

January/92

\$112.23

\$5.50

Feb.

\$121.25

\$5.50

Mar.

\$111.81

5.46

APR.

123.08

6.48

May

136.33

6.48

June

153.11

5.40

July

148.00

5.40

Aug.

143.69

5.40

Sept.

153.92

5.40

Oct.

154.16

5.40

Nov.

143.28

5.40

Dec.

133.82

5.40

January/93

126.82

5.25

Feb.

133.46

5.38

Mar.

133.30

5.27

APR

136.69

5.46

May

138.17

5.45

June

135.19

5.25



# GO FORWARD WATERFLOOD

1) RET. REC RES — 982721 m<sup>3</sup> (3.65 \* increase in recovery)

2) INITIAL PRODUCTIVITY OF NEW WELLS RESULTS IN HIGHER ROYALTY RATES.  
 - Crown Royalty share 6.2% GROSS REVENUE  
 FREEHOLD Royalty share 8.4% " "

Crown Royalty \$12.4 MM  
 FREEHOLD PROD TAX \$8.0 MM (3.7% GROSS REVENUE)

VALUE OF ROYALTY / FREEHOLD  
 HOLIDAY OIL VOLUME  
 (126.2 / m<sup>3</sup>) \* 133.65 / m<sup>3</sup>  
 Royalty (m<sup>3</sup>) 2894 + 1200 = ~~4094~~ 525600  
 SAVINGS

FREEHOLD TAX (293 + 416) - (11 + 295) = \$403,271  
 SAVINGS

TOTAL \$930,000

DRILL 43 wells  
 CONVERT 38 INJECTORS  
 (CROWN 14 \* 1300 = 18200 m<sup>3</sup>  
 8% Roy RATE = 1456 m<sup>3</sup> \* 130 = 189280  
 FREEHOLD 29 \* 1300 = 37700  
 12% tax RATE = 2262 \* 130 = 294060  
 348000

check royalty New oil  
 RATE 36 m<sup>3</sup>/d Royalty rate = 18.1%

## OPERATING COST

93 \$24.16 / m<sup>3</sup>94 \$24.18 / m<sup>3</sup>PROJECT \$46.86 / m<sup>3</sup>

CAPITAL INVESTMENT - \$12.87 MM (1993 + 94)

D&amp;C + EQUIP - \$240 M / well

CONCRETE - \$67 M / well

## TAX BURDENS

Provincial \$16.96 MM (8.0 % of Gross Rev.)

FEDERAL \$29.6 MM (13.9 % of Gross Rev.)

ROR @ 12% DCF - 38.84 %

PAY-OUT 3.5 yrs (AIT)

2.9 yrs (BIT)

DISC CASH FLOW

DISC. INV

= 2.2 BIT

1.22 AIT

NPV @ 12% DCF = 15.6 MM.

clarification of the cashflow stream.

gross royalty & mineral tax of \$18.59mm undisc.

$$+ \frac{1240}{8002} \times 65$$

by comparison AIT. undis cash flow  
\$ 69209 MM      \$ ~~53430 MM~~  
-15836

- discuss 199 incentive changes

(1) revenue neutral from govt perspective  
exchanged waterflood incentive for enhanced  
drilling incentive

- possibility of smaller scale pilot
- reduce injector to producer ratio 7-spot or 9-spot

JOHN  
- PIERSON  
ROYALTY / TAX  
SPREAD SHEET  
BIR

SOUTH PIERSON UNIT NO.1 WATERFLOOD ECONOMICS-ROYALTIES/TAXES

UNIT PROD

44658 m3/yr

3721.5 m3/month

TOTAL

ROY/TAX

3650.185 m3/yr

304.1821 m3/month

| TRACT | FACTOR   | SU FACTOR | SU PROD  | ROYALTY | PROD TAX |
|-------|----------|-----------|----------|---------|----------|
| 1     | 0.036859 | A         | 0.018429 | 68.59   | 9.79     |
|       |          | B         | 0.018429 | 68.59   | 9.79     |
| 2     | 0.040814 | A         | 0.020407 | 75.94   | 11.61    |
|       |          | B         | 0.020407 | 75.94   | 11.61    |
| 3     | 0.025189 | A         | 0.012594 | 46.87   | 4.56     |
|       |          | B         | 0.012594 | 46.87   | 4.56     |
| 4     | 0.014793 | A         | 0.007396 | 27.53   | 1.57     |
|       |          | B         | 0.007396 | 27.53   | 1.57     |
| 6     | 0.054202 | A         | 0.027101 | 100.86  | 17.77    |
|       |          | B         | 0.027101 | 100.86  | 17.77    |
| 7     | 0.039077 | A         | 0.019538 | 72.71   | 10.81    |
|       |          | B         | 0.019538 | 72.71   | 10.81    |
| 8     | 0.032098 | A         | 0.016049 | 59.73   | 7.59     |
|       |          | B         | 0.016049 | 59.73   | 7.59     |
| 22    | 0.025646 | A         | 0.012823 | 47.72   | 4.73     |
|       |          | B         | 0.012823 | 47.72   | 4.73     |
| 23    | 0.029816 | A         | 0.014908 | 55.48   | 6.54     |
|       |          | B         | 0.014908 | 55.48   | 6.54     |
| 24    | 0.026554 | A         | 0.013277 | 49.41   | 5.07     |
|       |          | B         | 0.013277 | 49.41   | 5.07     |
| 25    | 0.015777 | A         | 0.007888 | 29.36   | 1.79     |
|       |          | B         | 0.007888 | 29.36   | 1.79     |
| 26    | 0.041034 | A         | 0.020517 | 76.35   | 11.71    |
|       |          | B         | 0.020517 | 76.35   | 11.71    |
| 27    | 0.014331 | A         | 0.007165 | 26.67   | 1.48     |
|       |          | B         | 0.007165 | 26.67   | 1.48     |
| 28    | 0.026858 | A         | 0.013429 | 49.98   | 5.18     |
|       |          | B         | 0.013429 | 49.98   | 5.18     |
| 37    | 0.016111 | A         | 0.008055 | 29.98   | 1.87     |
|       |          | B         | 0.008055 | 29.98   | 1.87     |
| CROWN | 0.439159 |           |          | 204.12  |          |

|    |          |   |          |        |       |          |
|----|----------|---|----------|--------|-------|----------|
| 5  | 0.024955 | A | 0.012477 | 46.44  | 1.19  | 1.193404 |
|    |          | B | 0.012477 | 46.44  | 1.19  | 1.193404 |
| 9  | 0.039377 | A | 0.019688 | 73.27  | 6.15  | 6.153740 |
|    |          | B | 0.019688 | 73.27  | 6.15  | 6.153740 |
| 10 | 0.024243 | A | 0.012121 | 45.11  | 1.02  | 1.021897 |
|    |          | B | 0.012121 | 45.11  | 1.02  | 1.021897 |
| 11 | 0.027244 | A | 0.013622 | 50.69  | 1.80  | 1.799485 |
|    |          | B | 0.013622 | 50.69  | 1.80  | 1.799485 |
| 12 | 0.023832 | A | 0.011916 | 44.35  | 0.93  | 0.936570 |
|    |          | B | 0.011916 | 44.35  | 0.93  | 0.936570 |
| 13 | 0.032426 | A | 0.016213 | 60.34  | 3.48  | 3.479879 |
|    |          | B | 0.016213 | 60.34  | 3.48  | 3.479879 |
| 14 | 0.023177 | A | 0.011588 | 43.13  | 0.78  | 0.780211 |
|    |          | B | 0.011588 | 43.13  | 0.78  | 0.780211 |
| 15 | 0.056439 | A | 0.028219 | 105.02 | 12.37 | 12.37319 |
|    |          | B | 0.028219 | 105.02 | 12.37 | 12.37319 |
| 16 | 0.017444 | A | 0.008722 | 32.46  | 0.00  | -0.20918 |
|    |          | B | 0.008722 | 32.46  | 0.00  | -0.20918 |

|                   |          |   |          |       |        |          |
|-------------------|----------|---|----------|-------|--------|----------|
| 17                | 0.038463 | A | 0.019231 | 71.57 | 5.82   | 5.820568 |
|                   |          | B | 0.019231 | 71.57 | 5.82   | 5.820568 |
| 18                | 0.037381 | A | 0.018690 | 69.56 | 5.43   | 5.426156 |
|                   |          | B | 0.018690 | 69.56 | 5.43   | 5.426156 |
| 19                | 0.022874 | A | 0.011437 | 42.56 | 0.71   | 0.714817 |
|                   |          | B | 0.011437 | 42.56 | 0.71   | 0.714817 |
| 20                | 0.043832 | A | 0.021916 | 81.56 | 7.78   | 7.777681 |
|                   |          | B | 0.021916 | 81.56 | 7.78   | 7.777681 |
| 21                | 0.026698 | A | 0.013349 | 49.68 | 1.65   | 1.647337 |
|                   |          | B | 0.013349 | 49.68 | 1.65   | 1.647337 |
| 29                | 0.02087  | A | 0.010435 | 38.83 | 0.32   | 0.319131 |
|                   |          | B | 0.010435 | 38.83 | 0.32   | 0.319131 |
| 30                | 0.016213 |   | 0.008106 | 30.17 | 0.00   | -0.35335 |
|                   |          |   | 0.008106 | 30.17 | 0.00   | -0.35335 |
| 31                | 0.012294 |   | 0.006147 | 22.88 | 0.00   | -0.65162 |
|                   |          |   | 0.006147 | 22.88 | 0.00   | -0.65162 |
| 32                | 0.014097 |   | 0.007048 | 26.23 | 0.00   | -0.54478 |
|                   |          |   | 0.007048 | 26.23 | 0.00   | -0.54478 |
| 33                | 0.011065 |   | 0.005532 | 20.59 | 0.00   | -0.69477 |
|                   |          |   | 0.005532 | 20.59 | 0.00   | -0.69477 |
| 34                | 0.010733 |   | 0.005366 | 19.97 | 0.00   | -0.70230 |
|                   |          |   | 0.005366 | 19.97 | 0.00   | -0.70230 |
| 35                | 0.010446 |   | 0.005223 | 19.44 | 0.00   | -0.70740 |
|                   |          |   | 0.005223 | 19.44 | 0.00   | -0.70740 |
| 36                | 0.022309 |   | 0.011154 | 41.51 | 0.60   | 0.596784 |
|                   |          |   | 0.011154 | 41.51 | 0.60   | 0.596784 |
| 38                | 0.004429 |   | 0.002214 | 8.24  | 0.00   | -0.51215 |
|                   |          |   | 0.002214 | 8.24  | 0.00   | -0.51215 |
| FREEHOLD 0.560841 |          |   |          |       | 100.06 |          |



Home Oil and Natural Gas  
Conservation Board

555 — 330 Graham Avenue  
Winnipeg MB R3C 4E3  
CANADA

(204) 945-1111  
FAX: (204) 945-0586

June 2, 1993

Mr. G.C.K. Johnson, P. Eng.  
Coordinator, Southern Production  
Home Oil Company Limited  
1600 Home Oil Tower  
324 - 8th Avenue SW  
Calgary AB T2P 2Z5

Dear Mr. Johnson:

**Re: Pierson Lower Amaranth C Pool**  
**Application for Approval of a Waterflood**

The Board has completed its review of Home's application for approval of a waterflood in a portion of the Pierson Lower Amaranth C Pool. The Board's review also addressed Home's requests for reduced 16 ha spacing in the waterflood project area and for waiver of maximum permissible production rate (MPPR) restrictions.

#### **WATERFLOOD PROJECT APPROVAL**

Attached is a copy of Board Order No. PM 70 approving waterflood operations in a portion of the Pierson Lower Amaranth C Pool. Please note that water injection under Board Order No. PM 70 is not to commence until the Board has approved the Unit Agreement as required under Section 74 of The Mines Act.

The Board is concerned with the degree of reservoir depletion in portions of the waterflood project area. RFT pressure data from wells drilled in the fall of 1992 indicates portions of Sections 8 and 9-2-29 (WPM) are close to the bubble point. The Board does not want excessive pre-waterflood depletion to delay waterflood response and negatively impact the project's technical or economic success.

The Board is satisfied that Home can properly manage the reservoir during the two years required to complete infill drilling and injector conversions by following its proposed development schedule contained in Appendix H of the application and running RFT's on as many infill wells as needed to accurately

determine reservoir pressure. The Board requests Home follow its development schedule as closely as possible and advise the Petroleum Branch, in advance where possible, of any significant changes in the schedule.

Where during the course of project development it is discovered that the reservoir pressure in a portion of the project area is below the bubble point, the Board expects Home to initiate corrective measures such as accelerating injector conversions, increasing injection volumes or reducing reservoir withdrawals.

#### REDUCED 16 ha SPACING APPROVAL

On the effective date of unitization as approved by the Board under Section 74 of The Mines Act, spacing in the waterflood project area will be reduced to 16 ha. Spacing will be reduced by amending Board Order No. SU 9 (attached for your reference) to exclude the waterflood project area. A copy of the proposed revision to Schedule A under Board Order No. SU 9, to take effect upon unitization, is included for your information. Please note the Board also proposes to reduce spacing in LSD's 4 & 5 of Section 4-2-29 (WPM) to 16 ha under the same revision. The Board feels any wells drilled on these lands, near the productive limits of the pool, will not be capable of effectively draining 32 ha.

The Board is advised that Home has recently asked the Petroleum Branch about the possibility of commencing 16 ha infill drilling in the waterflood project area as soon as possible. The Board is of the opinion there is a high risk that infill drilling prior to unitization will accelerate reservoir pressure depletion and unnecessarily complicate and delay unitization. The Board is particularly concerned that additional data from 16 ha infill wells will make it difficult to equitably determine tract factors and will reduce Home's chances of reaching a voluntary unit agreement. If unitization is delayed any problems associated with reservoir pressure depletion will be aggravated.

The Board considers Home's interest in accelerating infill drilling to be a substantive change from what was requested in this application. If Home wishes the Board to consider the matter the company should reapply for approval to commence infill drilling prior to unitization. Such application should address the effect of accelerating infill drilling on reservoir depletion, waterflood recovery, project economics, unitization and project start-up.

#### WAIVER OF MPPR RESTRICTIONS

Attached is Board Order No. 81A approving the waiver of MPPR restrictions within the waterflood project area on a pattern by pattern basis.



After an injector has been converted, Home is to notify the Petroleum Branch when the conditions contained in the order have been met;

- (1) average reservoir pressure in the pattern exceeds 7600 kPa, and
- (2) reservoir withdrawals attributed to wells in the pattern are completely replaced by water injection in the pattern on a monthly basis.

Upon notification of satisfaction of these conditions, and unless otherwise advised by the Branch, MPPR restrictions will be automatically waived commencing the first day of the following month.

If you have any questions in respect of this approval, please contact L. R. Dubreuil, Director of Petroleum or John N. Fox, Chief Petroleum Engineer at (204) 945-6573 or 946-6574, respectively.

Yours respectfully,

A handwritten signature in black ink, appearing to read 'H. Clare Moster', with a long, sweeping underline that extends to the right.

H. Clare Moster  
Deputy Chairman



Order No. SU 9

An Order Pertaining to Drilling Spacing Units  
Pierson Area  
Lower Amaranth and Mission Canyon Formations

WHEREAS, clause (9)(b) of section 62 of "The Mines Act", being Chapter M160 of the Continuing Consolidation of the Statutes of Manitoba, provides as follows:

"62(9) Without restricting the generality of subsection (8) the board, with the approval of the minister, may make orders

(b) respecting the designation of the area that shall be allocated to a well in connection with fixing allowable production;"

AND WHEREAS, clause (1)(f) of section 63 of "The Mines Act" provides in part as follows:

"63(1) For the purpose of carrying out the provisions of this Part and Part III according to their intent, the Lieutenant Governor in Council may make such regulations and orders as are ancillary thereto, and are not inconsistent therewith; and every such regulation or order made under, and in accordance with the authority granted by, this section has the force of law; and, without restricting the generality of the foregoing, the Lieutenant Governor in Council may make regulations and orders

(f) prescribing spacing units and the size and shape of spacing units;"

AND WHEREAS, subsection (1) of section 20 of Manitoba Regulation 430/87R under The Mines Act ("the Petroleum Drilling and Production Regulation") provides as follows:

"20(1) Notwithstanding section 19, the board may, after a public hearing or after publication of notice, prescribe by order special drilling spacing units which may differ from normal drilling spacing units in size, shape or target area."

AND WHEREAS, subsection (3) of section 21 of the Petroleum Drilling and Production Regulation provides as follows:

"21(3) Where a special drilling spacing unit is prescribed under section 20, the board may prescribe the target area within which a well shall be completed in order to qualify for a maximum permissible production rate based on the area of the special drilling spacing unit."

AND WHEREAS, the Board received an application dated September 26, 1991 from Home Oil Company Limited and an application dated October 1, 1991 from Tundra Oil and Gas Ltd. for continuation of special 32 ha drilling spacing units for the Lower Amaranth Formation in the Pierson area ("the area of application"). Home Oil Company Limited also applied for approval of special 32 ha drilling spacing units for the Mission Canyon Formation.

AND WHEREAS, upon publication of notice of the application, the Board received an objection to the application.

AND WHEREAS, upon due consideration of the said applications and objection thereto, the Board considers continuation of special 32 ha drilling spacing units for the Lower Amaranth Formation and establishment of special 32 ha drilling spacing units for the Mission Canyon Formation in a portion of the area of application to be reasonable and desirable.

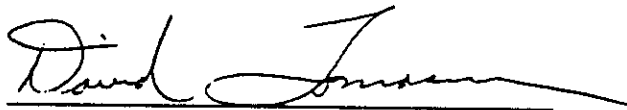
NOW THEREFORE, the Board orders that:

1. The spacing unit for each well drilled, or to be drilled, for the purpose of obtaining oil from the Jurassic Lower Amaranth Formation or the Mississippian Mission Canyon Formation within the area outlined on Schedule A is two legal subdivisions comprising the east half or the west half of a quarter section.
2. The target area of each drilling spacing unit shall be a square area in the even-numbered legal subdivision having sides one hundred metres from the sides of the legal subdivision and parallel to them.

3. The area outlined on Schedule A may be modified by the Board from time to time to meet changing circumstances.
4. Board Order No. SU 6 dated July 27, 1990 is hereby rescinded.



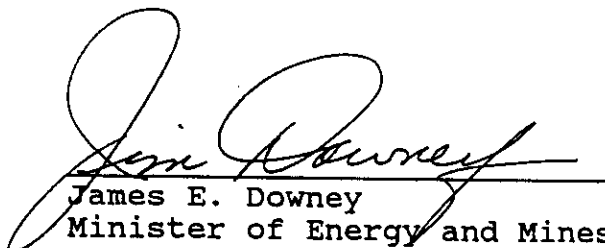
H. Clare Moster  
Deputy Chairman



David Tomasson  
Chairman

OIL AND NATURAL GAS  
CONSERVATION BOARD ORDER  
NO. SU 9 APPROVED THIS  
*25<sup>TH</sup>* DAY OF *JANUARY* A.D., 1993  
AT THE CITY OF WINNIPEG.

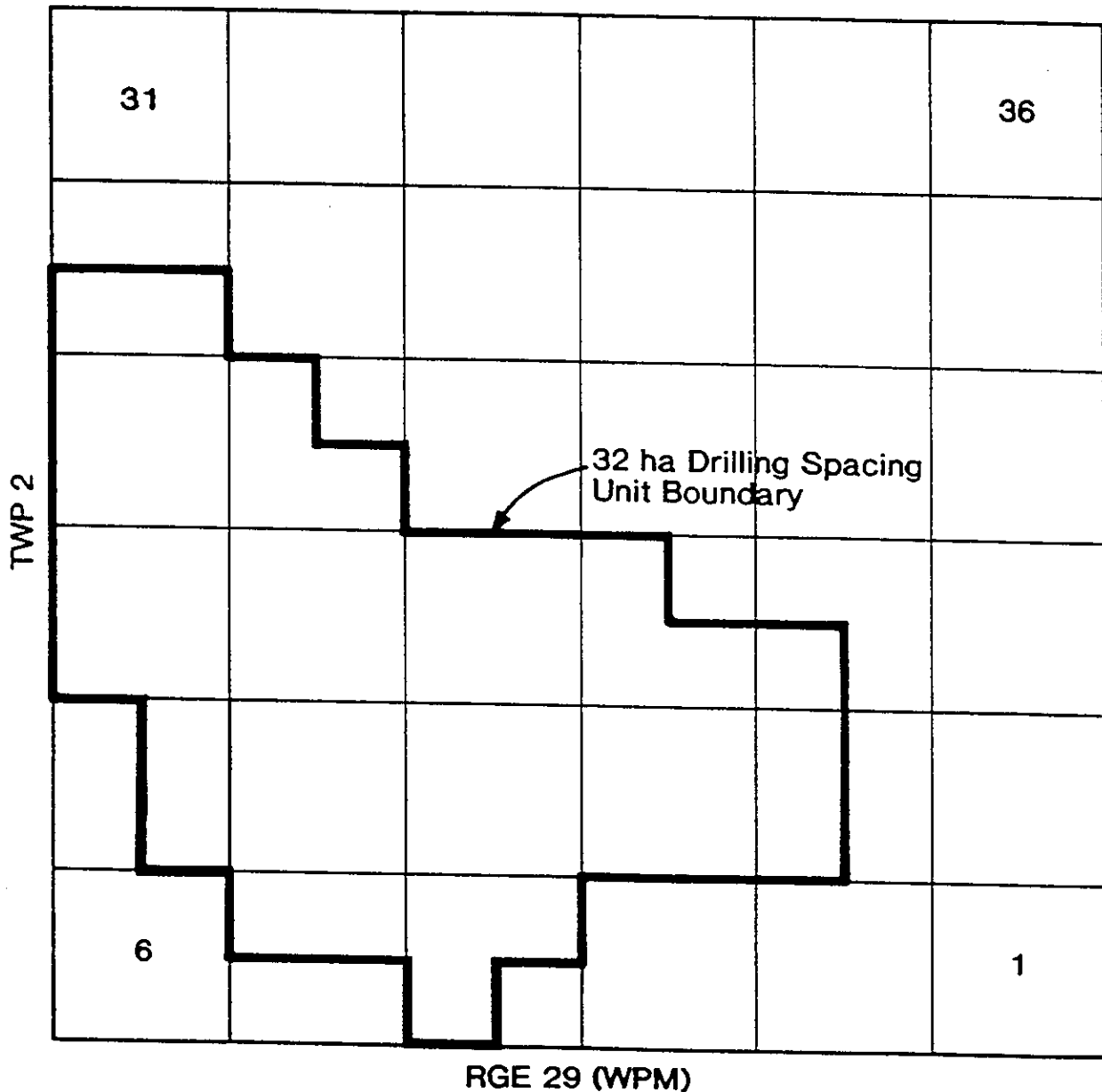
APPROVED:



James E. Downey  
Minister of Energy and Mines

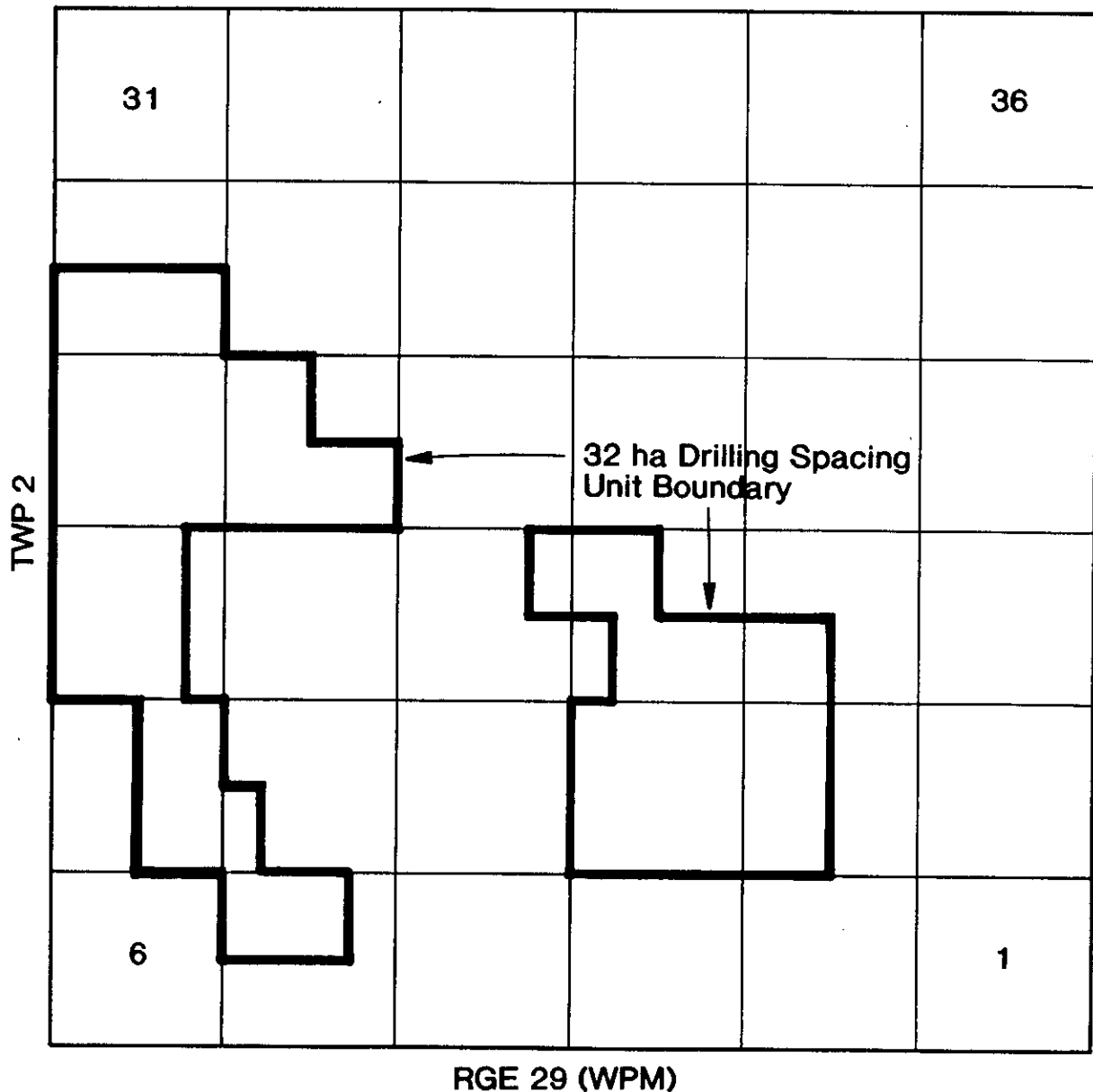
**BOARD ORDER NO. SU 9  
SCHEDULE A**

**PIERSON AREA  
32 ha DRILLING SPACING UNITS  
LOWER AMARANTH AND MISSION CANYON FORMATIONS**



**BOARD ORDER NO. SU 9  
SCHEDULE A – REVISED**

**PIERSON AREA  
32 ha DRILLING SPACING UNITS  
LOWER AMARANTH AND MISSION CANYON FORMATIONS**



EFFECTIVE DATE: \_\_\_\_\_

APPROVED: \_\_\_\_\_  
The Oil and Natural Gas Conservation Board

DATE: \_\_\_\_\_



**Order No. 81A  
An Order Pertaining to Maximum Permissible  
Production Rates in the Pierson Field**

WHEREAS, subsection 51(3) of The Petroleum Drilling and Production Regulation, being Manitoba Regulation 430/87R ("the regulation") states as follows:

"51(3) Notwithstanding anything in this section, the board upon application or upon its own initiative, may establish any maximum permissible production rate for a well or exempt a well from any of the provisions of this section."

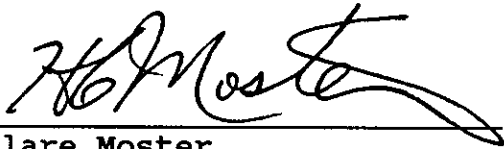
AND WHEREAS, the Board received an application dated February 22, 1993 from Home Oil Company Limited ("the operator"), for a waiver of maximum permissible production rate restrictions for wells producing from the Lower Amaranth and Mission Canyon formations in the waterflood project area outlined in Schedule A.

AND WHEREAS, upon publication of notice of the application, the Board received no objections to or interventions in the application.

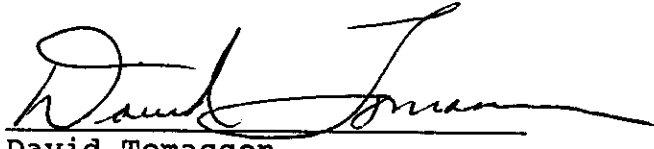
NOW, THEREFORE, the Board orders that:

1. Wells producing from the Pierson Lower Amaranth C Pool in an inverted 5-spot injection pattern within the waterflood project area outlined in Schedule A shall be exempt from the maximum permissible production rate restrictions of subsection 51(1) of the regulation when the following conditions have been met:
  - (a) the operator has demonstrated to the Board that the static reservoir pressure in the pattern exceeds 7600 kPa at a datum of 550 m subsea, and;

- (b) reservoir withdrawals attributed to wells in the pattern are completely replaced by water injection in the pattern on a monthly basis.
2. For any pattern within the waterflood project area where the provisions of section 1 are not met, the maximum permissible production rates established under subsection 51(1) of the regulation will apply.



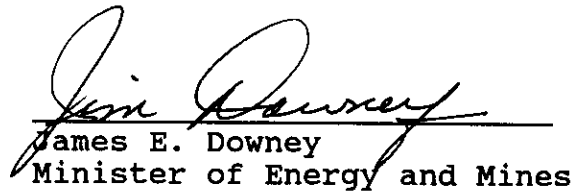
H. Clare Moster  
Deputy Chairman



David Tomasson  
Chairman

OIL AND NATURAL GAS CONSERVATION  
BOARD ORDER NO. 81A APPROVED THIS  
1<sup>st</sup> DAY OF June A.D., 1993  
AT THE CITY OF WINNIPEG.

APPROVED:



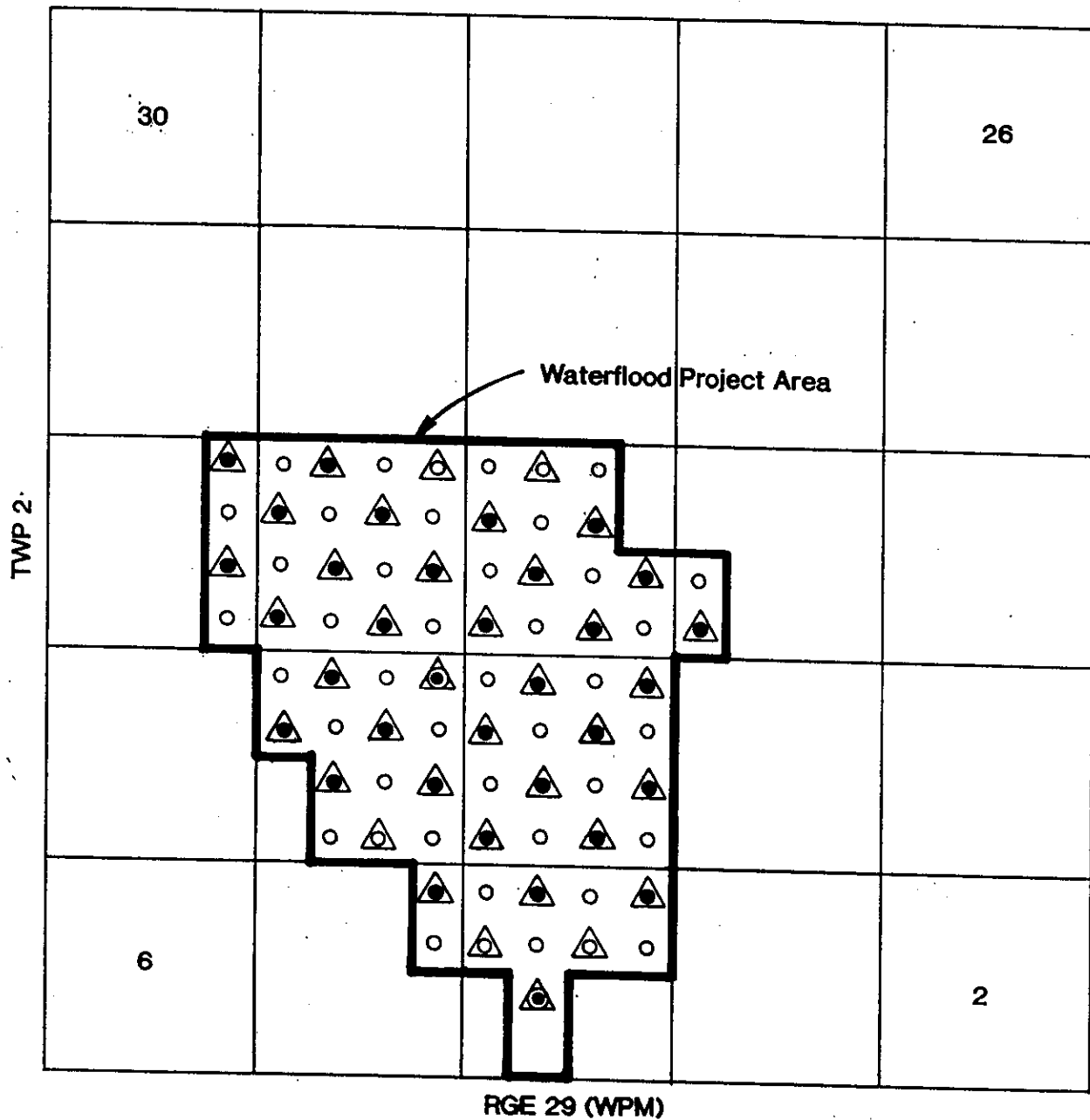
James E. Downey  
Minister of Energy and Mines



# BOARD ORDER NO. 81A

## SCHEDULE A

### PIERSON LOWER AMARANTH C POOL



#### LEGEND

- Current production well
- Production well to be drilled
- ⊙ Current water disposal well
- △ Well to be converted to water injection



The Oil and Natural Gas  
Conservation Board

555 — 330 Graham Avenue  
Winnipeg MB R3C 4E3  
CANADA

(204) 945-1111  
FAX: (204) 945-0586

**Order No. PM 70  
An Order Pertaining to Pressure  
Maintenance by Water Flooding  
Pierson Lower Amaranth C Pool**

WHEREAS, subsection (9) (d) of Section 62 of "The Mines Act", being Chapter M160 of the Continuing Consolidation of the Statutes of Manitoba, provides as follows:

"62(9) Without restricting the generality of subsection (8) the board, with the approval of the minister, may make orders

(d) requiring the repressuring, recycling, or pressure maintenance, of any pool or portion thereof where it is economical so to do, and for that purpose where necessary requiring the introduction or injection into any pool or portion thereof of gas, air, water or other substance;"

AND WHEREAS, the Board received an application dated February 22, 1993 from Home Oil Company Limited ("the operator") for approval of a project to inject water into the Pierson Lower Amaranth C Pool ("the pool") in the area of application outlined on Schedule A ("the waterflood project area").

AND WHEREAS, upon publication of notice of the application the Board received no objections to or interventions in the application.

NOW THEREFORE, the Board orders that:

1. The operator shall conduct pressure maintenance operations by the injection of water into the pool underlying the waterflood project area.
2. The pressure maintenance operation shall be in accordance with, and subject to, the following rules:

PRESSURE MAINTENANCE RULES

1(1) Water shall be injected into the pool through the wells shown on Schedule A and such other wells in the waterflood project area as the Board may order or approve.

1(2) After the commencement of injection, the operator shall, subject to any remedial work required to be performed on the wells referred to in subsection (1), endeavour to maintain continuous injection.

1(3) Notwithstanding the provisions of subsection (2), the Board may, upon its own motion or upon application by the operator, order the suspension of water injection into any well or wells, provided that the Board is satisfied that pressure maintenance operations in the waterflood project area will not be adversely affected.

1(4) The completion of the wells referred to in subsection (1) will be as prescribed by the Director of Petroleum.

2 The operator, upon the request of the Board, shall satisfy the Board as to the source, suitability and method of treatment of the water to be injected.

3(1) Before injection of water is commenced, the operator shall submit, to the Board, results of a survey conducted to determine the static reservoir pressure in the waterflood project area.

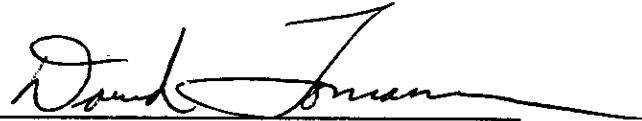
3(2) The operator shall, not less than six months nor more than 12 months after the commencement of injection, and at yearly intervals thereafter, conduct a survey to determine the static reservoir pressure in the waterflood project area.

3(3) The operator shall submit to the Petroleum Branch, the details of the surveys described in subsections (1) and (2), including a list of the wells to be surveyed, the measurement technique to be used, and the intended shut-in periods for each well, and approval shall be obtained from the Director of Petroleum before the program is carried out.

7        The operator, shall, within 60 days of the end of each calendar year, file with the Petroleum Branch a report of the pressure maintenance program, setting out graphically such interpretive information necessary to evaluate the efficacy of the waterflood.



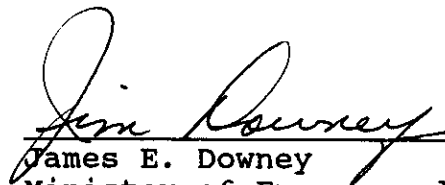
H. Clare Moster  
Deputy Chairman



David Tomasson  
Chairman

OIL AND NATURAL GAS CONSERVATION  
BOARD ORDER NO. PM 70 APPROVED THIS  
1<sup>st</sup> DAY OF *June* A.D. 1993  
AT THE CITY OF WINNIPEG.

APPROVED:

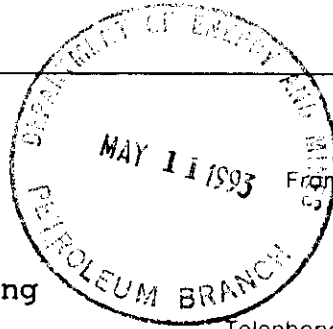


James E. Downey  
Minister of Energy and Mines



Date May 10, 1993

To David Tomasson  
Chairman  
Oil and Natural Gas  
Conservation Board  
327 Legislative Building



## Memorandum

H. Clare Moster  
Deputy Chairman  
Oil and Natural Gas  
Conservation Board  
1111

Subject THE OIL AND NATURAL GAS CONSERVATION BOARD

RE: - Order No. PM 70  
- Order No. 81A

Attached and recommended for your signature and the Minister's approval are two (2) copies of each of the subject Board Orders.

Please return to my attention when approved.

### BACKGROUND

The attached memo to the Board describes in detail the technical support for the Orders which relate to an application by Home Oil Company Limited for the Pierson Lower Amaranth C Pool.

Public notice of the application was made and no objections were received.


Order No. PM 70 provides authority to implement a waterflood pressure maintenance project in a portion of the subject pool. Plans are to drill 43 wells and convert 37 existing wells to water injection prior to September 1995. Estimates indicate that recovery from the pool will be increased by between 100-200%. Because of declining pressures in this area of the pool it is important that pressure maintenance be initiated as soon as possible so as not to adversely affect ultimate recovery from the pool.

Order No. 81A will exempt wells within those areas of the waterflood project where the reservoir pressure is being maintained through water injection from production rate restrictions. The pressure and injection conditions contained in the order will protect the reservoir while permitting the operator to maximize economic benefits from the project.

The applicant has also recently indicated an interest in amending the recently approved enlarged (32 ha) well spacing order for the pool. The draft covering letter to Home (copy attached) to accompany the approved orders indicates that the Board is prepared to revise the current well spacing order (Board Order No. SU9) effective the date of unitization of the project area. This will enable Home to drill the new wells on normal 16 ha spacing and not further aggravate the declining reservoir pressure situation or

First | Fold

complicate negotiations regarding unitization (i.e. determination of tract allocation factors).

  
H. Clare Moster

Attachment

cc: L.R. Dubreuil

MemDT124 Doc

**Home Oil Company Limited**

1600 Home Oil Tower  
324 Eighth Avenue S.W.  
Calgary, Alberta T2P 2Z5  
Telephone (403) 232-7100  
Fax (403) 232-7678



May 12, 1992

Province of Manitoba  
Department of Energy and Mines  
Room 309, Legislative Building  
450 Broadway Avenue  
WINNIPEG, Manitoba  
R3C 0V8

**Attention: Mr. J. N. Fox, P.Eng.**

Dear Sir,

**RE: South Pierson Preliminary Waterflood Report  
Lower Amaranth Pool**

Please find enclosed the original and a copy of the above noted report.

The purpose of this document is to advise the crown of Home Oil / Scurry-Rainbow's proprietary work towards the assessment of waterflood potential in the Lower Amaranth formation of the South Pierson field.

Technical work supports the implementation of a secondary recovery scheme in South Pierson to recover an additional 25% of the O.O.I.P. however, the economics for the project are marginal and sensitive to the large initial capital requirements.

Derived pressure data from flow and build-up analysis has been historically poor due to the tight nature of the reservoir. Further accurate pressure data, perhaps from infill well RFT's, is currently sought after and would greatly enhance future reservoir study work.

The immediate implementation of a small scale pilot project is recommended to determine the injectivity in the field and ensure that the waterflood is economically viable. A formal application for the pilot project is currently being prepared and will be forwarded to the crown by the end of June.

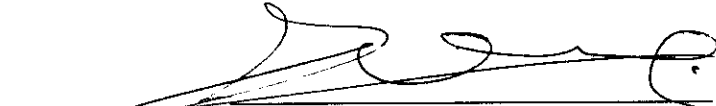
If you have any question or require further clarification regarding the report's content, please contact Curt Labelle at (403) 232-7457.

Sincerely,

**HOME OIL COMPANY LIMITED  
SCURRY-RAINBOW OIL LIMITED**

CWL/cwl

ENCL.



**J. H. Olthof, Manager  
Southern Production**

May 12, 1992

Province of Manitoba  
Department of Energy and Mines  
Room 309, Legislative Building  
450 Broadway Avenue  
WINNIPEG, Manitoba  
R3C 0V8

**Attention: Mr. J. N. Fox, P.Eng.**

Dear Sir,

**RE: South Pierson Preliminary Waterflood Report  
Lower Amaranth Pool**

cc: G.C.K. Johnson  
J. S. Murray  
Day File  
File PIER.GOV



OOIP -  $7 \times 10^6 \text{ m}^3$  - LAM or LAM/MC

ROIP -  $504.6 \times 10^3 \text{ L}^3$  PRIMER (7.2% OOIP ~ 2% OOIP FROM MC3)

SEC RATE - 22% / YR PRIMER

28% OF TOTAL REC.  
RESERVES  
based

$\bar{P} < P_b = 4550 \text{ kPa}$

NATREFLOOD

5 WELLS ON 16 HA SPACING

ROIP  $2.24 \times 10^6 \text{ L}^3$  32% OOIP

EA = 84 %

RECOMMENDED ~~the~~ PRESS  $< 17,000 \text{ kPa}$  Fracture press. (GRADING)

GOOD LATERAL CONTINUITY IN 3 AND RESERVOIR UNITS

- trapping mechanism - gradual  
percentage, present not  
economic, present and to be economically, or  
economically defined. However, <sup>ECONOMIC</sup> not all

- VOLUME OF OOIP IN MC

- FLUID INFUX FROM MC ~ 28% oil production TO DATE,  
WHAT % OF WATER PRODUCTION - DEGREE OF PRESSURE SUPPORT

- WHICH WELL / AREAS EXHIBITING INCREASED GAS PRODUCTION / ADVANCED DEPLETION - CONCERN LOSS RECOVERY
- MAJORITY OF WELLS REACH BP IN 1-3 YRS
- 28% OF REIN PROD. ATTRIBUTED TO HC COMMUNICATION
- 12-19 ADVANCE CORE ANALYSIS REC'D ?

TRACY-TARNER PREDICTION PRIMARY RECOVERY - 2.1% OOIP TO BUBBLE POINT  
(PRESENT REC. 2.1%) & 9.3% GDP TURN

AS K INCREASED TIME TO BREAKTHROUGH DECREASES AND  
RESERVES RECOVERED SUBSTANTIALLY QUICKER TO BREAKTHROUGH  
K Inc - 2.5 to 4.5 (WATER K 3.5 to 4.5) Time, (now 551 to 218 yr) - natural effect does appear to be

PROJECT AREA - INCLUDE ALL HUNE'S WELLS EXCEPT SEC 1-2-29

- LAM reservoir is very tight siltstone / sandstone with limited drainage area  $\rightarrow$  ?

- individual <sup>well</sup> decline rate variable 2% to 87% / well

CHECK FOR RFT DATA ON 1992 WELLS

TABLE ① { EXISTING WELLS  $\sim 286 \times 10^3 \text{ L}^2$  (4.1% OOIP)  
INFILLING PRICING (ARBITRARY SCHEDULE)  $\Delta$  RECOVERY  $218.6 \times 10^3 \text{ L}^2$  (3.1% OOIP)  
SPACING  $\sim 32$  ha ONLY

## INFILL DRILLING SCHEDULE (FROM TABLE 1)

| YR 1       | YR 2     | YR 3     | YR 4     | YR 5     | YR 6     | YR 7      |
|------------|----------|----------|----------|----------|----------|-----------|
| 6-8 COOP   | 12-4     | 4-10     | 4-4      | 12-11    | 14-6     | 10-18     |
| 14-8 COOP  | 2-8      | 12-10    | 10-4     | 16-16    | 4-11     | 12-18     |
| 10-16 COOP | 4-8      | 6-14     | 2-7      | 16-17    | 2-21     | 2-19      |
| 14-16      | 10-8     | 2-15     | 8-7      | 2-18     | 4-30     | 4-19      |
| <u>4</u>   | 2-9      | 8-15     | 16-7     | 14-18    | 6-30     | 8-19      |
|            | 6-9      | 12-15    | 2-10     | <u>5</u> | 8-30     | 8-20      |
|            | 10-9     | 14-15    | 6-15     |          | 10-30    | 14-20     |
|            | <u>7</u> | 14-19    | <u>7</u> |          | 12-30    | 6-21      |
|            |          | <u>8</u> |          |          | 14-30    | 8-21      |
|            |          |          |          |          | <u>9</u> | 4-29      |
|            |          |          |          |          |          | 6-29      |
|            |          |          |          |          |          | 16-30     |
|            |          |          |          |          |          | 6-31      |
|            |          |          |          |          |          | <u>14</u> |

## WATERFLOOD EVALUATION

- part of pressure data - conventional waterflood analysis  
used as simulation

net pay cut-off  $\Phi_D = 12$  (compares to  $k = 1 \text{ md}$ )

$h_{\text{aver}} = 4.3 \text{ m}$

$\Phi_{\text{Rgt}} = 12-20$   $\Phi_{\text{Lave}} = 15$

$S_{wc} = 41\%$   $S_{no} = 29\%$

$S_{\text{water}} = 43\%$  used

$\bar{P}_R = 10,500$

$T_R = 40^\circ\text{C}$

$B_{oi} = 1.169$

$B_{o_{bpt}} = 1.178$

$\mu_i = 1.35 \text{ cP}$

$\mu_{bpt} = 1.24 \text{ cP}$

CHECK FOR

6-19 PVT DATA

12-15 Advanced Core Analysis Study

} INCLUDED IN  
STUDY - APPENDIX

$E_A = 84\%$  (little recovery after breakthrough)

- WF forecast - dampening of primary prod. decline

WF RF = 32% 6018

- 5 spot injection pattern injector / prod. ratio = 1.0  
or 16 hr spacing - note: there is  
concerned the induced fracture trend  
affects performance HOC remains
- agree with HOC position the NC / LAM  
be concurrently produced  $\rightarrow$  Branch conditions
- horizontal injector (regally / base treatment)
- plan to maximize injection as over inject maximize  
production & minimize response.
- consider down & out side the simulation - base area  
high K ; higher h
- produced water for injection no emphasis good oil quality
- Pilot Project 1992  $\rightarrow$  injectivity test
- $\rightarrow$  6 yrs before field completely under waterflood
- $\rightarrow$  design wellhead injection measure
- $\rightarrow$  unitization plans underway WASKADA TRACT FACTORS.

1. THE PLAN TO DRILL 16 ha INJECTORS ?

71 - 16 ha LOCATIONS IN WATERFLOOD AREA

39 - 32 ha LOCATION IN WF AREA

HOC 103 UNDRILLED LOCATIONS WITHIN WF AREA VS 47  
WELLS DRILLED

ECONOMICS - CROWN REVENUE AND FREEMOLD PRODUCTION TAX  
HOLIDAY VOLUMES INCLUDED

MAPS USING TABLE 3

OOIP

ROIP RATE/TIME

RF " "

DO WELLS WITH NC PROD CONTRIBUTION HAVE  
NC OIL EVIDENT ON LOGS.

TABLE 5 - WATERFLOOD CASE

| RATE<br>L/D | PROD<br>L/D | COL PROD |
|-------------|-------------|----------|
|-------------|-------------|----------|

WHAT IMPACT ON RECOVERY DOES START-UP AFTER  
BUBBLE POINT REACTION.

HOC reviewed WF on 16 & 8 Lc spacing impact of  
8 Lc spacing to accelerate recovery

|       |         |   |                                |      |   |
|-------|---------|---|--------------------------------|------|---|
| Lower | 2.5 - d | } | ACCELERATION<br>OF<br>RECOVERY | 2.1* | NO IMPROVEMENT<br>IN <del>PROD</del> SWDP |
|       | 3.5 - d |   |                                | 2.1* |   |
|       | 4.5 - d |   |                                | 2.1* |   |

no 40 injection completion



## Memorandum

Date May 5, 1993

To The Oil and Natural Gas  
Conservation Board  
- David Tomasson, Chairman  
- H. Clare Moster, Deputy Chairman

From John N. Fox  
Chief Petroleum Engineer

Subject Home Oil Company Limited  
Application for Approval of a Waterflood  
Pierson Lower Amaranth C Pool

Telephone

Home Oil's application for approval to conduct a waterflood in the Pierson Lower Amaranth C Pool was advertised in the Manitoba Gazette (March 27, 1993) and the Melita New Era (April 6, 1993). Notice of the application was also sent to lessors and lessees in and adjacent to the area of application. The closing date for objections was April 23, 1993. No objections to the application were received.

### RECOMMENDATIONS

It is recommended that the Board approve the application and issue the following approvals (attached).

- (1) Board Order No. PM 70 approving a waterflood in a portion of the Pierson Lower Amaranth C Pool.
- (2) Reduced 16 ha spacing in the waterflood project area by modifying the area covered by Board Order No. SU 9. Reduced 16 ha spacing approval will be coincident with the effective date of the unit as approved by the Board under Section 74 of The Mines Act.
- (3) Board Order No. 81A approving a waiver of maximum permissible production rate (MPPR) restrictions for individual injection patterns when voidage in the pattern is being replaced.

The attached Board letter of approval to accompany the orders includes conditions associated with the above approvals and addresses Home's verbal request for permission to commence infill drilling prior to unitization.

### DISCUSSION

#### Waterflood Project

Home plans to implement a waterflood in a portion of the Pierson Lower Amaranth C Pool (Figure 1). The waterflood involves infill drilling on 16 ha spacing and conversion of

First | Fold



existing producers to injection to create inverted 5-spot injection patterns (Figure 1). Home has predicted waterflooding will increase the recovery from 10.6% OOIP under primary to 30.3% OOIP. Home expects the waterflood to perform in a manner similar to the Waskada Lower Amaranth waterfloods with injection arresting the production decline from 22%/year to less than 1%/year, with no significant oil bank being formed. Details of Home's waterflood study and predictions are outlined in the Branch's memo dated March 11, 1993.

The only concern the Branch has with Home's waterflood project is the degree of reservoir depletion prior to water injection commencing and its impact on recovery and project economics.

The optimum reservoir pressure at which to waterflood is the bubble point; waterflood response is not delayed by reservoir fill-up, reservoir oil viscosity is at a minimum improving areal sweep and productivity is not reduced by gas production above the solution GOR. Home recently conducted additional PVT analyses which indicated the bubble point pressure is 7584 kPa, not 4550 kPa as had previously been determined.

The Pierson Lower Amaranth C Pool is rapidly approaching the bubble point and in the more depleted portions of the project area in Sections 8 and 9, the reservoir pressure may already be below the bubble point. Figure 2 shows the most recent RFT and AWS (somewhat suspect) pressure data. Pressures in the E/2 of Section 8 and Section 9 range from 7600-8800 kPa and in the W/2 of Section 8 and Sections 17 and 18 from 9200-10000 kPa. If the reservoir pressure in the Pierson Lower Amaranth C Pool drops below the bubble point prior to commencement of water injection, as seems likely in parts of Section 8 and 9, a free gas saturation will develop in the reservoir. A minimal free gas saturation will not adversely affect areal sweep or displacement efficiency, as most of the free gas would be forced back into solution as water injection increases the reservoir pressure. A free gas saturation will however, increase the time required for reservoir fill-up and delay waterflood response. A free gas saturation near the wellbore will also increase the GOR and reduce oil productivity. These two factors combined though not directly affecting ultimate recovery, will certainly have a negative influence on the project economics and conversely may cause Home to hesitate and perhaps not expand the waterflood to the remainder of the C Pool. The literature also documents cases of reservoirs under waterflood where the oil bank has resaturated unswept low permeability portions of the reservoir containing free gas. If the free gas saturation becomes excessive (which is unlikely) channelling of the injected water could occur greatly reducing the volumetric sweep efficiency, as experienced in the Waskada Lower Amaranth gas flood conducted by Omega.

At this time the Branch is satisfied with Home's development schedule. Home plans to drill 43 wells and convert 37 wells to injection between August 1993 and August 1995 to complete the project (Table 1). In general Home plans to convert existing producers to injection within 4 months of completion of the drilling of the (4) infill wells in an injection pattern. The critical areas for immediate pressure support are the low pressure portions of Sections 8 and 9. Home plans on converting 13 wells to injection in Sections 8 and 9 by June 1994.

Home plans to run RFT's on a number of the infill wells to determine the reservoir pressure. The company indicated it would use this pressure data to modify its development schedule to ensure excessive reservoir depletion is avoided. The Branch will also review RFT pressure data and infill well production to ensure the reservoir is properly managed and that water injection is commenced at the appropriate time.

The Branch believes Home's waterflood project is technically sound and will result in a significant increase in recovery from the Pierson Lower Amaranth C Pool. The Branch also feels Home's proposal to waterflood on 16 ha spacing will accelerate waterflood response, improve areal sweep efficiency and maximize secondary recovery.

It is recommended that the Board issue Board Order No. PM 70 (attached) approving the application.

The Board should indicate in its letter of approval to accompany PM 70, that it expects Home to

- (1) follow its proposed development schedule (Table 1) as closely as possible and to advise the Branch, in advance where possible, of any changes in the schedule,
- (2) run an RFT on as many infill wells as necessary to accurately determine the reservoir pressure, and
- (3) avoid excessive reservoir depletion and if necessary, reduce reservoir withdrawals and accelerate injection conversions.

#### REDUCED 16 ha SPACING

Spacing for the Lower Amaranth and Mission Canyon formations within the waterflood project area is 32 ha as provided for in Board Order No. SU 9. Clause 3 of SU 9 provides for modification of the area covered by the order to meet changing conditions. It is proposed that the area covered by SU 9 be modified to exclude the waterflood project area and LSD's 4 and 5 of Section 4-2-29 (WPM). LSD's 4 and 5 of Section 4 are proposed for exclusion from SU 9

because the lands are near the oil/water contact for the Lower Amaranth and not considered capable of effectively draining 32 ha. A revised Schedule A under SU 9 is shown in Figure 3.

Home originally requested reduced 16 ha spacing approval be coincident with the effective date of the unit as approved by the Board. Recently, Home has asked the Branch about the possibility of commencing infill drilling on 16 ha spacing as soon as possible.

The Branch believes in this situation infill drilling and waterflood operations are integral and should occur at the same time. The Branch is also of the opinion that infill drilling prior to unitization will accelerate reservoir depletion and unnecessarily complicate and delay unitization.

Therefore it is recommended that reduced spacing approval be granted to coincide with the effective date of unitization as approved by the Board. The Board's letter of approval should indicate it views Home's request to accelerate infill drilling as a substantive change from this application and advise Home to reapply if it wishes to commence infill drilling prior to unitization. Home's application should address the effect of accelerating infill drilling on reservoir depletion, waterflood recovery, project economics, unit negotiations and project start-up.

#### WAIVER OF MPPR RESTRICTIONS

Home applied to have MPPR restrictions waived within the waterflood project area on a pattern by pattern basis. In recognition of the two years it will take to complete infill drilling and injector conversions, it is recommended that MPPR restrictions be waived on a pattern by pattern basis when

- (1) Home demonstrates reservoir pressure in the pattern exceeds - 7600 kPa, and
- (2) reservoir withdrawals from wells in the pattern are completely replaced by water injection in the pattern on a monthly basis.

Proposed Board Order No. 81A approving the waiver of MPPR restrictions under the above conditions is attached.

#### MISSION CANYON DEPLETION STRATEGY

Home has indicated the Lower Amaranth and Mission Canyon are in communication through natural and induced fractures in the reservoir. Home has assumed that in wells where predicted recovery from the Lower Amaranth is anomalously high, the

Mission Canyon is contributing production. Home has estimated that Mission Canyon production accounts for 26% or  $94.6 \times 10^3 \text{ m}^3$  of the total primary recoverable reserves in the project area. Figure 4 shows wells within the waterflood project area that Home assumes are contributing Mission Canyon production.

Home's depletion strategy for the Mission Canyon is to properly design the hydraulic fracture program for a well to just penetrate into the top of the MC-3b in areas where the MC-3b is suspected to be oil-bearing and concurrently produce the Lower Amaranth under waterflood and the Mission Canyon under primary. It is for this reason that Home is proposing to unitize both formations.

Home plans to try to confine injection to the Lower Amaranth because the Mission Canyon aquifer is expected to act as a thief zone. The waterflood may be detrimentally effected if out of zone injection occurs.

The Branch has done a quick assessment of the Mission Canyon in and adjacent to the project area. Seven wells have been completed in the MC-3b and the generally poor results are shown on Figure 4. The porous intervals in the MC-3b appear to be restricted in areal extent and the geological complexity of the area and poor log coverage makes it difficult to correlate porous zones between wells. Reservoir evaluation is further complicated by the difficulty in accurately calculating water saturations.

The Branch shares Home's view that it is not technically or economically feasible to waterflood the Mission Canyon. The Branch is satisfied with Home's Mission Canyon depletion strategy.



John N. Fox

JNF/hw

Attached.

Approved:


  
L. R. Dubreuil

TABLE I

Table H-1 South Pierson Development Schedule

| 1993             |           |                  |                  | 1994       |                  |                  |                | 1995            |        |                  |                |
|------------------|-----------|------------------|------------------|------------|------------------|------------------|----------------|-----------------|--------|------------------|----------------|
| Infill Location  | Timing    | Conversion       | Infill Location  | Timing     | Conversion       | Infill Location  | Timing         | Infill Location | Timing | Conversion       |                |
| 05-09-002-29 W1M | August    |                  |                  | January    | 14-08-002-29 W1M | 05-15-002-29 W1M | January        |                 |        |                  |                |
| 07-09-002-29 W1M | "         |                  | 03-08-002-29 W1M | "          | 12-09-002-29 W1M | 01-18-002-29 W1M | "              |                 |        |                  |                |
| 03-09-002-29 W1M | "         |                  | 09-05-002-29 W1M | "          | 06-09-002-29 W1M | 09-18-002-29 W1M | "              |                 |        |                  |                |
| 13-04-002-29 W1M | "         | 04-09-002-29 W1M | 11-04-002-29 W1M | February   | 10-08-002-29 W1M | 13-17-002-29 W1M | "              |                 |        |                  |                |
| 01-08-002-29 W1M | "         |                  | 15-04-002-29 W1M | "          | 12-08-002-29 W1M | 15-17-002-29 W1M | "              |                 |        |                  |                |
| 07-08-002-29 W1M | "         | 08-08-002-29 W1M | 09-04-002-29 W1M | "          |                  | 13-16-002-29 W1M | February       |                 |        |                  |                |
| 09-08-002-29 W1M | September |                  | 01-09-002-29 W1M | "          | 06-08-002-29 W1M | 15-16-002-29 W1M | "              |                 |        | 02-08-002-29 W1M |                |
| 11-09-002-29 W1M | "         |                  | 09-09-002-29 W1M | "          | 16-05-002-29 W1M |                  | May            |                 |        | 16-09-002-29 W1M |                |
| 13-09-002-29 W1M | "         | 14-09-002-29 W1M | 07-16-002-29 W1M | May        | 12-04-002-29 W1M |                  | "              |                 |        | 02-15-002-29 W1M |                |
| 15-09-002-29 W1M | "         |                  | 11-16-002-29 W1M | "          | 14-04-002-29 W1M |                  | June           |                 |        | 04-17-002-29 W1M |                |
| 03-16-002-29 W1M | "         | 08-09-002-29 W1M |                  | June       | 10-04-002-29 W1M |                  | "              |                 |        | 08-18-002-29 W1M |                |
| 01-17-002-29 W1M | "         |                  | 05-16-002-29 W1M | "          |                  |                  | "              |                 |        | 16-18-002-29 W1M |                |
| 15-08-002-29 W1M | "         | 16-04-002-29 W1M | 09-17-002-29 W1M | "          | 02-09-002-29 W1M |                  | July           |                 |        | 12-17-002-29 W1M |                |
| 11-08-002-29 W1M | October   |                  | 07-17-002-29 W1M | "          | 10-09-002-29 W1M |                  | "              |                 |        | 14-17-002-29 W1M |                |
| 03-17-002-29 W1M | "         |                  | 11-17-002-29 W1M | "          |                  |                  | "              |                 |        | 16-17-002-29 W1M |                |
| 01-16-002-29 W1M | "         |                  | 05-17-002-29 W1M | "          |                  |                  | August         |                 |        | 14-16-002-29 W1M |                |
|                  |           |                  | 16-17-002-29 W1M | "          |                  |                  |                |                 |        |                  |                |
|                  |           |                  | 14-16-002-29 W1M | July       | 02-16-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | "          | 08-16-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | "          | 06-16-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | August     | 04-16-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | "          | 08-17-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | "          | 02-17-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | September  | 06-17-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | "          | 10-17-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | "          | 12-16-002-29 W1M |                  |                |                 |        |                  |                |
|                  |           |                  |                  | October    | 10-16-002-29 W1M |                  |                |                 |        |                  |                |
| Total            |           |                  | 5 Conversions    | Total      |                  |                  | 22 Conversions | Total           |        |                  | 10 Conversions |
| 16 Infills       |           |                  |                  | 17 Infills |                  |                  |                | 7 Infills       |        |                  |                |

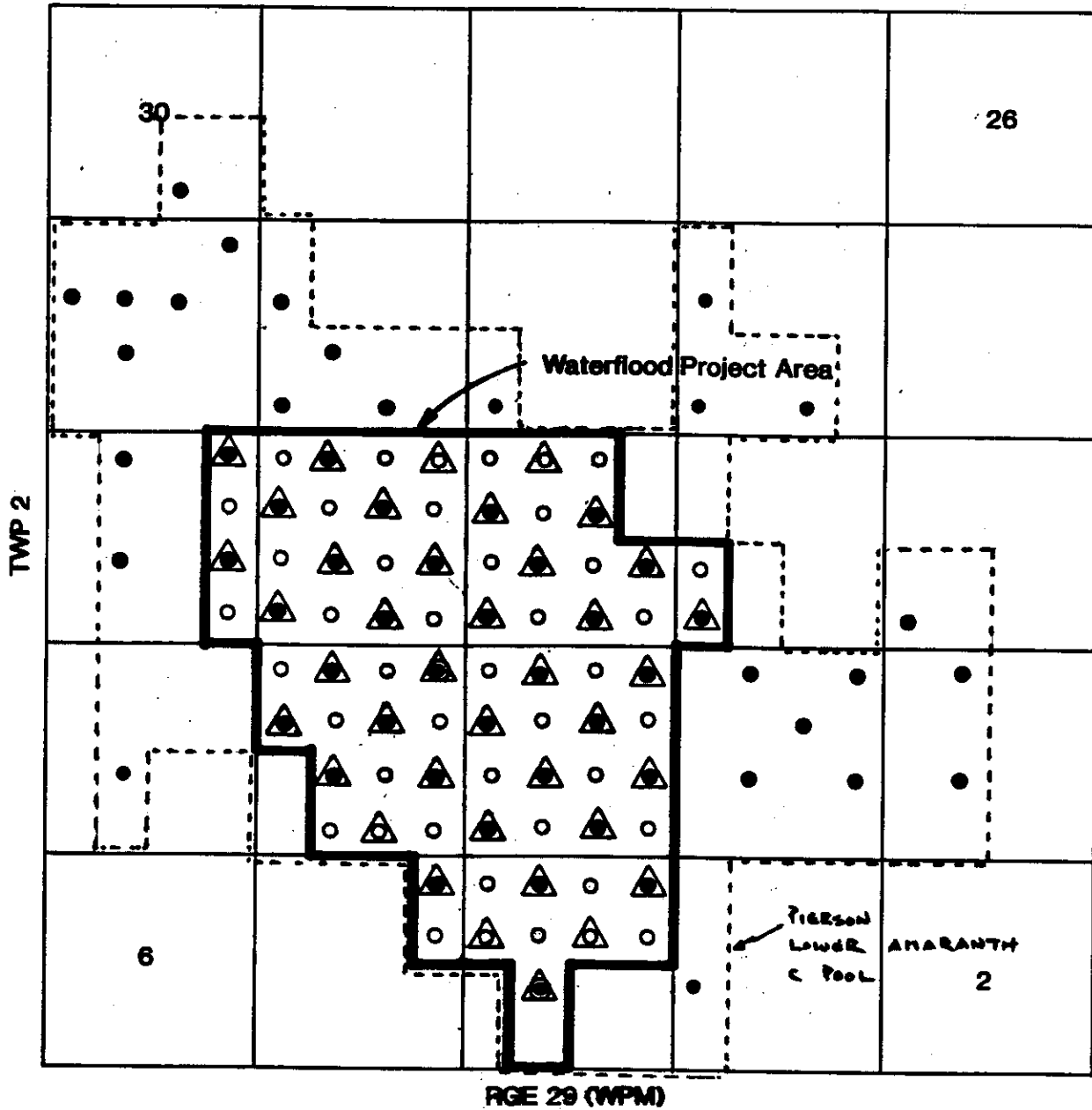
Assumptions: 5 days to drill each infill location and 10 days to convert and tie-in each injector location.

Note: Drilling, completions and pipelining will not be done during spring break-up in order to keep costs at a minimum.

32.4 Ha locations at 10-04, 12-04 and 02-08-002-29 W1M will be drilled prior to the infill locations in order to complete the proposed waterflood area. Locations at 04-08, 08-07 and 16-07-002-29 W1M will also be drilled prior to the infill locations in order to delineate the pool boundary and as possible expansion locations for the waterflood.

FIGURE 1

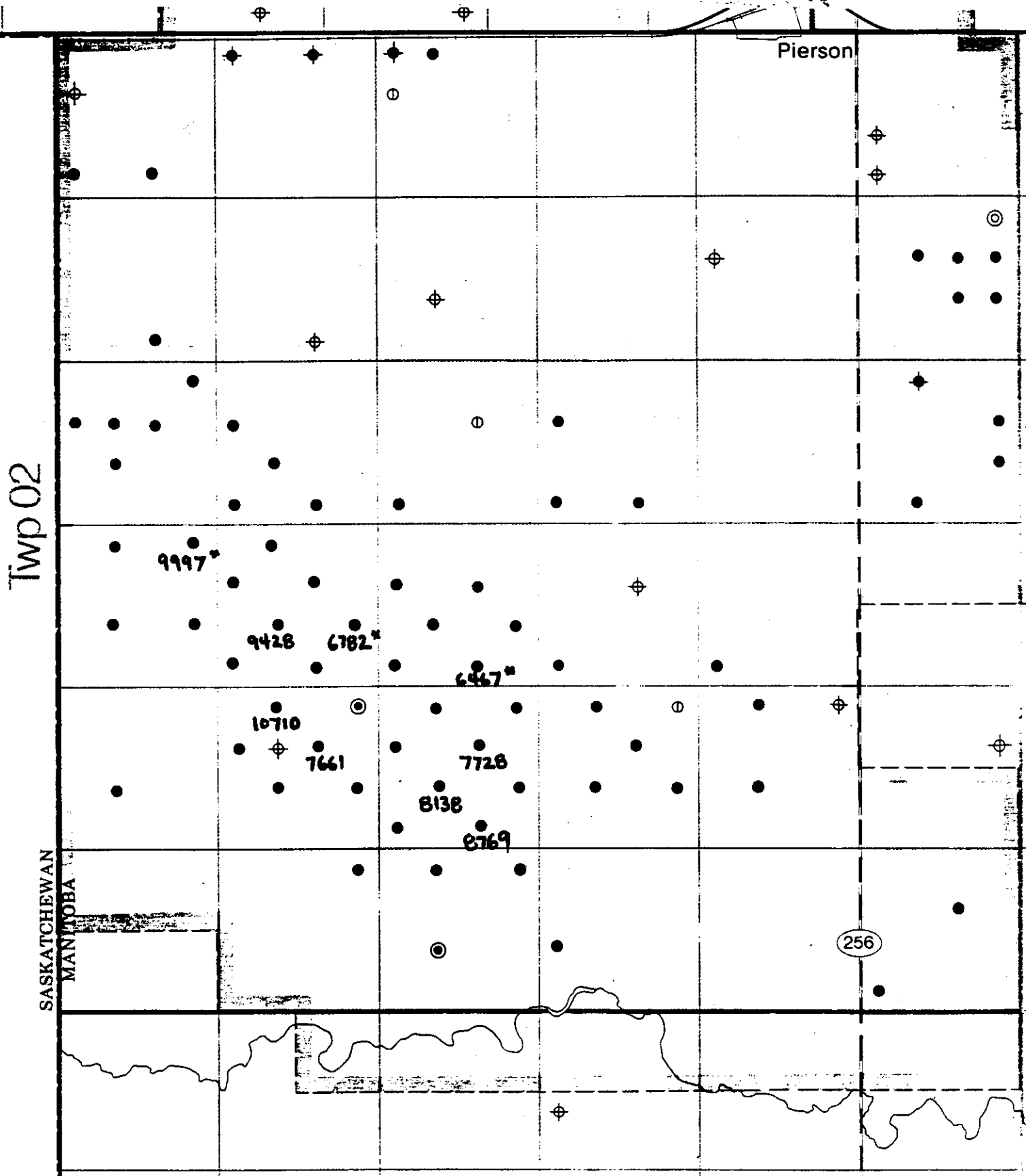
WATERFLOOD PROJECT AREA



LEGEND

- Current production well
- Production well to be drilled
- ⊙ Current water disposal well
- △ Well to be converted to water injection

FIGURE 2  
RESERVOIR PRESSURE

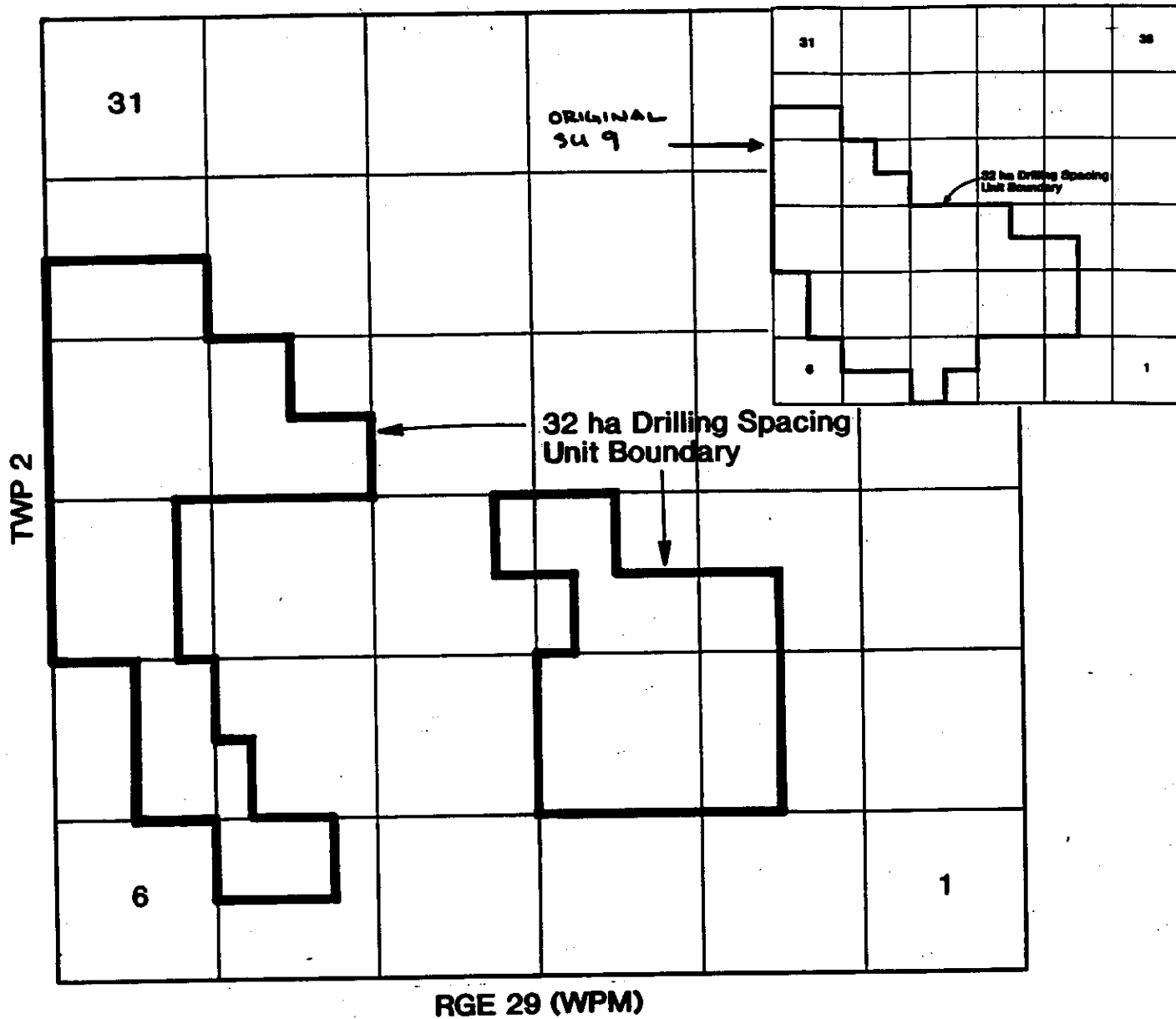


• 7661 KPa - LOWER ANARANTH RESERVOIR PRESSURE

\* AWS

**BOARD ORDER NO. SU 9**  
**REVISED SCHEDULE A**

**PIERSON AREA**  
**32 ha DRILLING SPACING UNITS**  
**LOWER AMARANTH AND MISSION CANYON FORMATIONS**



**FIGURE 3**

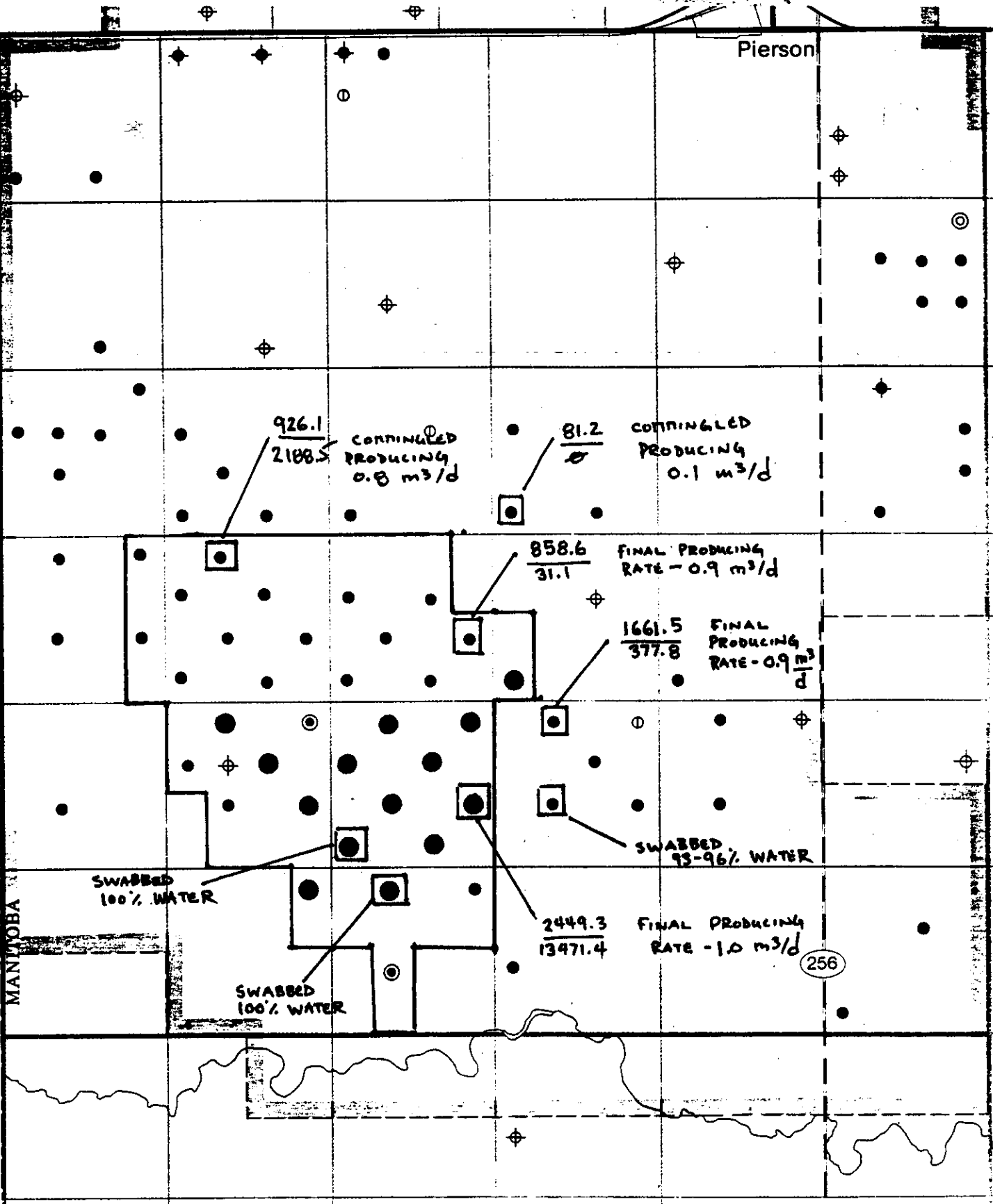


FIGURE 4

Twp 02

SASKATCHEWAN  
MANITOBA

Pierson



● WELLS DETERMINED BY HONE TO HAVE MISSISSIPPIAN PRODUCTION

■ WELLS COMPLETED IN THE MISSISSIPPIAN

858.1  
31.1

CUMULATIVE OIL PRODUCTION (m<sup>3</sup>)  
CUMULATIVE WATER PRODUCTION



The Oil and Natural Gas  
Conservation Board

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Winnipeg MB R3C 4E3  
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FAX: (204) 945-0586

Mr. G.C.K. Johnson, P. Eng.  
Coordinator, Southern Production  
Home Oil Company Limited  
1600 Home Oil Tower  
324 - 8th Avenue SW  
Calgary AB T2P 2Z5

Dear Mr. Johnson:

**Re: Pierson Lower Amaranth C Pool**  
**Application for Approval of a Waterflood**

The Board has completed its review of Home's application for approval of a waterflood in a portion of the Pierson Lower Amaranth C Pool. The Board's review also addressed Home's requests for reduced 16 ha spacing in the waterflood project area and for waiver of maximum permissible production rate (MPPR) restrictions.

#### **WATERFLOOD PROJECT APPROVAL**

Attached is a copy of Board Order No. PM 70 approving waterflood operations in a portion of the Pierson Lower Amaranth C Pool. Please note that water injection under Board Order No. PM 70 is not to commence until the Board has approved the Unit Agreement as require under Section 74 of The Mines Act.

The Board is concerned with the degree of reservoir depletion in portions of the waterflood project area. RFT pressure data from wells drilled in the fall of 1992 indicates portions of Sections 8 and 9-2-29 (WPM) are close to the bubble point. The Board does not want excessive pre-waterflood depletion to delay waterflood response and negatively impact the project's technical or economic success.

The Board is satisfied that Home can properly manage the reservoir during the two years required to complete infill drilling and injector conversions by following its proposed development schedule contained in Appendix H of the application and running RFT's on as many infill wells as needed to accurately

determine reservoir pressure. The Board requests Home follow its development schedule as closely as possible and advise the Petroleum Branch, in advance where possible, of any significant changes in the schedule.

Where during the course of project development it is discovered that the reservoir pressure in a portion of the project area is below the bubble point, the Board expects Home to initiate corrective measures such as accelerating injector conversions, increasing injection volumes or reducing reservoir withdrawals.

#### REDUCED 16 ha SPACING APPROVAL

On the effective date of unitization as approved by the Board under Section 74 of The Mines Act, spacing in the waterflood project area will be reduced to 16 ha. Spacing will be reduced by amending Board Order No. SU 9 (attached for your reference) to exclude the waterflood project area. A copy of the proposed revision to Schedule A under Board Order No. SU 9, to take effect upon unitization, is included for your information. Please note the Board also proposes to reduce spacing in LSD's 4 & 5 of Section 4-2-29 (WPM) to 16 ha under the same revision. The Board feels any wells drilled on these lands, near the productive limits of the pool, will not be capable of effectively draining 32 ha.

The Board is advised that Home has recently asked the Petroleum Branch about the possibility of commencing 16 ha infill drilling in the waterflood project area as soon as possible. The Board is of the opinion there is a high risk that infill drilling prior to unitization will accelerate reservoir pressure depletion and unnecessarily complicate and delay unitization. The Board is particularly concerned that additional data from 16 ha infill wells will make it difficult to equitably determine tract factors and will reduce Home's chances of reaching a voluntary unit agreement. If unitization is delayed any problems associated with reservoir pressure depletion will be aggravated.

The Board considers Home's interest in accelerating infill drilling to be a substantive change from what was requested in this application. If Home wishes the Board to consider the matter the company should reapply for approval to commence infill drilling prior to unitization. Such application should address the effect of accelerating infill drilling on reservoir depletion, waterflood recovery, project economics, unitization and project start-up.

#### WAIVER OF MPPR RESTRICTIONS

Attached is Board Order No. 81A approving the waiver of MPPR restrictions within the waterflood project area on a pattern by pattern basis.

After an injector has been converted, Home is to notify the Petroleum Branch when the conditions contained in the order have been met;

- (1) average reservoir pressure in the pattern exceeds 7600 kPa, and
- (2) reservoir withdrawals attributed to wells in the pattern are completely replaced by water injection in the pattern on a monthly basis.

Upon notification of satisfaction of these conditions, and unless otherwise advised by the Branch, MPPR restrictions will be automatically waived commencing the first day of the following month.

If you have any questions in respect of this approval, please contact L. R. Dubreuil, Director of Petroleum or John N. Fox, Chief Petroleum Engineer at (204) 945-6573 or 946-6574, respectively.

Yours respectfully,

H. Clare Moster  
Deputy Chairman



Order No. SU 9

An Order Pertaining to Drilling Spacing Units  
Pierson Area  
Lower Amaranth and Mission Canyon Formations

WHEREAS, clause (9)(b) of section 62 of "The Mines Act", being Chapter M160 of the Continuing Consolidation of the Statutes of Manitoba, provides as follows:

"62(9) Without restricting the generality of subsection (8) the board, with the approval of the minister, may make orders

(b) respecting the designation of the area that shall be allocated to a well in connection with fixing allowable production;"

AND WHEREAS, clause (1)(f) of section 63 of "The Mines Act" provides in part as follows:

"63(1) For the purpose of carrying out the provisions of this Part and Part III according to their intent, the Lieutenant Governor in Council may make such regulations and orders as are ancillary thereto, and are not inconsistent therewith; and every such regulation or order made under, and in accordance with the authority granted by, this section has the force of law; and, without restricting the generality of the foregoing, the Lieutenant Governor in Council may make regulations and orders

(f) prescribing spacing units and the size and shape of spacing units;"

AND WHEREAS, subsection (1) of section 20 of Manitoba Regulation 430/87R under The Mines Act ("the Petroleum Drilling and Production Regulation") provides as follows:

"20(1) Notwithstanding section 19, the board may, after a public hearing or after publication of notice, prescribe by order special drilling spacing units which may differ from normal drilling spacing units in size, shape or target area."

AND WHEREAS, subsection (3) of section 21 of the Petroleum Drilling and Production Regulation provides as follows:

"21(3) Where a special drilling spacing unit is prescribed under section 20, the board may prescribe the target area within which a well shall be completed in order to qualify for a maximum permissible production rate based on the area of the special drilling spacing unit."

AND WHEREAS, the Board received an application dated September 26, 1991 from Home Oil Company Limited and an application dated October 1, 1991 from Tundra Oil and Gas Ltd. for continuation of special 32 ha drilling spacing units for the Lower Amaranth Formation in the Pierson area ("the area of application"). Home Oil Company Limited also applied for approval of special 32 ha drilling spacing units for the Mission Canyon Formation.

AND WHEREAS, upon publication of notice of the application, the Board received an objection to the application.

AND WHEREAS, upon due consideration of the said applications and objection thereto, the Board considers continuation of special 32 ha drilling spacing units for the Lower Amaranth Formation and establishment of special 32 ha drilling spacing units for the Mission Canyon Formation in a portion of the area of application to be reasonable and desirable.

NOW THEREFORE, the Board orders that:

1. The spacing unit for each well drilled, or to be drilled, for the purpose of obtaining oil from the Jurassic Lower Amaranth Formation or the Mississippian Mission Canyon Formation within the area outlined on Schedule A is two legal subdivisions comprising the east half or the west half of a quarter section.
2. The target area of each drilling spacing unit shall be a square area in the even-numbered legal subdivision having sides one hundred metres from the sides of the legal subdivision and parallel to them.

3. The area outlined on Schedule A may be modified by the Board from time to time to meet changing circumstances.
4. Board Order No. SU 6 dated July 27, 1990 is hereby rescinded.



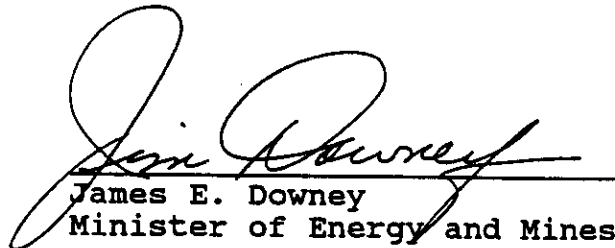
H. Clare Moster  
Deputy Chairman



David Tomasson  
Chairman

OIL AND NATURAL GAS  
CONSERVATION BOARD ORDER  
NO. SU 9 APPROVED THIS  
**25<sup>TH</sup> DAY OF JANUARY** A.D., 1993  
AT THE CITY OF WINNIPEG.

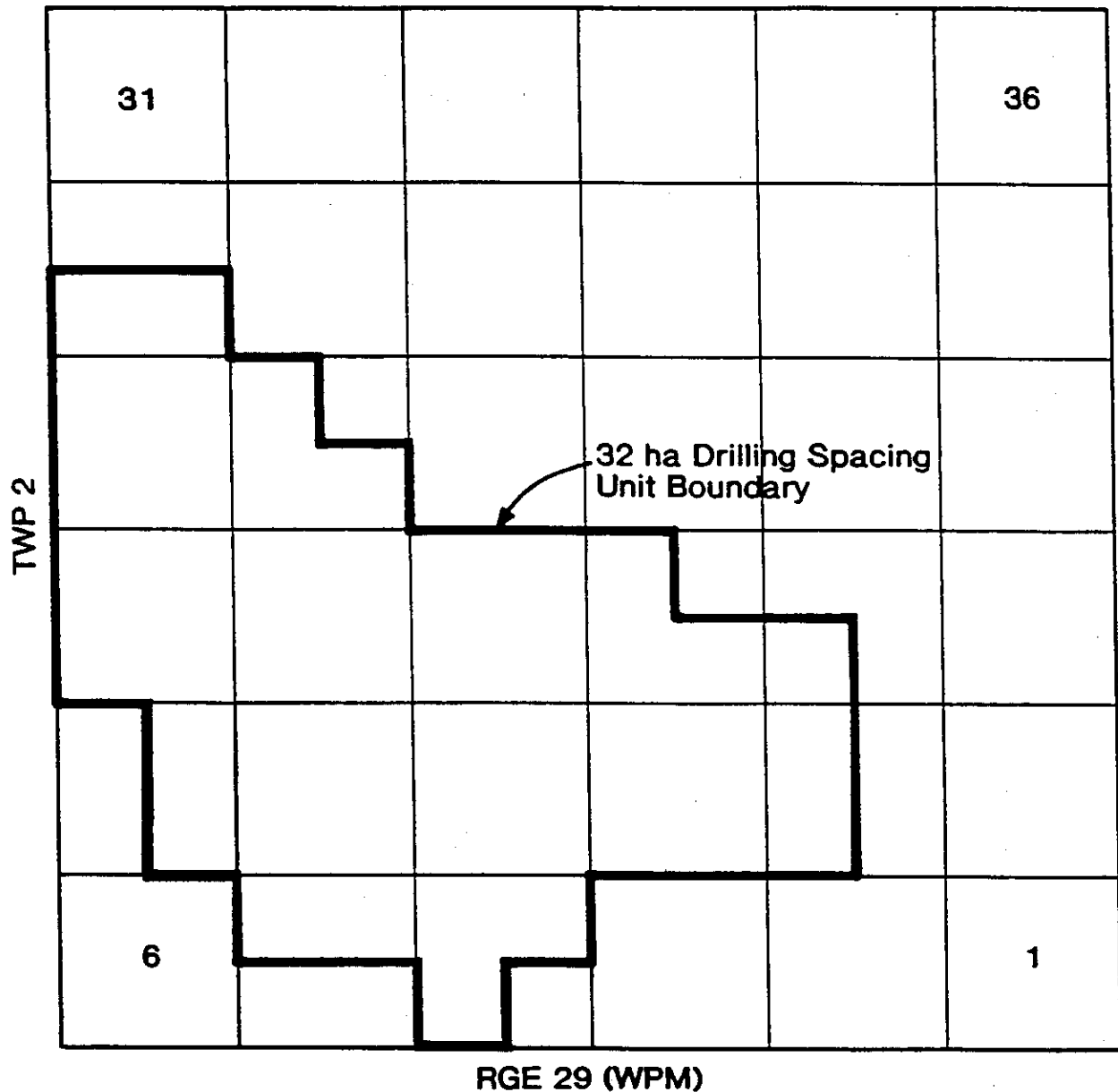
APPROVED:



James E. Downey  
Minister of Energy and Mines

**BOARD ORDER NO. SU 9  
SCHEDULE A**

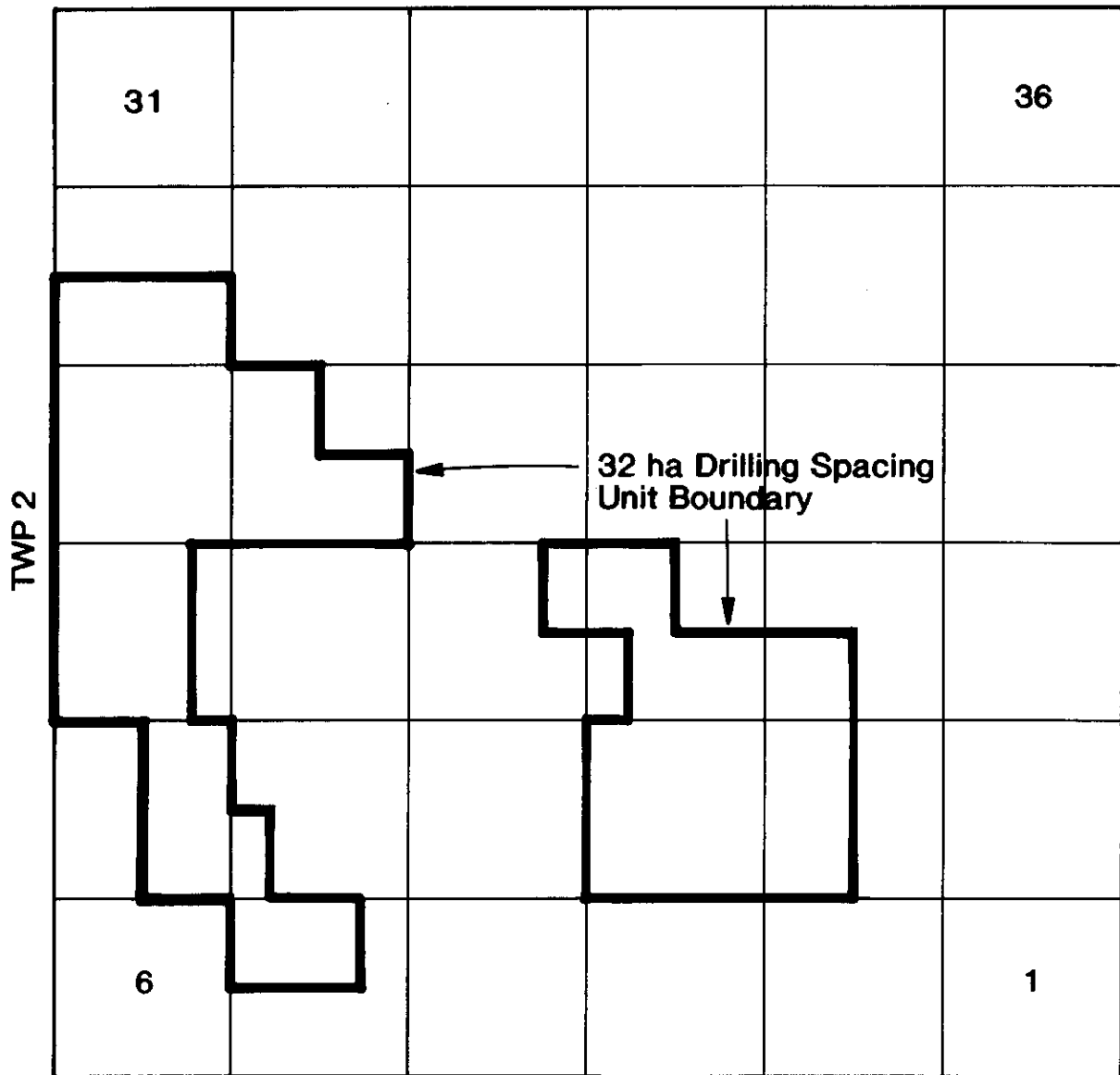
**PIERSON AREA  
32 ha DRILLING SPACING UNITS  
LOWER AMARANTH AND MISSION CANYON FORMATIONS**





**BOARD ORDER NO. SU 9  
SCHEDULE A – REVISED**

**PIERSON AREA  
32 ha DRILLING SPACING UNITS  
LOWER AMARANTH AND MISSION CANYON FORMATIONS**



EFFECTIVE DATE: \_\_\_\_\_

APPROVED: \_\_\_\_\_  
The Oil and Natural Gas Conservation Board

DATE: \_\_\_\_\_



The Oil and Natural Gas  
Conservation Board

555 — 330 Graham Avenue  
Winnipeg MB R3C 4E3  
CANADA

(204) 945-1111  
FAX: (204) 945-0586

**Order No. PM 70  
An Order Pertaining to Pressure  
Maintenance by Water Flooding  
Pierson Lower Amaranth C Pool**

WHEREAS, subsection (9)(d) of Section 62 of "The Mines Act", being Chapter M160 of the Continuing Consolidation of the Statutes of Manitoba, provides as follows:

"62(9) Without restricting the generality of subsection (8) the board, with the approval of the minister, may make orders

(d) requiring the repressuring, recycling, or pressure maintenance, of any pool or portion thereof where it is economical so to do, and for that purpose where necessary requiring the introduction or injection into any pool or portion thereof of gas, air, water or other substance;"

AND WHEREAS, the Board received an application dated February 22, 1993 from Home Oil Company Limited ("the operator") for approval of a project to inject water into the Pierson Lower Amaranth C Pool ("the pool") in the area of application outlined on Schedule A ("the waterflood project area").

AND WHEREAS, upon publication of notice of the application the Board received no objections to or interventions in the application.

NOW THEREFORE, the Board orders that:

1. The operator shall conduct pressure maintenance operations by the injection of water into the pool underlying the waterflood project area.
2. The pressure maintenance operation shall be in accordance with, and subject to, the following rules:

#### PRESSURE MAINTENANCE RULES

1(1) Water shall be injected into the pool through the wells shown on Schedule A and such other wells in the waterflood project area as the Board may order or approve.

1(2) After the commencement of injection, the operator shall, subject to any remedial work required to be performed on the wells referred to in subsection (1), endeavour to maintain continuous injection.

1(3) Notwithstanding the provisions of subsection (2), the Board may, upon its own motion or upon application by the operator, order the suspension of water injection into any well or wells, provided that the Board is satisfied that pressure maintenance operations in the waterflood project area will not be adversely affected.

1(4) The completion of the wells referred to in subsection (1) will be as prescribed by the Director of Petroleum.

2 The operator, upon the request of the Board, shall satisfy the Board as to the source, suitability and method of treatment of the water to be injected.

3(1) Before injection of water is commenced, the operator shall submit, to the Board, results of a survey conducted to determine the static reservoir pressure in the waterflood project area.

3(2) The operator shall, not less than six months nor more than 12 months after the commencement of injection, and at yearly intervals thereafter, conduct a survey to determine the static reservoir pressure in the waterflood project area.

3(3) The operator shall submit to the Petroleum Branch, the details of the surveys described in subsections (1) and (2), including a list of the wells to be surveyed, the measurement technique to be used, and the intended shut-in periods for each well, and approval shall be obtained from the Director of Petroleum before the program is carried out.

3(4) The operator shall submit to the Petroleum Branch, within 30 days of the completion date of the surveys described in subsections (1) and (2), a report which shall include:

(a) the static reservoir pressure data obtained from the survey, corrected to a common datum;

(b) an isobaric map of the pool within the waterflood project area based on the data obtained; and

(c) a discussion of the survey results and pressure distribution within the pool.

3(5) The Board may, at any time, require the operator to carry out such additional reservoir pressure surveys as it deems necessary.

4 The operator shall immediately report to the Board any indication of channelling or break-through of injected water to producing wells or any indication of other detrimental effects that may be attributable to the pressure maintenance operations.

5 The maximum wellhead pressure at which water is injected into the wells referred to in subsection 1(1) shall not exceed 5000 kPa or such other maximum pressure as the Board may prescribe and the Board may, from time to time, prescribe a maximum or minimum rate at which water shall be injected into any well in the waterflood project area.

6(1) The operator shall, not later than the last day of each month, file with the Petroleum Branch, a report of the quantity, source and pressure of water injected during the preceding month into each well referred to in subsection 1(1).

6(2) The operator shall, not later than the last day of each month, file with the Petroleum Branch a summary report of production and injection operations during the preceding month, which report shall include:

(a) a tabulation of total oil, total water and total gas produced;

(b) a tabulation of the number of producing wells and injection wells which were active;

(c) the results of at least one twenty-four hour production test on each producing well in the waterflood project area including volumes of oil, gas and water produced during the test; and

(d) a summary of any remedial operations carried out on any well in the waterflood project area;

7        The operator, shall, within 60 days of the end of each calendar year, file with the Petroleum Branch a report of the pressure maintenance program, setting out graphically such interpretive information necessary to evaluate the efficacy of the waterflood.

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H. Clare Moster  
Deputy Chairman

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David Tomasson  
Chairman

OIL AND NATURAL GAS CONSERVATION  
BOARD ORDER NO. PM 70 APPROVED THIS  
DAY OF                      A.D. 1993  
AT THE CITY OF WINNIPEG.

APPROVED:

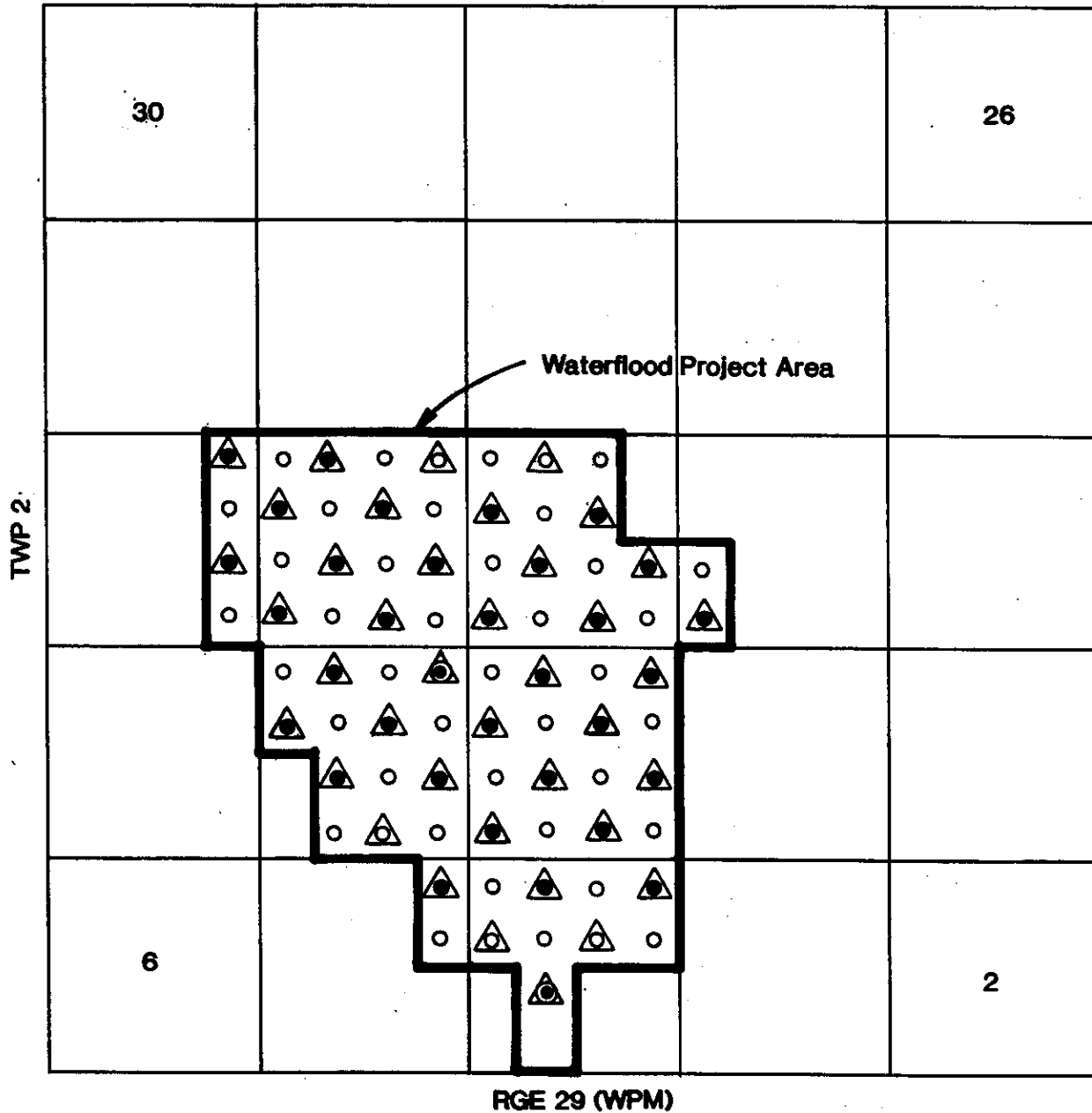
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James E. Downey  
Minister of Energy and Mines

# BOARD ORDER NO. PM 70

## SCHEDULE A

### PIERSON LOWER AMARANTH C POOL



#### LEGEND

- Current production well
- Production well to be drilled
- ⊙ Current water disposal well
- △ Well to be converted to water injection



The Oil and Natural Gas  
Conservation Board

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Winnipeg MB R3C 4E3  
CANADA

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**Order No. 81A**  
**An Order Pertaining to Maximum Permissible**  
**Production Rates in the Pierson Field**

WHEREAS, subsection 51(3) of The Petroleum Drilling and Production Regulation, being Manitoba Regulation 430/87R ("the regulation") states as follows:

"51(3) Notwithstanding anything in this section, the board upon application or upon its own initiative, may establish any maximum permissible production rate for a well or exempt a well from any of the provisions of this section."

AND WHEREAS, the Board received an application dated February 22, 1993 from Home Oil Company Limited ("the operator"), for a waiver of maximum permissible production rate restrictions for wells producing from the Lower Amaranth and Mission Canyon formations in the waterflood project area outlined in Schedule A.

AND WHEREAS, upon publication of notice of the application, the Board received no objections to or interventions in the application.

NOW, THEREFORE, the Board orders that:

1. Wells producing from the Pierson Lower Amaranth C Pool in an inverted 5-spot injection pattern within the waterflood project area outlined in Schedule A shall be exempt from the maximum permissible production rate restrictions of subsection 51(1) of the regulation when the following conditions have been met:
  - (a) the operator has demonstrated to the Board that the static reservoir pressure in the pattern exceeds 7600 kPa at a datum of 550 m subsea, and;

(b) reservoir withdrawals attributed to wells in the pattern are completely replaced by water injection in the pattern on a monthly basis.

2. For any pattern within the waterflood project area where the provisions of section 1 are not met, the maximum permissible production rates established under subsection 51(1) of the regulation will apply.

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H. Clare Moster  
Deputy Chairman

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David Tomasson  
Chairman

OIL AND NATURAL GAS CONSERVATION  
BOARD ORDER NO. 81A APPROVED THIS  
DAY OF A.D., 1993  
AT THE CITY OF WINNIPEG.

APPROVED:

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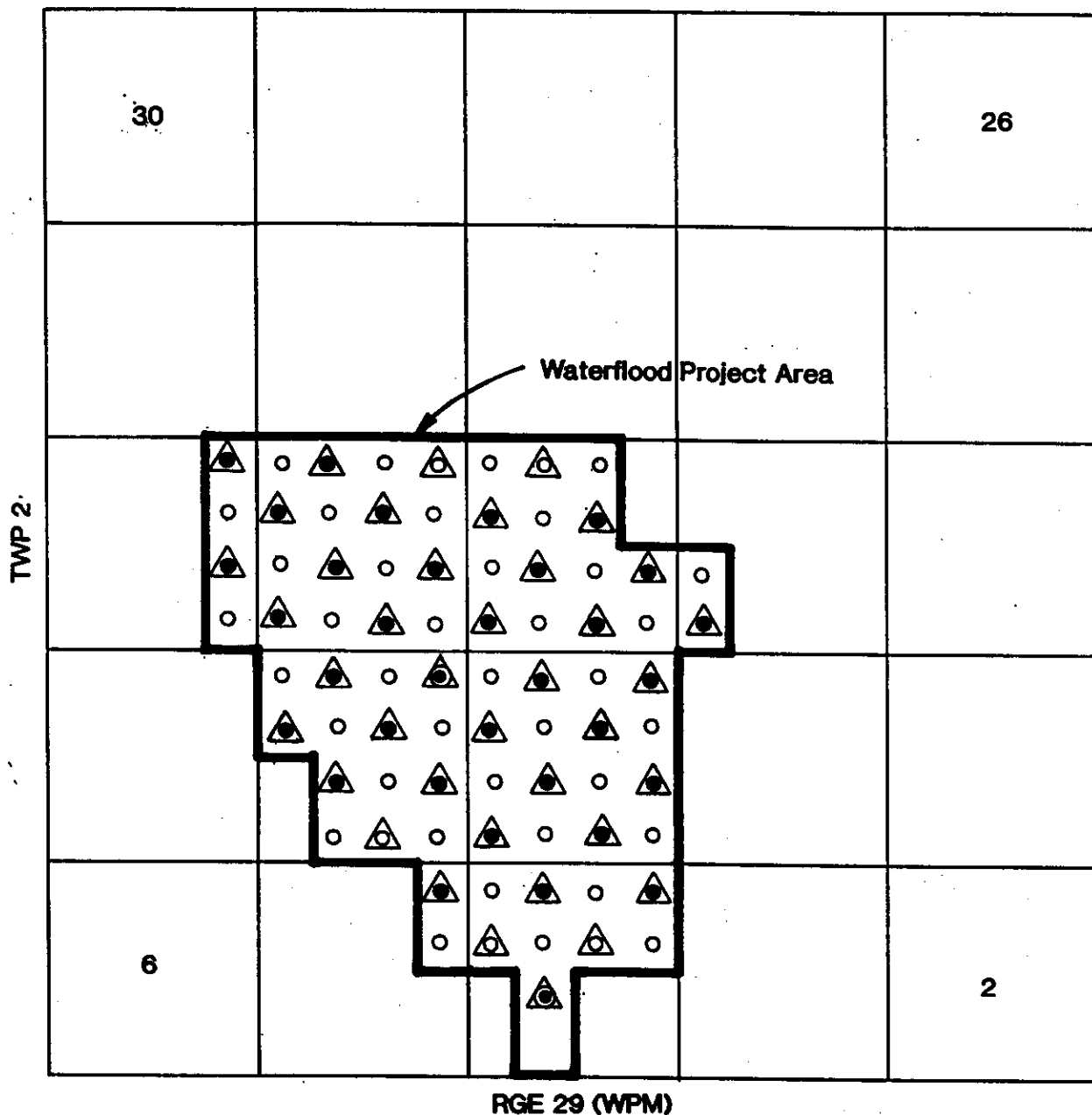
James E. Downey  
Minister of Energy and Mines



# BOARD ORDER NO. 81A

## SCHEDULE A

### PIERSON LOWER AMARANTH C POOL



#### LEGEND

- Current production well
- Production well to be drilled
- ⊙ Current water disposal well
- △ Well to be converted to water injection



## Memorandum

Date April 20, 1993

To John Fox  
Chief Petroleum Engineer

From Carol Martiniuk  
Petroleum Geologist

Subject Home Oil's Waterflood Application

As per your request, the following responds to some of the questions regarding Home's application that highlighted in your March 15/93 memo.

Questions #1 - #3 concerning the lateral continuity, flow patterns and fracturing and faulting in the Lower Amaranth were redirected to John Murray, Home Oil on March 15/93. John responded by fax on April 20/93 (see attached).

The following addresses the remainder of your questions concerning the stratigraphy and correlation of the Mission Canyon in the area covering the proposed waterflood area of the Pierson Field (T. 3; R. 29 WPM).

### Geology of the Mission Canyon:

In general, the Mission Canyon rocks of the Pierson Field consist of limestones and dolomitic limestones that represent a shallow carbonate shelf environment.

The Mission Canyon strata display an overall regressive sequence of low to moderate energy subtidal carbonate shelf environment to a restricted, very shallow water to possibly supratidal environment.

The MC-3 Member of the Mission Canyon is regionally truncated at the Mississippian unconformity. Immediately below the unconformity in most places, the MC-3 Member has been dolomitized and anhydritized to form a zone of alteration that acts as a 1 to 3m (average) thick cap rock throughout most of the field area.

Reservoir rocks in the Pierson pools are primarily coated grain packstones to grainstones (shoal) and non-coated grain packstones (backshoal). Porosities average 14% and are interparticle, moldic and intercrystalline. Permeabilities average 10 to 12 md.

The productive zones in the MC-3 Member of this portion of the Pierson Field occur within the MC-3b interval. The MC-3a interval appears to be water saturated.

Based on limited log data (most wells do not penetrate the Mission Canyon Formation), core/sample descriptions and previous work by H. Husain and S.P. Halabura, it appears that the productive zones in the MC-3b interval are trapped by lateral seals provided by a combination of porosity occlusion due to facies changes from high energy shoal deposits to a

lagoonal facies, and dolomitization and anhydritization at the Mississippian unconformity (altered zone).

The MC-3b reservoirs in the proposed waterflood area are divided into laterally discontinuous "porosity zones" (backshoal/shoal facies?) that are sealed above and below by "tight" limestones and dolostones (lagoonal facies?) (see cross sections Attachments I and II).

Production obtained from the MC-3b within this portion of the Pierson Field is from the 07 42G Pool (8-9-2-29 WPM, 6-10-2-29 WPM and 14-10-2-29 WPM); 07 42H Pool (8-16-2-29 WPM and 4-22-2-29 WPM); and the 07 42I Pool (14-17-2-29 WPM). All wells in 07 42G and the well at 8-16-2-29 WPM in the 07 42H Pool have been recompleted into the Jurassic Lower Amaranth (07 29C Pool). The wells at 14-17-2-29 WPM and 4-22-2-29 WPM were commingled with the Lower Amaranth 07 29C Pool in October, 1991.

#### Conclusion:

It is difficult to correlate the individual porosity zones within the MC-3b interval due to the lateral discontinuity of these units. The lack of core and sufficient log data precludes any thorough correlation of the Mission Canyon section for the proposed waterflood area.

The mappable sandstone reservoir units within the Lower Amaranth (i.e. "C" sand) are more laterally continuous than the porous reservoir units of the Mission Canyon. Therefore, it is unlikely that any waterflooding of the Mission Canyon would yield as great a volume of oil as that expected of the overlying Lower Amaranth sandstone units.

  
Carol

c.c. Bob Dubreuil

**Home Oil Company Limited**

1600 Home Oil Tower  
324 Eighth Avenue S.W.  
Calgary, Alberta T2P 2Z5  
Telephone (403) 232-7100  
Fax (403) 232-7678



Manitoba Energy and Mines  
Petroleum Branch  
#555-330 Graham Avenue  
Winnipeg, Manitoba  
R3C-4E3

January 23, 1992

Attention: **Mr. John Fox, Chief Petroleum Engineer**

Dear Mr. Fox:

RE: **Home Oil / Scurry-Rainbow South Pierson Field**  
**Waterflood Development and Reservoir Evaluation Study**

Further to our conversation of January 20, 1992 Home Oil Company Limited would like to present the results of the above mentioned Waterflood Development and Reservoir Evaluation Study one day during the week of February 17, 1992. Our presentation will include the following:

*Feb 20 on 21 on next wk*

1. (a) Evaluation of the South Pierson Field in it's existing Primary Rundown Mode
- (b) Waterflood Potential and Development
- (c) Horizontal Drilling potential
2. Economic Review

Home Oil Company Limited would also like to dicuss any possible incentives or Royalty Holiday Pooling associated with the above noted development.

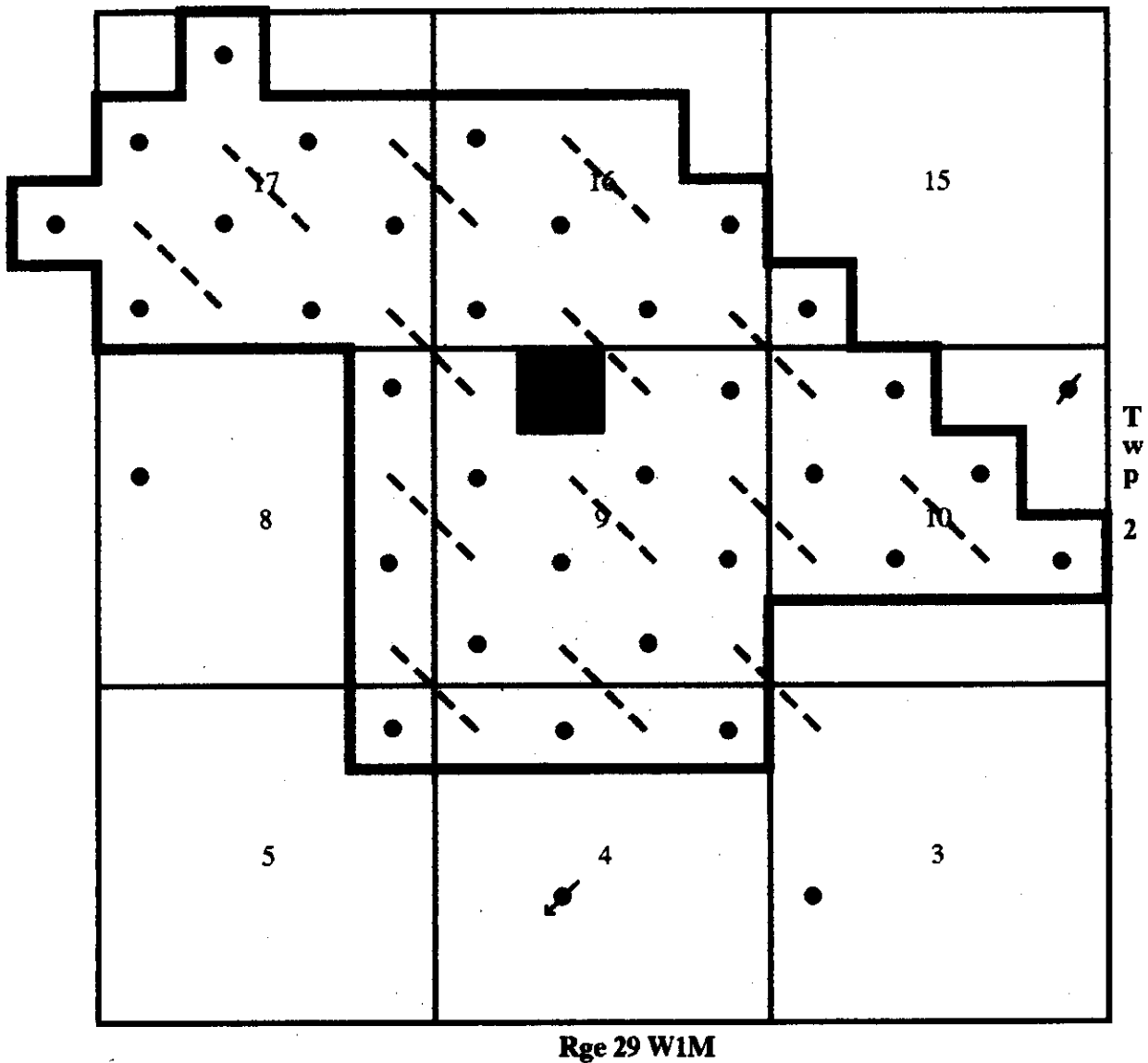
If the above preliminary agenda meets with your approval and/or if you have any questions, or concerns please contact Don Cairns at (403) 232-7337 to verify a date which agrees with your schedule.

Yours truly,

  
D.A. Cairns

Area Operations Engineer

# SOUTH PIERSON WATERFLOOD AREA



 Proposed Waterflood Area

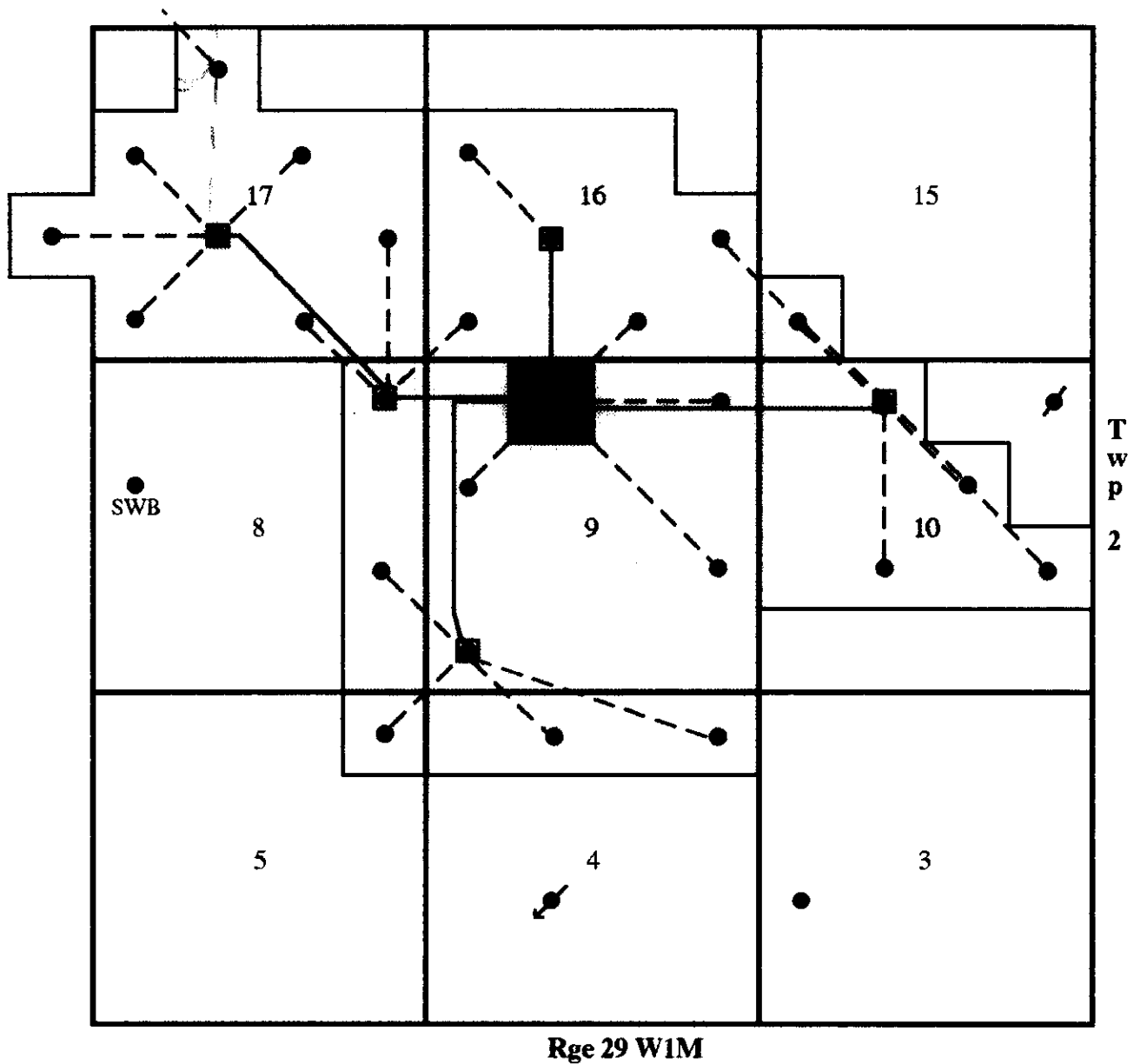
● Current Producing Wells

 Central Facilities

● Vertical In-fill Locations

--- Horizontal Locations

# SOUTH PIERSON WATERFLOOD



 Proposed Waterflood Area

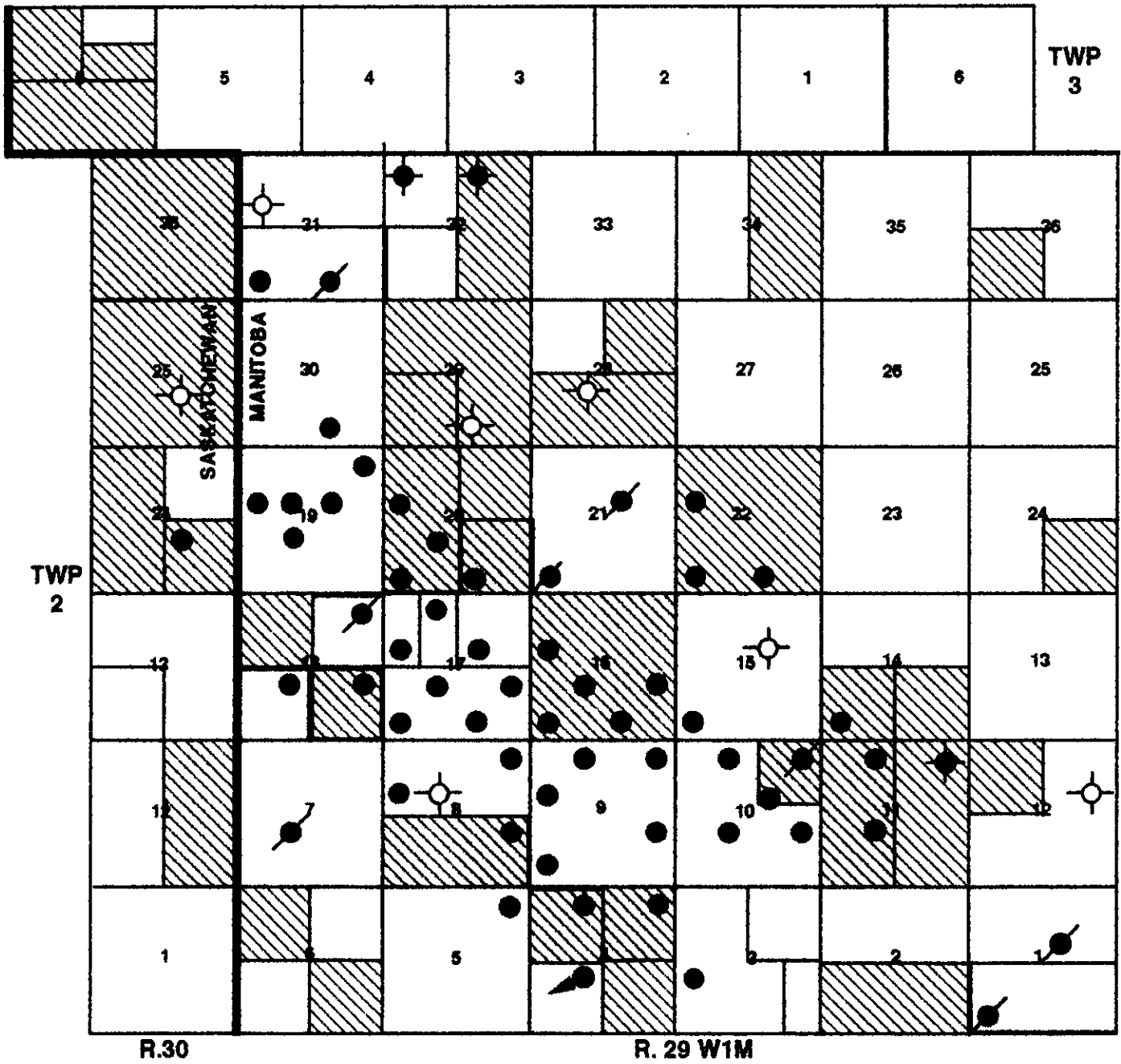
 Central Facilities



 Current Producing Wells

 Group Line

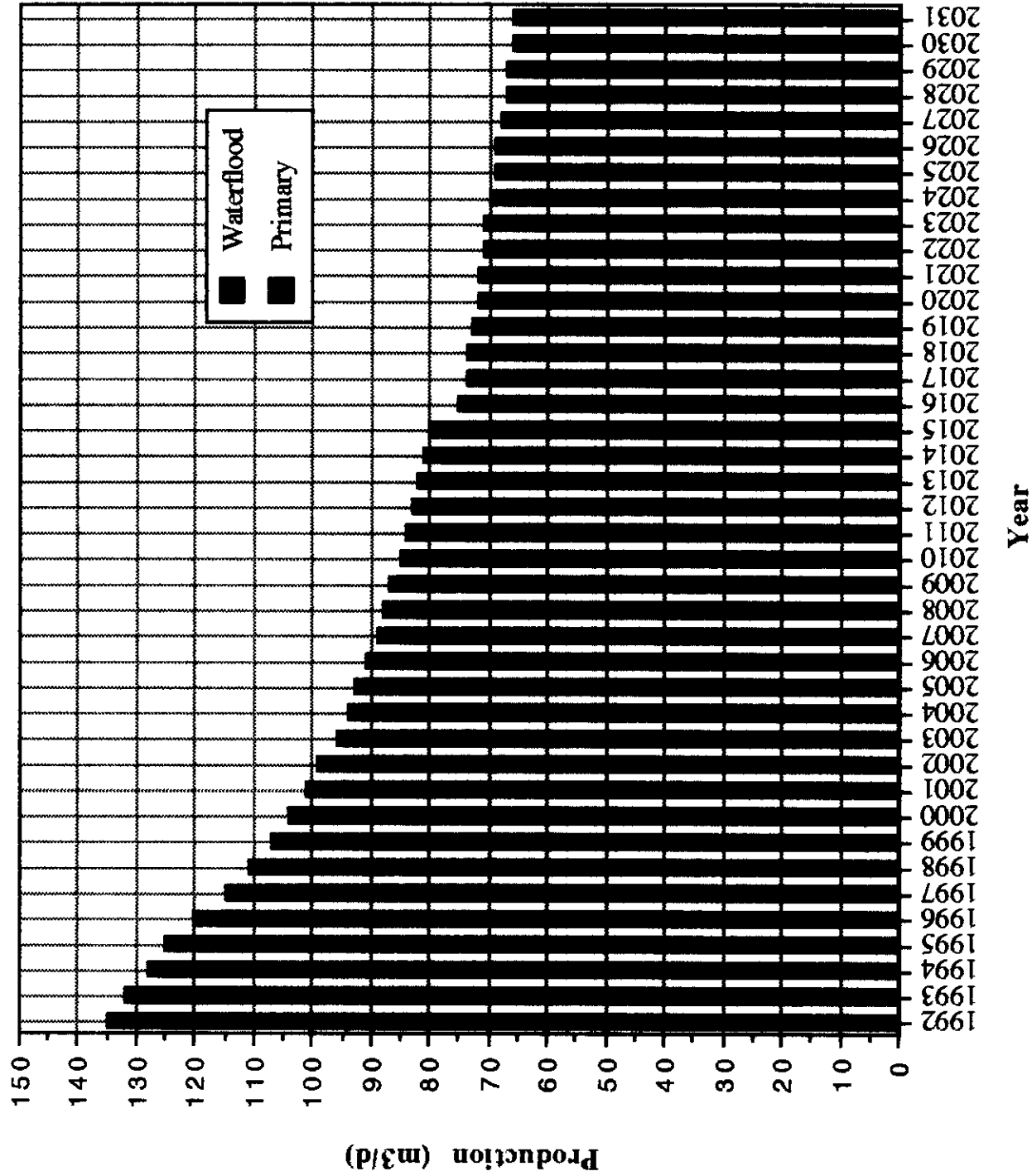
 Flow Line

# SOUTH PIERSON AREA



-  HOC / SRO LANDS
-  CROWN LAND

# **SOUTH PIERSON PRODUCTION FORECAST OF WATERFLOOD AREA**





Manitoba Energy and Mines

# **SOUTH PIERSON AREA STUDY**

February 20, 1992

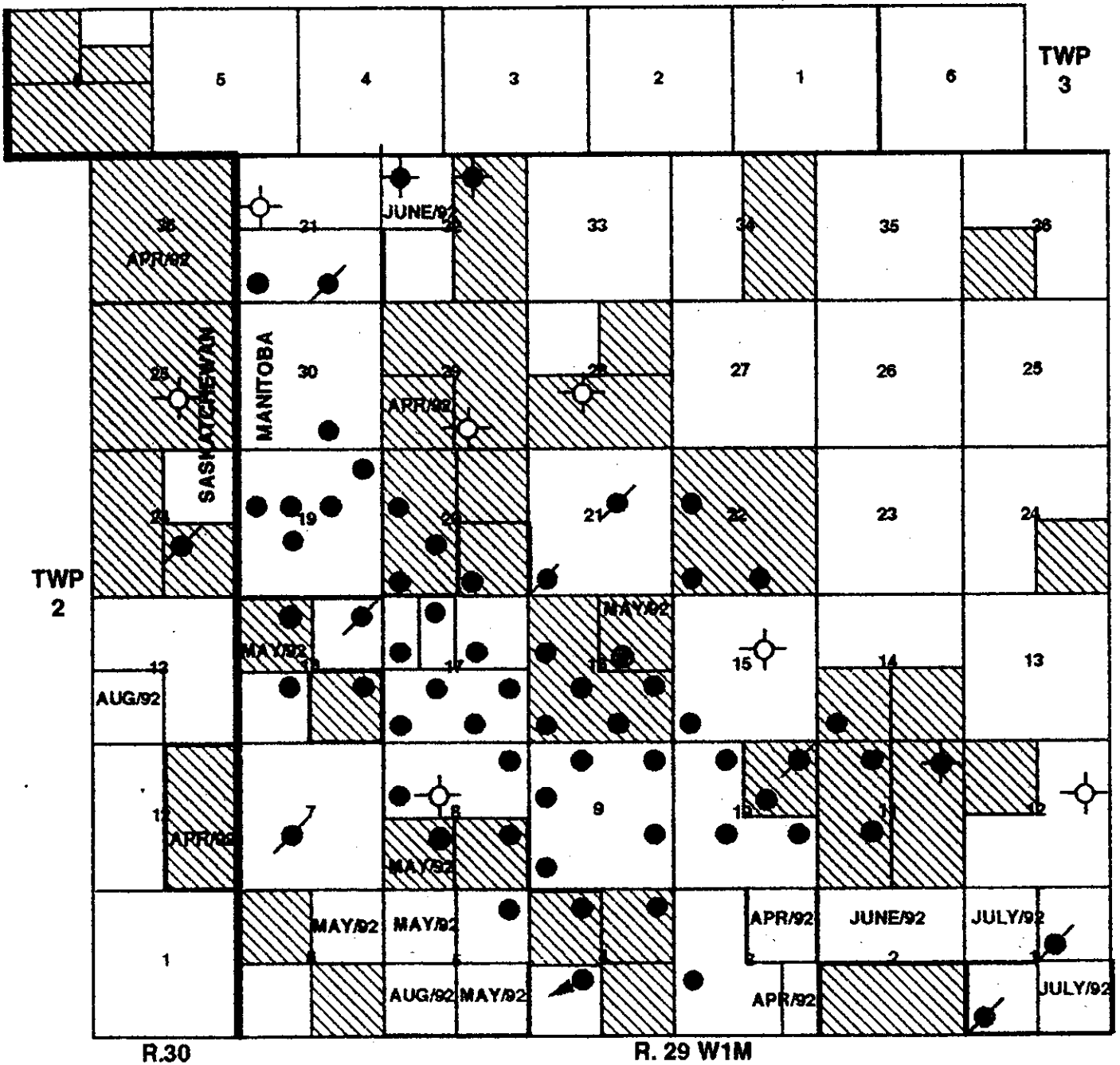
D. A. Cairns  
J. S. Murray  
C. W. Labelle

# **SOUTH PIERSON AREA STUDY**

## **INTRODUCTION**

- \* GEOLOGY REVIEW ( JOHN MURRAY)**
- \* AREA UPDATE (DON CAIRNS)**
- \* PRODUCTION REVIEW (DON CAIRNS)**
- \* PRIMARY VS. WATERFLOOD STUDY (CURT LABELLE)**
- \* CAPITAL COSTS & ECONOMICS (DON CAIRNS)**
- \* WATERFLOOD IMPLEMENTATION (DON CAIRNS)**
- \* SUMMARY (DON CAIRNS)**

# SOUTH PIERSON AREA



 HOC / SRO LANDS

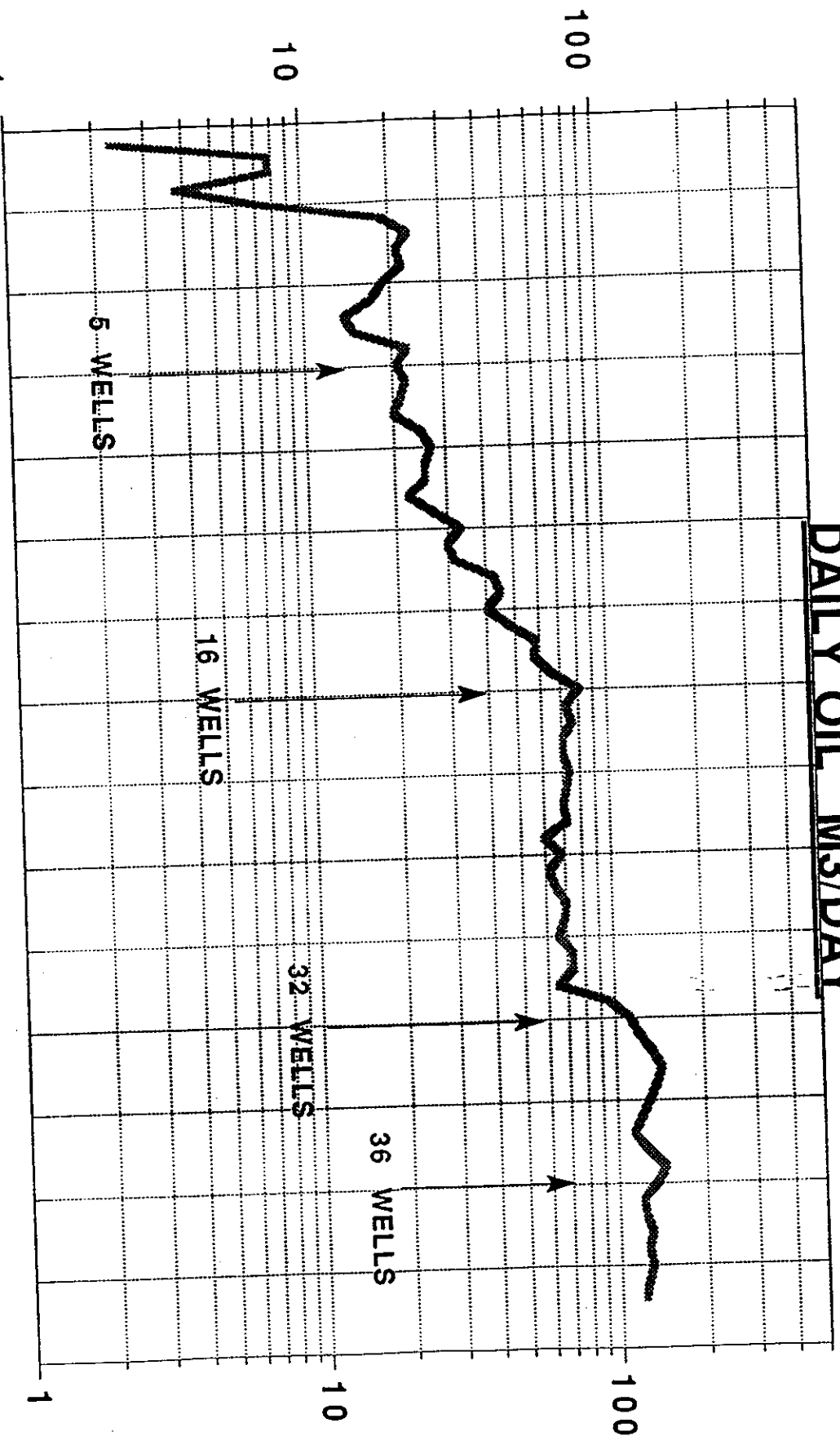
 CROWN LAND

 1992 CROWN EXPIRY

 1992 COMMITMENT LOCATIONS

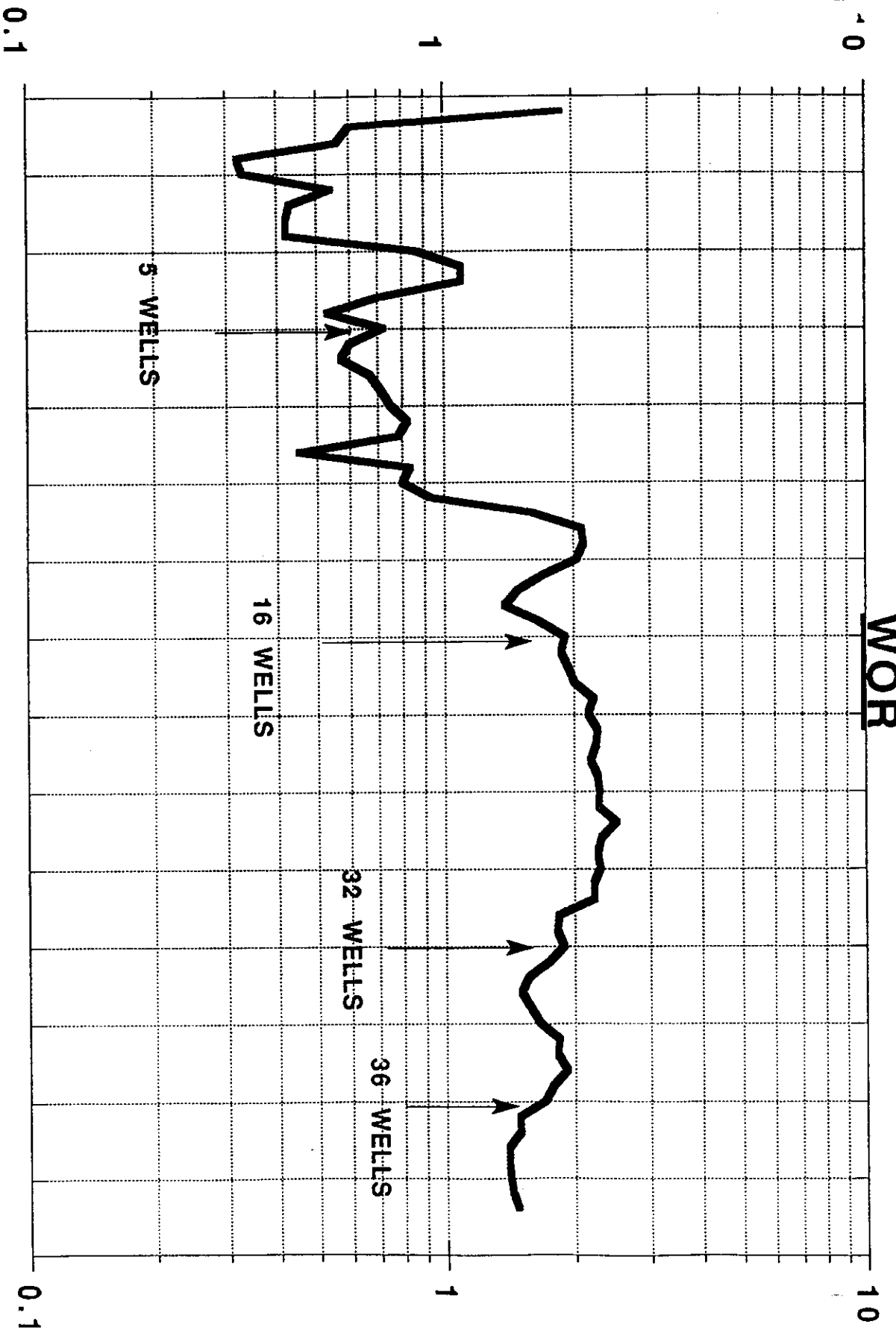
 1992 FREEHOLD EXPIRY

# **SOUTH PIERSON** **DAILY OIL M3/DAY**

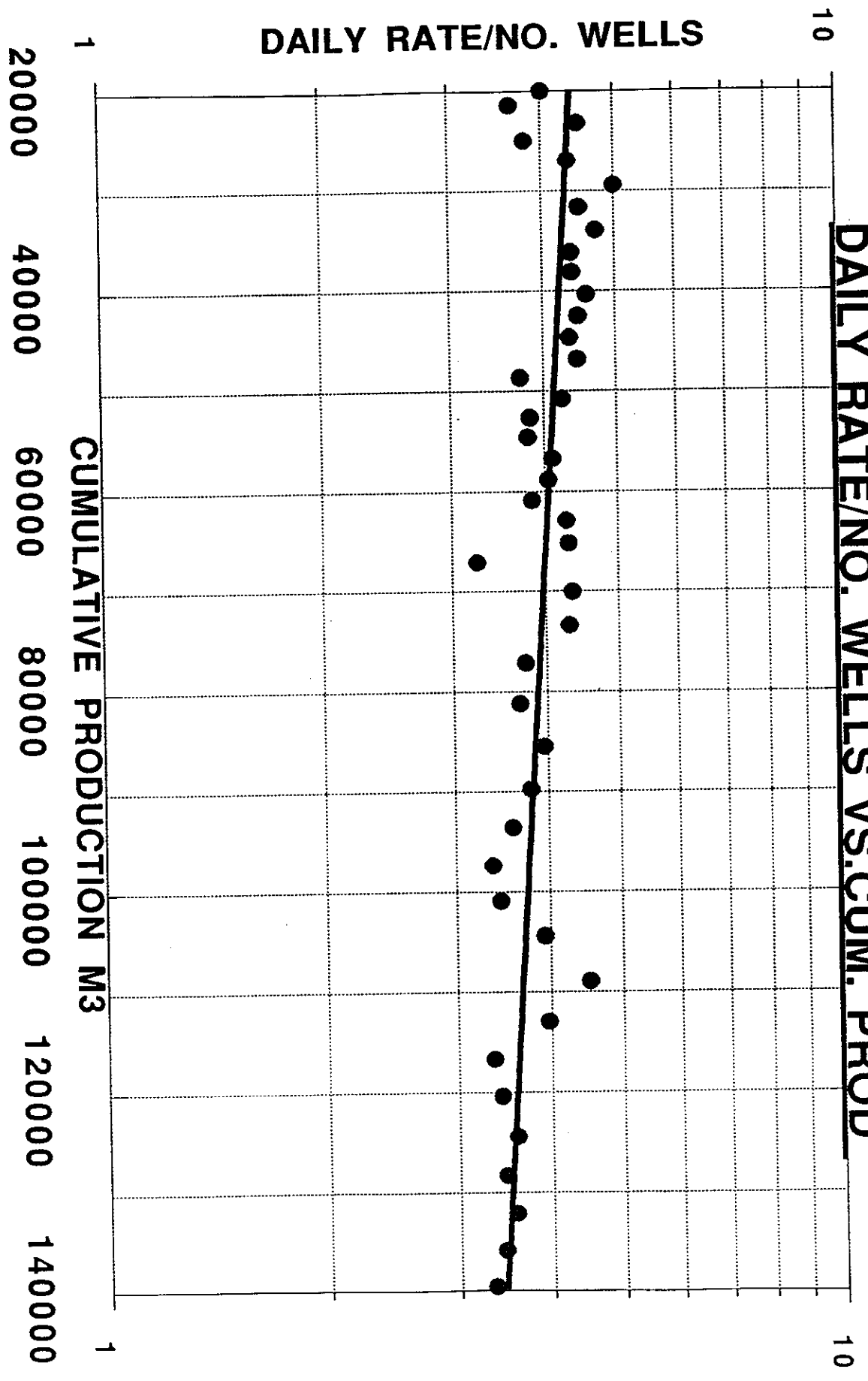


APR 86 FEB 87 DEC 87 OCT 88 AUG 89 JUN 90 APR 91

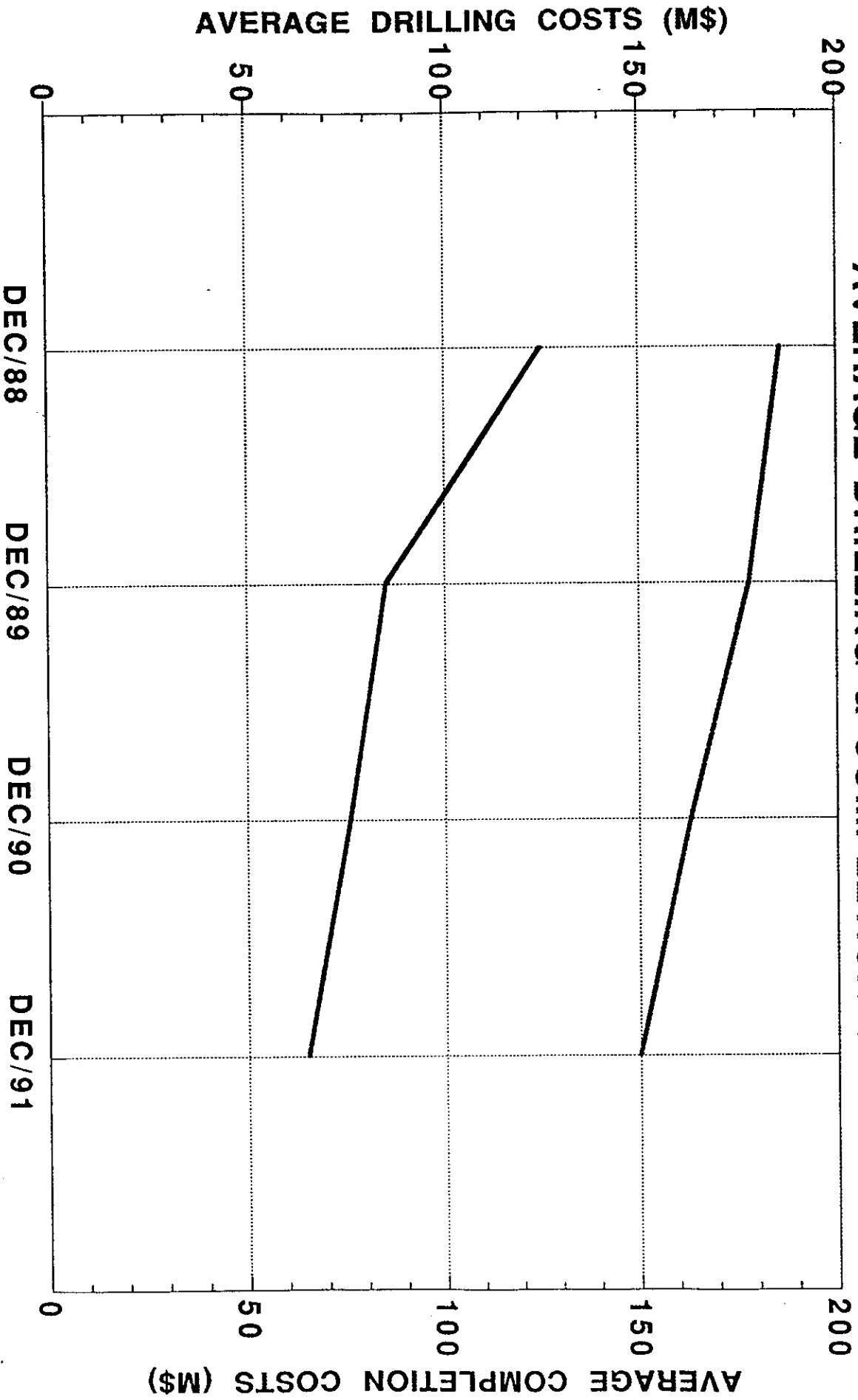
# SOUTH PIERSON WOR



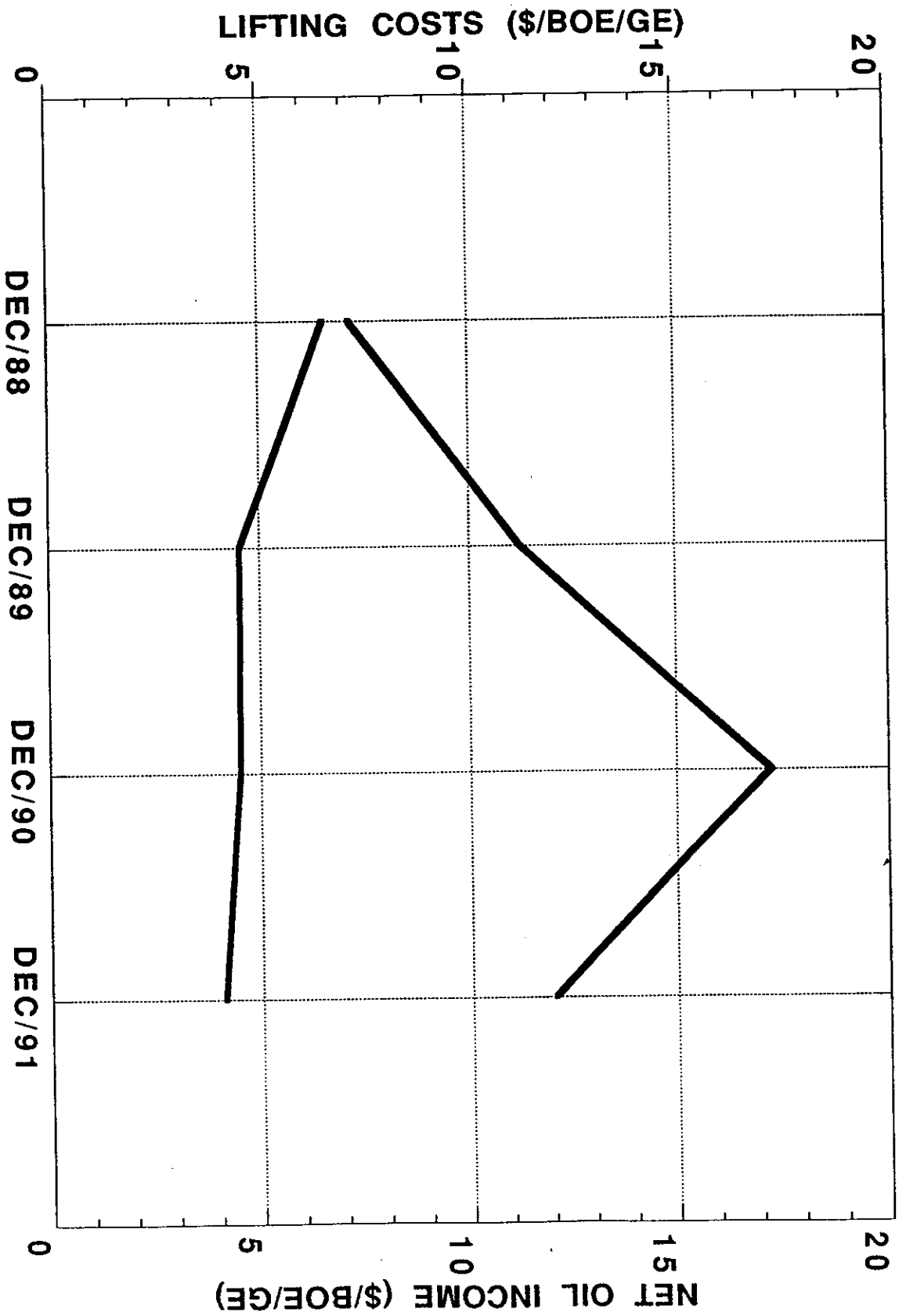
**SOUTH PIERSON PHD DATA**  
**DAILY RATE/NO. WELLS VS.CUM. PROD**



# SOUTH PIERSON AVERAGE DRILLING & COMPLETION COSTS



# SOUTH PIERSON LIFTING COSTS AND NET OIL INCOME





# **SOUTH PIERSON AREA STUDY**

## **RESERVOIR**

### **GEOLOGY**

- \* Jurassic Lower Amaranth Sandstone (Spearfish)
- \* Underlying Mississippian Mission Canyon Carbonate

### **RESERVOIR ROCK**

- \* Low Perm ( $k = 2 - 4$  md)
- \* Average Porosity = 15%
- \* Average Net Pay = 3.5 m
- \* Oil Saturation = approx 45%

### **FLUIDS**

- \* Oil Viscosity = 1.3 cp (36 API)
- \* Water Viscosity = 0.8 cp

### **DRIVE**

- \* Undersaturated Solution Gas Drive / No Gas Cap
- \* Currently above Bubble Point (4600 kPa)
- \* Expansion Drive

# **SOUTH PIERSON AREA STUDY**

## **PRIMARY DEPLETION EVALUATION**

- \* MATERIAL BALANCE / DECLINE ANALYSIS**
- \* MAPPING AND VOLUMETRIC RESERVES DETERMINATION**
- \* APPLICATION OF THEORETICAL MODELS**
- \* UNDERSTANDING OF GEOLOGY / HYDROCARBON SOURCE AND MIGRATION**
- \* GENERATION OF PRODUCTION FORECAST**

# SOUTH PIERSON AREA STUDY

## PRIMARY DEPLETION RESULTS

### VOLUMETRICS

\* PROJECT AREA O.O.I.P. = 4.4 10<sup>6</sup>M<sup>3</sup>  
= 27.6 MMSTB

### MAT. BALANCE

\* PROJECT AREA R.O.I.P. = 535,600 M<sup>3</sup>  
\* INDIVIDUAL AND COLLECTIVE  
\* RECOVERY FACTOR = 12%

### MODELS

\* TRACY-TARNER RECOVERY MODEL  
\* VOLUMETRIC SOLUTION GAS RESERVOIR  
\* RECOVERY FACTOR = 8%

### CONCLUSIONS

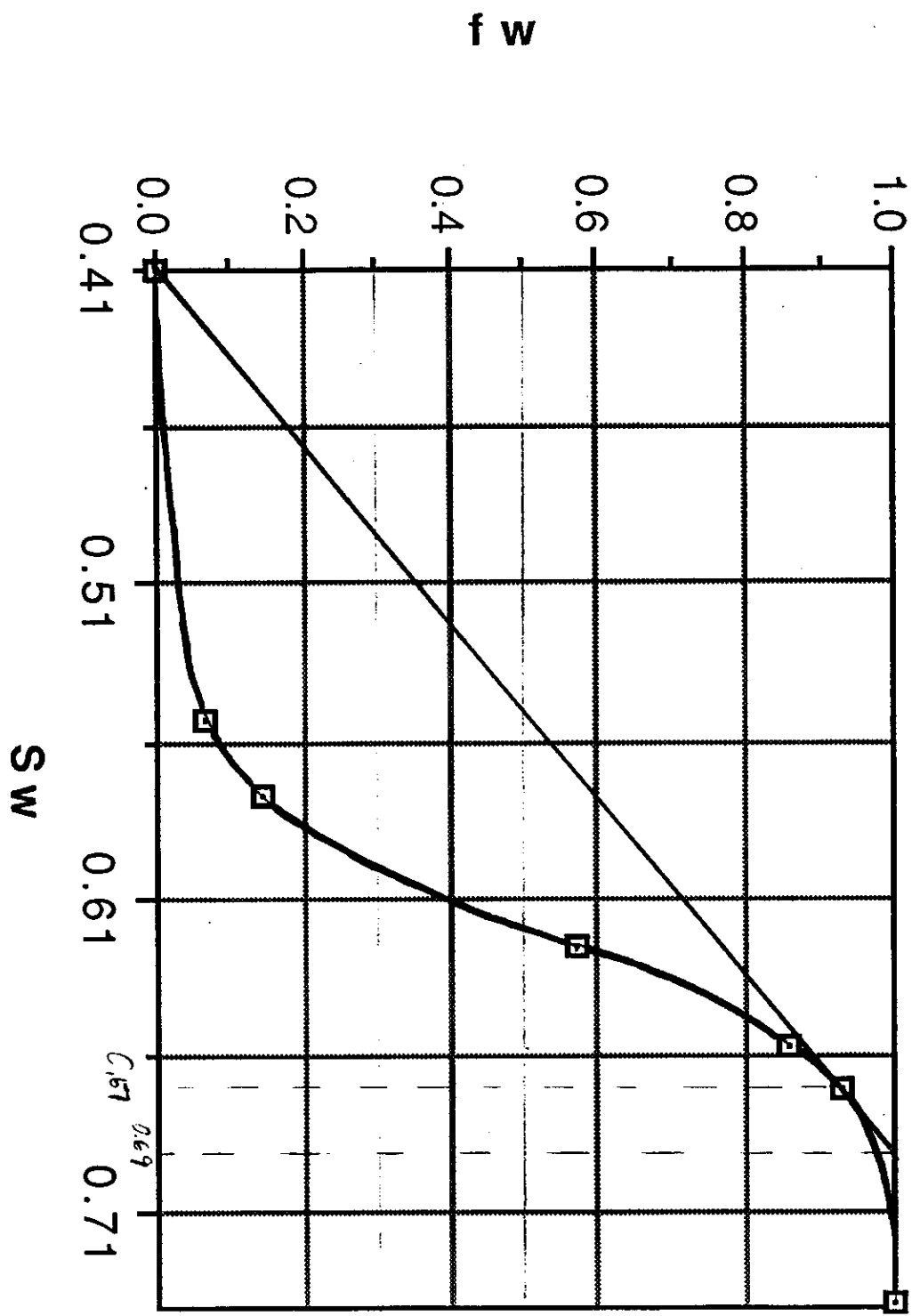
\* CONTRIBUTION FROM MISSION CANYON  
\* PRESSURE SUPPORT OR INFLUX?

# **SOUTH PIERSON AREA STUDY**

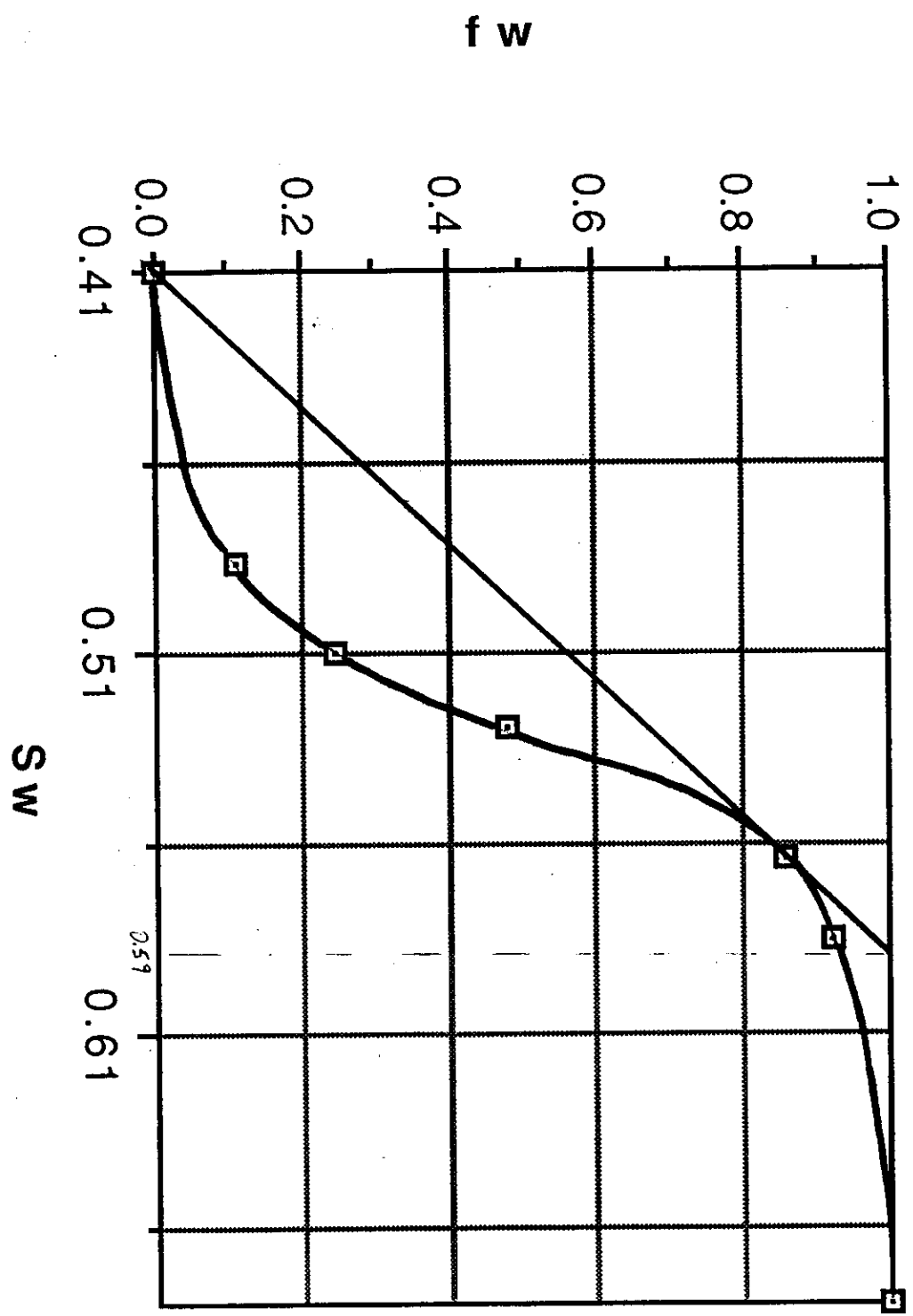
## **WATERFLOOD EVALUATION**

- \* REVIEW SPECIAL CORE ANALYSIS & RESERVOIR DATA**
- \* DEVELOPED WATERFLOOD MODEL BASED ON CRAIG ET AL**
- \* PATTERN SENSITIVITIES EVALUATED**
- \* WATERFLOOD PERFORMANCE PREDICTION GENERATED**

# SOUTH PIERSON - SAMPLE 4A



# SOUTH PIERSON - SAMPLE 4B

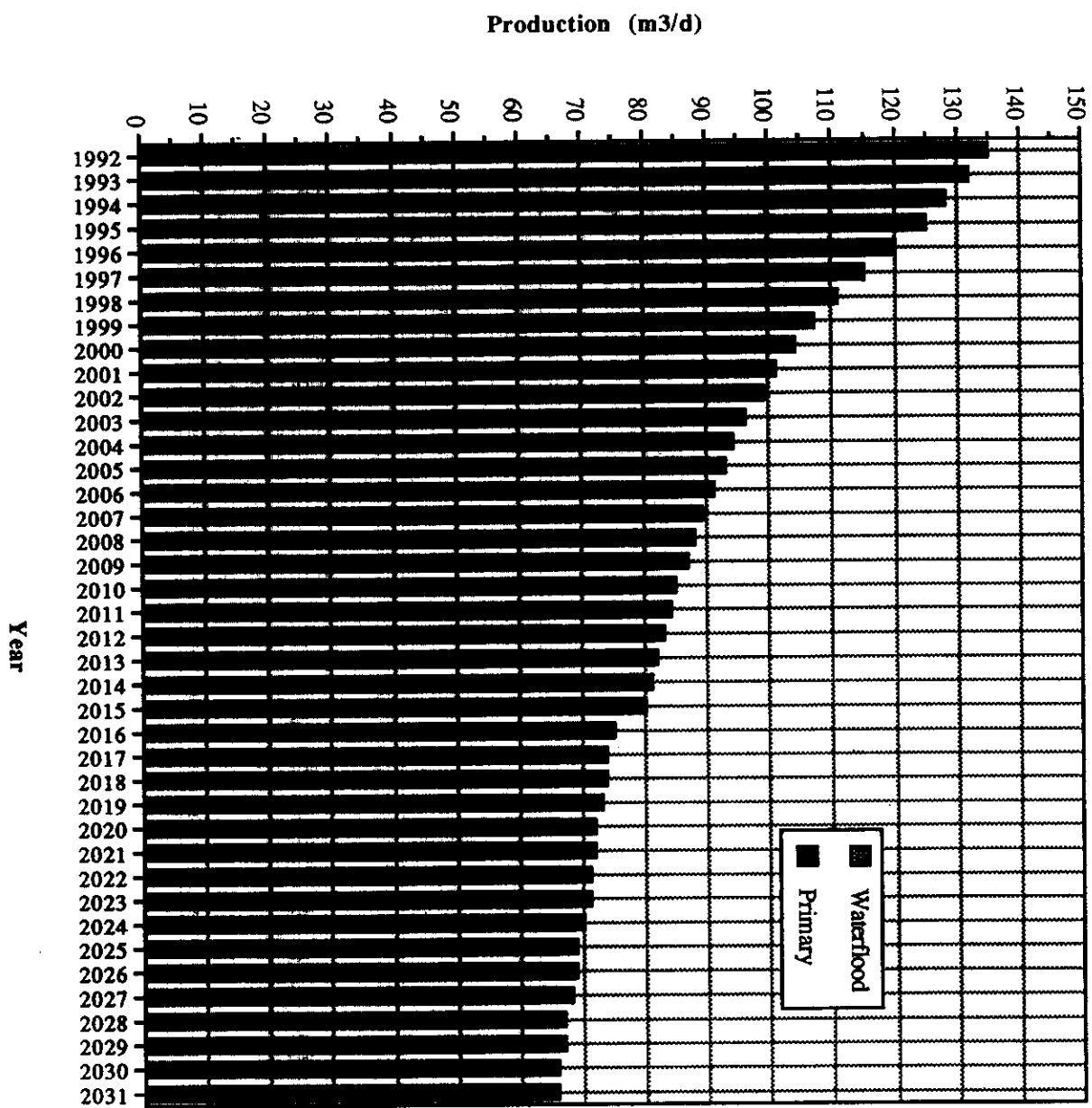


# **SOUTH PIERSON AREA STUDY**

## **WATERFLOOD RESULTS**

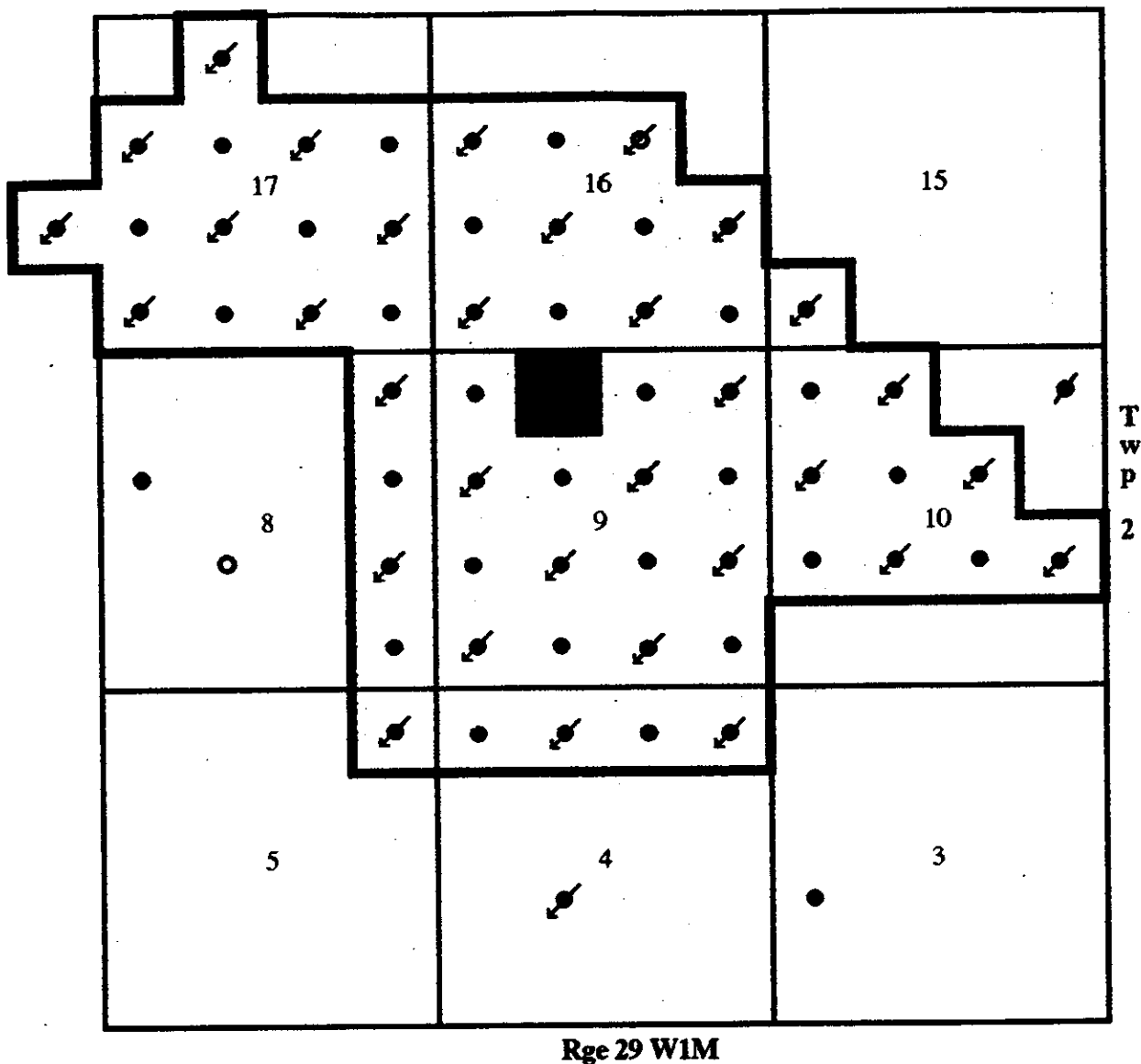
- \* PREDICTED SWEEP EFFICIENCY OF >80%**
- \* MATCHED MODEL TO EXISTING PRODUCTION**
- \* PREDICTED RECOVERY FACTOR OF 30 - 40 %**
- \* MINIMAL RECOVERY AFTER BREAKTHROUGH**
- \* 40 ACRE SPACING SELECTED AS MOST FEASIBLE**
- \* LONG FLOOD LIFE OF 35 - 40 YEARS**

# **SOUTH PIERSON PRODUCTION FORECAST OF WATERFLOOD AREA**





# SOUTH PIERSON WATERFLOOD AREA



 Proposed Waterflood Area

 Central Facilities

 Current Producing Wells converted to Injectors

 Infill Drilling Locations

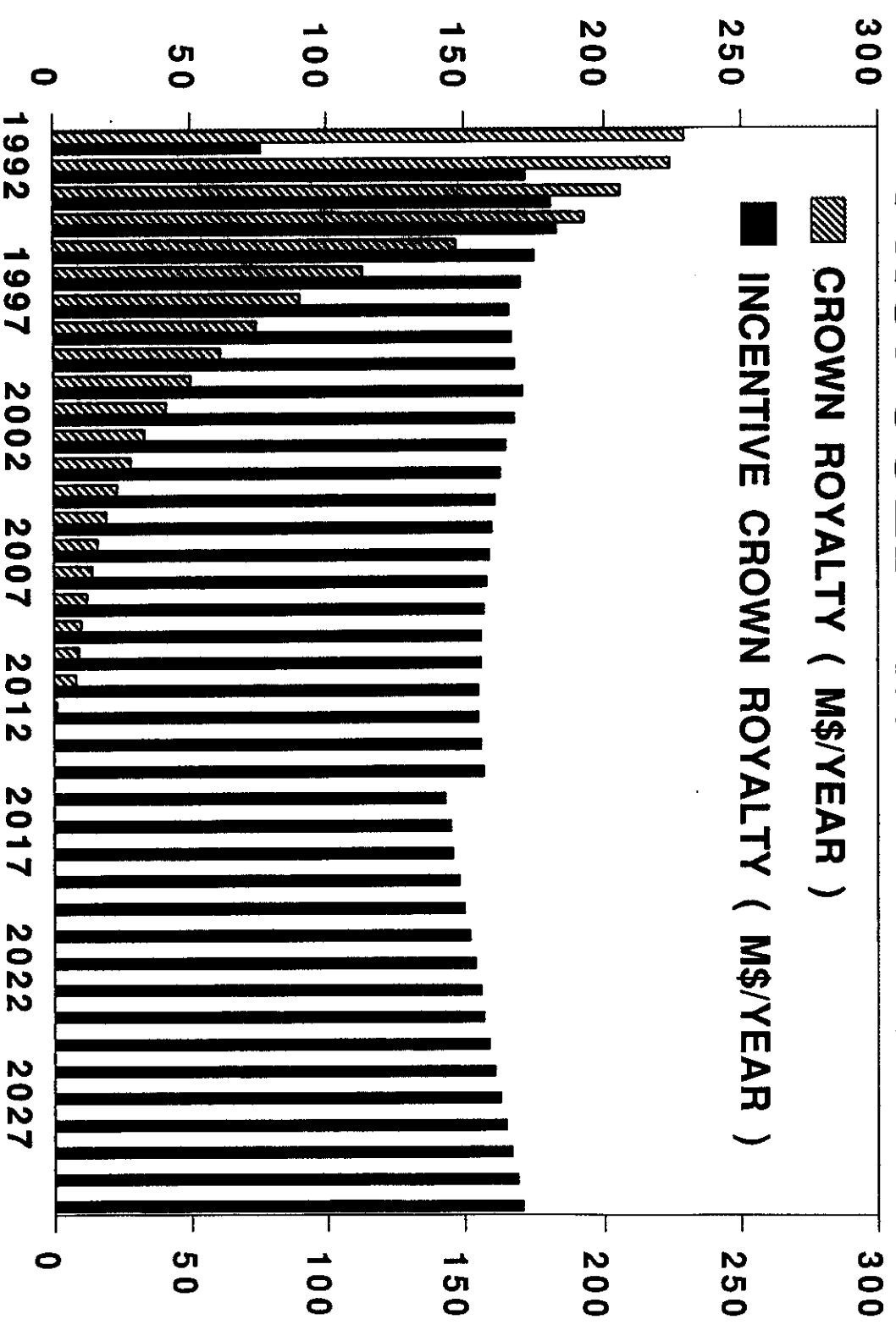
 1992 Drilling Locations

## **SOUTH PIERSON AREA STUDY**

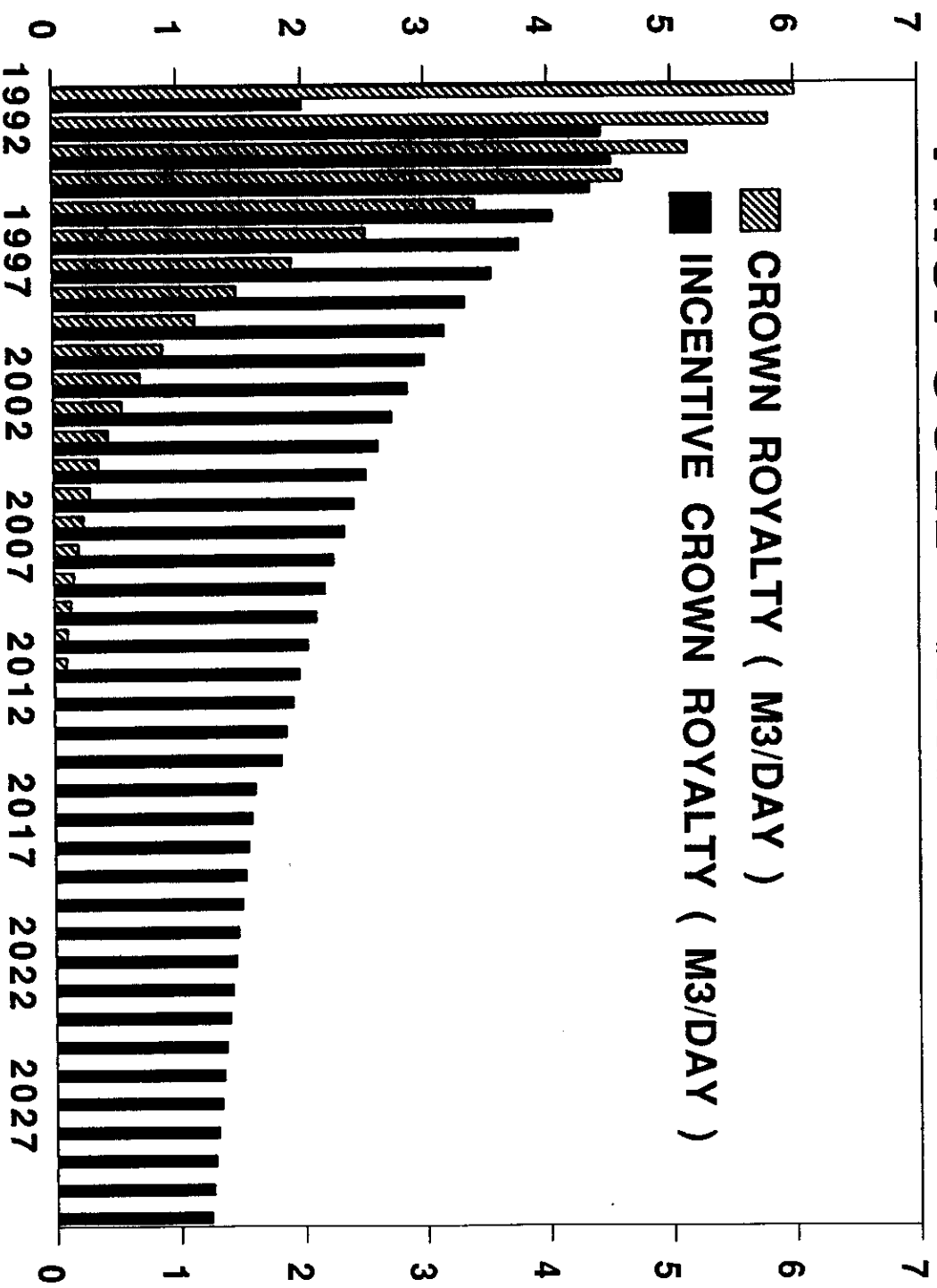
### **HORIZONTAL DRILLING EVALUATION**

- \* HORIZONTAL DRILLING TO REPLACE TWO (2) VERTICAL WELLS**
- \* PRODUCE FLUSH ZONE THEN CONVERT TO WATER INJECTION**
- \* INCREASED INJECTIVITY IN HORIZONTAL WELLBORE (I.E. ACCELERATED PRODUCTION FOR WATERFLOOD)**
- \* HORIZONTAL MODELS USED TO DETERMINE PRODUCTION CAPABILITY (15 - 20 M<sup>3</sup>/D)**
- \* ROYALTY RELIEF AND LOWER OPERATING / CAPITAL COSTS**
- \* SOME TECHNICAL CONCERNS MUST BE ADDRESSED**

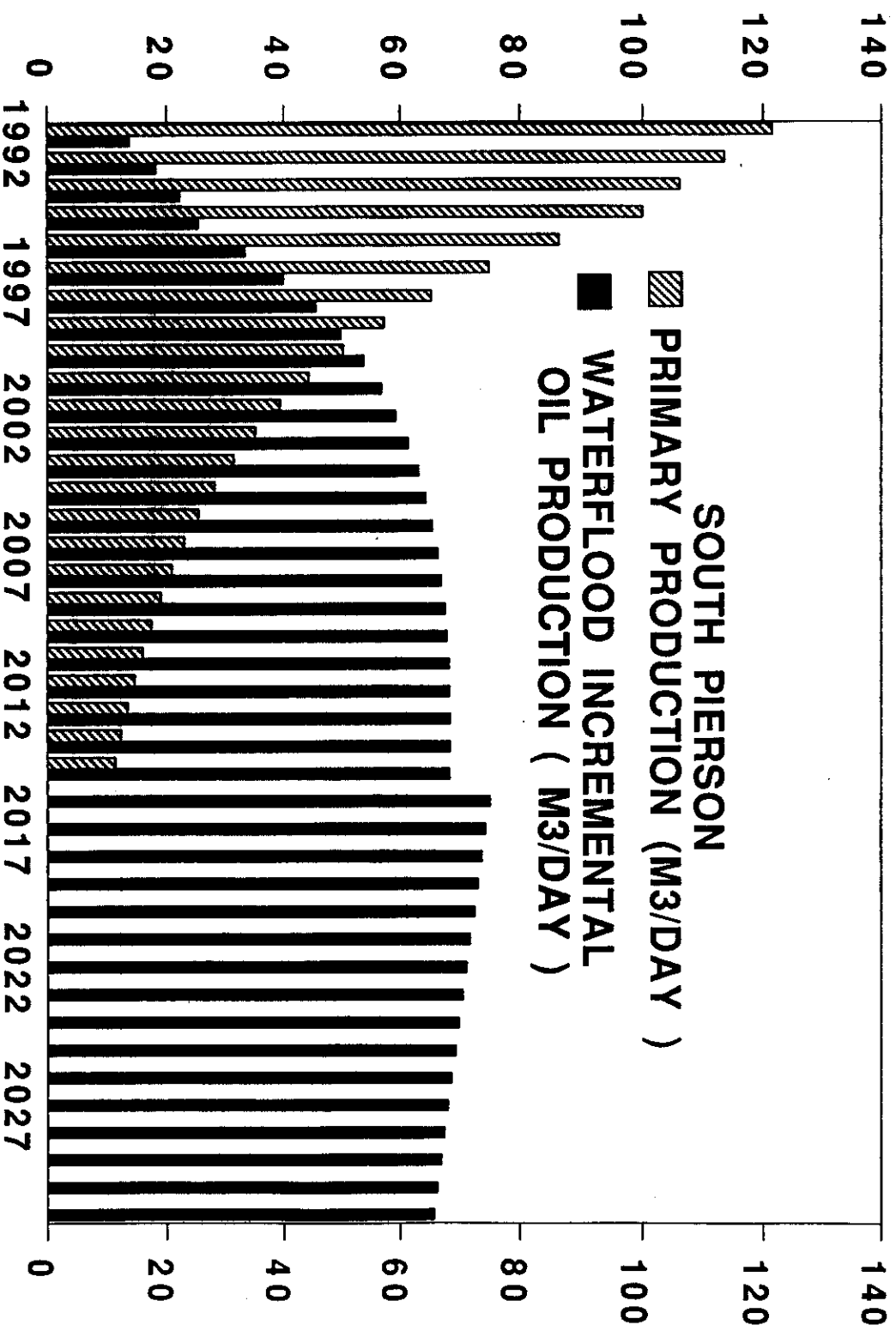
# SOUTH PIERSON PROPOSED WATERFLOOD



# SOUTH PIERSON PROPOSED WATERFLOOD



# **SOUTH PIERSON PROPOSED WATERFLOOD**

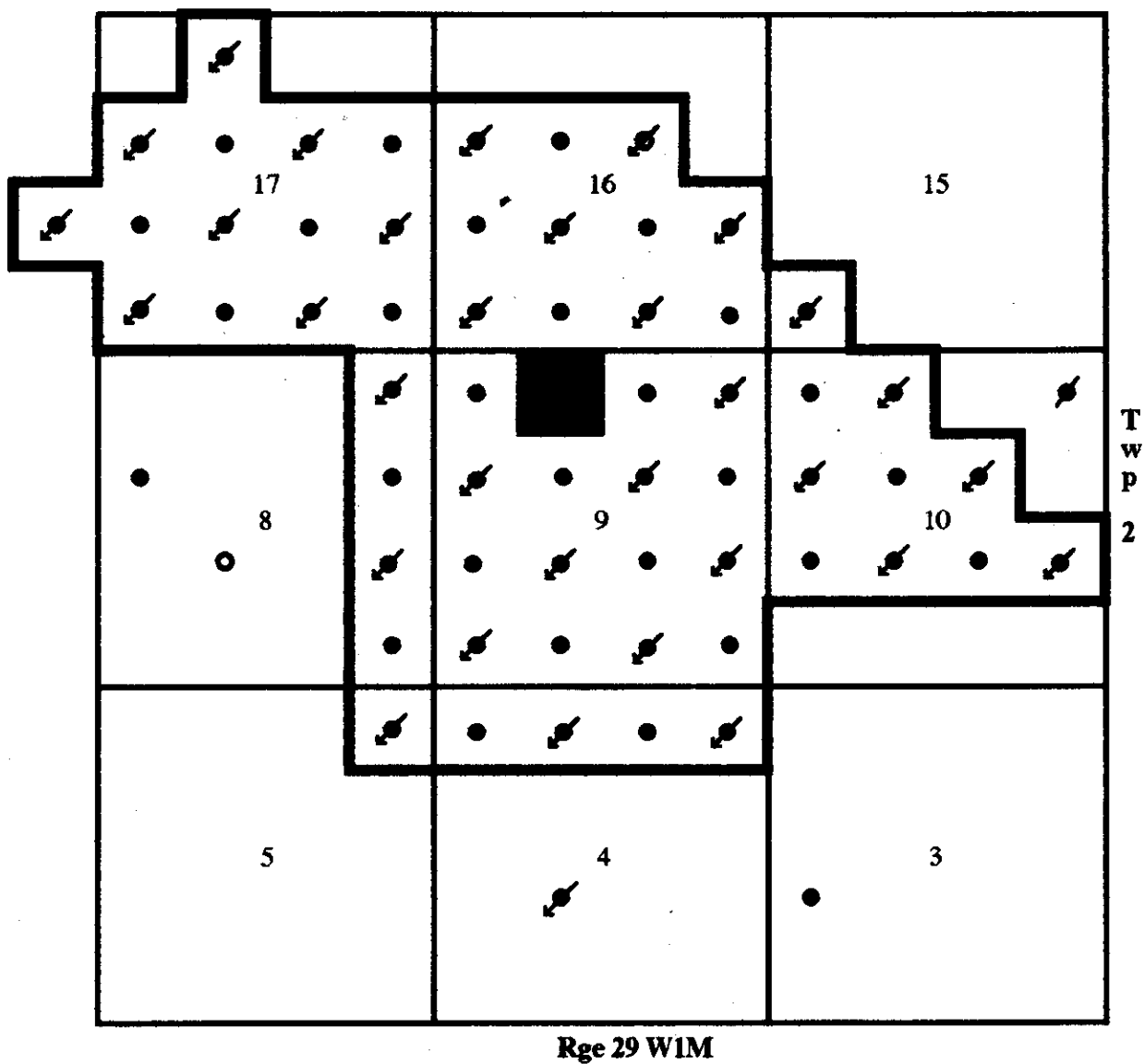


# **SOUTH PIERSON AREA STUDY**

## **SUMMARY**

- \* TECHNICAL MERIT IN WATERFLOOD BUT ECONOMICS ARE MARGINAL**
- \* E.O.R. INCENTIVES BENEFIT TO BOTH GOVERNMENT AND INDUSTRY**
- \* EXPEDITED DEVELOPMENT REQUIRED**
- \* HOME/SCURRY WILL COMMIT TO PILOT PROJECT**
- \* DETAILED PILOT PROJECT/WATERFLOOD REPORT TO FOLLOW**

# SOUTH PIERSON WATERFLOOD AREA



 Proposed Waterflood Area

 Central Facilities

 Current Producing Wells converted to Injectors

 Infill Drilling Locations

 1992 Drilling Locations

JUN 28 '93 13:10  
JUN 25 '93 10:21

FROM PETROLEUM-WASKADA  
FROM PIERSON-MAN

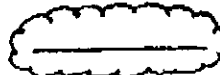
TO WINNIPEG  
TO WASK-E-M

PAGE.003  
PAGE.003  
25:01 05. 03 1111

PAGE 004  
\*\* TOTAL PAGE.004 \*\*

HONES PLANS  
FOR F/L FOR  
WF PROJECT

NEW FLOW LINES

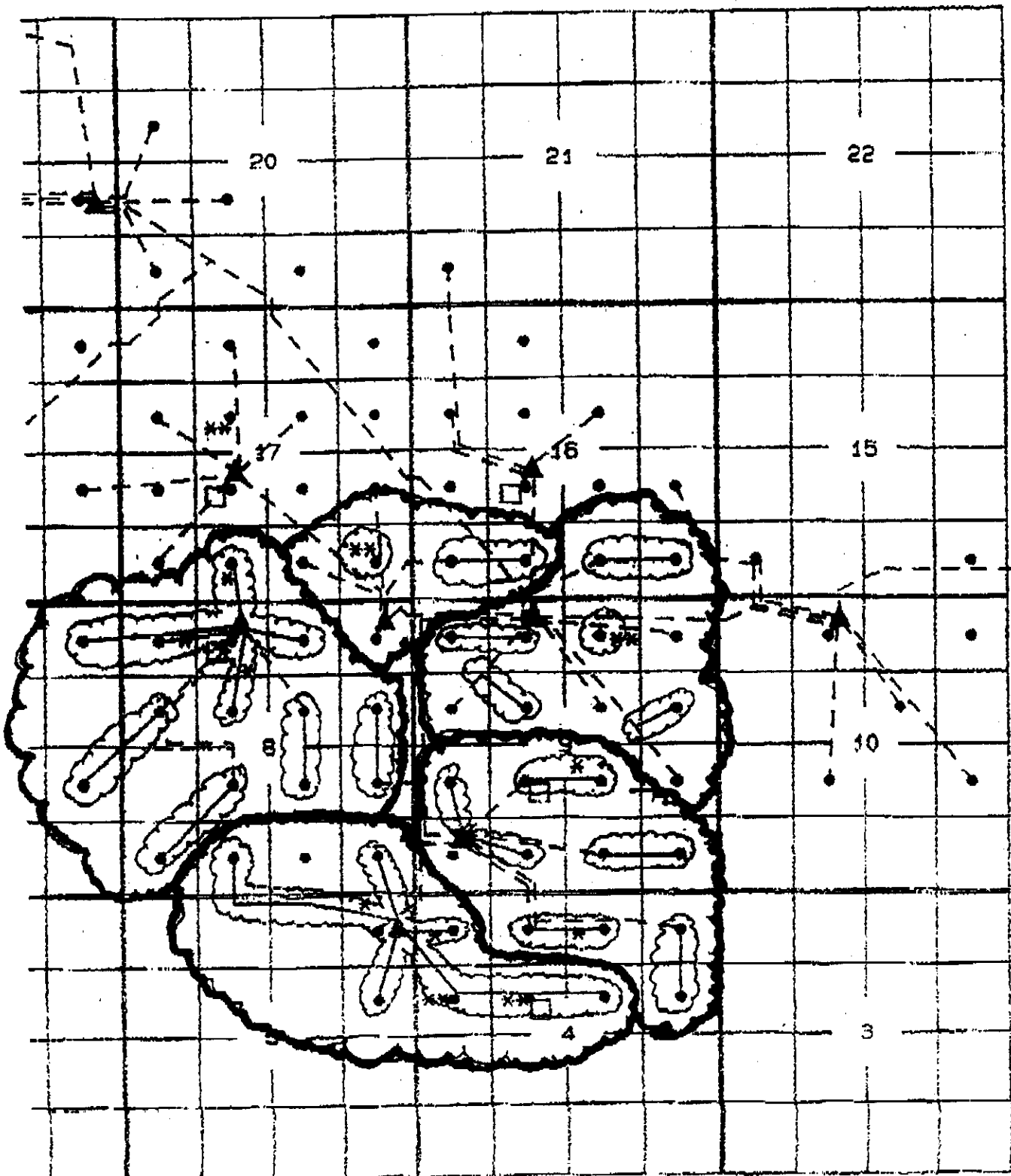


EXISTING FLOW LINES



\* - COMMON DITCHED WITH WATERLINE OR OTHER FLOWLINE

\*\* - SHORT LINE TO EXISTING FLOWLINE





PAGE.002

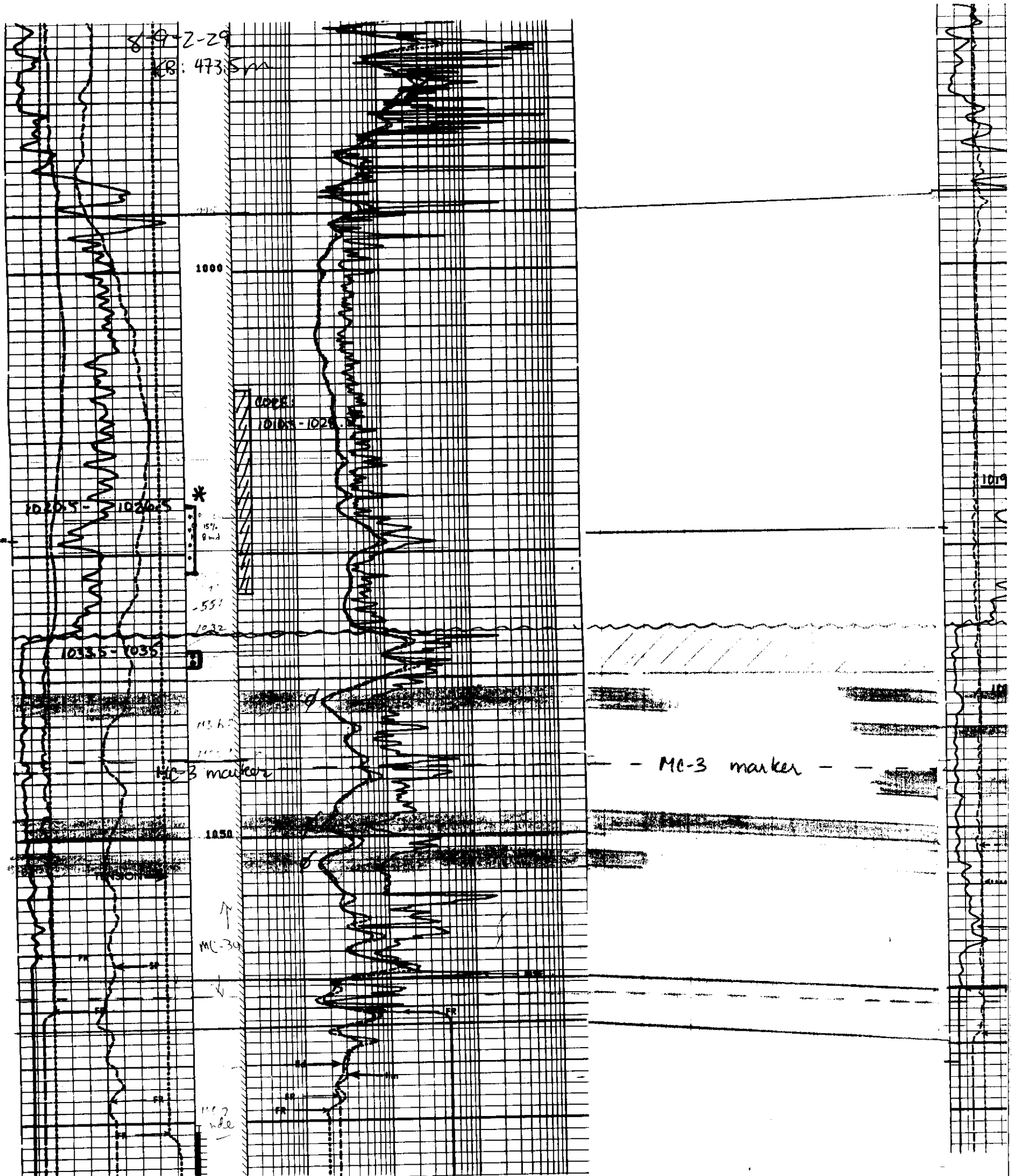
JUN 24 '93 12:42

| WELL | STATUS    | C/L WITH         | MONTHS C/L | TO SATELITE | 1993 DRILLING | 1994 DRILLING           |
|------|-----------|------------------|------------|-------------|---------------|-------------------------|
| 1    | ✓ 12 - 4  | NEW LINE         |            | 16 - 5      | JUN 93        |                         |
| 2    | ✓ 10 - 4  | NEW LINE         |            | 16 - 5      | JUN 93        |                         |
| 3    | ✓ 2 - 8   | NO FLOWLINE REQ. |            | 16 - 5      | JUN 93        |                         |
| 4    | ✓ 8 - 7   | 12 - 8           | 8          | 14 - 8      | ?             |                         |
| 5    | ✓ 4 - 8   | 6 - 8            | 8          | 14 - 8      | ?             |                         |
| 6    | ✓ 16 - 7  | NEW LINE         |            | 14 - 8      | ?             |                         |
| 7    | ✓ 5 - 9   | NEW LINE         |            | 4 - 9       | AUG 93        |                         |
| 8    | ✓ 7 - 9   | 6 - 9            | 5          | 4 - 9       | AUG 93        | DITCH WITH W/L TO 08-09 |
| 9    | ✓ 3 - 9   | NEW LINE         |            | 4 - 9       | AUG 93        |                         |
| 10   | ✓ 13 - 4  | NEW LINE         |            | 16 - 5      | AUG 93        | DITCH WITH W/L TO 16-05 |
| 11   | ✓ 1 - 8   | NEW LINE         |            | 16 - 5      | AUG 93        |                         |
| 12   | ✓ 7 - 8   | 10 - 8           | 6          | 14 - 8      | AUG 93        |                         |
| 13   | ✓ 9 - 8   | 8 - 8            |            | 4 - 9       | AUG 93        |                         |
| 14   | ✓ 11 - 9  | 12 - 9           | 4          | 14 - 9      | AUG 93        |                         |
| 15   | ✓ 13 - 9  | 14 - 9           | 0          | 14 - 9      | AUG 93        |                         |
| 16   | ✓ 15 - 9  | 18 - 9           | 20         | 14 - 9      | AUG 93        |                         |
| 17   | ✓ 3 - 16  | 4 - 16           | 12         | 16 - 8      | AUG 93        |                         |
| 18   | ✓ 1 - 17  | 8 - 17           | 12         | 16 - 8      | AUG 93        |                         |
| 19   | ✓ 15 - 8  | NEW LINE         |            | 14 - 8      | SEP 93        |                         |
| 20   | ✓ 11 - 8  | NEW LINE         |            | 14 - 8      | SEP 93        | DITCH WITH W/L TO 06-08 |
| 21   | ✓ 3 - 17  | NEW LINE         |            | 14 - 8      | SEP 93        | DITCH WITH W/L TO 06-17 |
| 22   | ✓ 1 - 16  | 2 - 16           | 9          | 14 - 9      | SEP 93        |                         |
| 23   | ✓ 13 - 8  | NEW LINE         |            | 14 - 8      | SEP 93        | DITCH WITH F/L FR 16-07 |
| 24   | ✓ 3 - 8   | NEW LINE         |            | 16 - 5      | SEP 93        | DITCH WITH W/L TO 02-08 |
| 25   | ✓ 9 - 5   | NEW LINE         |            | 16 - 5      | SEP 93        |                         |
| 26   | ✓ 11 - 4  | 10 - 4           | 4          | 16 - 5      | SEP 93        |                         |
| 27   | ✓ 15 - 4  | 14 - 4           | 3          | 4 - 9       | SEP 93        | DITCH WITH W/L TO 16-04 |
| 28   | ✓ 9 - 4   | 16 - 4           | 0          | 4 - 9       | SEP 93        |                         |
| 29   | ✓ 1 - 9   | 2 - 9            | 4          | 4 - 9       | SEP 93        |                         |
| 30   | ✓ 9 - 9   | 8 - 9            | 0          | 14 - 9      | OCT 93        |                         |
| 31   | ✓ 7 - 16  | 8 - 16           | 2          | 14 - 10     |               | MAY 94                  |
| 32   | ✓ 11 - 16 | NEW LINE         |            | 6 - 16      |               | MAY 94                  |
| 33   | ✓ 5 - 16  | 12 - 16          | 3          | 6 - 16      |               | MAY 94                  |
| 34   | ✓ 9 - 17  | 10 - 17          | 3          | 6 - 17      |               | MAY 94                  |
| 35   | ✓ 7 - 17  | 2 - 17           | 2          | 16 - 8      |               | MAY 94                  |
| 36   | ✓ 11 - 17 | NEW LINE         |            | 6 - 17      |               | MAY 94                  |
| 37   | ✓ 5 - 17  | 8 - 18           | 12         | 6 - 17      |               | JUN 94                  |
| 38   | 16 - 17   | 14 - 17          | 12         | 6 - 17      |               | JUN 94                  |
| 39   | 14 - 16   | 4 - 21           | 12         | 6 - 16      |               | JUN 94                  |
| 40   | 5 - 15    | 4 - 15           | 4          | 14 - 10     |               | JUN 94                  |
| 41   | 1 - 18    | 4 - 17           | 4          | 6 - 17      |               | JUN 94                  |
| 42   | 9 - 18    | 12 - 17          |            | 6 - 17      |               | JUN 94                  |
| 43   | 13 - 17   | 6 - 18           | FOREVER    | GROUPLINE   |               | JUL 94                  |
| 44   | 15 - 17   | 14 - 17          | 6          | 6 - 17      |               | JUL 94                  |
| 45   | 13 - 16   | 14 - 16          | 5          | 6 - 16      |               | JUL 94                  |
| 46   | 15 - 16   | 10 - 16          | 0          | 6 - 16      |               | JUL 94                  |

Current  
Amaranth  
Producer / Former  
Mission Canyon  
Producer

8-9-2-29 WPM

KB: 473.5m



\* Recompleted June/91 to Lower Amaranth

\*

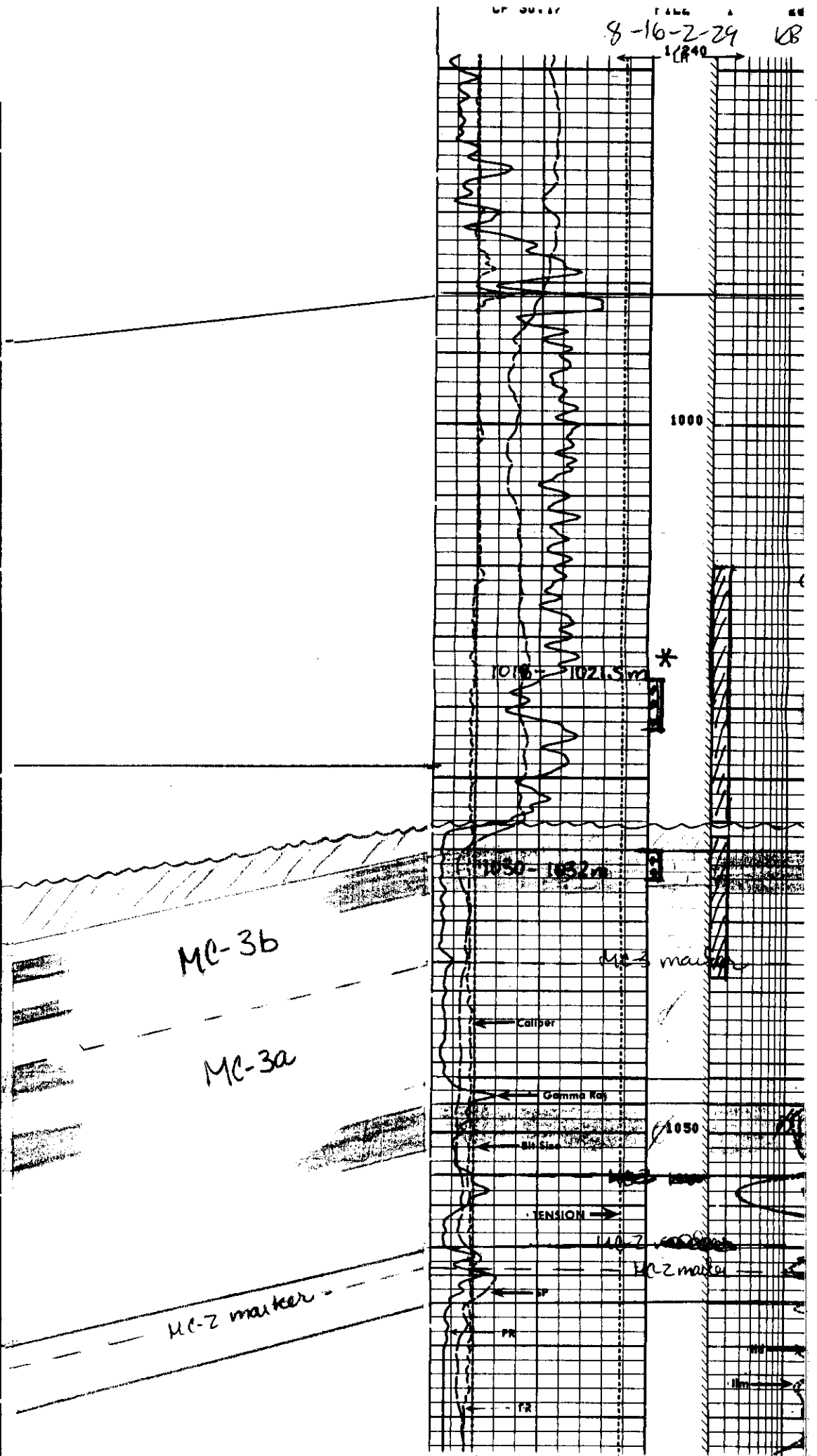
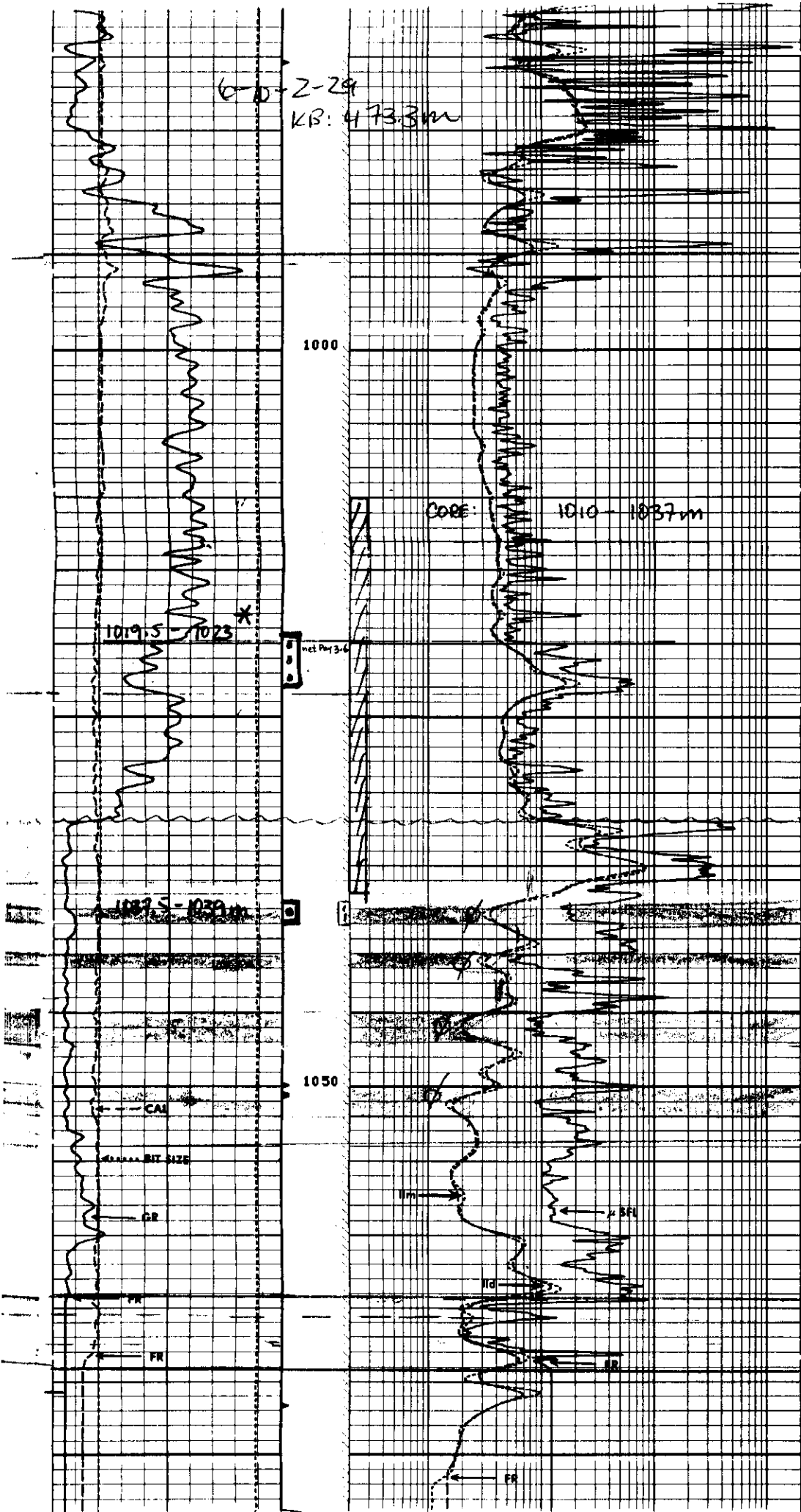
Current  
Amaranth  
Producer / Former  
Mission Canyon  
Producer

8-16-2

KB:

6-10-2-29 WPM

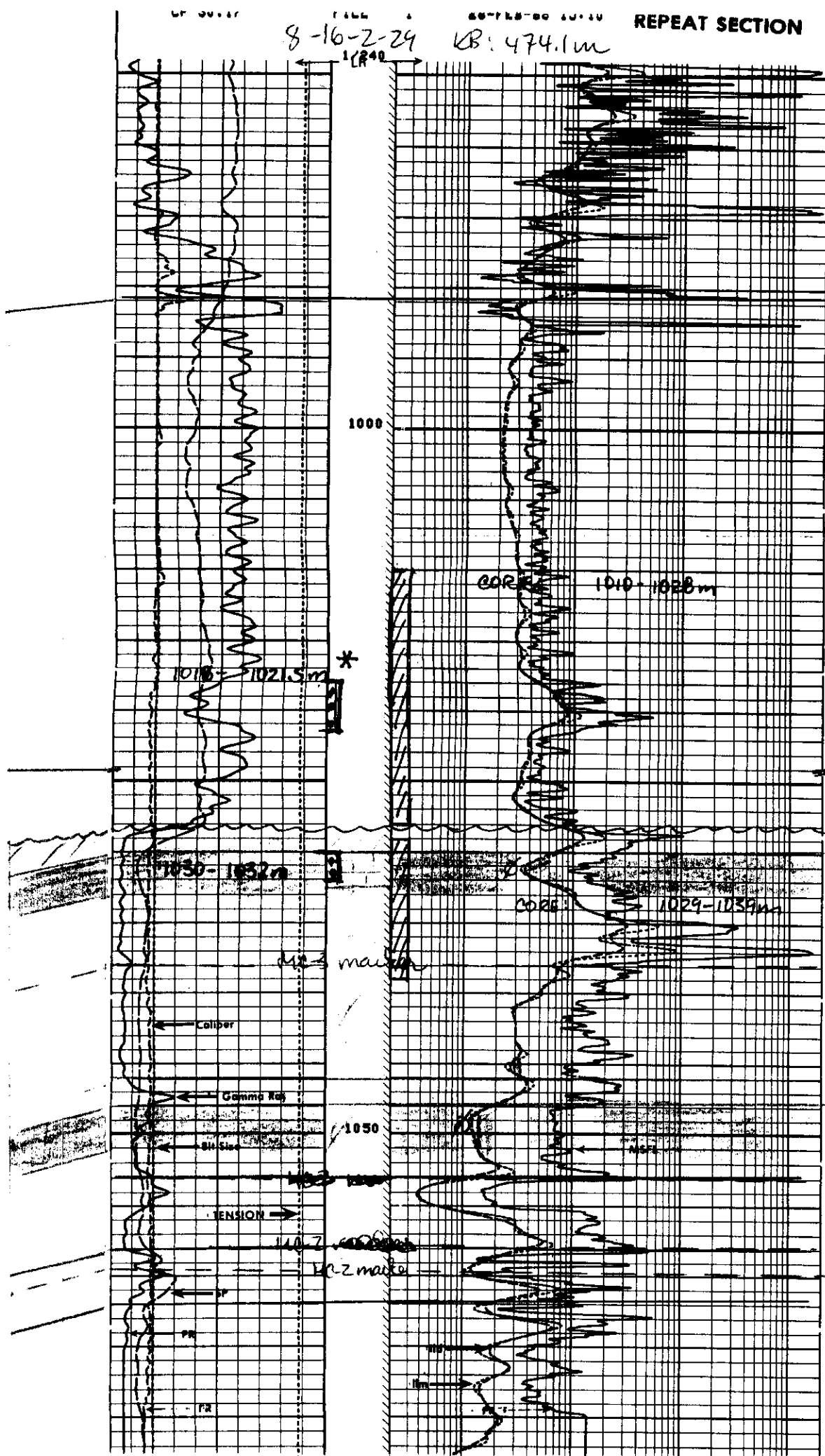
KB: 473.3m



\* Recompleted August/88 to Lower Amaranth

Current  
Amaranth  
Producer / Former  
Mission Canyon  
Producer

8-16-2-29 WPM  
KB: 474.1m



\* Recompleted March/90 to Lower Amaranth

---

DATUM

STRUCTURAL CROSS SECTION  
PIERSON FIELD

Apr. /93

Amara  
Producer

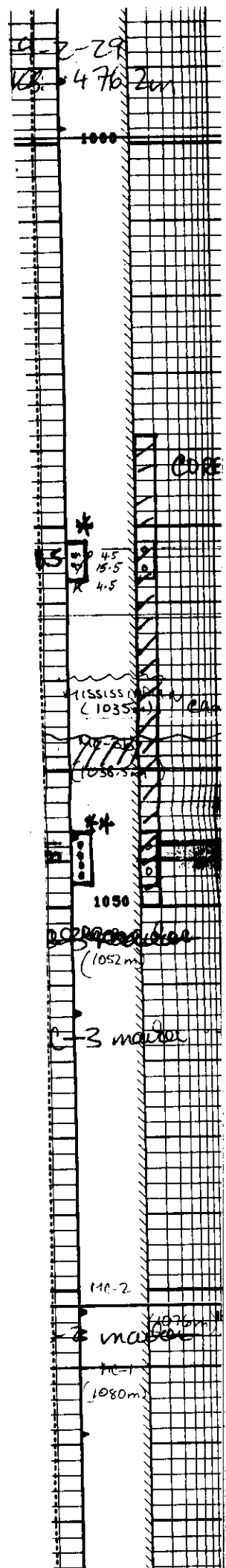
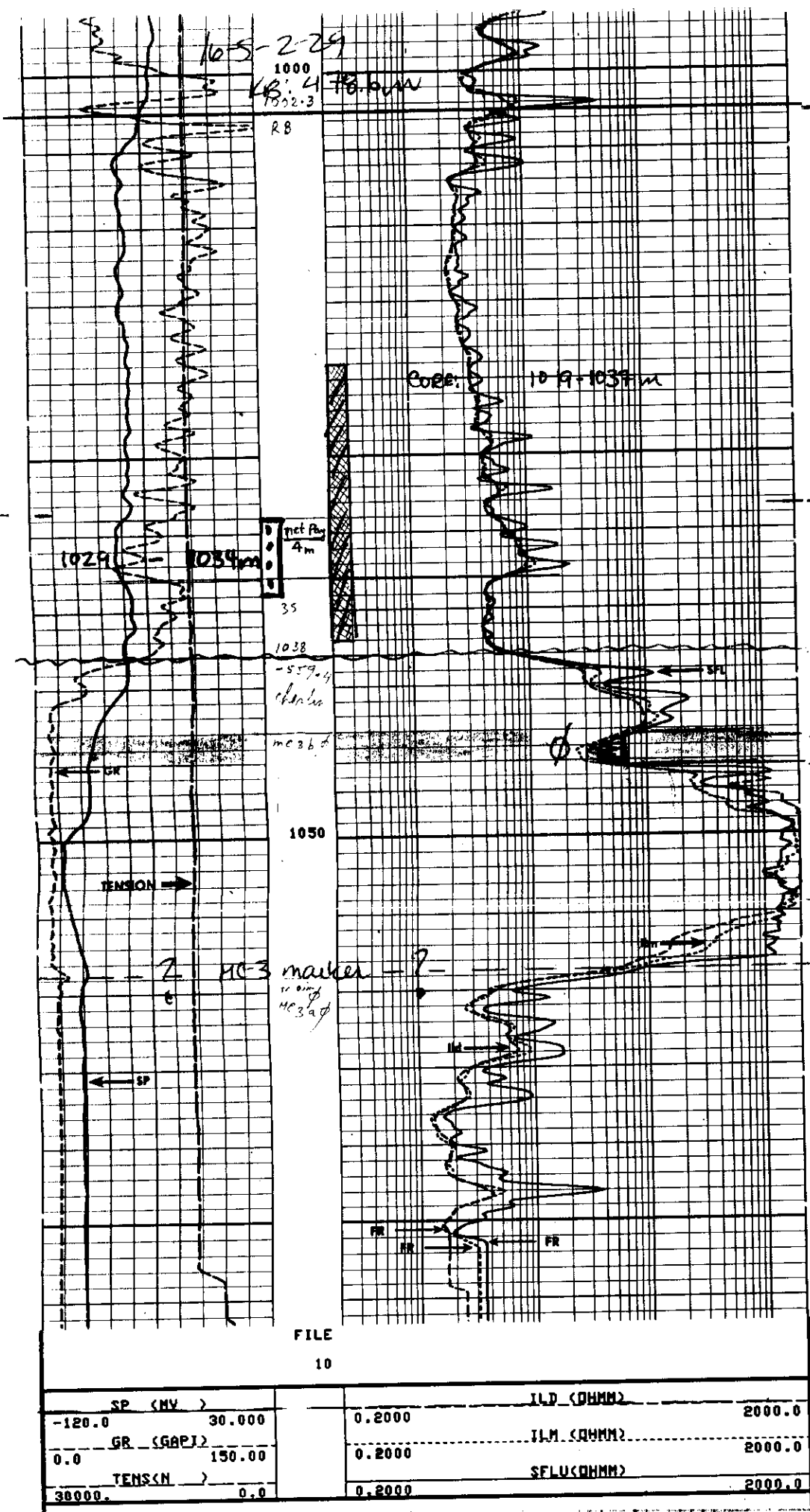
16-5-2-29 WPM

KB: 478.6m

Amara  
Produ

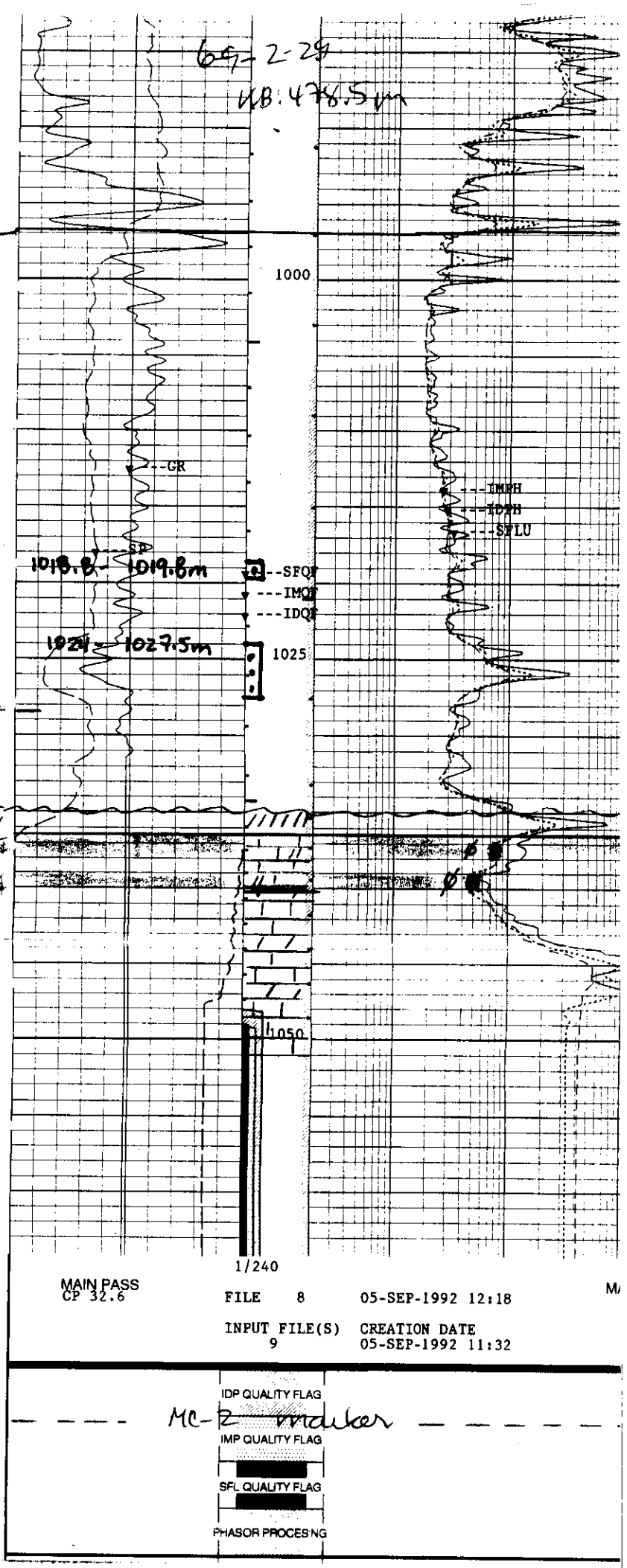
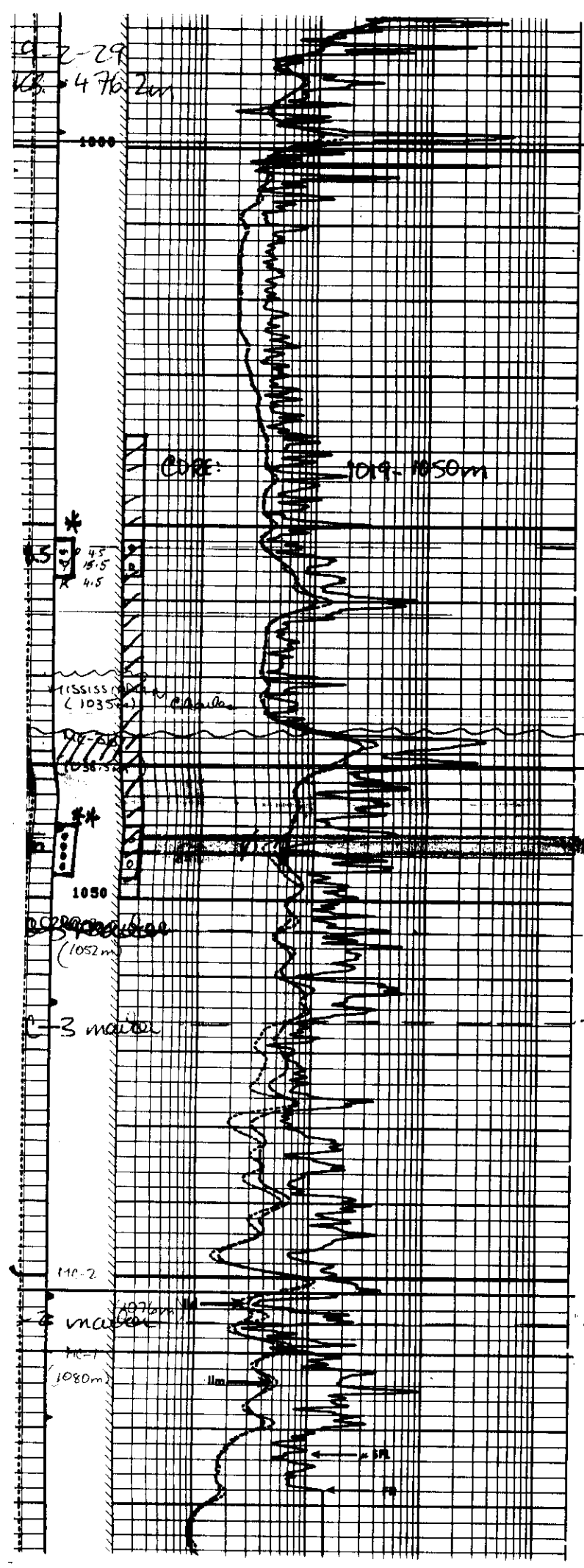
4-9-2-29 W

KB: 476.2m



4-9-2-29 WPM  
KB: 476.2m

6-2-29 WPM  
KB: 478.5m



action (July 1988)  
action (May 1988)

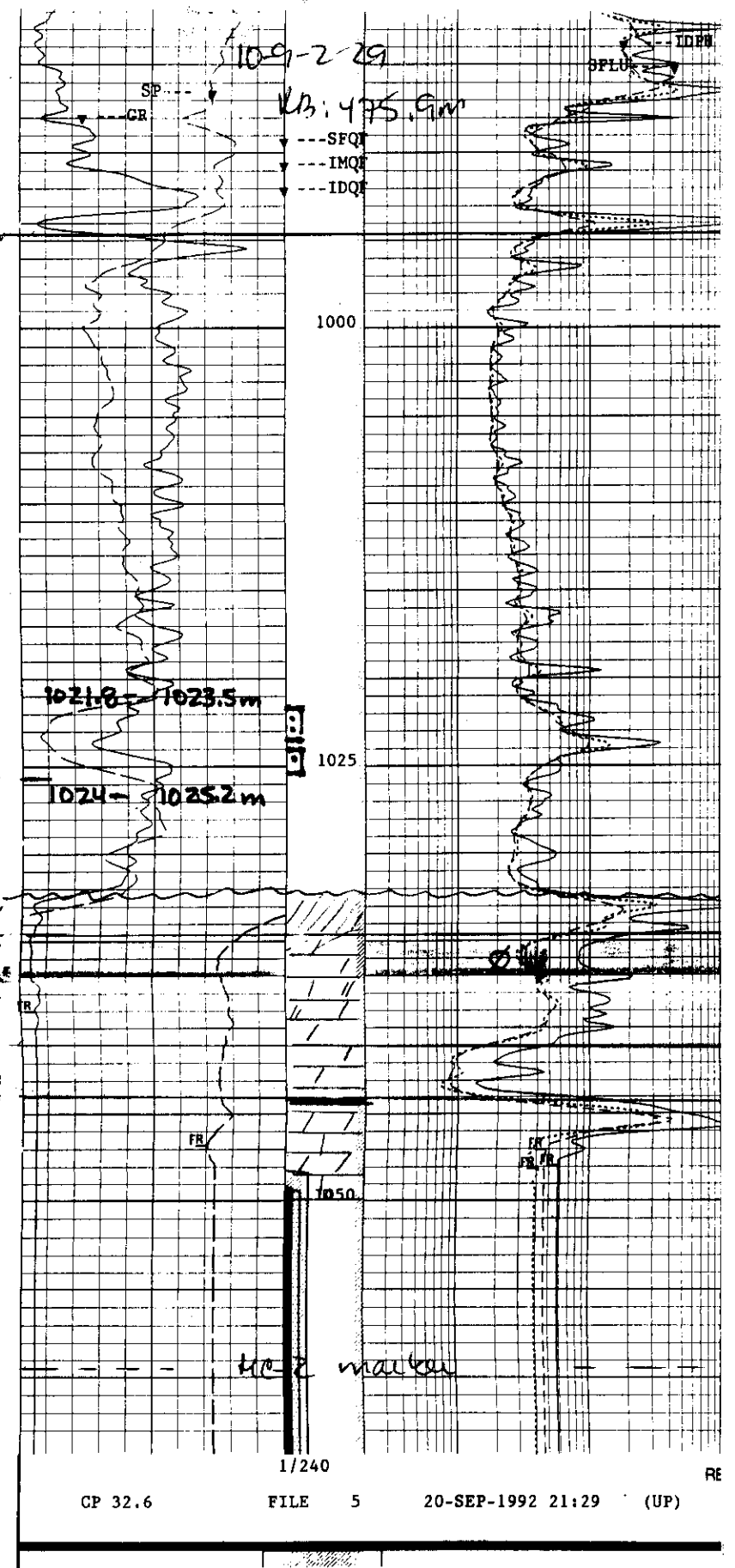
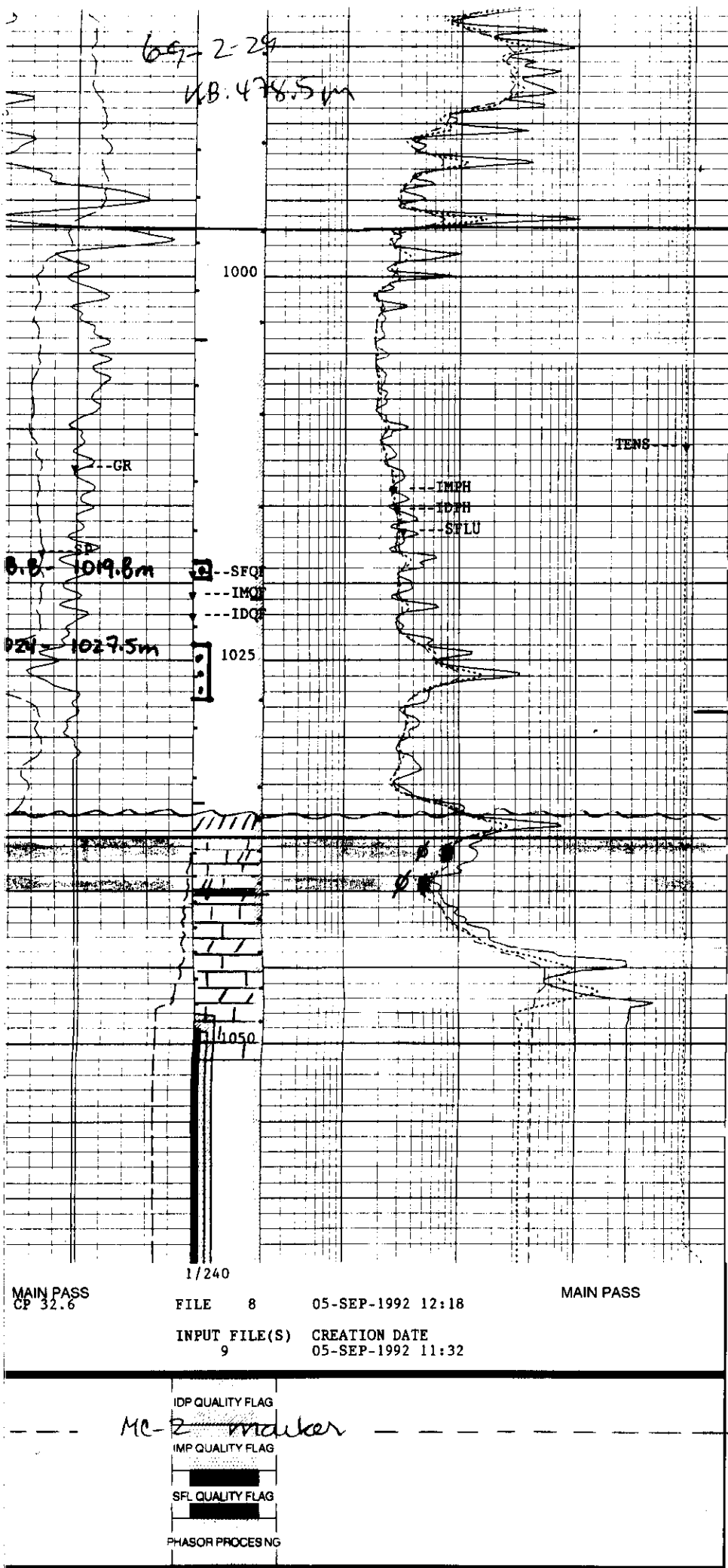
6- 2-29 WPM

KB: 478.5m

Amaranth  
Producers

10-9-2 29 WPM

KB: 475.9m



# LEGEND

- DOLOSTONE // ANHYDRITE
- LIMESTONE



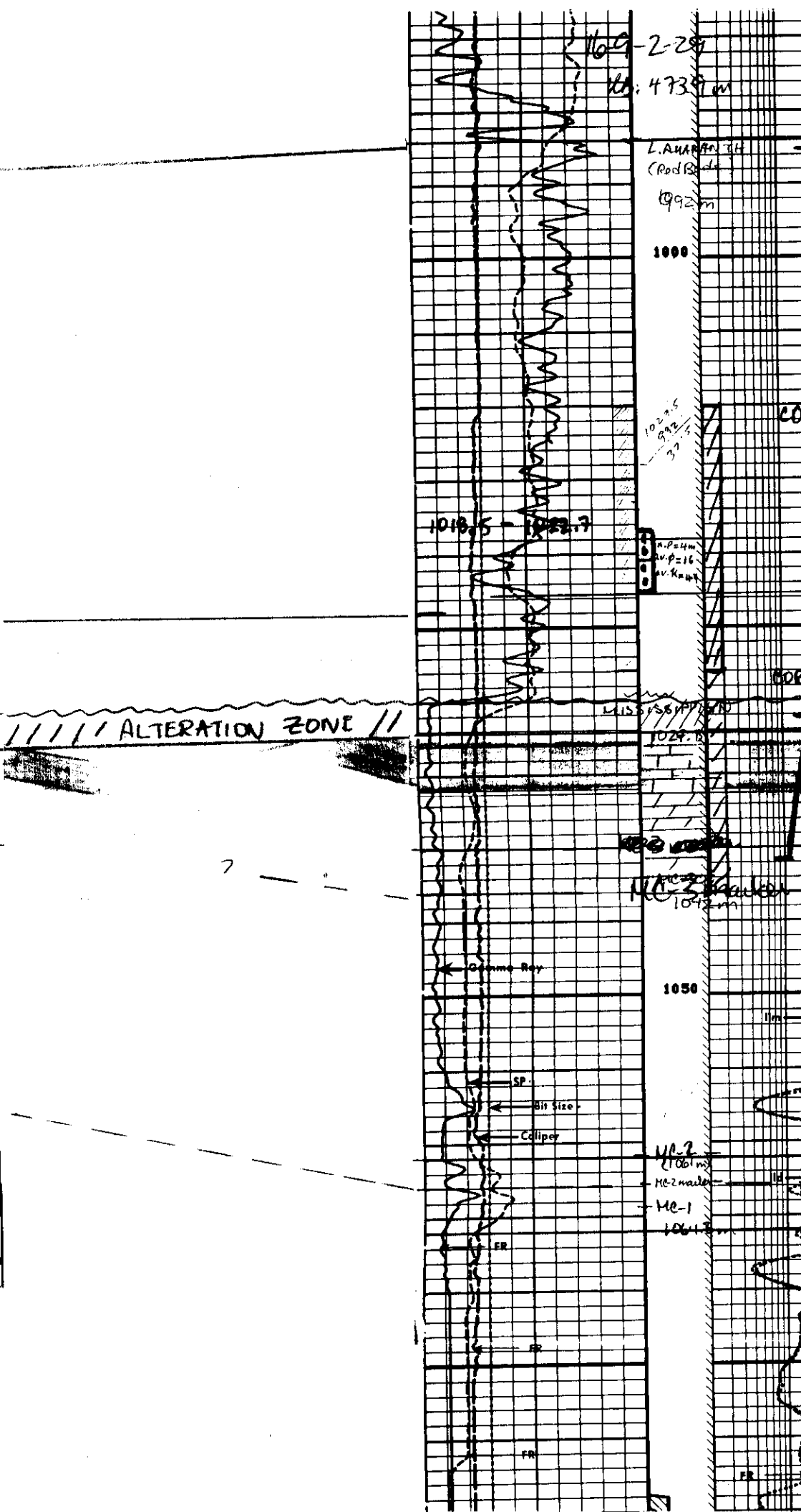
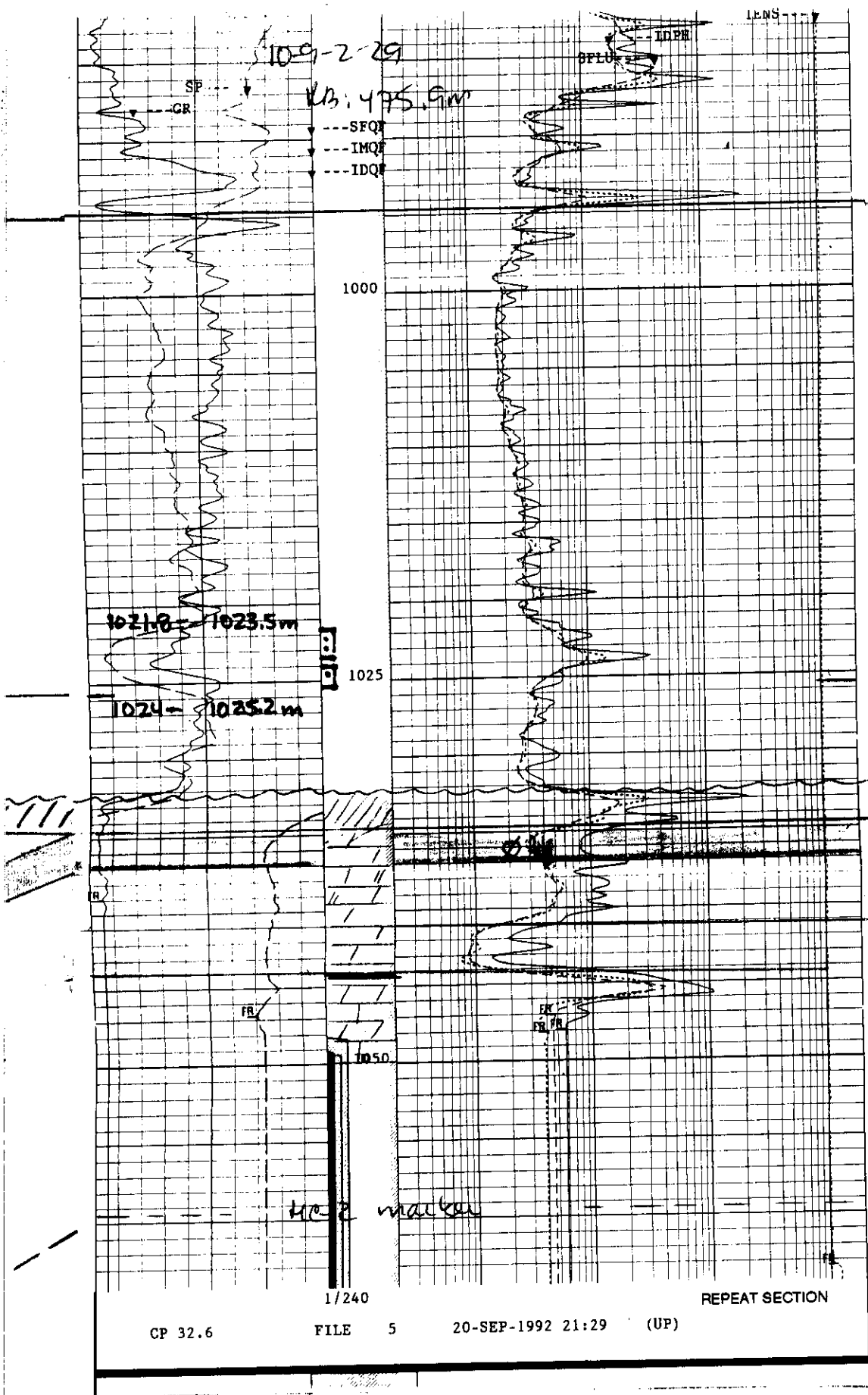
10-9-2 29 W/PM

KB: 475.9m

Amaranth  
Producer

16-9-2-29

KB: 473.9m

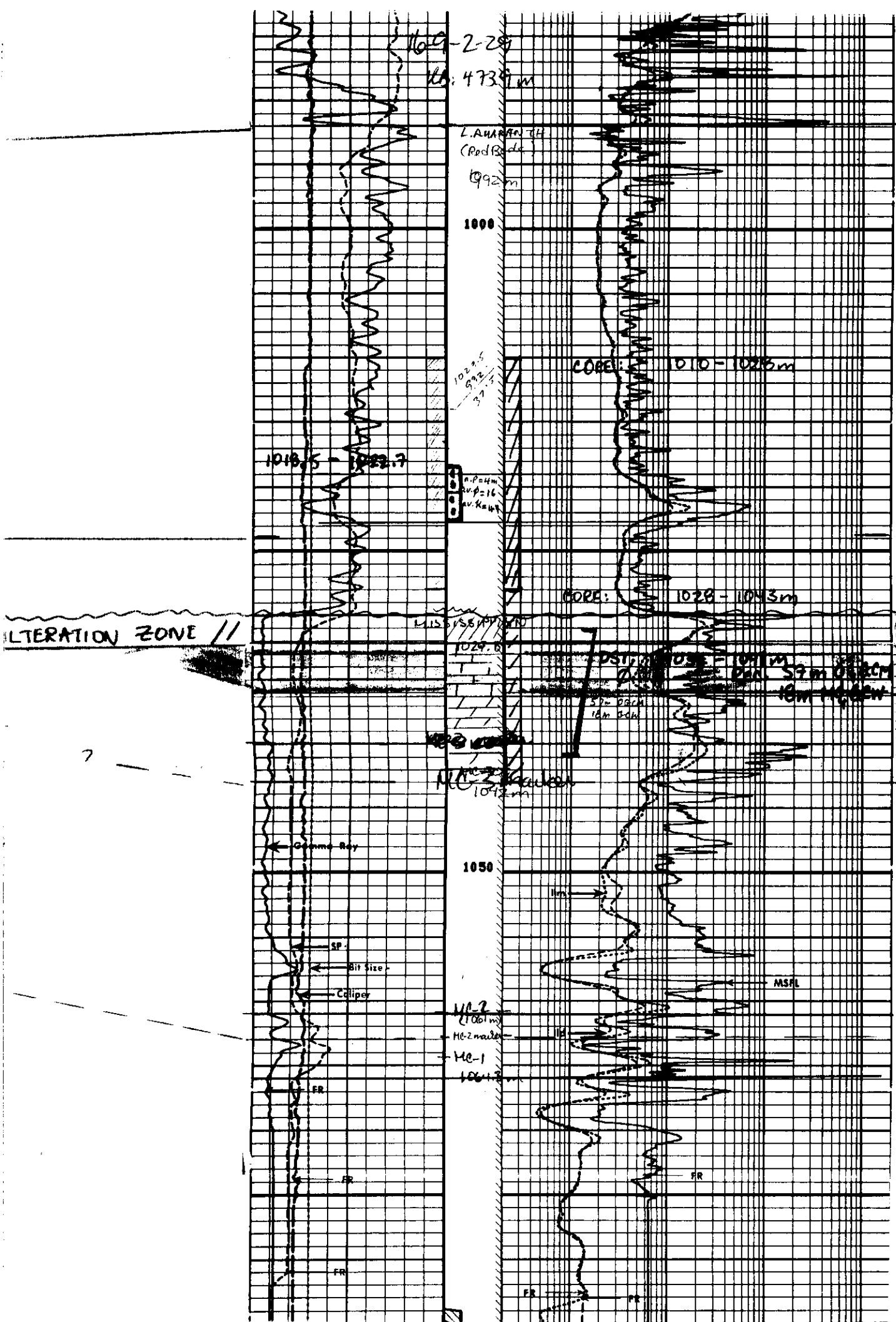


LEGEND

- DOLOSTONE // ANHYDRITE
- LIMESTONE

STRUCTURE

### STRUCTURAL CROSS SECTION



1993-04-12

Manitoba Energy and Mines  
Petroleum Branch  
555 - 330 Graham Avenue  
Winnipeg, Manitoba

C. Martiniuk  
Senior Geologist

Dear Carol:

The following are the answers to the questions which arose during the March 15 meeting between the Petroleum Branch and Home Oil representatives for the proposed South Pierson waterflood. I apologize for the delay and hope that the explanations sufficiently answer your concerns. Please call me at (403) 232-7541 anytime, if further clarification is necessary.

**Q1. Are the variations in the structure elevations due to fracturing or highs on the underlying Mississippian unconformity ?**

**A1.** The structural undulations of the "C" sand results from underlying reactivation along Mississippian joints.

Isopach values of the "waste zone", the redbeds located immediately above the Mississippian Unconformity, are relatively consistent averaging approximately 6.0 meters in thickness and varying by only about a meter over the waterflood area. This would suggest a relatively flat unconformity surface prior to deposition of Lower Amaranth redbeds. However, it appears that there was movement (faulting) within the Mississippian prior to this peneplaning. The gamma ray stratigraphic cross-section with the Mississippian unconformity surface as the datum in Figure 1 shows the correlation of reservoir units in the Lower Amaranth and porous units within the Mississippian. The section reveals a pre-erosional down faulted area interpreted from structural variations in the Tilston and overlying porosity units in the vicinity of the 16-08-002 29W1 well. There is approximately 15 meters of structural relief of the Tilston between 16-08 and 14-09 yet just over one meter of difference in the "C" sand elevation between the two wells, confirming the early movement (ie. prior to erosion of Mississippian). Late reactivation or settling along Mississippian fault planes or joints is believed to have caused the minor structural flexing within the Lower Amaranth section which resulted in undulations in the structural surface.

Figure 2 is an updated computer contoured map of the "C" structure. The major difference from the previously submitted structure map is a 4 meter correction in the structural elevation at 04-09 (erroneous KB value) which eliminates the closed high at this well. Also eliminated is the offset closed high at 16-05. The computer interpreted closed low at 06-08 is not altered after this change. My hand contoured interpretation is shown in Figure 3

**Q.2 Is there any lateral continuity of the Lower Amaranth ?**

**A.2** There is excellent lateral continuity of the Lower Amaranth reservoir units.

Stratigraphic correlations of the Lower Amaranth within the proposed waterflood area reveal that the reservoir units (A, B, and C) are remarkably continuous in all directions laterally. While the log character and isopachs remain consistent the reservoir quality does have a reasonable degree of variability or heterogeneity. Our waterflood recovery calculations have incorporated this heterogeneity by downgrading the anticipated ultimate secondary recovery from 36% to 29%.

**Q.3 Are there any preferential flow paths such as depositional channels in the Lower Amaranth ?**

A.3 There does not appear to be any abrupt macroscopic permeability trends. There is no evidence of channelling through the Lower Amaranth sheet deposits in the waterflood area. There is an obvious southwest-northeast trend of somewhat higher quality reservoir within the central portion of the waterflood but this is not the result of channeling, minor topographical variances prior to deposition and perhaps some subsequent diagenetic differences are more likely the cause of this heterogeneity.

There has also has not been any natural vertical fracturing observed within the Lower Amaranth section. The maximum horizontal stress direction has been measured from Formation Microscanner logging in the 12-19 well after initiation of a hydraulic fracture in the open hole. There is a possibility that because the Lower Amaranth reservoir units have taken the strain and not fractured, as have underlying brittle Mississippian carbonates, there may be some microscopic differences in these small pore throat diameters along versus against the maximum stress direction. If there was a microscopic permeability trend then we might expect to see some differences in KMAX and K90 in full diameter core analysis but this has not been observed.

**Q.4 How well do oil-bearing zones in the Mission Canyon correlate?**

**Q.5 What contribution does Mission Canyon have to the Lower Amaranth C Pool?**

A.4 There does not appear to be good correlation of the Mission Canyon reservoir as evidenced from the cross-section in Figure 1.

The oil bearing zones in the Mississippian are difficult to discern due to the invasion effects and correlation of porous units can be difficult and hence very subjective when a good stratigraphic marker such as the Tilston is not penetrated.

I am presently working on a log interpretation technique that may help in our determination of oil saturation within some of the Mississippian porous units that considers the "annulus effect" that is most apparent in the limestone reservoir. An example of this effect and the difficulty in log evaluation is the 16-09 well which was drill stem tested in the Mississippian after viewing the logs. The test recovered only slightly oil cut salt water and the zone was abandoned and the primary objective, the Lower Amaranth was completed and hydraulically fractured. The primary recovery of Lower Amaranth reserves and production decline analysis have suggested to us that there is oil influx from a zone other than the Lower Amaranth. It is likely that the Mississippian has been commingled via the hydraulic fracture. The poor recovery on the original DST suggests considerable invasion making a quantitative estimate of Mississippian reserves from log analysis difficult.

Presently we have quantified the Mississippian reserves from an assessment of the production decline expected from Lower Amaranth OOIP and assuming that any surplus is attributed to the Mississippian. At present the Mississippian is believed to contribute about 18% to the total waterflood production.

**Q.6 Are the Mission Canyon pools in T3-29 and T2R29w1 related?**

Home has not attempted detailed correlations within the Mission Canyon between these two pools. However the work by M Husain and S.P Halabura in their Manitoba Petroleum Branch report POF 7-86 on the "Petroleum Geology of the MC-3 Member, Mission Canyon Formation, Pierson Area, Southwestern Manitoba," demonstrate that the production is largely from different stratigraphic units than those producing in Home's production area.

7 Can you predict the extent of cap rock of the Mission Canyon? (ie. presence of Charles Fm. or alteration of zone at the Mississippian unconformity)

It is difficult to predict the extent of the anhydrite, either alteration or Charles Fm. We have mapped the cap rock so that we could avoid those areas with extremely thin cap rock and hence poor containment for hydraulic fracturing, however, there is great variability over short distances in the thickness and quality of this cap rock. An example of this variability is a comparison of 12-09 which has approximately 16 meters of cap rock while the offset at 14-09 has only about 1.0 meter.

Q.8 Do you have any porosity/permeability correlations for the Lower Amaranth? Do you have any core vs log data available?

Figure 4 shows a correlation between core porosity and permeability for the waterflood area. There is quite a scatter in this plot. The average porosity cutoff that equates to a 1.0 mD permeability cut off is 14%. I have broken the reservoir into three reservoir facies types with different porosity/permeability relationships and hence, different cutoff values to determine hydrocarbon pore volume. This will be discussed in the unit submission.

The correlation between the log and core porosity is shown in Figure 5 for the 12-09 well and Figure 6 for the 08-08 well. Unfortunately there is not a composite cross-plot available at the time of this report. The log porosity is measured with the Density log alone using a matrix density of 2730 kg/m<sup>3</sup> (established in a recent report submitted to the branch). I hope that you are satisfied with the correlation. A log type display of this correlation is shown at the right of each cross-plot. The more blocky log is the core porosity and the other log is the high resolution or high sample rate density log.

If you have any further questions or require further clarification please call me at (403) 232-7541.

Yours Sincerely



John S. Murray

APR 20 '93 14:04

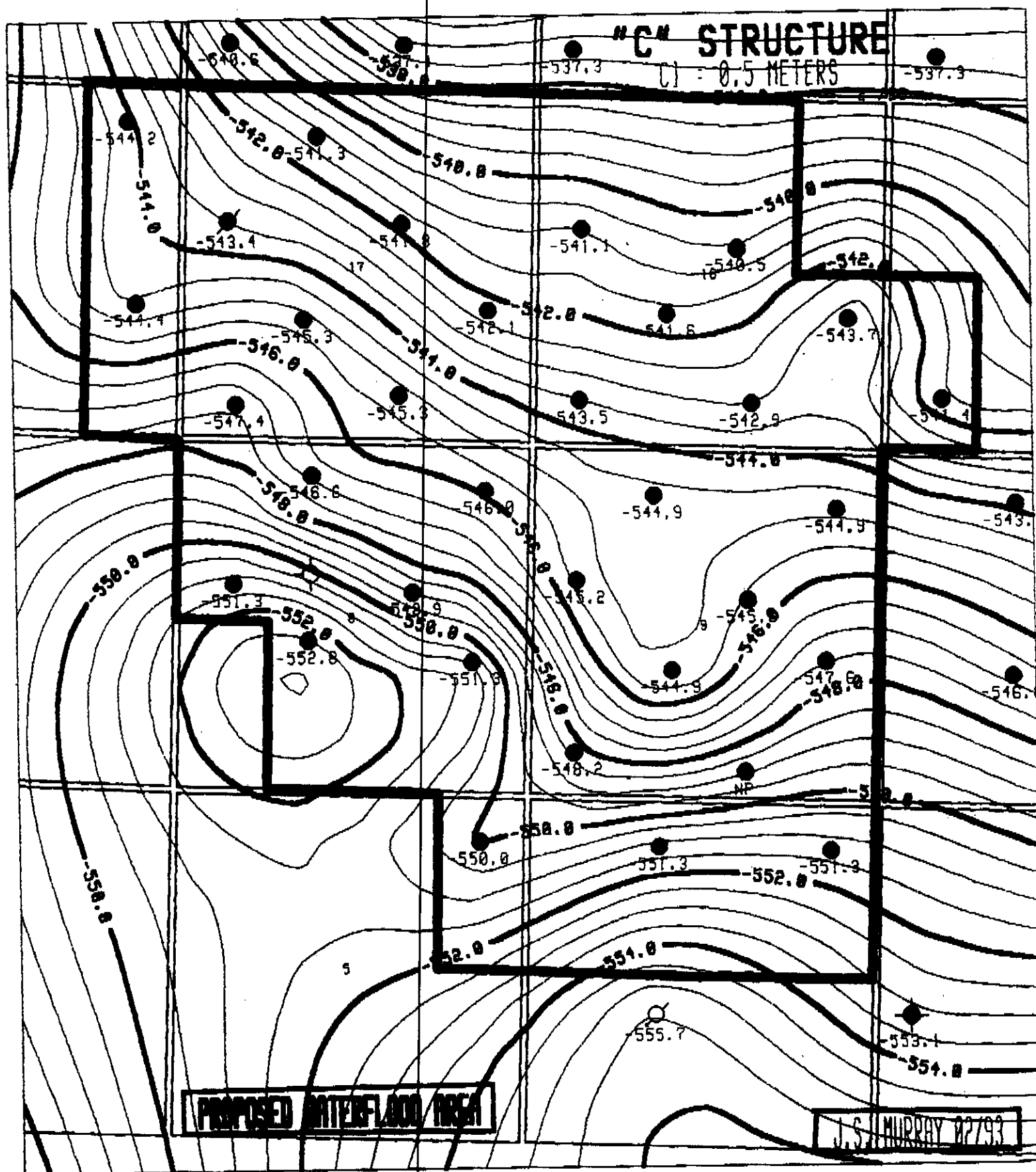


FIGURE 2

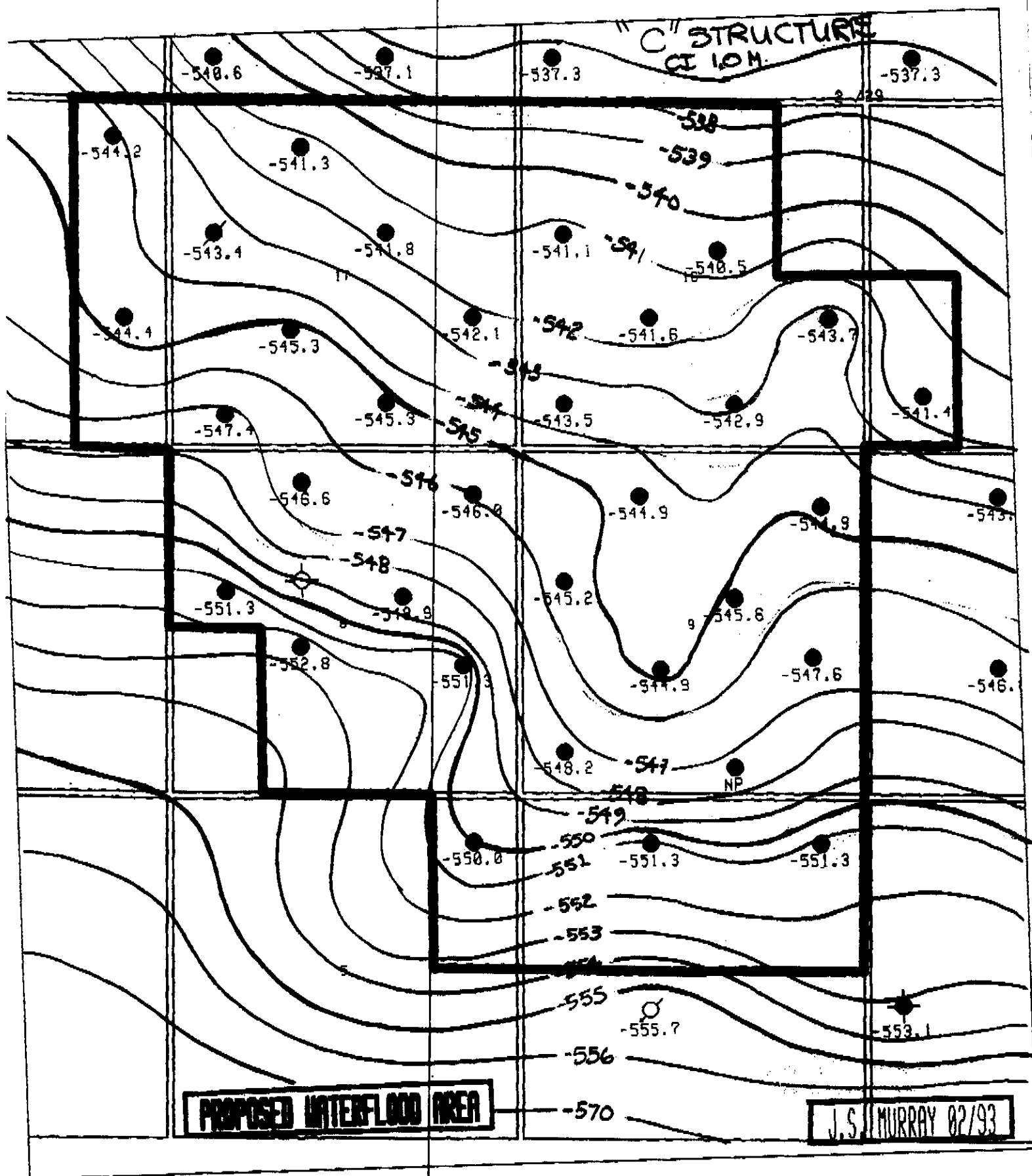
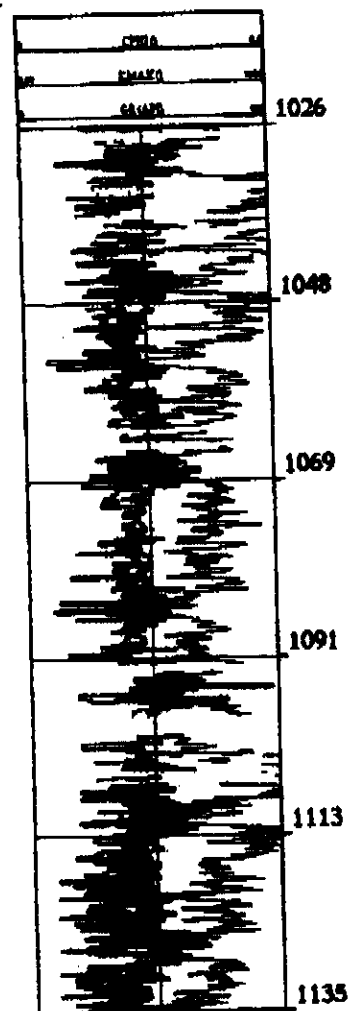
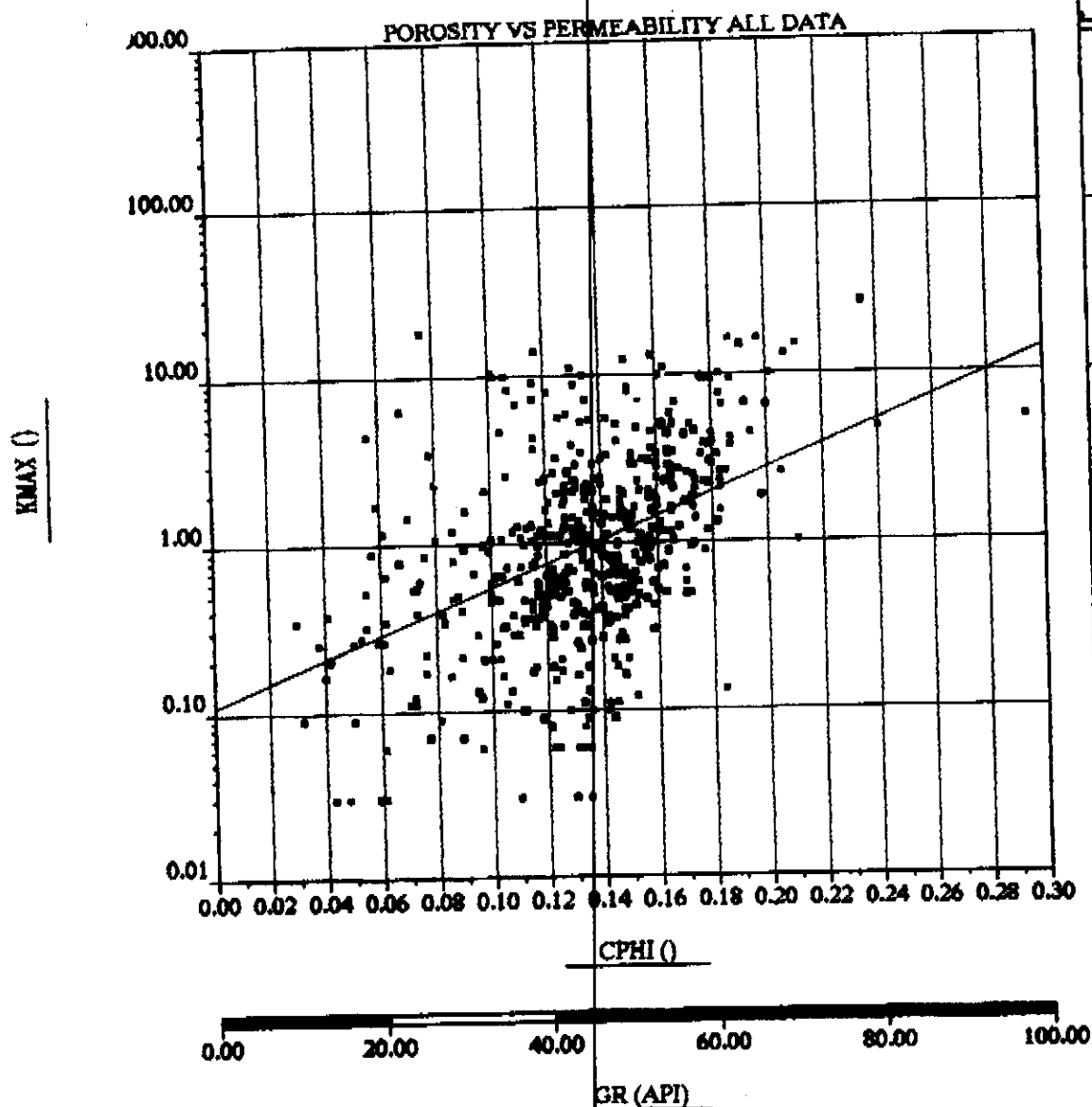


FIGURE 3.





$$y = 0.109151(10^{(7.012566x)})$$

FIGURE 4

D2730

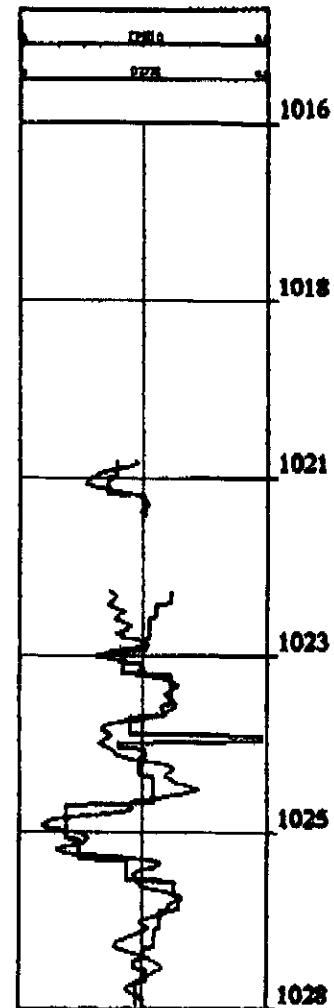
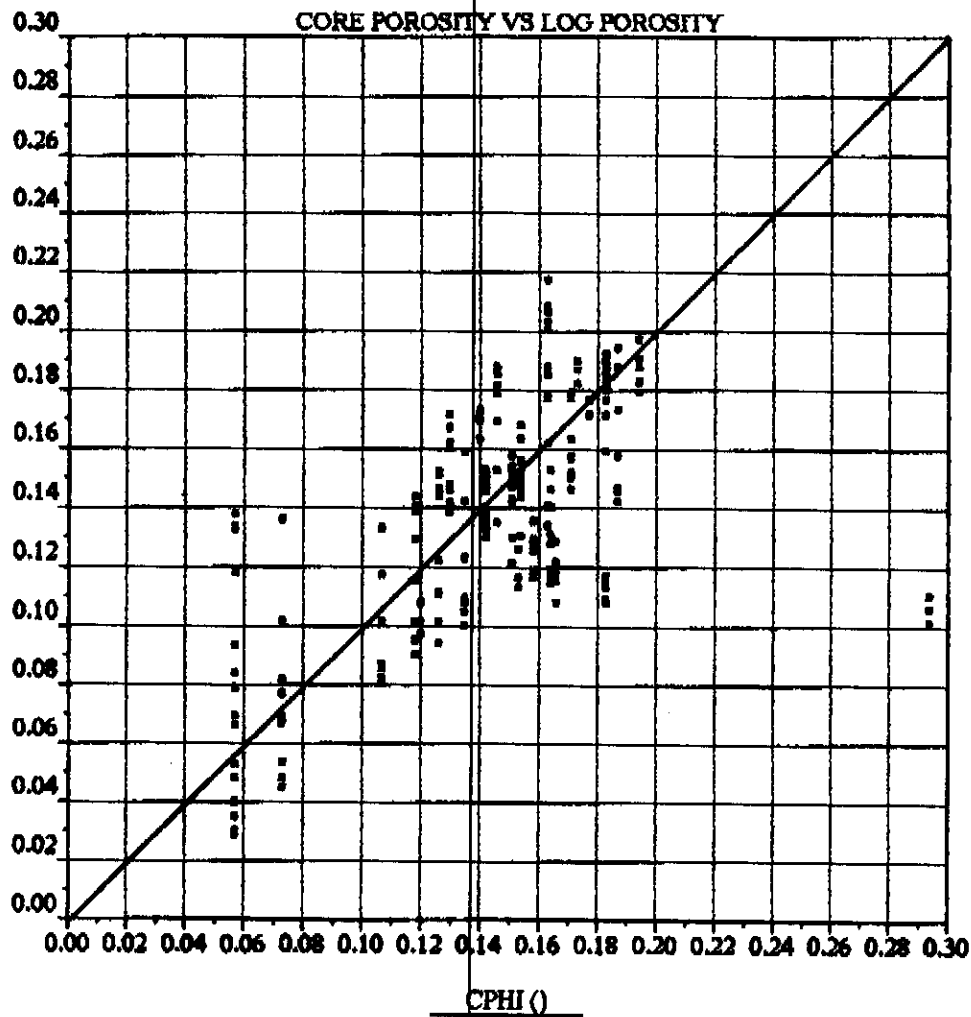


FIG 5.

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D2730

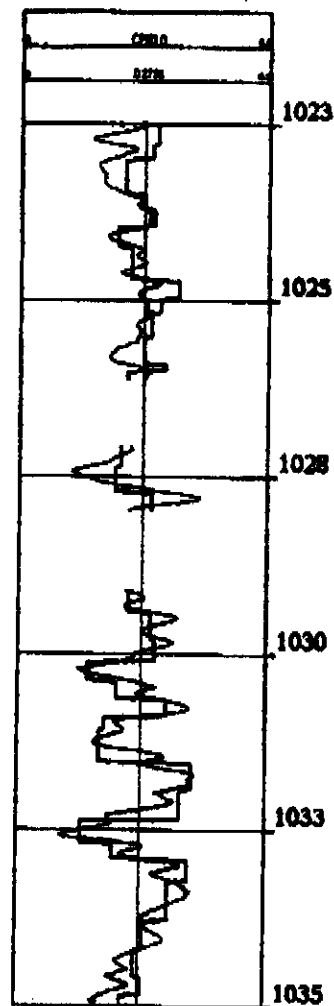
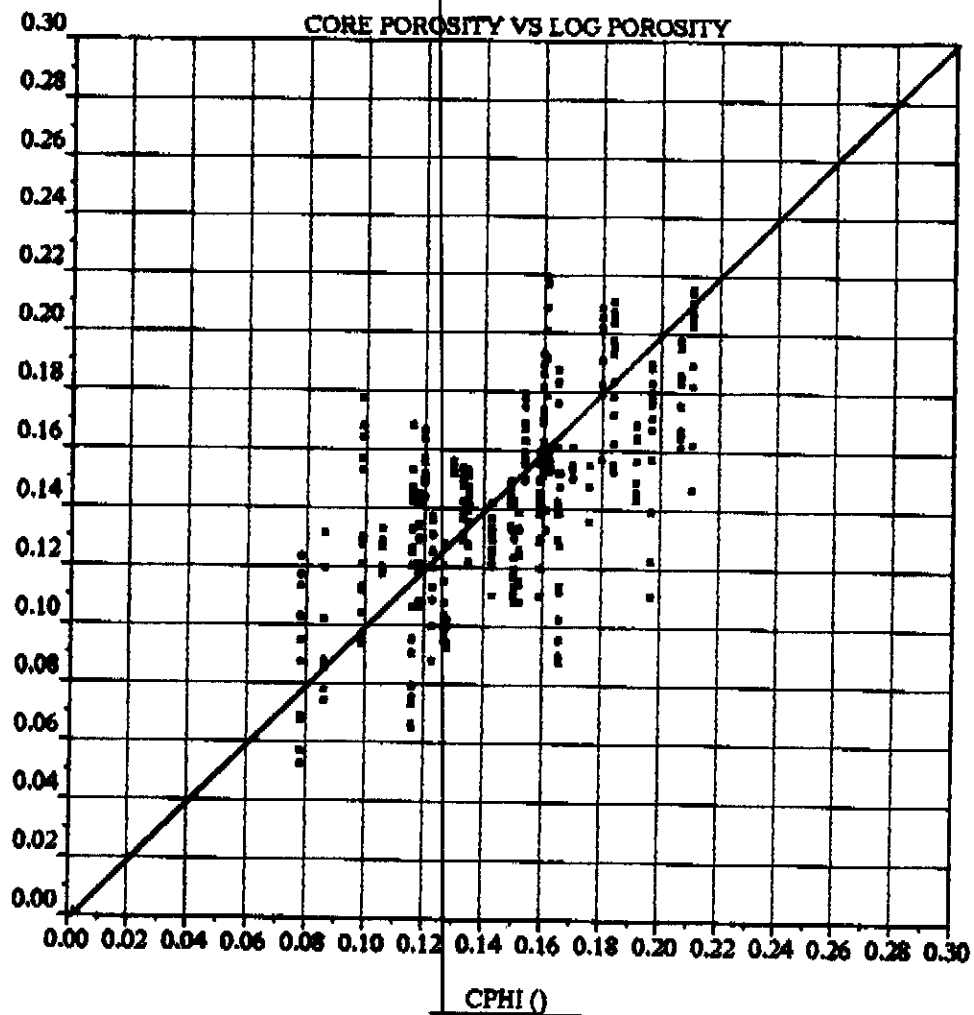


FIG 6.

## Home Oil Company Limited

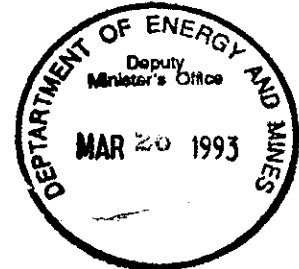
1600 Home Oil Tower  
324 Eighth Avenue S.W.  
Calgary, Alberta T2P 2Z5  
Telephone (403) 232-7100  
Fax (403) 232-7678

20



1993-03-18

Province of Manitoba  
Department of Energy and Mines  
Room 309, Legislative Building  
450 Broadway Avenue  
Winnipeg, Manitoba  
R3C 0V8



ATTENTION: Mr. L.R. Dubreuil,  
Director, Petroleum Branch

### **RE: South Pierson Waterflood Application Deficiencies - Addendum**

The following is Home Oil's further reply to topics raised during our meeting on March 15, 1993.

#### **Spacing**

Home Oil requests that the spacing for the Unit area be kept at 32 ha until the Unit agreement has been signed by all parties and approved by the Crown. Once approval has been granted, Home Oil proposes that the Unit area be decreased to 16 ha spacing Unit's in a manner coinciding with the planned development of the Unit area. An application will be made by Home Oil for each segment of the Unit that will be developed under 16 ha spacing prior to that segment being developed. This is anticipated to occur at the end of each year prior to the following year's development schedule as provided to the crown in the waterflood application.

#### **Maximum Permissible Producing Rates**

Home Oil plans to produce each pattern within the waterflood in such a manner so that the voidage replacement ratio (VRR) is maintained at 1.0. Home Oil therefore request that a waiver be granted for the maximum permissible producing rates as we intend to operate the waterflood in accordance with good production practices (GPP). This waiver should take effect once a pattern (including injector conversion) has been completed. Home Oil will provide the Crown with anticipated production and injection for each well within the completed pattern.

#### **Waterflood Area Primary Depletion Production Forecast**

Table 1.0 gives the production forecast for the Unit area if it were produced without the benefits of a waterflood. Note that the remaining production of 192,292 m<sup>3</sup> of oil is considerably lower than the estimated production provided in the waterflood application of 1,038,206 m<sup>3</sup> and that the years to depletion is only 14 compared to 38 for the waterflood.

## **Permeability and Porosity Correlation Trends**

The information in our previous letter is the extent of our understanding of any correlation between permeability and porosity. In the waterflood application there were two plots provided which showed porosity and permeability height contoured for the waterflood area. Slight inferences can be made from these maps in that the trend for permeability and porosity tends across the Unit area, however the reservoir is still considered relatively homogeneous in the macroscopic sense.

If you require further information, please contact me at (403) 232-7370, J.S.Murray at (403) 232-7541 or E.L.Doherty at (403) 232-7376.

Yours truly,

HOME OIL COMPANY LIMITED

A handwritten signature in black ink, appearing to be 'G.C.K. Johnson', written in a cursive style.

G.C.K.Johnson, P.Eng.  
District Co-ordinator  
Southern Production

GCKJ/ed

cc: R.Delbaere (Corvair Oils Ltd.)  
G.C.K.Johnson  
D.A.Cairns  
J.S.Murray  
D.R.Gateman  
E.L.Doherty  
Pier Corr

**Table 1.0 - South Pierson Unit Area Production Forecast Under Primary Depletion**

| Year | Oil/d (m3) | WOR (m3/m3) | Water/d (m3) | GOR (m3/m3) | Gas/d (e3m3) | WGR<br>(m3/e6m3) |
|------|------------|-------------|--------------|-------------|--------------|------------------|
| 1993 | 98.3       | 0.86        | 84.5         | 60          | 5.90         | 14333            |
| 1994 | 98.0       | 0.86        | 84.7         | 73          | 7.17         | 11807            |
| 1995 | 76.6       | 0.87        | 66.5         | 89          | 6.84         | 9727             |
| 1996 | 59.8       | 0.87        | 52.2         | 109         | 6.51         | 8012             |
| 1997 | 46.5       | 0.88        | 40.8         | 133         | 6.18         | 6600             |
| 1998 | 36.4       | 0.88        | 32.1         | 162         | 5.90         | 5437             |
| 1999 | 28.4       | 0.89        | 25.2         | 198         | 5.62         | 4479             |
| 2000 | 22.1       | 0.89        | 19.7         | 241         | 5.34         | 3690             |
| 2001 | 17.3       | 0.90        | 15.4         | 294         | 5.08         | 3039             |
| 2002 | 13.4       | 0.90        | 12.1         | 359         | 4.82         | 2504             |
| 2003 | 10.6       | 0.90        | 9.5          | 438         | 4.63         | 2063             |
| 2004 | 8.1        | 0.91        | 7.4          | 535         | 4.35         | 1699             |
| 2005 | 6.4        | 0.91        | 5.9          | 652         | 4.19         | 1400             |
| 2006 | 5.0        | 0.92        | 4.6          | 796         | 3.97         | 1153             |
| 2007 | 0.0        | 0.92        | 0.0          | 971         | 0.00         | #DIV/0!          |

Cum Oil Prod. 192,292 (m3)



Energy and Mines

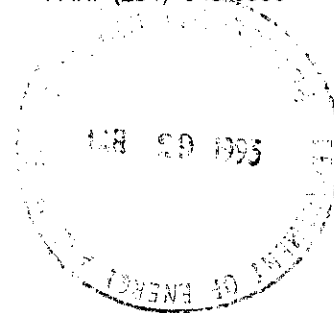
Petroleum

555 — 330 Graham Avenue  
Winnipeg, Manitoba, CANADA  
R3C 4E3

(204) 945-6577  
FAX: (204) 945-0586

March 18, 1993

Mr. G.C.K. Johnson, P. Eng.  
Home Oil Company Limited  
324-8th Avenue SW  
Calgary, Alberta  
T2P 2Z5



Dear Gary:

Re. Pierson Area - Waterflood Application

The Branch has reviewed your letter dated March 18, 1993. Your request for reduced 16 hectare spacing and waiver of maximum permissible production rate restrictions will be included in the Board's notice of your waterflood application.

As we discussed, it is agreed that Home's intent is to reduce spacing in the unit area or waterflood project area, the two terms being synonymous, from 32 hectares to 16 hectares, coincident with the effective date of the unit agreement. If you agree with this statement, please sign and return one copy of this letter to my attention.

Yours truly,

John N. Fox, P. Eng.  
Chief Petroleum Engineer

Per:

Home Oil Company Limited



## Memorandum

March 17, 1993

To : The Oil and Natural Gas  
Conservation Board  
- D. Tomasson  
- H. Clare Moster

From : John N. Fox  
Chief Petroleum Engineer  
Petroleum Branch

Telephone

Subject :

The Branch met with representatives from Home Oil on March 15, 1993. The administrative and technical concerns outlined in the Board's letter (93-03-14) were discussed.

Home Oil indicated its desire to

- (1) reduce spacing in the waterflood project area from 32 ha to 16 ha upon unitization, and
- (2) have MPPR restrictions waived upon commencement of the waterflood.

The Branch is now satisfied the sufficient information is available to advertise the application. Therefore it is recommended that notice of the application be published in the Manitoba Gazette and the Melita New Era. A copy of the proposed notice is attached.

ORIGINAL SIGNED BY  
JOHN N. FOX

Original Signed By  
G. A. DUBREUIL

John N. Fox

JNF/hw

Attached.



Mar 17/93

## HONE OIL - OUTSTANDING ISSUES

- formal request for
  - (a) reduced spacing
  - (b) waiver of NPAR restrictions
- MC log review internal wells - Sec 8, 9, 16-5, 4-15  
Sec 4, 2-16, 4-16
  - analogy Waskada MC complex, waterflood results
  - Pinnaroo MC completion results X-section 16-5 to 4-15 stratigraphic
- K vs  $\phi$  cross-plot & correlations to be submitted
- copy of new POT data
- comment -- revised program to implement WF with revised bubble pt pressure of 7584
- comment -- revised project area - not feasible  
8-7, 4-8 & 16-7
- 16-8 wellhead injection pressure  
3300-3400 kPa + 11.31 kPa/m + 1029 = 10038 Pa

# HOME OIL - PETROLEUM BRANCH MEETING MINUTES

MARCH 15, 1993

## ENERGY AND MINES LARGE BOARDROOM

### Home Oil

Eugene Doherty  
Don Cairns  
Jik Chan  
Donna Gateway  
Gary Johnson

### Petroleum Branch

Bob Dubreuil  
John Fox  
Carol Martiniuk  
Brad Thiessen

#### 1) Spacing

- for unitization purposes want to retain 32 ha spacing
- option: 16 ha spacing approved upon unitization
- stagger 16 ha spacing in accordance with drilling plans
- Corvair only other WIO (~2.5%)

#### 2) MPPR

- waiver of MPPR restrictions desired

#### 3) 16-8

- injection contained in Lower Amaranth, 10-12 m<sup>3</sup>/d stabilized rate, wellhead injection pressure 3400 kPa.
- 5 micro-screen for filtering
- started 2 rate injection test (lower and higher rates will be used)

#### 2) Unitization

- discussed Board hearing process, Home considers it unlikely that a hearing will be needed
- S. Spelliscy may cause concerns as he is attempting to purchase additional royalty interests
- plan to unitize both L. Amaranth and MC together
- example participation factor current productivity and remaining reserves 50%:50% (double dipping)

- LRD discussed initial productivity (1st 3-4 months) and HCPV
- interim participation factor discussed

### 3) Mission Canyon

- poor log coverage
- primary depletion only, not waterfloodable
- (3) MC producers poor results, high water-cut quickly
- geology complex (faulted thrust blocks)
- technically not feasible (infinite MC aquifer)
- required high VRR to flood both the LAm and MC
- some infills wells will be drilled into the MC where potential exists (concerns poor cement job)
- frac job designed to extend into top of MC (variable caprock thickness)
- 10-16 drilled with air  $s = -1.0$ ; I.P.,  $1.0 \text{ m}^3/\text{d}$ , after frac job increased productivity to  $6-7 \text{ m}^3/\text{d}$

### 4) Technical Questions

Home will produce high water producers to obtain additional water for injection

6-4 will remain a disposal water until no longer needed, then converted to Lower Amaranth injector

- Home considering simulating reservoir after waterflood
- individual well injection volumes to be measured at injection satellites
- Home trying to determine oil/water contact, the 3-4 well is expected to be near o/w contact
- bubble point 7584 kPa re-evaluated by Hycal, matches Tracey-Tarner model predictions
- initial conversions based on areas of low reservoir pressures
- high water production in Section 10, but still a possibility for future waterflood expansion

- Mississippian faults do not extend into L. Amaranth (Mississippian - brittle, L. Amaranth - plastic)
- copy of K-Ø correlation to be filed
- Home flexible on initial unit area, agreed with Branch's recommendation that Section 7 and SW/4 of Section 8 not be included in Phase I waterflood project area
- B<sub>0</sub> under review by Hycal, copy of new PVT data to be submitted
- Phase I - \$13.5 MM
- horizontal drilling plans under review extending NW from 2-15, \$750 M (D&C) 1-2 wks for Management decision
- primary recovery in Phase I a function of decline curve analysis

**5) Pierson WMA - Development Plan**

- discussed - Branch indicated it planned to meet with Natural Resources on March 16th.

**6) Home has discussed pipelining alternatives with their Marketing Department**

- (1) Producers P/L from Gainsborough (11 mi)
- (2) 8 mile line south to Anther N.D.

**7) Copy of Manitoba data/circulars/Act to Garry Johnson**

**8) Crown offsets reviewed by LRD**

advised HOC that no offsets will be called if development continues as per waterflood plans



The Oil and Natural Gas  
Conservation Board

555 — 330 Graham Avenue  
Winnipeg MB R3C 4E3  
CANADA

(204) 945-1111  
FAX: (204) 945-0586

March 14, 1993

Mr. G.C.K. Johnson, P. Eng.  
Coordinator, Southern Operations  
Home Oil Company Limited  
1600 Home Oil Tower  
324 - 8th Avenue SW  
Calgary, AB T2P 2Z5

Dear Mr. Johnson:

**RE: PIERSON WATERFLOOD APPLICATION**

The Board has completed a preliminary review of the subject application. The Board has the following administrative and technical questions and concerns. The Board also requires two (2) additional copies of the application.

**SPACING AND MAXIMUM PERMISSIBLE PRODUCTION RATES (MPPR's)**

In order to publish notice of the application, the Board needs formal notification of Home's plans for reduced 16 ha spacing and the company's position on MPPR's.

The Board requests Home acknowledge in writing its desire to amend Board Order No. SU 9 to reduce spacing in the waterflood project area from 32 ha to 16 ha.

In previous discussions with Home, the Board indicated it is prepared to entertain an application for waiver of MPPR restrictions in conjunction with the implementation of the waterflood. The waterflood application does not address MPPR's.

**INJECTIVITY TEST RESULTS - 16-8-2-29**

Please provide information on the results of the injectivity test at 16-8-2-29 including:

- a plot of injection rate and pressure versus time
- a list of tests and data collected

Based on the 16-8 injectivity test, is there any concern that injectivity will be a problem in the Lower Amaranth?

### **MISSION CANYON DEPLETION STRATEGY**

Home has indicated that the Lower Amaranth and Mission Canyon are in communication through natural and induced fractures. Home also estimated Mission Canyon reserves account for 26% of the total primary recoverable reserves in the project area. However, under the waterflood no incremental recoverable reserves are allocated to the Mission Canyon. The Board would like to know if it is technically and economically feasible to locate, assess and recover Mission Canyon reserves by concurrently waterflooding the Lower Amaranth and Mission Canyon. What is Home's overall depletion strategy for the Mission Canyon?

- 1) Has Home attempted to map hydrocarbon pore volume in the Mission Canyon?
- 2) Does Home intend to complete any of the infill wells or injectors in the Mission Canyon?
- 3) Home indicated in the application (126(g)(iii)) - "In cases where there is Mississippian oil contribution and the injector is known to be in communication with the Mississippian formation, injection rates will be increased accordingly to maintain a voidage replacement ratio within the Lower Amaranth of 1.0." Which wells are known to be in communication with the Mississippian? Does Home plan to injection profile log any injectors to determine placement of injected water? Does Home plan to try to allocate voidage between the Lower Amaranth and Mission Canyon?

### **TECHNICAL QUESTIONS**

- 1) Home indicated produced Lower Amaranth and Mission Canyon water would be re-injected to maintain a voidage-replacement ratio of 1.0 (126(f)(ii)). Later reference is made to measurement of water from a source well (126(f)(iv)). Is a water source well required and if so, which well will be converted and what formation will be used for source water?
- 2) For clarification, is it Home's plan to have water injection meters at each well or to meter both the individual well and group volumes at the 14-9 battery (126(f)(iv)). If all water injection will be done at the 14-9 battery, then it is assumed individual injection lines will be run to each injector.
- 3) What are Home's plans for the 6-4-2-29 Mission Canyon disposal well? Should the spacing unit for the 6-4 well, which includes the undrilled 3-4 location, be included in the waterflood project area?

- 4) In 126(h)(iii) Home states the company will maintain a reservoir pressure equal to or greater than the bubble point of 7500 KPa. Should this be 4550 KPa?
- 5) Does Home have any plans to eventually expand the waterflood to the east into sections 10, 11, 14 and 15?
- 6) Based on the reservoir mapping in Appendices D and E, does Home see any preferential flow patterns within the Lower Amaranth? Are there any faults or other flow barriers?
- 7) Has Home attempted to correlate porosity and permeability for the Lower Amaranth?
- 8) Please elaborate on the timing of the drilling of 4-8, 8-7 and 16-7 and how Home intends to modify this application in the event some or all of the wells prove successful.
- 9) Please confirm that Home intends to conduct additional core flow studies and PVT work to re-evaluate residual oil saturation and  $B_o$ . Appendix G indicates  $B_o = 1.196$  and the waterflood study indicated  $B_o = 1.169$  and  $B_{obpt} = 1.178$ ; which is correct?
- 10) The waterflood study indicated an estimated waterflood capital cost of \$ 30 MM. What is the capital cost of Phase I?
- 11) Please provide the Board with a copy of the primary production forecast for the waterflood project area.

If you have any questions please contact L.R. Dubreuil, Director, or John N. Fox, Chief Petroleum Engineer, at (204) 945-6573 and 945-6574 respectively.

Yours respectfully,



H. Clare Moster  
Deputy Chairman



1993-03-12

Province of Manitoba  
Department of Energy and Mines  
Room 309, Legislative Building  
450 Broadway Avenue  
Winnipeg, Manitoba  
R3C 0V8

ATTENTION: Mr. L.R.Dubreuil,  
Director, Petroleum Branch

**RE: South Pierson Waterflood Application Deficiencies**

The following is Home Oil's reply to the deficiencies raised in your letter dated March 9, 1992.

**Spacing and Maximum Permissible Production Rates (MPPR's)**

Home Oil requests that the area of the proposed waterflood be maintained at 32 hectare spacing. Our plan is to unitize the waterflood area on 32 hectare tracts and infill drill on 16 hectare spacing only after unitization has been approved. We hope that it will not be necessary to apply for reduced spacing within an accepted unit.

The MPPR's will be addressed in such a manner as to assure that a voidage replacement ratio (VRR) in each pattern is maintained at 1.0. Where there is Mississippian oil contribution, the well will be allowed to produce at its mechanical optimum rate as the Mission Canyon will not be integrated into the waterflood.

**Injectivity Test Results - 16-8-2-29 W1M**

Plots showing Injection Rate versus Time (Figure 1.0), Wellhead Pressure versus Time (Figure 2.0) and a composite of Rate and Pressure versus Time (Figure 3.0) are given. The plots show that although the wellhead pressure is approaching the maximum pressure of 3300 kPa, the injection rate is starting to stabilize at approximately 12 m<sup>3</sup>/day. The plots include data from start of injection on October 20, 1992 to January 4, 1993. Further injection rates recorded in the field but not included in the Figure's, indicate that the wellhead pressure has remained at approximately 3300 kPa at a corresponding rate of 10 to 12 m<sup>3</sup>/day. At the current injection rate, injection into the Lower Amaranth is not a problem with respect to meeting voidage replacement requirements for the waterflood. A preliminary study done in December, 1992 outlining pressure transient results is given as Appendix A and is provided for your further information.

A two rate injection test was recently initiated, with no results to date. Once results have been tabulated, they will be forwarded to the Crown complete with the calculations to determine formation permeability and skin.



## **Mission Canyon Depletion Strategy**

Due to the lack of log coverage over the Mission Canyon, it is not technically possible to assess possible reserves in this manner. The Mission Canyon is mostly wet, with an infinite acting aquifer. It is therefore not possible to waterflood the zone as it will act primarily as a thief zone. Wells that possibly contain Mission Canyon oil are identified using production decline analysis. This is done by first determining the recoverable oil in place in the Lower Amaranth. If the production decline indicates reserves in excess of the calculated Lower Amaranth reserves, it is assumed that the increase in reserves is from the Mission Canyon. If the watercut is higher than expected for the Lower Amaranth, it can also be assumed that there is fluid contribution from the Mission Canyon. Correlating wells with high watercuts and an increase in reserves helps in identification of potential wells with Mission Canyon oil production. A map outlining these wells is given in Figure 4.0.

Home Oil's strategy for depleting the Mission Canyon is to produce these wells under primary depletion, in the Mission Canyon formation only.

- 1) Incomplete log coverage and problems in the petrophysical evaluation have created difficulty in quantifying Mississippian hydrocarbon pore volume.

While we are attempting to establish the Mississippian HCPV for future development, we do not plan on including the HCPV value for unitization. The Mississippian contribution has been quantified instead through detailed production analysis along with information from Lower Amaranth HCPV and reservoir modelling. Hence, the Mississippian will be included into the tract factor calculation through production.

- 2) It is Home's position that an economic oil field would not exist in South Pierson without the widespread oil prone Lower Amaranth reservoir. The Mississippian reservoir is more restricted in its areal extent due to rapid facies and/or diagenetic changes with perhaps some pre-Jurassic faulting. Where present, the oil is believed to be within the transition zone and hence, the Mississippian can add significant volumes of water to production. However, the oil contribution from the underlying Mississippian via hydraulic fracture communication has not been ignored and we plan to access those areas of Mississippian oil potential through fracture stimulations which will be designed to penetrate into the uppermost Mississippian. Injection wells will be limited (if possible) to the Lower Amaranth.
- 3) Table 1.0 gives a list of wells suspected of being in communication with the Mississippian. Home Oil does not intend to profile log any of the injection wells due the wells being fraced during completion. Once the well is fraced, injection logging cannot determine where the water injection is occurring.

## **Technical Questions**

- 1) Water source wells are not required as there currently exists shut-in wells capable of producing high volumes of water. These wells will be returned to production as the water volumes are required.
- 2) Home Oil plans to use injection satellites to measure and distribute water throughout the field. Water will enter each satellite through a groupline where it will be split off into individual flowlines and measured.

- 3) Presently the Lower Amaranth is not considered to benefit from the 06-04 water disposal due to the fact that it disposes water directly into the Mississippian (the Lower Amaranth perforations have been cemented). It is unlikely that an infill well would be drilled for some time (if ever) at the 03-04 location. However, the 32 hectare tract at 06-04 is still desirable to the unit since all that is necessary to become an Amaranth injector is a small hydraulic fracture stimulation.
- 4) Recent PVT analysis has indicated that the bubble point pressure is approximately 7584 kPa. The new bubble point better matches Tracey Turner predictions with production decline analysis.
- 5) Home Oil is interested in obtaining the maximum value from all areas in South Pierson. The present waterflood area is considered a pilot waterflood project within an economically workable area in the "heart" of the pool. and with better evidence of a favourable economic response, Home Oil will definitely evaluate expansion of the waterflood into sections 10,11,14, and 15.
- 6) There are no preferential patterns of permeability from core analysis (KMAX Vs. K90) in the Lower Amaranth reservoir. Macroscopically, the reservoir is generally considered to be well correlatable but heterogeneous in quality. There is an obvious trend of better quality reservoir indicated by Flow Capacity and Porosity Height Mapping in a southwest-northeast orientation through the central portion of the waterflood area.

The Amaranth is not believed to be faulted and while there are numerous small scale permeability barriers there are no major lateral restrictions to fluid flow. A good indication of the lateral continuity is the reduced pressures observed in RFT tests within the Lower Amaranth in the 32 hectare infill wells.

- 7) Home Oil has correlated porosity and permeability over the Lower Amaranth in the South Pierson area and interpret the reservoir to be variable in quality but very continuous laterally. A cross-section of our petrophysical logs will be given to the board to support this claim.
- 8) The 08-07 well is scheduled to be drilled shortly after breakup. The 16-07 well is an outpost location that is considered to have relatively low risk but may not be drilled in the immediate future. Other low risk locations at 02-08 and 04-08 will be drilled prior to the 16-07 well location.

With the success of these wells, Home Oil anticipates the extension of the waterflood and unit boundary to incorporate these wells.

- 9) The oil formation volume factor  $B_o$  is expected to be 1.196 and it was this factor that was used in determining reserves. Once the rest of the PVT analysis is complete,  $B_o$  and  $B_{opbt}$  will be provided for the Crown.
- 10) Capital cost requirements for Phase 1 are anticipated to be 13.3 \$MM. Table 2.0 gives a breakdown of the capital requirements for the waterflood development on a yearly basis from 1993 to 1995. The 30 \$MM quoted in the waterflood study was for the much larger area shown in Figure 1.0 of that study and included extensive facility modifications. The Phase 1 area was chosen as it is considered to be the heart of the pool with the best well control and the existing facilities will be able to handle the production and injection volumes associated with the Phase 1 waterflood.

If you require further information, please contact me at (403) 232-7370, J.S.Murray at (403) 232-7541 or E.L.Doherty at (403) 232-7376.

Yours truly,

HOME OIL COMPANY LIMITED



G.C.K.Johnson, P.Eng.  
District Co-ordinator  
Southern Production

GCKJ/ed/jm

cc: R.Delbaere (Corvair Oils Ltd.)  
G.C.K.Johnson  
D.A.Cairns  
J.S.Murray  
D.R.Gateman  
E.L.Doherty  
Pier Corr

Figure 1.0 - Injection Rate vs Time

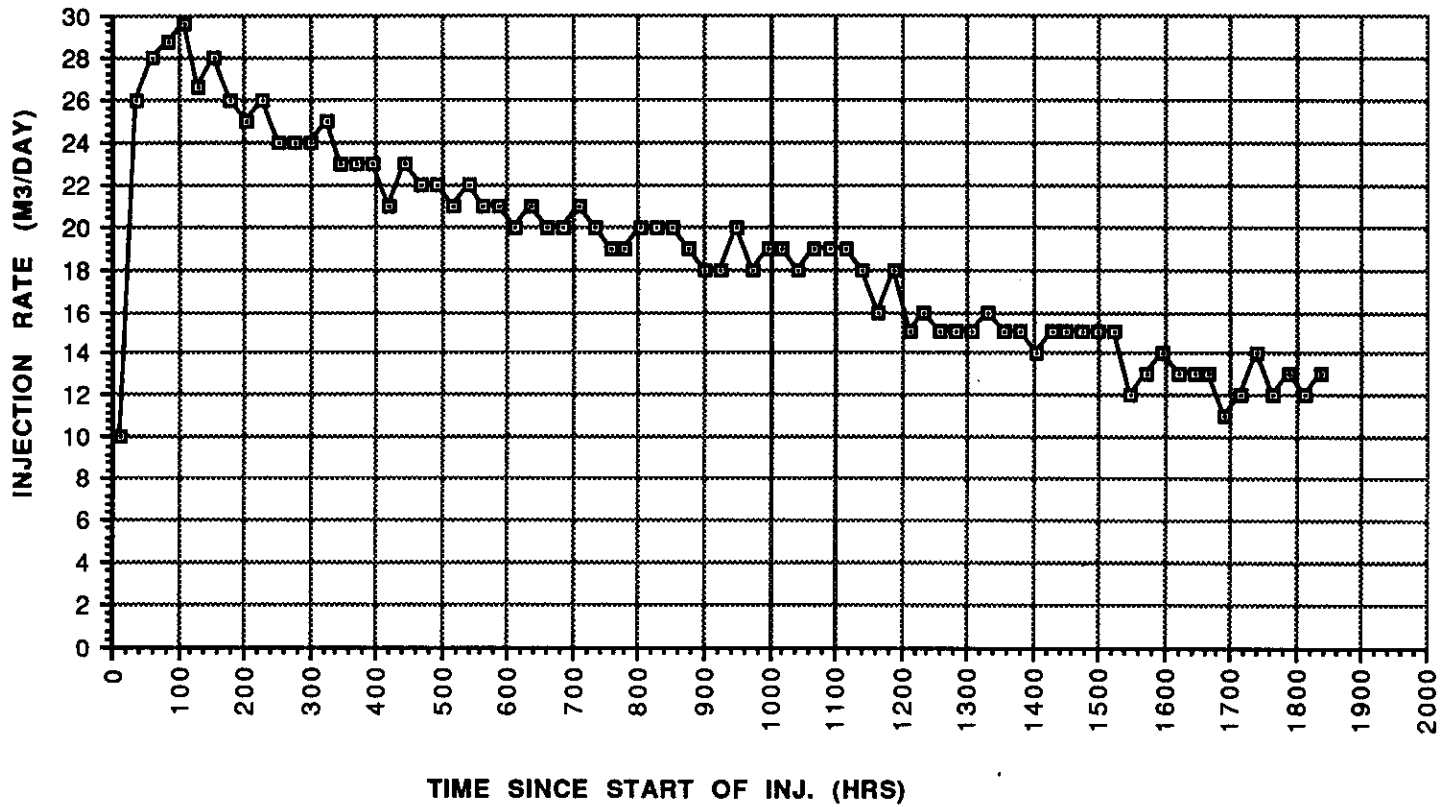
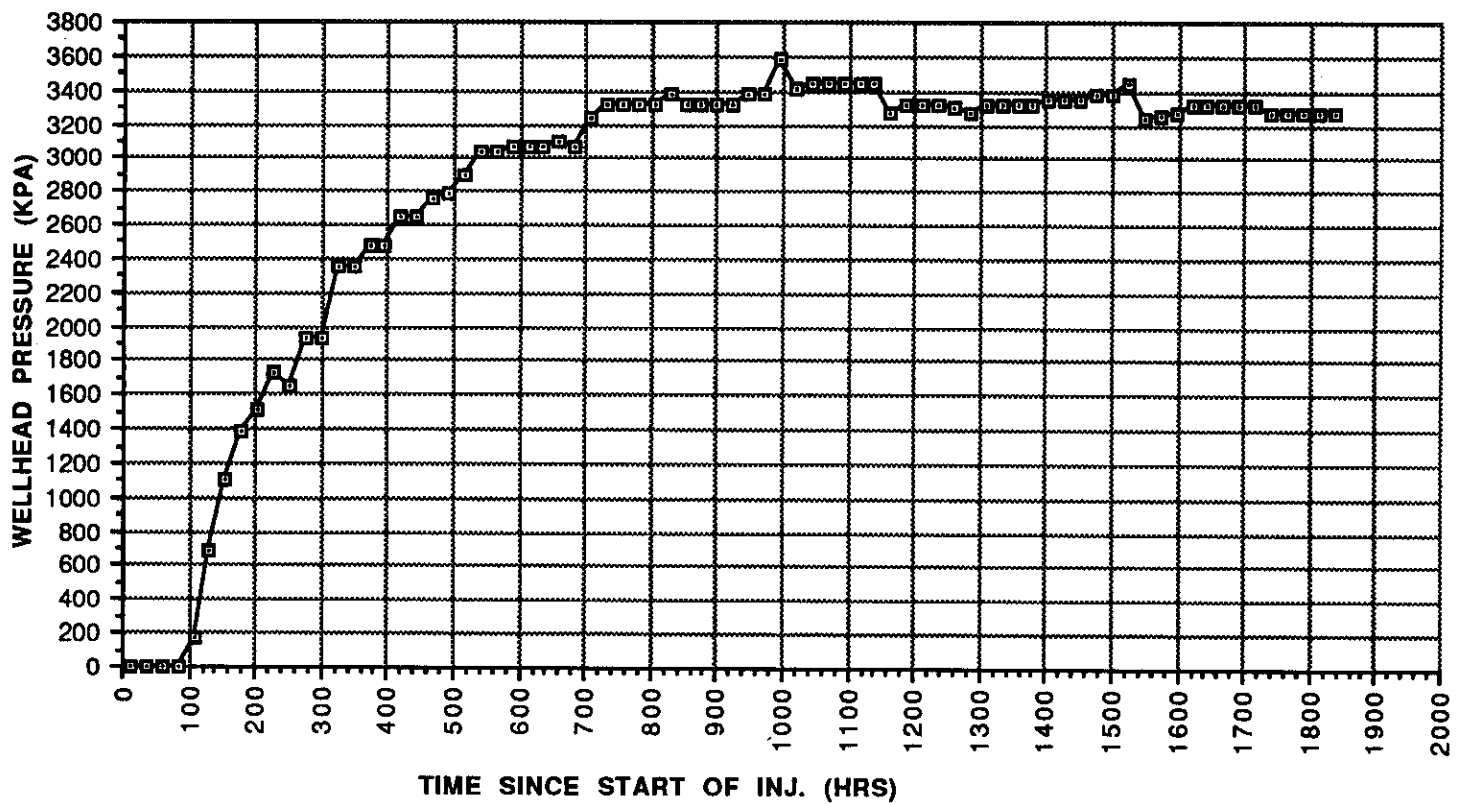
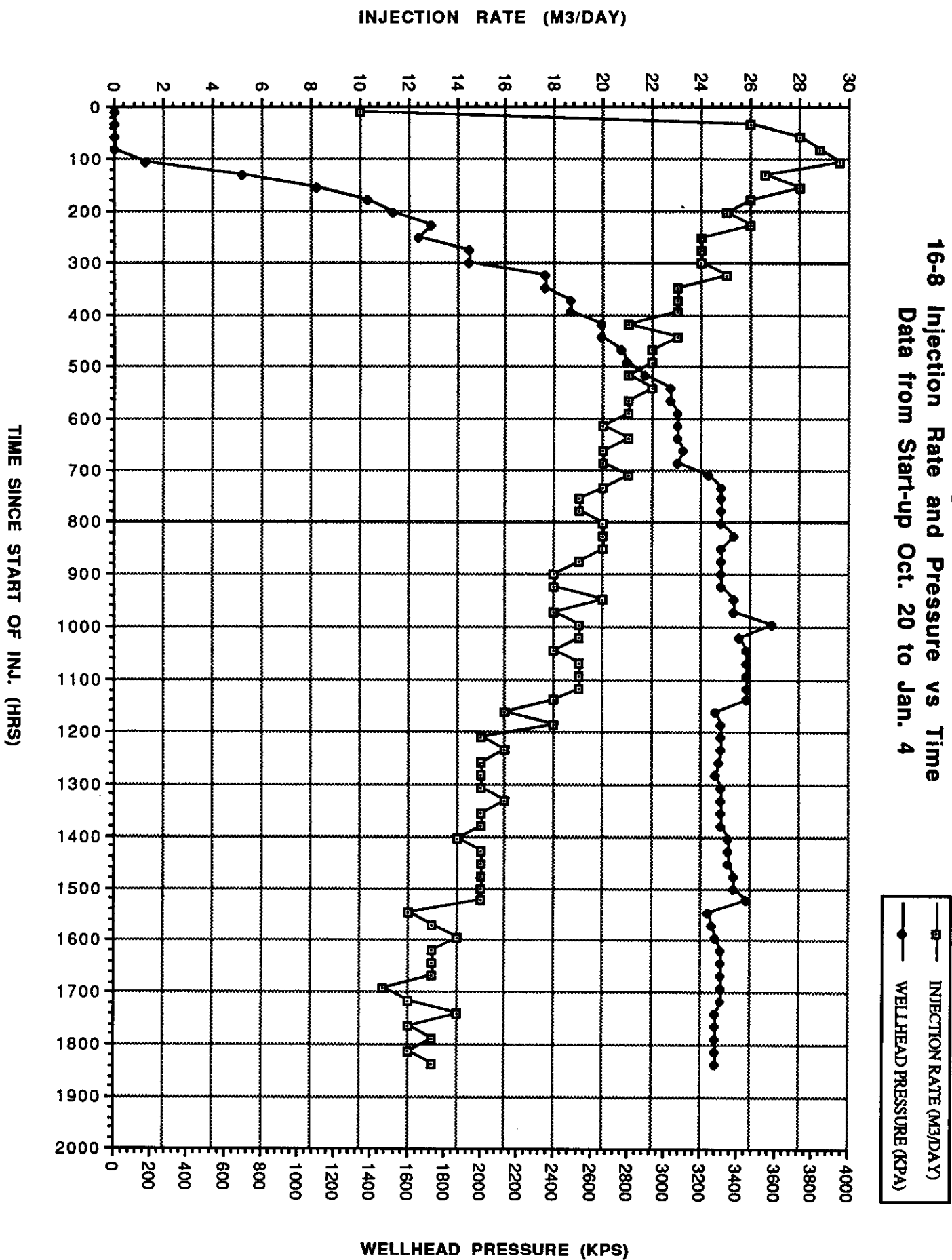


Figure 2.0 - Pressure vs Time



**Figure 3.0**  
**16-8 Injection Rate and Pressure vs Time**  
**Data from Start-up Oct. 20 to Jan. 4**



**Table 1.0 Wells Suspected of Communication With the Mississippian Formation**

| Location         | Watercut (%) | R.O.I.P * | Recoverable Oil Decline Analysis |
|------------------|--------------|-----------|----------------------------------|
| 06-04-002-29 W1M | DISPOSAL     | 19064     | DISPOSAL                         |
| 14-04-002-29 W1M | 17.3         | 9283      | 15851                            |
| 16-05-002-29 W1M | 58.7         | 11842     | 15600                            |
| 08-08-002-29 W1M | 67.7         | 9729      | 19250                            |
| 10-08-002-29 W1M | 3.6          | 10392     | 15467                            |
| 14-08-002-29 W1M | 14.9         | 6631      | 7899                             |
| 02-09-002-29 W1M | 15.7         | 3978      | 8270                             |
| 04-09-002-29 W1M | 66.6         | 7325      | 8600                             |
| 06-09-002-29 W1M | 30.8         | 5087      | 22678                            |
| 08-09-002-29 W1M | 16.9         | 7274      | N/A                              |
| 10-09-002-29 W1M | 10.2         | 9511      | 12793                            |
| 12-09-002-29 W1M | 15.9         | 12641     | 22000                            |
| 14-09-002-29 W1M | 93           | 8051      | 12870                            |
| 16-09-002-29 W1M | 10.9         | 10071     | 24385                            |
| 04-15-002-29 W1M | 1.8          | 12164     | 18500                            |
| 02-16-002-29 W1M | 0.5          | 7687      | 10500                            |
| 04-16-002-29 W1M | 0.5          | 7253      | 11600                            |
| 06-17-002-29 W1M | 90.5         | 10081     | 2300                             |
| 14-17-002-29 W1M | 70.2         | †         | †                                |
| 08-18-002-29 W1M | 10.1         | 8858      | 4444                             |
| 16-18-002-29 W1M | 82.9         | 4735      | N/A                              |

**R.O.I.P \* - Recoverable Oil in Place in the Lower Amaranth Only**

N/A - 08-09 Perforated in Mississippian,

16-18, Not enough information for accurate assessment

† - Watercut suggests Mississippian breakthrough

Table 2.0

PIERSON UNIT WATERFLOOD

| CAPITAL ITEM           | COST/EA   |
|------------------------|-----------|
| INJECTION CONVERSIONS: | \$50,000  |
| INJECTION FLOWLINES:   | \$20,000  |
| INJECTION GROUPLINES:  | \$50,000  |
| INFILL PROD WELLS:     | \$225,000 |
| INJECTION SATELLITES:  | \$45,000  |
| PRODUCTION SATELLITES: | \$50,000  |

| YEAR: 1993             |        |             | YEAR: 1994             |        |             | YEAR: 1995             |        |             |
|------------------------|--------|-------------|------------------------|--------|-------------|------------------------|--------|-------------|
|                        | NUMBER | COST        |                        | NUMBER | COST        |                        | NUMBER | COST        |
| INJECTION CONVERSIONS: | 5      | \$250,000   | INJECTION CONVERSIONS: | 22     | \$1,100,000 | INJECTION CONVERSIONS: | 10     | \$500,000   |
| INJECTION FLOWLINES:   | 5      | \$100,000   | INJECTION FLOWLINES:   | 22     | \$440,000   | INJECTION FLOWLINES:   | 10     | \$200,000   |
| INJECTION GROUPLINES:  | 2      | \$100,000   | INJECTION GROUPLINES:  | 2      | \$100,000   | INJECTION GROUPLINES:  | 1      | \$50,000    |
| INFILL PROD WELLS:     | 19     | \$4,275,000 | INFILL PROD WELLS:     | 17     | \$3,825,000 | INFILL PROD WELLS:     | 7      | \$1,575,000 |
| INJECTION SATELLITES:  | 2      | \$90,000    | INJECTION SATELLITES:  | 2      | \$90,000    | INJECTION SATELLITES:  | 1      | \$45,000    |
| PRODUCTION SATELLITES: | 2      | \$100,000   | PRODUCTION SATELLITES: | 1      | \$50,000    | PRODUCTION SATELLITES: | 0      | \$0         |
| TOTAL:                 |        | \$4,915,000 | TOTAL:                 |        | \$5,605,000 | TOTAL:                 |        | \$2,370,000 |
| PLANT MODIFICATIONS:   |        | \$150,000   | PLANT MODIFICATIONS:   |        | \$100,000   | PLANT MODIFICATIONS:   |        | \$50,000    |
| MISC OTHER:            |        | \$50,000    | MISC OTHER:            |        | \$50,000    | MISC OTHER:            |        | \$25,000    |
| TOTAL:                 |        | \$200,000   | TOTAL:                 |        | \$150,000   | TOTAL:                 |        | \$75,000    |
| YEARLY TOTAL:          |        | \$5,115,000 | YEARLY TOTAL:          |        | \$5,755,000 | YEARLY TOTAL:          |        | \$2,445,000 |

NOTES: SOME DUPLICATION OF EQUIPMENT (PUMPJACKS, FLOWLINES, ETC) WILL HELP REDUCE EQUIPMENT COSTS FOR NEW WELLS.  
AVERAGE DISTANCE FROM INJECTION SATELLITE TO WELL IS 2500 FEET.  
AVERAGE DISTANCE FROM 14-09 TO INJECTION SATELLITE IS 6000 FEET.  
INJECTION SATELLITE INCLUDES METERS, CHOKES, BUILDING.  
WATER PLANT OP COST AT \$30,000 PER YEAR. WELL OP COST AT \$1300/WELL/MO FOR PRODUCER AND \$150/WELL/MO FOR INJ.  
VARIABLE OP COSTS AT 12/M3 OF OIL PROD.

Home Oil Company Limited

INTER-OFFICE MEMORANDUM

TO: E. L. Doherty  
FROM: C. W. Labelle  
SUBJECT: **Preliminary Evaluation**  
**South Pierson 16-08 Waterflood Injectivity Project**

---

DATE: December 21, 1992

FILE: PIER - DEV

Please find attached the preliminary pressure transient results from the 16-08-002-29 W1M injectivity testing. The rate and pressure data were obtained from the South Pierson field staff and compiled by D. Cairns. A static water gradient of 11.31 kPa/m at a depth of 1029 meters was used to generate sandface pressures.

The results indicate no apparent skin damage at this time. The in-situ permeability is high at 8.97 md which may be attributed to the high injection pressure promoting better fracture conductivity and a natural propensity for water flow in the strongly water-wet Lower Amaranth formation.

These results are only preliminary and further testing is required. The injection pressure profile appears to be stabilizing however, which may expedite the execution date of the two-rate and subsequent fall-off tests.

If you require any clarification please contact Curt at 5502.

/cwl

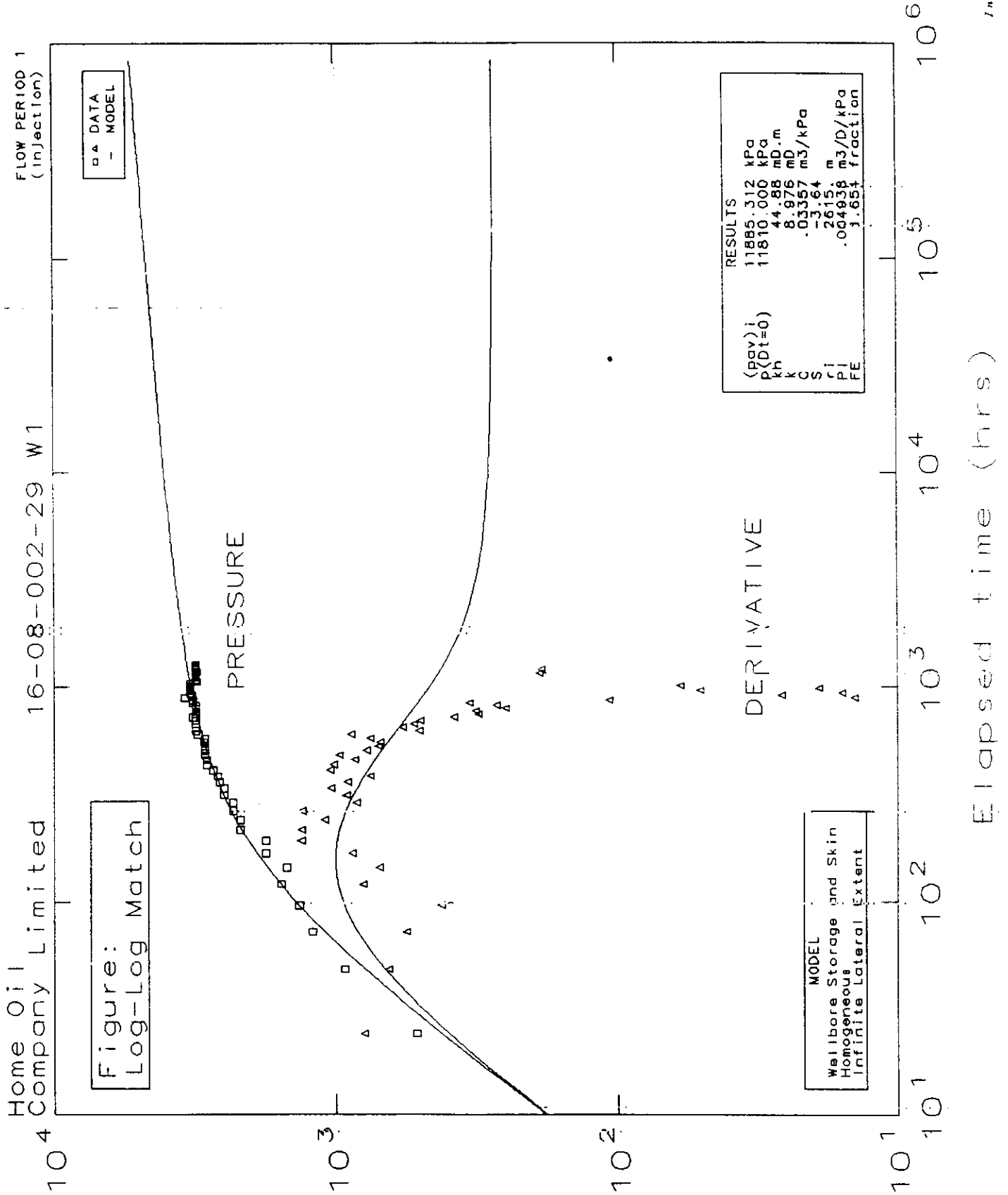
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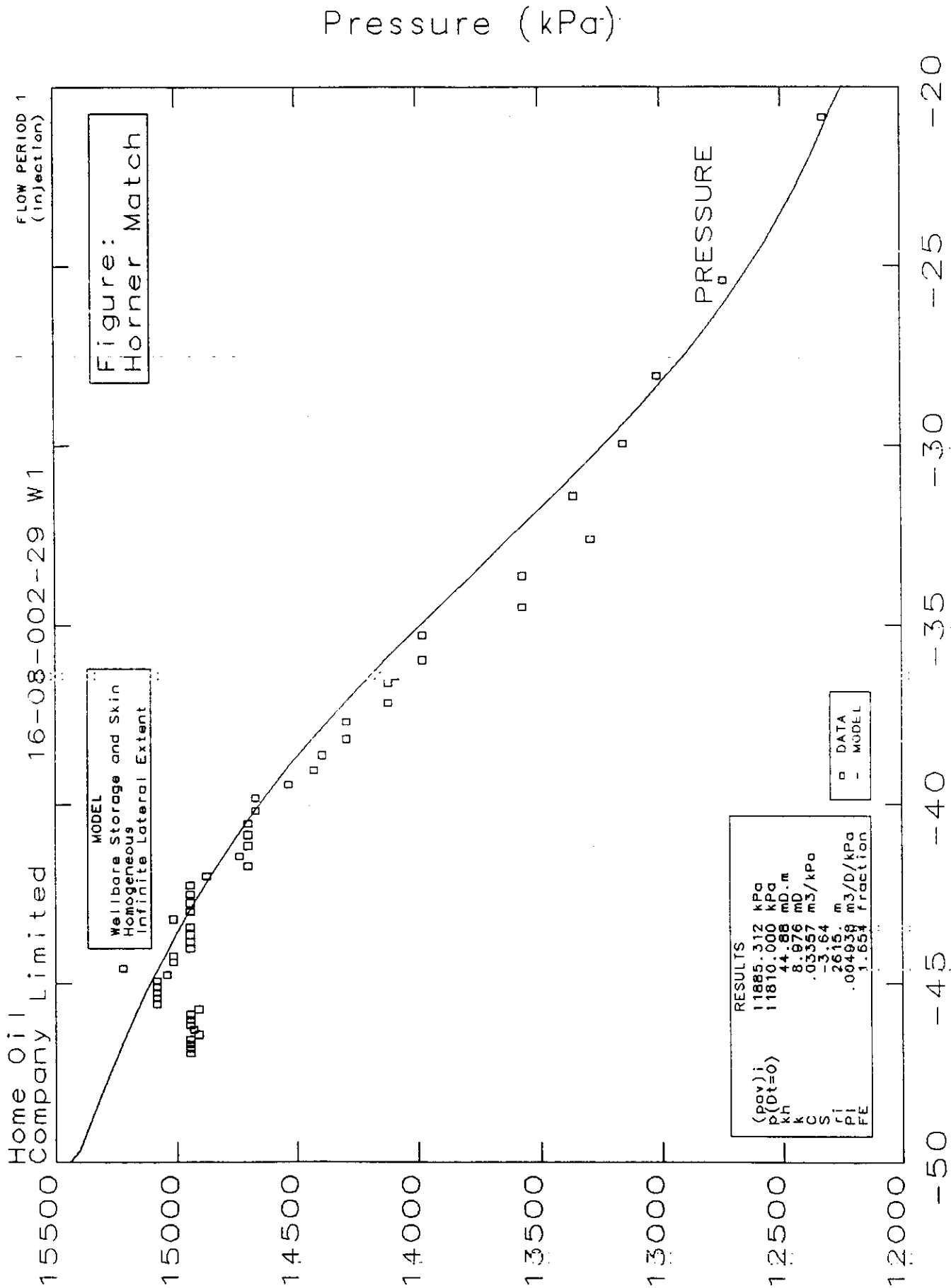
cc: D. A. Cairns  
J. S. Murray  
Day File  
PIER - DEV

  
C. W. Labelle

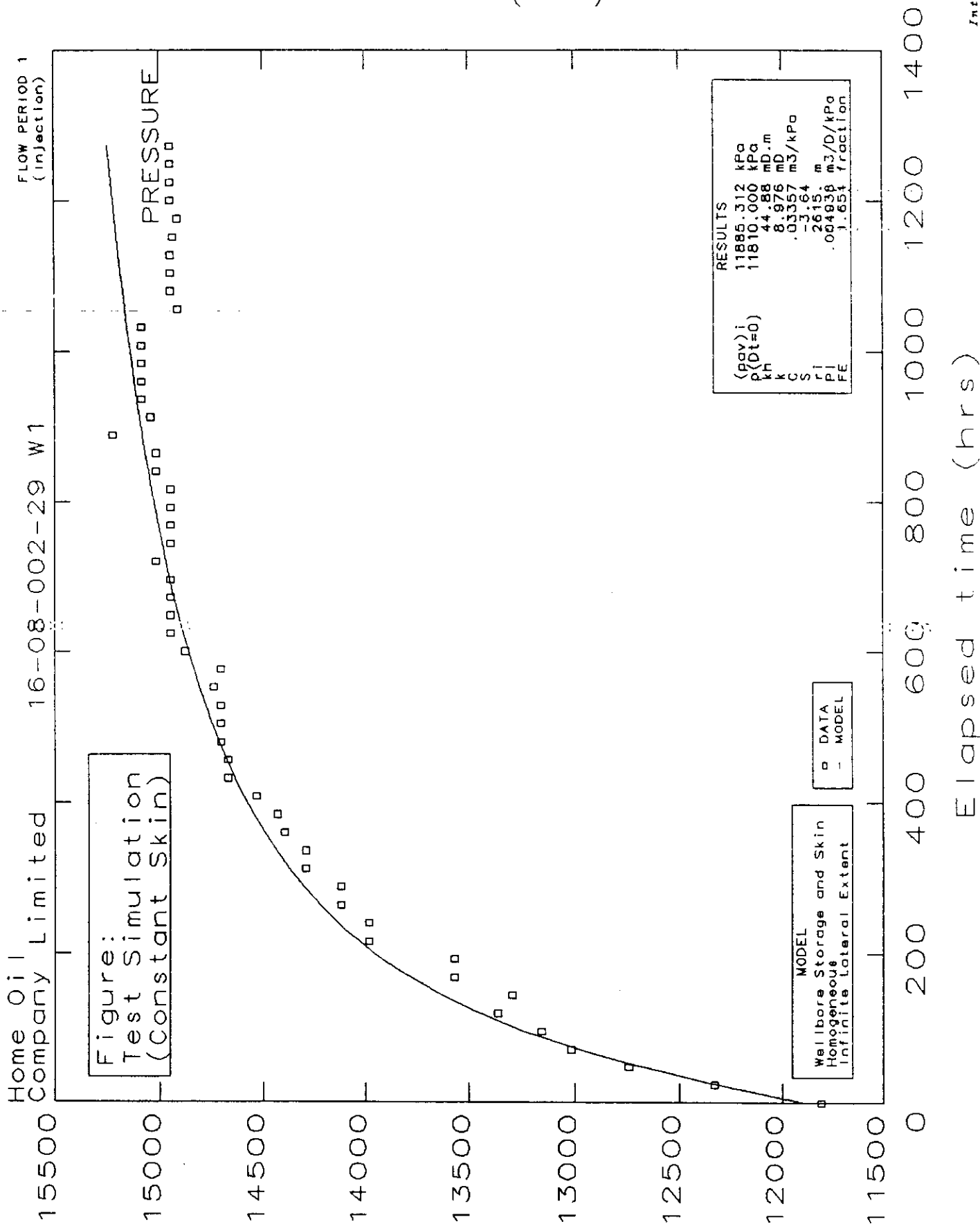


# Pressure Change and Derivative (kPa)





Superposition time (Sm3/D)



1

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Interpret/2

## WELL TEST ANALYSIS REPORT

Company: Home Oil Company Limited

Field: South Pierson  
 Formation: Lower Amaranth  
 Zone:  
 Well: 16-08-002-29 W1

Date: 21-Dec-92  
 Test No: 1  
 Test Date: Dec/92  
 Gauge:  
 Depth: 1029.00 m

Perforations: From To  
 1 m m

## ANALYSIS SUMMARY

Test of initial injection results. Water Gradient assumed to be 11.31 kpa/m static at 1029 meters depth. Wellhead pressures from D. Cairns. Further data required before full analysis. Initial results are good with little damage.

1

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## Results Summary

Company: Home Oil Company Limited

Field: South Pierson  
 Formation: Lower Amaranth  
 Zone:  
 Well: 16-08-002-29 W1

Date: 21-Dec-92  
 Test No: 1  
 Test Date: Dec/92  
 Gauge:  
 Depth: 1029.00 m

Near wellbore effects: Wellbore Storage and Skin  
 Reservoir behaviour: Homogeneous  
 Boundary effects: Infinite Lateral Extent

|              |           |          |
|--------------|-----------|----------|
| Flow Period: | 1         | UNITS    |
| (pav)i       | 11885.312 | kPa      |
| p(Dt=0)      | 11810.000 | kPa      |
| kh           | 44.88     | mD.m     |
| k            | 8.976     | mD       |
| C            | .03357    | m3/kPa   |
| S            | -3.64     |          |
| ri           | 2615.     | m        |
| PI           | .004938   | m3/D/kPa |
| FE           | 1.654     | fraction |

1

# Well & Reservoir Parameters

Company: Home Oil Company Limited

Field: South Pierson Date: 21-Dec-92

Formation: Lower Amaranth Test No: 1

Zone: Test Date: Dec/92

Well: 16-08-002-29 W1 Gauge:

Depth: 1029.00 m

## WELL AND RESERVOIR DATA (Water)

Multiphase flow at wellbore: NO

Multiphase in reservoir : NO

|                                |          |          |
|--------------------------------|----------|----------|
| Matrix Porosity                | .150     | fraction |
| Reservoir Thickness            | 5.00     | m        |
| Wellbore Radius                | .107     | m        |
| Distance To Producing Well (*) | 0.0      | m        |
| Water Formation Volume Factor  | 1.005    | Rm3/m3   |
| Water Viscosity                | .870     | cp       |
| Total Compressibility          | 1.450E-7 | 1/kPa    |

(\*) = For Interference Tests Only

1

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## Rates

Company: Home Oil Company Limited

Field: South Pierson Date: 21-Dec-92

Formation: Lower Amaranth Test No: 1

Zone: Test Date: Dec/92

Well: 16-08-002-29 W1 Gauge:

Depth: 1029.00 m

## RATES

| Flow Period | Start hrs | End hrs   | Duration hrs | Oil Sm3/D | Gas 1E3Sm3/D | Water Sm3/D |
|-------------|-----------|-----------|--------------|-----------|--------------|-------------|
| 1 0.0       |           | 1272.0000 | 1272.0000    | 0.0       | 0.0          | -15.12      |

1

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## Pressure History

Company: Home Oil Company Limited

Field: South Pierson  
Formation: Lower Amaranth  
Zone:  
Well: 16-08-002-29 W1

Date: 21-Dec-92  
Test No: 1  
Test Date: Dec/92  
Gauge:  
Depth: 1029.00 m

|    | TIME<br>hrs | PRESSURE<br>kPa |    | TIME<br>hrs | PRESSURE<br>kPa |
|----|-------------|-----------------|----|-------------|-----------------|
| 1  | 0.0         | 11810.000       | 28 | 648.0000    | 14947.000       |
| 2  | 24.0000     | 12327.000       | 29 | 672.0000    | 14947.000       |
| 3  | 48.0000     | 12741.000       | 30 | 696.0000    | 14947.000       |
| 4  | 72.0000     | 13017.000       | 31 | 720.0000    | 15016.000       |
| 5  | 96.0000     | 13155.000       | 32 | 744.0000    | 14947.000       |
| 6  | 120.0000    | 13362.000       | 33 | 768.0000    | 14947.000       |
| 7  | 144.0000    | 13293.000       | 34 | 792.0000    | 14947.000       |
| 8  | 168.0000    | 13569.000       | 35 | 816.0000    | 14947.000       |
| 9  | 192.0000    | 13569.000       | 36 | 840.0000    | 15016.000       |
| 10 | 216.0000    | 13982.000       | 37 | 864.0000    | 15016.000       |
| 11 | 240.0000    | 13982.000       | 38 | 888.0000    | 15222.999       |
| 12 | 264.0000    | 14120.000       | 39 | 912.0000    | 15044.000       |
| 13 | 288.0000    | 14120.000       | 40 | 936.0000    | 15085.000       |
| 14 | 312.0000    | 14292.000       | 41 | 960.0000    | 15085.000       |
| 15 | 336.0000    | 14292.000       | 42 | 984.0000    | 15085.000       |
| 16 | 360.0000    | 14396.000       | 43 | 1008.0000   | 15085.000       |
| 17 | 384.0000    | 14430.000       | 44 | 1032.0000   | 15085.000       |
| 18 | 408.0000    | 14534.000       | 45 | 1056.0000   | 14913.000       |
| 19 | 432.0000    | 14671.999       | 46 | 1080.0000   | 14947.000       |
| 20 | 456.0000    | 14671.999       | 47 | 1104.0000   | 14947.000       |
| 21 | 480.0000    | 14706.000       | 48 | 1128.0000   | 14947.000       |
| 22 | 504.0000    | 14706.000       | 49 | 1152.0000   | 14934.000       |
| 23 | 528.0000    | 14706.000       | 50 | 1176.0000   | 14913.000       |
| 24 | 552.0000    | 14740.999       | 51 | 1200.0000   | 14947.000       |
| 25 | 576.0000    | 14706.000       | 52 | 1224.0000   | 14947.000       |
| 26 | 600.0000    | 14879.000       | 53 | 1248.0000   | 14947.000       |
| 27 | 624.0000    | 14947.000       | 54 | 1272.0000   | 14947.000       |

1

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Analysis Parameters

Company: Home Oil Company Limited

Field: South Pierson  
Formation: Lower Amaranth  
Zone:  
Well: 16-08-002-29 W1

Date: 21-Dec-92  
Test No: 1  
Test Date: Dec/92  
Gauge:  
Depth: 1029.00 m

ANALYSIS MODEL, FLOW PERIOD: 1

Near wellbore effects: Wellbore Storage and Skin  
Reservoir behaviour: Homogeneous  
Boundary effects: Infinite Lateral Extent

ANALYSIS PARAMETERS, FLOW PERIOD:

Pressure match, PM  
Time match, TM  
Curve Match, Log CDe2S

1.819E-03 1/kPa  
3.431E-02 1/hr  
3.47

1

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Interpret/2

Analysis Results

Company: Home Oil Company Limited

Field: South Pierson  
Formation: Lower Amaranth

Date: 21-Dec-92

Test No: 1

Zone:

Test Date: Dec/92

Well: 16-08-002-29 W1

Gauge:

Depth: 1029.00 m

ANALYSIS MODEL, FLOW PERIOD: 1

Near wellbore effects: Wellbore Storage and Skin  
Reservoir behaviour: Homogeneous  
Boundary effects: Infinite Lateral Extent

ANALYSIS RESULTS, FLOW PERIOD: 1

|  |           |          |
|--|-----------|----------|
| Initial average reservoir pressure, (pav) <sub>i</sub> | 11885.312 | kPa      |
| P (Delta t = 0), p(Dt=0)                               | 11810.000 | kPa      |
| Permeability-thickness, kh                             | 44.9      | mD.m     |
| Permeability, k  | 8.98      | mD       |
| Wellbore storage coefficient, C                        | 3.357E-02 | m3/kPa   |
| Wellbore skin factor, S                                | -3.64     |          |
| Radius of investigation (approx), r <sub>i</sub>       | 2615.     | m        |
| Measured Productivity Index, PI                        | 4.938E-03 | m3/D/kPa |
| Flow Efficiency, FE                                    | 1.65      | fraction |



## Memorandum

Date March 11, 1993

To The Oil and Natural Gas  
Conservation Board  
- D. Tomasson  
- H. Clare Moster

From John N. Fox  
Chief Petroleum Engineer  
Petroleum Branch

Subject Home Oil Company Limited  
Application for Approval of  
Pressure Maintenance - Pierson Area

Telephone

Home Oil Company Limited applied February 26, 1993 for approval of pressure maintenance operations in a portion of the Pierson Lower Amaranth C Pool.

### RECOMMENDATIONS

Before the application can be advertised Home must advise the Board on its position in respect of reduced 16 ha spacing and waiver of maximum permissible production rate (MPPR) restrictions. The attached proposed Board deficiency letter addresses these issues and also includes a number of technical questions.

A draft copy of the proposed Board letter has been sent to Home to allow the company time to prepare for a meeting with the Branch on March 15, 1993.

#### 1.0 WATERFLOOD STUDY

In May 1992 Home submitted a waterflood study for the Lower Amaranth Formation in the Pierson area. The study provides the technical support for Home's waterflood application. The following summarizes the findings of the study.

#### 1.1 PRIMARY PRODUCTION PERFORMANCE

Home reviewed the primary production performance of the Pierson Lower Amaranth C & G Pools in the area shown on Figure 1. The primary recovery mechanism is oil expansion above the bubble point and solution gas drive below the bubble point. The average reservoir rock and fluid properties are listed in Table 1.

Home believes the Lower Amaranth and underlying Mission Canyon are in communication through natural and induced fractures created during completion of the wells.

Home estimated OOIP in the area outlined in Figure 1 of  $7000 \times 10^3 \text{ m}^3$ . Home has estimated primary recovery of 7.2% OOIP based on the Tracey - Tarner prediction model (predicts the performance of solution gas drive reservoirs based on reservoir rock and



fluid properties - relates pressure decline to oil recovery and GOR) and supported by decline curve analysis. Home believes the Mission Canyon may be contributing as much as 28% of the recoverable reserves.

## 1.2 PREDICTED WATERFLOOD PERFORMANCE

Home proposes to waterflood the Lower Amaranth using inverted 5-spot injection patterns on 16 ha spacing.

Waterflood performance is expected to be similar to that experienced in the Waskada Lower Amaranth A Pool. Water injection is expected to arrest the primary production decline of 22%/year to less than 1%/year. The Lower Amaranth is strongly water-wet and the flood front is expected to advance in a piston-like manner, with WOR's remaining relatively constant until water breakthrough. At breakthrough, the WOR is expected to increase drastically with little or no economic recovery after breakthrough.

Home predicts waterflood recovery could reach 40% OOIP but is of the opinion waterflood inefficiencies (out of zone injection, reservoir heterogeneity, low matrix permeability and slow waterflood response) will reduce the recovery to 32% OOIP. Areal sweep efficiency is predicted to be 84%.

Table 2 shows a comparison between the predicted and initial waterflood performance in Waskada Unit No. 16 and Home's predicted waterflood performance for the Lower Amaranth in the Pierson area. Based on this comparison a recovery of 32% OOIP under waterflood may be optimistic. The Branch believes the OOIP assigned to Waskada Unit No. 16 is very optimistic, perhaps twice as high as it should be.

Home has selected inverted 5-spot injection patterns versus the inverted 7- and 9-spot injection patterns used in the Waskada Lower Amaranth A Pool.

Home is of the opinion that the inverted 5-spot injection pattern's one to one producer to injector ratio will accelerate waterflood response, minimize the volume of out of zone injection and provide a better match of injection to voidage.

Home also reviewed waterflooding on 16 and 32 ha spacing using a range of permeabilities (2.5, 3.5 and 4.5 md). In all cases waterflood response and recovery is significantly accelerated on 16 ha spacing - initial productivity 3-5% higher, recovery after 15 years 23-38% OOIP vs 12-20% OOIP and time to breakthrough 15-28 years vs 32-59 years.

The Branch shares Home's opinion that waterflooding will significantly increase ultimate recovery in the Lower Amaranth in the Pierson area. The Branch also agrees that Home's plan to use inverted 5-spot injection patterns on 16 ha spacing will reduce

Some of the technical and economic risks associated with waterflooding the Lower Amaranth.

## **2.0 WATERFLOOD APPLICATION**

### **2.1 PROJECT AREA SELECTION**

Home has selected the central portion of the Pierson Lower Amaranth C Pool for Phase I of its proposed waterflood. The proposed waterflood project area is shown on Figure 2.

The proposed waterflood project area

- contains 34 of 60 wells drilled in the pool and includes the portions of the pool almost completely developed on 32 ha spacing
- produces 65.8% of the current pool production (Dec/92)
- has produced 69.8% of the cumulative pool production (Dec/92)
- has the greatest depletion, 3.8% OOIP recovered (Dec/92)

The Branch is satisfied with Home's selection of the project area. Home has also indicated if step-out locations at 4-8, 8-7 and 16-7 scheduled for Spring/93 are successful the project area would be expanded. Changes to the area of application at this late date creates problems with advertising the application and will delay the approval process. The Branch will discuss this problem with Home Oil at our March 15th meeting.

Home has also indicated that starting in 1996, the company will commence Phase II of the waterflood as shown in Figure 2.

### **2.2 PREDICTED PRIMARY AND SECONDARY PERFORMANCE**

Within the waterflood project area, Home estimates OOIP of  $3422 \times 10^3 \text{ m}^3$ . Home predicts a primary recovery of  $362.7 \times 10^3 \text{ m}^3$  or 10.6% OOIP, 3.4% OOIP higher than the average pool recovery of 7.2% OOIP.

Home has assigned Mission Canyon reserves to all wells where the predicted recovery exceeds 10.6% OOIP. Figure 3 shows the predicted Mission Canyon recoverable reserves for individual wells within the project area. In total, Home estimates Mission Canyon recoverable reserves of  $94.6 \times 10^3 \text{ m}^3$ , 26% of the recoverable reserves under primary production.

Home has predicted ultimate recovery from the waterflood project area of  $1038 \times 10^3 \text{ m}^3$  or 30.3% OOIP. The predicted recovery is 1.7% OOIP less than indicated in Home's waterflood study and the incremental recovery is 5.2% OOIP less. Home will be asked to explain these differences.

Figure 4 is plot of the forecast project area production under secondary recovery.

### **2.3 PROJECT SCHEDULE**

Home Oil plans to commence water injection in August 1993 after unitization is completed. To develop the project area on 16 ha spacing will take 3 years and involve the drilling of 38 infill wells and five 32 ha locations and conversion of 37 additional wells to injection. Table 3 is a development drilling and injector conversion schedule. Figures 5, 6 and 7 show how the inverted 5-spot injection patterns will be developed.

Sections 8 and 9 will be developed first in 1993 and early 1994. By the end of 1994, 28 of 39 injectors will have been converted and all but the periphery of the project area will be under waterflood.

Assuming Home follows its project development schedule (Table 3), the time between infill production commencing in a pattern and injector conversion is between 3-6 months. This short delay between infill drilling and injector conversion should not greatly accelerate reservoir depletion.

Based on RFT and AWS pressure data, the average reservoir pressure in the project area ranges from 7600-8800 kPa in the most depleted portion of the reservoir in the E/2 of Section 8 and Section 9 to 9200-10000 kPa in the W/2 of Section 8 and Sections 17 and 18 (Figure 8).

There is a need to continue to monitor reservoir pressure in the project area, to ensure pressure maintenance is implemented before the bubble point is reached. Home should be requested to provide the Board with its pressure monitoring plans.

### **3.0 OTHER MATTERS**

#### **3.1 REDUCED SPACING**

The waterflood project is within the area covered by Board Order No. SU 9 (issued January 25, 1993) which approved continuation of 32 ha spacing for the Lower Amaranth and Mission Canyon (Figure 9). At the time SU 9 was issued, the Branch was aware of Home's plans to waterflood on reduced 16 ha spacing. Clause 3 of SU 9 provides for modification of the area covered by the order, to address just this situation.

Home has not specifically applied to reduce the spacing and it is suggested the company be asked to include in its application a formal request to reduce the spacing in the waterflood project area from 32 to 16 ha.

#### **4.2 MPPR's**

The Board recently denied Home's application for continuation of increased MPPR's for the Lower Amaranth in the Pierson area ( $14\text{m}^3/\text{d}$  and  $360\text{ m}^3/\text{month}$ ). In its letter (January 26/93) the Board stated - "When a pressure maintenance scheme is implemented MPPR restrictions may, on application and in the absence of equity or conservation concerns, be waived within the waterflood project area." Home did not request the waiver of MPPR restrictions in its application. This point will need to be clarified with Home.

#### **4.3 Injectivity Test - 16-8-2-29**

On September 29, 1992 the Board approved a temporary 9 month injectivity test at 16-8-2-29. The purpose of the test was to evaluate Lower Amaranth injectivity. Home was to conduct a multi-rate injectivity test and a pressure fall-off. No data on the results of injection at 16-8 were submitted with the application.

#### **4.4 MISSION CANYON DEPLETION STRATEGY**

Home has not adequately addressed the recovery of Mission Canyon reserves. Home indicates the Lower Amaranth and Mission Canyon are in communication and has allocated primary recoverable reserves of  $94.6 \times 10^3\text{ m}^3$  to the Mission Canyon, 26% of the total primary recoverable reserves. However, under the waterflood, no incremental recoverable reserves are estimated for the Mission Canyon.

The Branch believes the following questions regarding Home's Mission Canyon depletion strategy should be asked

- (1) Has Home attempted to map hydrocarbon pore volume in the Mission Canyon?
- (2) Does Home intend to complete the Mission Canyon in any of the infill wells or in any of the injectors?
- (3) Which wells are known to be in communication with the Mission Canyon and does Home plan to injection profile log any injectors to determine the placement of injected water?
- (4) Is it technically and economically feasible to more accurately locate, assess and recover Mission Canyon reserves by concurrently waterflooding both the Lower Amaranth and Mission Canyon?

## 5.0 GENERAL

Home is meeting with Petroleum Branch staff on March 15, 1993 to discuss their waterflood application and unitization plans. At the meeting the Branch plans to discuss items listed in the proposed deficiency letter (attached). The matters of reduced spacing and waiver of MPPR restrictions must be addressed before the application is advertised.

Home plans to hold a public meeting in Pierson on the evening of March 15, 1993 and Branch staff will attend this meeting.

ORIGINAL SIGNED BY  
JOHN N. FOX

John N. Fox

JNF/hw

Attached.

Approved:

Original Signed By  
L. R. DUBREUIL

---

L. R. Dubreuil

**TABLE 1**

**PIERSON LOWER AMARANTH C POOL**

**RESERVOIR CHARACTERISTICS**

|                                   |  |
|-----------------------------------|--|
| Average Well Depth:               | 1050 meters  |
| Producing Formation:              | Lower Amaranth (Primary-Siltstone)<br>Mission Canyon (Secondary - Carbonate) |
| Reservoir Drive Mechanism:        | Expansion Drive above Bubble Point<br>Undersaturated                         |
| Initial Reservoir Pressure:       | 10,550 kPa   |
| Current Reservoir Pressure        | 7600 - 10 000 kPa  |
| Bubble Point Pressure:            | 4,550 kPa  |
| Current Well Spacing:             | 32 Hectare   |
| Average Permeability:             | 2.5-4.5 md   |
| Average Net Pay:                  | 4.3 meters (based on cut-offs of<br>1 md and 12% $\phi_D$ )                  |
| Average Porosity:                 | 14%  |
| Rock Compressibility:             | $0.87 \times 10^{-6}$ 1/kPa  |
| Oil Compressibility:              | $10.83 \times 10^{-7}$ 1/kPa   |
| Water Compressibility:            | $4.86 \times 10^{-7}$ 1/kPa  |
| Connate Water Saturation:         | 41%  |
| Average Initial Water Saturation: | 45%  |
| Residual Oil Saturation:          | 29-31%   |
| Oil Gravity:                      | 36° API  |
| Reservoir Temperature:            | 40° C  |
| Oil Formation Volume Factor:      | 1.169 (Initial)<br>1.178 (Bubble Point)                                      |
| Oil Viscosity:                    | 1.35 mPa.s (Initial)<br>1.24 mPa.s (Bubble Point)                            |

**TABLE 2**  
**COMPARISON OF WATERFLOOD PERFORMANCE**

|  | <b>Waskada<br/>Unit No. 16</b>   | <b>Pierson<br/>Lower Amaranth<br/>C Pool</b> |
|--|--|--|
| Original<br>Oil in Place                   | 85545m <sup>3</sup> /16 ha (optimistic)  | 43872 m <sup>3</sup> /16 ha                  |
| Primary Recovery<br>Factor                 | 9.3% OOIP  | 10.6% OOIP                                   |
| Primary Production<br>Decline Rate         | 22%/yr   | 22%/yr                                       |
| Secondary Recovery<br>Factor               | 29.1% OOIP (predicted<br>after<br>40 years)<br>11.7% OOIP (conservative<br>estimate based<br>on 1988-92<br>decline rate) | 30.3% OOIP                                   |
| Secondary Production<br>Decline Rate       | 3.7%/yr (predicted)<br>13.5%/yr (Actual 1988-92)   | 1%/yr (predicted)                            |
| Injection Pattern                          | Inverted 7-Spot  | Inverted 5-Spot                              |
| Waterflood Commenced                       | June 1987  | Fall 1993                                    |
| Cumulative<br>Voidage-Replacement<br>Ratio | 0.66 (Dec. 31/92)  | --   |
| Recovery to Date                           | 6.3% OOIP (Dec. 31/92)   | --   |

Table H-1 South Pierson Development Schedule

| 1993             |           |                  |                             | 1994      |                  |                  |          | 1995           |          |                  |  |
|------------------|-----------|------------------|-----------------------------|-----------|------------------|------------------|----------|----------------|----------|------------------|--|
| Infill Location  | Timing    | Conversion       | Infill Location             | Timing    | Conversion       | Infill Location  | Timing   | Conversion     | Timing   | Conversion       |  |
| 05-09-002-29 W1M | August    |                  | <del>05-08-002-29 W1M</del> | January   | 14-08-002-29 W1M | 05-15-002-29 W1M | January  |                | January  |                  |  |
| 07-09-002-29 W1M | "         |                  | 03-08-002-29 W1M            | "         | 12-09-002-29 W1M | 01-18-002-29 W1M | "        |                | "        |                  |  |
| 03-09-002-29 W1M | "         |                  | 09-05-002-29 W1M            | "         | 06-09-002-29 W1M | 09-18-002-29 W1M | "        |                | "        |                  |  |
| 13-04-002-29 W1M | "         | 04-09-002-29 W1M | 11-04-002-29 W1M            | February  | 10-08-002-29 W1M | 13-17-002-29 W1M | "        |                | "        |                  |  |
| 01-08-002-29 W1M | "         |                  | 15-04-002-29 W1M            | "         | 12-08-002-29 W1M | 15-17-002-29 W1M | "        |                | "        |                  |  |
| 07-08-002-29 W1M | "         | 08-08-002-29 W1M | 09-04-002-29 W1M            | "         | 06-08-002-29 W1M | 13-16-002-29 W1M | February |                | February |                  |  |
| 09-08-002-29 W1M | September |                  | 01-09-002-29 W1M            | "         | 16-05-002-29 W1M | 15-16-002-29 W1M | "        |                | "        |                  |  |
| 11-09-002-29 W1M | "         |                  | 09-09-002-29 W1M            | "         | 12-04-002-29 W1M |                  | May      |                | May      | 02-08-002-29 W1M |  |
| 13-09-002-29 W1M | "         | 14-09-002-29 W1M | 07-16-002-29 W1M            | May       | 14-04-002-29 W1M |                  | "        |                | "        | 16-09-002-29 W1M |  |
| 15-09-002-29 W1M | "         |                  | 11-16-002-29 W1M            | "         | 10-04-002-29 W1M |                  | "        |                | "        | 02-15-002-29 W1M |  |
| 03-16-002-29 W1M | "         | 08-09-002-29 W1M |                             | June      | 02-09-002-29 W1M |                  | June     |                | June     | 04-17-002-29 W1M |  |
| 01-17-002-29 W1M | "         | 16-04-002-29 W1M | 05-16-002-29 W1M            | "         | 10-09-002-29 W1M |                  | "        |                | "        | 08-18-002-29 W1M |  |
| 15-08-002-29 W1M | "         |                  | 09-17-002-29 W1M            | "         | 02-16-002-29 W1M |                  | "        |                | "        | 16-18-002-29 W1M |  |
| 11-08-002-29 W1M | October   |                  | 07-17-002-29 W1M            | "         | 08-16-002-29 W1M |                  | July     |                | July     | 12-17-002-29 W1M |  |
| 03-17-002-29 W1M | "         |                  | 11-17-002-29 W1M            | "         | 06-16-002-29 W1M |                  | "        |                | "        | 14-17-002-29 W1M |  |
| 01-16-002-29 W1M | "         |                  | 05-17-002-29 W1M            | "         | 04-16-002-29 W1M |                  | "        |                | "        | 16-17-002-29 W1M |  |
|                  |           |                  | 16-17-002-29 W1M            | "         | 08-17-002-29 W1M |                  | August   |                | August   | 14-16-002-29 W1M |  |
|                  |           |                  | 14-16-002-29 W1M            | July      | 02-17-002-29 W1M |                  | "        |                |          |                  |  |
|                  |           |                  |                             | "         | 06-17-002-29 W1M |                  | "        |                |          |                  |  |
|                  |           |                  |                             | August    | 10-17-002-29 W1M |                  | "        |                |          |                  |  |
|                  |           |                  |                             | "         | 12-16-002-29 W1M |                  | "        |                |          |                  |  |
|                  |           |                  |                             | September | 10-16-002-29 W1M |                  | "        |                |          |                  |  |
|                  |           |                  |                             | "         |                  |                  | October  |                |          |                  |  |
|                  |           |                  |                             | October   |                  |                  |          |                |          |                  |  |
| 16 Infills       | Total     | 5 Conversions    | 17 Infills                  | Total     | 22 Conversions   | 7 Infills        | Total    | 10 Conversions | Total    | 10 Conversions   |  |

Assumptions: 5 days to drill each infill location and 10 days to convert and tie-in each injector location.

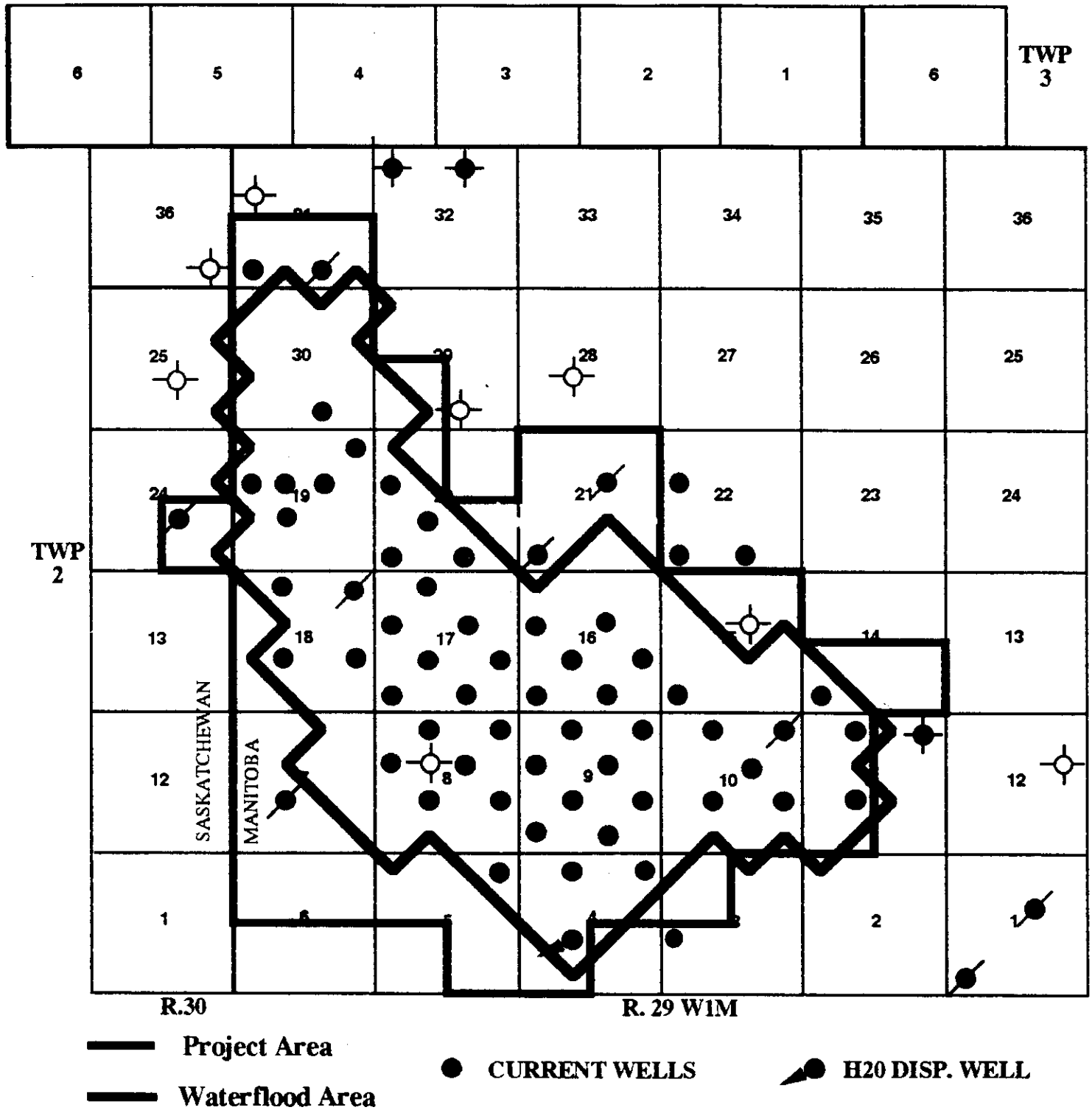
Note: Drilling, completions and pipelining will not be done during spring break-up in order to keep costs at a minimum.

32.4 Ha locations at 10-04, 12-04 and 02-08-002-29 W1M will be drilled prior to the infill locations in order to complete the proposed waterflood area. Locations at 04-08, 08-07 and 16-07-002-29 W1M will also be drilled prior to the infill locations in order to delineate the pool boundary and as possible expansion locations for the waterflood.



Figure 1.0

# PIERSON AREA



From HONE'S WATERFLOOD  
STUDY MAY/92

FIGURE 2

HOME'S PHASE I  
WATERFLOOD PROJECT AREA

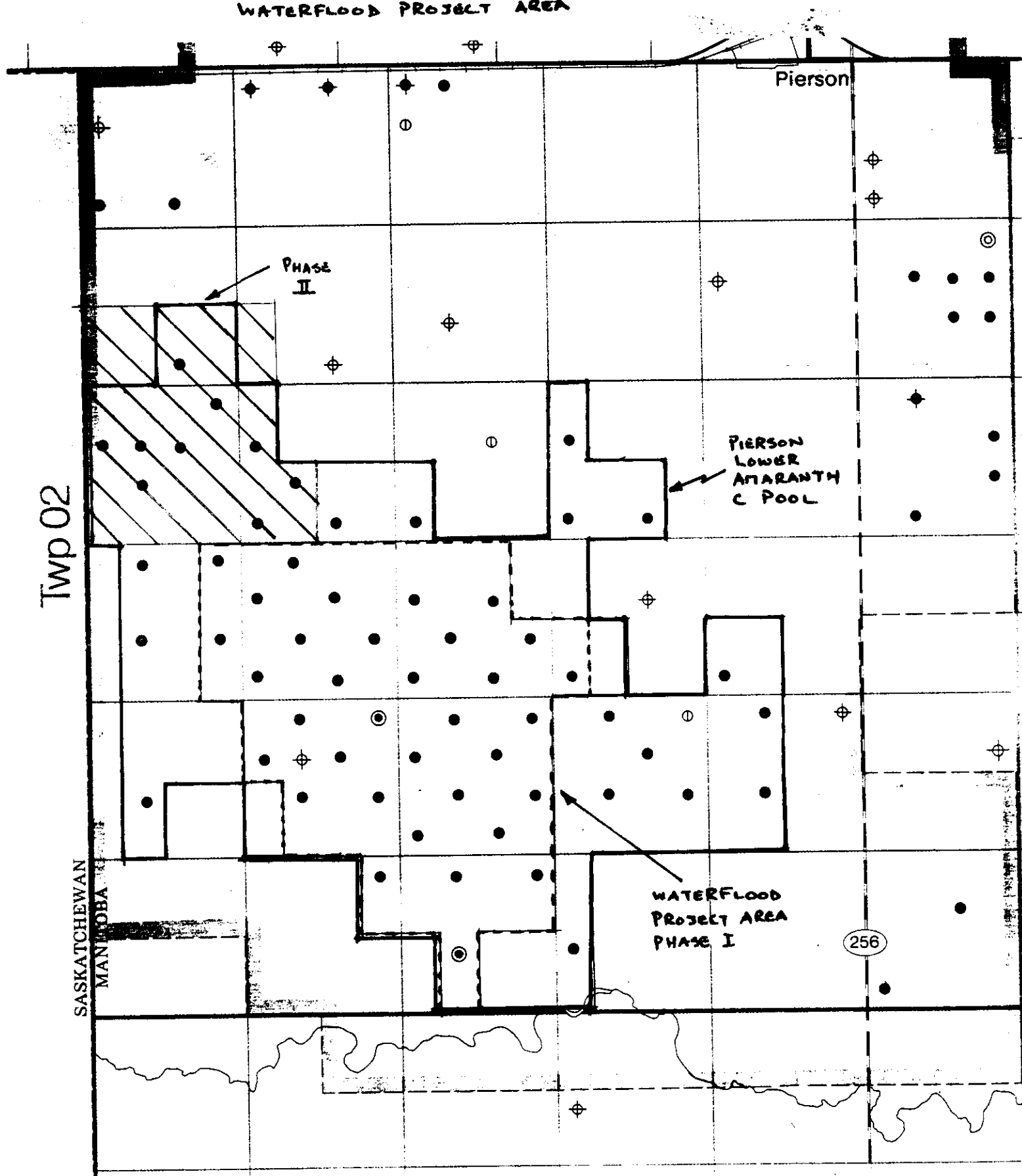
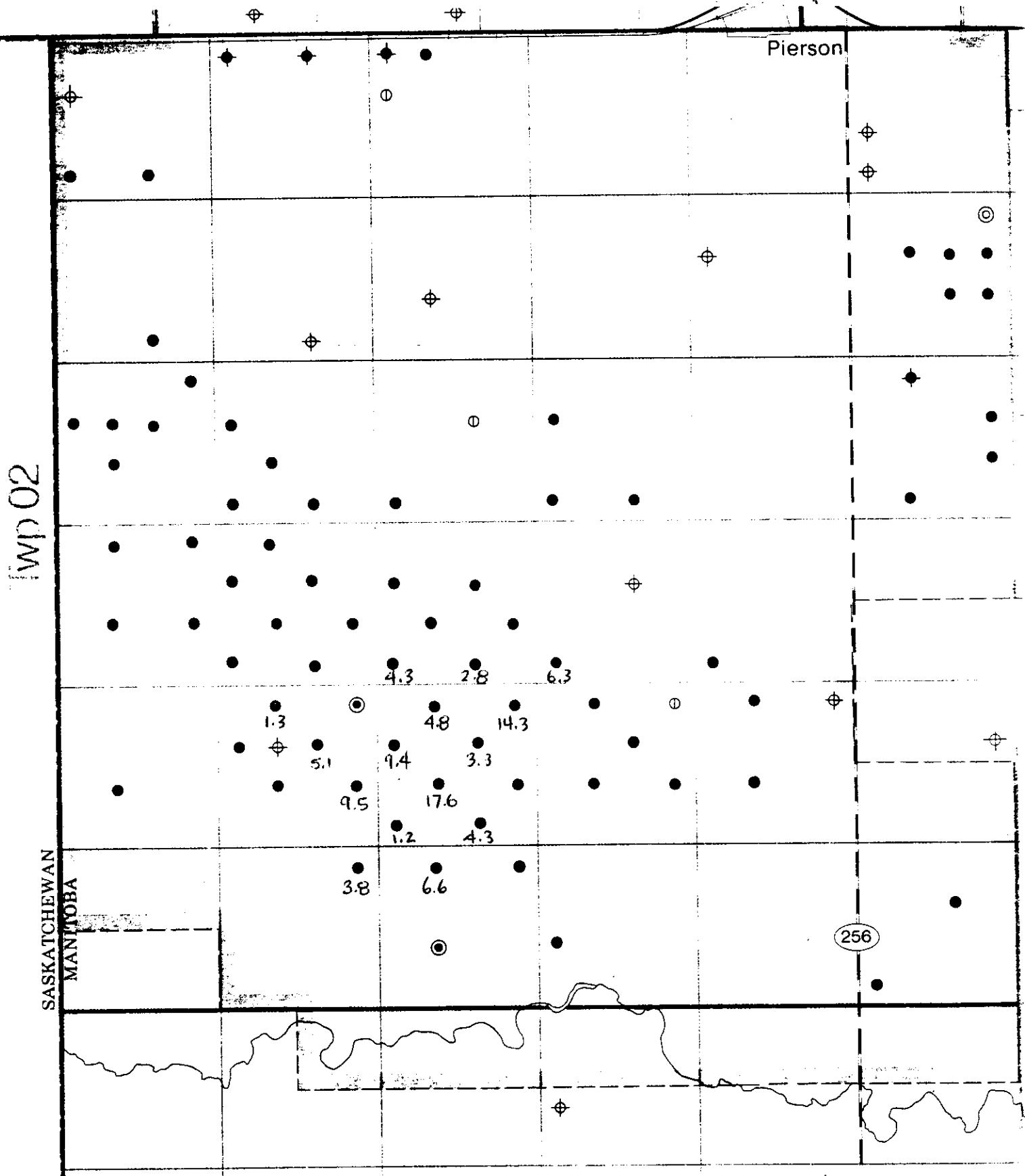


FIGURE 3  
MISSION CANYON RESERVES



6.5 - ESTIMATED NC RECOVERABLE  
RESERVES ( $10^3 m^3$ )

WELLS WITH  
NC RESERVES ALLOCATED  
BY HONE OIL

Figure 4  
WATERFLOOD PRODUCTION FORECAST

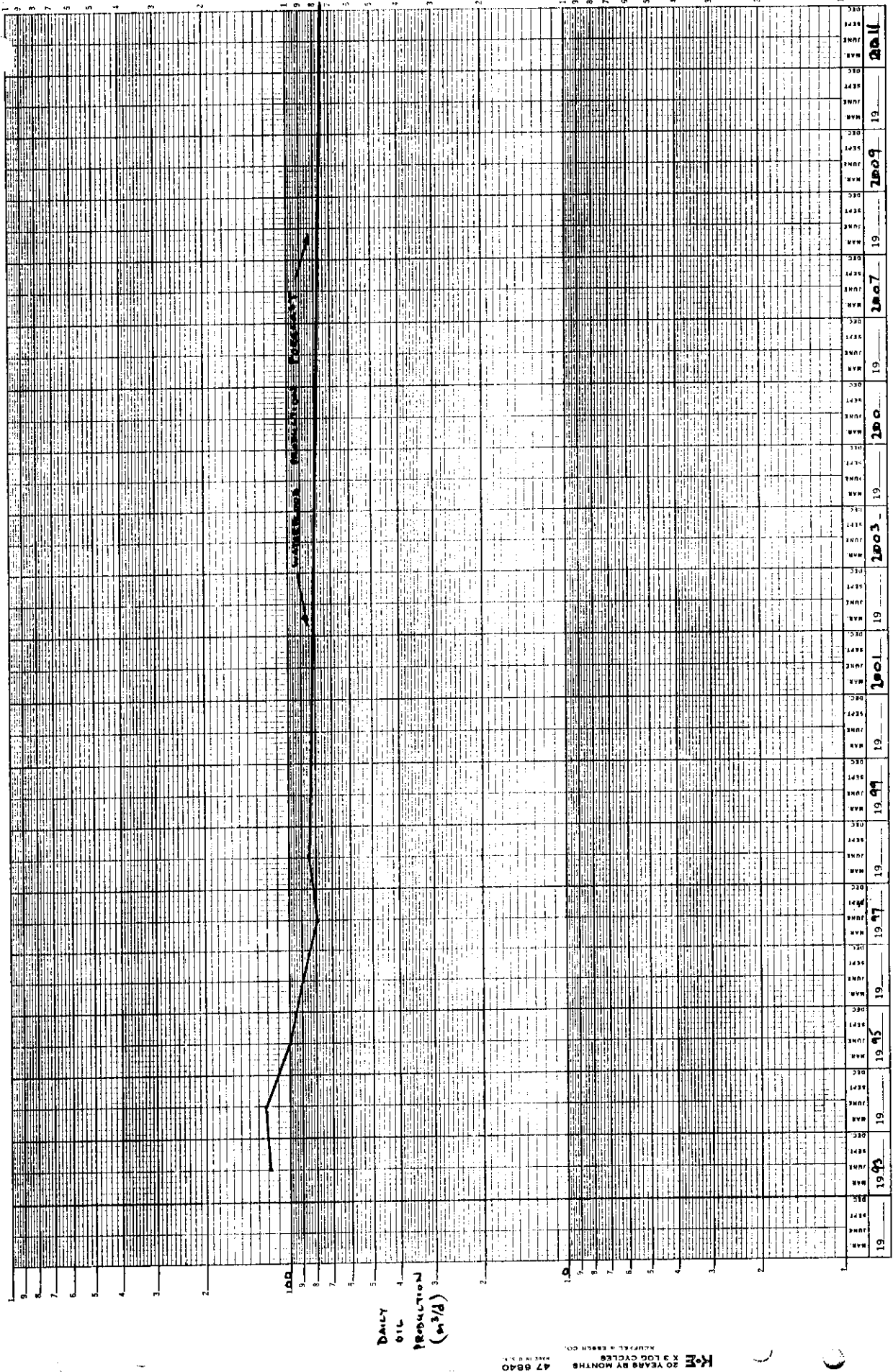
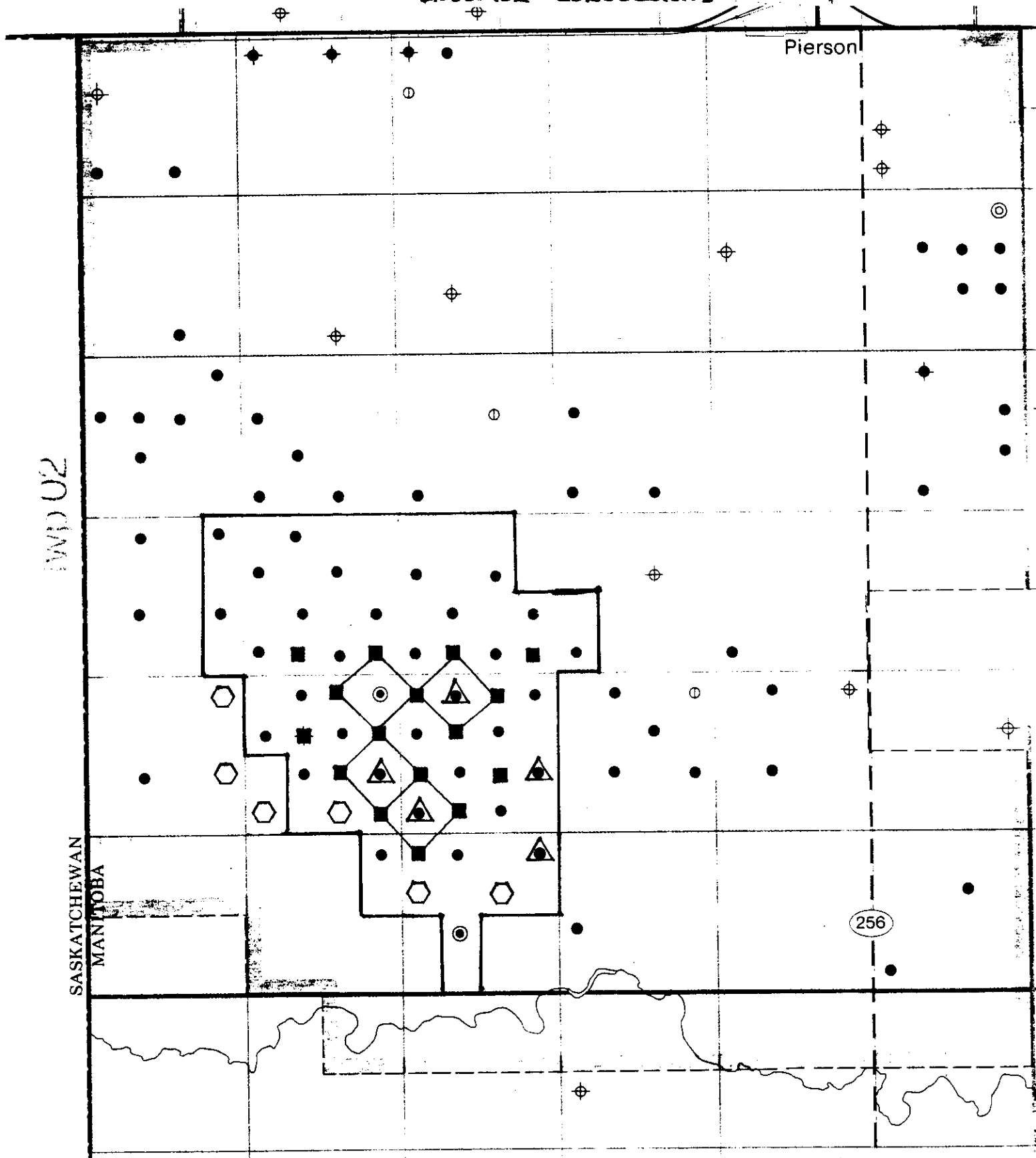


FIGURE 5  
1993 DRILLING LOCATIONS  
AND  
INJECTOR CONVERSIONS



■ INFILL DRILLING, FALL /93

○ 1993 32 ha LOCATIONS

FIGURE 6  
1993 & 94 DRILLING LOCATIONS  
AND INJECTOR CONVERSIONS

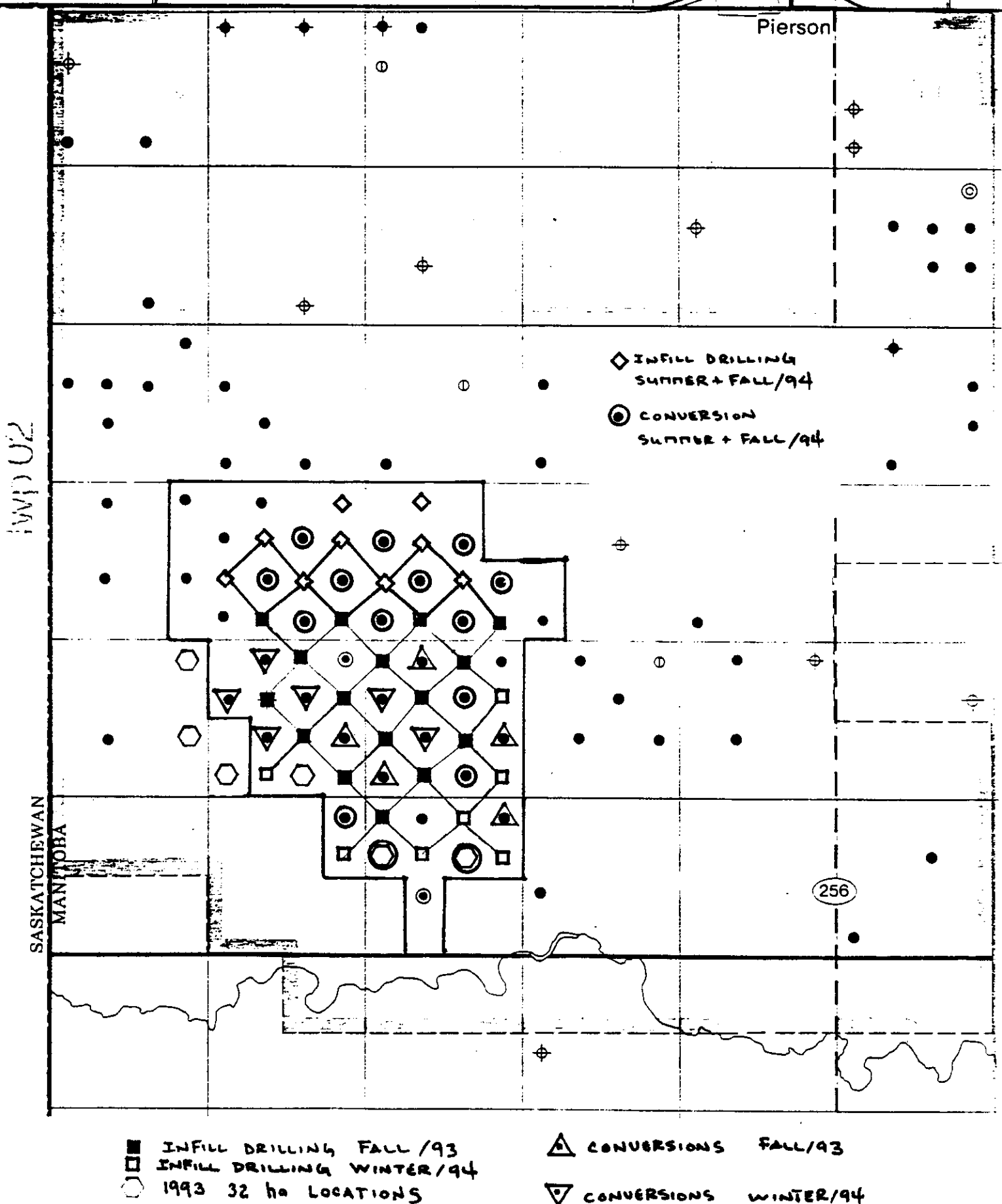
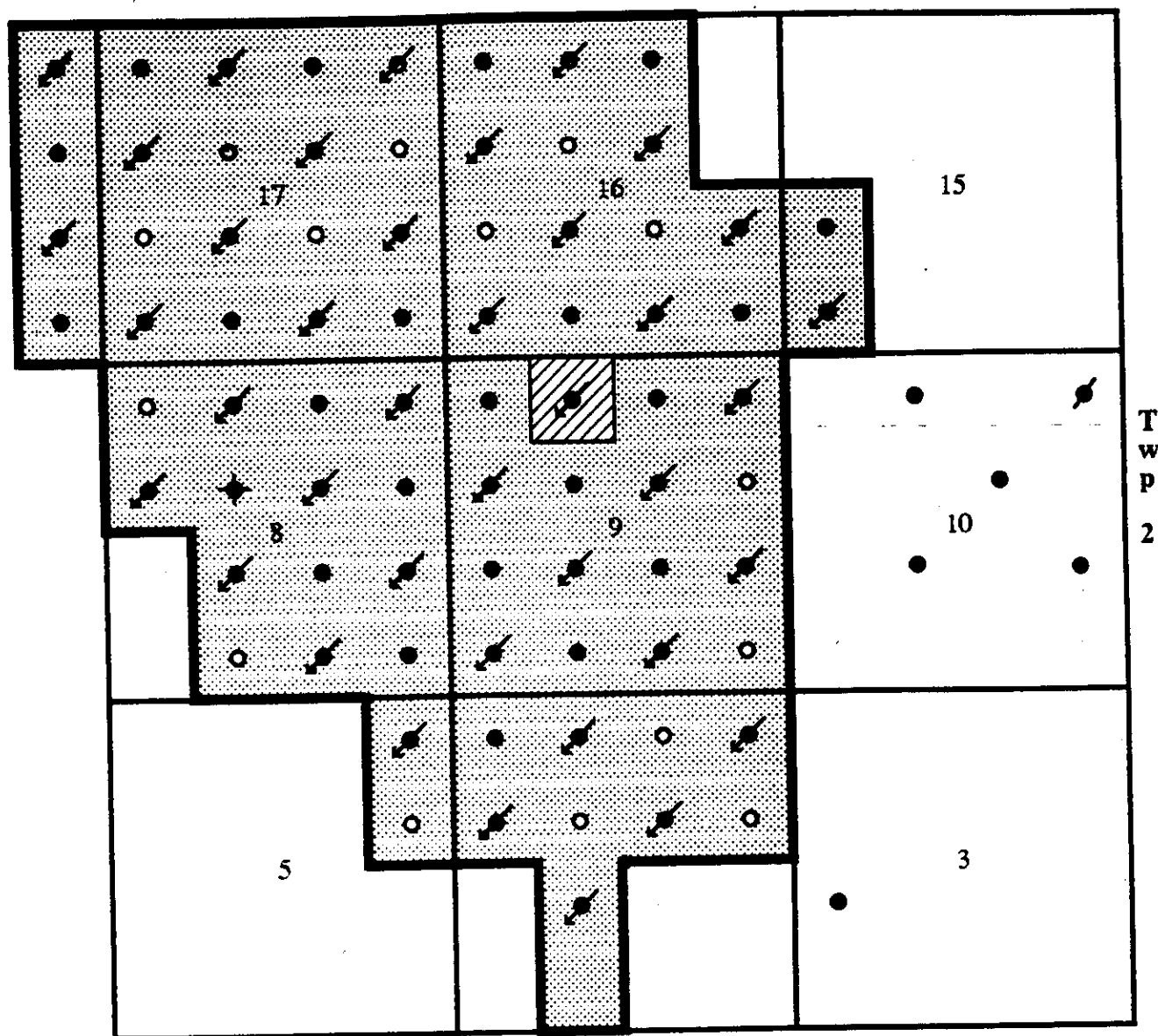


FIGURE 7

# FIGURE H-3 - 1995 SOUTH PIERSON DEVELOPMENT



Proposed Waterflood Area



Central Facilities



Injection Well



Current Producing Wells



1992 Infill Wells



1993 Infill Wells



1994 Infill Wells



1995 Infill Wells

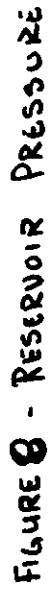
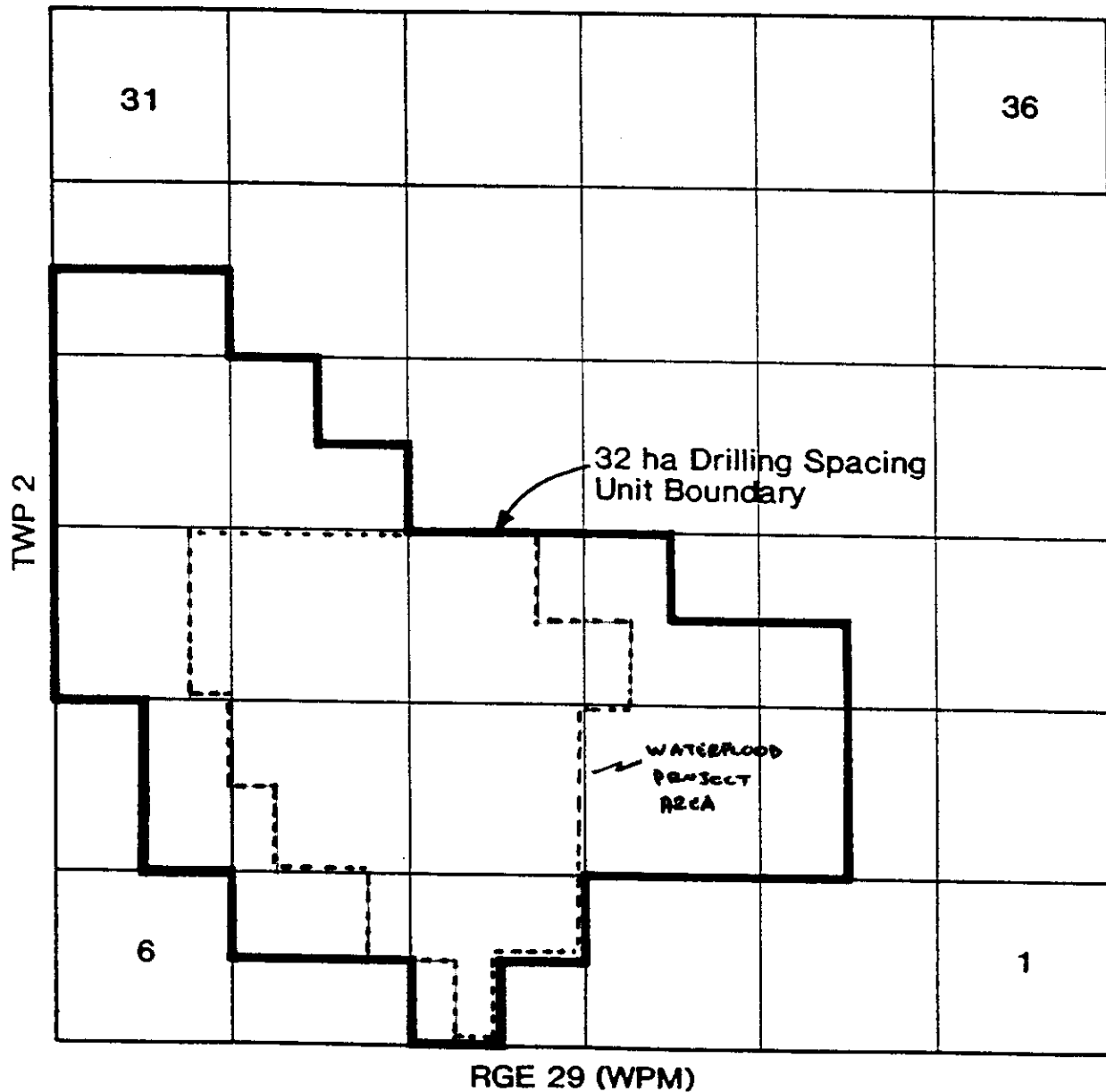




FIGURE 9

**BOARD ORDER NO. SU 9  
SCHEDULE A**

**PIERSON AREA  
32 ha DRILLING SPACING UNITS  
LOWER AMARANTH AND MISSION CANYON FORMATIONS**





The Oil and Natural Gas  
Conservation Board

555 — 330 Graham Avenue  
Winnipeg MB R3C 4E3  
CANADA

(204) 945-1111  
FAX: (204) 945-0586

March 14, 1993

Mr. G.C.K. Johnson, P. Eng.  
Coordinator, Southern Operations  
Home Oil Company Limited  
1600 Home Oil Tower  
324 - 8th Avenue SW  
Calgary, AB T2P 2Z5

Dear Mr. Johnson:

**RE: PIERSON WATERFLOOD APPLICATION**

The Board has completed a preliminary review of the subject application. The Board has the following administrative and technical questions and concerns. The Board also requires two (2) additional copies of the application.

**SPACING AND MAXIMUM PERMISSIBLE PRODUCTION RATES (MPPR's)**

In order to publish notice of the application, the Board needs formal notification of Home's plans for reduced 16 ha spacing and the company's position on MPPR's.

The Branch requests Home acknowledge in writing its desire to amend Board Order No. SU 9 to reduce spacing in the waterflood project area from 32 ha to 16 ha.

In previous discussions with Home, the Board indicated it is prepared to entertain an application for waiver of MPPR restrictions in conjunction with the implementation of the waterflood. The waterflood application does not address MPPR's.

**INJECTIVITY TEST RESULTS - 16-8-2-29**

Please provide information on the results of the injectivity test at 16-8-2-29 including:

- a plot of injection rate and pressure versus time
- a list of tests and data collected

Based on the 16-8 injectivity test, is there any concern that injectivity will be a problem in the Lower Amaranth?

### MISSION CANYON DEPLETION STRATEGY

Home has indicated that the Lower Amaranth and Mission Canyon are in communication through natural and induced fractures. Home also estimated Mission Canyon reserves account for 26% of the total primary recoverable reserves in the project area. However, under the waterflood no incremental recoverable reserves are allocated to the Mission Canyon. The Board would like to know if it is technically and economically feasible to locate, assess and recover Mission Canyon reserves by concurrently waterflooding the Lower Amaranth and Mission Canyon. What is Home's overall depletion strategy for the Mission Canyon?

- 1) Has Home attempted to map hydrocarbon pore volume in the Mission Canyon?
- 2) Does Home intend to complete any of the infill wells or injectors in the Mission Canyon?
- 3) Home indicated in the application (126(g)(iii)) - "In cases where there is Mississippian oil contribution and the injector is known to be in communication with the Mississippian formation, injection rates will be increased accordingly to maintain a voidage replacement ratio within the Lower Amaranth of 1.0." Which wells are known to be in communication with the Mississippian? Does Home plan to injection profile log any injectors to determine placement of injected water? Does Home plan to try to allocate voidage between the Lower Amaranth and Mission Canyon?

### TECHNICAL QUESTIONS

- 1) Home indicated produced Lower Amaranth and Mission Canyon water would be re-injected to maintain a voidage-replacement ratio of 1.0 (126(f)(ii)). Later reference is made to measurement of water from a source well (126(f)(iv)). Is a water source well required and if so, which well will be converted and what formation will be used for source water?
- 2) For clarification, is it Home's plan to have water injection meters at each well or to meter both the individual well and group volumes at the 14-9 battery (126(f)(iv)). If all water injection will be done at the 14-9 battery, then it is assumed individual injection lines will be run to each injector.
- 3) What are Home's plans for the 6-4-2-29 Mission Canyon disposal well? Should the spacing unit for the 6-4 well, which includes the undrilled 3-4 location, be included in the waterflood project area?

- 4) In 126(h)(iii) Home states the company will maintain a reservoir pressure equal to or greater than the bubble point of 7500 KPa. Should this be 4550 KPa?
- 5) Does Home have any plans to eventually expand the waterflood to the east into sections 10, 11, 14 and 15?
- 6) Based on the reservoir mapping in Appendices D and E, does Home see any preferential flow patterns within the Lower Amaranth? Are there any faults or other flow barriers?
- 7) Has Home attempted to correlate porosity and permeability for the Lower Amaranth?
- 8) Please elaborate on the timing of the drilling of 4-8, 8-7 and 16-7 and how Home intends to modify this application in the event some or all of the wells prove successful.
- 9) Please confirm that Home intends to conduct additional core flow studies and PVT work to re-evaluate residual oil saturation and  $B_o$ . Appendix G indicates  $B_o = 1.196$  and the waterflood study indicated  $B_o = 1.169$  and  $B_{obpt} = 1.178$ ; which is correct?
- 10) The waterflood study indicated an estimated waterflood capital cost of \$ 30 MM. What is the capital cost of Phase I?
- 11) Please provide the Board with a copy of the primary production forecast for the waterflood project area.

If you have any questions please contact L.R. Dubreuil, Director, or John N. Fox, Chief Petroleum Engineer, at (204) 945-6573 and 945-6574 respectively.

Yours respectfully,

H. Clare Moster  
Deputy Chairman



The Oil and Natural Gas  
Conservation Board

555 — 330 Graham Avenue  
Winnipeg MB R3C 4E3  
CANADA

(204) 945-1111  
FAX: (204) 945-0586

**NOTICE**  
**UNDER THE MINES ACT**  
**PIERSON OIL FIELD**

Home Oil Company Limited has made application under The Mines Act to conduct a waterflood in the Lower Amaranth Formation in that portion of the Pierson Field referred to as the "waterflood project area" and shown below.

Home Oil has also applied

- (1) to reduce the size of drilling spacing units in the waterflood project area as prescribed under Board Order No. SU 9 from 32 hectares to 16 hectares (one legal subdivision), upon unitization of the waterflood project area, and
- (2) for a waiver of maximum permissible production rate restrictions for wells producing from the waterflood project area, upon commencement of the waterflood.

As shown below the project involves infill drilling within the waterflood project area on 16 hectare drilling spacing units and converting the wells located on even-numbered legal subdivisions to water injection.

If no valid intervention or objection in writing is received by the Board at Room 555 - 330 Graham Avenue, Winnipeg, Manitoba, R3C 4E3 before April 23, 1993, the Board may approve the application.

Copies of the application can be obtained from:

Home Oil Company Limited  
324 - 8th Avenue S.W.  
Calgary, Alberta  
T2P 2Z5

Attention: Mr. G.C.K. Johnson, P. Eng.  
Phone: (403) 232-7370

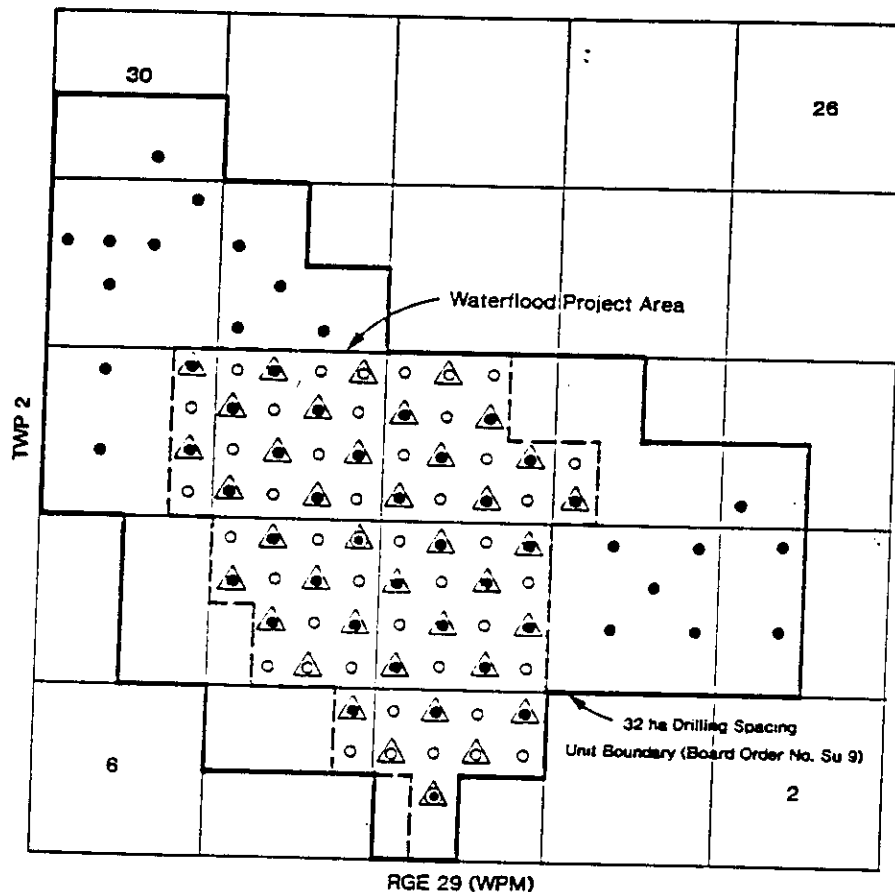
The application can be viewed at the offices of the Petroleum Branch:

555-330 Graham Avenue  
Winnipeg, Manitoba  
R3C 4E3

Waskada, Manitoba  
R0M 2E0

Phone: (204) 945-6577

Phone: (204) 673-2472



#### LEGEND

- Current production well
- Production well to be drilled
- ⊙ Current water disposal well
- △ Well to be converted to water injection

Dated at Winnipeg, this 19<sup>th</sup> day of March, 1993.

H. Clare Moster  
Deputy Chairman



**NOTICE**  
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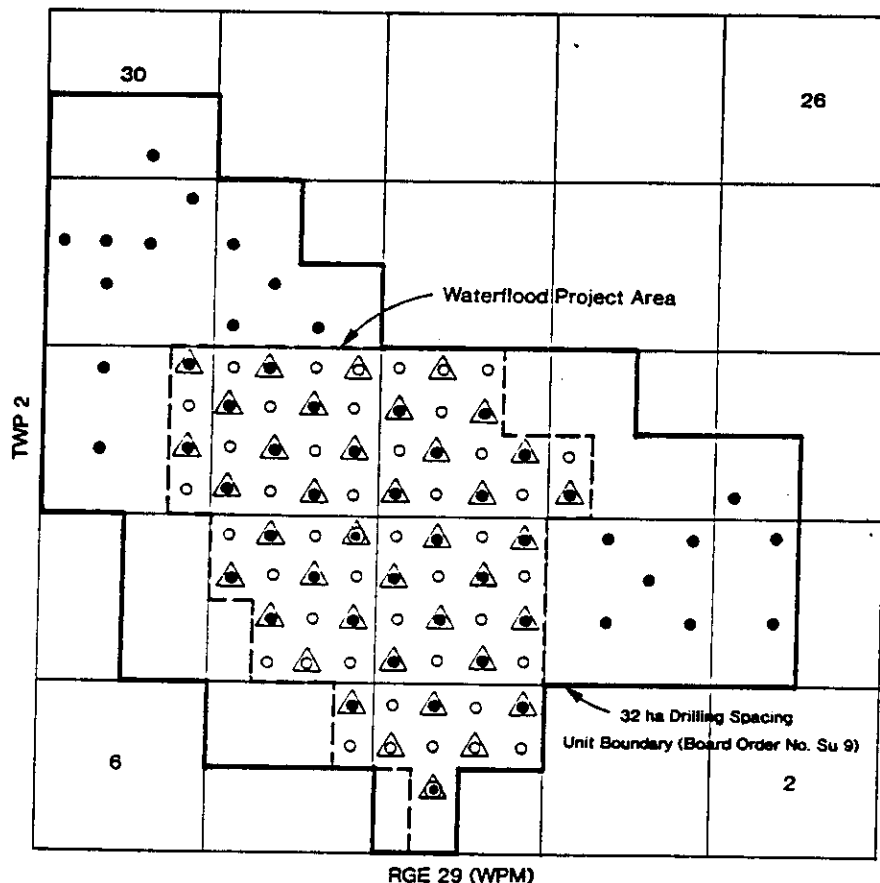
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Winnipeg, Manitoba  
R3C 4E3

Waskada, Manitoba  
R0M 2E0

Phone: (204) 945-6577

Phone: (204) 673-2472



#### LEGEND

- Current production well
- Production well to be drilled
- ⊙ Current water disposal well
- △ Well to be converted to water injection

Dated at Winnipeg, this 19<sup>th</sup> day of March, 1993.

H. Clare Moster  
Deputy Chairman



|  |    |    |    |     |     |
|--|----|----|----|-----|-----|
| *A 45 NE ¼   | 4  | 10 | 28 | WPM |     |
| All rights below the base of the Lodgepole Formation |    |    |    |     |     |
| LSD's 4, 5, 6, 9, 10 & 16                            |    |    |    |     |     |
|  | 10 | 10 | 28 | WPM |     |
| All rights below the base of the Lodgepole Formation |    |    |    |     |     |
| LSD 3, 15  |    |    |    |     |     |
| & NW ¼   | 10 | 10 | 28 | WPM |     |
| All  | 11 | 10 | 28 | WPM |     |
| All rights below the base of the Lodgepole Formation |    |    |    |     |     |
| SW ¼   | 14 | 10 | 28 | WPM | 576 |
| All rights below the base of the Lodgepole Formation |    |    |    |     |     |
| *SEE ADDENDUM  |    |    |    |     |     |
| A 46 N ½   | 2  | 11 | 29 | WPM | 128 |
| A 47 SW ¼  | 10 | 11 | 29 | WPM | 64  |
| A 48 All   | 11 | 11 | 29 | WPM | 256 |
| A 49 SE ¼  | 18 | 11 | 29 | WPM | 64  |
| A 50 NW ¼  | 16 | 12 | 29 | WPM | 64  |
| A 51 SE ¼  | 20 | 12 | 29 | WPM | 64  |
| A 52 N ½   | 34 | 15 | 26 | WPM | 128 |
| A 53 NE ¼  | 4  | 16 | 26 | WPM | 64  |
| *A 54 All  | 11 | 16 | 29 | WPM |     |
| All  | 12 | 16 | 29 | WPM |     |
| All  | 14 | 16 | 29 | WPM | 768 |
| *A 55 NW ¼   | 16 | 16 | 29 | WPM | 64  |
| A 56 All   | 22 | 16 | 29 | WPM | 256 |
| *A 57 All  | 28 | 16 | 29 | WPM |     |
| All  | 29 | 16 | 29 | WPM |     |
| All  | 32 | 16 | 29 | WPM | 768 |
| **A 58 All   | 30 | 16 | 29 | WPM | 256 |
| *SEE ADDENDUM  |    |    |    |     |     |

**ADDENDUM TO  
PUBLIC OFFERING OF  
CROWN OIL AND NATURAL GAS RIGHTS  
MAY 5, 1993**

**Parcel Nos: A-42, A-45, A-54, A-55, A-57 and A-58**

These parcels have been identified as having special wildlife significance. Surface access may be subject to special restrictions or approval of a development plan. For further information please contact:

**BOB DUBREUIL, Director  
Petroleum Branch,  
Manitoba Energy & Mines,  
Telephone: (204) 945-6573.**

4243—13

**NOTICE  
PIERSON OIL FIELD**

Home Oil Company Limited has made application under The Mines Act to conduct a waterflood in the Lower Amaranth Formation in that portion of the Pierson Field referred to as the "waterflood project area" and shown below.

Home Oil has also applied

(1) to reduce the size of drilling spacing units in the waterflood project area as prescribed under Board Order No. SU 9 from 32 hectares to 16 hectares (one legal subdivision), upon unitization of the waterflood project area, and  
(2) for a waiver of maximum permissible production rate restrictions for wells producing from the waterflood project area, upon commencement of the waterflood.

As shown below the project involves infill drilling within the waterflood project area on 16 hectare drilling spacing units and converting the wells located on even-numbered legal subdivisions to water injection.

If no valid intervention or objection in writing is received by the Board at Room 555-330 Graham Avenue, Winnipeg, Manitoba, R3C 4E3 before April 23, 1993, the Board may approve the application.

Copies of the application can be obtained from:

Home Oil Company Limited  
324-8th Avenue S.W.  
Calgary, Alberta  
T2P 2Z5

Attention: Mr. G.C.K. Johnson, P. Eng.

Phone: (403) 232-7370

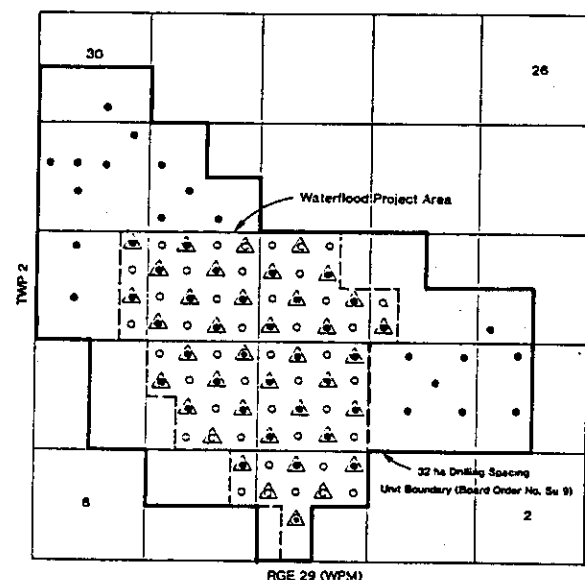
The application can be viewed at the offices of the Petroleum Branch:

555-330 Graham Avenue  
Winnipeg, Manitoba  
R3C 4E3

Waskada, Manitoba  
R0M 2E0

Phone: (204) 945-6577

Phone: (204) 673-2472



- LEGEND**
- Current production well
  - Production well to be drilled
  - ⊙ Current water disposal well
  - △ Well to be converted to water injection

Dated at Winnipeg, this 19th day of March, 1993.

4265—13

**H. CLARE MOSTER,  
Deputy Chairman.**

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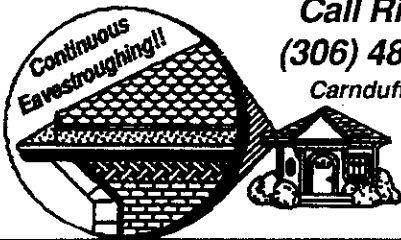
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For all your Eavestroughs, Fascia, Soffit, Siding  
and Carpentry needs...

Call Rick at:  
(306) 482-5277  
Carnduff, Sask.



NOTICE

Under the Mines Act  
Pierson Oil Field

Home Oil Company Limited has made application under The Mines Act to conduct a waterflood in the Lower Amaranth Formation in that portion of the Pierson Field referred to as the "waterflood project area" and shown below.

Home Oil has also applied

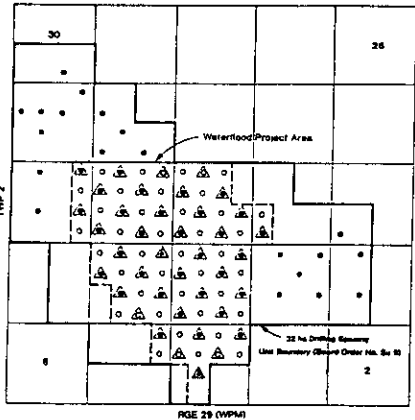
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- (2) for a waiver of maximum permissible production rate restrictions for wells producing from the waterflood project area, upon commencement of the waterflood.

As shown below the project involves infill drilling within the waterflood project area on 16 hectare drilling spacing units and converting the wells located on even-numbered legal subdivisions to water injection. If no valid Intervention or objection in writing is received by the Board at Room 555-330 Graham Avenue, Winnipeg, Manitoba, R3C 4E3 before April 23, 1993, the Board may approve the application. Copies of the application can be obtained from:

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Calgary, Alberta T2P 2Z5  
Attention: Mr. G. C. K. Johnson, P. Eng.  
Phone (403) 232-7370

The application can be viewed at the offices of the Petroleum Branch:  
555-330 Graham Avenue  
Winnipeg, Man.  
R3C 4E3  
Phone: (204) 945-6577

Waskada, Man.  
R0M 2E0  
Phone: (204) 673-2472



LEGEND  
● Current production well  
○ Production well to be drilled  
△ Well to be converted to water injection

Dated at Winnipeg, this 19th day of March, 1993.  
H. Clare Moster, Deputy Chairman

Ethel Veazie  
5438 E. Baltimore  
Mesa, Arizona  
85205

Tundra Oil and Gas Ltd  
1111 One Lowland Place  
Winnipeg, MB R3B 0X4

74800 Manitoba Ltd.  
Box 102  
Pierson, MB  
R0M 1S0

Corbin Oils Ltd  
~~Box 102~~ Box 3827  
Edmonton, AB  
T5L 4J8

John Hammell  
Box 102  
Pierson, MB  
R0M 1S0

The Canada Trust Company  
311-6th Avenue SW  
Calgary AB  
T2P 3H2

T.D.L. Petroleum Inc.  
Box 700  
Carnduff SK  
S0C 0S0

Sceptre Resources Ltd.  
3100 9150 - 6th Avenue SW  
Calgary AB  
T2P 3Y7

Pan Canadian Petroleum Ltd  
150 - 9th Avenue S.W.  
Calgary, AB  
T2P 2S5

Sarah Ruby Caney  
Box 1013  
Virden, MB R0M 2C0

Wayne Gordon Tingey  
Box 95  
Lyleton, MB  
R0M 1Q0

**TABLE B-1  
MINERAL RIGHTS HOLDERS**

|   |   |   |
|---|---|---|
| <del>Martinovsky,<br/>Kathleen L.</del>       | <del>Box 1<br/>Gerald, Sask.<br/>S0A 1B0</del>                      | <del>ptn SE36-1-29 W1M<br/>sec 1-2-29 W1M</del> |
| <del>Glinz, Norman</del>                      | <del>Box 78, Route #2<br/>Bottineau, North<br/>Dakota 58318</del>   | <del>NW36-1-29 W1M<br/>NE1-2-29 W1M</del>       |
| <del>Dressler, Gerald<br/>Ralph</del>         | <del>1116 Rosser Avenue<br/>Brandon, Manitoba<br/>R7A 0L3</del>     | <del>SW1-2-29 W1M</del>                         |
| <del>Kearns, Kevin<br/>Marcus</del>           | <del>6215 North 31st<br/>Drive<br/>Phoenix, Arizona<br/>85017</del> | <del>SW1-2-29 W1M</del>                         |
| <del>South West Oil<br/>Limited</del>         | <del>Box 855<br/>Melita, Manitoba<br/>R0M 1L0</del>                 | <del>NW1-2-29 W1M</del>                         |
| Crossman Petroleums<br>Ltd.                   | Box 212<br>Pierson, Manitoba<br>R0M 1S0                             | N2, SW10, NW10 & ptn<br>sec 15-2-29 W1M         |
| Klimosko, Donald<br>and Janet                 | 268 Edgebank Circle<br>N.W.<br>Calgary, Alberta<br>T3A 4W1          | NE3-2-29 W1M                                    |
| Raymond, Terry and<br>Carol                   | RR #2<br>Cochrane, Alberta<br>T0L 0W0                               | NE3-2-29 W1M                                    |
| Troy Oils Ltd.                                | #705, 805 8th<br>Avenue S.W.<br>Calgary, Alberta<br>T2P 1H7         | NE3-2-29 W1M                                    |
| <del>Manitoba Crown<br/>Lease L 861-693</del> |   | <del>N4-4-29 W1M</del>                          |
| Kielhorn, Kevin<br>Paul                       | 111 Youville Street<br>Winnipeg, Manitoba<br>R2H 2R9                | SE5-2-29 W1M                                    |
| Kielhorn, Robert<br>Henry                     | 15495 Madrona Drive<br>Surrey, B.C.<br>V4A 5N2                      | SW5-2-29 W1M                                    |
| Smith, Estate of<br>Doris Amanda              | General Delivery<br>Pierson, Manitoba<br>R0M 1S0                    | NE5-2-29 W1M                                    |

INCLUDE \*

|   |   |                        |
|---|---|------------------------|
| Hart, George<br>Douglas                       | #25, 366 94 Avenue<br>S.E.<br>Calgary, Alberta<br>T2J 5P1       | NW5 & NE6-2-29 W1M     |
| Nicoll, Charles<br>Thom                       | Box 246<br>Treherne, Manitoba<br>R0G 2V0                        | sec 7-2-29 W1M         |
| Nicoll, William<br>John                       | 713 Poplar Bay<br>Portage La Prairie,<br>Manitoba<br>R1N 3K4    | sec 7-2-29 W1M         |
| Botterill, Isabelle<br>Edna                   | Box 610<br>Portage La Prairie,<br>Manitoba<br>R1N 3B9           | sec 7-2-29 W1M         |
| McMillan, Ehtel May                           | 152 4 Street N.E.<br>Portage La Prairie,<br>Manitoba<br>R1N 1L6 | sec 7-2-29 W1M         |
| Culbert, Margaret<br>Ann                      | General Delivery<br>Rossendale,<br>Manitoba<br>R0H 1C0          | sec 7-2-29 W1M         |
| McLeod, Mary F.                               | Apt 219, 4318 53<br>Street<br>Camrose, Alberta<br>T4V 4G3       | sec 7-2-29 W1M         |
| <del>Manitoba Crown<br/>lease L-861-696</del> |   | <del>S8-2-29 W1M</del> |
| Montreal Trust<br>Company of Canada           | 411 8th Avenue S.W.<br>Calgary, Alberta<br>T2P 1E7              | NE8-2-29 W1M           |
| Boyd, Isabelle                                | Box 248<br>Pierson, Manitoba<br>R0M 1S0                         | NE8-2-29 W1M           |
| Boyd, Patricia Ann                            | 2520 Renzoni Road<br>Mississauga,<br>Ontario<br>L5K 1W9         | NW8-2-29 W1M           |
| Allison, Carolyn<br>Beth                      | Box 96<br>Elkhorn, Manitoba<br>R0M 1S0 0N0                      | NW8-2-29 W1M           |

|  |  |                                    |
|--|--|------------------------------------|
| Amoco Canada<br>Petroleum                                  | Box 200, Station<br>"M"<br>Calgary, Alberta<br>T2P 2H8                             | SW9, SE 10, NE17 &<br>S19-2-29 W1M |
| Kielhorn, Robert<br>Henry                                  | 15495 Madrona Drive<br>Surrey, B.C.<br>V4A 5N2                                     | S9-2-29 W1M                        |
| Kielhorn, John<br>Graham                                   | 13619 Klamath Drive<br>Houston, Texas<br>77041 USA                                 | N9-2-29 W1M                        |
| Murray, John   | Box 3<br>Pierson, Manitoba<br>R0M 1S0  | SE10-2-29 W1M                      |
| <del>Manitoba Crown<br/>Lease L 851-528</del>              |  | <del>NE10-2-29 W1M</del>           |
| <del>Manitoba Crown<br/>Lease L 862-771</del>              |  | <del>SW11-2-29 W1M</del>           |
| <del>Manitoba Crown<br/>Lease L 862-770</del>              |  | <del>NW11-2-29 W1M</del>           |
| <del>Manitoba Crown<br/>Lease L 862-772</del>              |  | <del>SW14-2-29 W1M</del>           |
| Robvest Minerals   | c/o Terence Daniels<br>General Delivery<br>Pierson, Manitoba<br>R0M 1S0            | ptn sec 15-2-29 W1M                |
| A/C Estate of<br>Lovell Gough<br>Stevens<br>Account 558811 | c/o Royal Trust<br>Corporation of<br>Canada<br>Box 748<br>Winnipeg, Man<br>R3C 2M2 | ptn section 15-2-29<br>W1M         |
| <del>Manitoba Crown<br/>Lease L 851-529</del>              |  | <del>sec 16-2-29 W1M</del>         |
| Southam, D.D. and<br>I.M.                                  | Box 243<br>Melita, Manitoba<br>R0M 1L0   | SE17 & SW17-2-29<br>W1M            |
| Home Oil Company<br>Limited                                | 1600, 324 8th<br>Avenue S.W.<br>Calgary, Alberta<br>T2P 2Z5                        | S17-2-29 W1M                       |

|  |  |  |
|--|--|--|
| Campbell Oil Properties                        | Box 84<br>Pierson, Manitoba<br>ROM 1S0   | Lsd 12 and 13 of<br>sec 17 and NE17-2-<br>29 W1M |
| <del>Manitoba Crown<br/>Lease L 861-697</del>  |  | <del>SE18-2-29 W1M</del>                         |
| Wang Oil Properties                            | C/O Wilfred Wang<br>General Delivery<br>Pierson, Manitoba<br>ROM 1H0 1S0   | SW18-2-29 W1M                                    |
| Eikanger Minerals Ltd.                         | Box 252 Pierson,<br>Manitoba<br>ROM 1S0  | NE18-2-29 W1M                                    |
| <del>Manitoba Crown<br/>Lease L 861-698</del>  |  | <del>NW18-2-29 W1M</del>                         |
| Silker, Donald and<br>Hagerty, Edward          | Route 2, Box 245<br>Hector, Minn 55342<br>USA  | N19-2-29 W1M                                     |
| Silker, Donald                                 | Route 2, Box 245<br>Hector, Minn 55342<br>USA  | N19-2-29 W1M                                     |
| Silker, Neil Robert                            | 2410 Redleaf Court<br>Window, Minn<br>USA 56101  | N19-2-29 W1M                                     |
| Flueher, Patricia<br>Ann                       | Route #2<br>Buffalo Lake, Minn<br>USA 55314  | N19-2-29 W1M                                     |
| <del>Manitoba Crown<br/>Lease L 851-530</del>  |  | <del>S &amp; NW 20-2-29 W1M</del>                |
| Kielhorn, Paul and<br>Freberg, Harold<br>Edwin | 310 Tenant Crescent<br>Saskatoon, Sask<br>S7H 4Y8  | N & SE21-2-29 W1M                                |
| Lee, Kenneth James                             | Box 35<br>Pierson, Manitoba<br>ROM 1S0   | SW21-2-29 W1M                                    |
| <del>Salvation Army</del>                      | <del>c/o Pollock &amp; Co.<br/>Attention: Harvey<br/>Pollock<br/>1610 155 Carleton<br/>Street<br/>Winnipeg, Manitoba<br/>R3C 3H8</del> | <del>sec 30-2-29 W1M</del>                       |
| <del>Mayes, Leona Ilene</del>                  | <del>Box 41<br/>Pierson, Manitoba<br/>ROM 1S0</del>  | <del>S31 &amp; NE31-2-29<br/>W1M</del>           |

|                                       |   |                          |
|---------------------------------------|---|--------------------------|
| <del>Madril Oil<br/>Royalties</del>   | <del>c/o Sandy Drier<br/>Box 93<br/>Pierson, Manitoba<br/>ROM 1S0</del> | <del>S31-2-29 W1M</del>  |
| <del>Mayes, Ronald La<br/>Verne</del> | <del>c/o Sandy Drier<br/>Box 93<br/>Pierson, Manitoba<br/>ROM 1S0</del> | <del>NE31-2-29 W1M</del> |
| <del>Drier, Sany<br/>Frederick</del>  | <del>Box 93<br/>Pierson, Manitoba<br/>ROM 1S0</del>                     | <del>NE31-2-29 W1M</del> |



**TABLE B-3  
SURFACE OWNERS**

|  |   |  |
|--|---|--|
| Mcmechan, Anthony<br>Lyle                    | Box 201<br>Pierson, Manitoba<br>ROM 1S0                               | ptn SW1, E7 & NE16-<br>2-29 W1M              |
| <del>Bird, Willian<br/>Prescott</del>        | <del>Box 23<br/>Lyleton, Manitoba<br/>ROM 1S0</del>                   | <del>ptn NE1-2-29 W1M</del>                  |
| Hammell, John                                | Box 102<br>Pierson, Man<br>ROM 1S0                                    | NW3 & W4-2-29 W1M                            |
| Hammell, Albert                              | Box 102<br>Pierson, Man<br>ROM 1S0                                    | ptn NE3 & NE4-2-29<br>W1M                    |
| <del>Smith, Doris Amanda<br/>Estate of</del> | <del>Box 122<br/>Pierson, Man<br/>ROM 1S0</del>                       | <del>ptn NE5-2-29 W1M</del>                  |
| <del>Wang, Ralph John</del>                  | <del>Box 104<br/>Pierson, Man<br/>ROM 1S0</del>                       | <del>ptn SW7-2-29 W1M</del>                  |
| Wildlife Branch                              | Box 24, 1495 St.<br>James Street<br>Winnipeg, Man<br>R3H 0W9          | NE & S8-2-29 W1M                             |
| Southam, David<br>James                      | Box 14<br>Pierson, Man<br>ROM 1S0                                     | pth NW8-2-29 W1M                             |
| Hammell, Larry Alan                          | Box 2<br>Pierson, Man<br>ROM 1S0                                      | ptn S9-2-29 W1M                              |
| <del>Kielhorn, John<br/>Graham</del>         | <del>13619 Klamath Falls<br/>Drive<br/>Houston, Texas<br/>77041</del> | <del>ptn N9-2-29 W1M</del>                   |
| <del>Murray, John</del>                      | <del>Box 3<br/>Pierson, Manitoba<br/>ROM 1S0</del>                    | <del>ptn SE10 &amp; SW11-2-<br/>29 W1M</del> |
| <del>Crossman, Glen<br/>Howard</del>         | <del>Box 149<br/>Pierson, Man<br/>ROM 1S0</del>                       | <del>ptn SW10-2-29 W1M</del>                 |
| <del>Crossman, Francis<br/>George</del>      | <del>Box 212<br/>Pierson, Man<br/>ROM 1S0</del>                       | <del>ptn N10 &amp; SE20-2-29<br/>W1M</del>   |

|                                     |   |  |
|-------------------------------------|---|--|
| <del>Daniels, Neale and Diane</del> | <del>Box 26<br/>Pierson, Man<br/>ROM 1S0</del>          | <del>ptn NW11 -2-29 W1M</del>            |
| <del>Daniels, Robert W.</del>       | <del>Box 26<br/>Pierson, Man<br/>ROM 1S0</del>          | <del>ptn SW 14-2-29 W1M</del>            |
| Daniels, K.R. and Douglas, G.       | Box 21 Site 250,<br>RR1<br>Brandon, Manitoba<br>R7A 5H1 | ptn SW15-2-29 W1M                        |
| <del>Southam, Douglas David</del>   | <del>Box 243<br/>Melita, Man<br/>ROM 1L0</del>          | <del>ptn SE 16-2-29 W1M</del>            |
| Murray, Gordon Edward               | Box 134<br>Pierson, Manitoba<br>ROM 1S0                 | ptn SW16-2-29 W1M                        |
| Lee, George Allan                   | Box 92<br>Pierson, Man<br>ROM 1S0                       | ptn NW16-2-29 W1M                        |
| <del>Southam, D.D. &amp; I.M.</del> | <del>Box 128<br/>Melita, Man<br/>ROM 1L0</del>          | <del>ptn SW 17 &amp; SE17-2-29 W1M</del> |
| Riddell, Gregory & Brenda           | Box 253<br>Pierson, Man<br>ROM 1S0                      | ptn S6 & NE 17-2-29 W1M                  |
| <del>Campbell, John Peter</del>     | <del>Box 84<br/>Pierson, Man<br/>ROM 1S0</del>          | <del>ptn NW17-2-29 W1M</del>             |
| Wang, Ralph John                    | Box 104<br>Pierson, Man<br>ROM 1S0                      | ptn N6 & SE18-2-29 W1M                   |
| <del>Wang, Wilfred L.</del>         | <del>Box 146<br/>Pierson, Man<br/>ROM 1S0</del>         | <del>ptn SW 18-2-29 W1M</del>            |
| <del>Eikanger, Linda Jean</del>     | <del>Box 155<br/>Pierson, Man<br/>ROM 1S0</del>         | <del>ptn NE 2-29 W1M</del>               |
| Wang, Dwain Laverne                 | Box 146<br>Pierson, Man<br>ROM 1S0                      | ptn NW18-2-29 W1M                        |
| <del>Mayes, Gordon Wesley</del>     | <del>Box 157<br/>Pierson, Man<br/>ROM 1S0</del>         | <del>ptn SW 19-2-29 W1M</del>            |

March 12/93

To: C.D. Martiniuk

From: J.N. Fox

Re: Home's Waterflood Application

Please review & comment on the following questions regarding Home's application.

(1) What causes are there for variations in the regional structure as shown on Home's structure map (Fig D-1)

- fracture blocks
- high on underlying Mississippian

(2) Is there any concern with the lateral continuity of the Lower Anasazi in the area

(3) Would the depositional nature of the Lower Anasazi lead to any preferential flow channels (see dh and kh maps Fig D-2, E1 & E2)

(4) Can you develop a structure map on the MC that might help locate oil reserves in that area

(5) Is it possible to correlate stratigraphically oil-bearing zones in the MC.

(c) What is your opinion on the accumulation contribution of MC oil reserves underlying the Pioneer Lower Anasazi C Pool.

(7) Can any analogies be drawn between the MC pools in Trap 3-29 and the MC in Trap 2-29.

cc. L.R.D.

Questions for John Murray:

- \* D-1 (Main "C" structure = struct. on "C" sand)
  - variations (fracturing or highs on ~~underlying~~ <sup>due to</sup> ~~underlying~~ Miss.?)
- \* Any lateral continuity of Lower Amaranth? (E-1/E-2/D-2)
- \* Any preferential path of flow - i.e. dep. channels? in Lower Amaranth?
- \* ~~Does structure of HC play significant part with~~
- \* How will do oil-bearing zones in Mission Canyon correlate?
- \* What contributions does Mission Canyon have to Lower Amaranth C Pool?
  - all the <sup>HC</sup> pools in T.3 R.29 and T.2 R.29 related?
- \* Can you predict extent of cap rock of Mission Canyon i.e. presence of Charles Fm. or alluviation zone at Mississippian unconformity
- \* porosity/permeability correlations for the Lower Amaranth - any core w. log data available?

G-4-2-29 - PERF. IN MISS 1069-1073 - DISPOSAL WELL, NO DST, L. AM CORE  
(3902)

14-4-2-29 - PERF. IN MC - JUNE 21/88 - 1043m - 1044.5  
B.P. @ 1040m - JULY 11/88  
(4037)  
NO DST  
L. AMAR CORE

16-4-2-29 - PERF IN L. AMAR  
NO DST  
L. AMAR CORE

16-5-2-29 - PERF IN L. AMAR  
NO DST  
L. AMAR CORE

G-8-2-29 - PERF. IN L. AMAR  
NO DST'S  
NO CORE'S

8-8-2-29 - PERF. IN L. AMAR  
NO DST'S  
~~NO CORE'S~~ L. AMAR. CORE

10-8-2-29 - PERF IN L. AMAR  
NO DST'S  
NO CORE'S

11-8-2-29 - - ADD. "Dra  
(2665) 1 - DST - 1043<sub>u</sub> - 1053<sub>u</sub> - Rec. 18<sub>u</sub> Sl. GO Fldo Hws  
1 - CORE 1043 - 1055 (ANALYSIS)

12-8-2-29 - PERF. IN L. AMAR  
No DST'S  
No CORES

14-8-2-29 - PERF. IN L. AMAR  
No DST'S  
No CORES

16-8-2-29 - PERF. IN L. AMAR - SWO  
(3710) - DST IN MC - 1044<sub>u</sub> - 1051<sub>u</sub> - Rec 50<sub>u</sub> MCLW  
- CORE IN L. AMAR

2-9-2-29 - PERF IN L. AMAR  
- No DST'S  
- No CORES

4-9-2-29 - PERF IN MC FROM 1045<sub>u</sub> - 1048.5 - No Production  
(4040) - B.P. SET AT 1045<sub>u</sub> (3m Cnt.  
- No DST'S  
- 2 CORES CUT (- L. AMAR.  
1 - MC - 1052.6<sub>u</sub> - 1050<sub>u</sub> - ANAL (?))

6-9-2-29 - PERF IN L. AMAR.  
- NO DST'S  
- NO CORES

8-9-2-29 - PERF IN MC - 1033.5n - 1035.0n - MAR 23(87) - ON PROD.  
JUNE 4(91) BP @ 1032n ~ 1035n CUT  
PERF IN L. AMAR  
- NO DST'S  
- L. AMAR CORE

10-9-2-29 - PERF IN L. AMAR  
- NO DST'S  
- NO CORES

12-9-2-29 (40+5) - PERF IN L. AMAR  
- NO DST'S  
- 2 CORES CUT - 1020n - 1035n - L. AMAR & MC  
- 1035n - 1036n - MC. (ANAL.)

14-9-2-29 (3963) - PERF IN L. AMAR.  
- NO DST'S  
- 2 CORES CUT - 1022n - 1040n - L. AMAR & MC } (ANAL.)  
- 1040n - 1055n - MC

16-9-2-29 (3964) - PERF IN L. AMAR.  
- DST IN MC - 1031n - 1041n - REC 52n O'S GCW  
- 18n M'S GCW  
2 CORES CUT - 1010 - 1028 - L. AMAR & MC } ANAL.  
- 1028 - 1043 MC



G-10-2-29  
(4041)

- PERF W MC - 1037.5m - 1039m - ~~1040m~~ JULY 16/88 - <sup>PROD</sup> 2 MTHS.
- PERF W L. Anne - 1019.5m - 1023.0m - JULY 23/88
- AUG 8/88 - Cmt. SQ. MC PERF. ON PRON. AUG 13/88
- NO DISTCT
- 2 COAST CUT - 1010m - 1025m - L. Anne & MC } (ANAC)  
- 1025m - 1037m - MC

8-10-2-29 - PERF. IN L. AMP  
- NO DST'S  
- 1 - LAMP CORE

10-10-2-29 - PERF IN L. AMAR  
- NO DST'S  
- NO CORET

14-10-2-29 - PERF IN MC - 1033.0 - 1035.0 - ON PROD JUNE 1 (FF)  
(4042) - B.P. SET AT 1032 ~ 1033 ~ CMT. - MAR 19C  
- PERF IN L. AREA  
- NO DST'S  
- 2 CORER CUT - 1010 - 1023 - L. AREA  
- 1023 - 1037 - L. AREA & MC

16-10-2-29 — PERF W L. AMAR  
- NO DST'S  
- L. AMAR CORE

2-16-2-29 - PERF IN L. AMAR  
- No DST'S  
- L. AMAR. CORE

4-16-2-29 - PERFS IN L. AMAR  
- No DST'S  
- L. AMAR CORE

6-16-2-29 - PERFS IN L. AMAR  
- No DST'S  
- L. AMAR CORE

8-16-2-29 - PERF. W MC 1030~ - 1032~ - ON PROD - JUNE 12/88  
(40 43) - ON MAR 2/90 - SET B.P. @ 1028~ CAP ~1/3 m CAT.  
- PERF IN L. AMAR  
- No DST'S  
- 2 CORE CUT

- 1010 - 1028 - L. AMAR } ANAL.  
- 1029 - 1039 - MC

10-16-2-29 - O.H. IN L. AMAR  
- DST IN L. AMAR  
- L. AMAR CORE

12-16-2-29 - LOWER AMAR PERFS  
- No DST'S  
- No CORES



(0) 08-16-002-29 W1M (0)



ManPB  
89-05-05  
14:23:26

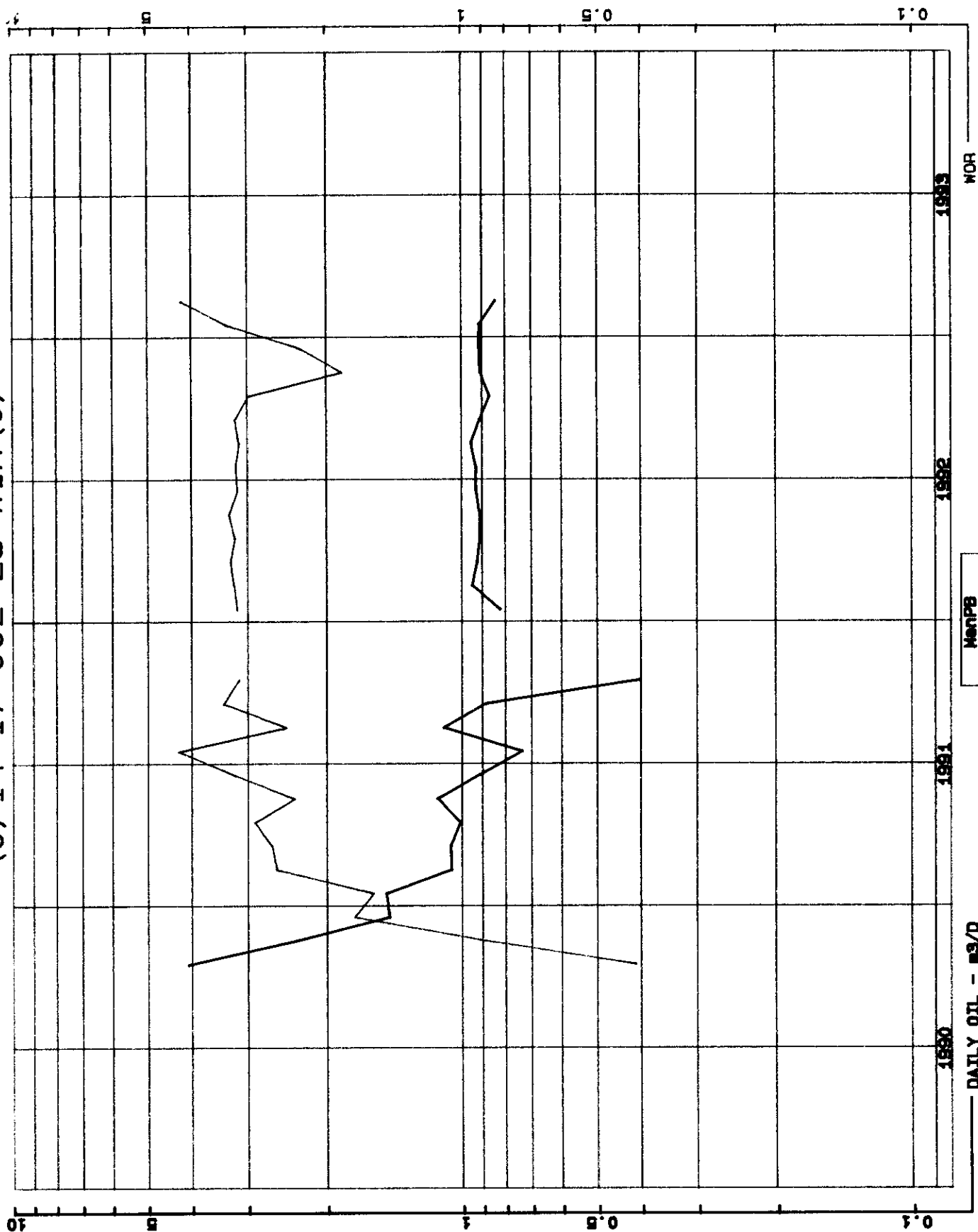
DAILY OIL - m3/D

WOF

|       |    |                             |        |      |
|-------|----|-----------------------------|--------|------|
| FIELD | 7  | PROVINCE MAN.               | LAND#1 | 93   |
| POOL  | 42 | WORKING INTEREST 100.00000% | LAND#2 | 0    |
| BLOCK | 8  | ON PRDN 1988-06-12          | LAND#3 | 4043 |
| ACCT6 | 0  | ON INJN NOT ON YET          |        |      |

| MONTH   | HOURS | OIL<br>m3/M | WATER<br>m3/M | OIL<br>m3/d | WOR  | CUM.OIL<br>m3 | CUM.WAT<br>m3 |
|---------|-------|-------------|---------------|-------------|------|---------------|---------------|
| 1988-06 | 336   | 54.9        | 8.7           | 3.9         | 0.16 | 54.9          | 8.7           |
| 1988-07 | 744   | 84.6        | 2.6           | 2.7         | 0.03 | 139.5         | 11.3          |
| 1988-08 | 720   | 76.2        | 1.5           | 2.5         | 0.02 | 215.7         | 12.8          |
| 1988-09 | 600   | 34.5        | 1.5           | 1.4         | 0.04 | 250.2         | 14.3          |
| 1988-10 | 744   | 83.0        | 2.1           | 2.7         | 0.03 | 333.2         | 16.4          |
| 1988-11 | 696   | 60.8        | 1.0           | 2.1         | 0.02 | 394.0         | 17.4          |
| 1988-12 | 744   | 52.0        | 0.7           | 1.7         | 0.01 | 446.0         | 18.1          |
| 1989-01 | 744   | 41.9        | 1.9           | 1.4         | 0.05 | 487.9         | 20.0          |
| 1989-02 | 312   | 17.1        | 1.1           | 1.3         | 0.06 | 505.0         | 21.1          |
| 1989-03 | 576   | 26.7        | 1.7           | 1.1         | 0.06 | 531.7         | 22.8          |
| 1989-04 | 672   | 35.6        | 1.7           | 1.3         | 0.05 | 567.3         | 24.5          |
| 1989-05 | 672   | 37.4        | 0.9           | 1.3         | 0.02 | 604.7         | 25.4          |
| 1989-06 | 720   | 35.3        | 0.8           | 1.2         | 0.02 | 640.0         | 26.2          |
| 1989-07 | 672   | 29.1        | 0.7           | 1.0         | 0.02 | 669.1         | 26.9          |
| 1989-08 | 744   | 33.7        | 0.7           | 1.1         | 0.02 | 702.8         | 27.6          |
| 1989-09 | 720   | 27.2        | 1.1           | 0.9         | 0.04 | 730.0         | 28.7          |
| 1989-10 | 744   | 28.6        | 0.9           | 0.9         | 0.03 | 758.6         | 29.6          |
| 1989-11 | 720   | 25.7        | 0.5           | 0.9         | 0.02 | 784.3         | 30.1          |
| 1989-12 | 744   | 27.3        | 0.3           | 0.9         | 0.01 | 811.6         | 30.4          |
| 1990-01 | 744   | 26.9        | 0.4           | 0.9         | 0.01 | 838.5         | 30.8          |
| 1990-02 | 672   | 20.1        | 0.3           | 0.7         | 0.01 | 858.6         | 31.1          |

(0) 14-17-002-29 W1M (0)

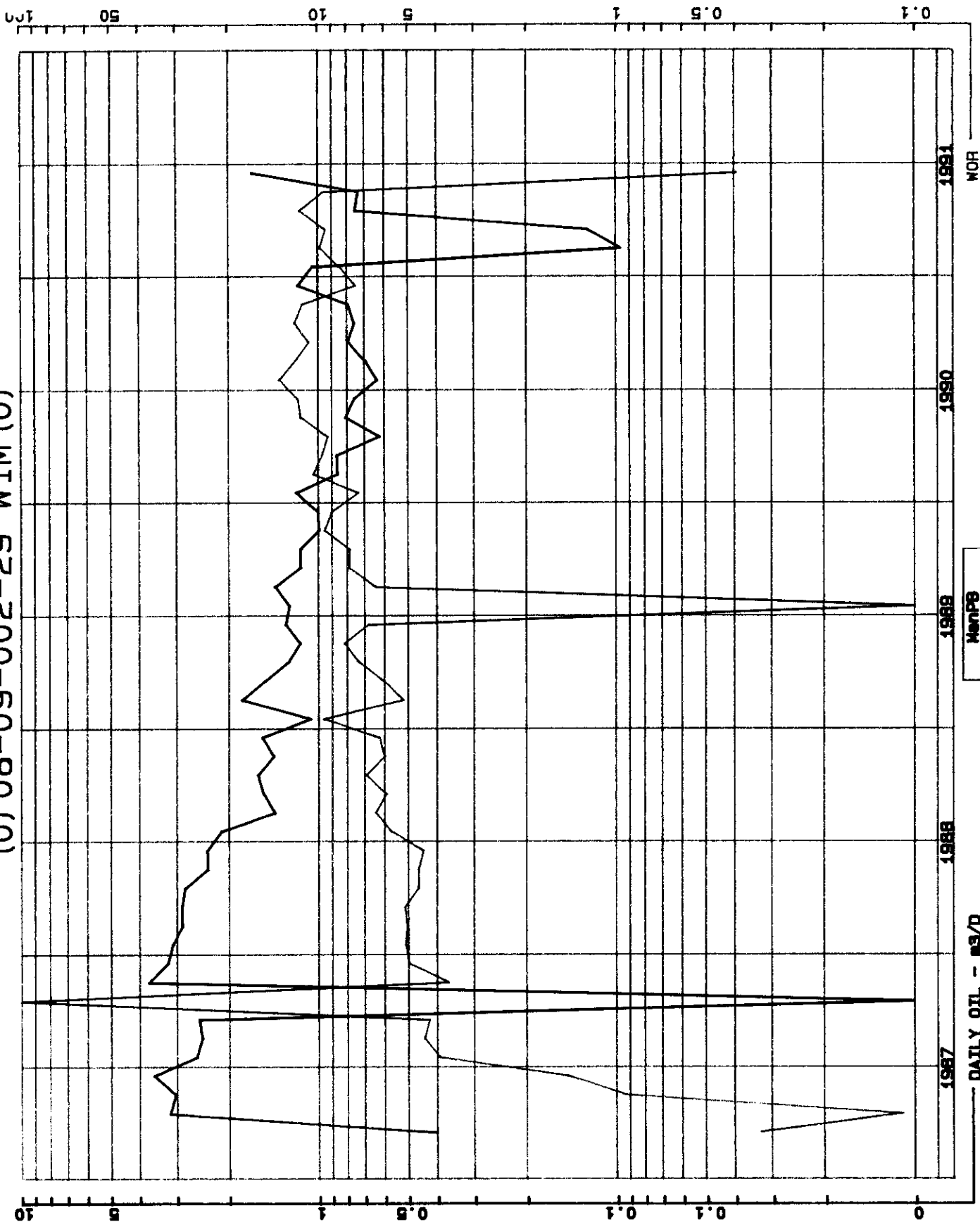


MerPB  
93-05-05  
14:18:11

DAILY OIL - m3/D

NOR

(0) 08-09-002-29 W1M (0)



ManPB  
99-05-05  
14:18:38

DAILY OIL - m3/D

WOR

PAGE NO. 1      \*\*\*      S T O R E      \*\*\*      ManPB  
                                  SOUTH1      93-04-27  
                                  WELL (0108-09-002-29 WIM(0))      14:20:01

FIELD 7      PROVINCE MAN.      LAND#1 93  
 PODL 42      WORKING INTEREST 0.00000%      LAND#2 1  
 BLOCK 7      ON PRDN 1987-03-22      LAND#3 3906  
 ACCTG 0      ON INJN NOT ON YET

| MONTH   | HOURS | OIL<br>m3/M | WATER<br>m3/M | OIL<br>m3/d | WOR   | CUM.OIL<br>m3 | CUM.WAT<br>m3 |
|---------|-------|-------------|---------------|-------------|-------|---------------|---------------|
| 1987-03 | 72    | 12.6        | 4.1           | 4.2         | 0.33  | 12.6          | 4.1           |
| 1987-04 | 720   | 95.8        | 10.4          | 3.2         | 0.11  | 108.4         | 14.5          |
| 1987-05 | 600   | 94.2        | 87.1          | 3.8         | 0.92  | 202.6         | 101.6         |
| 1987-06 | 720   | 107.9       | 156.2         | 3.6         | 1.45  | 310.5         | 257.8         |
| 1987-07 | 744   | 80.1        | 313.1         | 2.6         | 3.91  | 390.6         | 570.9         |
| 1987-08 | 744   | 76.7        | 337.8         | 2.5         | 4.40  | 467.3         | 908.7         |
| 1987-09 | 672   | 76.2        | 321.6         | 2.7         | 4.22  | 543.5         | 1230.3        |
| 1987-10 | 144   | 0.0         | 66.7          | 0.0         | 99.99 | 543.5         | 1297.0        |
| 1987-11 | 720   | 112.7       | 408.3         | 3.8         | 3.62  | 656.2         | 1705.3        |
| 1987-12 | 744   | 100.3       | 496.8         | 3.2         | 4.95  | 756.5         | 2202.1        |
| 1988-01 | 720   | 96.4        | 491.4         | 3.2         | 5.10  | 852.9         | 2693.5        |
| 1988-02 | 696   | 83.6        | 418.9         | 2.9         | 5.01  | 936.5         | 3112.4        |
| 1988-03 | 744   | 90.0        | 461.1         | 2.9         | 5.12  | 1026.5        | 3573.5        |
| 1988-04 | 720   | 84.8        | 389.1         | 2.8         | 4.59  | 1111.3        | 3962.6        |
| 1988-05 | 672   | 73.4        | 337.5         | 2.6         | 4.60  | 1184.7        | 4300.1        |
| 1988-06 | 720   | 71.4        | 315.6         | 2.4         | 4.42  | 1256.1        | 4615.7        |
| 1988-07 | 744   | 66.0        | 374.7         | 2.1         | 5.68  | 1322.1        | 4990.4        |
| 1988-08 | 744   | 43.6        | 279.7         | 1.4         | 6.42  | 1365.7        | 5270.1        |
| 1988-09 | 720   | 46.2        | 271.4         | 1.5         | 5.87  | 1411.9        | 5541.5        |
| 1988-10 | 744   | 49.9        | 344.9         | 1.6         | 6.91  | 1461.8        | 5886.4        |
| 1988-11 | 720   | 42.5        | 253.0         | 1.4         | 5.95  | 1504.3        | 6139.4        |
| 1988-12 | 744   | 48.2        | 300.5         | 1.6         | 6.23  | 1552.5        | 6439.9        |
| 1989-01 | 744   | 33.0        | 316.4         | 1.1         | 9.59  | 1585.5        | 6756.3        |
| 1989-02 | 672   | 50.9        | 262.0         | 1.8         | 5.15  | 1636.4        | 7018.3        |
| 1989-03 | 744   | 47.0        | 282.6         | 1.5         | 6.01  | 1683.4        | 7300.9        |
| 1989-04 | 720   | 38.0        | 276.9         | 1.3         | 7.29  | 1721.4        | 7577.8        |
| 1989-05 | 744   | 35.8        | 292.4         | 1.2         | 8.17  | 1757.2        | 7870.2        |
| 1989-06 | 720   | 38.9        | 262.8         | 1.3         | 6.76  | 1796.1        | 8133.0        |
| 1989-07 | 672   | 38.9        | 2.4           | 1.4         | 0.06  | 1835.0        | 8135.4        |
| 1989-08 | 744   | 43.6        | 278.5         | 1.4         | 6.39  | 1878.6        | 8413.9        |
| 1989-09 | 720   | 34.6        | 272.0         | 1.2         | 7.86  | 1913.2        | 8685.9        |
| 1989-10 | 744   | 35.8        | 279.6         | 1.2         | 7.81  | 1949.0        | 8965.5        |
| 1989-11 | 720   | 29.9        | 283.9         | 1.0         | 9.49  | 1978.9        | 9249.4        |
| 1989-12 | 744   | 31.3        | 280.5         | 1.0         | 8.96  | 2010.2        | 9529.9        |
| 1990-01 | 720   | 37.0        | 269.4         | 1.2         | 7.28  | 2047.2        | 9799.3        |
| 1990-02 | 672   | 24.2        | 250.3         | 0.9         | 10.34 | 2071.4        | 10049.6       |
| 1990-03 | 744   | 27.0        | 260.9         | 0.9         | 9.66  | 2098.4        | 10310.5       |
| 1990-04 | 504   | 18.7        | 172.6         | 0.9         | 9.23  | 2117.1        | 10483.1       |
| 1990-05 | 720   | 25.2        | 287.3         | 0.8         | 11.40 | 2142.3        | 10770.4       |
| 1990-06 | 720   | 22.8        | 266.2         | 0.8         | 11.68 | 2165.1        | 11036.6       |
| 1990-07 | 744   | 19.7        | 265.4         | 0.6         | 13.47 | 2184.8        | 11302.0       |
| 1990-08 | 744   | 21.7        | 257.5         | 0.7         | 11.87 | 2206.5        | 11559.5       |
| 1990-09 | 696   | 24.0        | 255.9         | 0.8         | 10.66 | 2230.5        | 11815.4       |



PAGE 1 2      \*\*\*    S T O R E    \*\*\*      ManPB  
                      SOUTH1                      93-04-27  
                      WELL (0)08-09-002-29 N1M(0)      14:20:01

FIELD 7                      PROVINCE MAN.                      LAND#1 93  
 POOL 42                      WORKING INTEREST 0.00000%                      LAND#2 1  
 BLOCK 7                      ON PRDN 1987-03-22                      LAND#3 3906  
 ACCT6 0                      ON INJN NOT ON YET

| MONTH   | HOURS | OIL  | WATER | OIL  | WOR   | CUM.OIL | CUM.WAT |
|---------|-------|------|-------|------|-------|---------|---------|
|         |       | m3/M | m3/M  | m3/d |       | m3      | m3      |
| 1990-10 | 744   | 23.5 | 281.2 | 0.8  | 11.97 | 2254.0  | 12096.6 |
| 1990-11 | 720   | 24.0 | 269.5 | 0.8  | 11.23 | 2278.0  | 12366.1 |
| 1990-12 | 744   | 36.4 | 270.4 | 1.2  | 7.43  | 2314.4  | 12636.5 |
| 1991-01 | 744   | 32.5 | 274.4 | 1.0  | 8.44  | 2346.9  | 12910.9 |
| 1991-02 | 72    | 2.7  | 26.5  | 0.9  | 9.81  | 2349.6  | 12937.4 |
| 1991-03 | 96    | 3.9  | 36.6  | 1.0  | 9.38  | 2353.5  | 12974.0 |
| 1991-04 | 620   | 22.7 | 261.2 | 0.9  | 11.51 | 2376.2  | 13235.2 |
| 1991-05 | 672   | 22.8 | 216.6 | 0.8  | 9.50  | 2399.0  | 13451.8 |
| 1991-06 | 168   | 50.3 | 19.6  | 7.2  | 0.39  | 2449.3  | 13471.4 |

(0) 14-10-002-29 W1M (0)



ManPB  
93-06-05  
14:21:07

DAILY OIL - m3/D

MOR

PAGE NO. 1      \* \* \*    S T O R E    \* \* \*      ManPB  
                          SOUTH1                      93-04-27  
                          WELL (0)14-10-002-29 WIN(0)                      14:21:20

FIELD    7                      PROVINCE MAN.                      LAND#1    93  
 POOL    42                      WORKING INTEREST 100.00000%                      LAND#2    1  
 BLOCK    7                      ON PRDN 1988-06-01                      LAND#3 4042  
 ACCTG    0                      ON INJN NOT ON YET

| MONTH   | HOURS | OIL   | WATER | OIL  | WOR  | CUM.OIL | CUM.WAT |
|---------|-------|-------|-------|------|------|---------|---------|
|         |       | m3/M  | m3/M  | m3/d |      | m3      | m3      |
| 1988-06 | 528   | 148.1 | 37.3  | 6.7  | 0.25 | 148.1   | 37.3    |
| 1988-07 | 744   | 153.1 | 14.1  | 4.9  | 0.09 | 301.2   | 51.4    |
| 1988-08 | 720   | 116.3 | 158.4 | 3.9  | 1.36 | 417.5   | 209.8   |
| 1988-09 | 720   | 99.4  | 17.7  | 3.3  | 0.18 | 516.9   | 227.5   |
| 1988-10 | 744   | 108.5 | 18.2  | 3.5  | 0.17 | 625.4   | 245.7   |
| 1988-11 | 696   | 83.1  | 10.6  | 2.9  | 0.13 | 708.5   | 256.3   |
| 1988-12 | 744   | 86.1  | 7.2   | 2.8  | 0.08 | 794.6   | 263.5   |
| 1989-01 | 744   | 97.6  | 5.7   | 3.1  | 0.06 | 892.2   | 269.2   |
| 1989-02 | 672   | 87.9  | 5.2   | 3.1  | 0.06 | 980.1   | 274.4   |
| 1989-03 | 744   | 91.9  | 6.5   | 3.0  | 0.07 | 1072.0  | 280.9   |
| 1989-04 | 720   | 83.4  | 6.7   | 2.8  | 0.08 | 1155.4  | 287.6   |
| 1989-05 | 744   | 79.4  | 7.1   | 2.6  | 0.09 | 1234.8  | 294.7   |
| 1989-06 | 720   | 75.8  | 6.0   | 2.5  | 0.08 | 1310.6  | 300.7   |
| 1989-07 | 672   | 62.0  | 4.2   | 2.2  | 0.07 | 1372.6  | 304.9   |
| 1989-08 | 720   | 61.5  | 5.4   | 2.1  | 0.09 | 1434.1  | 310.3   |
| 1989-09 | 720   | 48.6  | 5.5   | 1.6  | 0.11 | 1482.7  | 315.8   |
| 1989-10 | 744   | 48.5  | 4.8   | 1.6  | 0.10 | 1531.2  | 320.6   |
| 1989-11 | 720   | 41.1  | 8.0   | 1.4  | 0.19 | 1572.3  | 328.6   |
| 1989-12 | 744   | 32.0  | 15.8  | 1.0  | 0.49 | 1604.3  | 344.4   |
| 1990-01 | 744   | 27.5  | 17.3  | 0.9  | 0.63 | 1631.8  | 361.7   |
| 1990-02 | 672   | 24.3  | 13.4  | 0.9  | 0.55 | 1656.1  | 375.1   |
| 1990-03 | 144   | 5.4   | 2.7   | 0.9  | 0.50 | 1661.5  | 377.8   |

## Background

### PROJECT AREA SELECTION

~~RETURN~~

### DEVELOPMENT SCHEDULE

### PILUT INJECTION K-8

### SPRING

### NPP2

### WATERFLOOD DESIGN & PREDICTIONS OOIP, EOIP, INJECTION STRATEGY

- estimated production rate primary vs secondary
- waterflood performance
  - WF Study May/92
  - WF prediction method
- measure data

- reservoir description / parameter
- predicted recovery
- production forecast
- pattern selection

- other matters
  - 1993 pressure survey plus
  - MC geological & reservoir study

- review Section 10 & 11 for need for 32 to 40 spacing

MPR's

- Board letter to HOC Jan 26/93

"When a pressure maintenance scheme is implemented MPR restrictions may, on application and in the absence of equity or conservation concerns, be waived within the waterflood project area

- Concerns

- delayed implementation of pres. maintenance coupled with accelerated reservoir depletion

16-8-2-29 Injectivity Test APPROX Aug/92

- Sep 29/92 Board approved a temporary 9 month injectivity test @ 16-8-2-29 (Oct/92 - Jul/93)

- HOC to conduct a multi-rate inj test  
pressure fall-off test

- max wellhead injection press 7500 kPa

- max inj. volume 10000 m<sup>3</sup>

- note: HOC max. BH inj. press 15300 which  
equates to a max wellhead inj. press 6490  
face per surface 18000 kPa

- water treatment chemical treatment & filtered (series)  
(remove suspended solids, trace oil, scale inhibition)

- injection lines ~~intermittently~~ ~~used~~ ~~steel~~ ~~lines~~ Fibreglass

WF Study May/92

✓ Home submitted a waterflood study for the LAm F in the Pioneer area in May/92

- ✓ under-saturated reservoir - <sup>primary</sup> recovery mechanism  
oil expansion above the bubble pt (4550 kPa)  
→ sol<sup>n</sup> gas drive
- ✓ HOC estimated primary recovery in LAm C & G pools 7.2% OOIP of which 28% of production (2% OOIP) was attributed to the underlying MC (based Tracy-Tanner prediction method) within project area
- ✓ MC in communication with the LAm through induced fractures created during completion of the wells
- waterflood performance - ult. rec ~ 40% utilizing 5 spot inj. patterns on 16 ha spacing
- piston-like displacement will take place in the reservoir which is strongly water-wet
- areal sweep eff. is predicted to be 84% with little or no economic recovery after water breakthrough (30-50<sup>80 ac</sup> years) (15-25<sup>40 ac</sup> yrs)
- ✓ waterflood inefficiencies (out of zone injection, ineffectivity problems, reservoir heterogeneity, slow waterflood response)
- ✓ reduce predicted waterflood recovery to 32% OOIP
- assumed WF implement prior to bubble pt being reached

- average reservoir parameters

$$k = 2.5 \text{ to } 4.5 \text{ md}$$

$$S_{wi} = 41\%$$

$$S_{or} = 29\%$$

} special core study

waterflood prediction model data used

$$S_{wi} = 45\%$$

$$S_{or} = 31\%$$

$$k = 3.5 \text{ md}$$

Initial reservoir pressure 10500 kPa

$$B_{oi} = 1.169 @ 10500 \text{ kPa}$$

$$B_{o \text{ bpt}} = 1.178$$

$$\mu_{oil} = 1.35 \text{ mPa}\cdot\text{s}$$

$$\mu_{oil \text{ bpt}} = 1.3 \text{ mPa}\cdot\text{s}$$

- production forecast under WF  $\rightarrow$  correct <sup>primary production</sup> decline rate to  $< 1.0/\text{yr}$ . similar to experience
- ✓ Workarea LHA A Pool vs primary decline rate average  $22\%/yr$ .
- selected S-spot injection pattern vs 7 or 9 spot used in Workarea to accelerate WF response, reduce injectivity rates to try & reduce probability of out of zone injection, better match of injection to voidage
- plans to concurrently produce LHA/HA
- source water  $\rightarrow$  produced water + Mississippi water



Hoc reviewed waterflooding on 5-spot inj. patterns using both 40 & 80 ac spacing and a range of average permeabilities 2.5, 3.5 & 4.5 md in all cases, the initial production, % recovery after 15 yrs and time to breakthrough was more economically favourable under 16 La spacing

initial productivity 3-5% higher

✓ % recovery after 15 yrs 23-38% for 16 La.

12-20% for 32 La

✓ time to breakthrough 15-28 yrs for 16 La

32-59 yrs for 32 La.

✓ 16 Lae vs. 32 La → accelerated recovery

Capital Cost Est. \$30 mm.

## SPACING

Board Order No. SU 9 issued Jan 25/93

Clause 3 - The area outlined in Schedule A may be modified by the Board from time to time to meet changing conditions.

- applies to LA & MC

- reservoir pressure data 7600 - 8800 kPa in E/2 Sec 8 & Sec 9  
RFT results from 1992 drilling

- less depleted areas W/2 8, 17 & 18 9200 - 10000 kPa

- it is proposed to continue 32 LA spacing in the remainder of the area covered by Board Order No. SU 9 to ensure 16 ha infill drilling does not occur prematurely, accelerating depletion & reducing ultimate recovery.

MC ~ identified MC OOI?

- developed strategy to maximize combined MC/LAM recovery

- Phase I + II outlined
- source water for injection → produced water
  - ✓ - compare wedge in project area with HOC production in known field NOV DEC /92
- ✓ - measurement injection well meters + group meter ~~etc~~.
  - under MEASUREMENT SECTION, HOME INDICATES "measurement will also be taken of the water taken from the source well" -
    - ✓ is Home intending to supplement produced water
- ✓ - 5 spot injection pattern, one to one injector to producer ratio
- ✓ - estimated wellhead injection pressure 85% of est. fracture pressure of 18000 kPa which equates to a sand face i.e. pressure of 15300 kPa (need summary of 16-8 injectivity test)
- please indicate which proposed injectors are known/expected to be communication with the MC Fm
  - ✓
- planned VRR = 1.0

~ PHASE 1 (?)

✓ - estimated total production (waterflood area)  $1038 \times 10^3 \text{ m}^3$

- waterflood performance - <sup>strongly</sup> water wet reservoir, the waterflood flood front will advance in a piston-like manner, WOR's will remain relatively constant until breakthrough at which time the WOR will increase dramatically
- ✓ - water injection <sup>expected</sup> to commence in Aug/93 after unitization is complete
- "Home Oil will maintain a reservoir pressure equal to or greater than the bubble point pressure of 7500 kPa", note the bubble point pressure is 4550 kPa, is 7500 kPa the anticipated preper operating pressure
- ✓ 6-4-2-29 presently completed in the MC only
- Fluid cover OK 6-7-2-29
- nothing to distinguish WF area from remainder of
- ✓ C Pool wnt  $\phi h$ ,  $h_{gross}$  or net, HCPV
- ✓ - k vs  $\phi$  correlation (?)
- kh trend SSW - NNE especially thru Sec 8 & 9

- calculate LAM & MC <sup>recoverable</sup> reserves
- OOIIP / SW calculated assuming <sup>area</sup> 32.4 ha  $\phi = 14\%$   
 $SW_i = 45\%$   $B_o = 1.196$  (re-evaluating  $SW_i$  &  $B_o$ )
- primary recovery (Tracey Tanner Prediction)  
 10.6 % OOIIP
- WF recovery +  $\Delta 20\%$  OOIIP

TABLE G-1 PHASE I

OOIIP - 3422  $10^3 L^3$

ReIP - 362.7  $10^3 L^3$  (10.7% OOIIP)

INDIVIDUAL WELL  
 RATE-CUR EST.  
 317.5  $10^3 L^3$   
 on 9.3% OOIIP

Lower Am Reserves (ReIP)

Proven Developed <sup>Proven & undeveloped</sup>  
 220796 + 48550

• 5 undrilled 32 ha locations

Proven  $\rightarrow$  269345

74.3% of total ReIP

TABLE G-1 is OOIIP for both the LAM & MC (if so could we get separate methane reserve estimates)

LAM recovery  $\rightarrow$  7.9% OOIIP

WF Reserves LAM.

Probable  $\rightarrow$  342200 10% (OOIIP)

Possible  $\rightarrow$  342200 10% OOIIP

MC reserves assigned where rate-of-recovery exceeds pool average of 10.7% OOIIP

$$\begin{array}{rcl}
 \text{MC Rec. Reserves (per)} & 94620 \text{ m}^3 & (2.8\% \text{ OOIIP}) \\
 \text{undevelop} & 5163 & \\
 \hline
 & 99783 & (2.9\% \text{ OOIIP})
 \end{array}$$

It is assumed

- ~~However~~ there is a small probability of recovering incremental MC reserves by WF
- ✓ - HOC plan to run RFT on all or a portion of the infill wells scheduled to be drilled in Fall/93
- understanding the successful wells at 4-8, 8-17 & 16-17 will result in HOC applying to increase the Phase I WF area
- conversions <sup>immediately</sup> follow infill drilling

- better portion of reservoir in Sect 4, 8, 9. developed first
- conversion done when inflow pattern complete
  - time between inflow production & injection conversion  
3-6 months

1

- notice to surface owners → every 1/4 section in F area will have an injection well

PHASE I

N/2 & LSD 346 - 4  
LSD 9 & 16 - 15  
~~SEC~~ 8  
SWC 9  
SW/4 - 15  
16  
17  
E/2 18

W/2 NE ✓  
✓  
NE S/2 NW ✓  
S/2 N/2 ✓  
SW ✓  
NE SE SW NW ✓  
SW SE NE NW ✓  
SE  
CONFIRM L.J. EIKANGER  
SELF OWNER IN NE/4 of  
Section 18 ✓

PHASE II

Sec 19  
W/2 20  
SW/4 29  
S/2 30

SW NE NW  
SW NW ✓

- note: Home Oil has notified surface owners of intention to inject into

16-18, 8-18  
12-8, 10-8, 2-8  
14-8  
2-9, 4-9, 6-9, 8-9  
10-9, 12-9, 14-9, 16-9  
2-16, 8-16,  
2-15, 4-15  
16-4, 10-4, 14-4, 12-4  
4-16, 6-16, 10-16  
12-16, 14-16  
2-17, 4-17, 6-17, 8-17  
10-17, 16-17  
12-17, 14-17  
16-5



- TIMING OF PHASE II <sup>(1996)</sup>, acknowledge planned expansion

- DAN TO PREPARE NOTICE & DISTRIBUTION TO  
OFFSET MINERAL OWNERS (WITHIN & ADJOINING)  
PROJECT AREA

- DAN TO MAKE A COPY OF TOWNSHIP MAP

- WHICH AREA TO GIVE NOTICE

OPTIONS

- PLOT ON  
MAP
- (a) PHASE I WF + ADJACENT 1/4 sections
  - (b) PHASE I & II WF + " " "
  - (c) SU 9 AREA + " " "
  - (d) SU 9 AREA only
  - (e) Pioneer LAR C Pool

MINERAL OWNER ADDRESSES (HOME OIL SOLE LESSOR)

TWP 2-29

Sec N~~7~~2 & SW/4 - 1

N/2 2

NE/4 3

N/2 4

SE/4, SW/4, NE/4, NW/4 5 ✓

NE/4 6

7 ✓

S/2, N/2 8 ✓

SW/4, S/2, N/2 9 ✓

SE/4, SW/4, NW/4, NE/4 10 ✓

SW/4, NW/4 11

12

13

SW/4 14

PTN 15

16 ✓

LSD 12413

17 NE/4, SE/4, SW/4

✓ 18 SE/4, SW, NE, NW

✓ 19 S/2, N/2

20 S/2, NW

✓ 21 N/2, SE, SW

22

23

24

25

26

27

28

29

30 ✓

31 S/2, NE

- Waskada Field - 5 MC waterfloods

Waskada Unit No. 1      Wh inj commenced 1976-05  
MC 3b A Pool      terminated Dec/83

- gas inj. commenced Mar/86

Pool OOIP =  $265 \times 10^3 \text{ m}^3$

A = 176 ha

$\phi h_{ave} = 0.35 \text{ ha} \cdot \text{m}$

UNIT OOIP = 143 264 m<sup>3</sup>

A = 96 ha

$\phi h = 0.36$

mc 3b B Pool      Waskada Unit No. 9      Wh inj commenced Mar/86  
inj terminated Jan/88 - over-injection, LAm communication  
penetration water breakthrough

- no adverse effects observed in production  
performance

- pressure support from aquifer

-  $P \approx 4000 \text{ kPa}$

Pool OOIP = 230 826

A $\phi h$  = 53.09 ha·m

UNIT

OOIP = 217 478

RF<sub>oil</sub> = 22.9%

RF<sub>WF</sub> =  $\Delta 12.1\%$

A $\phi h$  = 50.02 ha·m

Waskada Unit No. 10  
MC 3a C Pool

A = 208 ha

- pressure support from aquifer

$P \approx 6000 \text{ kPa}$

P<sub>bpt</sub> 3158 kPa

R<sub>oi</sub> = 1.15

SW<sub>i</sub> = 0.50

P<sub>r</sub> =

OOIP = 478,000 m<sup>3</sup>

RF<sub>oil</sub> = 4.2% OOIP

RF<sub>WF</sub> =  $\Delta 5\%$

$\phi h_{ave} = 0.53 \text{ ha} \cdot \text{m}$

- Wh inj commenced Feb/86  
terminated Apr/87 - with  
breakthrough, LAm communication  
little positive  
effect on oil  
production

Waskada Unit No. 12 - with inj commenced May/86  
 me 3a & Pool originally 3 injection, only 1 still  
 active

- aquifer pressure support

$$\bar{P} \approx 5000 \text{ kPa}$$

Pool { 001P 839304 m<sup>3</sup> RF<sub>pool</sub> = 3.2% 001P RF<sub>wp</sub> = Δ10%  
 Sw<sub>i</sub> = 50%  
 b<sub>oi</sub> = 1.15  
 Aφ<sub>h</sub> = 193.04  
 ↳ severe production decline

UNIT { 001P 680870 m<sup>3</sup>  
 A = 352 ha  
 Aφ<sub>h</sub> = 156.6 ha·m  
 φ<sub>haver</sub> = 0.44 φ·m  
 - some initial response to waterflood Sep/86

Twp 02

SASKATCHEWAN  
MANITOBA

Pierson

256

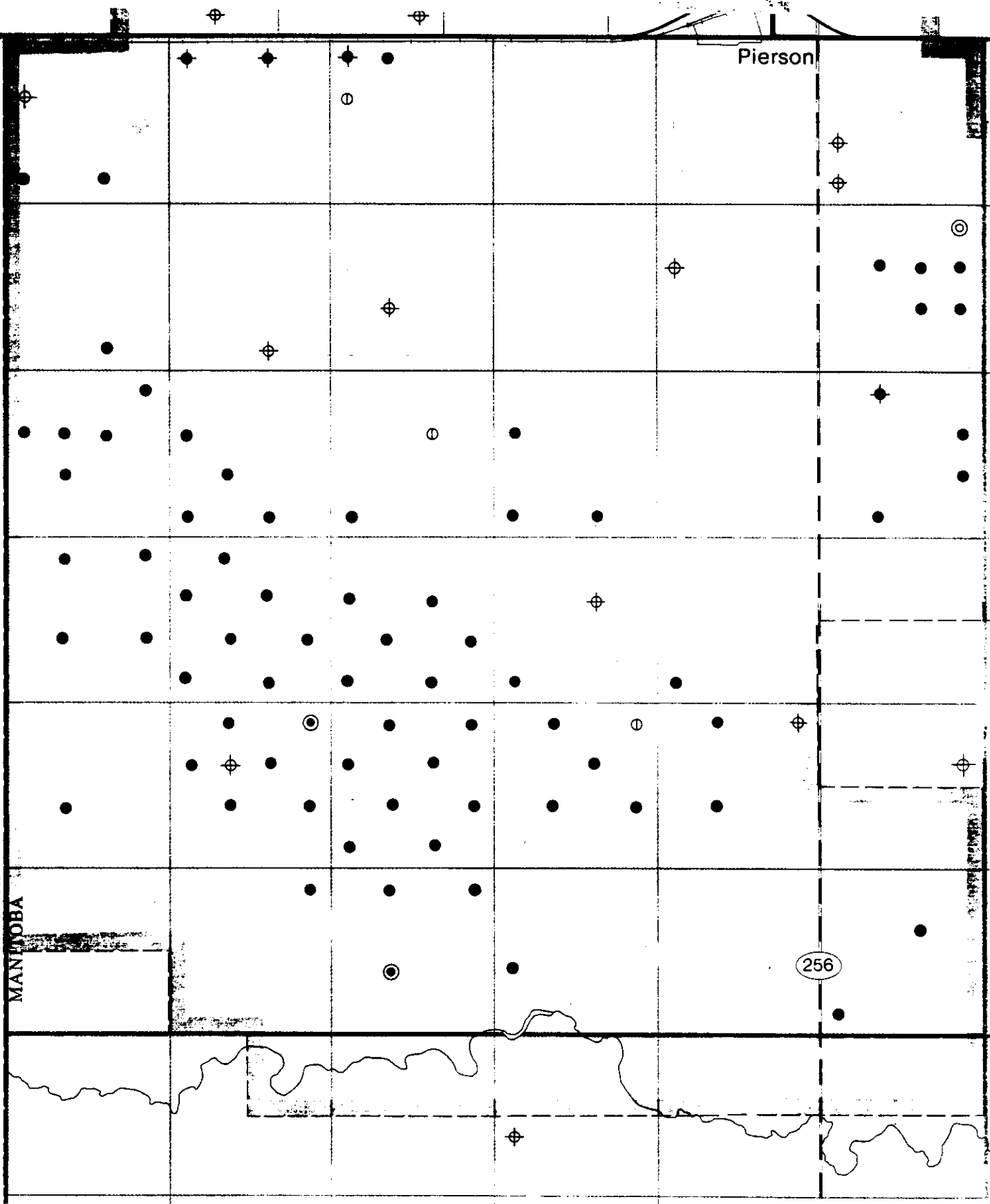
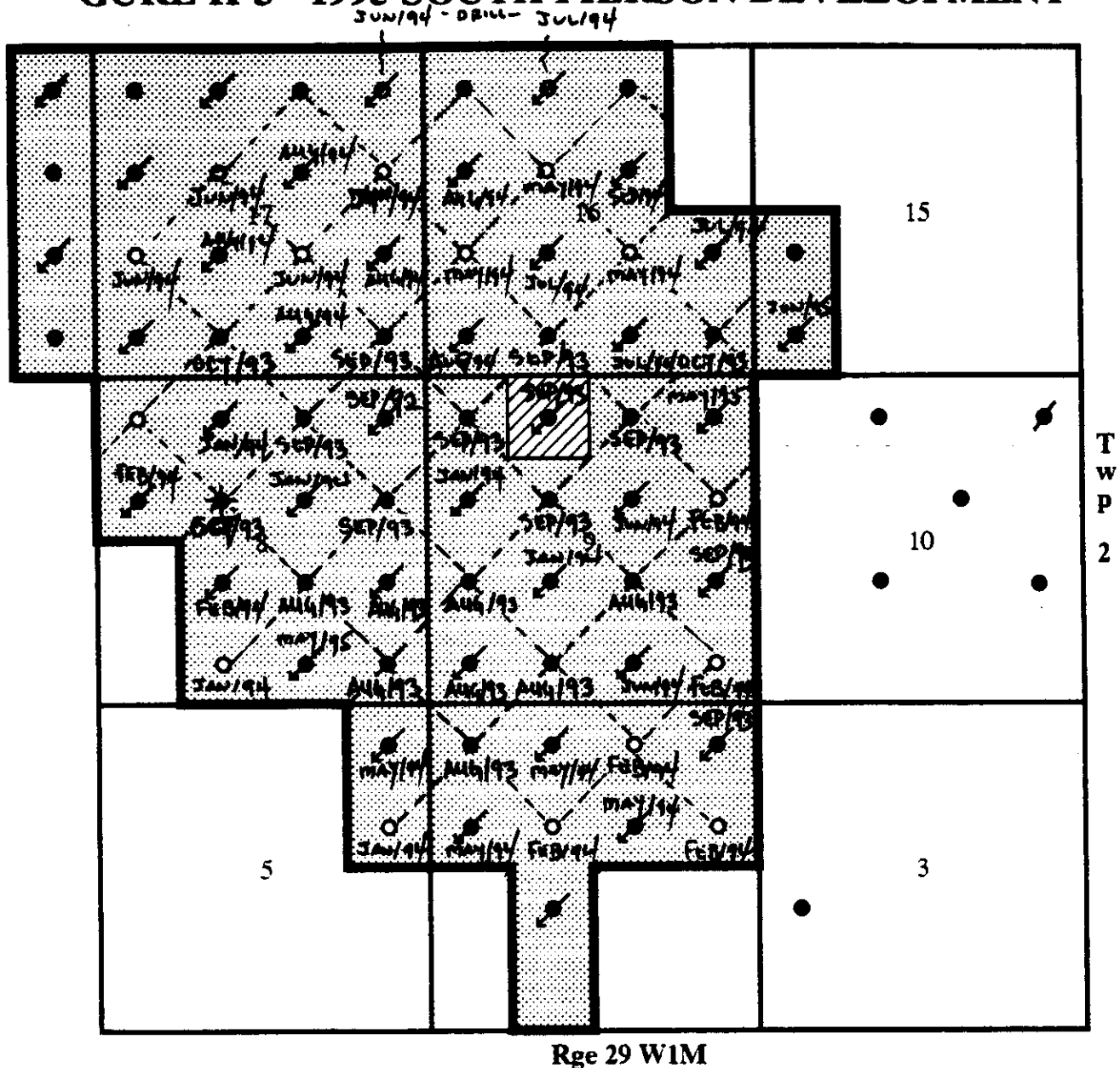


FIGURE 7

# FIGURE H-3 - 1995 SOUTH PIERSON DEVELOPMENT



Proposed Waterflood Area



Central Facilities



Injection Well



Current Producing Wells



1992 Infill Wells



1993 Infill Wells



1994 Infill Wells



1995 Infill Wells

## CRITICAL PATTERNS

INFILL DRILLING

COMPLETED SEP/93

10-8, 6-9 + 12-9

COMPLETED FEB/94

2-9, 10-9

COMPLETED FEB/94

16-9

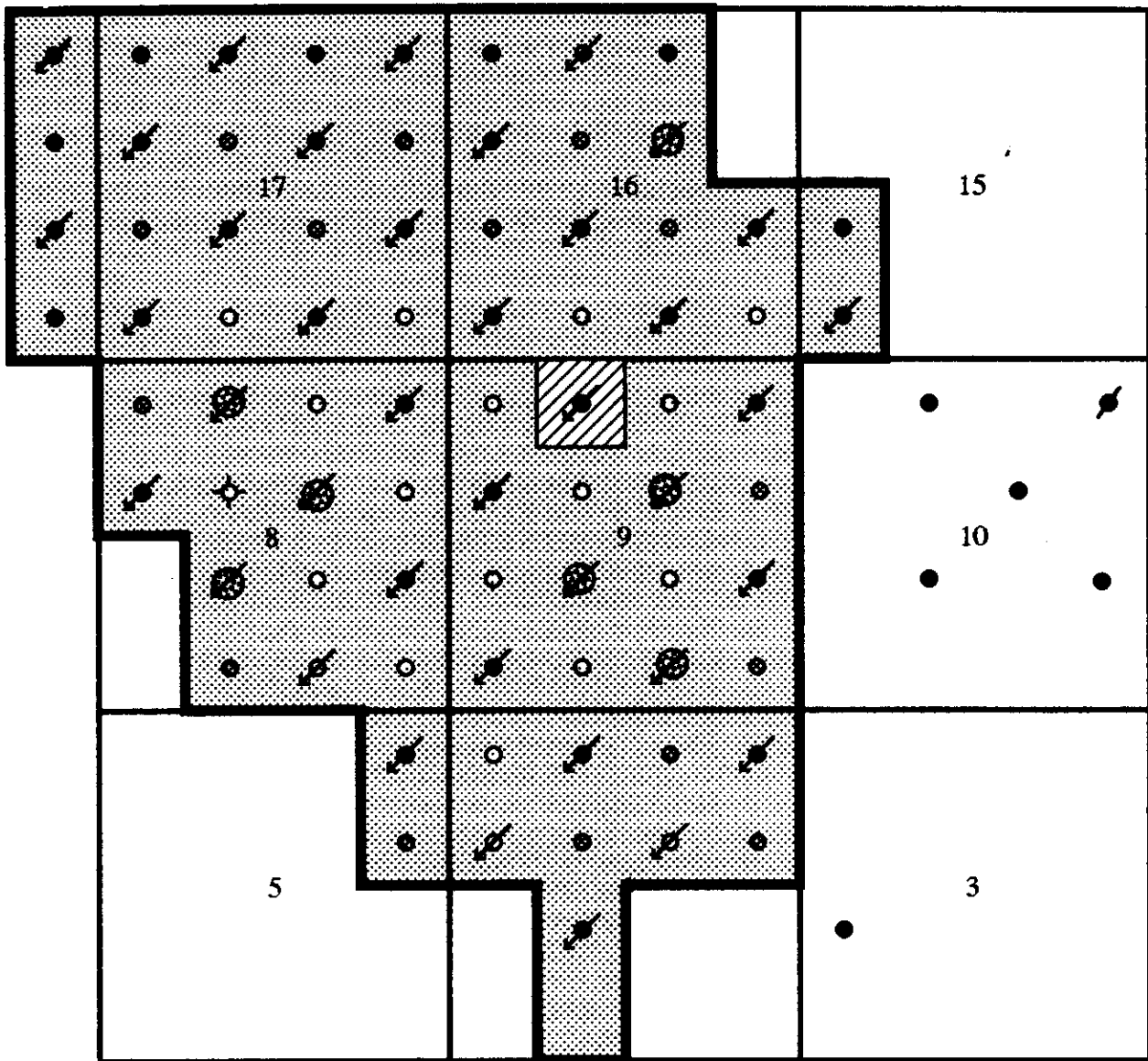
## CONVERSION

JAN/94 - + MON DELAY

JUN/94 + NON DELAY

MAY/95 15 MON DELAY







# SOUTH PIERSON DEVELOPMENT

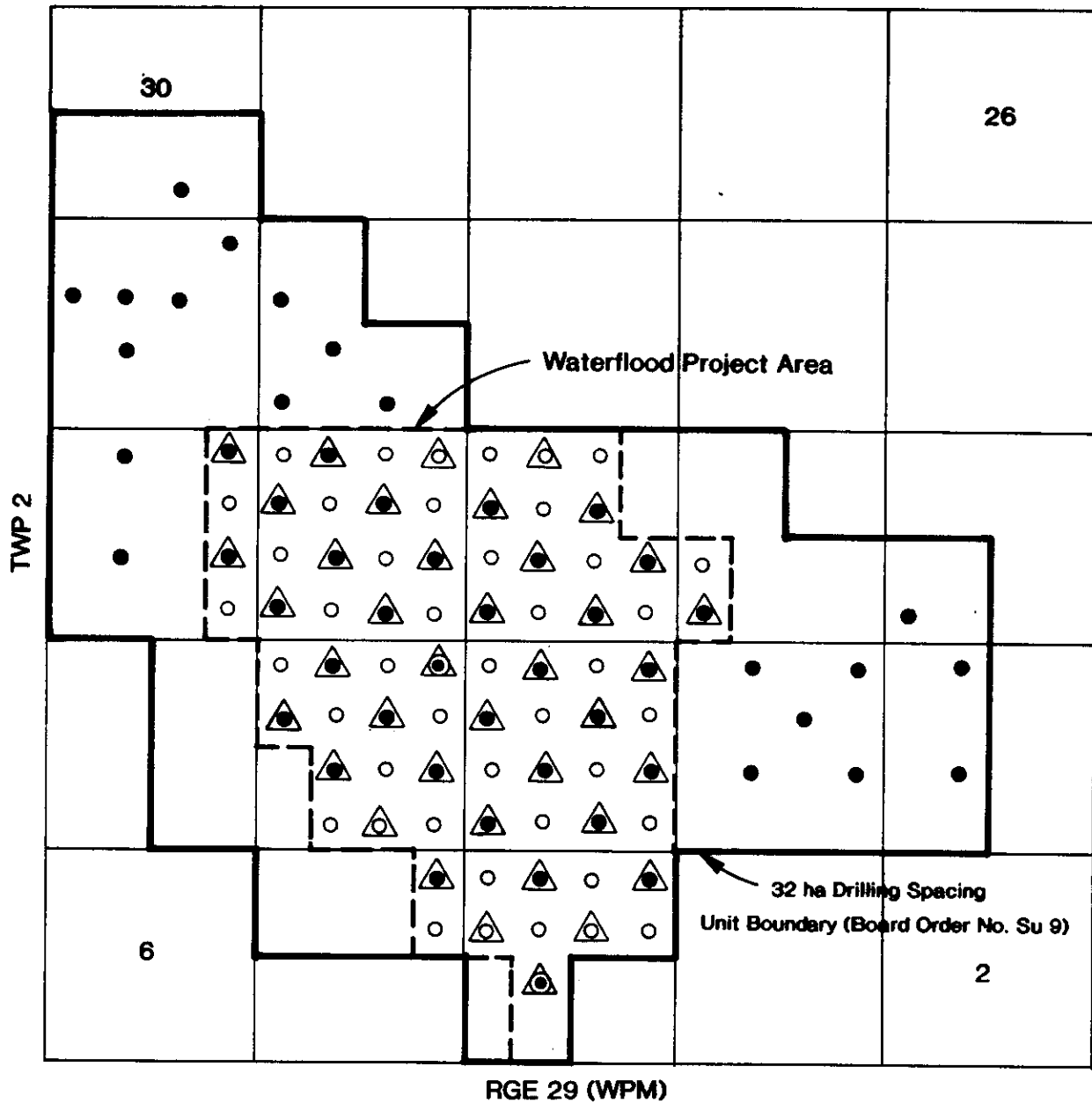


Rge 29 W1M

 Proposed Waterflood Area

 Central Facilities

-  Injection Well
-  Current Producing Wells
-  1992 Infill Wells
-  1993 Infill Wells
-  1994 Infill Wells
-  1995 Infill Wells



### LEGEND

- Current production well
- Production well to be drilled
- ⊙ Current water disposal well
- △ Well to be converted to water injection

FIGURE 2

05/14/91 14:15

Date 8408-9112

Operator :

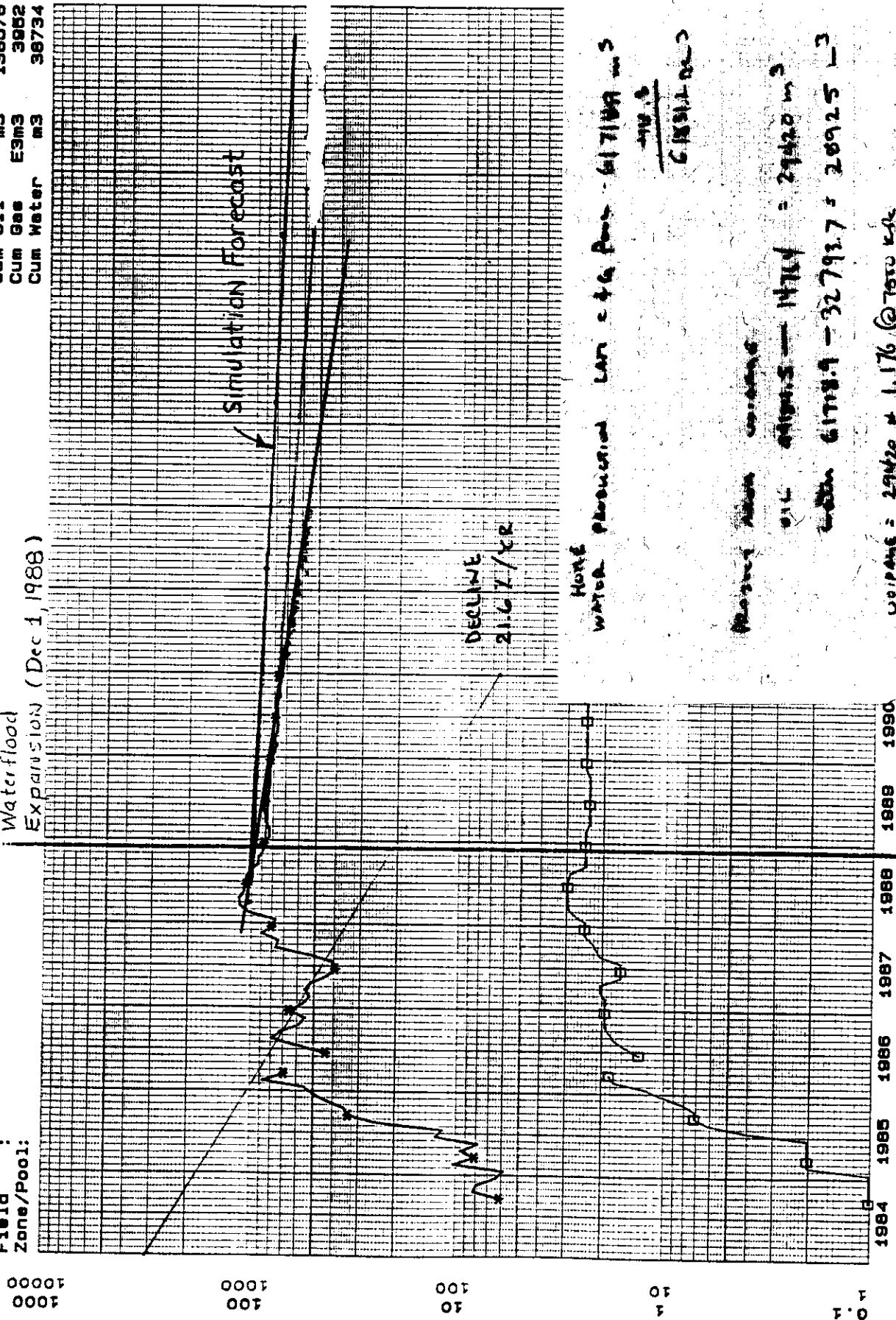
Field :

Zone/Pool:

Type :

Cum Oil m3 138576  
Cum Gas E3m3 3952  
Cum Water m3 36734

Waterflood  
Expansion (Dec 1, 1988)



More production can = 46 Pms - 617189 m<sup>3</sup>  
- 46.3  
618312 m<sup>3</sup>

More production can = 46 Pms  
oil 44941.5 - 14764 = 29420 m<sup>3</sup>  
with 61718.9 - 32793.7 = 28925 m<sup>3</sup>

Oil Pms = 29420 + 1.176 @ Total KRF  
+ 28925 m<sup>3</sup>

63523 m<sup>3</sup>

□ \* Num Wells  
□ \* Avg Daily Oil m3/d

(Dec 31/92)



Table H-2 South Pierson Production Forecast

| Year | Oil/d (m3) | WOR (m3/m3) | Water/d (m3) | GOR (m3/m3) | Gas/d (e3m3) | WGR (m3/e6m3) |
|------|------------|-------------|--------------|-------------|--------------|---------------|
| 1993 | 118.0      | 0.86        | 101.5        | 60          | 7.08         | 14333         |
| 1994 | 121.8      | 0.86        | 105.3        | 60          | 7.31         | 14405         |
| 1995 | 99.2       | 0.87        | 86.2         | 60          | 5.95         | 14477         |
| 1996 | 89.4       | 0.87        | 78.0         | 60          | 5.36         | 14549         |
| 1997 | 79.6       | 0.88        | 69.8         | 60          | 4.78         | 14622         |
| 1998 | 85.0       | 0.88        | 74.9         | 60          | 5.10         | 14695         |
| 1999 | 84.2       | 0.89        | 74.6         | 60          | 5.05         | 14769         |
| 2000 | 83.3       | 0.89        | 74.2         | 60          | 5.00         | 14843         |
| 2001 | 82.5       | 0.90        | 73.8         | 60          | 4.95         | 14917         |
| 2002 | 82.7       | 0.90        | 74.4         | 60          | 4.96         | 14991         |
| 2003 | 80.8       | 0.90        | 73.0         | 60          | 4.85         | 15066         |
| 2004 | 80.0       | 0.91        | 72.7         | 60          | 4.80         | 15142         |
| 2005 | 79.2       | 0.91        | 72.3         | 60          | 4.75         | 15217         |
| 2006 | 78.4       | 0.92        | 71.9         | 60          | 4.70         | 15293         |
| 2007 | 77.6       | 0.92        | 71.6         | 60          | 4.66         | 15370         |
| 2008 | 76.9       | 0.93        | 71.3         | 60          | 4.61         | 15447         |
| 2009 | 76.1       | 0.93        | 70.9         | 60          | 4.57         | 15524         |
| 2010 | 75.3       | 0.94        | 70.5         | 60          | 4.52         | 15602         |
| 2011 | 74.6       | 0.94        | 70.2         | 60          | 4.48         | 15680         |
| 2012 | 73.8       | 0.95        | 69.8         | 60          | 4.43         | 15758         |
| 2013 | 73.1       | 0.95        | 69.5         | 60          | 4.39         | 15837         |
| 2014 | 72.4       | 0.95        | 69.1         | 60          | 4.34         | 15916         |
| 2015 | 71.7       | 0.96        | 68.8         | 60          | 4.30         | 15996         |
| 2016 | 70.9       | 0.96        | 68.4         | 60          | 4.25         | 16076         |
| 2017 | 70.2       | 0.97        | 68.0         | 60          | 4.21         | 16156         |
| 2018 | 69.5       | 0.97        | 67.7         | 60          | 4.17         | 16237         |
| 2019 | 68.8       | 0.98        | 67.4         | 60          | 4.13         | 16318         |
| 2020 | 68.1       | 0.98        | 67.0         | 60          | 4.09         | 16400         |
| 2021 | 67.5       | 0.99        | 66.8         | 60          | 4.05         | 16482         |
| 2022 | 66.8       | 0.99        | 66.4         | 60          | 4.01         | 16564         |
| 2023 | 66.1       | 1.00        | 66.0         | 60          | 3.97         | 16647         |
| 2024 | 65.5       | 1.00        | 65.7         | 60          | 3.93         | 16730         |
| 2025 | 64.8       | 1.01        | 65.4         | 60          | 3.89         | 16814         |
| 2026 | 64.2       | 1.01        | 65.1         | 60          | 3.85         | 16898         |
| 2027 | 63.5       | 1.02        | 64.7         | 60          | 3.81         | 16982         |
| 2028 | 62.9       | 1.02        | 64.4         | 60          | 3.77         | 17067         |
| 2029 | 40.0       | 1.03        | 41.2         | 60          | 2.40         | 17152         |
| 2030 | 20.0       | 1.03        | 20.7         | 60          | 1.20         | 17238         |
| 2031 | 0.0        | 1.04        | 0.0          | 0           | 0.00         | 0             |

Cum Oil Prod. 1,038,206 (m3)

Figure 4  
WATERFLOOD PRODUCTION FORECAST

