Manitoba

Energy and Mines

Petroleum

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

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

January 11, 1991

Mr. C. G. Folden, P. Eng.
Manager Reservoir Engineering
Chevron Canada Resources
500 - 5th Avenue S.W.
Calgary, Alberta
T2P 0L7

Dear Sir:

Re: Over-Production
Chevron Virden 3-17-9-25 (WPM)

As of January 1, 1991 the subject well had accumulated over-production of 297.4 m^3 since the expiry of Board Order No. 79A, August 31, 1990.

Subsection 51(5) of the Petroleum Drilling and Production Regulation requires the accumulated over-production be deducted from the succeeding month's maximum permissible monthly production rate ("monthly MPR"). Therefore for the month of January, 1991, the effective date of the MPR increase, the revised monthly MPR for the subject well is 302.6 m^3.

If you have any questions please contact the undersigned at (204) 945-6574.

Yours truly,

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

JNF:cvs

cc: Lyle Martinson
Chevron, Virden

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

FILE
a) VIRDEN LODGEPOLE C Pn
MPR INCREASE
b) Board MPR orders

January 10, 1991

Mr. C.G. Folden, P. Eng.
Manager, Reservoir Engineering
Chevron Canada Resources
500 - 5th Avenue S.W.
Calgary, Alberta
T2P 0L7

Dear Sir:

RE: Application for an Increase in Maximum Permissible Production Rate Chevron Virden 3-17-9-25 (WPM)

Your application for an increase in the maximum permissible production rate for the well, Chevron Virden 3-17-9-25 (WPM), is hereby approved. Effective January 1, 1991, the maximum permissible daily and monthly production rates for the well, Chevron Virden 3-17-9-25 (WPM), are increased to 22 m^3 and 600 m^3 of clean oil, respectively.

The Petroleum Branch will advise Chevron of any over-production accumulated after the expiry of Board Order No. 79A, August 31, 1990 and before January 1, 1991. Over-production, unless it exceeds the maximum permissible monthly production rate of 600 m^3, is to be deducted from the succeeding month's maximum permissible monthly production rate. If the over-production exceeds 600 m^3, the well is to be shut-in in accordance with subsection 51(6) of the Petroleum Drilling and Production Regulation.

The Board believes an interim maximum permissible production rate increase is a viable way of gathering the production and reservoir data needed to make the correct decision on permanent maximum permissible production rate changes. The additional production and pressure data collected during the six month approval period has assisted in the evaluation of this application. However, the Board is disappointed in Chevron's inability to produce the wells at the increased maximum permissible production rate approved under Board Order No. 79A. The Board believes an additional investment in artificial lift and production facilities would have allowed the gathering of more detailed performance data for development of an optimum reservoir depletion strategy.

Yours respectfully,

ORIGINAL SIGNED BY:
H. CLARE MOSTER

H. Clare Moster
Deputy Chairman

cc: Petroleum Branch

bcc: Ian Haugh
Wm. McDonald

November 27, 1990

The Oil and Natural Gas
Conservation Board
- Ian Haugh, Chairman
- H. Clare Moster, Deputy Chairman
- Wm. McDonald, Member

John N. Fox
Chief Petroleum Engineer
Petroleum Branch

RE: Application for an Increase in Maximum Permissible Production Rate - Chevron Virden 3-17-9-25 (WPM)

Chevron Canada Resources has made application for an increase in maximum permissible production rate (MPR) to 22 m^3/d and 600 m^3/month for the subject well.

RECOMMENDATION

It is recommended that notice of the application be sent directly to the offsetting lessors and lessees. A copy of the proposed notice is attached.

If no objections are received, it is recommended that the Board approve by letter, a daily MPR of 22 m^3 and a monthly MPR of 600 m^3 for the well, Chevron Virden 3-17-9-25 (WPM). A copy of the proposed Board letter of approval is attached.

DISCUSSION

Board Order No. 79A (February 16, 1990) approved a temporary six month increase in MPR for seven wells located in the SW/4 of Section 17-9-25 (WPM) and the S/2 and NE/4 of Section 18-9-25 (WPM) ("the area of application" - Figure 1) to 20 m^3/d /well with a total monthly MPR for the seven wells of 3000 m^3. The purpose of the interim six month approval from March through August, 1990 was to allow Chevron an opportunity to collect the production and reservoir information needed to evaluate the effect of increased production rates on reservoir performance.

WELL PERFORMANCE

The well performance during the six month approval, except for the 3-17 well, is characterized by decreasing oil production and increasing WOR. Table 1 shows the individual well production before and after the approval period. Figure 2 is a plot of total daily oil production and WOR for the seven wells in the area of application. The plot shows a constant increase in WOR with no correlation to daily oil production. With the exception of the 5-17 well, there is no indication of sensitivity of WOR to production rate.

The 5-17 well during testing in July, 1990 showed some WOR rate sensitivity.

Date	Oil Production (m^3/d)	Water Cut (%)
July 16	8.1	47
July 19	5.9	38
July 21	9.9	52

However, during the remainder of the approval period, the 5-17 well exhibited similar behavior to the other wells - decreasing oil production and increasing WOR (Figure 3).

The following observations during the approval period support the conclusion that there is strong aquifer pressure support in the area of application.

(1) The linear trend of increasing WOR with cumulative production (Figure 4).

(2) Reservoir pressure surveys at 3-18 and 7-18 in April, 1990 indicated reservoir pressures of 6645 kPa and 6698 kPa, respectively, almost unchanged from the initial reservoir pressure of 6700 kPa.

(3) In general, there was little change in casing pressure and fluid levels at the wells during the approval period indicating, even at increased production rates, there was little change in bottomhole flowing pressure.

As a result of the increasing WOR combined with the limited fluid handling and water disposal capacity at the 10-8-9-25 battery, Chevron was unable to consistently produce the wells at a MPR of 20 m^3/d. Chevron is reluctant to make the large capital investment necessary to install artificial lift and upgrade the battery and therefore has not applied for continuation of Board Order No. 79A.

Despite Chevron's inability to produce the wells at 20 m^3/d, production and pressure data collected during the approval period confirm the following:

(1) increased production rates have not had an adverse effect on WOR and therefore ultimate recovery does not appear to be rate sensitive, and

(2) strong aquifer support has resulted in negligible pressure drawdown at the wells, even at increased production rates, reducing concerns of inequitable drainage.

MPR INCREASE - CHEVRON VIRDEN 3-17-9-25 (WPM)

Chevron has applied for an increase in daily MPR for the 3-17-9-25 well from 11 m^3/d and 290 m^3/month to 22 m^3/d and 600 m^3/month.

It is evident from Table 1 that the producing characteristics of the 3-17 well are significantly different from the other wells in the area of application. The 3-17 well produces from the Upper Virden Member (UV) of the Lodgepole Formation (Figure 5). The other wells in the area of application produce from the Upper Whitewater Member (UW) of the Lodgepole Formation. The 3-17 well has produced consistently above 15 m^3/d since April, 1990 with an average WOR of 0.08 m^3/m^3 (Figure 6). The IPR curve for the 3-17 well (Figure 7) shows the well is capable of producing 22 m^3/d with minimal pressure drawdown. The well also receives good aquifer pressure support as shown by the casing pressure and total production versus time plot in Figure 8.

The 3-17-9-25 well is located on a structural high (Figure 9). Logs, well completions and production histories for the wells in Sections 8, 17 and 18-9-25 (WPM) were reviewed to estimate an oil/water contact for the UV of -213.6 m subsea. Based on the structure map, the only locations offsetting 3-17 with UV potential are the SW/4 of Section 17 and Lsd's 14 and 15 in Section 8. It is recommended that notice of the application need only be sent directly to the offsetting lessors and lessees shown in Figure 10. A copy of the proposed notice is attached.

The two primary concerns with approval of an increase in MPR are the effect of increased production on ultimate recovery and on the correlative rights of offsetting lessors and lessees. The performance of 3-17 and the other wells during the approval period indicate increased production rates do not appear to have an adverse effect on ultimate recovery.

Two factors combine to significantly reduce the probability of inequitable drainage,

(1) the structural position of the 3-17 well on a localized structural high with limited areal extent (Figure 9), and

(2) the proximity of the underlying aquifer and the strong aquifer pressure support.

If no objections are received from the lessors and lessees offsetting the 3-17-9-25 well, it is recommended that the application be approved. The proposed Board letter of approval granting a daily MPR of 22 m^3 and monthly MPR of 600 m^3 for the 3-17-9-25 well is attached.

ORIGINAL SIGNED BY
JOHN N. FOX

John N. Fox

Att'd.

Original ...

Approved by: ______________________
L.R. Dubreuil, Director

TABLE 1

PRODUCTION DATA

Well	November 1989 Oil (m^3/d)	November 1989 WOR (m^3/m^3)	September 1990 Oil (m^3/d)	September 1990 WOR (m^3/m^3)	Cumulative Production Oil (m^3)	Cumulative Production Water (m^3)
3-17-9-25	8.45	0.14	16.2	0.1	3890	262
4-17-9-25	11.54	1.90	3.8	7.6	1898	5705
5-17-9-25	12.64	0.15	7.9	2.2	2889	2254
3-18-9-25	5.48	4.53	3.5	9.8	1415	9266
7-18-9-25	8.56	1.20	3.96	6.5	2543	5626
8-18-9-25	9.51	2.05	5.5	7.5	4132	12022
9-18-9-25	8.57	2.74	7.7	16.4	3462	24989

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

DOUBLE REGISTERED

November 28, 1990

Pan Canadian Petroleum Ltd.
P.O. Box 2850
Calgary, Alberta
T2P 2S5

Attention: Land Department

Dear Sir:

RE: Application for an Increase in
Maximum Permissible Production Rate
Chevron Virden 3-17-9-25 (WPM)

This letter is to notify you that Chevron Canada Resources has made application to The Oil and Natural Gas Conservation Board ("the Board") for an increase in the maximum permissible production rate for the well, Chevron Virden 3-17-9-25 (WPM).

The 3-17-9-25 well is in the Virden Lodgepole C Pool and has a prescribed maximum permissible production rate of 11.0 m^3 of clean oil per day and 290 m^3 of clean oil per month. Chevron has applied for an increase in the maximum permissible production rate to 22 m^3 of clean oil per day and 600 m^3 of clean oil per month.

This application is subsequent to Board Order No. 79A which provided a temporary increase in maximum permissible production rate for wells in the SW/4 of Section 17-9-25 (WPM) and the S/2 and NE/4 of Section 18-9-25 (WPM). Board Order No. 79A was in effect from March 1, 1990 to August 31, 1990.

If no intervention in writing is received by the Board at Room 309, Legislative Building, Winnipeg, Manitoba, R3C 0V8 on or before December 14, 1990, the Board may approve the application.

Additional information in respect of the application may be obtained from Mr. Kelly Edwards, Chevron Canada Resources, 500 - Fifth Avenue S.W., Calgary, Alberta, T2P 0L7 [phone (403) 234-5388].

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

DOUBLE REGISTERED

November 28, 1990

Encor Energy Corporation Inc.
9th floor, 300-5th Avenue S.W.
Calgary, Alberta
T2P 4G8

Attention: Land Department

Dear Sir:

RE: Application for an Increase in
Maximum Permissible Production Rate
Chevron Virden 3-17-9-25 (WPM)

This letter is to notify you that Chevron Canada Resources has made application to The Oil and Natural Gas Conservation Board ("the Board") for an increase in the maximum permissible production rate for the well, Chevron Virden 3-17-9-25 (WPM).

The 3-17-9-25 well is in the Virden Lodgepole C Pool and has a prescribed maximum permissible production rate of 11.0 m^3 of clean oil per day and 290 m^3 of clean oil per month. Chevron has applied for an increase in the maximum permissible production rate to 22 m^3 of clean oil per day and 600 m^3 of clean oil per month.

This application is subsequent to Board Order No. 79A which provided a temporary increase in maximum permissible production rate for wells in the SW/4 of Section 17-9-25 (WPM) and the S/2 and NE/4 of Section 18-9-25 (WPM). Board Order No. 79A was in effect from March 1, 1990 to August 31, 1990.

If no intervention in writing is received by the Board at Room 309, Legislative Building, Winnipeg, Manitoba, R3C 0V8 on or before December 14, 1990, the Board may approve the application.

Additional information in respect of the application may be obtained from Mr. Kelly Edwards, Chevron Canada Resources, 500 - Fifth Avenue S.W., Calgary, Alberta, T2P 0L7 [phone (403) 234-5388].

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

DOUBLE REGISTERED

November 28, 1990

Amoco Canada Resources Ltd.
P.O. Box 200
Calgary, Alberta
T2P 2H8

Attention: Land Department

Dear Sir:

RE: Application for an Increase in
Maximum Permissible Production Rate
Chevron Virden 3-17-9-25 (WPM)

This letter is to notify you that Chevron Canada Resources has made application to The Oil and Natural Gas Conservation Board ("the Board") for an increase in the maximum permissible production rate for the well, Chevron Virden 3-17-9-25 (WPM).

The 3-17-9-25 well is in the Virden Lodgepole C Pool and has a prescribed maximum permissible production rate of 11.0 m^3 of clean oil per day and 290 m^3 of clean oil per month. Chevron has applied for an increase in the maximum permissible production rate to 22 m^3 of clean oil per day and 600 m^3 of clean oil per month.

This application is subsequent to Board Order No. 79A which provided a temporary increase in maximum permissible production rate for wells in the SW/4 of Section 17-9-25 (WPM) and the S/2 and NE/4 of Section 18-9-25 (WPM). Board Order No. 79A was in effect from March 1, 1990 to August 31, 1990.

If no intervention in writing is received by the Board at Room 309, Legislative Building, Winnipeg, Manitoba, R3C 0V8 on or before December 14, 1990, the Board may approve the application.

Additional information in respect of the application may be obtained from Mr. Kelly Edwards, Chevron Canada Resources, 500 - Fifth Avenue S.W., Calgary, Alberta, T2P 0L7 [phone (403) 234-5388].

Yours respectfully,

H. Clare Moster
Deputy Chairman

D R A F T

Mr. C.G. Folden, P. Eng.
Manager, Reservoir Engineering
Chevron Canada Resources
500 - 5th Avenue S.W.
Calgary, Alberta
T2P 0L7

Dear Sir:

RE: Application for an Increase in
Maximum Permissible Production Rate
Chevron Virden 3-17-9-25 (WPM)

Your application for an increase in the maximum permissible production rate for the well, Chevron Virden 3-17-9-25 (WPM), has been reviewed by the Board. Notice of the application was sent to the offsetting lessors and lessees and no objections were received.

The Board hereby approves a maximum permissible daily production rate of 22 m^3 of clean oil and a maximum permissible monthly production rate of 600 m^3 of clean oil for the well, Chevron Virden 3-17-9-25 (WPM). The increase in maximum permissible production rate shall take effect immediately.

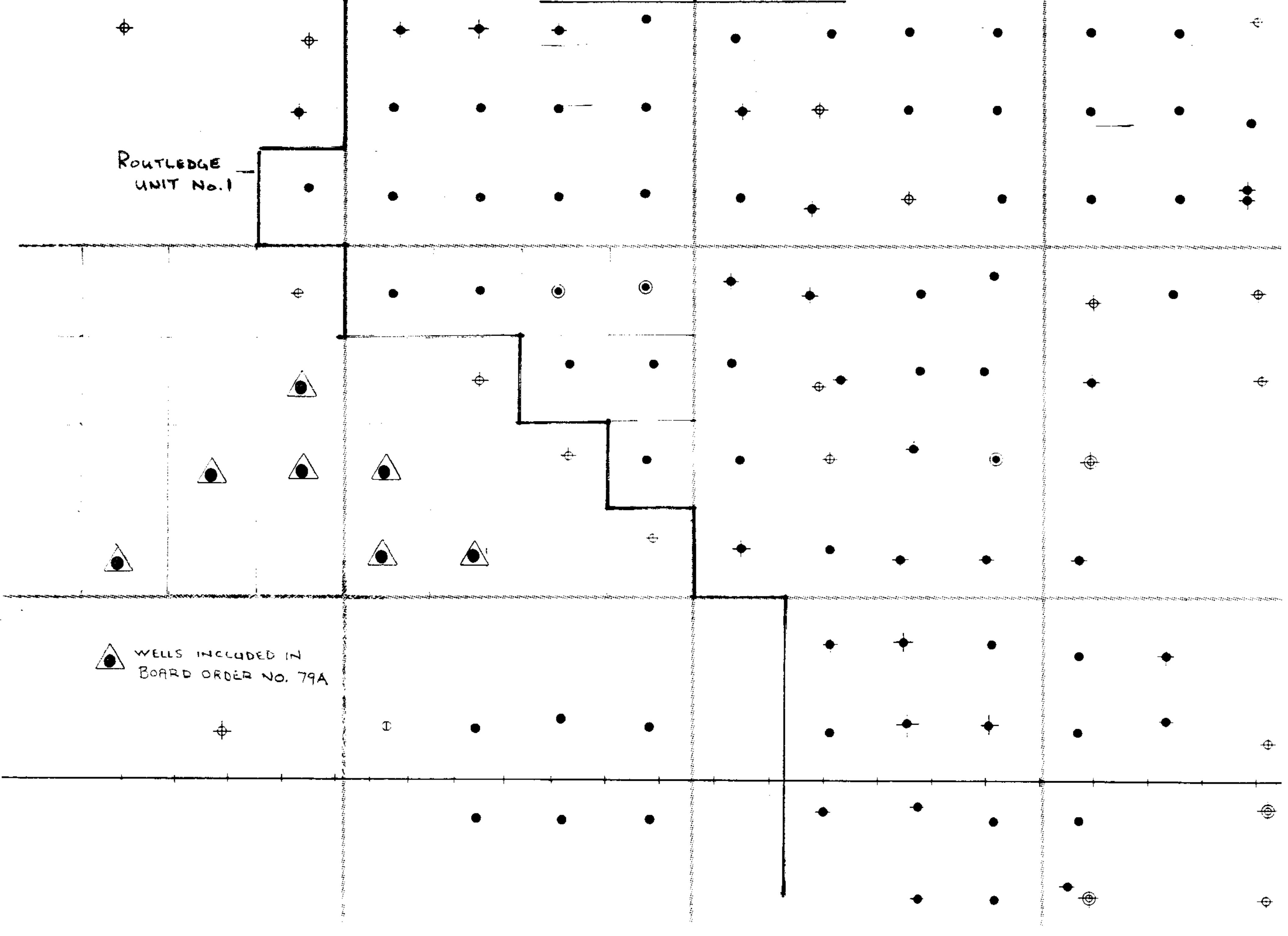
The Petroleum Branch will advise Chevron of any over-production accumulated after the expiry of Board Order No. 79A, August 31, 1990 and before the effective date of this approval. Over-production, unless it exceeds the maximum permissible monthly production rate of 600 m^3, is to be deducted from the succeeding month's maximum permissible monthly production rate. If the over-production exceeds 600 m^3, the well is to be shut-in in accordance with subsection 51(6) of the Petroleum Drilling and Production Regulation.

Though facility limitations and capital expenditure considerations restricted Chevron's ability to meet the increased maximum permissible production rate approved under Board Order No. 79A, the Board believes the production and pressure data collected during the six month approval period has assisted in the evaluation of this application. The Board still believes an interim maximum permissible production rate increase is a viable way of gathering the production and reservoir data needed to make the correct decision on permanent maximum permissible production rate changes.

Yours respectfully,

H. Clare Moster
Deputy Chairman

FIGURE 1
AREA OF APPLICATION



PRODUCTION PLOT

3-17-9-25, 4-17-9-25, 5-17-9-25

3-18-9-25, 7-18-9-25, 8-18-9-25, 9-18-9-25

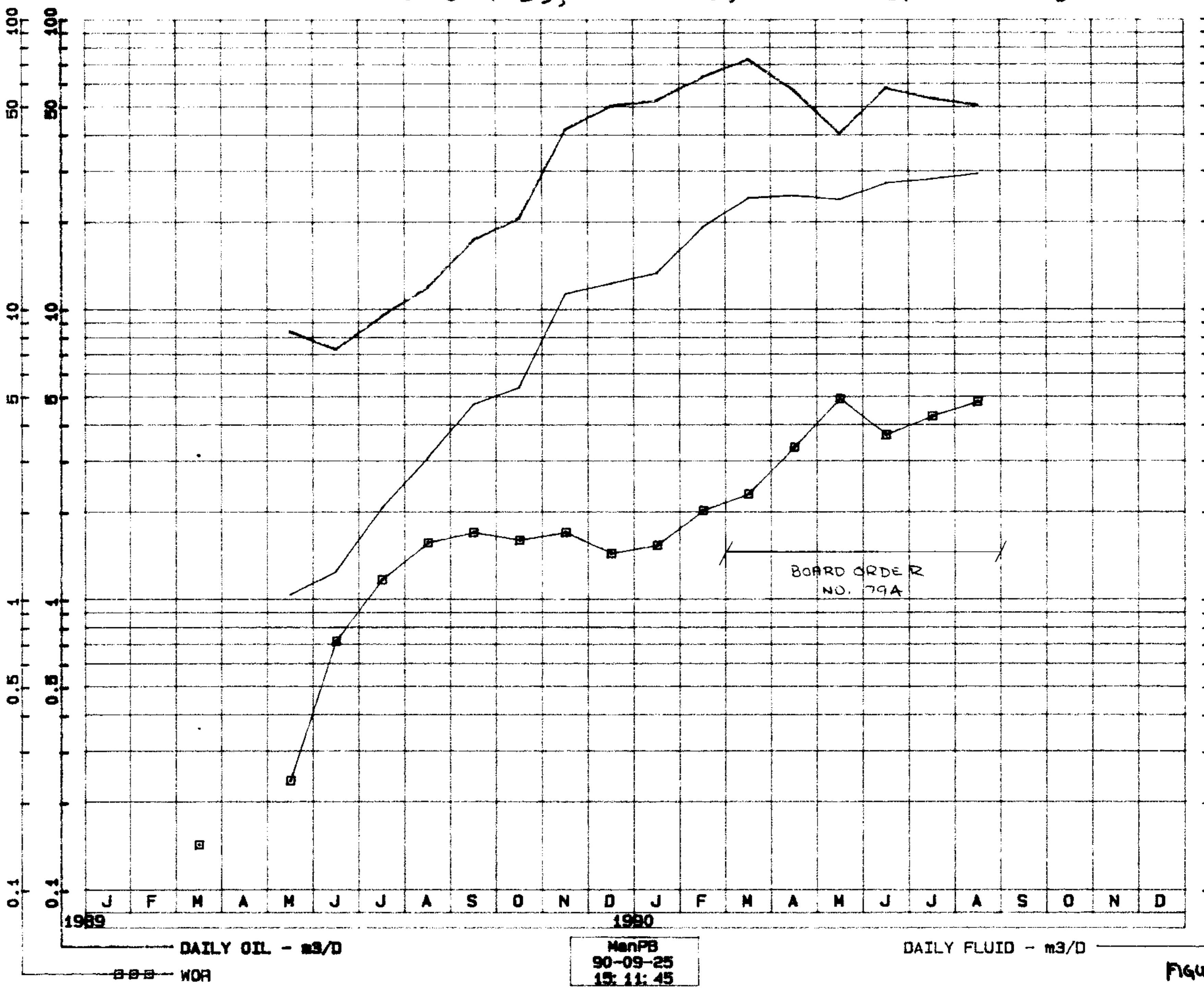


FIGURE 2

PRODUCTION 5-17-9-25 (WPM)

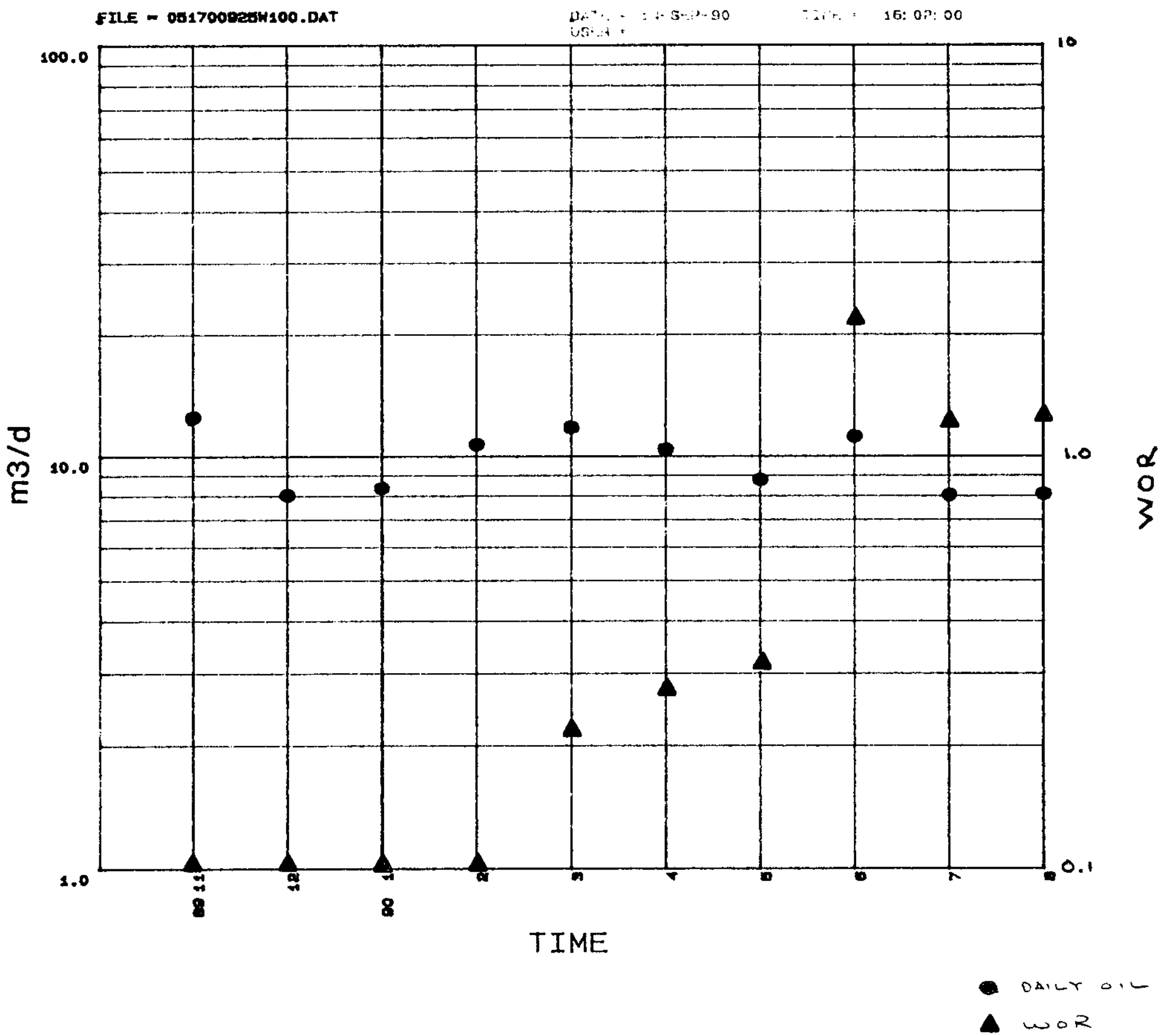
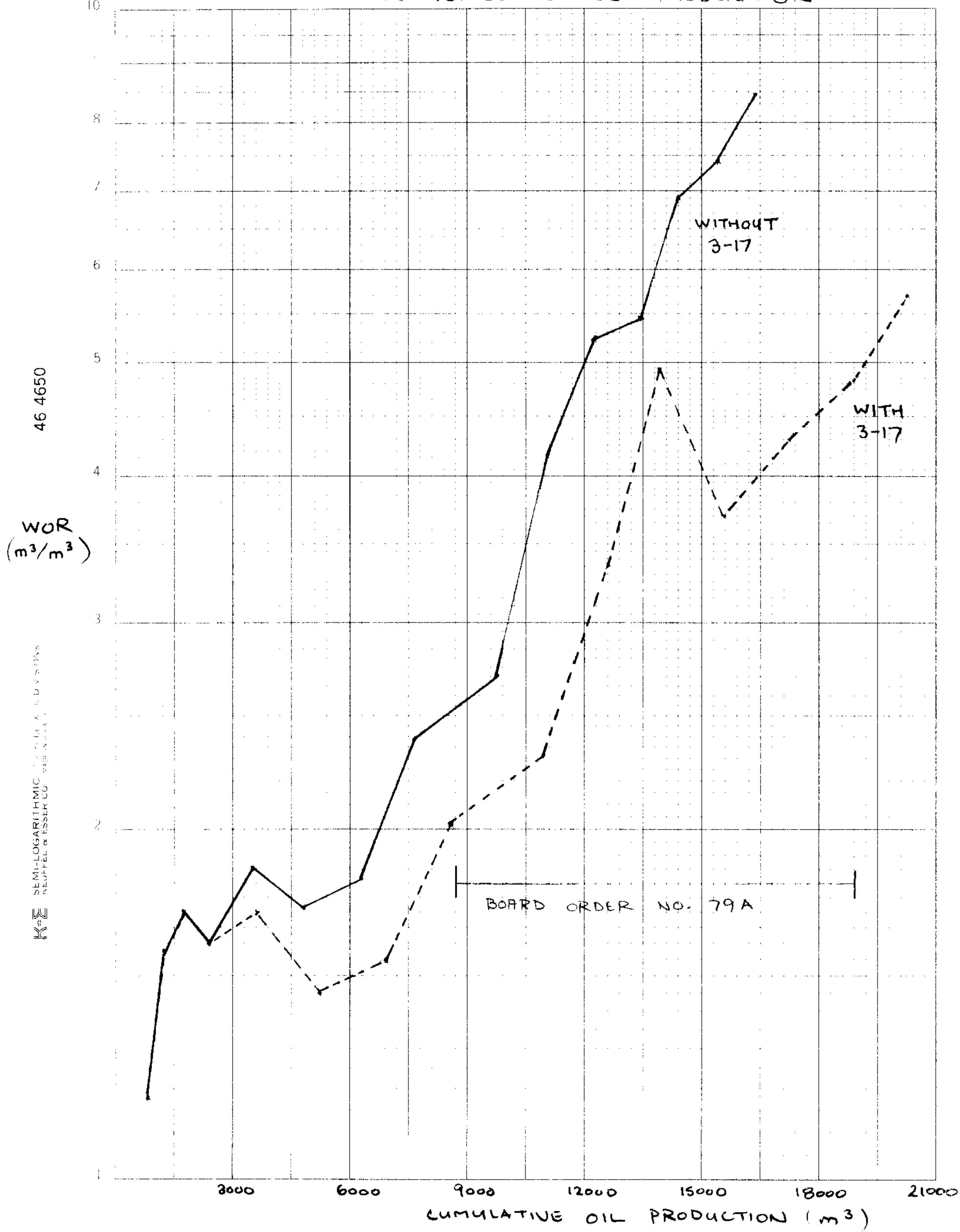
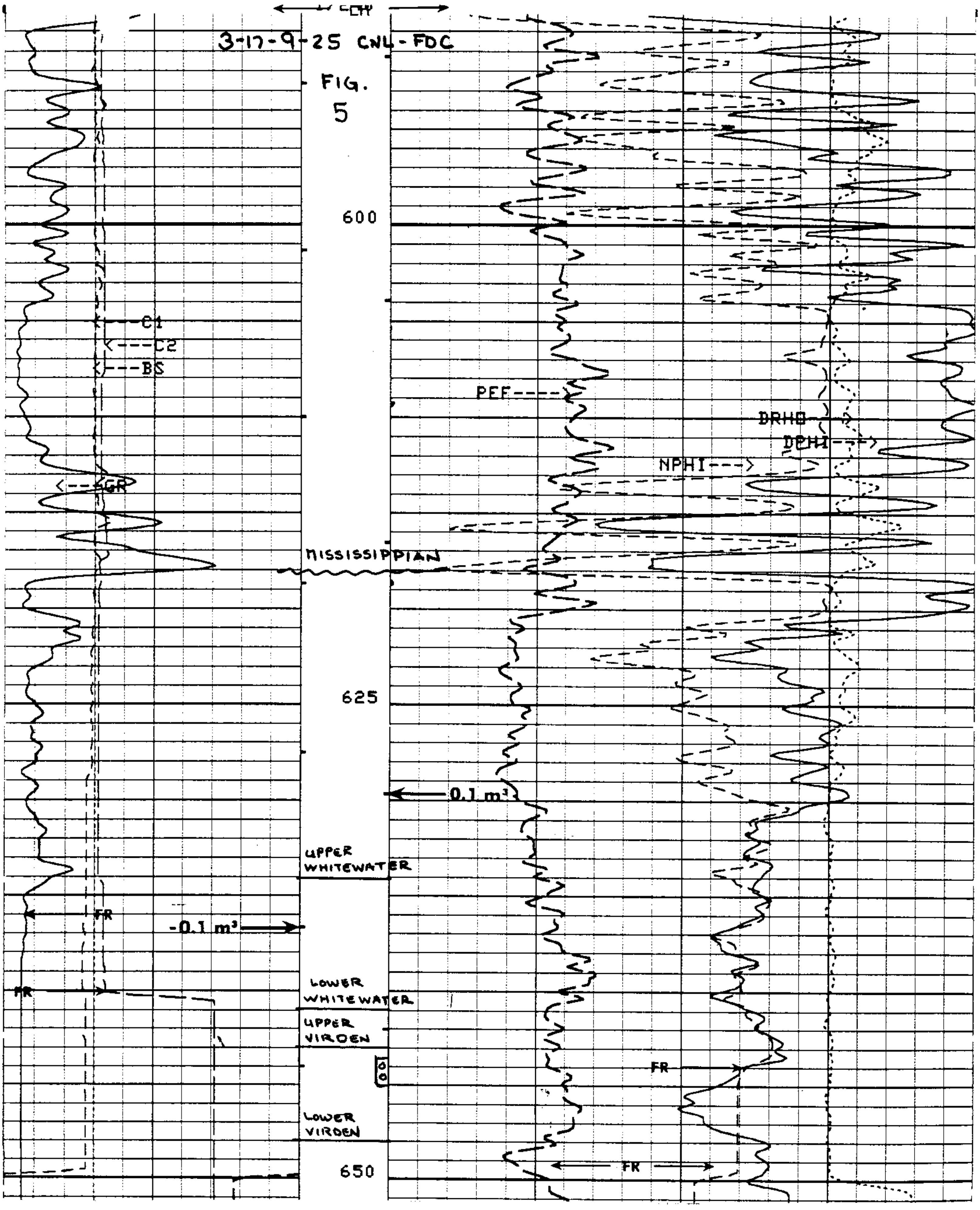


FIGURE 3

FIGURE 4

WOR VS. CUMULATIVE PRODUCTION





3-17-9-25 CNL-FDC
FIG. 5
600
625
650
C1
C2
BS
GR
FR
-0.1 m³
PEF
DRHO
DPHI
NPHI
0.1 m³
FR
MISSISSIPPIAN
UPPER WHITEWATER
LOWER WHITEWATER
UPPER VIRDEN
LOWER VIRDEN

PRODUCTION 3-17-9-25 (WPM)

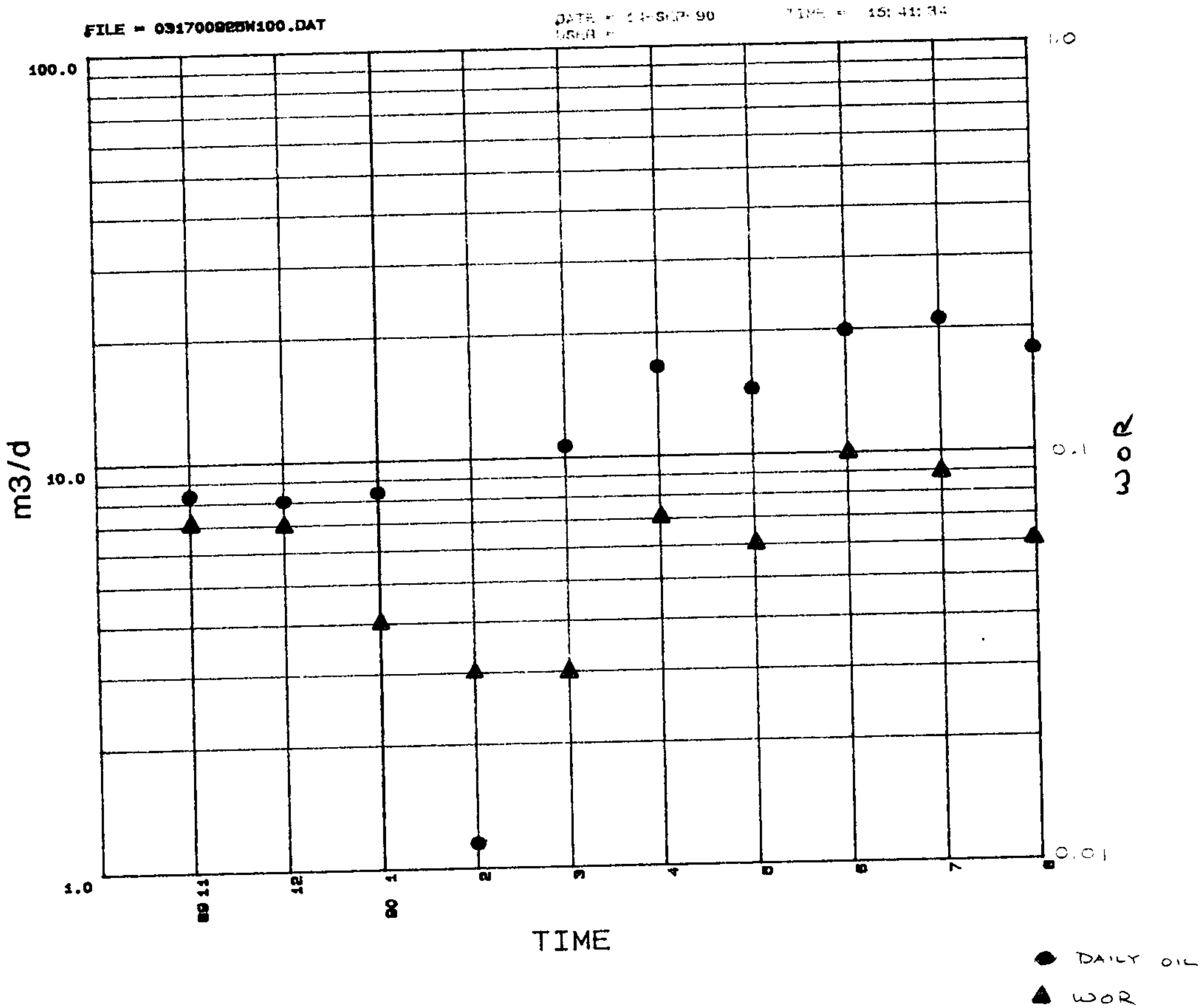
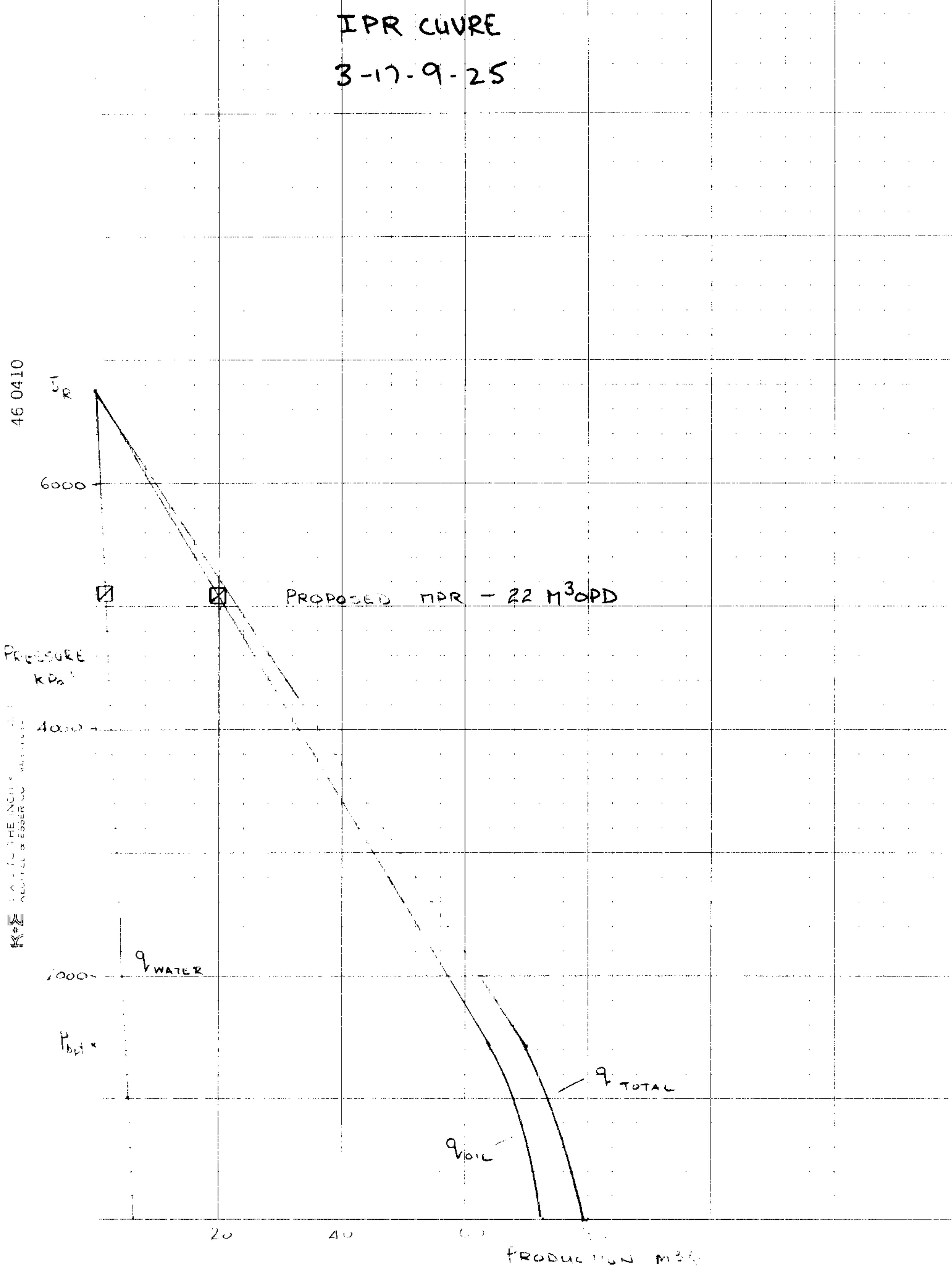


FIGURE 6

FIGURE 7


IPR CUVRE
3-17-9-25
46 0410
P_R
6000
PROPOSED MPR - 22 M³OPD
PRESSURE
KPa
4000
2000
q_{WATER}
P_{b}
q_{TOTAL}
q_{OIL}
20
40
PRODUCTION M³

CASING PRESSURE VS. TIME

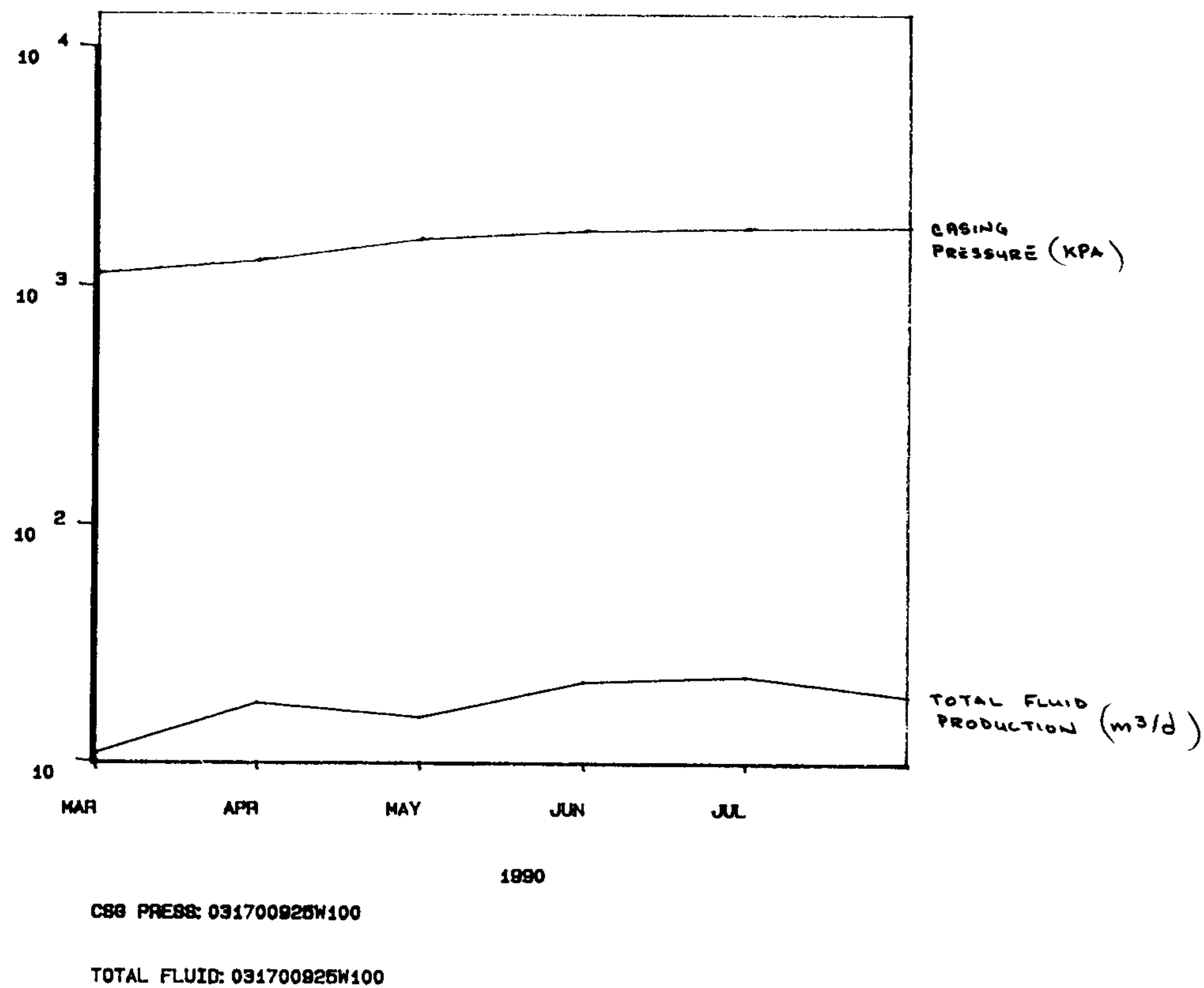
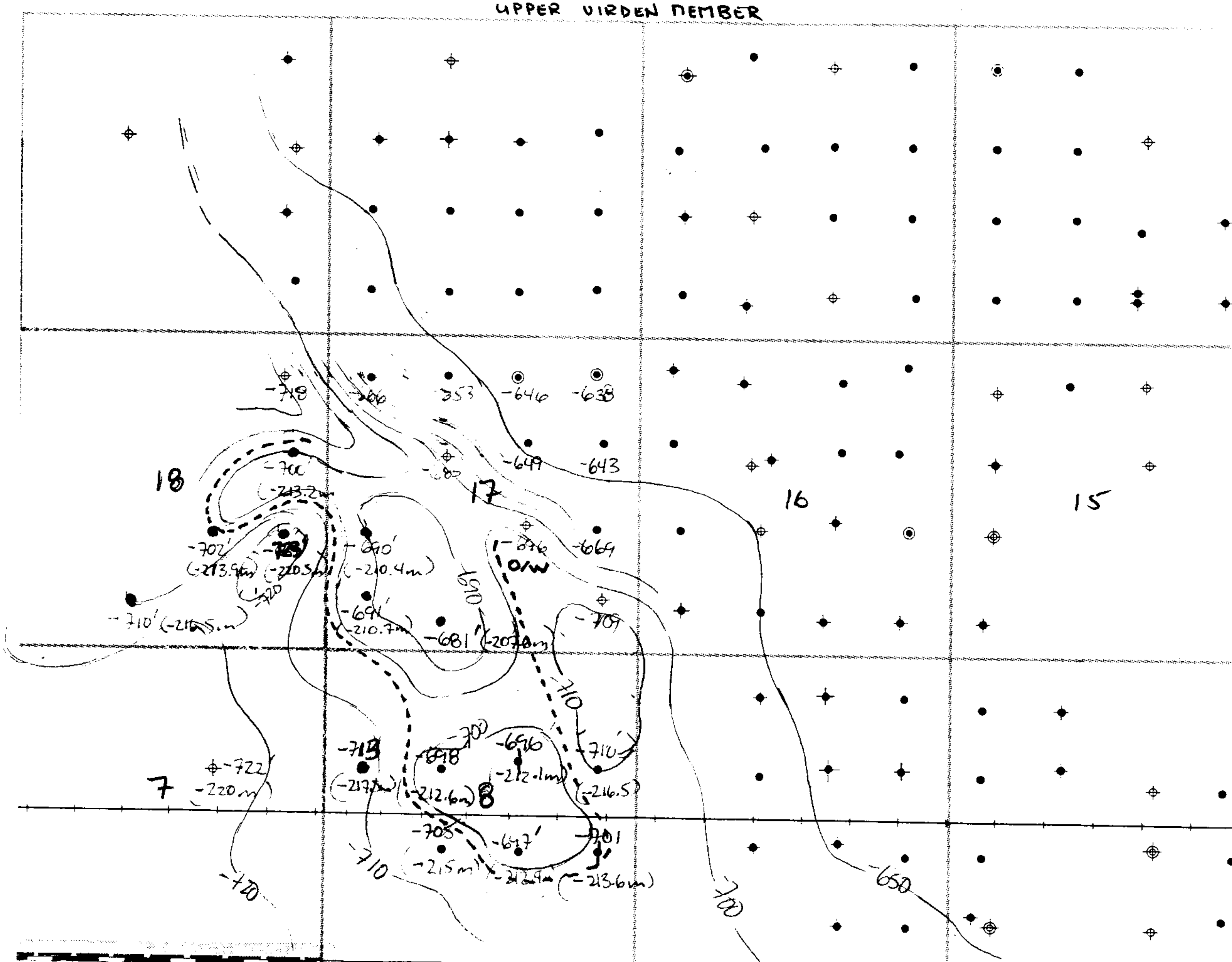


FIGURE 8

STRUCTURE MAP
UPPER VIRDEN MEMBER



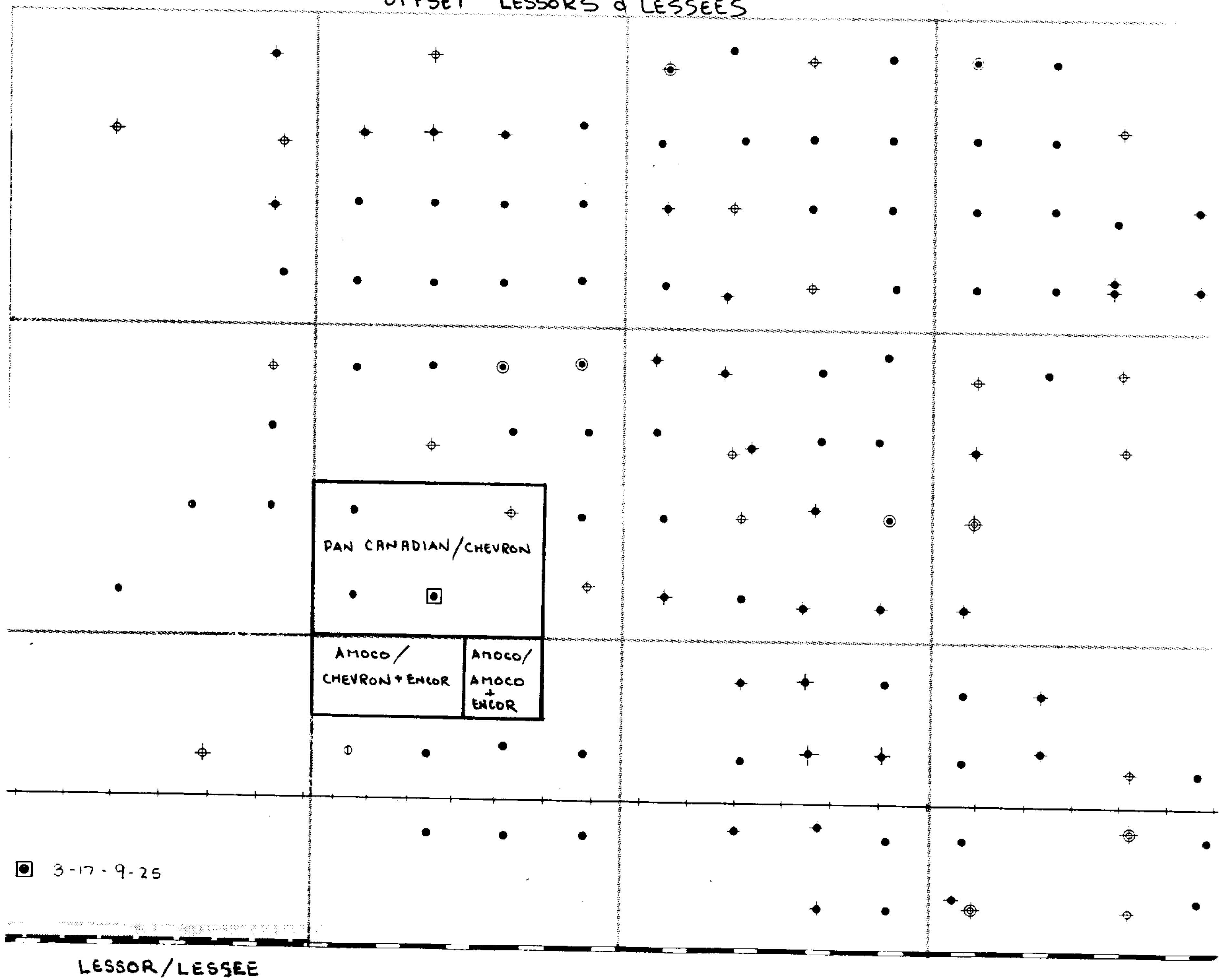
- - - - UPPER VIRDEN OIL/WATER CONTACT

CI = 10'

FIGURE 9

FIGURE 10

OFFSET LESSORS & LESSEES



Chevron

Chevron Canada Resources
500 - Fifth Avenue S.W., Calgary, Alberta T2P 0L7
Phone (403) 234-5000 Fax (403) 234-5947

D.M. Clementz
Manager Engineering

November 26, 1990

Revisions to Application for Special MPPR
for Chevron Virden 03-17-09-25 WPM

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

Attention: Mr. J. N. Fox

Gentlemen:

As per our telephone discussion of November 26, 1990, Chevron Canada Resources, a Partnership by its managing partner, Chevron Canada Resources Limited, wishes to revise its September 18, 1990 Application for Special MPPR for Chevron Virden 03-17-09-25 WPM. Instead of a maximum daily production rate of 20 m^3 oil, Chevron requests a maximum daily production rate of 22 m^3 oil, and a maximum monthly volume of 600 m^3 oil. This will allow for operational flexibility while at the same time limiting monthly volumes to what they would have been at an MPPR of 20 m^3/d.

Should you have any questions or require more information, please call Mr. Kelly Edwards at (403) 234-5388. Your early consideration of this Revision is appreciated.

Yours very truly,

Kelly Edwards

C. G. FOLDEN, P.Eng.
Manager
Reservoir Engineering

KAE/er

ALLOWABLE EXEMPTION APPLICATION

UNIT CHEVRON VIRDEN 3-17-9-25 (WPM) APPLICATION NO. 90 5 MPR

APPLICATION RECEIVED SEP 18/90

MEMO TO BOARD

DEFICIENCY LETTER NOV 26 REQUESTED CHEVRON APPLY FOR BOTH A DAILY & MONTHLY MPR INCREASE

PUBLICATION OF NOTICE

MANITOBA GAZETTE OFFSET LESSORS & LESSEES DIRECTLY

S/2 OF SEC. 17-9-25 (WPM)

N/2 OF SEC 8-9-25 (WPM)

LAST DATE FOR OBJECTION

OBJECTIONS RECEIVED

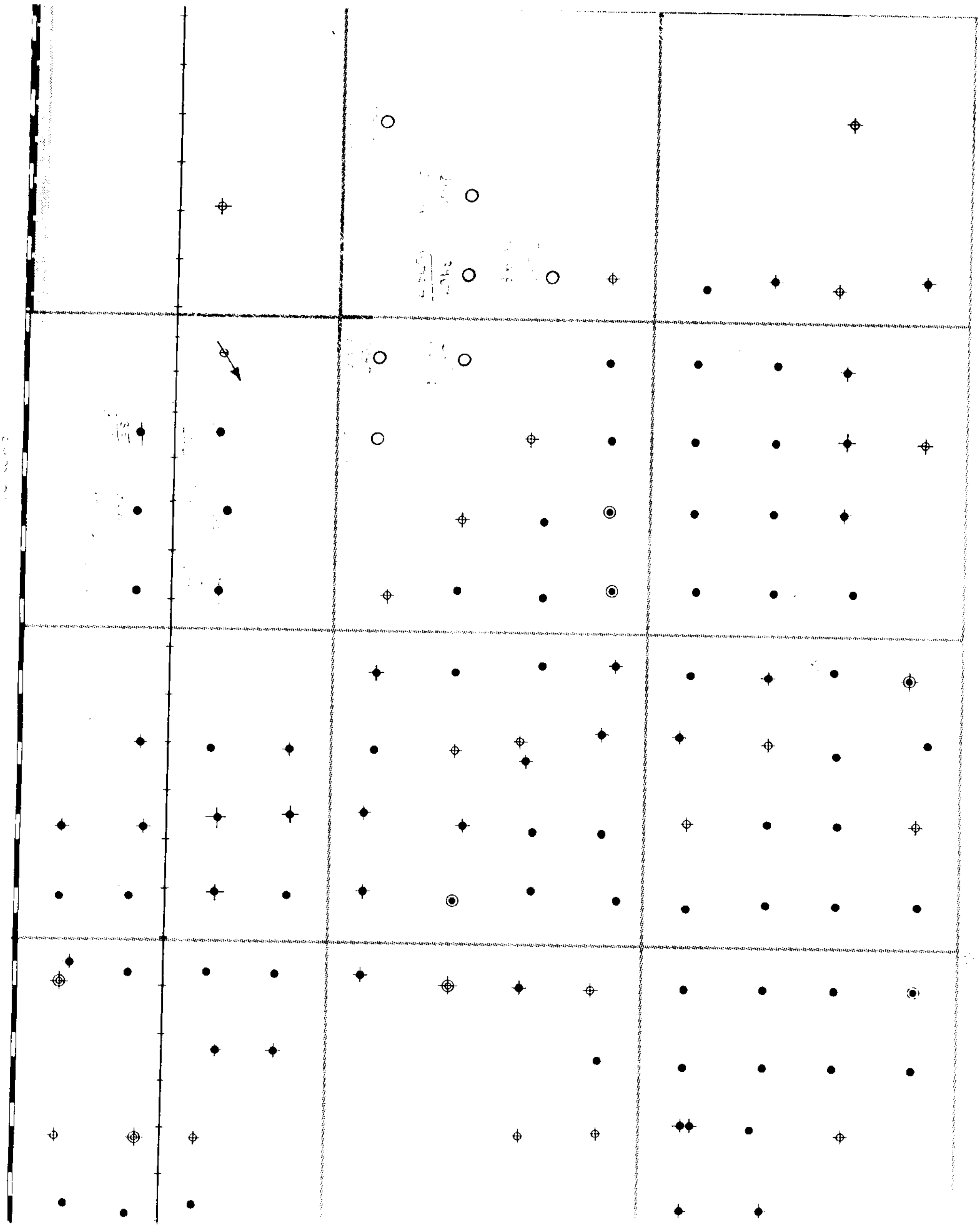
MEMO TO BOARD W/ORDER

ORDER NO. _______ SIGNED

APPROVED ORDER TO COMPANY

ORDER AND OTHER MATERIAL FILED

OTHER COMMENTS:



Chevron

Chevron Canada Resources

500 - Fifth Avenue S.W., Calgary, Alberta T2P 0L7

Phone (403) 234-5597 Fax (403) 234-5597

D.M. Clementz

Manager, Engineering

1990-09-18

Routledge Lodgepole
Board Order No. 79A
MPPR Increase in
SW 1/4 17-9-25 WPM and
S 1/2 and NE 1/4 18-9-25 WPM

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

Attention: Mr. L. R. Dubreuil
Director

Gentlemen:

Chevron Canada Resources, a Partnership by its managing partner Chevron Canada Resources Limited, as operator of the wells in the subject area, requests that Board Order No. 79A to test at an MPPR of 20 m^3/d not be extended. Results of the test are summarized below. Chevron would, however, like to make application for a special MPPR of 20 m^3/d for Well Chevron Virden 3-17-9-25 WPM.

Test Results

The test results were, in general, disappointing due to the fact that Chevron was unable to consistently produce these wells at an oil rate of 20 m^3/d. Two main factors contributed to the limited rates:

1. Facility limitations which made it impossible to handle the increased fluid production.

2. Large capital expenditures required for most of the wells in order to produce at an MPPR of 20 m^3/d. Artificial lift would have been required.

The only well to consistently achieve oil rates of 20 m^3/d for an extended period was 3-17-9-25 WPM. This well produced at 20 m^3/d over a period of two months, and well above 10 m^3/d for five months. The performance of 3-17 will be discussed fully in the Application section below. Plots of monthly oil rates are shown in Appendix A for all wells. The well location is shown in the upper left-hand corner as the file name.

In general, the increase in log WOR for the wells followed a linear trend with cumulative production, and was not rate sensitive. This can be noted on the plots of log WOR vs. cumulative production in Appendix B. The only well to show a sensitivity of WOR to rate was 5-17-9-25 WPM. This was observed during July when the rate was varied over several days, during which test results were:

Time Period	Choke (mm)	Oil Rate (m^3/d)	WOR (%)
July 16&18	4.8	8.1	47
July 19	4.0	5.9	38
July 21	5.6	9.9	52

Reservoir pressure remained constant during the test. Plots of the average casing pressure (kPa) measured each month and the total fluid rate (m^3/d) are shown in Appendix C. In general, there was little change in the casing pressures and liquid levels reflecting little change in FBHP, which in turn indicated little change in average reservoir pressure. The lack of pressure drop over the duration of the test indicates good aquifer support in the test area. Also, pressure surveys run on 3-18 and 7-18 during the test period showed reservoir pressures (6645 and 6698 kPa respectively) almost unchanged from discovery pressures of approximately 6700 kPa.

In summary:

1. One well (3-17) consistently produced at 20 m^3/d oil without showing any detrimental effects to oil recovery due to increased drawdown.

2. The remaining wells were not produced at 20 m^3/d because of capital cost and facility considerations.

3. One well (5-17) had a WOR which was rate sensitive.

4. There is strong aquifer support to these wells.

We trust the results of this test will not deter the Petroleum Branch from considering further applications of this sort in the future, where warranted.

Application for Special MPPR of 20 m^3/d for Chevron Virden 3-17-9-25 WPM

Chevron Canada Resources hereby makes application under Subsection 51(3) to amend the MPPR for Chevron Virden 3-17-9-25 WPM from 9.5 m^3/d oil to 20 m^3/d oil. In support of this application Chevron offers the following:

1. This well was produced consistently at 20 m^3/d during June and July, and 18 m^3/d during August. Figure 1 shows the oil rate per producing day for each month the well has produced.

2. The WOR was not sensitive to rate. In fact, the WOR actually decreased during July and August compared to June. A plot of log WOR vs. cumulative oil production clearly shows that increased oil rates did not have an adverse effect on the WOR (Figure 2). Instead of a linear increase, the plot shows a flattening behaviour.

3. This well benefits from strong aquifer support. The level of support is indicated by Figure 3 where casing pressures and total fluid rates are plotted against time. The average casing pressure increased slightly with time even though the total fluid rates also increased. In a well with poor pressure support, the casing pressure would be expected to drop with time and production.

4. This well produces from the Upper Virden (UV) member and, therefore, may have production characteristics different from the rest of the wells in sections 17 and 18 which produce from the Upper Whitewater (UW) member. Also, there are several streaks of low vertical permeability throughout the UV pay which would act as barriers to coning. A copy of the core analysis for 3-17 is shown in Table 1.

5. The geological placement of 3-17 suggests it will be a good producer. The well is in an area of high structure, as shown in Figure 4. It has good UV pay, which is shown in Figure 5. Also, 3-17 is relatively distant from the aquifer, and should drain more than its 16 hectare spacing.

6. Production from this well will continue to be monitored, and if recovery is being adversely affected at the higher MPPR, the rates will be cut back.

Should you require more information or have any questions concerning this application, please call Mr. Kelly Edwards at (403) 234-5388.

Yours very truly,

Kelly Edwards

for C. G. FOLDEN, P.Eng.
Manager
Reservoir Engineering

KAE/er
Attach.

Table 1

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 3-17-9-25
Location : LSD XX/03-17-009-25 W1M/X
Province : MANITOBA, CANADA

Field : VIRDEN
Formation : LODGEPOLE
Coring Equip.: DIAMOND
Coring Fluid : WATER BASE MUD

File No.: 52138- 150
Date : 1989 11 05
Analysts: RJH
Core Dia: 89

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
CORE NO.1 628.50 - 645.00m (Core Recieved 16.45m) (12Boxes)														
1	628.50- 28.81	0.31	0.11	0.20	0.19	0.05	0.062	0.108	0.034	2480.	2780.	0.167	0.639	dol i ppv anhy cht
-	628.81- 28.92	0.11												anhy
2	628.92- 29.16	0.24	0.11	0.62	0.26	<.01	0.149	0.074	0.017	2630.	2830.	0.100	0.750	dol i ppv anhy shbk
3	629.16- 29.45	0.29	0.13	0.07	0.05	<.01	0.020	0.059	0.017	2690.	2860.	0.000	0.752	dol i anhy
-	629.45- 29.51	0.06												anhy
4	629.51- 29.72	0.21	0.12	0.73	0.54	0.03	0.153	0.092	0.019	2530.	2790.	0.188	0.654	dol i ppv anhy cht :
-	629.72- 30.25	0.53												ls anhy cht
5	630.25- 30.60	0.35	0.27	0.07	0.07	<.01	0.024	0.056	0.021	2580.	2730.	0.118	0.610	ls i anhy
-	630.60- 32.38	1.78												ls anhy sshy cht
6	632.38- 32.74	0.36	0.21	0.45	0.41	<.01	0.162	0.082	0.029	2480.	2700.	0.180	0.376	ls i cht sshy
-	632.74- 33.38	0.64												ls cht shy
7	633.38- 33.56	0.18	0.10	0.12	0.11	0.06	0.022	0.061	0.011	2560.	2730.	0.208	0.416	ls i gyp anhy
-	633.56- 34.42	0.86												ls shy anhy
8	634.42- 34.73	0.31	0.13	0.19	0.12	0.05	0.059	0.054	0.015	2560.	2700.	0.209	0.432	ls i ppv sv foss cht shbk
-	634.73- 35.63	0.90												ls cht gyp sshy
9	635.63- 35.91	0.28	0.10	0.81	0.64	0.17	0.227	0.059	0.017	2520.	2680.	0.222	0.349	ls i ppv sv foss gyp anhy
10	635.91- 36.12	0.21	0.10	0.61	0.60	0.42	0.128	0.134	0.027	2320.	2680.	0.163	0.277	ls i cht gyp vfrac
SP 11	636.12- 36.23	0.11		0.50			0.055	0.063	0.007		2710.	0.233	0.259	ls i ppv sv foss
12	636.23- 36.52	0.29	0.12	11.9	5.36	0.57	3.451	0.106	0.032	2420.	2700.	0.092	0.436	ls i ppv sv foss shbk frac
13	636.52- 36.80	0.28	0.13	1.68	1.57	0.25	0.470	0.094	0.025	2440.	2690.	0.227	0.173	ls i ppv sv foss cht shbk
14	636.80- 37.01	0.21	0.09	30.1	25.9	3.19	6.321	0.087	0.019	2450.	2690.	0.233	0.202	ls i ppv sv foss gyp
-	637.01- 37.12	0.11												ls gyp cht
SP 15	637.12- 37.24	0.12		63.2			7.584	0.076	0.010		2670.	0.268	0.339	ls i ppv mv foss cht
16	637.24- 37.46	0.22	0.07	*	92.4	*		0.125	0.029	2350.	2690.	0.235	0.189	ls i vug foss vfrac
17	637.46- 37.90	0.44	0.10	2.87	0.56	0.64	1.263	0.056	0.026	2540.	2690.	0.166	0.467	ls i ppv sv foss cht vfrac

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 3-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-150
Date : 1989 11 05

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER		DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
SP	18	637.90- 37.99	0.09		0.63			0.057	0.071	0.006		2700.	0.261	0.177	ls i ppv sv foss
	19	637.99- 38.41	0.42	0.09	0.32	0.26	0.18	0.134	0.063	0.025	2530.	2700.	0.092	0.126	ls i gyp 30 API
	20	638.41- 38.60	0.19	0.15	3.58	1.38	0.19	0.680	0.059	0.011	2520.	2680.	0.200	0.229	ls i ppv sv foss cht
	21	638.60- 38.89	0.29	0.14	0.70	0.68	0.49	0.203	0.088	0.026	2480.	2720.	0.000	0.775	ls i ppv foss
	22	638.89- 39.09	0.20	0.17	1850.	0.87	3.26	370.000	0.080	0.016	2500.	2720.	0.086	0.383	ls i foss pyr vfrac
	23	639.09- 39.36	0.27	0.14	3.15	2.94	0.08	0.850	0.099	0.027	2440.	2700.	TRACE	0.551	ls i ppv foss gyp
	24	639.36- 39.53	0.17	0.14	5.25	2.29	0.42	0.892	0.076	0.014	2500.	2710.	0.207	0.230	ls i ppv sv foss anhy
-		639.53- 39.74	0.21												ls cht gyp
SP	25	639.74- 39.83	0.09		0.87			0.078	0.078	0.007		2710.	0.298	0.236	ls i ppv sv foss
	26	639.83- 40.17	0.34	0.26	3.73	3.57	0.38	1.268	0.089	0.031	2460.	2700.	0.107	0.681	ls i ppv sv foss gyp
	27	640.17- 40.38	0.21	0.13	1.95	1.24	0.09	0.410	0.071	0.015	2520.	2710.	0.000	0.817	ls i ppv foss gyp cht
SP	28	640.38- 40.45	0.07		2.79			0.195	0.077	0.006		2700.	0.225	0.157	ls i ppv sv foss
SP	29	640.45- 40.58	0.13		0.23			0.030	0.050	0.007		2700.	0.143	0.512	ls i ppv foss cht
-		640.58- 43.34	2.76												ls shy gyp cht
SP	30	643.34- 43.45	0.11		0.81			0.089	0.064	0.007		2680.	0.125	0.301	ls i ppv sv foss
	31	643.45- 43.93	0.48	0.11	0.60	0.35	0.11	0.288	0.112	0.053	2440.	2750.	0.000	0.928	ls i gyp anhy pyr
	32	643.93- 44.18	0.25	0.22	1.41	0.51	0.39	0.352	0.123	0.030	2400.	2740.	0.000	0.737	ls i ppv foss anhy vfrac
	33	644.18- 44.37	0.19	0.12	5.72	3.68	1.49	1.087	0.105	0.019	2430.	2710.	0.000	0.749	ls i ppv sv foss
	34	644.37- 44.58	0.21	0.07	10.9	9.94	7.23	2.289	0.117	0.025	2410.	2730.	0.249	0.251	ls i ppv sv foss 31 API
	35	644.58- 44.81	0.23	0.09	4.03	3.98	2.75	0.927	0.114	0.025	2430.	2740.	0.299	0.301	ls i ppv sv foss
SP	36	644.81- 44.95	0.14		150.			21.000	0.117	0.017		2690.	0.206	0.272	ls i sv foss
		644.95- 45.00	0.05												Lost core
		CORE NO.2 645.00 - 650.00m (Core Recieved 4.70m) (4 Boxes)													
	37	645.00- 45.38	0.38	0.26	162.	113.	49.7	61.560	0.136	0.053	2330.	2700.	0.196	0.301	ls i sv mv foss
	38	645.38- 45.71	0.33	0.27	41.8	39.4	3.81	13.794	0.112	0.036	2400.	2700.	0.215	0.266	ls i ppv sv foss shbk 32 API
	39	645.71- 46.09	0.38	0.27	57.8	55.6	12.4	21.964	0.119	0.046	2370.	2690.	0.124	0.533	ls i ppv sv foss
	40	646.09- 46.35	0.26	0.08	20.8	18.1	0.98	5.408	0.116	0.031	2390.	2700.	0.167	0.535	ls i ppv mv foss

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 3-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-150
Date : 1989 11 05

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH	INTVL REP	SAMPLE LENGTH	PERMEABILITY			CAPACITY (MAXIMUM) Kair	POROSITY (HELIUM)	CAPACITY (HELIUM)	BULK DENSITY	GRAIN DENSITY	SATURATION (PORE VOLUME)		DESCRIPTION
				(MAXIMUM) Kair	(90 DEG) Kair	(VERTICAL) Kair						OIL	WATER	
	m	m	m	mD	mD	mD	mD-m	fraction	ϕ-m	kg/m3	kg/m3	frac	frac	
SP 41	646.35- 46.47	0.12		4.97			0.596	0.106	0.013		2710.	0.061	0.699	ls i ppv foss gyp shbks
SP 42	646.47- 46.63	0.16		16.9			2.704	0.100	0.016		2700.	0.125	0.340	ls i ppv sv foss
SP 43	646.63- 46.76	0.13		6.90			0.897	0.084	0.010		2700.	0.185	0.270	ls i ppv foss
SP 44	646.76- 46.86	0.10		299.			29.900	0.105	0.010		2680.	0.251	0.339	ls i sv foss
45	646.86- 47.07	0.21	0.16	8.58	7.64	5.34	1.802	0.150	0.032	2300.	2710.	0.000	0.647	ls i ppv sv foss 33 API
46	647.07- 47.34	0.27	0.21	1.48	1.45	0.36	0.400	0.074	0.019	2510.	2710.	0.163	0.210	ls i ppv foss anhy
	647.34- 49.70	2.36												ls shy cht gyp
	649.70- 50.00	0.30												Lost core

Figure 1

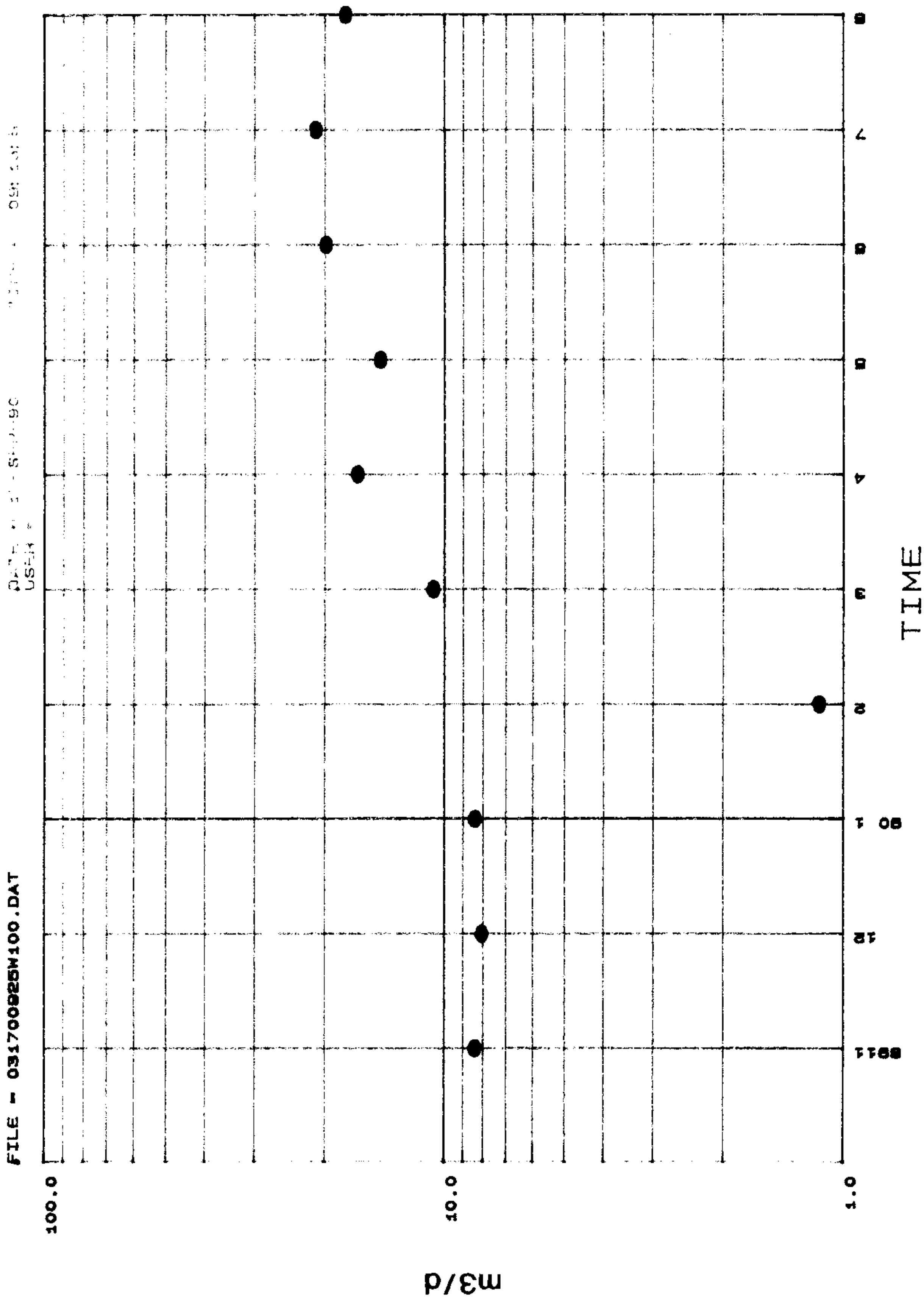
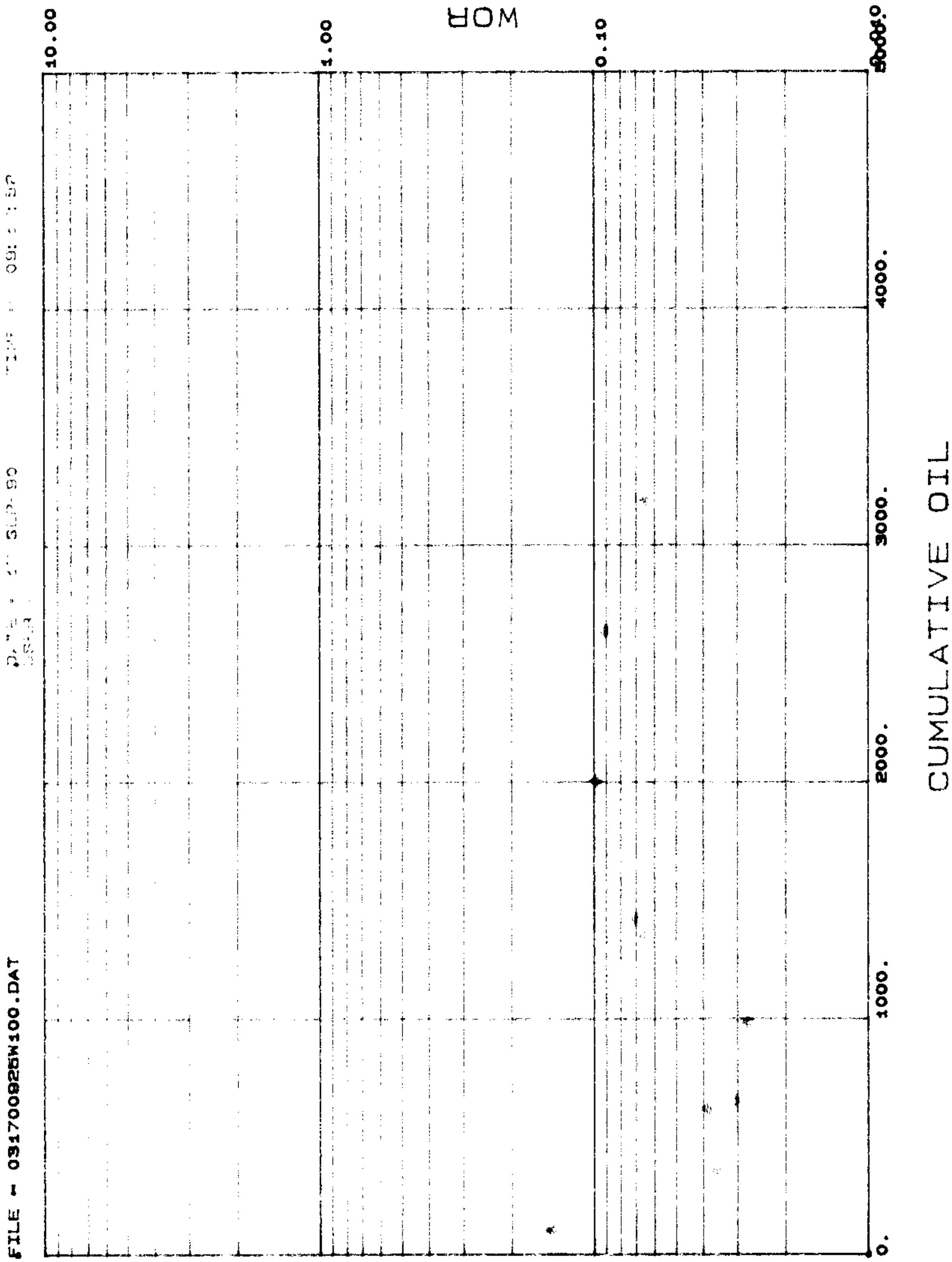


Figure 2



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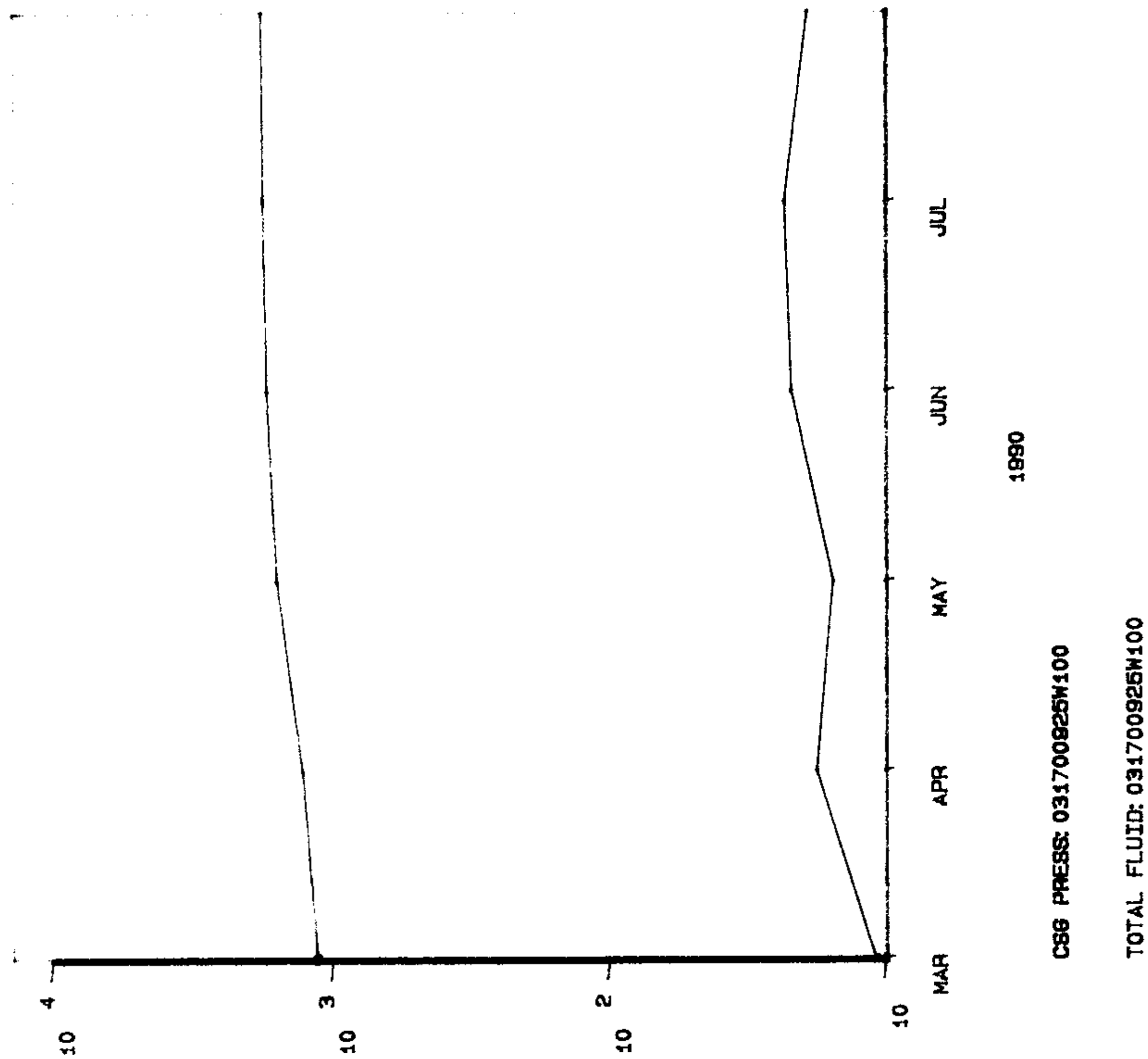
CUMULATIVE OIL

Figure 3



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10^2
10
MAR
APR
MAY
JUN
JUL
1990
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TOTAL FLUID: 031700925W100

Figure 4

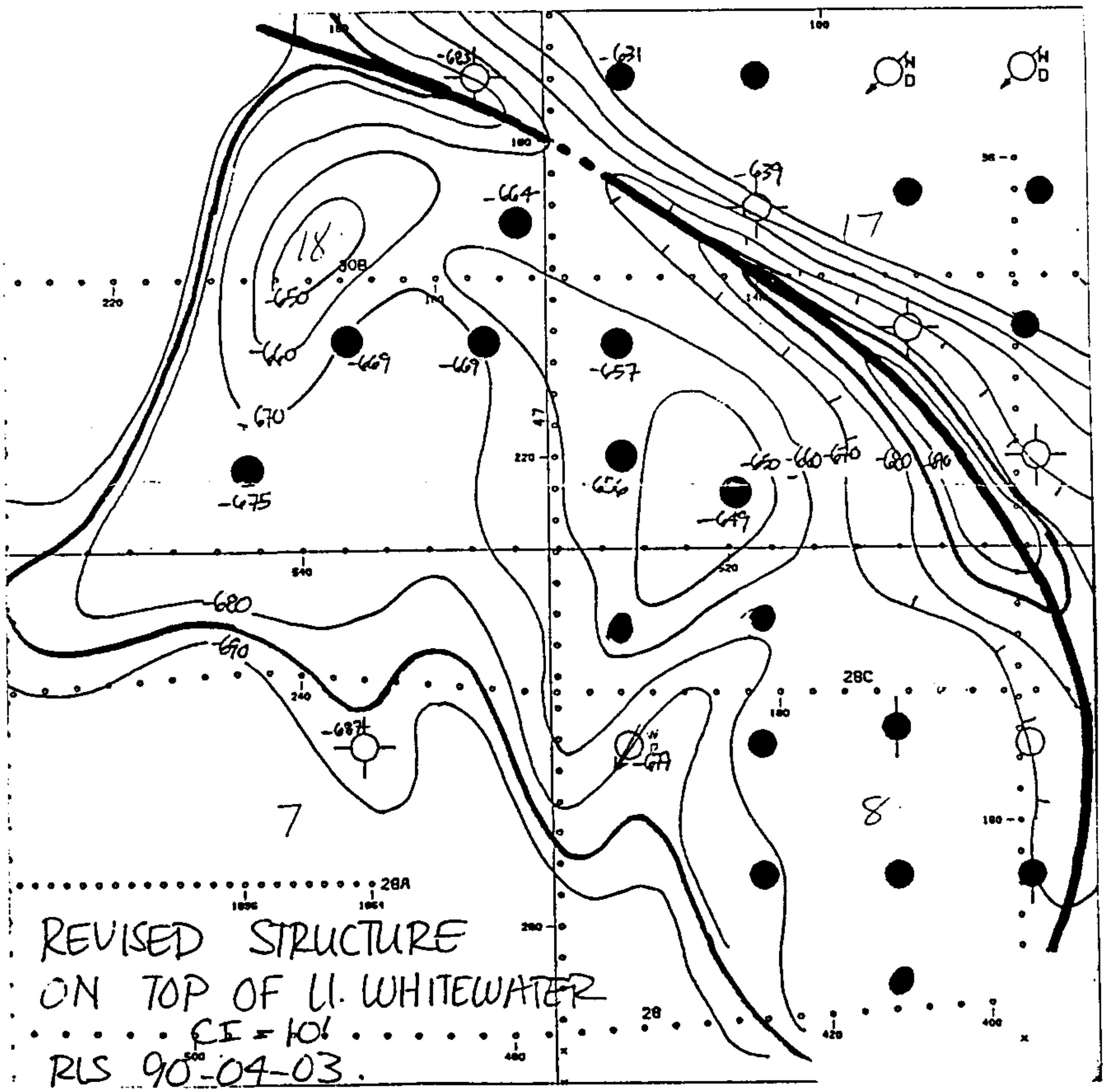
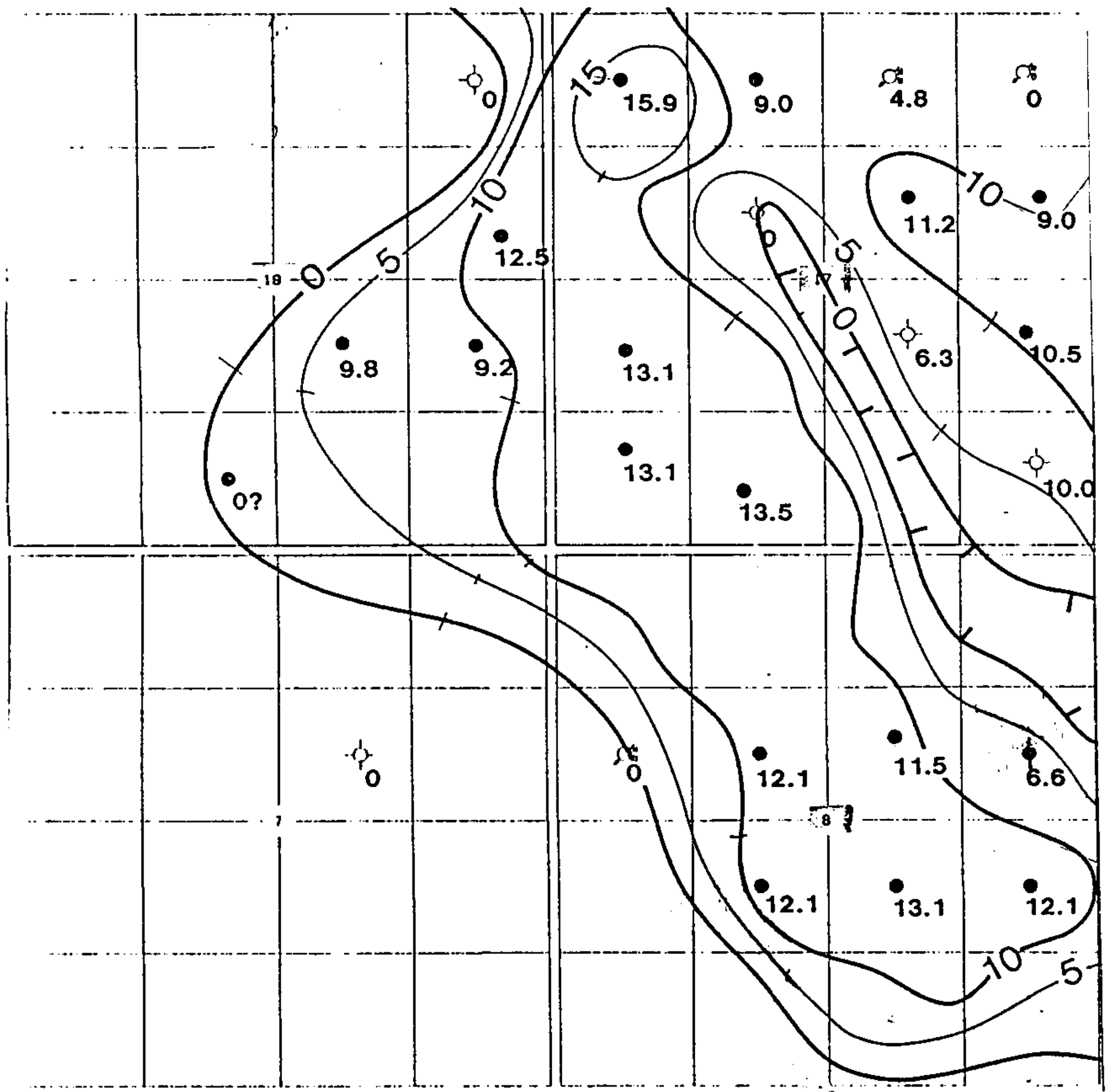


Figure 5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13.1
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0?
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5

APPENDIX A

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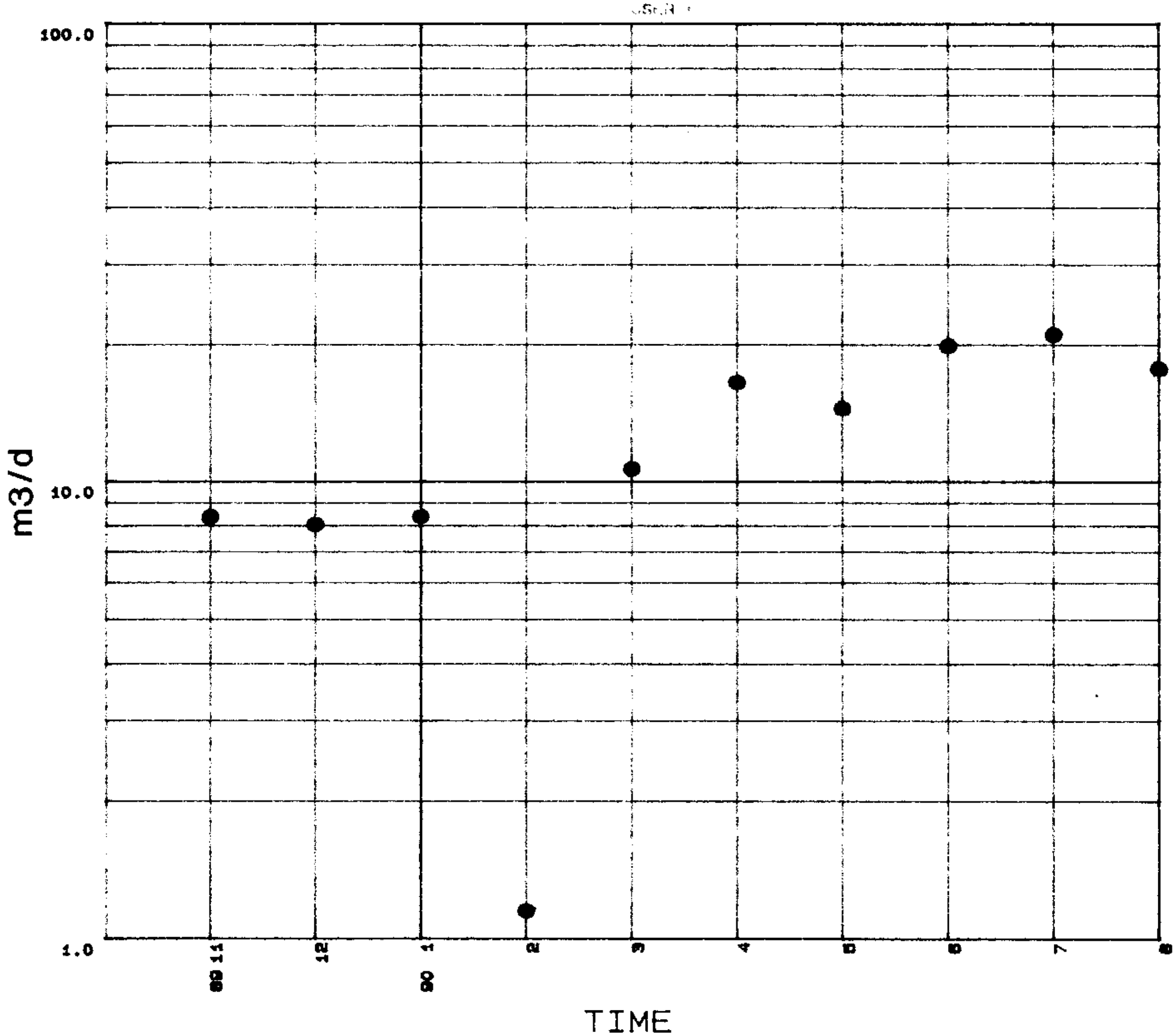

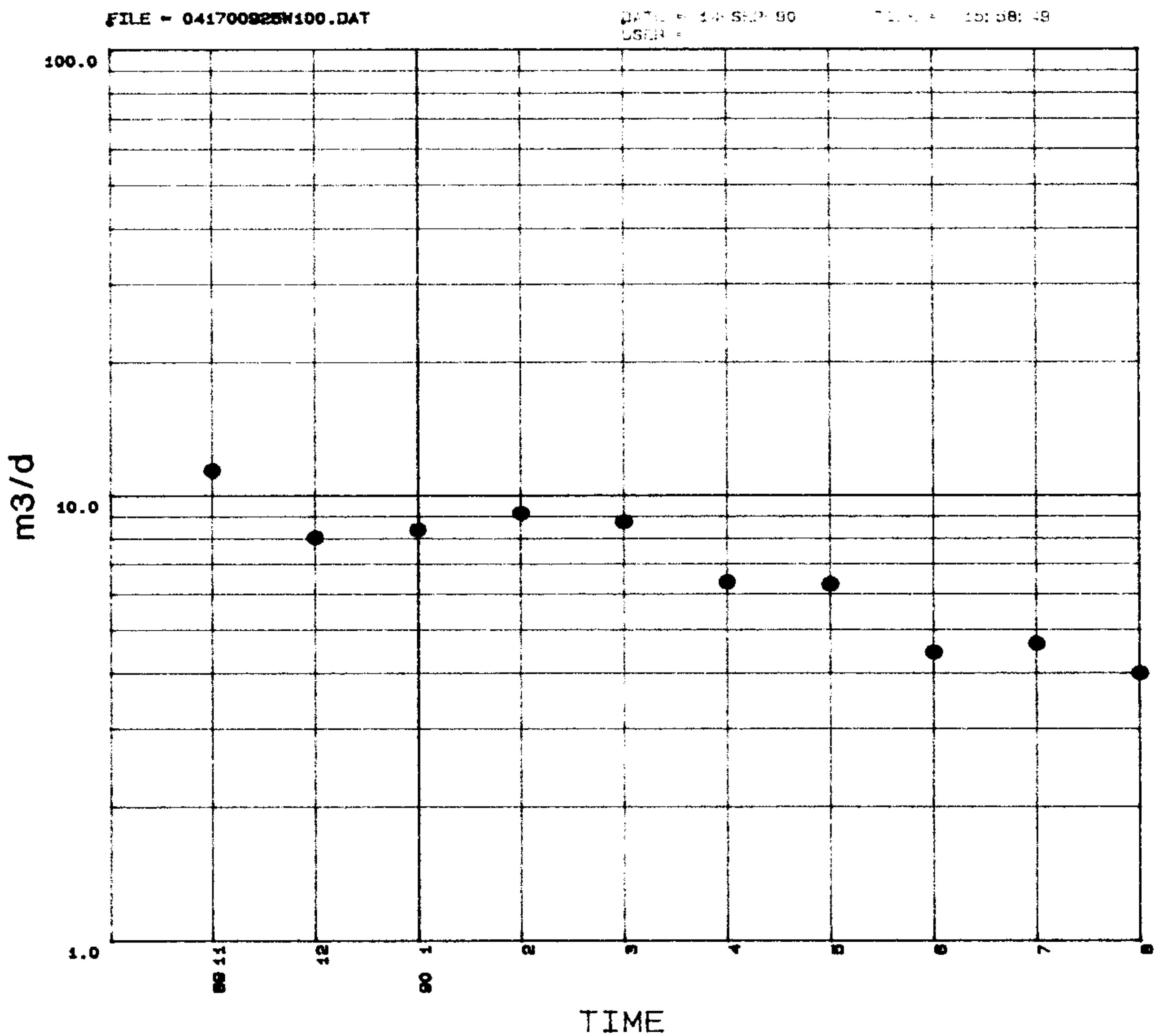
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12
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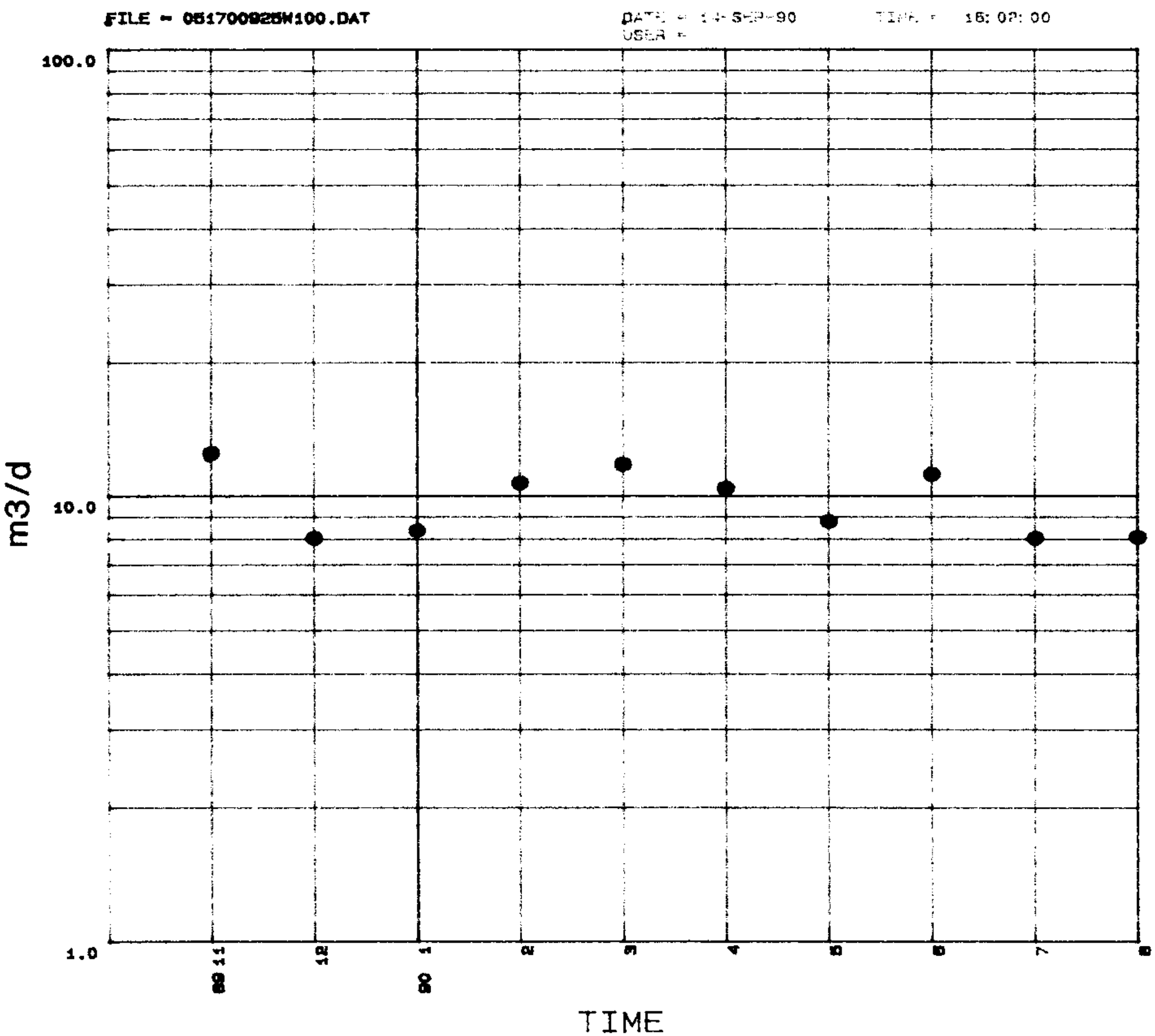
8
TIME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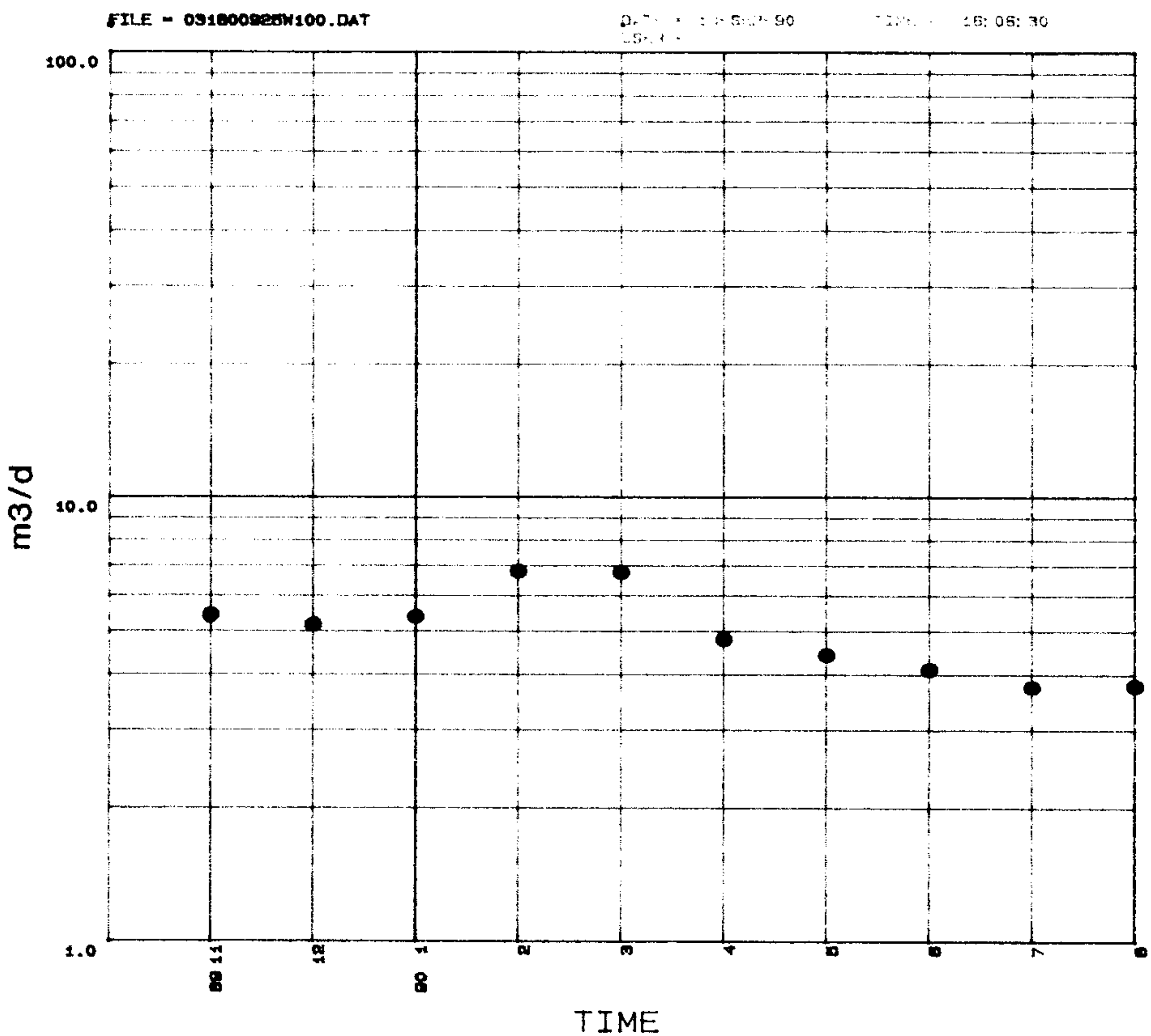
12
90 1
2
3
4
5
6
7
8
TIME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6
7
8
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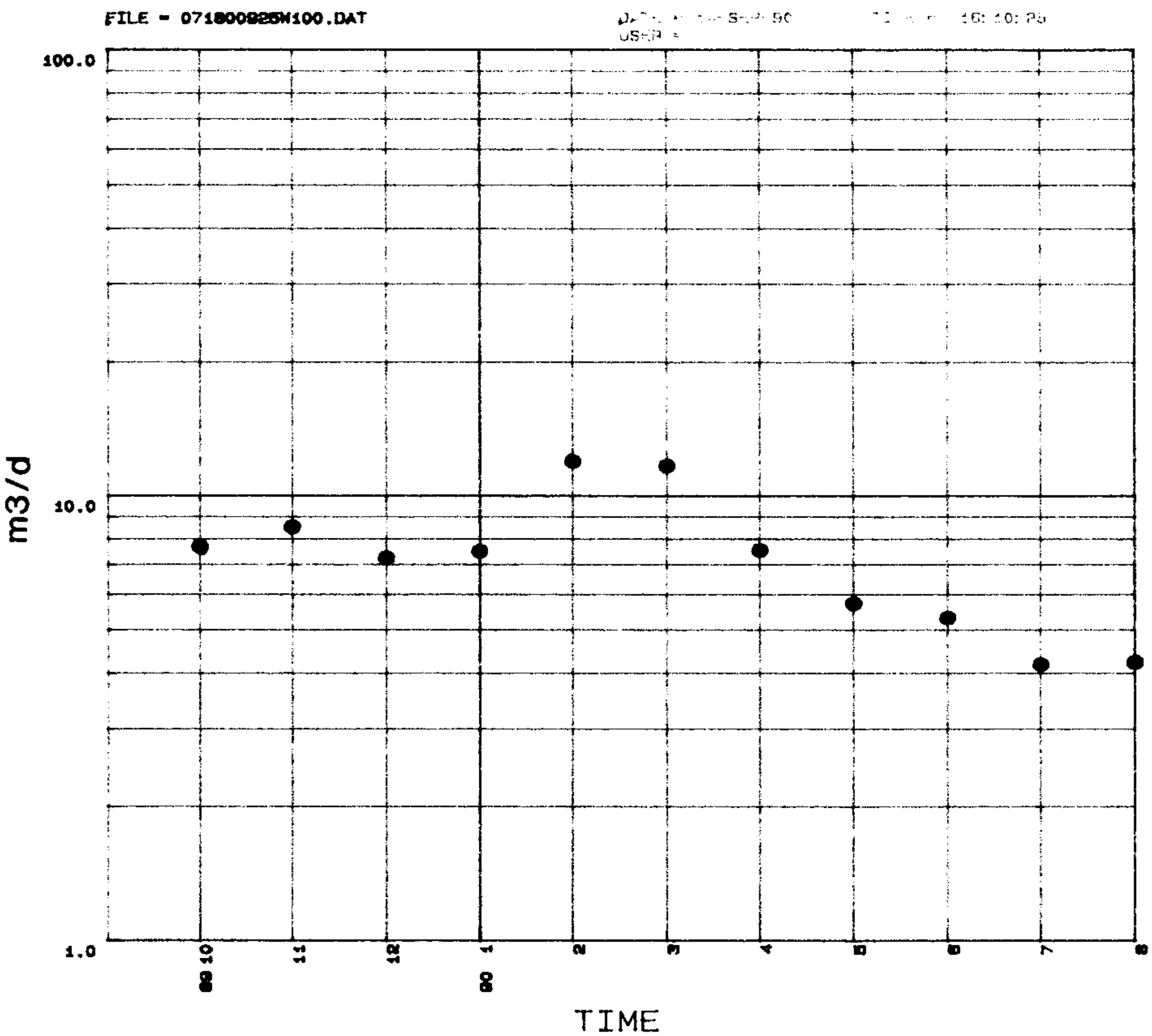

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12
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2
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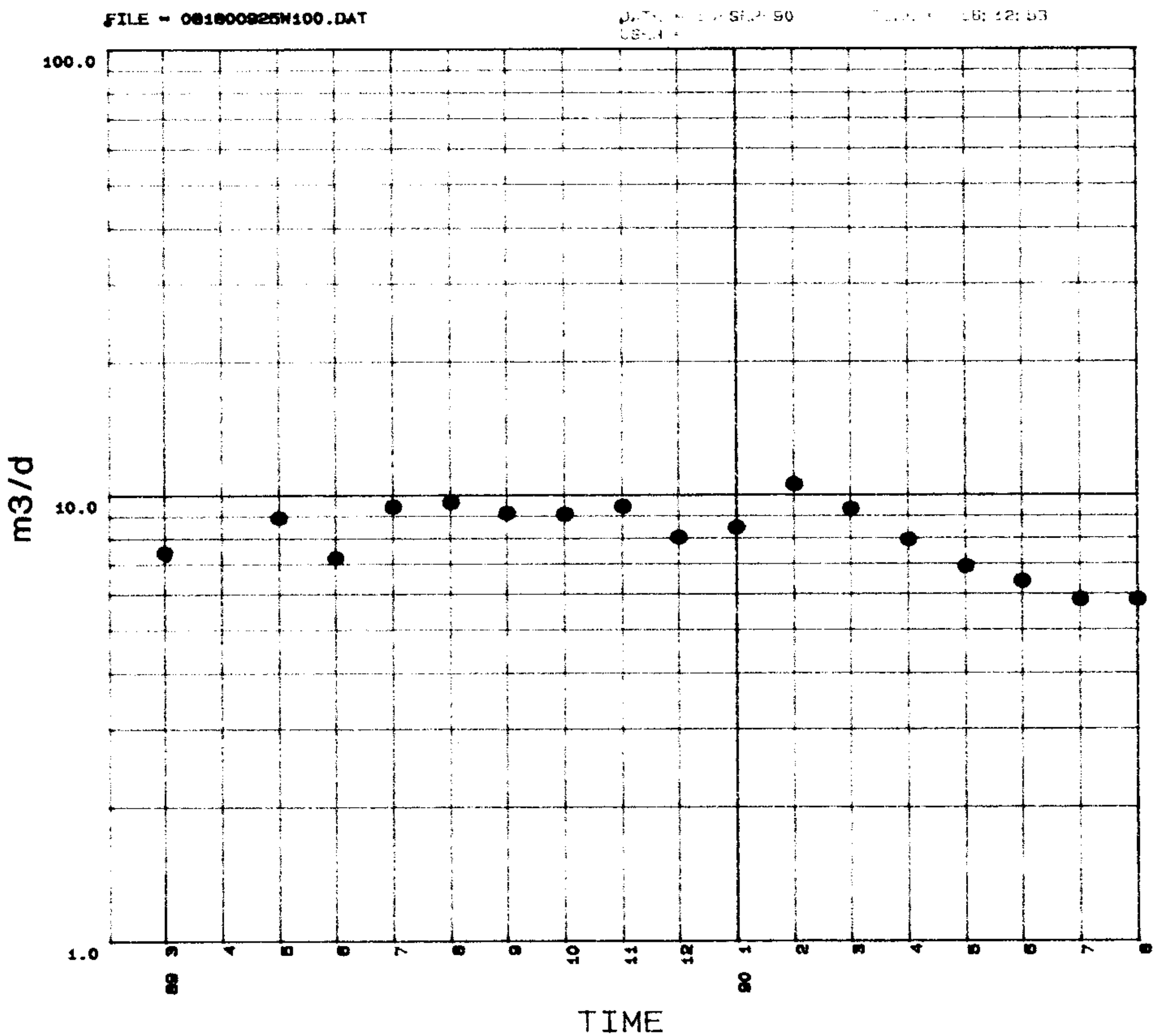
6
7
8
TIME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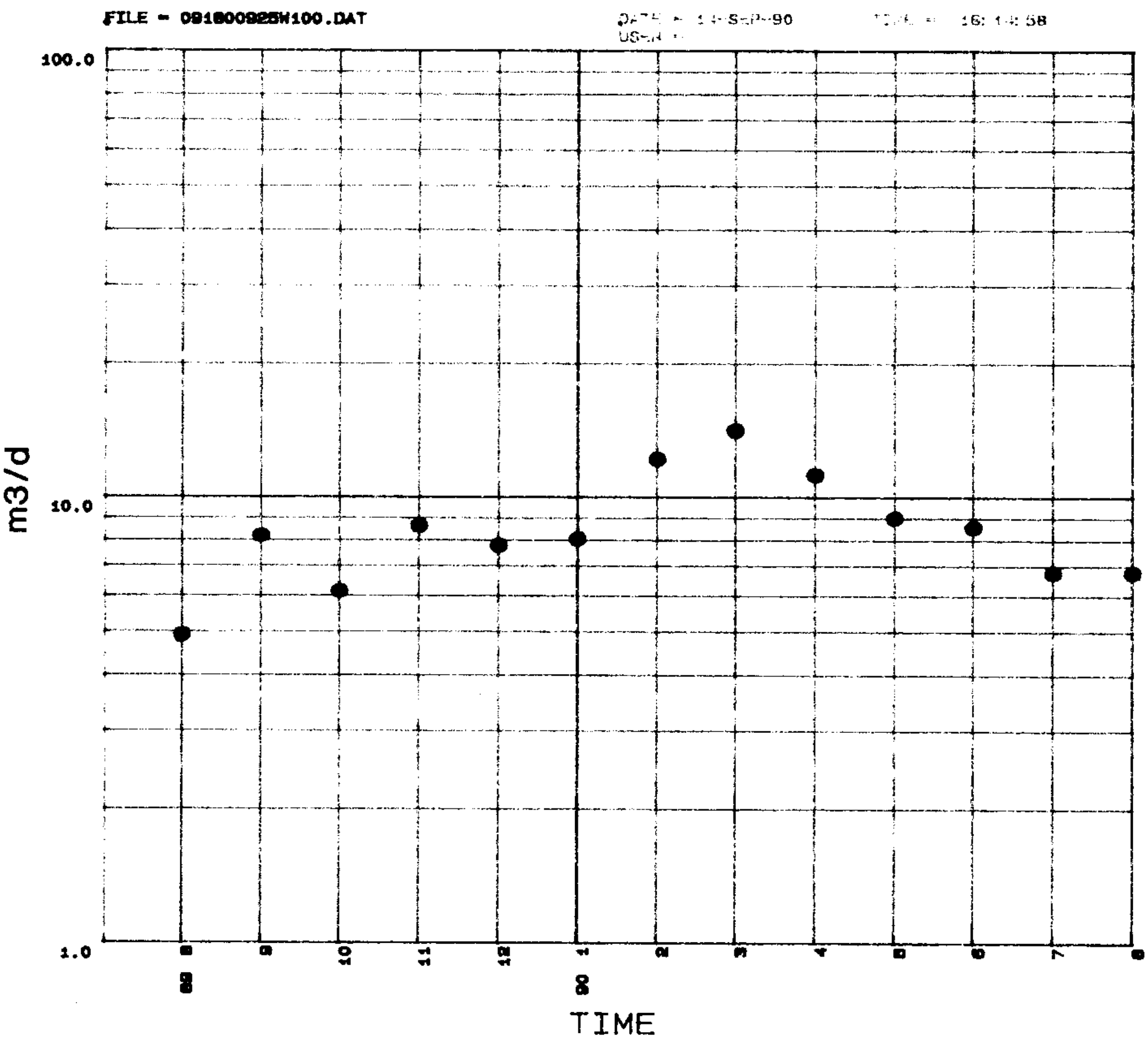
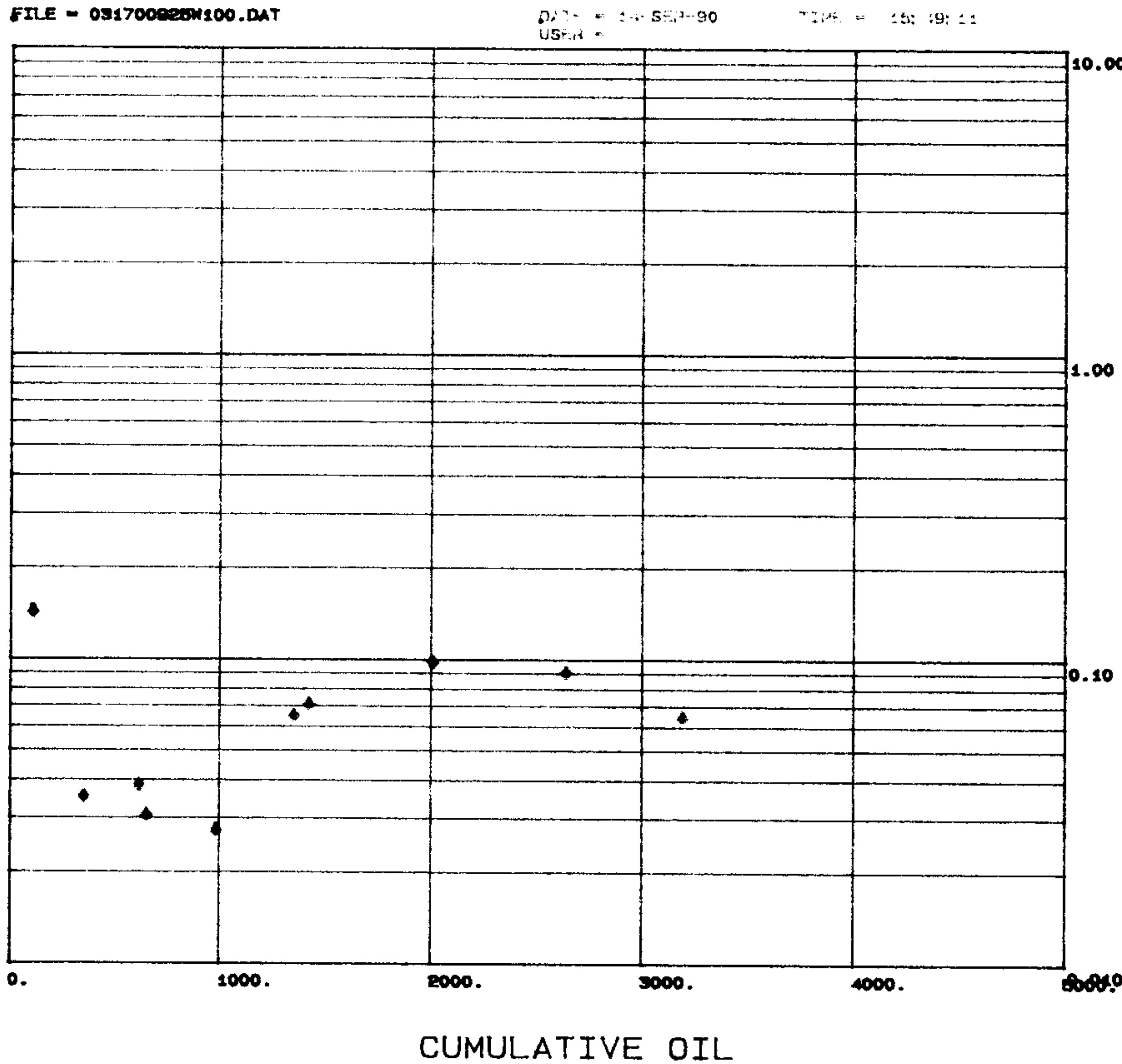
12
1
2
3
4
5
6
7
8
89
90
TIME



100.0
10.0
1.0
m3/d
8
9
10
11
12
1
2
3
4
5
6
7
8
89
90
TIME

APPENDIX B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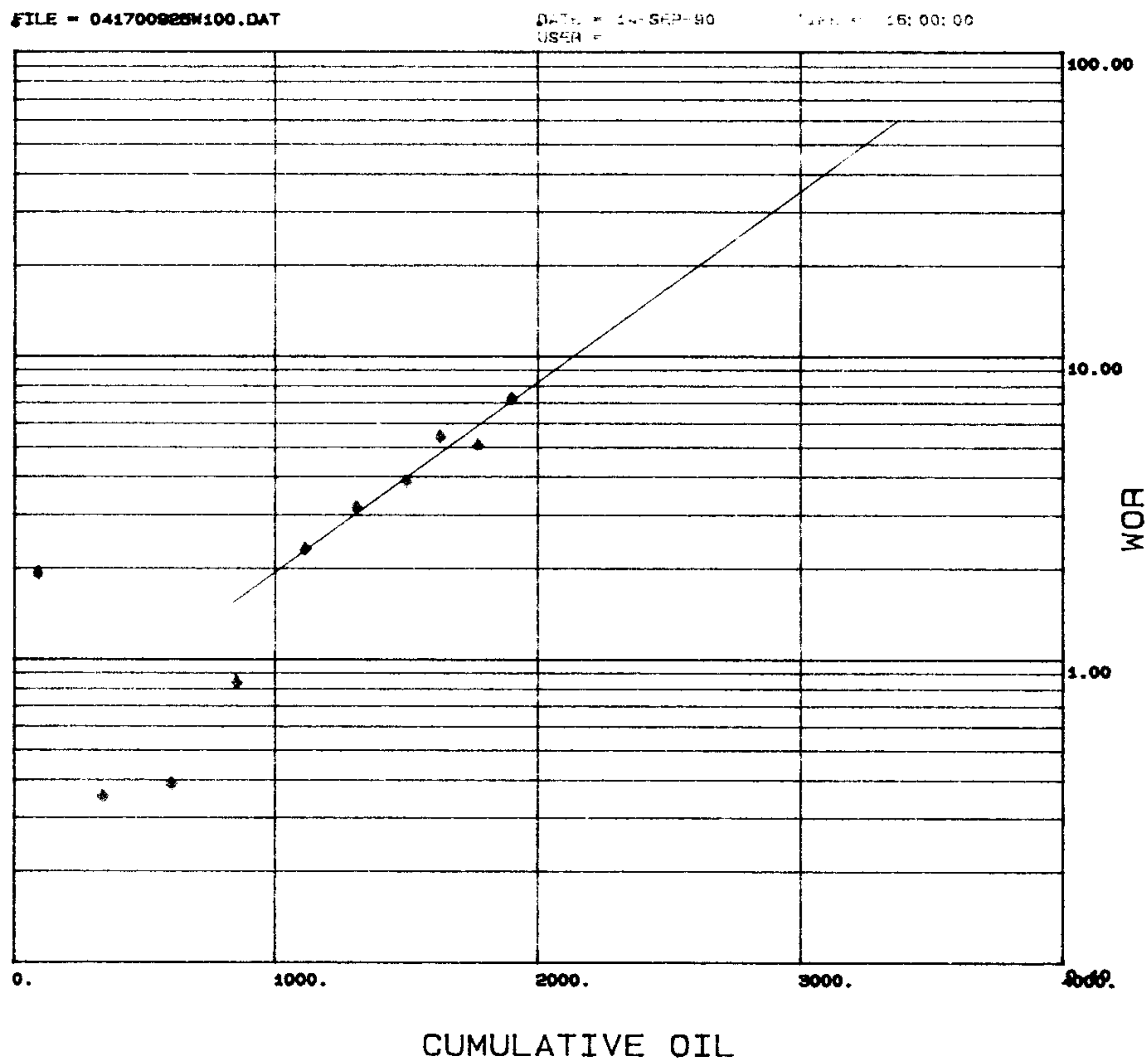
CUMULATIVE OIL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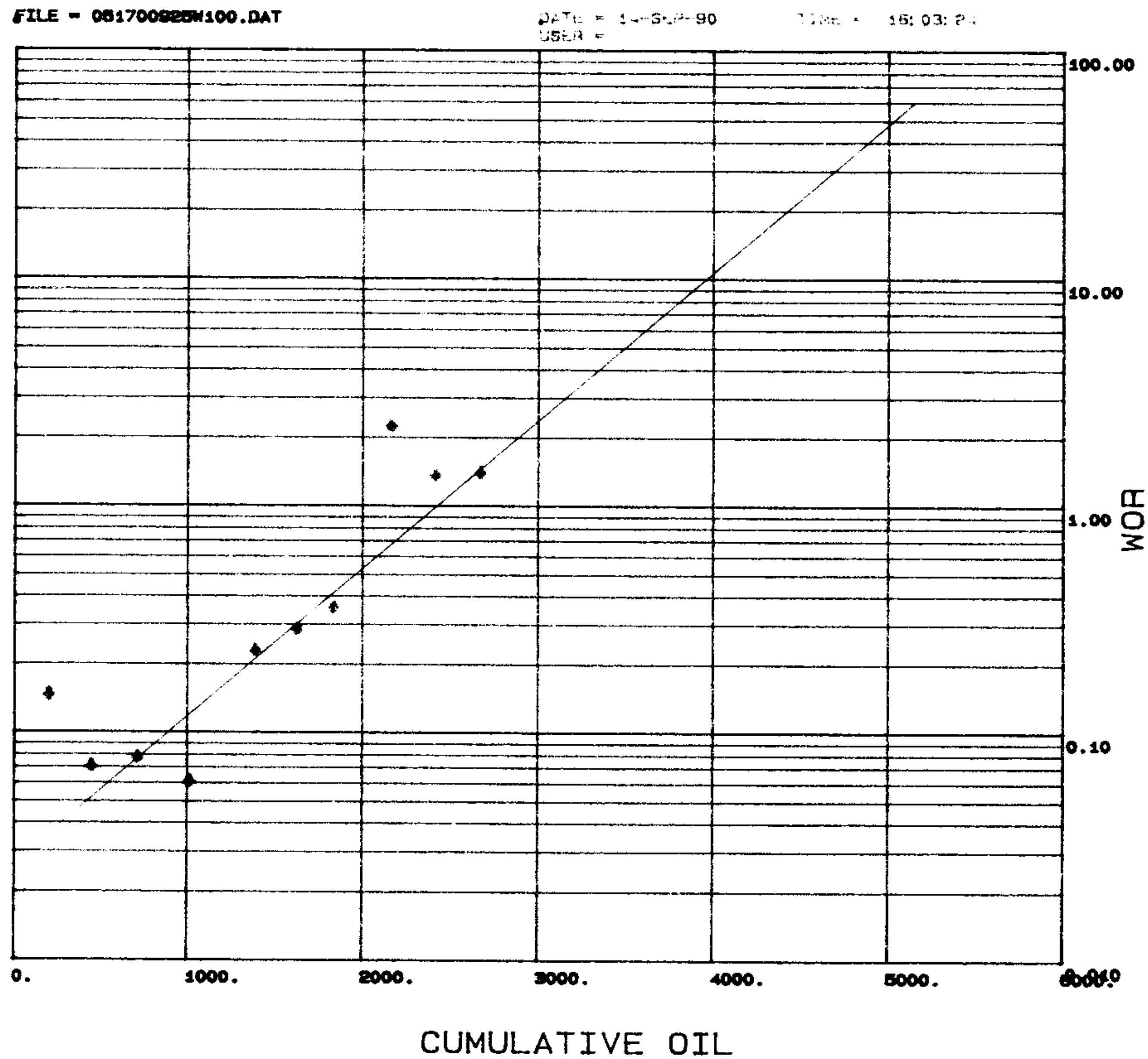
CUMULATIVE OIL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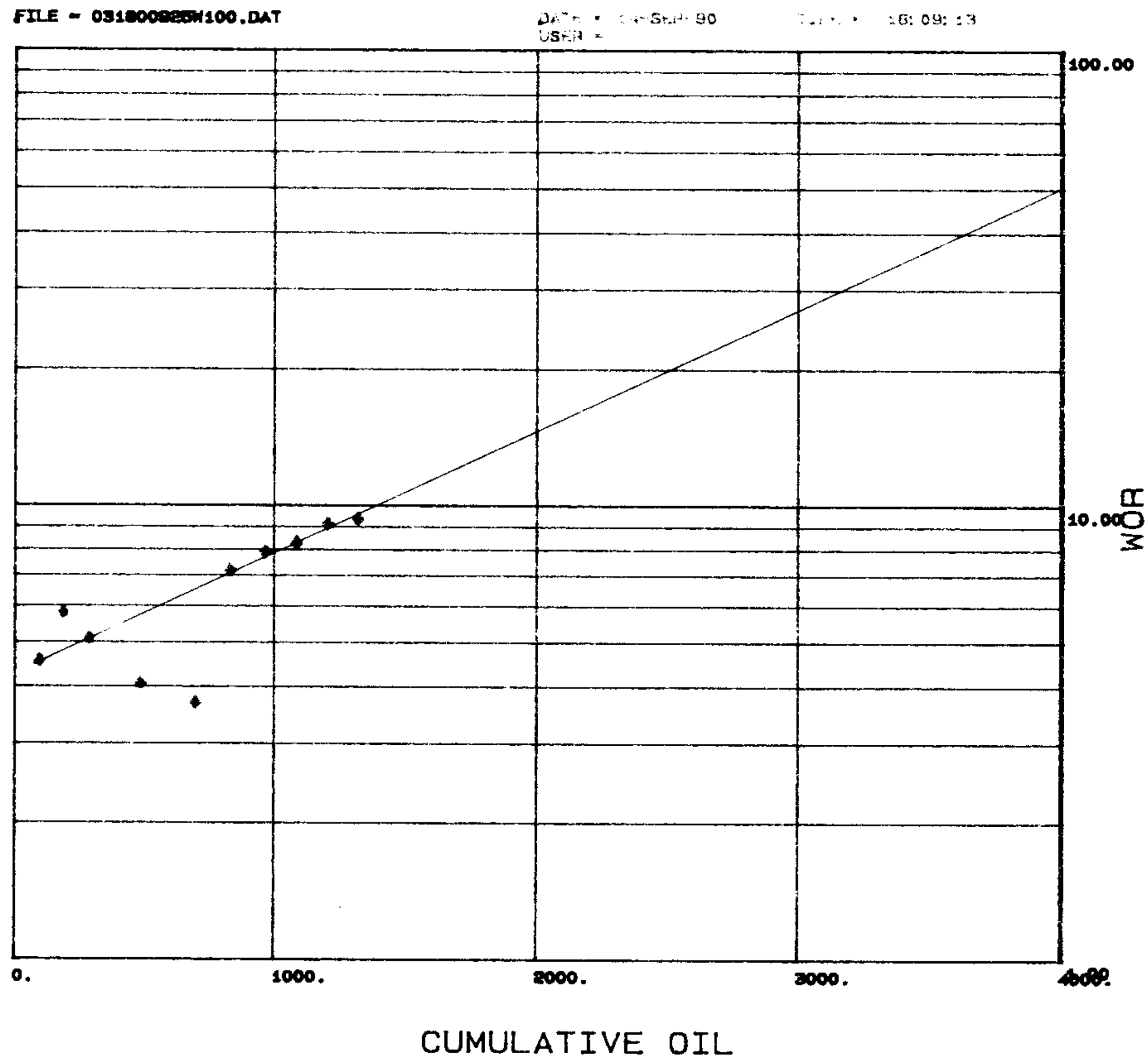
CUMULATIVE OIL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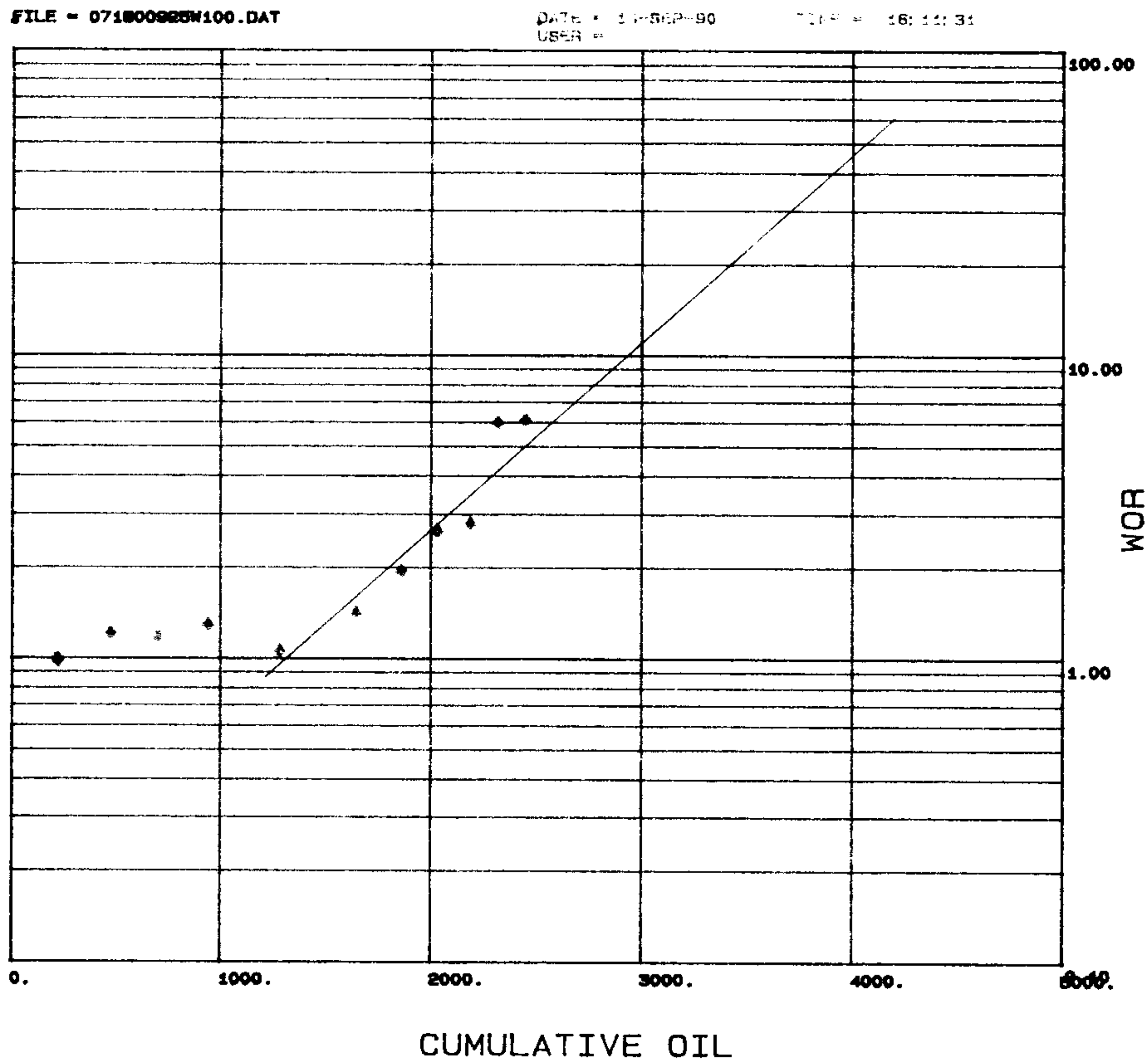
CUMULATIVE OIL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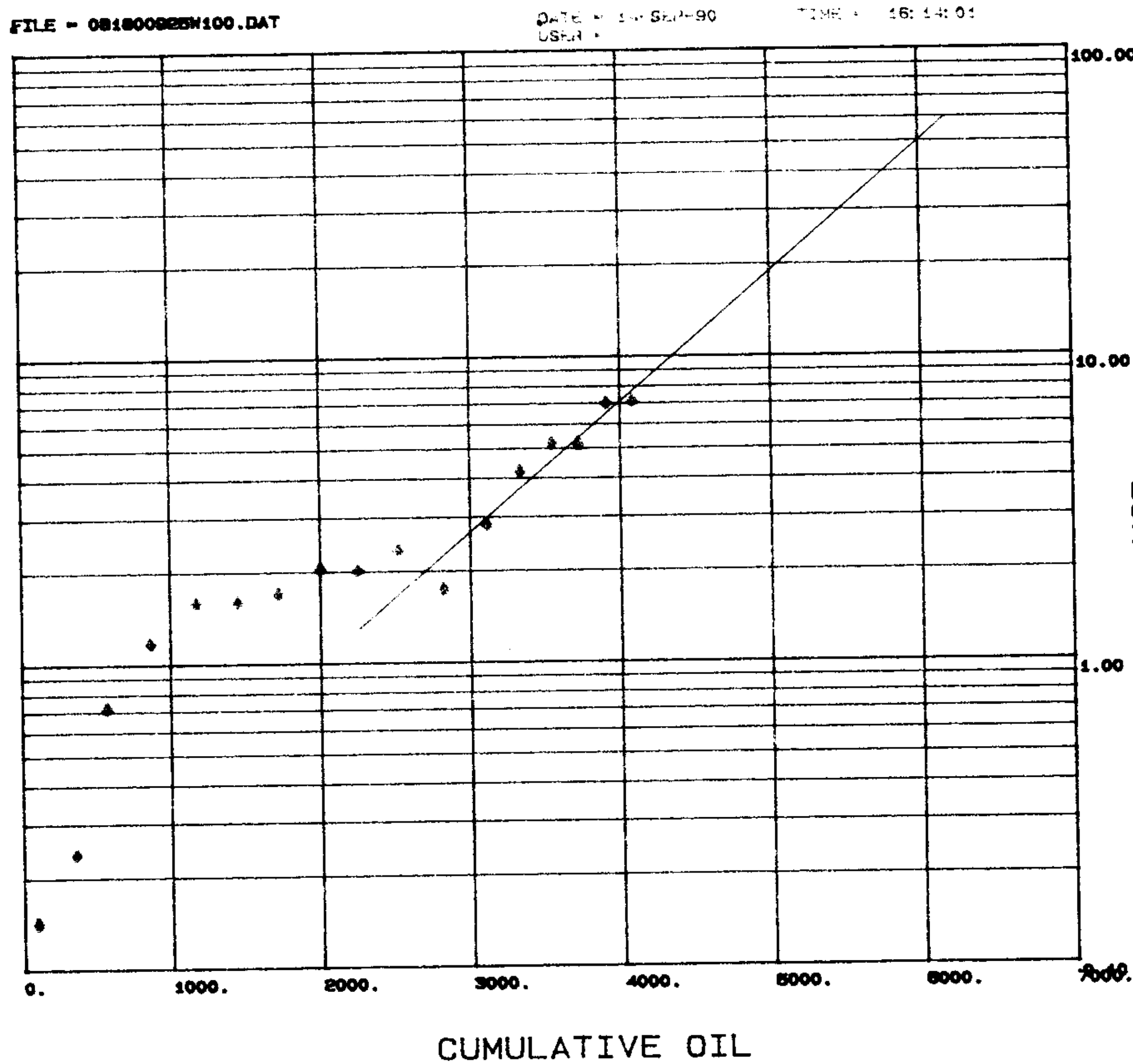
CUMULATIVE OIL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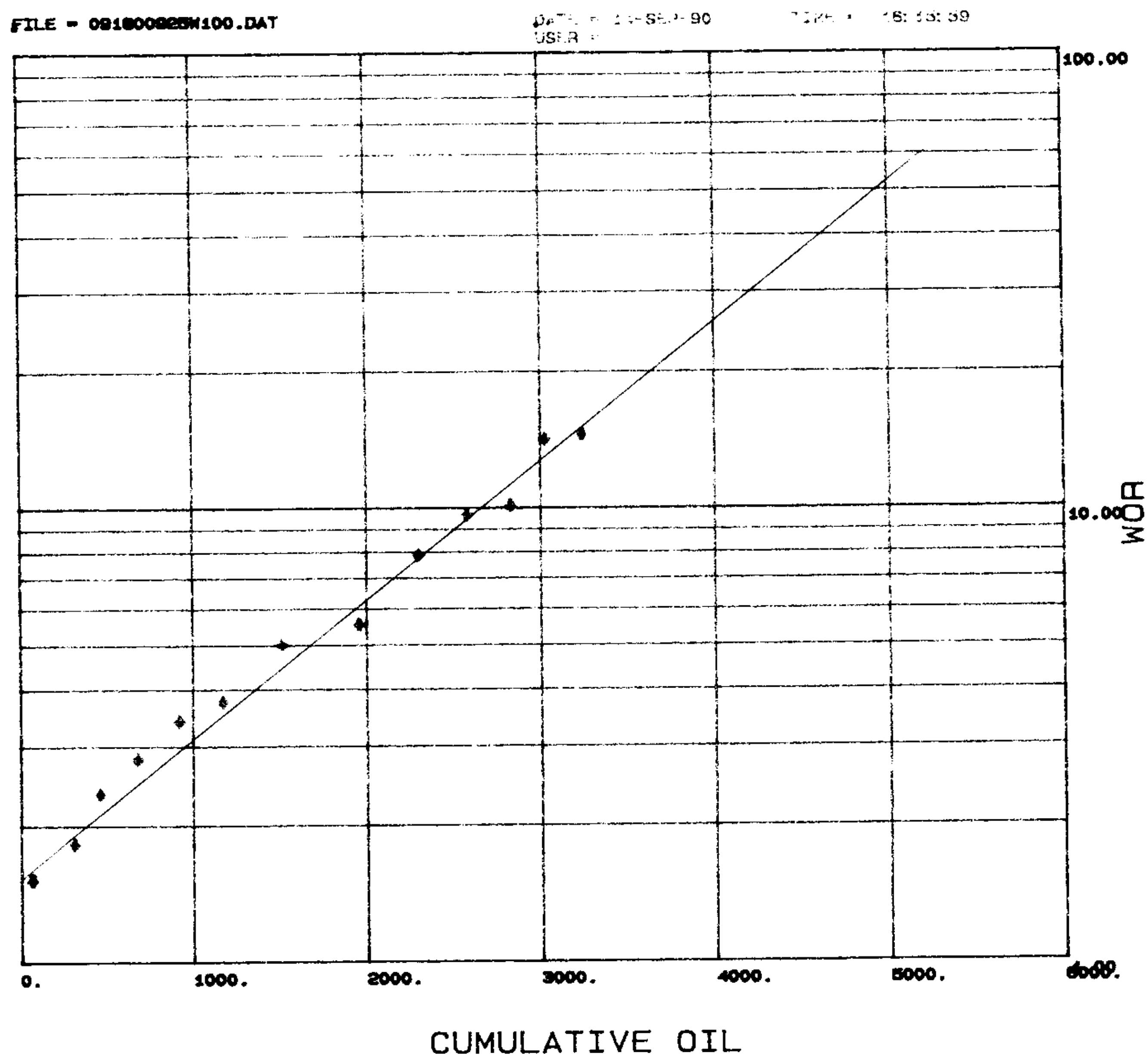
6000.
WOR
CUMULATIVE OIL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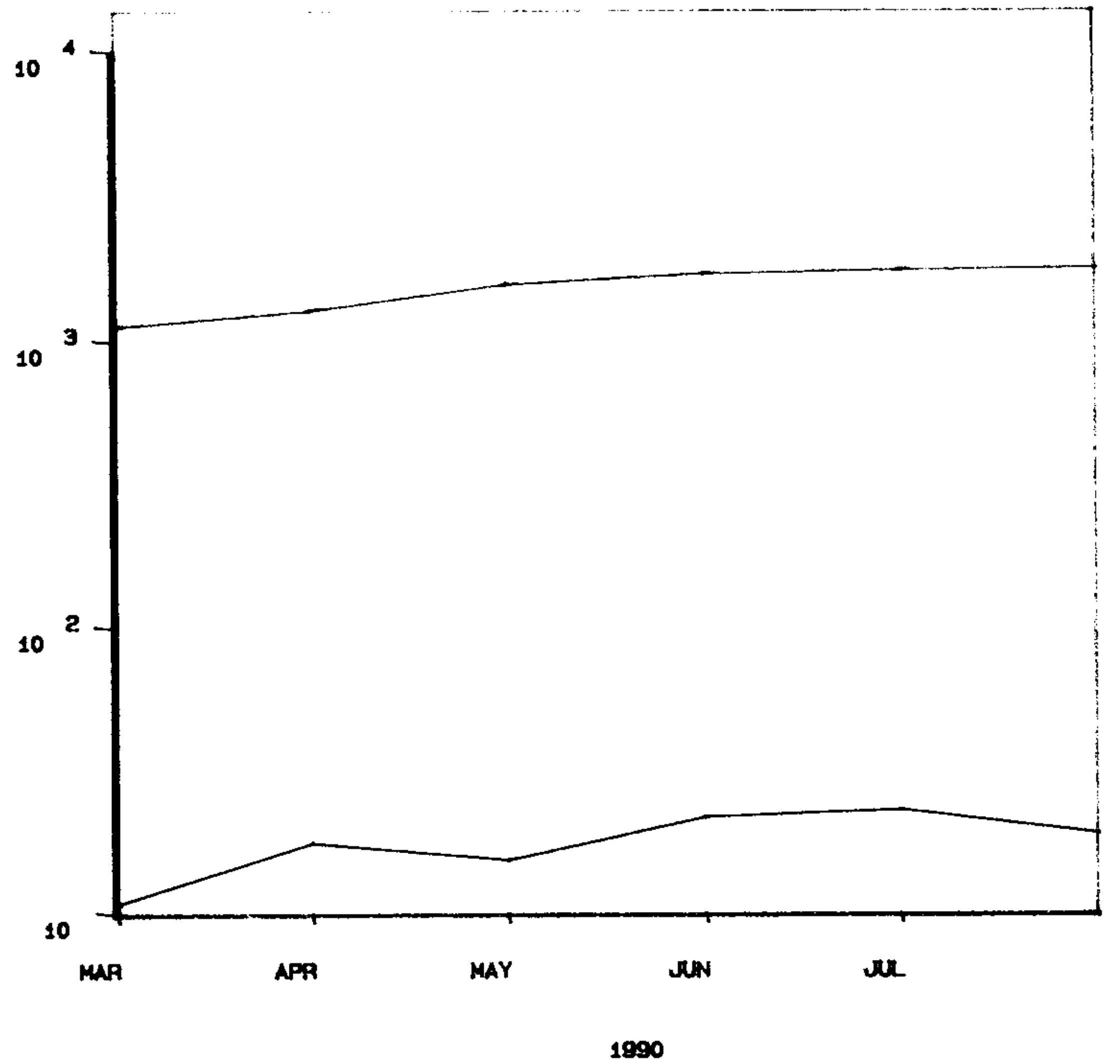
6000.
CUMULATIVE OIL

APPENDIX C



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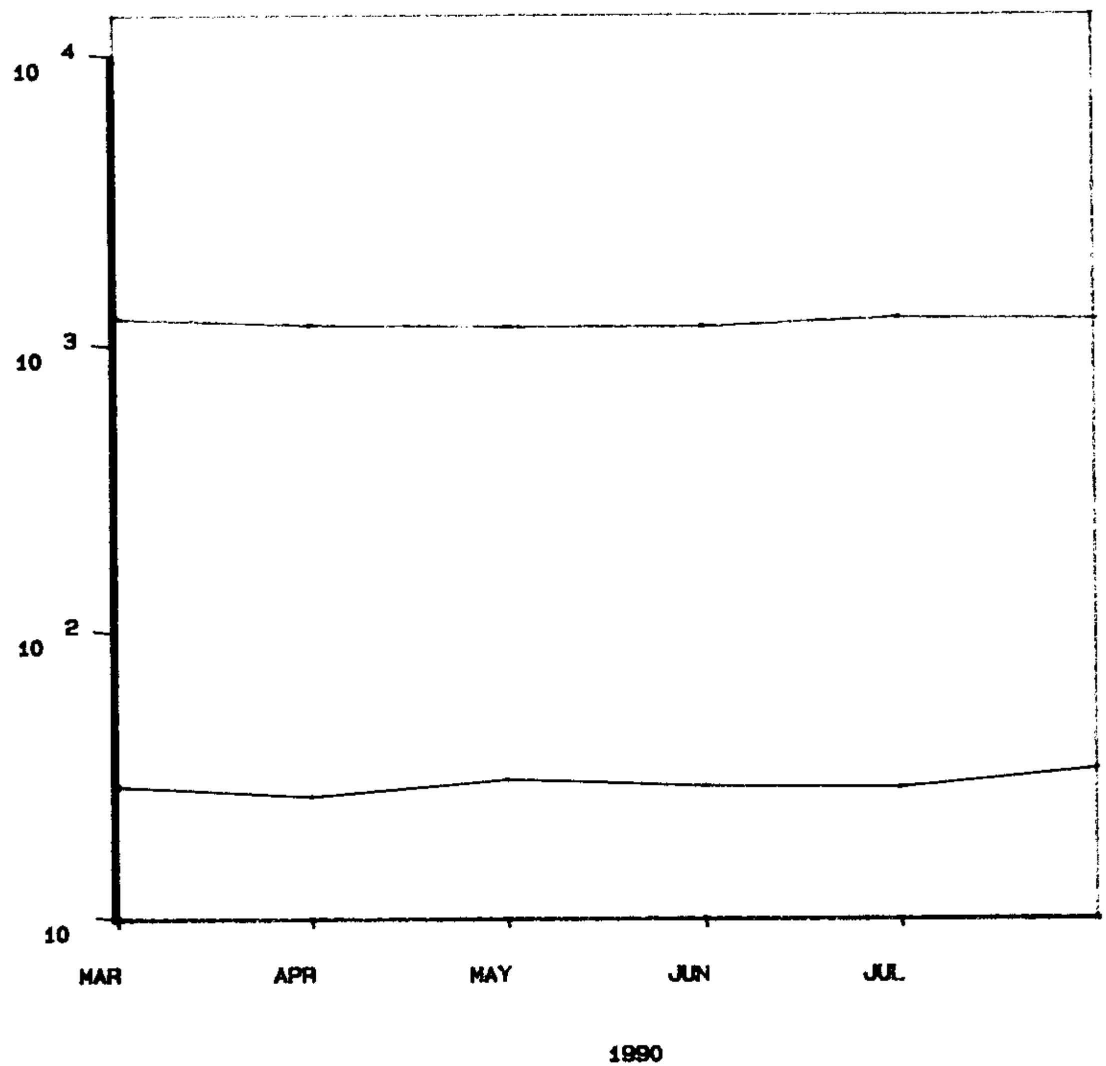
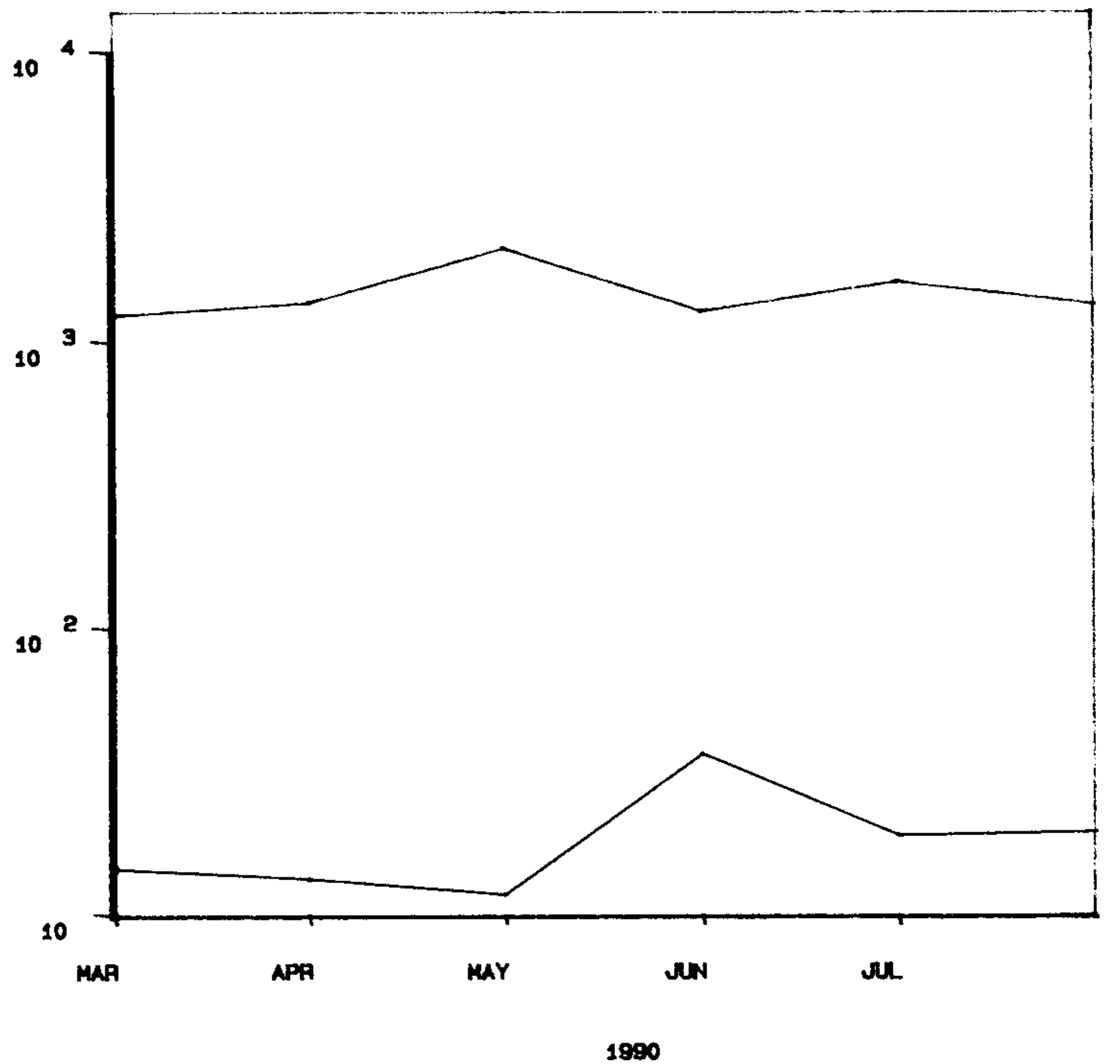
TOTAL FLUID: 031700925W100



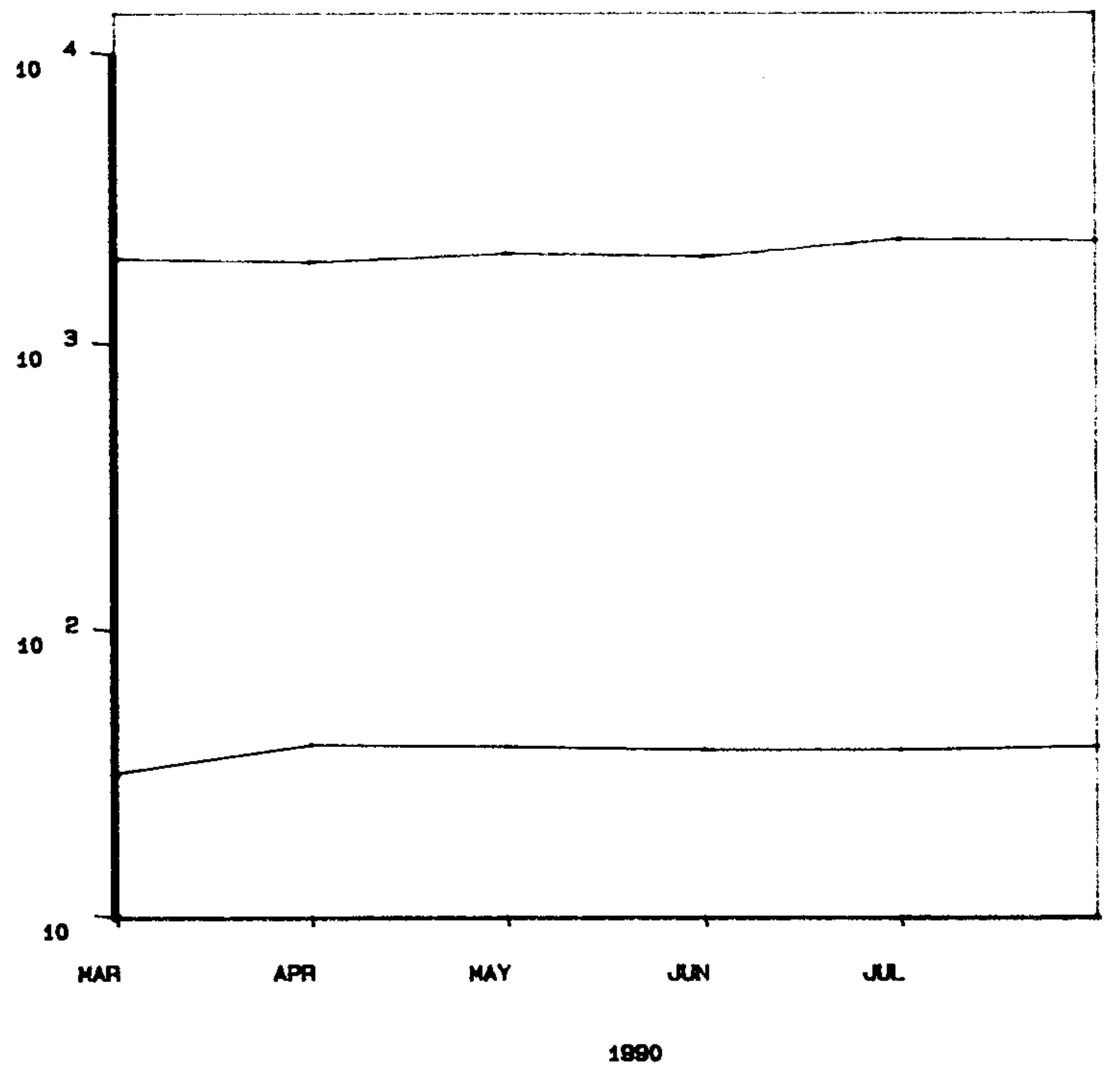
CSG PRESS: 041700925W100

TOTAL FLUID: 041700925W100



CSG PRESS: 051700925W100

TOTAL FLUID: 051700925W100



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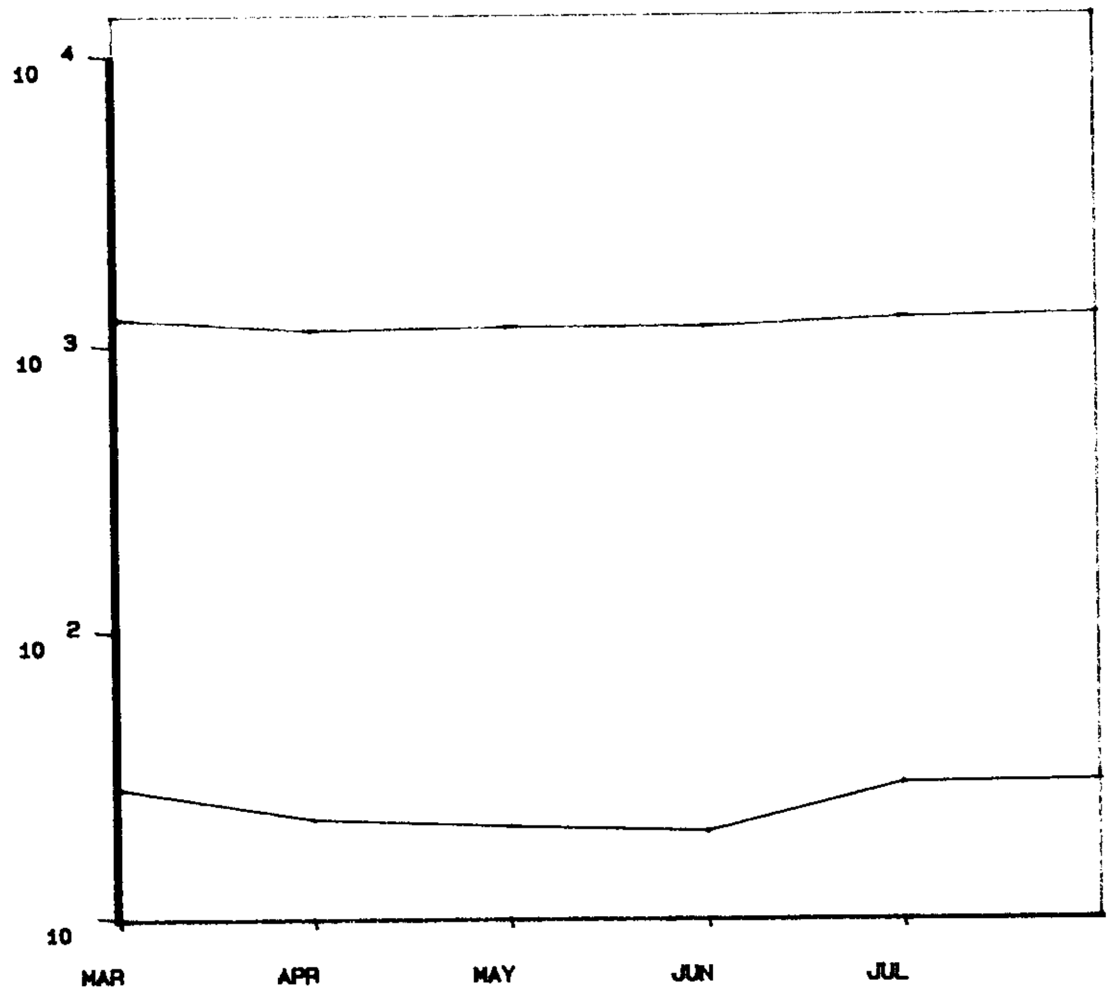
TOTAL FLUID: 031800925W100



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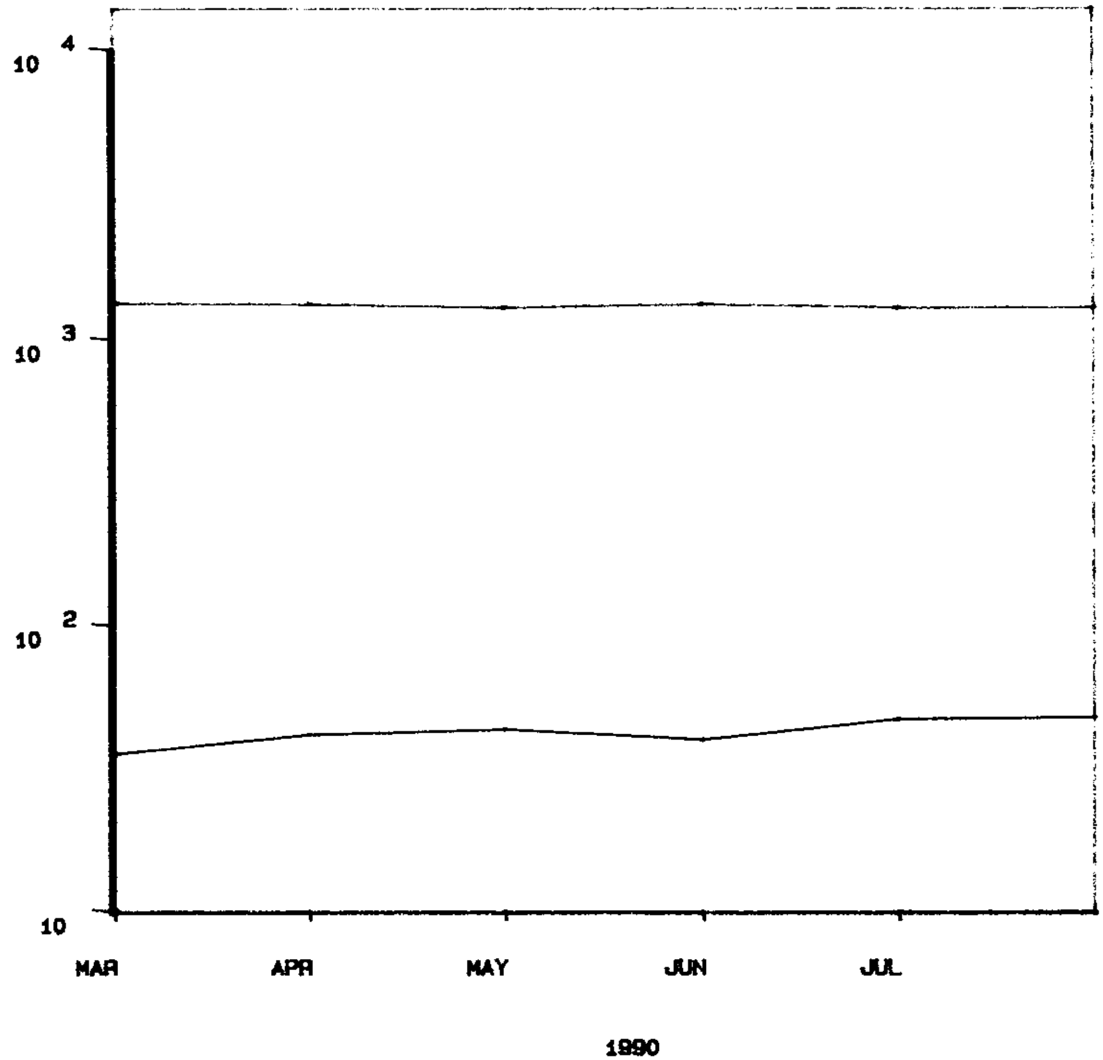
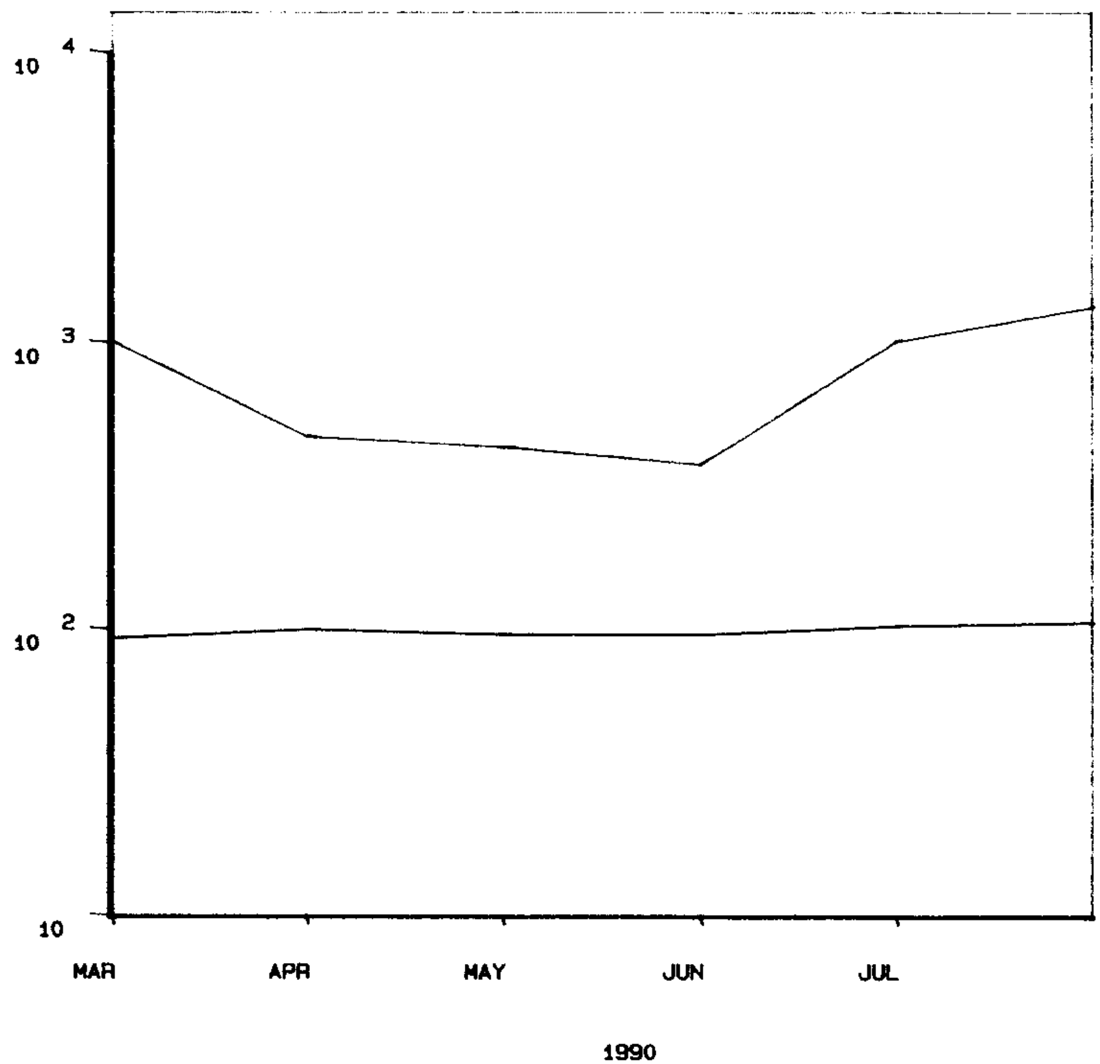
TOTAL FLUID: 071800925W100



CSG PRESS: 081800925W100

TOTAL FLUID: 081800925W100



CSG PRESS: 091800925W100

TOTAL FLUID: 091800925W100

The wells in Sections 8, 17 & 18 9-23 W1M were reviewed to determine an oil/water contact in the Upper Virden Member Fm. The o/w contact is difficult to pick from logs. The most reliable indication of the o/w contact is the initial well completion and production histories. The 6-8, 9-8 and 12-8 wells all swabbed 95% water from the U.V. during completion. The 11-8 well which is [illegible] the UV has produced 1542 m3 oil with a cumulative WOR 23.5 m3/m3 and is suspended. Based on this information the estimated oil/water contact is -213.6 m SS.

The [illegible] logs in U Virden [illegible] two structural highs [illegible] 3-17-9-23 [illegible]. The two highs [illegible] undrilled locations 13-16 [illegible] making the [illegible] of oil [illegible] in the U.V. from these locations very unlikely.

SUMMARY OF 6 MONTH MPR TEMPORARY INCREASE

MARCH 1 to AUG 31/90

MONTH	OIL	WATER	TOTAL FLUID	WOR	COMMENTS
MAR/90	2277.3	5257.6	7534.9	2.31	9-18 installed longer pump, in-line gear pumps installed 4-17 installed pumpjack
APR	1713.8	5717.3	7431.1	3.34	3-17, 5-17 electrified install in-line gear pump
MAY	1270.9	6147.5	7418.4	4.84	
JUN	1750.0	6442.9	8192.9	3.68	
JUL	1659.8	7121.9	8781.7	4.21	
AUG	1573	7566.9	9139.9	4.81	
	10274.8				
MAR - MAY	1754	5707	7461	3.25	
JUN - AUG	1660	7044	8703	4.24	

A/ PRESSURE SURVEY APRIL 24/90

WELL	RESERVOIR PRESSURE	ORIGINAL RESERVOIR PRESS.
3-18	6645	
7-18	6698	
8-18	6682	
9-18		6757

Well	Structure Top U.W.W.	Structure Top U.V.		Completion
[illegible]	-649'	-68[illegible]'	-207.6	
4-17	-6[illegible]'	-691'	-210.[illegible]	UV completed [illegible] 4 [illegible] [illegible] cement squeeze [illegible]
[illegible]	[illegible]'	-690'	-210.4	
[illegible]	-6[illegible]'	-710'	-216.-	
[illegible]	-66[illegible]'	-[illegible]02'	[illegible]	
[illegible]	66[illegible]'	[illegible]	[illegible]	DST [illegible] only water
[illegible]	[illegible]'	700'	[illegible]	
6-8	-671		-213.7)	UWW & UV wet cum. prod oil 3.7 [illegible] 420
7-9	-666'		-212.4	completed across L.WW & UV contact
8-9	-673		(-212.3)	completed UWW & UV
9-8	-6[illegible]5		-215.5	UWW & UV wet cum prod 6.7 oil [illegible] W.
10-9	-664		-212.1	completed UWW & UV
11-8			-213	[illegible] completed UWW & UV
12-8			-216.-	UWW & UV wet converted SWD [illegible]
16-12 9-26			-220.[illegible]	UWW & UV wet

WELL	INTERVAL	H	ϕ_c	Δt	ϕ_D	ϕ_N	R_t
3-17	643-47.5	3.36	11.4		13	—	[illegible]
4-17	645-650	[illegible]	13.9	210	14	-	19
5-17	647-[illegible]	2.99	12.7	-	12.5	-	18
3-18	654 [illegible]		—	-	10.5 - 1[illegible]		9
7-18	[illegible]-56	4.26	11.9		15		9

Note: [illegible]

TOP
UV.

Squeezed PERFS

0.5 FLOW TRACE OF OIL

Low dry

UV 650

642 =

90.95% water

10-8-9 DST 645-65

420 m Gassy oil
2% SW

UV 647 647 - 649 40% wc

well cleaned ... 196000 ...

Top UV ... Deut ...

11-8 646 (-2 ...) 648 ...

640.5-645 ... 86% wc

12 8 653 (...) ... very poor inflow

645-650 100% wc

propose to cement ... SWD Nov 88 ... 686-69...

16-12-9.26 ...

... 2...

48% ...

28 ...

... Flowed 90% wc

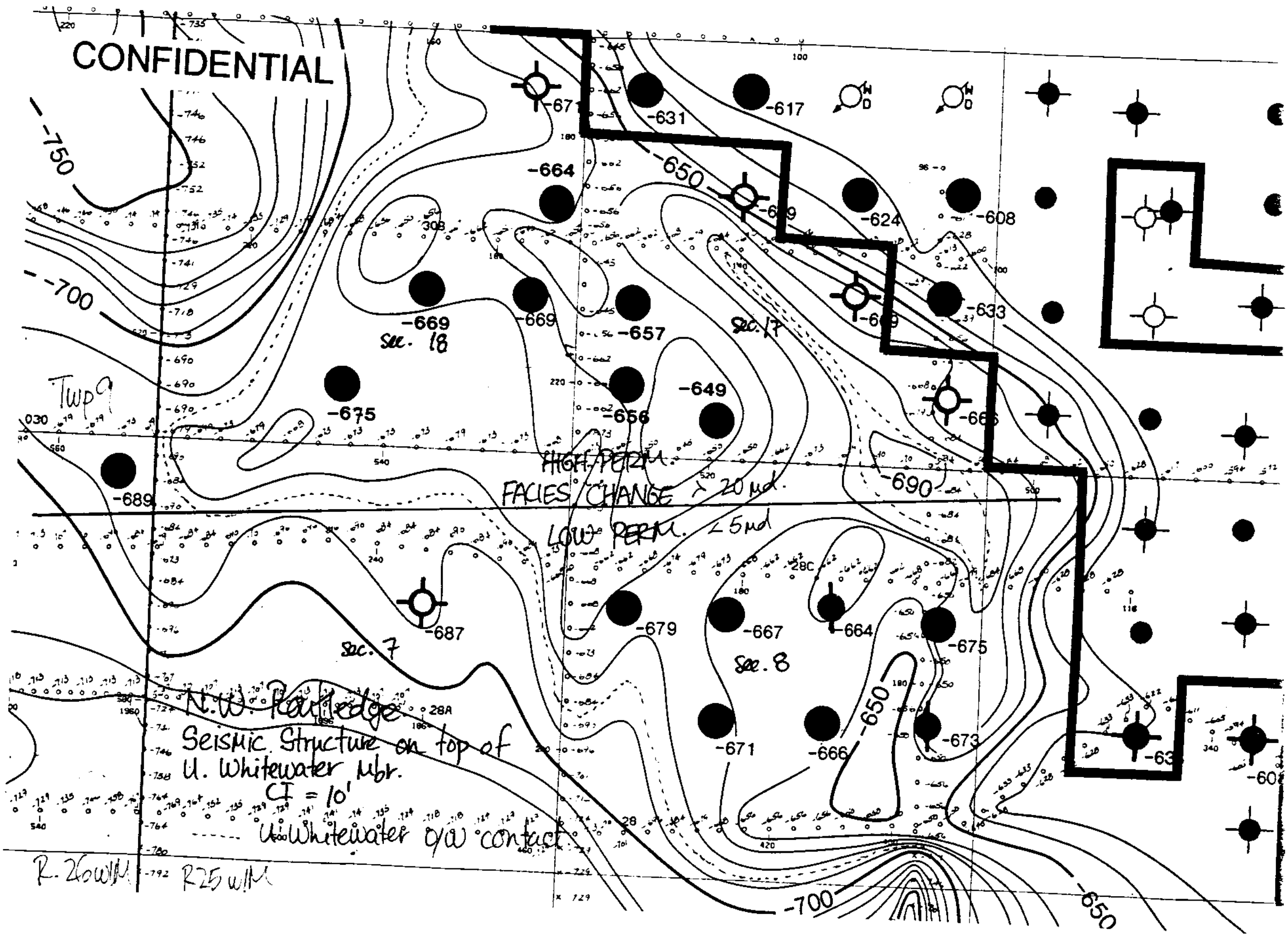
6 ... Declined ... 8

4-17 DST U. Virden recovered A00m GCCSWCO
233m GCOCSW
FSIP 6[illegible] kPa

U. Virden [illegible] 645.5-[illegible] m -210.2 to -211.7 m

flowed 4.7 m3/hr 15% [illegible]
[illegible]

8-19 DST L.W.W / U. Virden 652-[illegible] m
recovered [illegible] [illegible]
610 m [illegible]
[illegible]



CONFIDENTIAL
-750
-700
-650
-690
Twp 9
R. 26 W1M
R 25 W1M
Sec. 18
Sec. 17
Sec. 7
Sec. 8
HIGH PERM ~ 20 md
FACIES CHANGE
LOW PERM < 5 md
N.W. Parkledge
Seismic Structure on top of
U. Whitewater Mbr.
CI = 10'
U. Whitewater o/w contact

IPR CALCULATION 3 [illegible] 9 2[illegible]

(1) ABOVE THE [illegible] PT. THE PI EQ^N APPLIES

$$PI = \frac{q}{\bar{P}_R - P_{wf}}$$

q_{L_T} = 21 07 m³/d $\bar{P}_R$ = 6[illegible] kPa

q_o = [illegible] P_{wf} = [illegible]

q_w = 1.[illegible] m³/d

PI_o = .012 PI_w = .001 PI_T = .013 m³/d/kPa

(2) IPR AT THE BUBBLE PT (VOGEL)

$$\frac{q_b}{q_c} = 1.8 \frac{(\bar{P}_R - P_b)}{P_b}$$

P_b = 1427 kPa (PVT 2-8-9.25)

$$\frac{q_b}{q_c} = 6.71$$

$q_{b_{oil}}$ = .012 (6750 - 1427) = 63.9 m³/d $q_{c_{oil}}$ = 9.5

$q_{b_{WTR}}$ = .001 (6750 - 1427) = [illegible] m³/d $q_{c_{WTR}}$ = 0.8

q_{TOTAL} = 69.2 m³/d $q_{c_{TOTAL}}$ = 10.3

IPR [illegible] BUBBLE [illegible]

$$\frac{q}{q_{r}} = 1.8\,\frac{\bar{P}_R}{\bar{P}_b} - 0.8 - 0.2\left(\frac{P_{wf}}{P_b}\right) - 0.8\left(\frac{P_{wf}}{P_b}\right)^2$$

IPR @ P_{wf} = [illegible] kPa

$$\frac{q}{q_{r}} = 1.8\left[\;[illegible]\;\right] - 0.8 - 0.2\left(\underset{0.35}{\frac{500}{1427}}\right) - 0.8\left(\underset{0.123}{\frac{500}{1427}}\right)^2$$

$$\frac{q}{q_{r}} = 2.55$$

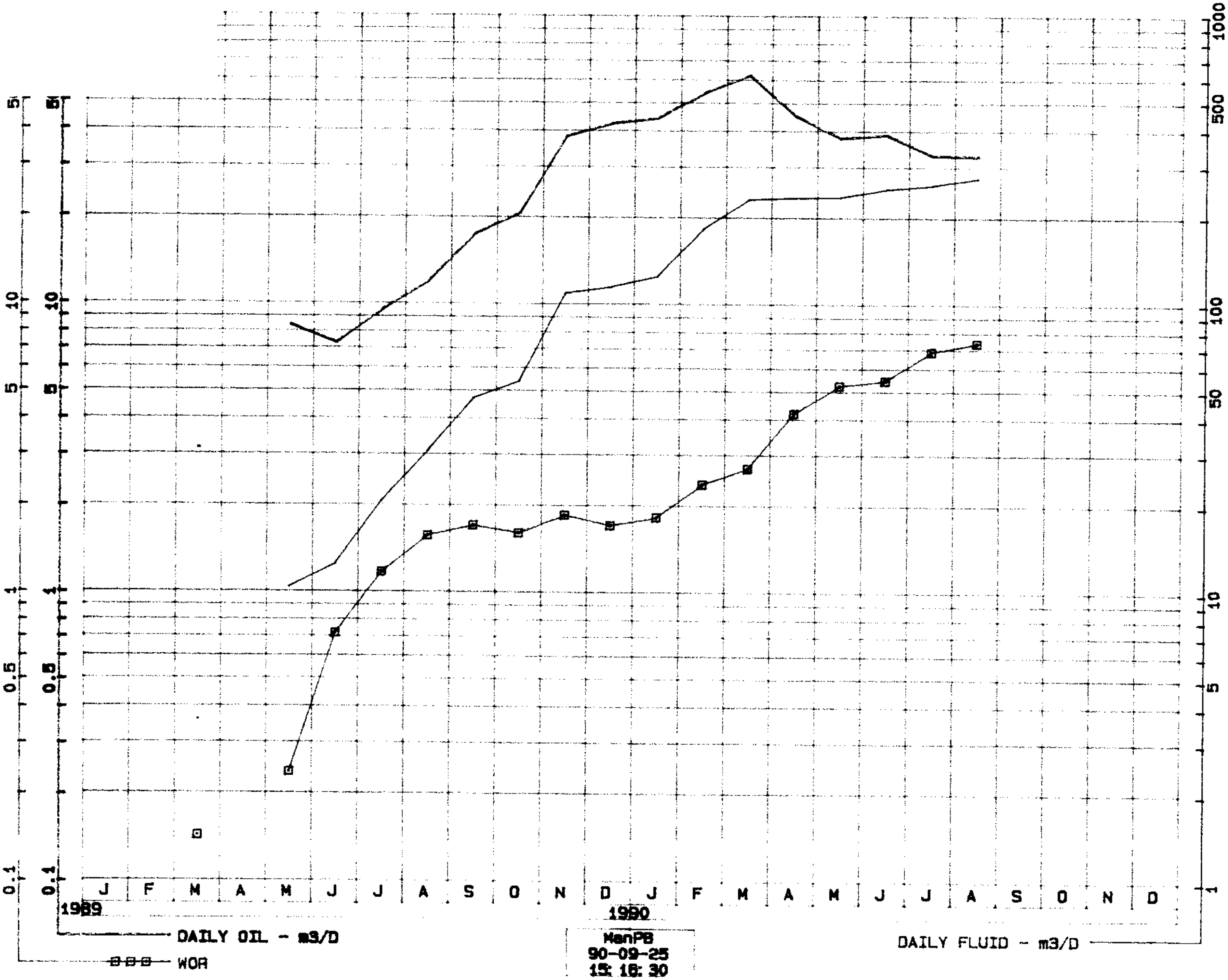
q_{oil} = [illegible] m^3/d q_{water} = 6.0 m^3/d

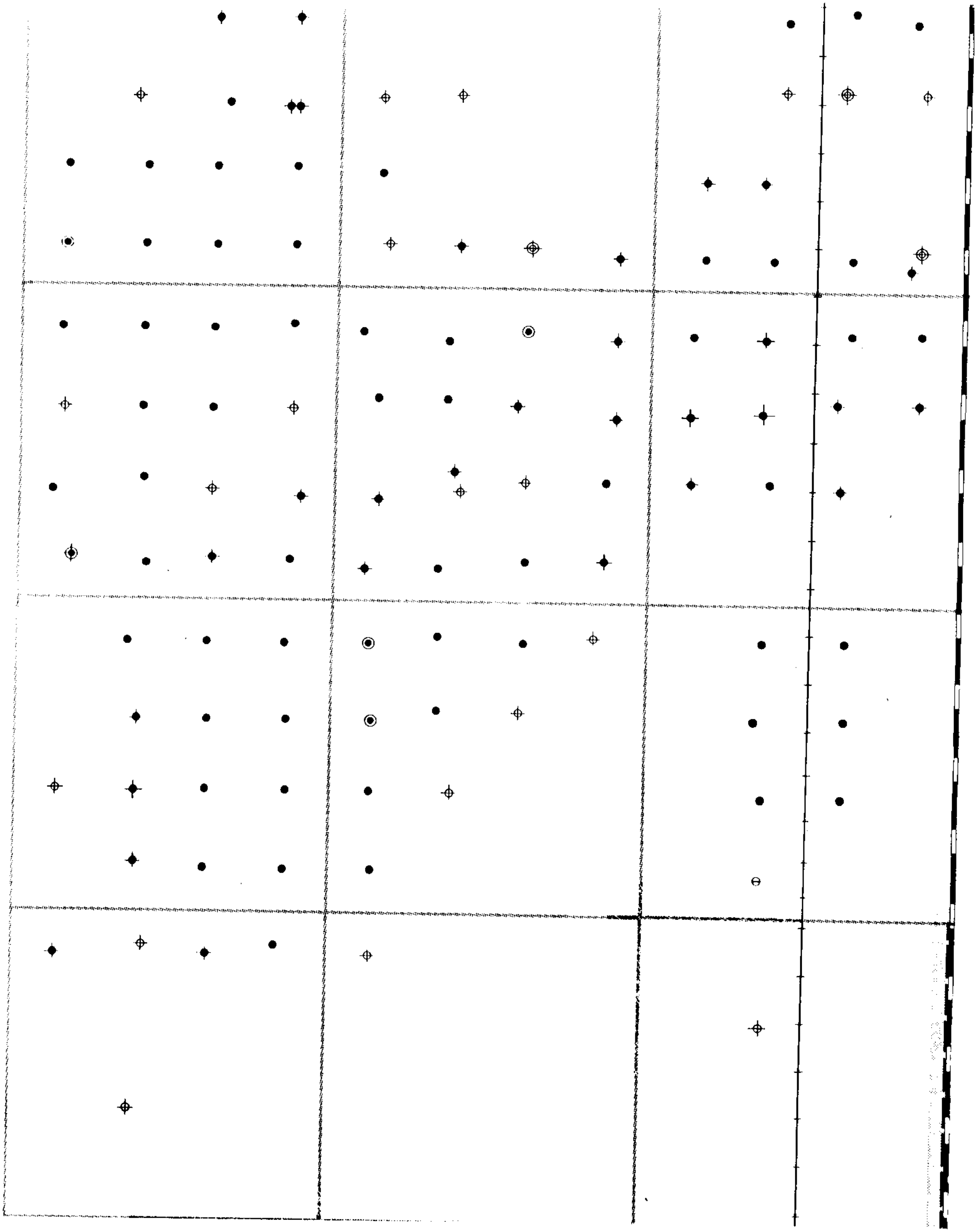
q_{total} = [illegible]

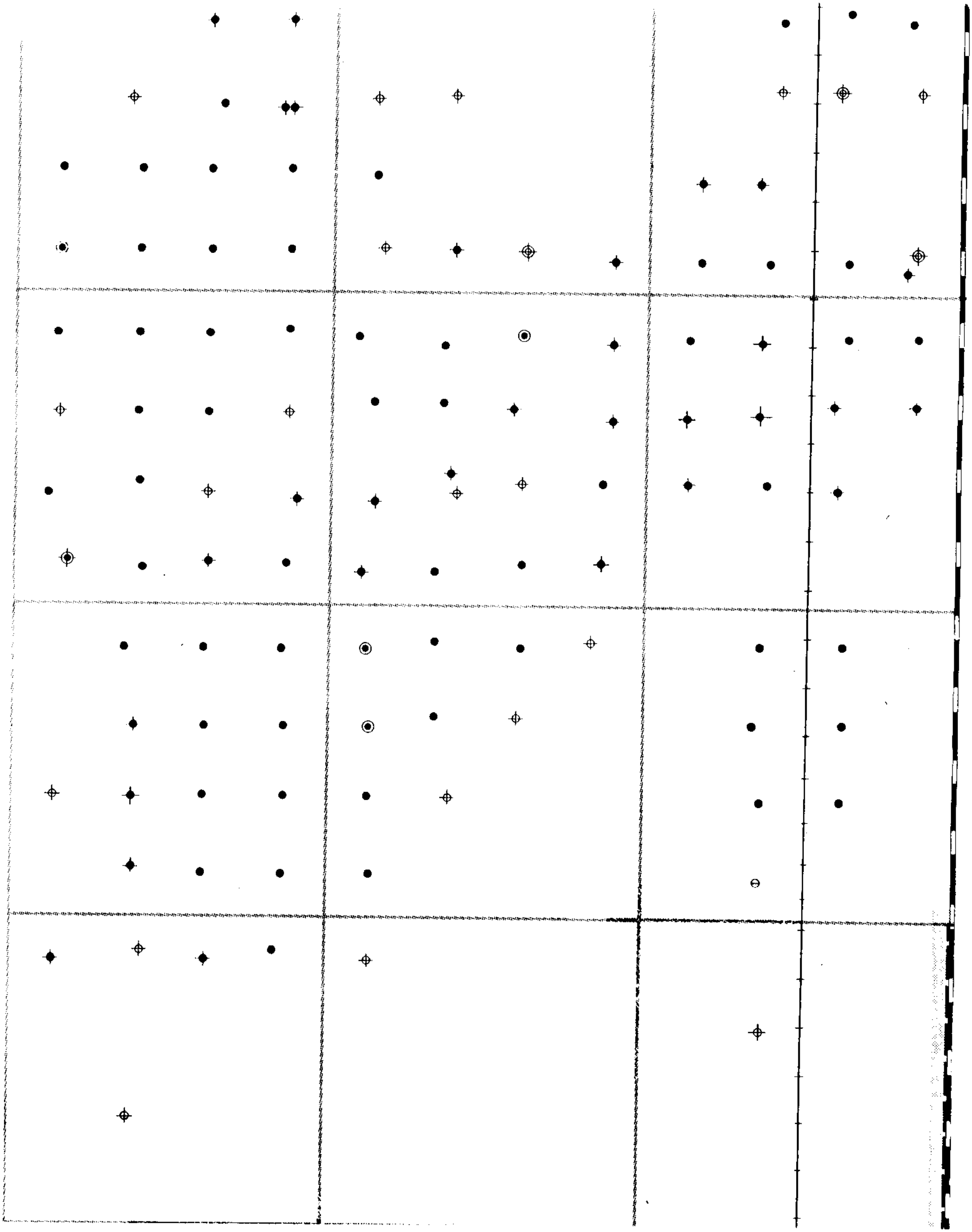
q_{max} = 73.3 q_{max} = 6.2 q_{TOTAL} = [illegible] m^3/d

Without
17-9-25

WITHOUT
3-17-9-25







APEX Analytical Laboratories Ltd.

WATER ANALYSIS

Field	Value
CONTAINER IDENTITY	PLASTIC
SAMPLE POINT I.D. #	
LABORATORY NUMBER	CHEV-035-11630
LICENCE NO.	
OPERATOR NAME AND ADDRESS	CHEVRON CANADA RESOURCES LIMITED
CPA NUMBER	
WELL NAME	5-17-9-25-W1
ELEVATIONS METERS KB	
ELEVATIONS METERS GRD	
FIELD OR AREA	ROUTLEDGE
POOL OR ZONE	Upper Whitewater
NAME OF SAMPLER	
COMPANY	CHEVRON
TEST RECOVERY	
TEST TYPE	
NO	
MULTIPLE RECOVERY	
SAMPLING POINT	WELLHEAD
AMT & TYPE OF CUSHION	
MUD RESISTIVITY @25°C	

INTERVAL/PERFORATIONS: FROM ___ m TO ___ m; FROM ___ m TO ___ m

TYPE OF PRODUCTION: PUMPING ___ FLOWING ___ GAS LIFT ___ SWAB ___

PRODUCTION RATES: WATER ___ m³/d OIL ___ m³/d GAS ___ 10³m³

GAUGE PRESSURE KPa: SEPARATOR ___ TREATER ___ AS RECEIVED ___

TEMPERATURES °C: SEPARATOR ___ TREATER ___ AS RECEIVED ___

DATE SAMPLED (Y M D H.M)	DATE RECEIVED (Y M D)	DATE REPORTED (Y M D)	ANALYST
89 11 17	89 12 07	89 12 19	R.H. & M.C.

ION	C g m⁻³	MASS FRACTION	C mol m⁻³
Na	11800		513
K	268		6.9
Ca	18500		462
Mg	700		29
Ba			
Sr			
Fe	1100		20

ION	C g m⁻³	MASS FRACTION	C mol m⁻³
Cl	52483		1480
Br			
I			
HCO_3	16.3		0.27
SO_4	834		8.7
CO_3	<0.5		<0.01
OH			
H_2S	ABSENT		

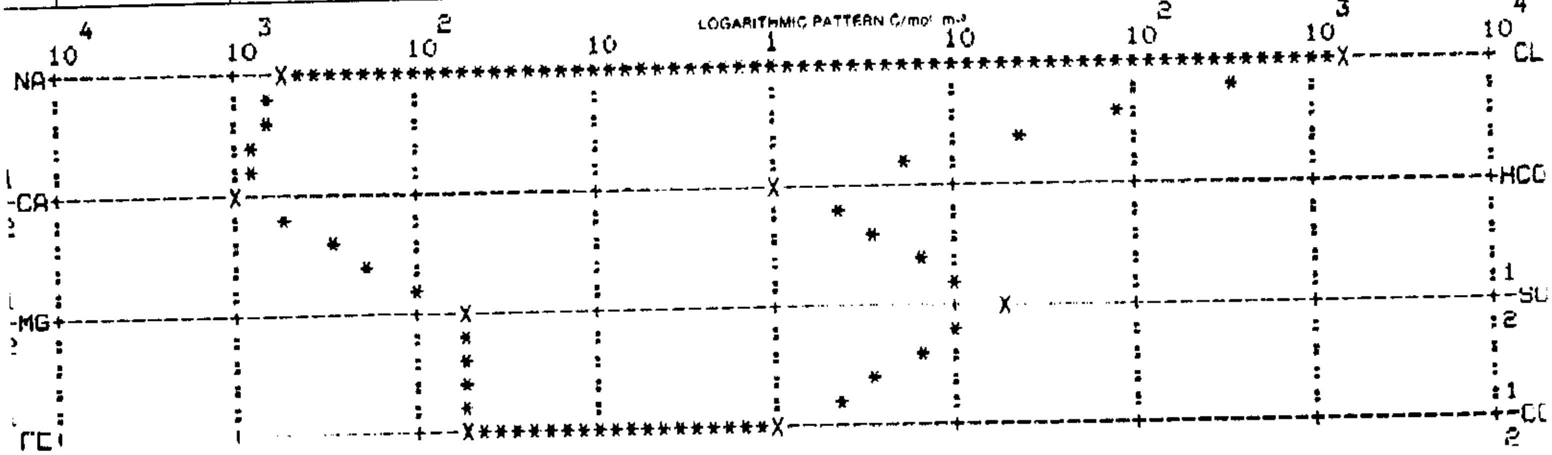
TOTAL SOLIDS C/g m⁻³

BY EVAPORATION @ 110°C	BY EVAPORATION @ 180°C	AT IGNITION	CALCULATED
			85693

PROPERTIES

RELATIVE DENSITY	REFRACTIVE INDEX	OBSERVED PH	RESISTIVITY Ωm
1.076 @ 25 °C	------- @ 25°C	4.94 @ 24°C	0.089 @ 25°C

LOGARITHMIC PATTERN C/mol m⁻³



REMARKS IRON PERFORMED ON FILTERED SAMPLE

APEX Analy[illegible]cal Laboratories Ltd.

WATER ANALYSIS

SAMPLE POINT I.D. #:

LABORATORY NUMBER: CHEV-035-11630

[illegible]INER IDENTITY: PLAS[illegible]

OPERATOR NAME AND ADDRESS: CHEVRON CANADA RESOURCES LIMITED

LICENCE NO.:

ELEVATIONS METERS — KB:

WELL NAME: 3-18-9-25-W1

CPA NUMBER:

NAME OF SAMPLER:

COMPANY: CHEVRON

FIELD OR AREA: FLOSSIE LAKE

POOL OR ZONE: Upper ~~Whi[illegible]~~ Whitewater Flossie Lake

TEST RECOVERY:

TEST TYPE: NO:

MULTIPLE RECOVERY:

AMT & TYPE OF CUSHION:

MUD RESISTIVITY: @2[illegible]

SAMPLING POINT: SWAB SAMPLE

TYPE OF PRODUCTION — PUMPING: FLOWING: GAS LIFT: SWAB:

INTERVAL/PERFORATIONS — FROM: m TO: m FROM: m TO: m

PRODUCTION RATES — OIL: m³/d GAS: WATER: m³/d

GAUGE PRESSURE - KPa — SEPARATOR: TREATER: AS RECEIVED:

TEMPERATURES °C — SEPARATOR: TREATER: AS RECEIVED:

DATE SAMPLED (Y M D H/M): 89 11 14

DATE RECEIVED (Y M D): 89 12 07

DATE REPORTED (Y M D): 89 12 19

ANALYST: R.H. & M.C.

ION	C g m⁻³	MASS FRACTION	C mol m⁻³
Na	17000		739
K	475		12
Ca	1500		37
Mg	562		23
Ba			
Sr			
Fe	2.03		0.04

ION	C g m⁻³	MASS FRACTION	C mol m⁻³
Cl	26492		747
Br			
I			
HCO_3	891		15
SO_4	3581		37
CO_3	<0.5		<0.01
OH			
H_2S	ABSENT		

TOTAL SOLIDS C/g m⁻³

BY EVAPORATION @ 110°C:

BY EVAPORATIO[N]:

AT IGNITION:

CALCULATED: 50058

PROPERTIES

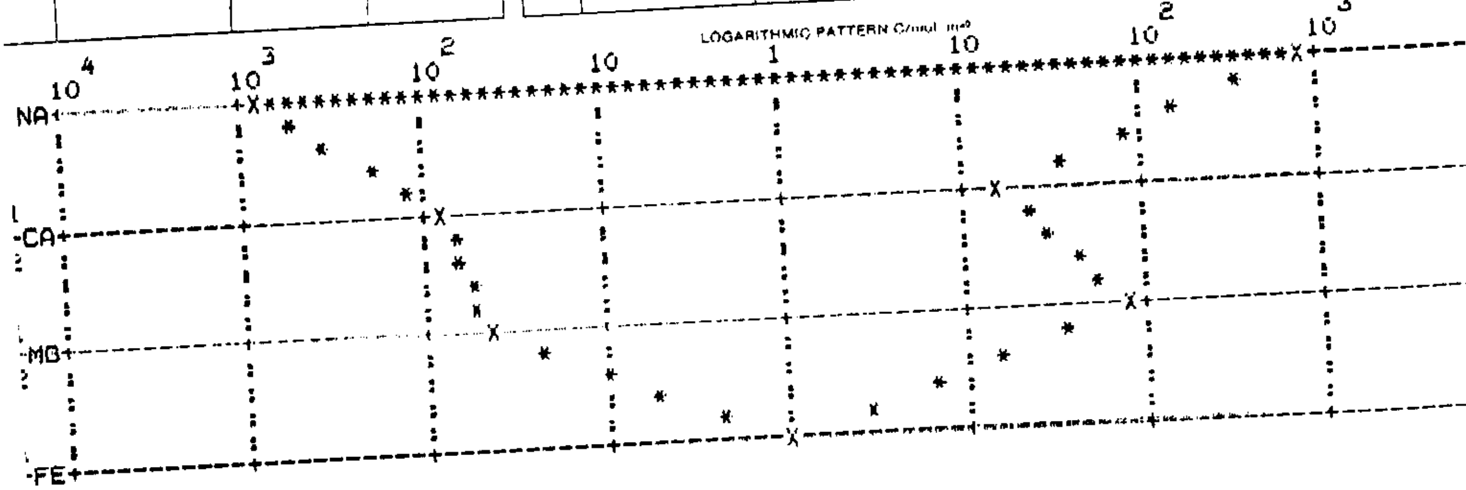
RELATIVE DENSITY: 1.044 @ 25 °C

REFRACTIVE IN[DEX]: -------

OBSERVED PH: 7.50 @ 1.6

RESISTIVITY: 0.14

LOGARITHMIC PATTERN C/mol m⁻³



REMARKS: IRON PERFORMED ON FILTERED SAMPLE

BAKER OIL TREATING
Division of Magnachem Limited
A Baker Oil Tools Company

WATER ANALYSI

COMPANY	Chevron Canada Resources Limited
COMPANY ADDRESS	Virden Manitoba
FIELD	Chevron Virden 9-8
COUNTY OR MUNICIPALITY	
LEASE OR UNIT	
WELL(S) NAME OR NO.	9-8-9-25 W1
WATER SOURCE (FORMATION)	Upper Virden
DEPTH, FT.	
BHT, F	
SAMPLE SOURCE	Swab returns at rig tank
TEMP. °C	
WATER, BBL/DAY	
OIL, BBL/DAY	
DATE SAMPLED	July 20/88
TYPE OF WATER	[X] PRODUCED [ ] SUPPLY [ ] WATERFLOOD

WATER ANALYSIS PATTERN

(NUMBER BESIDE ION SYMBOL INDICATES me/l* SCALE UNIT)

Scale: 20 15 10 5 0 5 10 15

Na^+ 20

Ca^{++}

Mg^{++}

Fe^{+++}

DISSOLVED SOLIDS

CATIONS	me/l*	mg/l*
Total Hardness	150	
Calcium, Ca^{++}	140	2800
Magnesium, Mg^{++}	10	122
Iron (Total) Fe^{+++}	-	.2
Barium, Ba^{++}	-	-
Sodium, Na^+(calc.)	694.1	15964.5
Mn		
ANIONS		
Chloride, Cl^-	817.9	29000
Sulfate, $SO_4^=$	3.21	154
Carbonate, $CO_3^=$	-	-
Bicarbonate, HCO_3^-	23	1403
Hydroxyl, OH^-	-	-
Sulfide, $S^=$	-	-

DISSOLVED GASES

Hydrogen Sulfide, H_2S

Carbon Dioxide, CO_2

Oxygen, O_2

PHYSICAL PROPERTIES

pH

Conductivity

Specific Gravity 1

Turbidity, JTU Units

Total Dissolved Solids (calc.) 49

Stability Index @ ___ C

@ ___ C

$CaSO_4$ Solubility @ ___ C

@ ___ C

Max. $CaSO_4$ Possible (calc.)

Max. $BaSO_4$ Possible (calc.)

Residual Hydrocarbons

TOTAL SOLIDS BY EVAPORATION

*NOTE: me/l and ... used interchangea... respectively. Whe... used, corrections ... specific gravity.

REMARKS AND RECOMMENDATIONS:

Interval : 650-652.3 mkb

K.B. : 434.5m Ground: 430.4m

MAGNACHEM REPRESENTATIVE	ADDRESS	OFFICE PHONE
Murray Fleck	Estevan Sask	634-3313

DATE | DISTRIBUTION

NOV 16 '90 15:49 204 748 6762 PA

GROUP NAME:
LIST OF WELLS

(0)03-17-009-25 W1M(0)	(0)04-17-009-25 W1M(0)	(0)05-17-009-25 W1M(0)
(0)03-18-009-25 W1M(0)	(0)07-18-009-25 W1M(0)	(0)08-18-009-25 W1M(0)
(0)09-18-009-25 W1M(0)		

Pr NO. 1 *** S T O R E *** ManPB
VIRDEN7 90-09-26
08:58:24

MONTH	OIL m3/D	FLUID m3/D	WOR	CUM.OIL m3
1989-03	3.1	3.6	0.14	97.6
SHUT IN				
1989-05	8.4	10.4	0.24	358.6
1989-06	7.3	12.5	0.72	577.2
1989-07	9.5	20.7	1.17	873.1
1989-08	12.0	30.8	1.57	1245.2
1989-09	17.4	47.2	1.70	1768.4
1989-10	20.8	54.1	1.60	2413.5
1989-11	42.0	113.5	1.70	3672.9
1989-12	50.7	123.5	1.44	5243.7
1990-01	52.8	134.1	1.54	6881.9
1990-02	63.8	192.9	2.03	8667.4
1990-03	73.5	243.1	2.31	10944.7
1990-04	57.1	248.0	3.35	12656.7
1990-05	40.4	239.3	4.93	13908.4
1990-06	58.3	273.6	3.69	15658.4
1990-07	53.5	283.0	4.29	17318.2
1990-08	50.7	294.8	4.81	18891.2

RESERVOIR VOIDAGE

B_o = 1.097 * .9953 = 1.0912 rm³/stm³
26895 kPa

oil = 18891.2 m³ * 1.0912 = 20626 rm³

wh = [illegible]

GROUP NAME:

LIST OF WELLS

(0)04-17-009-25 W1M(0)	(0)05-17-009-25 W1M(0)	(0)03-18-009-25 W1M(0)
07-18-009-25 W1M(0)	(0)08-18-009-25 W1M(0)	(0)09-18-009-25 W1M(0)

PA_ NO. 1 *** S T O R E *** ManPB
VIRDEN7 90-09-26
08:59:46

MONTH	OIL m3/D	FLUID m3/D	WOR	CUM.OIL m3
1989-03	3.1	3.6	0.14	97.6
SHUT IN				
1989-05	8.4	10.4	0.24	358.6
1989-06	7.3	12.5	0.72	577.2
1989-07	9.5	20.7	1.17	873.1
1989-08	12.0	30.8	1.57	1245.2
1989-09	17.4	47.2	1.70	1768.4
1989-10	20.8	54.1	1.60	2413.5
1989-11	38.3	109.3	1.85	3563.1
1989-12	42.5	115.1	1.71	4882.1
1990-01	44.4	125.3	1.82	6259.1
1990-02	54.2	183.1	2.38	7777.8
1990-03	62.7	232.0	2.70	9722.7
1990-04	45.3	235.5	4.20	11081.2
1990-05	37.9	236.6	5.25	12255.3
1990-06	39.0	252.4	5.47	13426.5
1990-07	33.0	260.7	6.89	14450.5
1990-08	32.9	275.8	7.39	15469.7

MANITOBA ENERGY AND MINES

REPORT PPS1520

WELL PRODUCTION RECORD
1990

FIELD : 05 VIRDEN
POOL : 59C LODGEPOLE C
UNIT :
OPERATOR : 001 CHEVRON CANADA RESOURCES LIMITED
WELL LOC. : 03 -17-09-25
LICENCE : 4150

O & G RIGHTS : F
ON PRODUCTION DATE : 89.11.18

PRE-UNIT OIL PROD. : 0.0 m³
PRE-UNIT WATER PROD. : 0.0 m³

MONTH	NUMBER DAYS ON PRODUCTION	OIL PRODUCED m³	WATER PRODUCED m³	OIL RATE m³/d	WOR	TEST OIL m	TEST WATER m
Cum at Dec 31/89		361.6	24.5				
	739	251.8	8.9				
JAN	31	261.2	10.1	8.43	0.04	0.0	0.0
FEB	28	266.8	9.3	9.53	0.03	0.0	0.0
MAR	31	332.4	9.2	10.72	0.03	0.0	0.0
APR	22	353.5	23.0	16.07	0.07	16.4	0.9
MAY	5	77.6	5.0	15.52	0.06	0.0	0.0
JUN	30	578.8	56.2	19.29	0.10	23.9	1.8
JUL	31	635.8	57.8	20.51	0.09	0.0	0.0
AUG	0	553.8 ~~0.0~~	35.8 0.0			0.0	0.0
SEP	0	0.0	0.0			0.0	0.0
OCT	0	0.0	0.0			0.0	0.0
NOV	0	0.0	0.0			0.0	0.0
DEC	0	0.0	0.0			0.0	0.0
YTD	178	2 506.1	170.6	14.08	0.07		
CUMMULATIVE		2 867.7	195.1		0.07		

STATUS CHANGES:

***** END OF REPORT *****

MANITOBA ENERGY AND MINES

REPORT PPS1520

WELL PRODUCTION RECORD
1990

FIELD : 05 VIRDEN
POOL : 59C LODGEPOLE C
UNIT :
OPERATOR : 001 CHEVRON CANADA RESOURCES LIMITED
WELL LOC. : 04 -17-09-25
LICENCE : 4137

O & G RIGHTS : F
ON PRODUCTION DATE : 89.11.16

PRE-UNIT OIL PROD. : 0.0 m³
PRE-UNIT WATER PROD. : 0.0 m³

MONTH	NUMBER DAYS ON PRODUCTION	OIL PRODUCED m³	WATER PRODUCED m³	OIL RATE m³/d	WOR	TEST OIL m	TEST WATER m
Cum at Dec 31/89		344.2	264.9				
	739	281.9	89.2				
JAN	31	261.2	101.5	8.43	0.39	0.0	0.0
FEB	27	218.5	207.6	8.09	0.95	8.5	7.0
MAR	30	263.7	607.0	8.79	2.30	8.2	20.3
APR	30	194.5	613.5	6.48	3.15	6.7	18.8
MAY	31	203.1	710.9	6.55	3.50	7.1	22.2
JUN	30	129.9	706.6	4.33	5.44	5.3	22.7
JUL	31	145.3	738.2	4.69	5.08	0.0	0.0
AUG	0	0.0	0.0			0.0	0.0
SEP	0	0.0	0.0			0.0	0.0
OCT	0	0.0	0.0			0.0	0.0
NOV	0	0.0	0.0			0.0	0.0
DEC	0	0.0	0.0			0.0	0.0
YTD	210	1 416.2	3 685.3	6.74	2.60		
CUMMULATIVE		1 760.4	3 950.2		2.24		

STATUS CHANGES:

***** END OF REPORT *****

MANITOBA ENERGY AND MINES

REPORT PPS1520

WELL PRODUCTION RECORD
1990

FIELD : 05 VIRDEN
POOL : 59C LODGEPOLE C
UNIT :
OPERATOR : 001 CHEVRON CANADA RESOURCES LIMITED
WELL LOC. : 05 -17-09-25
LICENCE : 4151

O & G RIGHTS : F
ON PRODUCTION DATE : 89.11.13
PRE-UNIT OIL PROD. : 0.0 m³
PRE-UNIT WATER PROD. : 0.0 m³

MONTH	NUMBER DAYS ON PRODUCTION	OIL PRODUCED m³	WATER PRODUCED m³	OIL RATE m³/d	WOR	TEST OIL m	TEST WATER m
Cum at Dec 31/89		454.2	47.8				
	739	251.9	17.9				
JAN	31	261.2	20.3	8.43	0.08	0.0	0.0
FEB	28	266.8	18.5	9.53	0.07	0.0	0.0
MAR	31	370.5	86.1	11.95	0.23	11.1	2.8
APR	23	243.8	69.2	10.60	0.28	0.0	0.0
MAY	25	225.6	72.6	9.02	0.32	9.8	2.8
JUN	30	328.0	734.3	10.93	2.24	13.5	23.6
JUL	31	250.6	342.7	8.08	1.37	0.0	0.0
AUG	0	0.0	0.0			0.0	0.0
SEP	0	0.0	0.0			0.0	0.0
OCT	0	0.0	0.0			0.0	0.0
NOV	0	0.0	0.0			0.0	0.0
DEC	0	0.0	0.0			0.0	0.0
YTD	199	1 946.5	1 343.7	9.78	0.69		
CUMMULATIVE		2 400.7	1 391.5		0.58		

STATUS CHANGES:

***** END OF REPORT *****

MANITOBA ENERGY AND MINES

REPORT PFS1520

WELL PRODUCTION RECORD
1990

FIELD : 05 VIRDEN
POOL : 59C LODGEPOLE C
UNIT :
OPERATOR : 001 CHEVRON CANADA RESOURCES LIMITED
WELL LOC. : 03 -18-09-25
LICENCE : 4146

O & G RIGHTS : C
ON PRODUCTION DATE : 89.11.15

PRE-UNIT OIL PROD. : 0.0 m³
PRE-UNIT WATER PROD. : 0.0 m³

MONTH	NUMBER DAYS ON PRODUCTION	OIL PRODUCED m³	WATER PRODUCED m³	OIL RATE m³/d	WOR	TEST OIL m	TEST WATER m
Cum at Dec 31/89	18	192.4 93.8	989.2 543.0				
JAN	19	102.8	525.1	5.41	5.11	6.4	25.3
FEB	28	169.4	780.9	6.05	4.61	6.3	25.3
MAR	31	211.0	778.3	6.81	3.69	0.0	0.0
APR	28	136.6	978.5	4.88	7.16	5.0	31.7
MAY	31	142.6	1 022.4	4.60	7.17	4.9	31.7
JUN	30	120.0	987.1	4.00	8.23	0.0	0.0
JUL	31	116.7	1 067.5	3.76	9.15	4.3	32.9
AUG	0	0.0	0.0			0.0	0.0
SEP	0	0.0	0.0			0.0	0.0
OCT	0	0.0	0.0			0.0	0.0
NOV	0	0.0	0.0			0.0	0.0
DEC	0	0.0	0.0			0.0	0.0
YTD	198	999.1	6 139.8	5.05	6.15		
CUMMULATIVE		1 191.5	7 129.0		5.98		

STATUS CHANGES:

***** END OF REPORT *****

MANITOBA ENERGY AND MINES

REPORT PPS1520

WELL PRODUCTION RECORD
1990

FIELD : 05 VIRDEN
POOL : 59C LODGEPOLE C
UNIT :
OPERATOR : 001 CHEVRON CANADA RESOURCES LIMITED
WELL LOC. : 07 -18-09-25
LICENCE : 4138

O & G RIGHTS : F
ON PRODUCTION DATE : 89.10.07

PRE-UNIT OIL PROD. : 0.0 m^3
PRE-UNIT WATER PROD. : 0.0 m^3

MONTH	NUMBER DAYS ON PRODUCTION	OIL PRODUCED m^3	WATER PRODUCED m^3	OIL RATE m^3/d	WOR	TEST OIL m	TEST WATER m
Cum at Dec 31/89	739	708.0 226.7	795.7 267.4				
JAN	31	235.0	304.6	7.53	1.30	0.0	0.0
FEB	28	297.3	358.2	10.62	1.20	12.0	12.5
MAR	31	365.9	515.9	11.80	1.41	11.0	16.7
APR	28	214.4	413.9	7.66	1.93	7.8	13.4
MAY	31	185.0	445.3	5.97	2.41	6.4	13.8
JUN	30	155.7	429.8	5.19	2.76	0.0	0.0
JUL	31	130.7	787.1	4.22	6.02	4.8	24.2
AUG	0	0.0	0.0			0.0	0.0
SEP	0	0.0	0.0			0.0	0.0
OCT	0	0.0	0.0			0.0	0.0
NOV	0	0.0	0.0			0.0	0.0
DEC	0	0.0	0.0			0.0	0.0
YTD	210	1 584.0	3 254.8	7.54	2.05		
CUMMULATIVE		2 292.0	4 050.5		1.77		

STATUS CHANGES:

***** END OF REPORT *****

MANITOBA ENERGY AND MINES

REPORT PPS1520

WELL PRODUCTION RECORD
1990

FIELD : 05 VIRDEN
POOL : 59C LODGEPOLE C
UNIT :
OPERATOR : 001 CHEVRON CANADA RESOURCES LIMITED
WELL LOC. : 08 -18-09-25
LICENCE : 4104

O & G RIGHTS : F
ON PRODUCTION DATE : 89.03.15

PRE-UNIT OIL PROD. : 0.0 m³
PRE-UNIT WATER PROD. : 0.0 m³

MONTH	NUMBER DAYS ON PRODUCTION	OIL PRODUCED m³	WATER PRODUCED m³	OIL RATE m³/d	WOR	TEST OIL m	TEST WATER m
Cum at Dec 31/89		2 255.1	3 036.0				
	239	256.9	505.1				
JAN	31	265.1	615.3	8.55	2.32	10.1	18.1
FEB	28	263.6	518.5	9.41	1.97	10.0	17.0
MAR	31	292.5	821.4	9.44	2.81	8.8	26.7
APR	28	226.1	950.4	8.07	4.20	8.2	30.7
MAY	31	119.0	1 284.6	3.84	10.79	4.1	39.9
JUN	30	187.8	1 024.9	6.26	5.46	0.0	0.0
JUL	31	176.2	1 233.1	5.68	7.00	6.7	39.0
AUG	0	0.0	0.0			0.0	0.0
SEP	0	0.0	0.0			0.0	0.0
OCT	0	0.0	0.0			0.0	0.0
NOV	0	0.0	0.0			0.0	0.0
DEC	0	0.0	0.0			0.0	0.0
YTD	210	1 530.3	6 448.2	7.29	4.21		
CUMMULATIVE		3 785.4	9 484.2		2.51		

STATUS CHANGES:

***** END OF REPORT *****

MANITOBA ENERGY AND MINES

REPORT FPS1520

WELL PRODUCTION RECORD
1990

FIELD : 05 VIRDEN
POOL : 59C LODGEPOLE C
UNIT :
OPERATOR : 001 CHEVRON CANADA RESOURCES LIMITED
WELL LOC. : 09 -18-09-25
LICENCE : 4122

O & G RIGHTS : C
ON PRODUCTION DATE : 69.08.17

PRE-UNIT OIL PROD. : 0.0 m^3
PRE-UNIT WATER PROD. : 0.0 m^3

MONTH	NUMBER DAYS ON PRODUCTION	OIL PRODUCED m^3	WATER PRODUCED m^3	OIL RATE m^3/d	WOR	TEST OIL m	TEST WATER m
Cum at Dec 31/89		928.2	2 332.5				
	739	242.8	826.3				
JAN	31	251.7	941.2	8.12	3.74	0.0	0.0
FEB	28	303.1	1 723.3	10.83	5.69	11.3	56.0
MAR	31	441.3	2 439.8	14.24	5.53	13.7	82.0
APR	30	343.1	2 679.5	11.44	7.81	11.8	82.1
MAY	31	298.8	2 626.1	9.64	8.79	10.3	81.0
JUN	30	249.8	2 516.2	8.33	10.08	0.0	0.0
JUL	31	204.5	2 887.7	6.60	14.12	7.8	91.5
AUG	0	0.0	0.0			0.0	0.0
SEP	0	0.0	0.0			0.0	0.0
OCT	0	0.0	0.0			0.0	0.0
NOV	0	0.0	0.0			0.0	0.0
DEC	0	0.0	0.0			0.0	0.0
YTD	212	2 092.3	15 815.8	9.87	7.56		
CUMMULATIVE		3 020.5	18 148.3		6.01		

STATUS CHANGES:

***** END OF REPORT *****

Chevron

Chevron Canada Resources
P.O. Box 100, Virden, Manitoba R0M 2C0
Phone (204) 748-1334 Fax (204) 748-6762

1990-09-10

Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
WINNIPEG, Manitoba
R3C 4E3

ATTENTION: Mr. L. R. Dubreuil

Dear Sir:

RE: Board Order No. 79A
Maximum Permissible Production Rate Increase
Monthly Testing and Performance Report - 1990-08

As requested in your approval letter dated 1990-02-26, the following information is submitted:

5-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-08-06					-Tubing 520kPa Casing 1380kPa -Tubing 450kPa Casing 1345kPa
MONTHLY:	252.1	353.0	605.1	58.3	-Well produced for 31 days

4-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-08-06					-Tubing 415kPa Casing 1210kPa
-13					-Tubing 450kPa Casing 1240kPa
MONTHLY:	124.7	903.4	1028.1	87.9	-Well produced for 31 days

9-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-08-06					-Tubing 660kPa Casing 1345kPa
-13					-Tubing 590kPa Casing 1345kPa
MONTHLY:	211.4	3058.3	3269.7	93.5	-Well produced for 31 days.

3-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-08-06					-Tubing 760kPa Casing 1790kPa
-12	22.26	1.24	23.5	5.3	
-13	24.99	1.48	26.5	5.5	-Tubing 760kPa Casing 1790kPa
-14	23.13	1.13	24.3	4.6	-Choke size 4.2mm
-15	21.15	1.13	22.3	5.0	-Choke size 4.0mm
-16	20.43	1.07	21.5	5.0	
MONTHLY:	553.8	35.8	589.6	6.1	-Well produced for 31 days.

3-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-08-06					-Tubing 275kPa Casing 2275kPa
-13					-Tubing 275kPa Casing 2275kPa
MONTHLY:	117.4	1099.6	1217.0	90.4	-Well produced for 31 days

7-18-9-25:

1990-08-06					-Tubing 85kPa Casing 1240kPa
-13					-Tubing 85kPa Casing 1310kPa
MONTHLY:	131.5	810.9	942.4	86.0	-Well produced for 31 days

8-18-9-25:

1990-08-06					-Tubing 235kPa Casing 1310kPa
-13					-Tubing 240kPa Casing 1240kPa
MONTHLY:	182.1	1305.9	1488.0	87.8	-Well produced for 31 days
7WELL TOTAL:	1573.0	7566.9	9139.9	82.8	

The proration factors used for all 7 wells in 1990-08 were:

Oil - 0.91366147
Water - 1.12664777

Annular fluid levels were checked on 1990-08-27 and all 7 wells were full.

If additional information is required, please contact Mr. Kevin Anderson or Mr. Lyle Martinson at 748-1334 or at the letterhead address.

Yours truly,

Kevin Anderson

for L. A. Martinson, P. Eng.
Area Superintendent
Virden

KA/cm

JOHN

Chevron

Chevron Canada Resources
P.O. Box 100, Virden, Manitoba R0M 2C0
Phone (204) 748-1334 Fax (204) 748-6762

DEPARTMENT OF ENERGY AND MINES
AUG 20 1990
PETROLEUM BRANCH

1990-08-15

Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
WINNIPEG, Manitoba
R3C 4E3

ATTENTION: Mr. L. R. Dubreuil

Dear Sir:

RE: Board Order No. 79A
Maximum Permissible Production Rate Increase
Monthly Testing and Performance Report - 1990-07

As requested in your approval letter dated 1990-02-26, the following information is submitted:

5-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-07-16	8.00	6.86	14.86	46.2	-Choke size 4.8mm -Tubing 550kPa Casing 1450kPa
-17	8.20	7.42	15.62	47.5	-Choke size 4.8mm
-19	5.86	3.60	9.46	38.0	-Choke size 4.0mm
-21	9.86	10.78	20.64	52.2	-Choke size 5.6mm
-23					-Tubing 520kPa Casing 1520kPa
-30					-Tubing 550kPa Casing 1930kPa
MONTHLY:	250.6	343.0	593.6	57.8	-Well produced for 31 days

4-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-07-16					-Tubing 650kPa Casing 1380kPa
-23					-Tubing 410kPa Casing 1210kPa
-30					-Tubing 410kPa Casing 1170kPa
MONTHLY:	145.3	739.0	884.3	83.6	-Well produced for 31 days

9-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-07-03	8.32	81.67	89.99	90.8	
-16					-Tubing 690kPa Casing 550kPa
-18					-Pump change. Installed 69.9mm tubing pump.
-23					-Tubing 590kPa Casing 1100kPa
-26	7.93	93.0	100.93	92.1	
-30					-Tubing 660kPa Casing 1380kPa
MONTHLY:	204.5	2891.0	3095.5	93.4	-Well produced for 30 days.

3-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-07-16					-Tubing 830kPa Casing 1720kPa -Choke size 4.4mm
-23					-Tubing 760kPa Casing 1790kPa
-30					-Tubing 760kPa Casing 1790kPa
MONTHLY:	635.8	57.8	693.6	8.3	-Well produced for 30 days

3-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-07-11	4.52	33.59	38.11	88.1	
-12	4.27	32.74	37.01	88.5	
-13	4.20	32.42	36.62	88.5	
-16					-Tubing 260kPa Casing 2310kPa
-23					-Tubing 260kPa Casing 2340kPa
-30					-Tubing 270kPa Casing 2280kPa
MONTHLY:	116.7	1068.7	1185.4	90.1	-Well produced for 31 days

7-18-9-25:

1990-07-07	4.87	24.07	28.94	83.2	
-08	4.81	24.26	29.07	83.4	
-09	4.88	24.45	29.33	83.4	
-16					-Tubing 120kPa Casing 1240kPa
-23					-Tubing 100kPa Casing 1240kPa
-30					-Tubing 70kPa Casing 1280kPa
MONTHLY:	130.7	788.0	918.7	85.8	-Well produced for 31 days

8-18-9-25:

1990-07-16					-Tubing 260kPa Casing 1310kPa
-23					-Tubing 250kPa Casing 1240kPa
-30					-Tubing 250kPa Casing 1310kPa
MONTHLY:	176.2	1234.4	1410.6	87.5	-Well produced for 30 days

7WELL TOTAL:	1659.8	7121.9	8781.7	81.1

The proration factors used for all 7 wells in 1990-07 were:

Oil - 0.88359046
Water - 1.06500167

Annular fluid levels were checked on 1990-07-30 and all 7 wells were full.

If additional information is required, please contact Mr. Kevin Anderson or Mr. Lyle Martinson at 748-1334 or at the letterhead address.

Yours truly,

Kevin Anderson

for L. A. Martinson, P. Eng.
Area Superintendent
Virden

KA/cm

Chevron

Chevron Canada Resources
P.O. Box 100, Virden, Manitoba R0M 2C0
Phone (204) 748-1334 Fax (204) 748-6762

1990-07-12

Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
WINNIPEG, Manitoba
R3C 4E3

ATTENTION: Mr. L. R. Dubreuil

Dear Sir:

RE: Board Order No. 79A
Maximum Permissible Production Rate Increase
Monthly Testing and Performance Report - 1990-06

As requested in your approval letter dated 1990-02-26, the following information is submitted:

5-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-06-01					-Opened choke to 7.1mm
-04					-Tubing 620kPa Casing 1450kPa
-09	13.71	22.77	36.48	62.4	-Tubing 520kPa Casing 1240kPa
-10	13.43	18.49	31.92	57.9	- " "
-11	14.02	19.89	33.91	58.7	- " "
-14	14.08	23.87	37.95	62.9	-Opened choke to 8.7mm
-15	13.53	23.23	36.76	63.2	- "
-16	13.59	23.64	37.23	63.5	- "
-18					-Tubing 480kPa Casing 1210kPa
-25					-Tubing 655kPa Casing 1310kPa
MONTHLY:	328.0	739.4	1067.4	69.3	-Well produced for 29 days

4-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-06-04					-Tubing 500kPa Casing 1170kPa
-11					-Tubing 570kPa Casing 1170kPa
-18					-Tubing 550kPa Casing 1170kPa
-23	5.14	21.63	26.77	80.8	- " "
-24	5.64	23.86	29.50	80.9	- " "
-25					-Tubing 300kPa Casing 1170kPa
MONTHLY:	130.1	711.5	841.6	84.5	-Well produced for 29 days

9-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-06-04					-Tubing 565kPa Casing 500kPa
-11					-Tubing 620kPa Casing 600kPa
-18					-Tubing 550kPa Casing 480kPa
-25					-Tubing 620kPa Casing 530kPa
MONTHLY:	249.8	2535.8	2785.6	91.0	-Well produced for 29 days

3-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-06-01	16.52	3.32	19.84	16.7	-7.1mm choke
-02	44.45	5.74	50.19	11.4	-Opened choke to 7.9mm -Tubing 760kPa Casing 1520kPa
-03	49.23	4.32	53.55	8.1	-Changed choke to 6.7mm -Tubing 830kPa Casing 1585kPa
-04					-Changed choke to 4.0mm
-06	20.95	2.59	23.54	11.0	-Changed choke to 4.8mm -Tubing 830kPa Casing 1860kPa
-11					-Tubing 860kPa Casing 1790kPa
-18					-Tubing 830kPa Casing 1790kPa
-19	21.21	1.48	22.69	6.5	- " "
-20	26.77	2.14	28.91	7.4	- " "
-25					-Tubing 830kPa Casing 1830kPa
MONTHLY:	579.1	56.6	635.7	8.9	-Well produced for 29 days

3-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-06-04					-Tubing 275kPa Casing 2000kPa
-11					-Tubing 275kPa Casing 2070kPa
-18					-Tubing 275kPa Casing 1655kPa
-25					-Tubing 270kPa Casing 2275kPa
MONTHLY:	120.0	994.0	1114.0	89.2	-Well produced for 29 days

7-18-9-25:

1990-06-04					-Tubing 120kPa Casing 1170kPa
-11					- " "
-18					-Tubing 100kPa Casing 1100kPa
-25					-Tubing 100kPa Casing 1240kPa
MONTHLY:	155.7	432.9	588.6	73.5	-Well produced for 29 days

8-18-9-25:

1990-06-04					-Tubing 270kPa Casing 1310kPa
-11					-Tubing 260kPa Casing 1310kPa
-18					-Tubing 250kPa Casing 1310kPa
-25					- " "
-27	6.69	38.62	45.31	85.2	- " "
-28	6.77	39.72	46.49	85.4	- " "
-29	6.70	38.86	45.56	85.3	- " "
MONTHLY:	187.3	972.7	1160.0	83.8	-Well produced for 29 days

7Well Total:	1750.0	6442.9	8192.9	78.6

The proration factors used for all 7 wells in 1990-06 were:
Oil - 0.82526390
Water - 1.06926705

Annular fluid levels were checked on 1990-06-25 and all 7 wells were full.

Production rates were more favorable in June (average $60m^3$OPD) than in May (average $41m^3$ OPD) due to consistent producing with in-line gear pumps at 3,7,8-18 and 3,5-17 and pumping jacks at 4-17 and 9-18.

If additional information is required, please contact Mr. Kevin Anderson or Mr. Lyle Martinson at 748-1334 or at the letterhead address.

Yours truly,

Kevin Anderson

for L. A. Martinson, P. Eng.
Area Superintendent
Virden

KA/cm

JOHN

Chevron

Chevron Canada Resources

P.O. Box 100, Virden, Manitoba R0M 2C0
Phone (204) 748-1334 Fax (204) 748-6762

DEPARTMENT OF ENERGY AND MINES
JUN 20
PETROLEUM BRANCH

1990-06-14

Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
WINNIPEG, Manitoba
R3C 4E3

ATTENTION: Mr. L. R. Dubreuil

Dear Sir:

RE: Board Order No. 79A
Maximum Permissible Production Rate Increase
Monthly Testing and Performance Report - 1990-05

As requested in your approval letter dated 1990-02-26, the following information is submitted:

5-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-05-07					-Hotoiled casing and tubing with 11m^3 crude -resumed flowing production on 5.6mm choke. Tubing 1000kPa Casing 1380kPa
-09					-Electrified well and installed in-line gear pump to boost tubing pressure
-14					-Tubing 790kPa Casing 2070kPa
-16	9.89	3.75	13.64	27.5	-Tubing 790kPa Casing 2070kPa
-17	9.26	2.08	11.34	18.3	- " "
-18	10.26	2.61	12.87	20.3	- " "
-21					-Tubing 760kPa Casing 2550kPa
-28					-Tubing 690kPa Casing 2550kPa
-29					-Increased choke size to 6.0mm
-30					-Increased choke size to 6.4mm
Monthly:	211.5	75.1	286.6	26.2	-Well produced for 24 days

4-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-05-07					-Tubing 415kPa Casing 1170kPa
-13	7.16	22.15	29.31	75.6	- " "
-14	7.11	22.35	29.46	75.9	-Tubing 380kPa Casing 1170kPa
-21					-Tubing 430kPa Casing 1170kPa
-28					-Tubing 470kPa Casing 1170kPa
Monthly:	190.4	735.2	925.6	79.4	-Well produced for 30 days

9-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-05-01					-Tubing 330kPa Casing 345kPa
-02	10.44	80.43	90.87	88.5	-Tubing 430kPa Casing 450kPa
-03	10.26	81.43	91.69	88.8	- " "
-07					- " "
-14					-Tubing 460kPa Casing 430kPa
-21					-Tubing 470kPa Casing 430kPa
-28					-Tubing 520kPa Casing 480kPa
Monthly:	280.0	2716.1	2996.1	90.7	-Well produced for 31 days

3-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-05-07					-Hotoiled casing and tubing with 12m^3 crude-resumed flowing production on 4.0mm choke. Tubing 1210kPa Casing 1380kPa
-14					-Tubing 550kPa Casing 1450kPa
-21					-Tubing 620kPa Casing 1720kPa
-22					-Electrified well
-27					-Installed in-line gear pump to boost tubing pressure
-28					-Tubing 480kPa Casing 2000kPa
-29	16.06	5.29	21.35	24.8	-Tubing 900kPa Casing 1310kPa Flowing on 6.4mm choke
-30	15.17	2.86	18.03	15.9	-Tubing 900kPa Casing 1310kPa Opened choke to 7.1mm choke
-31	13.07	1.99	15.06	13.2	-Tubing 760kPa Casing 1860kPa Blew down choke - resumed flowing on 7.1mm choke
Monthly:	72.8	5.2	78.0	6.7	-Well produced for 5 days

3-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-05-07					-Tubing 275kPa Casing 2070kPa
-11	4.64	31.85	36.49	87.3	- " "
-12	4.64	32.36	37.00	87.5	- " "
-14					- " "
-21					-Tubing 310kPa Casing 2000kPa
-28					-Tubing 290kPa Casing 2000kPa
Monthly:	133.6	1057.4	1191.0	88.8	-Well produced for 30 days

7-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-05-07					-Tubing 140kPa Casing 1170kPa
-08	6.44	13.55	19.99	67.8	-Tubing 130kPa Casing 1170kPa
-09	6.46	14.13	20.59	68.6	- " "
-14					-Tubing 140kPa Casing 1170kPa
-21					-Tubing 120kPa Casing 1100kPa
-28					-Tubing 110kpa Casing 1170kPa
Monthly:	173.4	460.5	633.9	72.6	-Well produced for 30 days

8-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
1990-05-05	7.74	33.21	40.95	81.1	-Tubing 290kPa Casing 1310kPa
-06	7.78	33.00	40.78	80.9	- " "
-14					- " "
-21					-Tubing 290kPa Casing 1240kPa
-28					-Tubing 275kPa Casing 1240kPa
-29					-Changed gear pump sheave size from 89mm to 102mm to increase production
Monthly:	209.2	1098.0	1307.2	84.0	-Well produced for 30 days
7Well Total:	1270.9	6147.5	7418.4	82.9	

The proration factors used for all 7 wells in 1990-05 were: oil - 0.88382747
water - 1.09386383

Annular fluid levels were checked on 1990-05-28 and all 7 wells were full.

Production rates were less than favorable in 1990-05 (average $41m^3$OPD) mainly due to 3-17 and 5-17's intermittent flowing conditions (produced 5 days and 24 days respectively). Since these wells are now electrified and consistently producing with in-line gear pumps, production rates in future months should be substantially higher.

If additional information is required, please contact Mr. John Cooke or Mr. Lyle Martinson at 748-1334 or at the letterhead address.

Yours truly,

John Cooke

For L. A. Martinson, P. Eng.
Area Superintendent
Virden

JC/cm

JOHN

Chevron Canada Resources
P.O. Box 100, Virden, Manitoba R0M 2C0
Phone (204) 748-1334 Fax (204) 748-6762

1990-05-23

Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
WINNIPEG, Manitoba
R3C 4E3

ATTENTION: Mr. L. R. Dubreuil

Dear Sir:

RE: Board Order No. 79A
Maximum Permissible Production Rate Increase
Monthly Testing and Performance Report - 1990-04

As requested in your approval letter dated 1990-02-26, the following information is submitted:

5-17-9-25:

Not tested during 90-04 due to inconsistent flowing conditions. Planning to electrify well at month end so an in-line gear pump can be installed.

	REMARKS
90-04-02	-Tubing 830 kPa Casing 1380 kPa
-09	-Tubing 790 kPa Casing 1380 kPa
-16	-Tubing 760 kPa Casing 1380 kPa
-18	-Well ceased flowing
-24	-Attempted to run BHP survey - encountered wax at 60 m. Unable to hotoil well due to road bans.
-30	-Tubing 690 kPa Casing 1380 kPa.

	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	
Monthly:	241.8	69.1	310.9	22.2	-Well produced for 23 days

. . . ./Page two

4-17-9-25:

	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
90-04-02					-Tubing 485 kPa Casing 1240 kPa
-09					-Tubing 590 kPa Casing 1170 kPa
-16					-Tubing 550 kPa Casing 1170 kPa
-23	6.73	20.78	27.51	75.5	-Tubing 590 kPa Casing 1170 kPa
-24	6.75	16.85	23.60	71.4	-Tubing 550 kPa Casing 1170 kPa
-25	6.47	18.53	25.00	74.0	-Tubing 550 kPa Casing 1170 kPa
-30					-Tubing 380 kPa Casing 1170 kPa
Monthly:	192.9	612.2	805.1	76.0	-Well produced all month

9-18-9-25:

	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
90-04-02					-Tubing 380 kPa Casing 380 kPa
-03	12.72	81.73	94.40	86.5	-Tubing 380 kPa Casing 380 kPa
-04	11.88	82.28	94.16	87.4	-Tubing 380 kPa Casing 380 kPa
-05	11.90	82.05	93.95	87.3	-Tubing 370 kPa Casing 380 kPa
-09					-Tubing 345 kPa Casing 620 kPa
-12	11.89	82.16	94.05	87.4	-Tubing 345 kPa Casing 620 kPa
-16					-Tubing 550 kPa Casing 550 kPa
-23					-Tubing 690 kPa Casing 520 kPa
-30					-Tubing 480 kPa Casing 390 kPa
Monthly:	340.3	2673.9	3014.2	88.7	-Well produced all month

3-17-9-25:

	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
90-04-02					-Tubing 825 kPa Casing 1170 kPa
-09					-Tubing 825 kPa Casing 1170 kPa
-16					-Tubing 825 kPa Casing 1170 kPa
-19	19.94	1.13	21.07	5.4	-Flowing through 4.0 mm choke
-20	12.83	0.64	13.47	4.8	-Tubing 825 kPa Casing 1310 kPa
-21	16.65	1.07	17.72	6.0	-Flowing through 4.4 mm choke
-22					-Well ceased flowing
-24					-Attempted to run BHP survey- encountered wax at 60 m. Unable to hot oil well due to road bans. Well resumed flowing production.
-25	16.47	0.95	17.42	5.5	-Tubing 620 kPa Casing 1380 kPa
-30					-Tubing 480 kPa Casing 1450 kPa -Well ceased flowing
Monthly:	366.5	24.0	390.5	6.1	-Well produced for 22 days

. . . . ./Page three

3-18-9-25:

	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	%WATER	REMARKS
90-04-02					-Tubing 275 kPa Casing 1930 kPa
-09					-Tubing 275 kPa Casing 1930 kPa
-16	5.63	31.00	36.63	84.6	-Tubing 275 kPa Casing 1930 kPa
-17	5.00	31.74	36.74	86.4	-Tubing 275 kPa Casing 1930 kPa
-18	5.01	31.70	36.71	86.4	-Tubing 275 kPa Casing 1930 kPa
-21	5.05	31.79	36.84	86.3	-Tubing 275 kPa Casing 1930 kPa
-23					-Shut-in well for BHP survey
-24					-Ran BHP survey; 6645 kPa at MPP
-30					-Tubing 275 kPa Casing 1930 kPa
Monthly:	135.4	976.5	1111.9	87.8	-Well produced for 28 days

7-18-9-25:

90-04-02					-Tubing 220 kPa Casing 1100 kPa
-09					-Tubing 170 kPa Casing 1135 kPa
-13	7.63	13.49	21.12	63.9	-Tubing 140 kPa Casing 1240 kPa
-14	8.33	13.12	21.45	61.2	-Tubing 140 kPa Casing 1100 kPa
-15	7.60	13.69	21.29	64.3	-Tubing 140 kPa Casing 1100 kPa
-16					-Tubing 140 kPa Casing 1100 kPa
-19	7.85	13.41	21.26	63.1	-Tubing 140 kPa Casing 1135 kPa
-23					-Shut-in well for BHP survey
-24					-Ran BHP survey; 6698 kPa at MPP
-30					-Tubing 140 kPa Casing 1135 kPa
Monthly:	212.6	413.1	625.7	66.0	-Well produced for 28 days

8-18-9-25:

90-04-02					-Tubing 275 kPa Casing 1310 kPa
-09					-Tubing 300 kPa Casing 1310 kPa
-10	8.24	30.70	38.94	78.8	-Tubing 300 kPa Casing 1310 kPa
-11	8.31	30.89	39.20	78.8	-Tubing 300 kPa Casing 1310 kPa
-16	8.27	30.79	39.06	78.8	-Tubing 275 kPa Casing 1310 kPa
-23					-Shut-in well for BHP survey
-24					-Ran BHP survey; 6471 kPa at MPP
-30					-Tubing 300 kPa Casing 1380 kPa
Monthly:	224.3	948.5	1172.8	80.9	-Well produced for 28 days

. . . ./Page four

	OIL(m³)	WATER(m³)	TOTAL(m³)	%WATER
7 well Total:	1713.80	5717.30	7431.1	76.9

The proration factors used for all 7 wells in 1990-04 were:oil-0.9673908
water-1.10014697

Annular fluid levels were checked on 1990-04-30 and all 7 wells were full.

Attached are the results of the bottomhole pressure survey that was performed on 1990-04-24. Note that 3-17 and 5-17's data will not be used as the extrapolated BHP data is unreliable. From this data, specific tests, and Chevron's "Pipeflow" computer program, the following is a summary of calculated bottom-hole producing pressures (Pwf) for the subject wells';

WELL	TEST DATE	OIL (m^3)	WATER (m^3)	TOTAL (m^3)	%WATER	Pr (kPa)	Pwf (kPa)	FTHP (kPa)	REMARKS
3-17	90-04-19	19.94	1.13	21.07	5.4	6750	5131	760	Pr assumed
4-17	90-03-06	6.36	7.78	14.14	55.0	6750	4614	140	Pr assumed
5-17	90-03-17	11.15	2.80	13.95	20.1	6750	5546	760	Pr assumed
3-18	90-03-04	5.26	30.53	35.79	85.3	6645	6325	310	Pwf appears high
7-18	90-03-07	11.01	16.77	27.78	60.4	6698	4943	170	
8-18	90-03-08	8.8	26.70	35.5	75.2	6471	5953	345	Pr appears low(fill)
9-18	90-03-27	13.74	82.07	95.81	85.7	6756	4497	480	Assume 7 kPa/m gradient

As additional test data is gathered and analyzed and as rates are increased, accurate IPR curve data will be generated and submitted for your review.

If additional information is required, please contact Mr. John Cooke at 748-1334 or at the letterhead address.

Yours truly,

John Cooke

for L. A. Martinson, P. Eng.
Area Superintendent
Virden

JC/cm

TELEPHONE 748-1849
MOBILE YL6-2963
P.O. BOX 2115 VIRDEN, MANITOBA R0M 2C0

Armstrong Perforating Ltd.

SUBSURFACE PRESSURE SURVEY

Date: April 24,1990 Pool VIRDEN Datum

Well Name	Location	Time Press. Meas'd	Date	Shut-in Period Hours	Tubing Press. KPA	Casing Press. KPA	Fluid Level	Fluid Grad.	Gas Grad.	Temp. at Run Depth C	Run Depth M	Datum Depth M	Press. at Run Depth KPA	Press. at Datum KPA	Gauge No. 32385N	Remarks
CHEVRON VIRDEN 3-17	3-17-9-25WPM	-	April24	-	585	-	Full	.363	-	-	61	644.25	1085	5668		WAXED OFF
CHEVRON VIRDEN 5-17	5-17-9-25WPM	-	April24	-	596	-	-	.266	-	-	61	638.25	1020	4432		WAXED OFF
CHEVRON VIRDEN 3-18	3-18-9-25WPM	-	April24	-	314	-	Full	.439	-	28.9	637.75	637.75	6645	6645		
CHEVRON VIRDEN 7-18	7-18-9-25WPM	-	April24	-	368	-	Full	.435	-	27.8	642.75	642.75	6698	6698		
CHEVRON VIRDEN 8-18	8-18-9-25WPM	-	April24	-	357	-	Full	.377	-	33.3	620.8	641.25	6471	6682		FILL IN HOLE

JOHN

Chevron

Chevron Canada Resources

P.O. Box 100, Virden, Manitoba R0M 2C0
Phone (204) 748-1334 Fax (204) 748-6762

DEPARTMENT OF ENERGY AND MINES
APR 18 1990
PETROLEUM BRANCH

1990-04-16

Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
WINNIPEG, Manitoba
R3C 4E3

ATTENTION: Mr. L. R. Dubreuil

Dear Sir:

RE: Board Order No. 79A
Maximum Permissible Production Rate Increase
Monthly Testing and Performance Report - 1990-03

As requested in your approval letter dated 1990-02-26, the following information is submitted:

5-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	% WATER	REMARKS
1990-03-17	11.15	2.80	13.95	20.1	-Flowing through 4.8mm choke
-19					-Tubing 760 kPa; Casing 1100 kPa
-20	13.13	3.98	17.11	23.3	-Flowing through 5.6mm choke
-25	12.57	3.51	16.08	21.8	- " " " "
-26					-Tubing 480 kPa; Casing 1380 kPa
-27					-Due to declining tubing pressure, a tank truck was tied into the tubing and 2.4m^3 of fluid was flowed into it. Tubing pressure increased to 900 kPa and flowing production on a 5.6mm choke was resumed.
Monthly:	370.60	86.10	456.70	18.9	

. . . ./Page 2

4-17-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	% WATER	REMARKS
1990-03-06	6.36	7.78	14.14	55.0	-Producing with in-line gear pump
-19					-Tubing 140 kPa; Casing 1240 kPa
-24					-Installed a 114 pumpjack and a 38.1mm rod pump. Pumpjack running at 14 SPM with a 137cm (54") stroke length
-26					-Tubing 480 kPa; Casing 1240 kPa
-29	8.20	20.39	28.59	71.3	
Monthly:	263.70	607.00	870.70	69.7	

9-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	% WATER	REMARKS
1990-02-23	11.39	56.00	67.39	83.1	-Producing with a 50.8mm rod pump at 10 SPM and a 127cm (50") stroke length
-19					-Tubing 620 kPa; Casing 1550 kPa
-25					-Installed larger 57.2mm pump to increase rate
-26					-Tubing 480 kPa; Casing 480 kPa
-27	13.74	82.07	95.81	85.7	
Monthly:	441.30	2439.80	2881.10	84.7	

3-17-9-25:

Not tested during 1990-03
Well flowing through 5.2mm choke

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	% WATER	REMARKS
1990-03-19					-Tubing 620 kPa; Casing 1035 kPa
-26					-Tubing 825 kPa; Casing 1240 kPa
Monthly:	332.30	9.20	341.50	2.7	

3-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	% WATER	REMARKS
1990-03-04	5.26	30.53	35.79	85.3	-Producing with in-line gear pump
-19					-Tubing 310 kPa; Casing 2000 kPa
-26					-Tubing 275 kPa; Casing 1930 kPa
Monthly:	211.00	778.30	989.30	78.7	

. . . . /Page 3

7-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	% WATER	REMARKS
1990-03-07	11.01	16.77	27.78	60.4	-Producing with in-line gear pump
-19					-Tubing 170 kPa; Casing 1240 kPa
-26					-Tubing 170 kPa; Casing 1240 kPa
Monthly:	365.90	515.90	881.80	58.5	

8-18-9-25:

DATE	OIL(m^3)	WATER(m^3)	TOTAL(m^3)	% WATER	REMARKS
1990-03-08	8.80	26.70	35.50	75.2	-Producing with in-line gear pump
-19					-Tubing 380 kPa; Casing 1310 kPa
-26					-Tubing 345 kPa; Casing 1345 kPa
Monthly:	292.50	821.30	1113.80	73.7	
7 well Total:	2277.30	5257.60	7534.90	69.8	

The proration factors used for all 7 wells in 1990-03 were: oil - 1.07206929
water - 0.99232604

Annular fluid levels were checked on 1990-03-26 and all 7 wells were full (fluid to surface).

It is intented to obtain static bottom-hole pressure data on the 5 flowing/ gear pumped wells during 1990-04 so that bottom-hole producing presure information and accurate IPR curve data can be submitted in future reports (including pumped wells 9-18 and 4-17).

If additional information is required, please contact Mr. John Cooke at 748-1334 or at the letterhead address.

Yours truly,

John Cooke
for: L. A. Martinson, P. Eng.
Area Superintendent
Virden

JC/tjs

Manitoba

Energy and Mines Petroleum

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

(204) 945-6577

March 28, 1990

Chevron Canada Resources
P.O. Box 100
Virden, Manitoba
ROM 2CO

Attention: Mr. L.A. Martinson, P. Eng.
Area Superintendent, Virden

Dear Lyle:

RE: Maximum Permissible Production Rate Increase - Board Order No. 79A
Well Testing Program

The well testing program outlined in your letter dated March 19, 1990 is hereby acknowledged.

Your proposal to gradually increase production rates on four (4) wells, while using the remaining three (3) wells as "control" wells, is acceptable. Your plans to conduct a minimum of one 24 hour test/month/well is also acceptable. We request that fluid levels be shot on all wells at least monthly.

With respect to the overall intent of the testing program, the Branch expects the testing program to provide the background data for any future application for an increase in maximum permissible production rate (MPPR). Some questions that should be addressed by Chevron in a future application are:

(1) Did the water-cut on individual wells vary significantly with rate? Is there any evidence of a critical production rate?

(2) Is there any evidence of non-uniform edge-water encroachment that could be attributed to the increased pressure drawdown?

(3) Did the increased voidage rate result in a significant decline in reservoir pressure?

(4) Overall, did the increases in MPPR have an adverse effect on recovery?

If you have any other questions in respect of this matter, please contact the undersigned or John Fox at 945-6573 or 945-6574 respectively.

Yours truly,

L.R. Dubreuil
Director

JNF/ibj

$$PI = \frac{q}{\bar{p}_0 - p_{wf}} = \frac{0.007082\,kh}{B_o \mu \ln\left(\frac{r_e}{r_w}\right)} , \; bbl/d/psi$$

IPR (inflow-performance relationship) -

PI decreases as ΔP (drawdown) increases

- stratified reservoirs see Fig. 2-11 (assume no vert communication--)
  composite IPR curve - improving PI with increasing
  production rate - differential depletion (ratio k_h/k_v large)

EFFECT OF DRAWDOWN ON WOR

- see pg. 69 test well at different drawdowns & measure
  oil & water production rates

  - study the variation of water-cut with rate, can
    determine an IPR for both oil & water

- water influx - WOR increasing with increasing cumul. prod.

- I assume fluid levels were shot to determine p_{wf} @
  2 stabilized producing rates.

- Structural position of the well has an effect on performance Sec 17 vs Sec 18

provide composite IPR curves - for each well especially - determination of oil & water production performance to confirm if slight increase in ~~[illegible]~~ cut observed will
- voidage has resulted in pressure ⊕ press. depletion

- confirmation of ~~recovery~~ drive mechanism edge-water drive / aquifer advance

linear log WOR vs cumulative oil pred.

- favorable conditions for oil recovery

-> anticipate a greater vol. of wtr. produced as edge-wtr encroachment => regional migration not adverse affect down-dip wells.

- reservoir press. is related to ratio of water influx to voidage & assume voidage does not considerably exceed influx resulting in pressure decline

stable advance pressure gradients established around wellbore
- rate sensitive -> edge water encroachment
caused by high drawdown => water fingering - critical production rate
adversely affect performance

Chevron

Chevron Canada Resources
P.O. Box 100, Virden, Manitoba R0M 2C0
Phone (204) 748-1334 Fax (204) 748-6762

1990-03-19

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

Attention: Mr. L. R. Dubreuil
Director

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
Well Testing Program

In reply to your approval letter dated 1990-02-26, the following information is submitted:

(1) Schedule of Rate Changes

5-17-9-25
- Current estimated production 15 m^3OPD,5m^3WPD
- The flowing rate was recently increased, although a production test has not yet been performed. Following a test to confirm the new rate, the production will be gradually increased over the test period to achieve the 20 m^3OPD target.

4-17-9-25
- Current production 6.4 m^3OPD, 7.8 m^3WPD
- As soon as possible (weather permitting), install a 114 pumpjack with a 38.1 mm rod insert pump initially to produce approximately 25 m^3FPD (estimated 10-12 m^3OPD)
- Increase bottomhole pump sizes as required to increase the rates gradually over the test period to attain the 20 m^3OPD target.

9-18-9-25
- Current production 13 m^3OPD, 54 m^3WPD
- Increase bottom hole pump sizes as required over the test period to achieve the 20 m^3OPD target.

3-17-9-25
- Current production 17 m^3OPD, 2 m^3WPD
- This well will be used primarily for flexibility i.e. if other rate changed wells are not performing as predicted, 3-17 rates can be increased to attain the 20 m^3 OPD target. The intent will be to gain the necessary information to assist with this application.

3-18-9-25 - Current production 6.3 m^3OPD, 25.3 m^3WPD
- Increase the rates as much as possible utilizing the existing in-line booster pump. Current suction pressure is only 140 kPa, so the amount of increase may be minimal. A further production increase would require a substantial capital investment for installation of artificial lift. Since the 10-8 battery is currently operating at maximum capacity, this is not being considered at this time.

7-18 & 8-18-9-25
- Current production 12 m^3OPD, 12.5 m^3WPD (7-18)
  Current production 10 m^3OPD, 17.0 m^3WPD (8-18)
- It is proposed to leave these rates as is so they can be used as a "base" production reference. If the wells previously selected for 20 m^3OPD cannot realize their targets, these wells will be increased gradually in an attempt to achieve the 3000 m^3/month allowable.

A detailed rate change program is very difficult to provide as the necessary steps will be decided on well performance, not on a time frame.

(2) Production Testing

It is proposed to conduct a minimum of one 24 hour test/month/well during the test period. Additional testing will be done as required during the test period to maximize production information.

(3) Fluid Level Measurements

Currently all seven (7) wells have fluid to surface on the annulus. As rates are increased on the "pumped" wells, sonologs will be taken periodically to properly evaluate bottomhole producing conditions. It is also proposed to obtain weekly tubing and casing pressures for additional production information.

It should be re-emphasized that the 10-8-9-25 battery is currently operating at maximum capacity. It is planned to shut in 11-8-9-25 immediately (current production of 1.3 m^3OPD, 32.5 m^3WPD) to allow some flexibility during the test period. Because of our capacity limitations, adjustments may have to be made to the proposed testing program. The monthly reporting to the Petroleum Branch will keep you informed of all changes.

Chevron apologizes for the delay in responding to this request and for any inconvenience this may have caused.

If further information is required regarding this proposal, please contact John Cooke at 748-1334 or at the letterhead address.

Yours truly,

John Cooke

for/ L. A. Martinson, P. Eng.
Area Superintendent
Virden

JC/cm

Manitoba

Energy and Mines Petroleum

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

(204) 945-6577

February 26, 1990

Chevron Canada Resources
500 - 5th Avenue S.W.
Calgary, Alberta
T2P 0L7

Attention: Mr. C. G. Folden, P. Eng.
Manager, Reservoir Engineering

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

Your application for exemption from maximum permissible rate restrictions for wells located in the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 & NE 1/4 of Section 18-9-25 (WPM) has been approved in part by The Oil and Natural Gas Conservation Board ("the Board").

Board Order No. 79A, attached, grants Chevron an increase in the maximum permissible daily and monthly production rate for an interim period of six (6) months commencing March 1, 1990. The maximum permissible daily production rate for the wells in the area of application is 20 m^3 of clean oil with the restriction that the total combined maximum permissible monthly production rate for the seven wells is 3 000 m^3 of clean oil.

In accordance with clause 6 of the Board Order, Chevron is hereby requested to submit the following production and reservoir information needed to evaluate the effect of increased production rates on reservoir performance.

(1) A detailed well testing program prior to March 12, 1990. The testing program should include a schedule of rate changes for each well and the frequency of individual well production testing and fluid level measurements.

(2) A monthly production testing and well performance report to be submitted before the 15th day of the following month. The report should include the daily and monthly oil and water production and calculated bottomhole producing pressure for each well. The report should also include IPR curves for individual wells as determined and an explanation of any anomalous production results.

With respect to notice of the application, the Board had decided to notify the offsetting lessors and lessees of the Board's Order directly, instead of advertising the application. Chevron was requested to provide the names and addresses of the offsetting lessors and lessees. I was disappointed in the effort put forth by Chevron to provide this information in an accurate and timely manner. Please ensure in the future that the names and addresses of lessors and lessees provided with an application are thoroughly researched and accurate.

If Chevron wishes to make further application under subsection 51(3) of the Petroleum Drilling and Production Regulation for exemption from or amended to the maximum permissible production rate after the expiry of Board Order No. 79A, it is suggested that such application be filed 1 - 2 months prior to the expiry of the Order.

If you have any questions in respect of this matter, please contact the undersigned or John Fox, Chief Petroleum Engineer at 945-6573 and 945-6574, respectively.

Yours sincerely,

L. R. Dubreuil
Director

Attachment

JNF/LRD/sml

bc: Virden Office

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

Order No. 79A
An Order Pertaining to Maximum Permissible Production Rates in the Virden 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, Chevron Canada Resources is the operator of wells in the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 and NE 1/4 of Section 18-9-25 (WPM) ("the area of application");

AND WHEREAS, Chevron Canada Resources made application dated December 11, 1989, for exemption from maximum permissible production rate restrictions for wells in the area of application;

AND WHEREAS, upon due consideration of the said application, the Board has found that an increase in the maximum permissible daily and monthly production rate for an interim period of six months is reasonable and desireable;

NOW, THEREFORE, the Board orders that:

1 The maximum permissible daily production rate for the following wells is 20 cubic metres of clean oil:

Chevron Virden 3-17-9-25 (WPM)
Chevron Virden 4-17-9-25 (WPM)
Chevron Virden 5-17-9-25 (WPM)
Chevron Virden Prov. 3-18-9-25 (WPM)
Chevron Virden 7-18-9-25 (WPM)
Chevron Virden 8-18-9-25 (WPM)
Chevron Virden Prov. 9-18-9-25 (WPM)

2 The combined maximum permissible monthly production rate for the seven wells in section 1 is 3 000 cubic metres of clean oil.

3 This Order shall take effect on March 1, 1990 and shall expire on August 31, 1990 unless otherwise extended by the Board as provided for in section 4 or rescinded by the Board as provided for in section 7.

4 This Order may be extended by the Board, upon application, for a period of up to one month subject to the restriction that over the period this Order remains in effect a maximum volume of 18 000 cubic metres of clean oil may be produced.

5(1) The operator shall, prior to July 31, 1990, conduct a pressure survey on one well in each of the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 or NE 1/4 of Section 18-9-25 (WPM) to determine the static reservoir pressure.

5(2) The operator shall submit to the Petroleum Branch, the details of the surveys described in subsection (1), 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.

6 The operator shall submit such information and reports on the production and reservoir performance of the wells listed in section 1 as may be requested by the Director of Petroleum.

7 This Order may be rescinded by the Board at any time without notice.

H. Clare Moster
Deputy Chairman

Ian Haugh
Chairman

THE OIL AND NATURAL GAS CONSERVATION
BOARD ORDER NO. 79A APPROVED THIS
16TH DAY OF FEBRUARY A.D., 1990
AT THE CITY OF WINNIPEG

APPROVED:

Harold Neufeld
Minister of Energy and Mines

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Western Manitoba Nursing Home Inc.
C/O Box 520
Virden, Manitoba
ROM 2CO

Dear Sir:

Re: **Board Order No. 79A**
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Encor Energy Corporation Inc.
9th Floor, 300 - 5th Avenue S.W.
Calgary, Alberta
T2P 3C4

Attention: Land Department

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Mary Madeline Rose Read
C/O Golden Sun RV Resort
SP H20-999 W. Broadway
Apache Junction, Arizona
85220 USA

Dear Madame:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H. C. Moster

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Henry Victor Louis Vanderschaeghe
C/O Golden Sun RV Resort
SP E3-999 W. Broadway
Apache Junction, Arizona
85220 USA

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

HG Moster

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Ben Ober
Box 456
Centralia, Illinois
62801 USA

Attention: Mr. Ober

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

HC Moster

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Virden & District Elderly Persons
Housing Corporation
C/O Box 520
Virden, Manitoba
ROM 2CO

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Bertha Germaine Adeline Kernel
Box 1703
Virden, Manitoba
ROM 2CO

Dear Madame:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Murphy Oil Company Ltd.
1700 - 800 - 6th Ave. S.W.
Calgary, Alberta
T2P 3Y3

Attention: Land Department

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Amoco Canada Resources Ltd.
P.O. Box 200
Calgary, Alberta
T2P 2H8

Attention: Land Department

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H C Moster

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Pan Canadian Petroleum Ltd.
P.O. Box 2850
Calgary, Alberta
T2P 2S5

Attention: Land Department

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

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You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H.C. Moster

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

The Canada Trust Company
505 - 3rd Street S.W.
Calgary, Alberta
T2P 3E6

Attention: Oil Royalty Department for the
Account of Williston Basin Trust

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

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

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Ms. Nettie Sawatsky
Box 1582
Virden, Manitoba
ROM 2CO

Dear Ms. Sawatsky:

Re: **Board Order No. 79A**
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

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You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectfully,

H C Moster

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

The Anglican Church of Canada
Parish of St. Mary's The Virgin
C/O Box 520
Virden, Manitoba
ROM 2CO

Dear Sir:

Re: Board Order No. 79A
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

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

Yours respectfully,

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

February 26, 1990

Hospital District # 10
C/O Box 520
Virden, Manitoba
ROM 2CO

Dear Sir:

Re: **Board Order No. 79A**
Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM)

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

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

Yours respectfully,

H C Moster

H. Clare Moster
Deputy Chairman

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

Order No. 79A
An Order Pertaining to Maximum Permissible Production Rates in the Virden 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, Chevron Canada Resources is the operator of wells in the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 and NE 1/4 of Section 18-9-25 (WPM) ("the area of application");

AND WHEREAS, Chevron Canada Resources made application dated December 11, 1989, for exemption from maximum permissible production rate restrictions for wells in the area of application;

AND WHEREAS, upon due consideration of the said application, the Board has found that an increase in the maximum permissible daily and monthly production rate for an interim period of six months is reasonable and desireable;

NOW, THEREFORE, the Board orders that:

1 The maximum permissible daily production rate for the following wells is 20 cubic metres of clean oil:

Chevron Virden 3-17-9-25 (WPM)
Chevron Virden 4-17-9-25 (WPM)
Chevron Virden 5-17-9-25 (WPM)
Chevron Virden Prov. 3-18-9-25 (WPM)
Chevron Virden 7-18-9-25 (WPM)
Chevron Virden 8-18-9-25 (WPM)
Chevron Virden Prov. 9-18-9-25 (WPM)

2 The combined maximum permissible monthly production rate for the seven wells in section 1 is 3 000 cubic metres of clean oil.

3 This Order shall take effect on March 1, 1990 and shall expire on August 31, 1990 unless otherwise extended by the Board as provided for in section 4 or rescinded by the Board as provided for in section 7.

This Order may be extended by the Board, upon application, for a period of up to one month subject to the restriction that over the period this Order remains in effect a maximum volume of 18 000 cubic metres of clean oil may be produced.

5(1) The operator shall, prior to July 31, 1990, conduct a pressure survey on one well in each of the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 or NE 1/4 of Section 18-9-25 (WPM) to determine the static reservoir pressure.

5(2) The operator shall submit to the Petroleum Branch, the details of the surveys described in subsection (1), 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.

6 The operator shall submit such information and reports on the production and reservoir performance of the wells listed in section 1 as may be requested by the Director of Petroleum.

7 This Order may be rescinded by the Board at any time without notice.

H. Clare Moster
Deputy Chairman

Ian Haugh
Chairman

THE OIL AND NATURAL GAS CONSERVATION BOARD ORDER NO. 79A APPROVED THIS 16TH DAY OF FEBRUARY A.D., 1990 AT THE CITY OF WINNIPEG

APPROVED:

Harold Neufeld
Minister of Energy and Mines

MEMORANDUM

TO ______ CC ______ DATE ______

FROM ______ FILE ______ NUMBER PAGE ______ OF ______

SUBJECT JOB

TAG

John:

Pls. replace: Murphy Oil Company (81.25%)
& Ben Ober (18.75%)

as the lessee's for 11,12,13-17-9-25 W1M.

Apparently the interests on records (& as reported to you originally) have changed several times over the past 20 years. To the best of our knowledge, the above two parties are the current lessees

Ben Ober ok
*Box 456
Centralia, Illinois 62801

Murphy address previously provided.

Scott Robinson.

GO-144 (85-02)

MEMORANDUM

TO Scott / 748 CC DATE 90-02-21

FROM Jim / A39 FILE NUMBER PAGE 1 OF 1

SUBJECT JOB TAG

Scott -

Here are the majority of the addresses you requested. I have not been able to contact John E Robertson at the telephone # given me by information - it may not even be the right person at all, given the age of the caveat. Similarly, the address for Halliburton Oil Producing Co. is very old, but searches through the Oil + Gas Index, telephone books and general conversations with old timers have all drawn blanks. I guess an old address is better than none, and the lawyers at Aiken, Macauley and Thorvaldson may know the present company's whereabouts (if the firm still exists).

The rest of the addresses should check out okay. If you need any more assistance let me know - if we had more time I could possibly expedite things through Manitoba Land Titles via our lawyers down in Winnipeg, but even this would take some time as Brandon Land Titles has been unusually swamped (and hence, slow) lately.

Best Regards

Jim

CO 141 (85/07)

(note: HBOG now owned by Amoco)

① Amoco Canada Resources Ltd.
PO Box 200
Calgary, Alta T2P 2H8

② PanCanadian Petroleum Ltd.
PO Box 2850
Calgary, Alta T2P 2S5

③ Nettie Sawadsky
Box 1582
Virden, Man. R0M 2C0

④ The Canada Trust Company
Att'n: Oil Royalty Dep't for the Acct of Williston Basin Trust
505-3rd St. SW
Calgary, Alta T2P 3E6

⑤ Minister of Finance
Manitoba Energy and Mines - Petroleum Resources Division
555-330 Graham Ave.
Winnipeg, Man. R3C 4E3

⑥ Encor Energy Corporation Inc ✓
9 Flr 300 5 Ave SW
Calgary, Alta

OR

Encor Energy Corporation Ltd.
3700 Bow Valley Sq. 4
Calgary, Alta.

⑦ ok Murphy Oil Company Ltd. ✓ or
1700 800-6 Ave SW
Calgary Alta, T2P 3Y3
Attention: Land Department

957-0050

c/o Aikins, Macauley & Thorvaldson
~~#3, 333 Broadway Ave.~~
30th Floor, Commodity Exchange Tower
360 Main Street
Winnipeg, Manitoba. R3C 4G1

(8) 4 letters (1) Virden + District Elderly Persons Housing Corporation, (2) Western Manitoba Nursing Home Inc., (3) Hospital District #10 and (4) the Anglican Church of Canada (Parish of St. Mary's the Virgin, Virden, Manitoba, within the Diocese of Brandon).
c/o Box 520, Virden, Manitoba ROM 2CO.

(9) Bertha Germaine Adeline Kernel
Box 1703
Virden, Manitoba ROM 2CO

(10) Henry Victor Louis Vanderschaeghe
c/o Golden Sun RV Resort
SP E3 - 999 W Broadway
Apache Junction, Arizona USA 85220

(11) Mary Madeline Rose Read
c/o Golden Sun RV Resort
SP H20 - 999 W Broadway
Apache Junction, Arizona USA 85220

Unknown BRANDON
John E. Robertson - 728-0416 - no answer ?
Halliburton Oil Producing Company

(12) Halliburton Oil Producing Company.
c/o Richardson, Richardson + Co
274 Garry Street
Winnipeg, Manitoba

← suspect a sister or daughter company of Halliburton in the U.S. is the lessee. Halliburton here in Canada claims they had/have no producing compan[y] or leases

Scott
234-5026
Transferred to Canada Trust
CHECKED 90-02-26

Attachment 2

List of Mineral Owners and Lessees

Land	Mineral Owner	Lessee
13-07-9-25 W1M	50% - Dome	Open
	25% - Toronto General Trusts Corp. ?	Jack George
	25% - Virden and District Elderly Persons Housing Corp.	726-6279
	- Western Manitoba Nursing Home Inc.	
	- Hospital District #10	
	- Anglican Church	
14-07-9-25 W1M	Same as above ?	Open
15-07-9-25 W1M	Same as above	Open
16-07-9-25 W1M	Same as above	Open
1 13-08-9-25 W1M	100% - Dome (Amoco)	93.75% Chevron
		6.25% Encor
14-08-9-25 W1M	Same as above	
15-08-9-25 W1M	100% - Dome	87.5% HBOG Amoco
		12.5% Encor
02-17-9-25 W1M	100% - CPR	100% Chevron
03-17-9-25 W1M	100% - CPR (PanCanadian)	100% Chevron
2 04-17-9-25 W1M	100% - CPR	100% Chevron
05-17-9-25 W1M	100% - CPR	100% Chevron
06-17-9-25 W1M	100% - CPR	100% Chevron
07-17-9-25 W1M	100% - CPR	100% Chevron 294-5000
NW 1/4 11-17-9-25 W1M	33-1/3% H.V.L. Vanderschaeghe ?	Murphy
	33-1/3% M.M.R. Read	Halliburton Ben
	33-1/3% B.G.A. Kernel	J. E. Robertson Olsen
12-17-9-25 W1M	Same as above	
13-17-9-25 W1M	Same as above	
3 4 01-18-9-25 W1M	75% N. Sawatsky	100% Chevron
	25% Canada Trust	
02-18-9-25 W1M	Crown	100% Chevron
5 03-18-9-25 W1M	Crown	100% Chevron
04-18-9-25 W1M	Crown	100% Chevron
05-18-9-25 W1M	Crown (Minister of Finance, Energy + Mines - Petroleum Winnipeg)	100% Chevron
06-18-9-25 W1M	Crown	100% Chevron

Attachment 2 (cont'd)

Land	Mineral Owner	Lessee
07-18-9-25 W1M	75% N. Sawatsky 25% Canada Trust	100% Chevron
08-18-9-25 W1M	Same as above	
09-18-9-25 W1M	Crown	100% Chevron
10-18-9-25 W1M	Crown	100% Chevron
15-18-9-25 W1M	Crown	100% Chevron
16-18-9-25 W1m	Crown	100% Chevron

_Amoco Canada Resources Ltd.
P.O. Box 200
Calgary, Alberta
" P 2H8 Attention: Land Department Dear Sir:_Pan Canadian Petroleum Ltd.
). Box 2850
Calgary, Alberta
T2P 2S5 Attention: Land Department Dear Sir:_Ms. Nettie Sawatsky
Box 1582
Virden, Manitoba
ROM 2CO Dear: Ms. Sawatsky_Enron Oil Canada Ltd.
1300, 700 - 9th Avenue S.W.
Calgary, Alberta
T2P 3V4 Attention: Mr. D. K. Palmer Dear Sir:_The Canada Trust Company
505 - 3rd Street S.W.
Calgary, Alberta
T2P 3E6 Attention: Oil Royalty Department for the
Account of Williston Basin Trust Dear Sir:_

Manitoba

Memorandum

Date February 8, 1990

To The Oil and Natural Gas Conservation Board

Ian Haugh - Chairman
H.C. Moster - Deputy Chairman
Wm. McDonald - Member

From John N. Fox
Chief Petroleum Engineer
Petroleum Branch

Subject

Telephone

Re: Chevron Canada Resources - Application for Exemption From Maximum Permissible Production Rate Restrictions - SW 1/4 of Section 17-9-25 (WPM) & S 1/2 & NE 1/4 of Section 18-9-25 (WPM)

First | Fold

Chevron Canada Resources has made application under subsection 51(3) of the Petroleum Drilling and Production Regulation (the "Regulation") for exemption from the Maximum Permissible Production Rate (MPPR) of 290 m^3/month for seven wells located in the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 and NE 1/4 of Section 18-9-25 (WPM). Chevron has indicated it plans to produce these wells at approximately 20 m^3 OPD, but it has not suggested a limiting MPPR.

Recommendations

It is recommended that for an interim period of six months from March 1, 1990 to August 31, 1990 the maximum permissible daily production rate per well and the maximum permissible monthly production rate for the seven wells be set at 20 m^3 and 3 000 m^3, respectively. A copy of proposed Board Order No. 79A is attached. The draft Board Order contains a provision that upon application, the interim six month period may be extended to seven months on the condition that the maximum volume of oil that may be produced under the Board Order remains unchanged at 18 000 m^3.

It is also recommended that the Board Order contain a provision that Chevron be required to submit such information as may be requested by the Director of Petroleum to properly evaluate the effect of increased production rates on reservoir performance.

It is further recommended that the Board notify offsetting working interest and royalty owners of the increase in maximum permissible production rates. The notification would indicate that should a well be drilled on a location offsetting one of the wells included in the interim approval, the Board upon application will consider extending the Order to include such a well. A copy of the proposed letter of notification is attached.

Discussion

Chevron has drilled seven wells southwest of Routledge Unit No. 1 (Figure 1) in the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 and NE 1/4 of Section 18-9-25 (WPM) ("the area of application"). To date only two wells, 8-18-9-25 (8 months) and 9-18-9-25 (4 months) have been on production for more than 1-2 months. Table 1 lists the individual wells and their production for November, 1989.

The wells have been included in the Virden Lodgepole C Pool and are subject to a maximum permissible daily and monthly production rate of 11 m^3 and 290 m^3, respectively as per Schedule D of the Regulation. Chevron has applied for an exemption from maximum permissible production rate restrictions for wells in the area of application.

The two primary concerns that must be addressed when considering an increase in MPPR are the effect of increased production on ultimate recovery and on the correlative rights of offsetting working interest and royalty owners.

Effect of Production Rate on Ultimate Recovery

Chevron has provided production and bottom hole flowing pressure data for 8-18-9-25 and 9-18-9-25. From this data inflow performance (IPR) curves have been developed for the wells. The IPR curves (Figures 2 & 3) indicate both wells have high productivity and could produce 20 m^3 OPD with a pressure drawdown of only 15-20% of reservoir pressure. What the curves cannot be used to predict is the effect of an increase in production rate on ultimate recovery.

At this early stage of reservoir depletion it is impossible to predict whether an increase in production rate in the area of application will result in an increase or decrease in recovery or if recovery is in fact not rate dependent.

The wells in the area of application are completed in the Upper Whitewater and Upper Virden members of the Lodgepole Formation near the regional oil/water contact. The wells received strong pressure support from a downdip aquifer to the southwest.

The performance of the wells is expected to be similar to the performance of wells located in Section 8-9-25 (WPM) now part of the Virden Lodgepole C Pool and in particular the 7-8-9-25 (WPM) well (Figure 1).

Figure 4 is a plot of the production history of the wells in Section 8-9-25 (WPM). The plot shows a continual increase in WOR from 1.0 to 15 m^3/m^3 since production commenced in 1987, while oil production has remained relatively constant. This suggests that near the regional oil/water contact encroachment of the downdip aquifer occurs independent of the production rate suggesting that oil recovery is independent of production rate.

In November 1987, the Board granted the 7-8-9-25 (WPM) well an increase in daily MPPR to 40 m^3/d for an interim six month period. During the six months the daily oil production ranged from 2.4 - 16 m^3 OPD (5.9 - 46 m^3 FPD). Over the same period the WOR continually increased from 1.06 to 2.83m^3/m^3 independent of the production rate. At the end of the six month period the production had declined to 4 m^3 OPD. Figure 5, which is a plot of the production history for 7-8-9-25 (WPM), supports the suggestion that in the area of application an increase in production rates will not have an adverse effect on oil recovery.

Chevron has postulated that because there is a large variation in permeability within the reservoir an increase in pressure drawdown will allow the less permeable zones which are not depleted under the current drawdown to be depleted. This may result in a slight increase in oil recovery in the area of application.

There is insufficient production performance from the wells in the application area to warrant a permanent exemption from or increase in MPPR. However, there appears to be enough evidence to suggest that oil recovery will not be adversely effected by an increase in production rates over the short term.

The only way to properly evaluate the effect of higher production rates on ultimate recovery is to allow the wells to be produced at higher rates.

It is recommended that Chevron be granted a daily MPPR of 20 m^3 OPD for each well and a total monthly MPPR for the seven wells of 3 000 m^3 OPM, for an interim period of six months from March 1, 1990 to August 31, 1990.

The increase in daily MPPR to 20 m^3 OPD for a six month period will allow Chevron an opportunity to properly evaluate the effect of increased production rates on reservoir performance.

The monthly MPPR of 3 000 m^3 which equates to an average of 15 m^3 OPD/well, is approximately one half the rate increase proposed by Chevron and represents a 970 m^3 increase above the present monthly MPPR of 2 030 m^3 (7 wells * 290 m^3 OPM/well). At 3 000 m^3 OPM Chevron has the flexibility to produce some wells at 20 m^3 OPD while the other wells would be restricted to 10 m^3 OPD which is less than the present daily MPPR. This flexibility should minimize operating difficulties which may be encountered by Chevron during the six month period.

To ensure the collection of production and reservoir information needed to properly evaluate the effect of increased production rates on reservoir performance it is recommended that Chevron be required to:

1) submit a detailed well testing program prior to March 1, 1990. The testing program should include a schedule of rate changes for each well and the frequency of individual well production testing and fluid level measurements,

2) submit monthly production testing and well performance reports including calculated IPR's for each well,

3) conduct a pressure survey on one well in the SW 1/4 of Section 17-9-25 (WPM) and one well in the S 1/2 or NE 1/4 of Section 18-9-25 (WPM) before July 31, 1990.

It is proposed to allow Chevron to apply for a one month extension of this approval in recognition of operational problems that may be encountered such as the need to install artificial lift or production restrictions due to limited treater or disposal capacity. The restriction on such an extention would be that the total volume of oil produced over the term of the approval would remain unchanged at 18 000 m^3 or less (6 months *3 000 m^3/mon).

Effect of Production Rate on Correlative Rights

There is a concern that an increase in the daily and monthly MPPR will result in the inequitable drainage of oil from offsetting lands. Figures 6 & 7 show the lessors and lessees in and adjacent to the area of application.

To evaluate the effect of increasing the MPPR on offset lands, the following worse case senario was developed.

It was assumed that the effect of increasing the pressure drawdown at a well in the application area is immediately observed at the spacing unit boundary resulting in an instantaneous flow across the boundary. At a production rate of 20 m^3 OPD, a pressure drawdown of 310 kPa or 4.6% of the original reservoir pressure was calculated at the spacing unit boundary (Figure 8). This drawdown results in an estimated flow of 1.2 m^3 OPD across the spacing unit boundary.

Figure 9 and Table 2 summarize the locations where inequitable drainage could occur. Assuming that during the six month approval period a well is produced at 20 m^3 OPD for 50% of the time, this will result in drainage of 55 m^3 oil from an adjacent spacing unit. If the time required for the influence of the pressure drawdown to reach the spacing unit boundary is factored in, this drainage volume could conservatively be reduced to 25 m^3 oil.

Because of the negligible effect on correlative rights of increasing the MPPR for a interim period of six months and the minimum amount of technical information presently available, no benefit will be gained by publishing notice of this application. Instead it is recommended that the Board notify the offset lessors and lessees of its decision. The letter should include the provision that if a well is drilled on offsetting lands, the Board upon application will consider extending this approval to that well. A copy of the proposed Board letter of notification is attached.

After the expiry of the six month period, if Chevron makes a further application for an exemption from or increase in the MPPR, it is suggested notice of such an application should be published at that time.

ORIGINAL SIGNED BY
JOHN N. FOX

John N. Fox
Chief Petroleum Engineer

JNF:sml

Attachments

Original Signed By
L. R. DUBREUIL

Approved by: ______________________________
L.R. Dubreuil, Director

Manitoba

The Oil and Natural Gas
Conservation Board

Room 309
Legislative Building
Winnipeg, Manitoba, CANADA
R3C 0V8

(204) 945-3130

Order No. 79A
An Order Pertaining to Maximum Permissible Production Rates in the Virden 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, Chevron Canada Resources is the operator of wells in the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 and NE 1/4 of Section 18-9-25 (WPM) ("the area of application");

AND WHEREAS, Chevron Canada Resources made application dated December 11, 1989, for exemption from maximum permissible production rate restrictions for wells in the area of application;

AND WHEREAS, upon due consideration of the said application, the Board has found that an increase in the maximum permissible daily and monthly production rate for an interim period of six months is reasonable and desireable;

NOW, THEREFORE, the Board orders that:

1 The maximum permissible daily production rate for the following wells is 20 cubic metres of clean oil:

Chevron Virden 3-17-9-25 (WPM)
Chevron Virden 4-17-9-25 (WPM)
Chevron Virden 5-17-9-25 (WPM)
Chevron Virden Prov. 3-18-9-25 (WPM)
Chevron Virden 7-18-9-25 (WPM)
Chevron Virden 8-18-9-25 (WPM)
Chevron Virden Prov. 9-18-9-25 (WPM)

2 The combined maximum permissible monthly production rate for the seven wells in section 1 is 3 000 cubic metres of clean oil.

3 This Order shall take effect on March 1, 1990 and shall expire on August 31, 1990 unless otherwise extended by the Board as provided for in section 4 or rescinded by the Board as provided for in section 7.

This Order may be extended by the Board, upon application, for a period of up to one month subject to the restriction that over the period this Order remains in effect a maximum volume of 18 000 cubic metres of clean oil may be produced.

5(1) The operator shall, prior to July 31, 1990, conduct a pressure survey on one well in each of the SW 1/4 of Section 17-9-25 (WPM) and the S 1/2 or NE 1/4 of Section 18-9-25 (WPM) to determine the static reservoir pressure.

5(2) The operator shall submit to the Petroleum Branch, the details of the surveys described in subsection (1), 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.

6 The operator shall submit such information and reports on the production and reservoir performance of the wells listed in section 1 as may be requested by the Director of Petroleum.

7 This Order may be rescinded by the Board at any time without notice.

H. Clare Moster
Deputy Chairman

Ian Haugh
Chairman

THE OIL AND NATURAL GAS CONSERVATION
BOARD ORDER NO. 79A APPROVED THIS
DAY OF A.D., 1990
AT THE CITY OF WINNIPEG

APPROVED:

Harold Neufeld
Minister of Energy and Mines

List of Addressees to Follow

Re: Maximum Permissible Production Rate Increase
SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section
18-9-25 (WPM) Board Order No. 79A

This letter is to notify you that The Oil and Natural Gas Conservation Board ("the Board") has granted Chevron Canada Resources an increase in the maximum permissible daily and monthly production rate for wells located in the SW 1/4 of Section 17-9-25 (WPM) and S 1/2 & NE 1/4 of Section 18-9-25 (WPM) for an interim period of six months, commencing March 1, 1990. A copy of Board Order No. 79A is attached.

Please be advised that should a well be drilled on a location offsetting one of the wells included in Board Order No. 79A, the Board upon application, will consider extending the Order to include such a well.

You will be notified should Chevron make further application for a change in the maximum permissible production rate after the expiry of Board Order No. 79A.

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

Yours respectively,

H. Clare Moster
Deputy Chairman

TABLE 1

Production Data
November, 1989

WELL	DAILY OIL (m^3/d)	WOR m^3/m^3
3-17-9-25	8.45	0.14
4-17-9-25	11.54	1.90
5-17-9-25	12.64	0.15
3-18-9-25	5.48	4.53
7-18-9-25	8.56	1.20
8-18-9-25	9.51	2.05
9-18-9-25	8.57	2.74

TABLE 2

Potential Drainage

Location	Producing Well	Potential Drainage Volume Daily (M^3 OPD)	6 months* (M^3)	Lessor	Lessee
14-7-9-25	3-18-9-25	0.3	27	Dome Et Al	Open
13&14-8-9-25	3-17-9-25 4-17-9-25	0.6	55	Dome	Chevron - 93.75% Enron - 6.26%
12-17-9-25	5-17-9-25 9-18-9-25	0.6	55	Read Et Al	Murphy Et Al
1&2-18-9-25	4-17-9-25 3-18-9-25	0.6	55	Sawatsky Canada Trust	Chevron
6&10-18-9-25	7-18-9-25 9-18-9-25	0.6	55	Crown	Chevron

*Assumes the offsetting producing well is produced at 20 m^3 OPD for 3 of the 6 months.

APPLICATION AREA

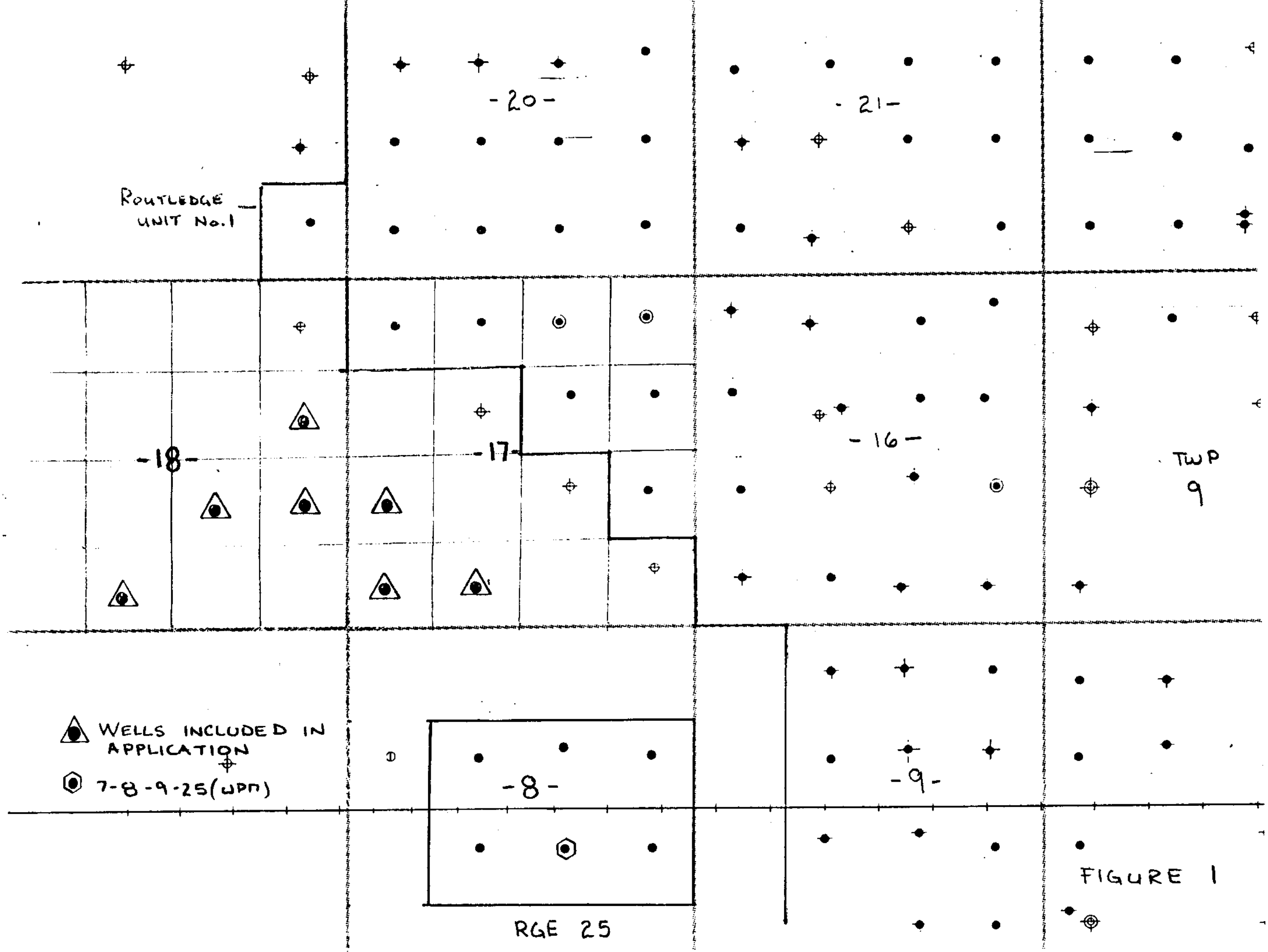


FIGURE 1

IPR - 8-18-9-25

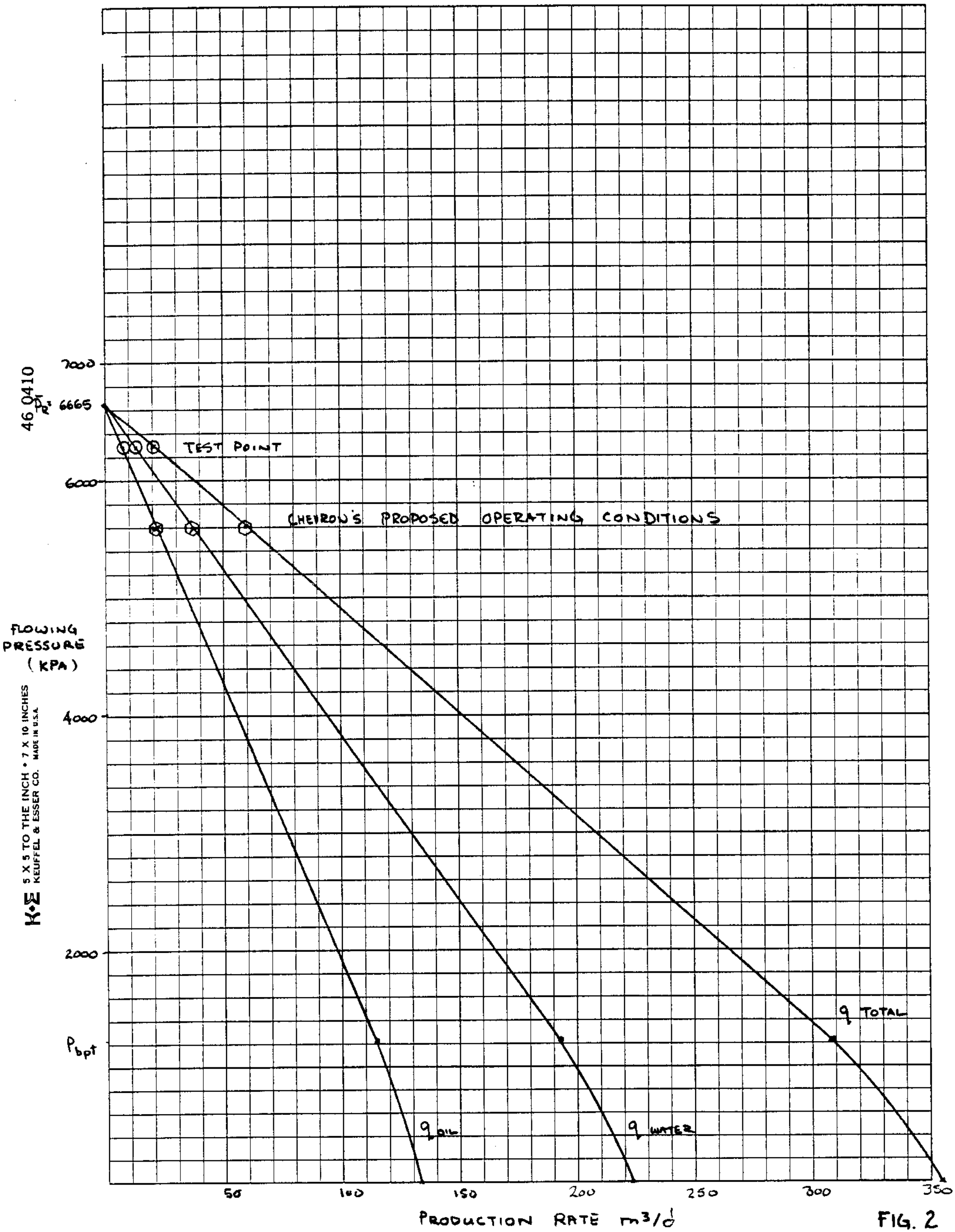


FIG. 2

IPR - 9-18-9-25

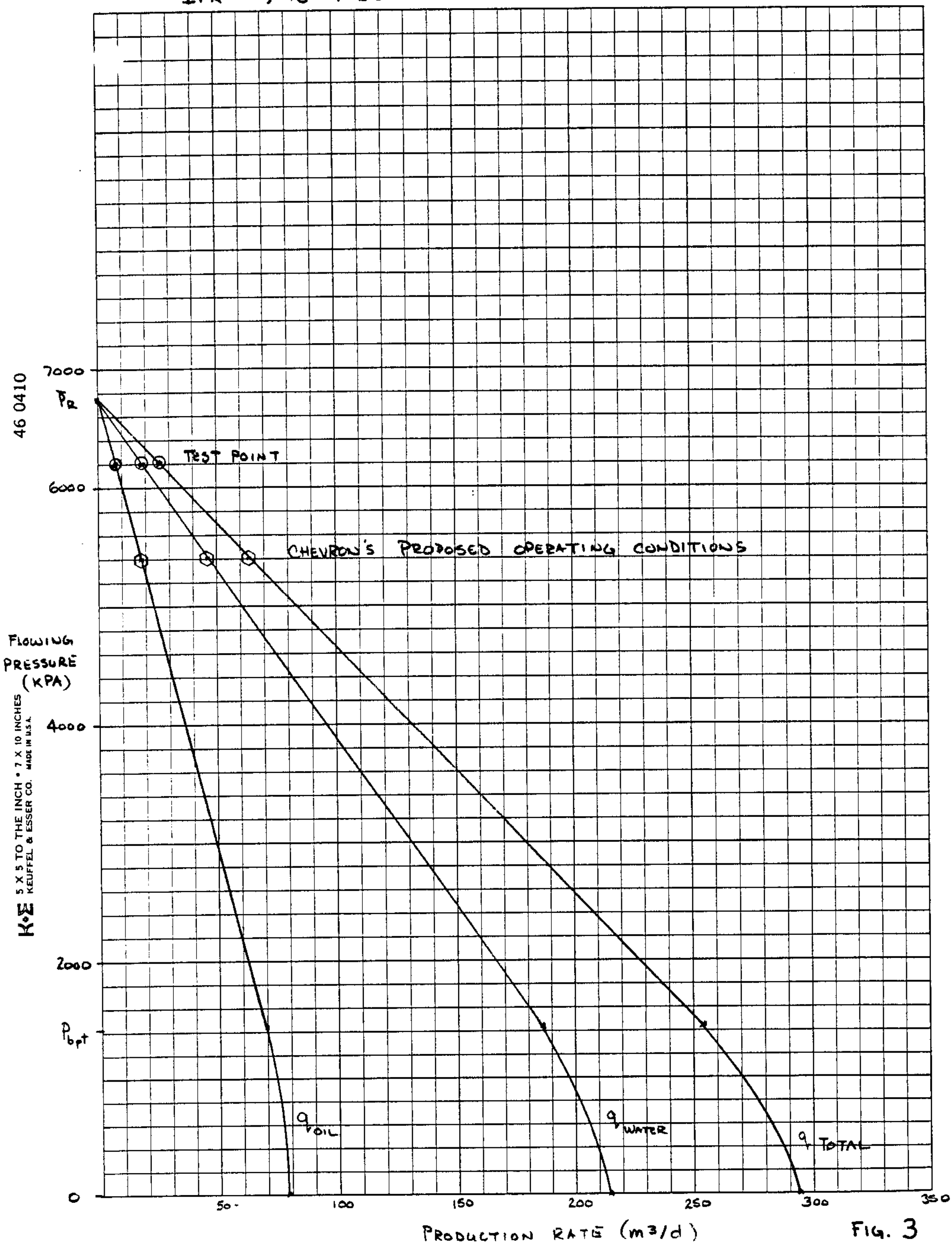


FIG. 3

SEC. 8-9-25 (WPM) PRODUCTION HISTORY

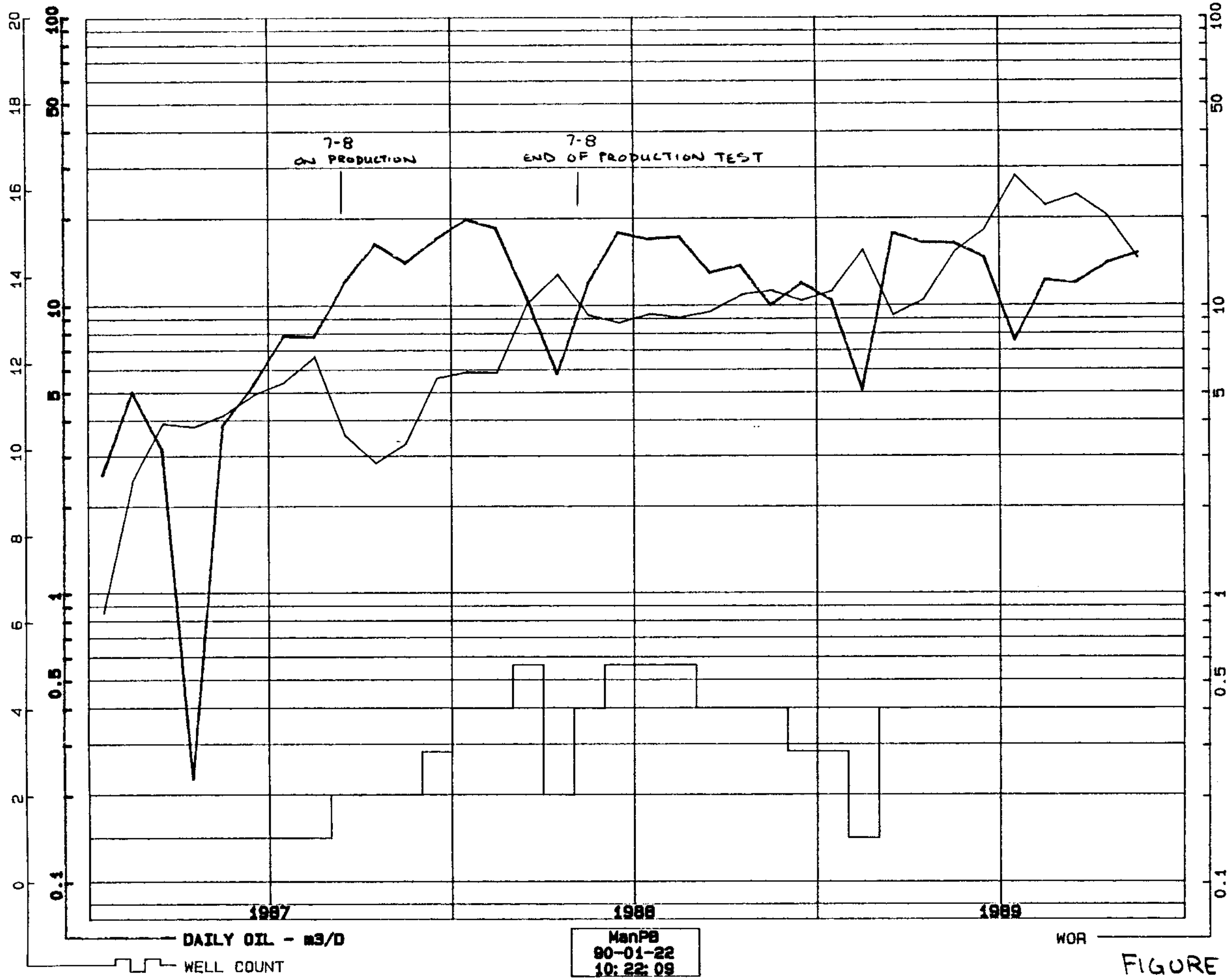


FIGURE 4

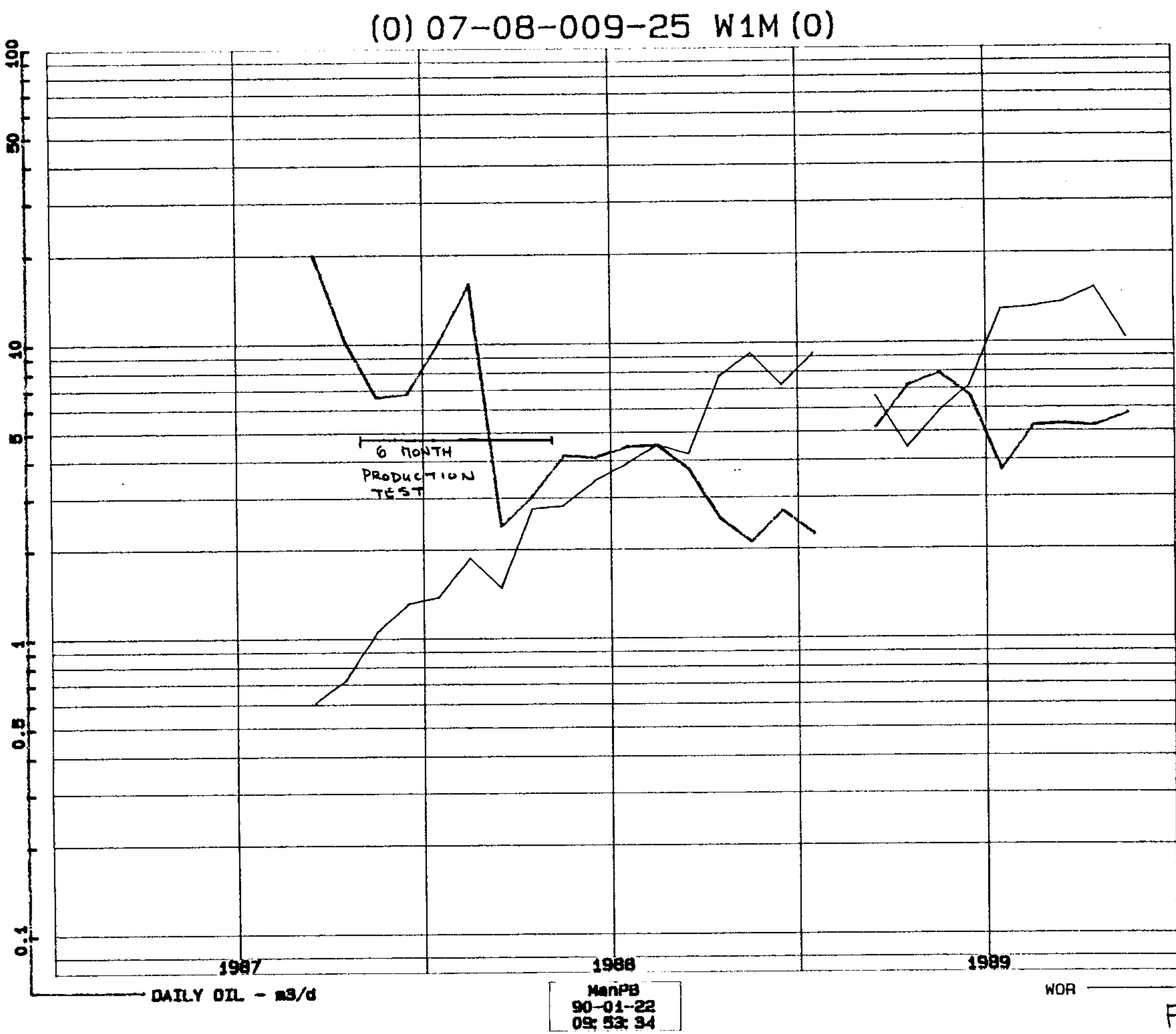

(0) 07-08-009-25 W1M (0)
100
50
10
5
1
0.5
0.1
1987
1988
1989
6 MONTH
PRODUCTION
TEST
DAILY OIL - m3/d
WOR
ManPB
90-01-22
09:53:34

FIGURE 5

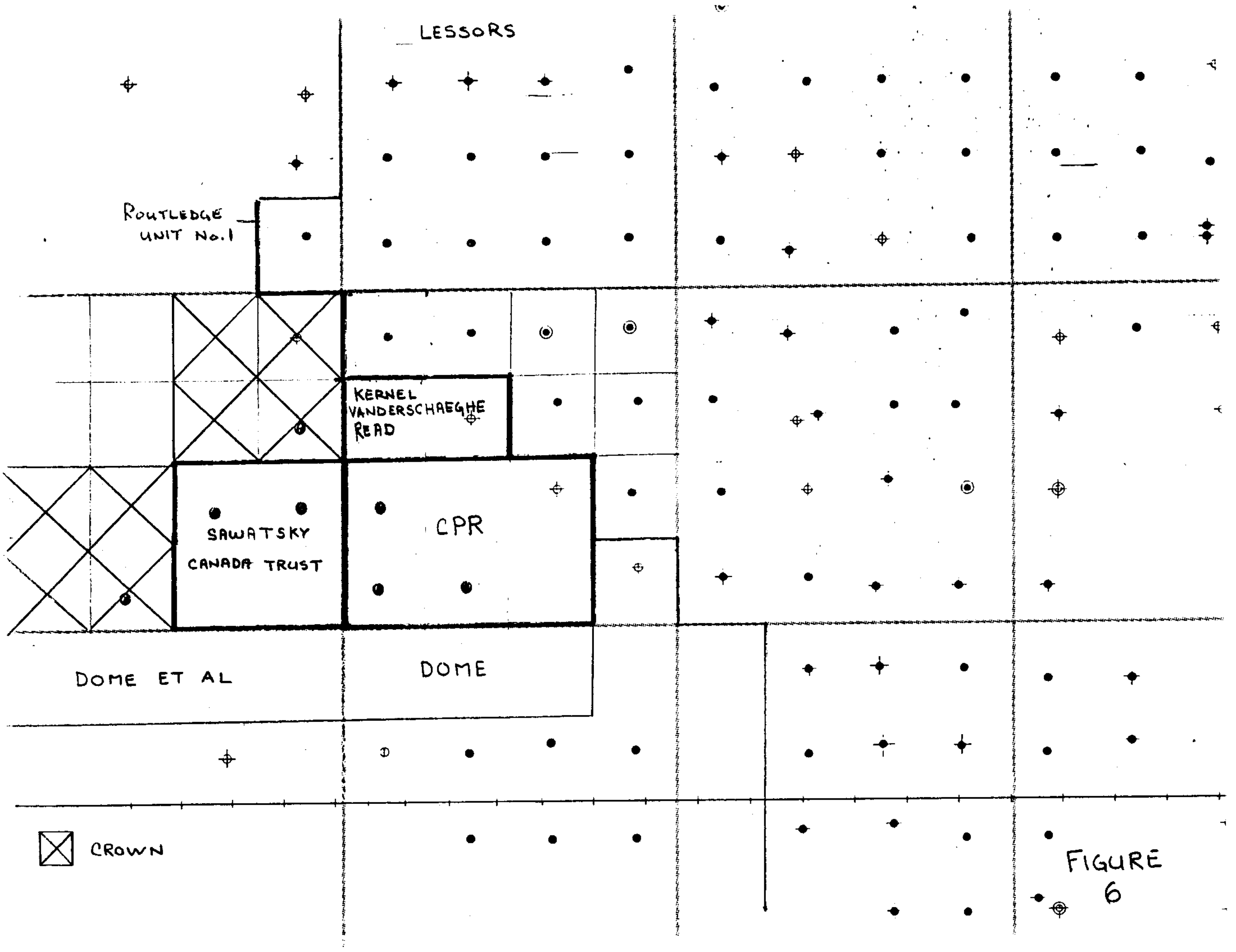

LESSORS
ROUTLEDGE UNIT No.1
KERNEL
VANDERSCHAEGHE
READ
SAWATSKY
CANADA TRUST
CPR
DOME ET AL
DOME
CROWN

FIGURE 6

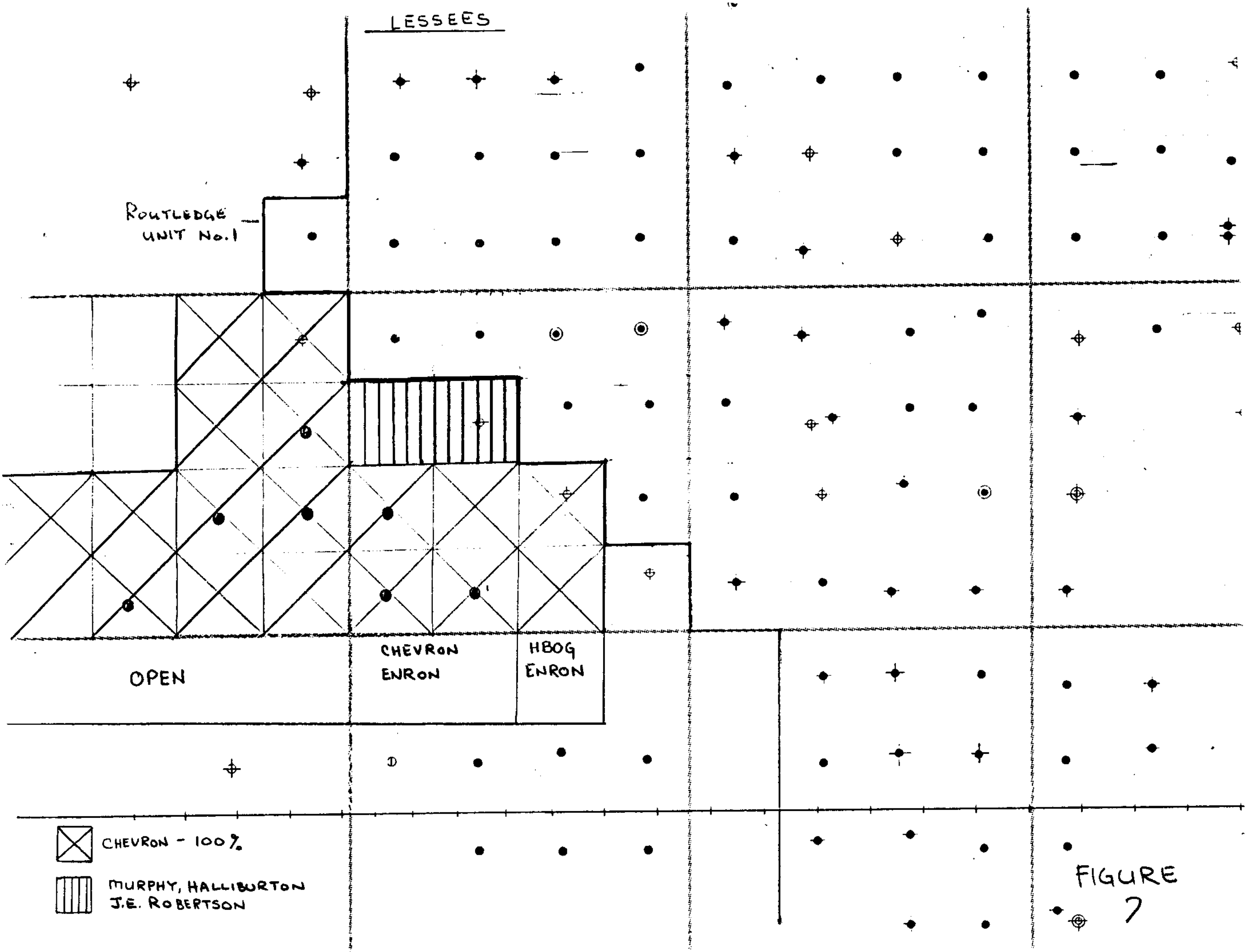
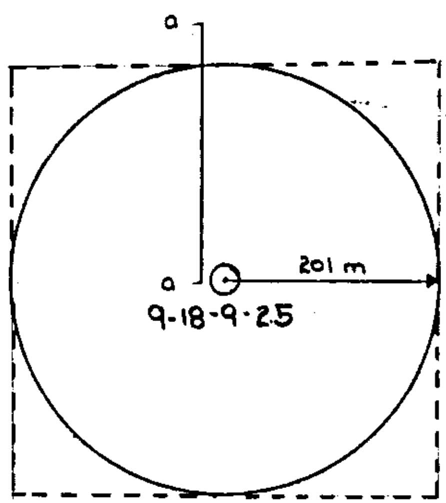

LESSEES
ROUTLEDGE UNIT No. 1
OPEN
CHEVRON ENRON
HBOG ENRON
CHEVRON - 100%
MURPHY, HALLIBURTON J.E. ROBERTSON

FIGURE 7

PROPOSED PRODUCING CONDITIONS



SINGLE WELL IN 16 HA SPACING UNIT

PRESSURE DISTRIBUTION IN RESERVOIR

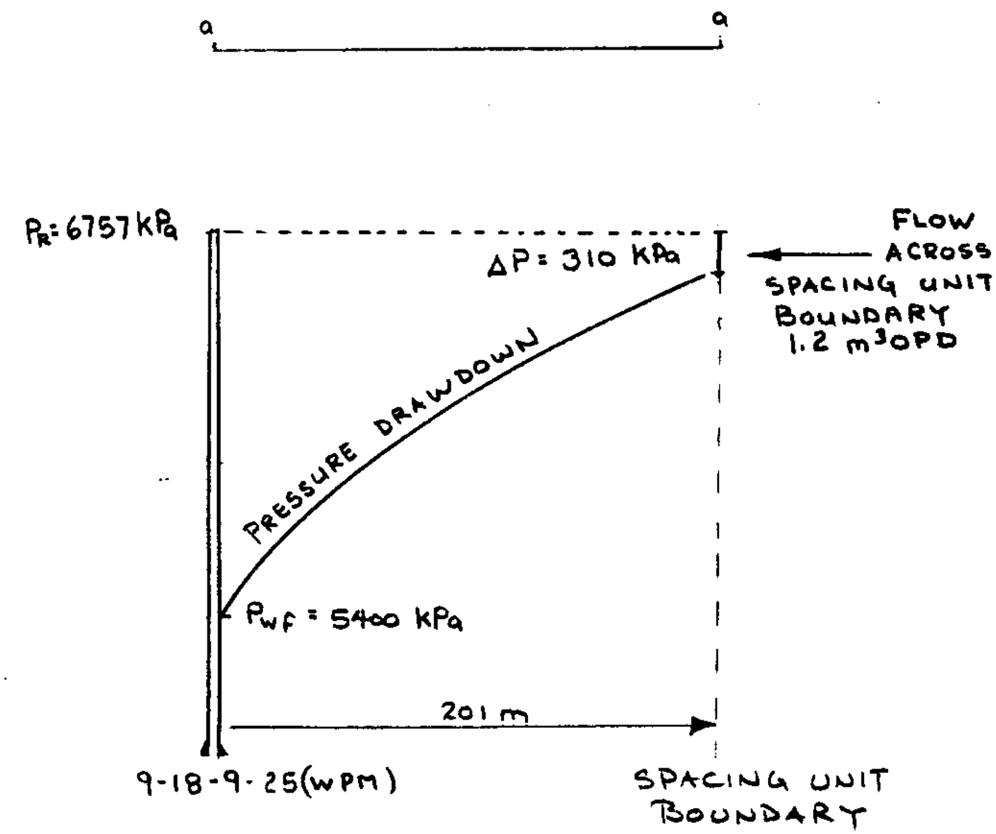


FIGURE 8

POTENTIAL DRAINAGE

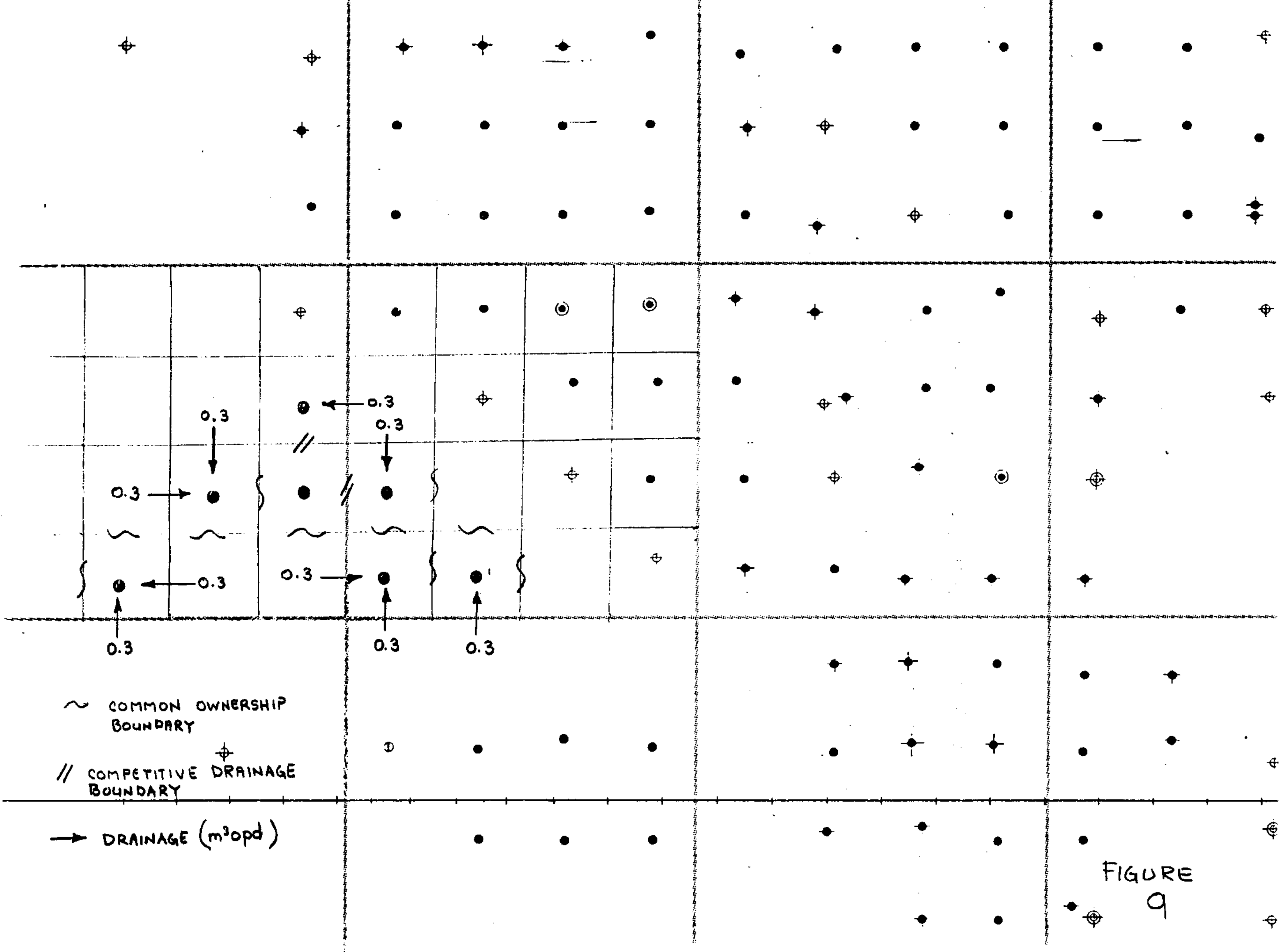
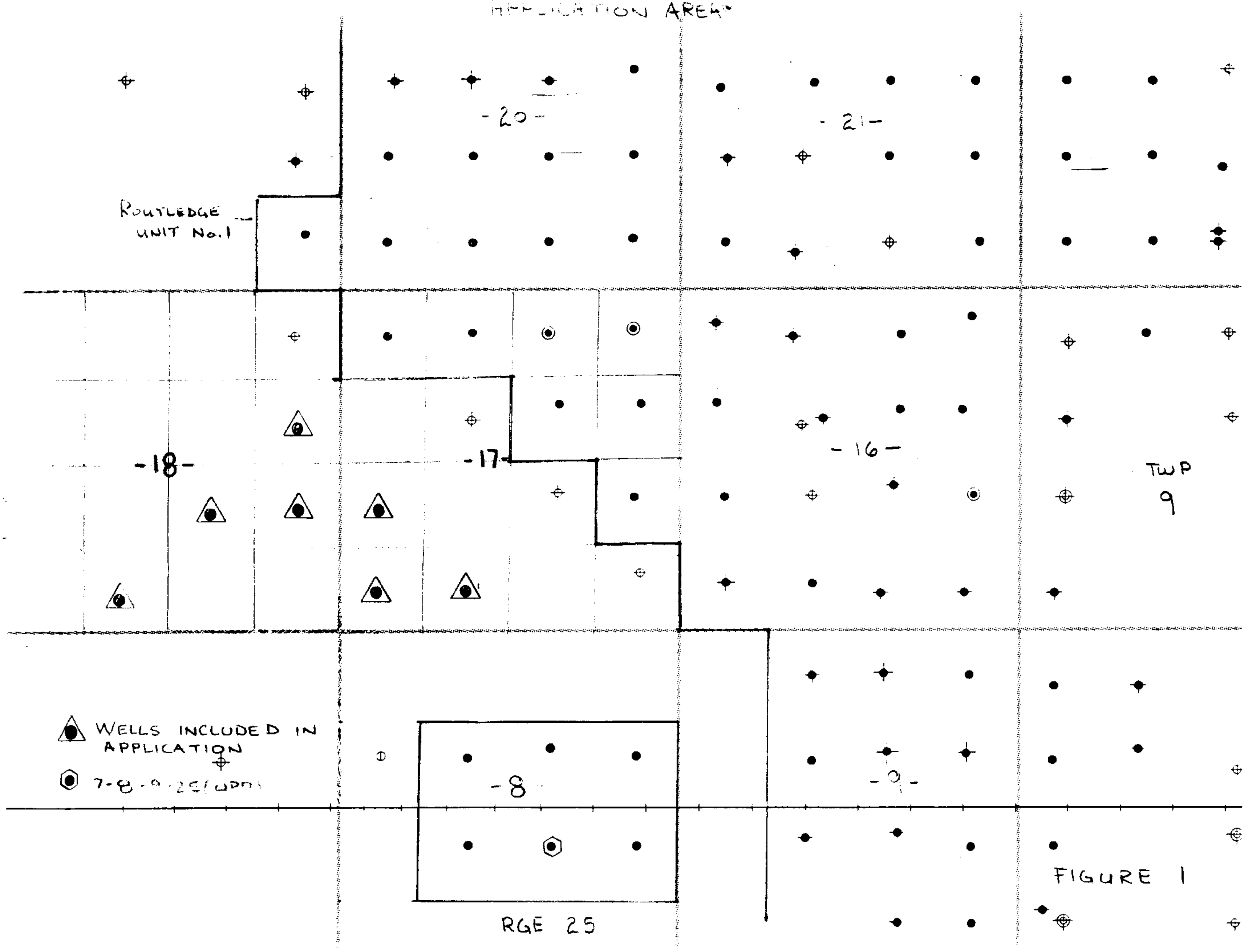


FIGURE 9



APPLICATION AREA
-20-
-21-
ROUTLEDGE
UNIT No. 1
-18-
-17-
-16-
TWP
9
WELLS INCLUDED IN
APPLICATION
-8-
-9-
RGE 25

FIGURE 1

Partial Reservoir Fluid Study

for

Chevron Canada Resources Limited

Chevron Virden 7-8-9-25 (W1M)

Virden Field, Manitoba

File Number: 55377-87-383 **1988 02 17**

Western Atlas International
A Litton/Dresser Company

CORE LABORATORIES

1988 02 17

Chevron Canada Resources Limited
500 - Fifth Avenue S.W.
Calgary, Alberta
T2P 0L7

Attention: Ms. Bonnie Nickel

Subject: Partial Reservoir Fluid Study
Chevron Virden 7-8-9-25 (W1M)
Vidren Field, Manitoba
File Number: 55377-87-383

Gentlemen:

Samples of separator gas and oil were collected from the subject well by a representative of Core Laboratories on 1987 12 11. The samples were then submitted to our Calgary laboratory for use in a reservoir fluid study.

Initially, the separator samples were physically recombined to the specified gas-oil ratio of 21.60 m^3/m^3 stock tank liquid. A portion of the fluid was then transferred, under pressure, to a high-pressure, windowed cell and heated to the reported reservoir temperature of 32.0°C. The saturation pressure and the pressure-volume relations of the fluid were determined at this temperature. The differential vaporization test could not be conducted due to the low saturation pressure. The viscosity of the fluid was measured at 32.0°C for pressures exceeding the saturation pressure to atmospheric pressure. A two-stage separator test was also conducted, simulating field operating conditions at the time of sampling. The composition of the recombined reservoir fluid was determined by low temperature, fractional distillation.

Thank you for the opportunity to be of service. Please contact me if you have any questions concerning the enclosed data.

Yours truly,

CORE LABORATORIES CANADA

Tom B. Martin

Tom B. Martin
Supervisor
PVT Laboratory

TC/cmdc

CORE LABORATORIES

TABLE OF CONTENTS

SECTION I

Tabular Data

COMPANY Chevron Canada Resources Limited
WELL Chevron Virden 7-8-9-25 (W1M)

VOLUMETRIC DATA OF RESERVOIR FLUID SAMPLE

1. Saturation pressure (P_s) (bubble point) 1 427 kPa (gauge) at 32.0 °C.

2. Thermal expansion (β_o) of reservoir fluid: Volume @ 32.0°C: Volume @ 19.4°C

   At 34 474 kPa (Gauge) = 1.00896

3. Compressibility (C_o) of reservoir fluid @ reservoir temperature: Vol/Vol/kPa:

From 34 474 kPa to 27 579 kPa	= 6.84×10^{-7}
From 27 579 kPa to 20 684 kPa	= 7.10×10^{-7}
From 20 684 kPa to 13 790 kPa	= 7.51×10^{-7}
From 13 790 kPa to 6 895 kPa	= 8.06×10^{-7}
From 6 895 kPa to 3 447 kPa	= 8.45×10^{-7}
From 3 447 kPa to 1 427 kPa	= 8.93×10^{-7}

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COMPANY Chevron Canada Resources Limited
WELL Chevron Virden 7-8-9-25 (W1M)

FILE 55377-87-383

PRESSURE VOLUME RELATIONS AT 32.0 °C

PRESSURE kPa (Gauge)	RELATIVE VOLUME V/Vsat (1)	Y FUNCTION (2)	OIL DENSITY kg/m^3
34 474	0.9753		856.8
27 579	0.9799		852.7
20 684	0.9847		848.6
13 790	0.9898		844.2
6 895	0.9953		839.5
3 447	0.9982		837.1
2 758	0.9988		836.6
1 427	1.0000		835.6
1 248	1.0228	5.823	
1 158	1.0399	5.357	
1 034	1.0734	4.713	
889	1.1372	3.961	
772	1.2237	3.352	
689	1.3196	2.922	
586	1.5130	2.385	
517	1.7261	2.027	
462	1.9845	1.740	

(1) Cubic metres at indicated pressure and temperature per cubic metre of saturated oil.

(2) $$Y = \frac{(Psat - P)}{(P + 101.325)(\text{Relative Volume} - 1)}$$

CORE LABORATORIES

COMPANY Chevron Canada Resources Limited
WELL Chevron Virden 7-8-9-25 (W1M)

FILE 55377-87-383

RESERVOIR FLUID VISCOSITY

PRESSURE, kPa (GUAGE)	OIL VISCOSITY mPa.S
34 474	5.631
27 579	5.269
20 684	4.900
13 790	4.537
6 895	4.164
3 447	3.976
1 472	3.870
0	5.573

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COMPANY Chevron Canada Resources Limited
WELL Chevron Virden 7-8-9-25 (W1M)

FILE 55377-87-383

SEPARATOR TEST OF RESERVOIR FLUID SAMPLE

SEPARATOR PRESSURE kPa (Gauge)	SEPARATOR TEMPERATURE °C	GAS-OIL RATIO R_1 (1)	GAS-OIL RATIO R_1 (2)	OIL GRAVITY ° API @ 15.6°C	FORMATION VOLUME FACTOR B_o (3)	SEPARATOR VOLUME FACTOR (4)	RELATIVE DENSITY OF LIBERATED GAS (5)
1 427							
to							
90	26.0	18.84	19.28			1.029	1.275
to							
0	15.0	1.50	1.50	33.1	1.097	1.000	1.379
		Total	20.78				

(1) Cubic metres of gas @ 101.325 kPa (absolute) and 15.0°C per cubic metre of oil @ indicated pressure and temperature.
(2) Cubic metres of gas @ 101.325 kPa (absolute) and 15.0°C per cubic metre of stock tank oil @ 15.0°C.
(3) Cubic metres of saturated oil @ 1 427 kPa (gauge) and 32.0°C per cubic metre of stock tank oil @ 15.0°C.
(4) Cubic metres of oil @ indicated pressure and temperature per cubic metre of stock tank oil @ 15.0°C.
(5) AIR = 1.000.

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COMPANY Chevron Canada Resources Limited
WELL Chevron Virden 7-8-9-25 (W1M)

FILE 55377-87-383

FLASH TEST OF SEPARATOR OIL SAMPLE

STOCK TK. PRESSURE kPa (Gauge)	STOCK TK. TEMPERATURE °C	GAS-OIL RATIO R_1 (1)	GAS-OIL RATIO R_1 (2)	STOCK TANK OIL ° API @ 15.6°C	SEPARATOR VOLUME FACTOR B_o (3)	STOCK TK. VOLUME FACTOR (4)	RELATIVE DENSITY OF LIBERATED GAS (5)
90 to 0	15.6		1.50	32.9	1.017		1.039
		Total	1.50				

This date was used to develop the recombined reservoir fluid i.e., the separator sample were physically recombined to the specified gas-oil ratio of 21.60 m^3/m^3 stock tank oil.

(1) Cubic metres of gas @ 101.325 kPa (absolute) and 15.0°C per cubic metre of oil @ indicated pressure and temperature.
(2) Cubic metres of gas @ 101.325 kPa (absolute) and 15.0°C per cubic metre of stock tank oil @ 15.0°C.
(3) Cubic metres of saturated oil @ 90 kPa (gauge) and 26.0°C per cubic metre of stock tank oil @ 15.0°C.
(4) Cubic metres of oil @ indicated pressure and temperature per cubic metre of stock tank oil @ 15.0°C.
(5) AIR = 1.000.

COR LABORATORIES

HYDROCARBON LIQUID ANALYSIS

B277
CONTAINER IDENTITY

55377-87-383
LABORATORY NUMBER

Chevron Canada Resources Limited
OPERATOR

6 of 9
PAGE

LSD 7-8-9-25 W1M
LOCATION

Chevron Virden 7-8-9-25
WELL OR SAMPLE LOCATION NAME

KB ELEV. (m) GR ELEV. (m)

Virden, Manitoba
FIELD OR AREA

POOL OR ZONE

SAMPLER

TEST TYPE & NO.

TEST RECOVERY

Recombined Reservoir Fluid
POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °C
MUD RESISTIVITY

PUMPING FLOWING GAS LIFT SWAB

TEST INTERVALS (metres)

WATER m^3/d OIL m^3/d GAS m^3/d

SEPARATOR RESERVOIR 1 427 CONTAINER WHEN SAMPLED @ °C CONTAINER WHEN RECEIVED @ °C
PRESSURES, kPa (gauge)

SEPARATOR 32.0
TEMPERATURES, °C

DATE SAMPLED (Y/M/D) DATE RECEIVED (Y/M/D) DATE ANALYZED (Y/M/D) 88 01 28 ANALYST DP REMARKS

COMPONENT	MOLE FRACTION	MASS FRACTION	LIQUID VOLUME FRACTION
N_2	0.0071	0.0011	0.0012
CO_2	0.0260	0.0065	0.0066
H_2S	0.0094	0.0018	0.0019
C_1	0.0053	0.0005	0.0014
C_2	0.0382	0.0066	0.0153
C_3	0.0753	0.0190	0.0312
iC_4	0.0230	0.0076	0.0113
C_4	0.0620	0.0206	0.0294
iC_5	0.0307	0.0127	0.0169
C_5	0.0297	0.0123	0.0162
$C_{6}+$	0.6933	0.9113	0.8686
TOTAL	1.0000	1.0000	1.0000

OBSERVED PROPERTIES OF C_6+ RESIDUE (15/15°C)

DENSITY: 874.3 kg/m^3
RELATIVE DENSITY: 0.8751
API @ 15.5° C: 30.3
RELATIVE MOLECULAR MASS: 230

CALCULATED PROPERTIES OF TOTAL SAMPLE (15/15°C)

DENSITY: 833.4 kg/m^3
RELATIVE DENSITY: 0.8342
API @ 15.5° C: 38.2
RELATIVE MOLECULAR MASS: 174.96

REMARKS

CORE LABORATORIES

HYDROCARBON LIQUID ANALYSIS

OPERATOR	Chevron Canada Resources Limited	PAGE	7 of 9
WELL	Chevron Virden 7-8-9-25	FILE	55377-87-383
SAMPLE POINT	Recombined Reservoir Fluid	DATE	88 01 28

Analysis of C_6+ Fraction

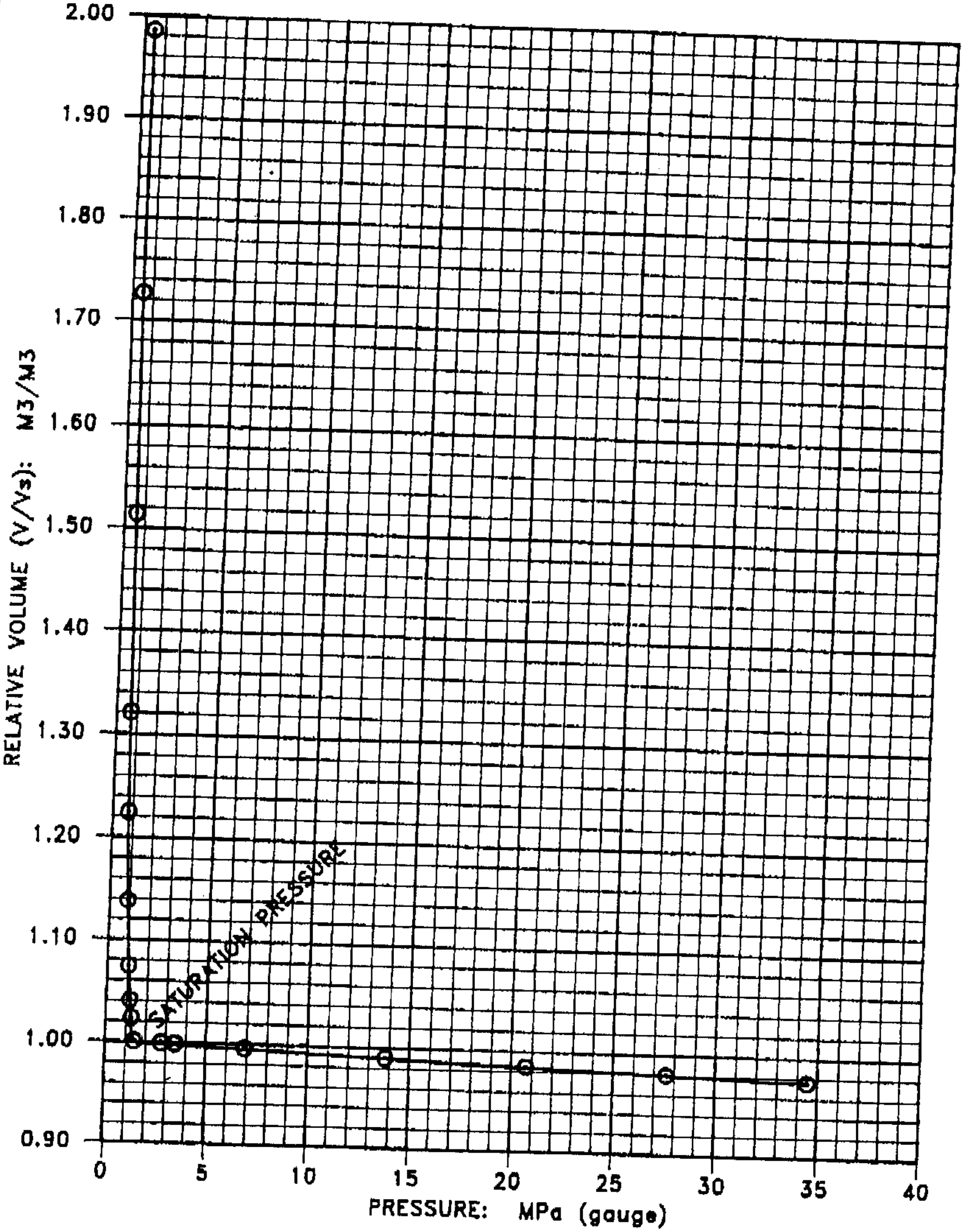
Boiling Point Range (°C)	Component	Carbon Number	Mole Fraction	Mass Fraction
36.1- 68.9	Hexanes	C_6	0.0415	0.0216
68.9- 98.3	Heptanes	C_7	0.0449	0.0272
98.3-125.6	Octanes	C_8	0.0504	0.0347
125.6-150.6	Nonanes	C_9	0.0371	0.0287
150.6-173.9	Decanes	C_{10}	0.0416	0.0357
173.9-196.1	Undecanes	C_{11}	0.0372	0.0351
196.1-215.0	Dodecanes	C_{12}	0.0320	0.0328
215.0-235.0	Tridecanes	C_{13}	0.0318	0.0353
235.0-252.2	Tetradecanes	C_{14}	0.0300	0.0359
252.2-270.6	Pentadecanes	C_{15}	0.0320	0.0410
270.6-287.8	Hexadecanes	C_{16}	0.0254	0.0347
287.8-302.8	Heptadecanes	C_{17}	0.0186	0.0270
302.8-317.2	Octadecanes	C_{18}	0.0217	0.0333
317.2-330.0	Nonadecanes	C_{19}	0.0204	0.0330
330.0-344.4	Eicosanes	C_{20}	0.0153	0.0261
344.4-357.2	Heneicosanes	C_{21}	0.0133	0.0237
357.2-369.4	Docosanes	C_{22}	0.0125	0.0235
369.4-380.0	Tricosanes	C_{23}	0.0109	0.0214
380.0-391.1	Tetracosanes	C_{24}	0.0106	0.0216
391.1-401.7	Pentacosanes	C_{25}	0.0097	0.0206
401.7-412.2	Hexacosanes	C_{26}	0.0082	0.0181
412.2-422.2	Heptacosanes	C_{27}	0.0076	0.0174
422.2-431.7	Octacosanes	C_{28}	0.0071	0.0170
431.7-441.1	Nonacosanes	C_{29}	0.0068	0.0167
441.1 PLUS	Triacontanes Plus	C_{30}+	0.0579	0.2106
80.0	Benzene	C_6H_6	0.0007	0.0003
110.6	Toluene	C_7H_8	0.0033	0.0018
136.1-138.9	Ethylbenzene, p + m-Xylene	C_8H_{10}	0.0082	0.0052
144.4	o-Xylene	C_8H_{10}	0.0057	0.0037
168.9	1,2,4 Trimethylbenzene	C_9H_{12}	0.0022	0.0016
48.9	Cyclopentane	C_5H_{10}	0.0020	0.0008
72.2	Methylcyclopentane	C_6H_{12}	0.0120	0.0061
81.1	Cyclohexane	C_6H_{12}	0.0174	0.0088
101.1	Methylcyclohexane	C_7H_{14}	0.0173	0.0103
	TOTAL		0.6933	0.9113
68.9 PLUS	Mole Fraction of C_7+			0.6498
68.9 PLUS	Mass Fraction of C_7+			0.8889
68.9 PLUS	Calculated Relative Molecular Mass of C_7+			240
68.9 PLUS	Calculated Relative Density of C_7+			0.8820
68.9 PLUS	Calculated Density of C_7+ (kg/m^3)			881.2

SECTION II

Illustrations

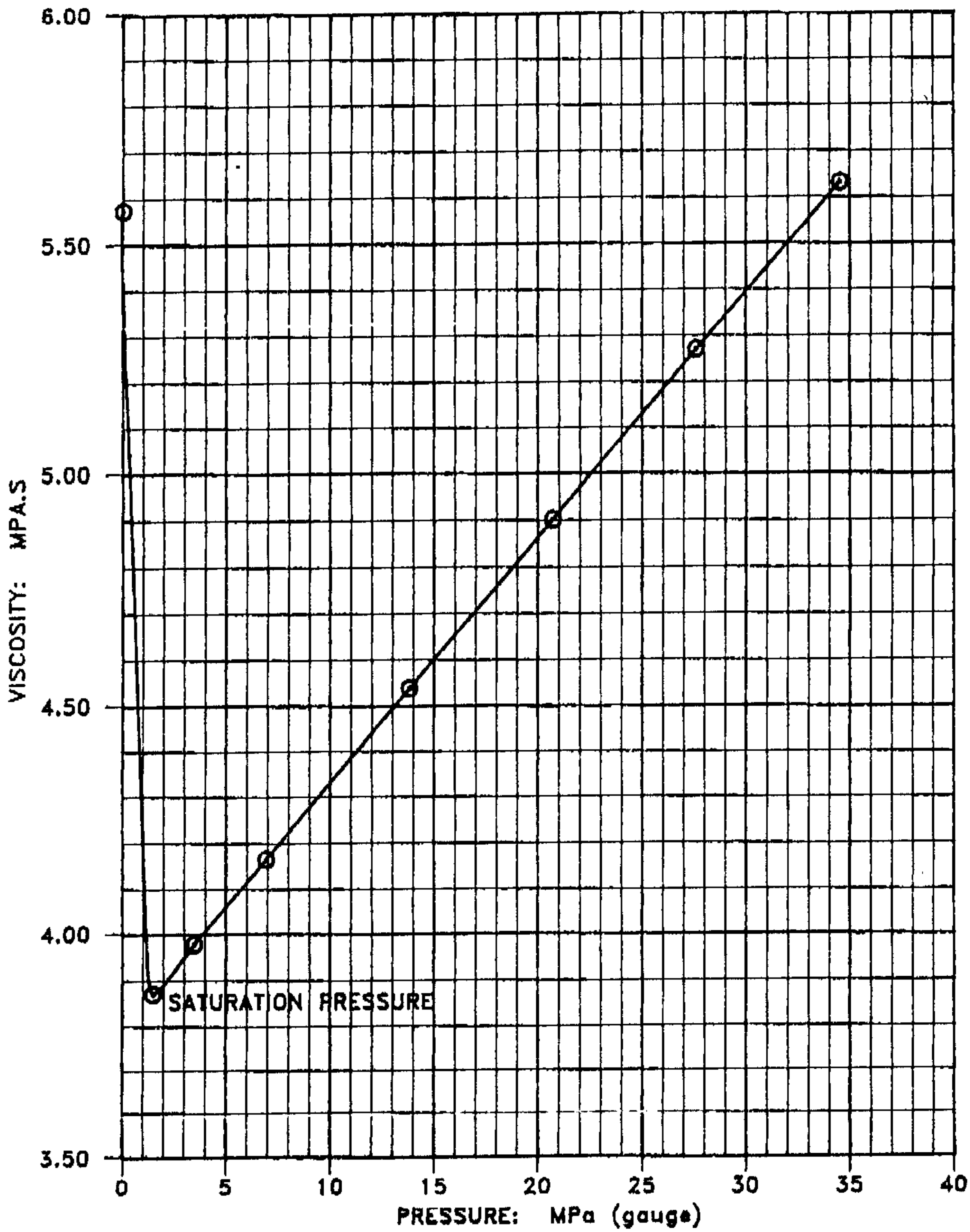
File 55377-87-383
Well Chevron Virden
7-8-9-25 (W1M)

RELATIVE VOLUME (V/Vs)



File 55377-87-383
Well Chevron Virden
7-8-9-25 (W1M)

OIL VISCOSITY



Gas Well Files

CORE LABORATORIES

GAS ANALYSIS

CS34
CONTAINER IDENTITY

55380-87-1750
LABORATORY NUMBER

Chevron Canada Resources Limited
OPERATOR

1 of 3
PAGE

LSD 7-8-9-25 W1M
LOCATION

Chevron Virden 7-8-9-25
WELL OR SAMPLE LOCATION NAME

KB ELEV. (m) GR ELEV. (m)

Virden, Manitoba
FIELD OR AREA

POOL OR ZONE

Core Laboratories
SAMPLER

TEST TYPE & NO.

TEST RECOVERY

Gas Leg
POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °C
MUD RESISTIVITY

TEST INTERVALS (metres)

PUMPING FLOWING GAS LIFT SWAB

WATER m³/d OIL m³/d GAS m³/d

PRESSURES, kPa (gauge): SEPARATOR; RESERVOIR; 90; CONTAINER WHEN SAMPLED @ °C; CONTAINER WHEN RECEIVED 90 @22 °C

TEMPERATURES, °C: SEPARATOR 26

DATE SAMPLED (Y/M/D)	DATE RECEIVED (Y/M/D)	DATE ANALYZED (Y/M/D)	ANALYST	REMARKS
87 12 11	87 12 15	87 12 19	RH	

COMPONENT	MOLE FRACTION AIR FREE AS RECEIVED	MOLE FRACTION AIR FREE ACID GAS FREE	mL/m³ AIR FREE AS RECEIVED
H_2	0.0001		
He	0.0003		
N_2	0.0400		
CO_2	0.1407		
H_2S	0.0492		
C_1	0.0313		
C_2	0.1875		
C_3	0.2855		1050.0
iC_4	0.0632		276.2
C_4	0.1287		541.9
iC_5	0.0338		165.2
C_5	0.0241		116.6
C_6	0.0114		62.6
C_{7+}	0.0042		28.7
TOTAL	1.0000		2241.2
		C_{5+}	373.1

CALCULATED GROSS HEATING VALUE
MJ/m³ @15°C & 101.325 kPa (abs.)

MOISTURE FREE	MOISTURE & ACID GAS FREE
77.25	93.87

CALCULATED VAPOUR PRESSURE
kPa (abs.) @37.8°C

PENTANES PLUS: 105.5

CALCULATED TOTAL SAMPLE PROPERTIES (AIR=1) @ 15° C & 101.325 kPa
MOISTURE FREE AS SAMPLED

DENSITY	RELATIVE DENSITY	RELATIVE MOLECULAR MASS
1.881 kg/m³	1.535	44.5

CALCULATED PSEUDOCRITICAL PROPERTIES

	AS SAMPLED	ACID GAS FREE
pPc	4849.9 kPa (abs)	kPa (abs)
pTc	350.6 K	K

REMARKS

Hydrogen sulphide determined in the lab.

Note: The Gross Heating Value has been calculated in accordance to AGA Report #5.

CORE LABORATORIES

HYDROCARBON LIQUID ANALYSIS

V3528
CONTAINER IDENTITY

55380-87-1750
LABORATORY NUMBER

Chevron Canada Resources Limited
OPERATOR

2 of 3
PAGE

LSD 7-8-9-25 W1M
LOCATION

Chevron Virden 7-8-9-25
WELL OR SAMPLE LOCATION NAME

KB ELEV. (m) GR ELEV. (m)

Virden, Manitoba
FIELD OR AREA

Upper Virden Whitewater
POOL OR ZONE

Core Laboratories
SAMPLER

TEST TYPE & NO. TEST RECOVERY

Separator Liquid
POINT OF SAMPLE

AMT. & TYPE CUSHION

@ °C
MUD RESISTIVITY

PUMPING FLOWING GAS LIFT SWAB

WATER m^3/d OIL m^3/d GAS m^3/d

TEST INTERVALS (metres)

90
SEPARATOR

RESERVOIR

@ °C CONTAINER WHEN SAMPLED

@ °C CONTAINER WHEN RECEIVED

PRESSURES, kPa (gauge)

26
SEPARATOR

TEMPERATURES, °C

DATE SAMPLED (Y/M/D)	DATE RECEIVED (Y/M/D)	DATE ANALYZED (Y/M/D)	ANALYST	REMARKS
87 12 11	87 12 15	87 12 18	DP	

COMPONENT	MOLE FRACTION	MASS FRACTION	LIQUID VOLUME FRACTION
N_2	Trace	Trace	Trace
CO_2	0.0025	0.0005	0.0006
H_2S	0.0020	0.0003	0.0004
C_1	0.0001	0.0000	0.0000
C_2	0.0068	0.0010	0.0024
C_3	0.0327	0.0071	0.0120
iC_4	0.0152	0.0044	0.0067
C_4	0.0488	0.0141	0.0206
iC_5	0.0308	0.0110	0.0151
C_5	0.0315	0.0113	0.0153
C_{6+}	0.8296	0.9503	0.9269
TOTAL	1.0000	1.0000	1.0000

OBSERVED PROPERTIES OF C_{6+} RESIDUE (15/15°C)

don't use! Ge

DENSITY	RELATIVE DENSITY	API @ 15.5° C
816.2 kg/m^3	0.8170	29.9

231
RELATIVE MOLECULAR MASS

CALCULATED PROPERTIES OF TOTAL SAMPLE (15/15°C)

use! Ge

DENSITY	RELATIVE DENSITY	API @ 15.5° C
854.8 kg/m^3	0.8556	34.0

201.66
RELATIVE MOLECULAR MASS

REMARKS

Refer to page 3 of 3 for extended analysis of hexanes plus.

CORE LABORATORIES

HYDROCARBON LIQUID ANALYSIS

OPERATOR Chevron Canada Resources Limited
WELL Chevron Virden 7-8-9-25
SAMPLE POINT Separator Liquid

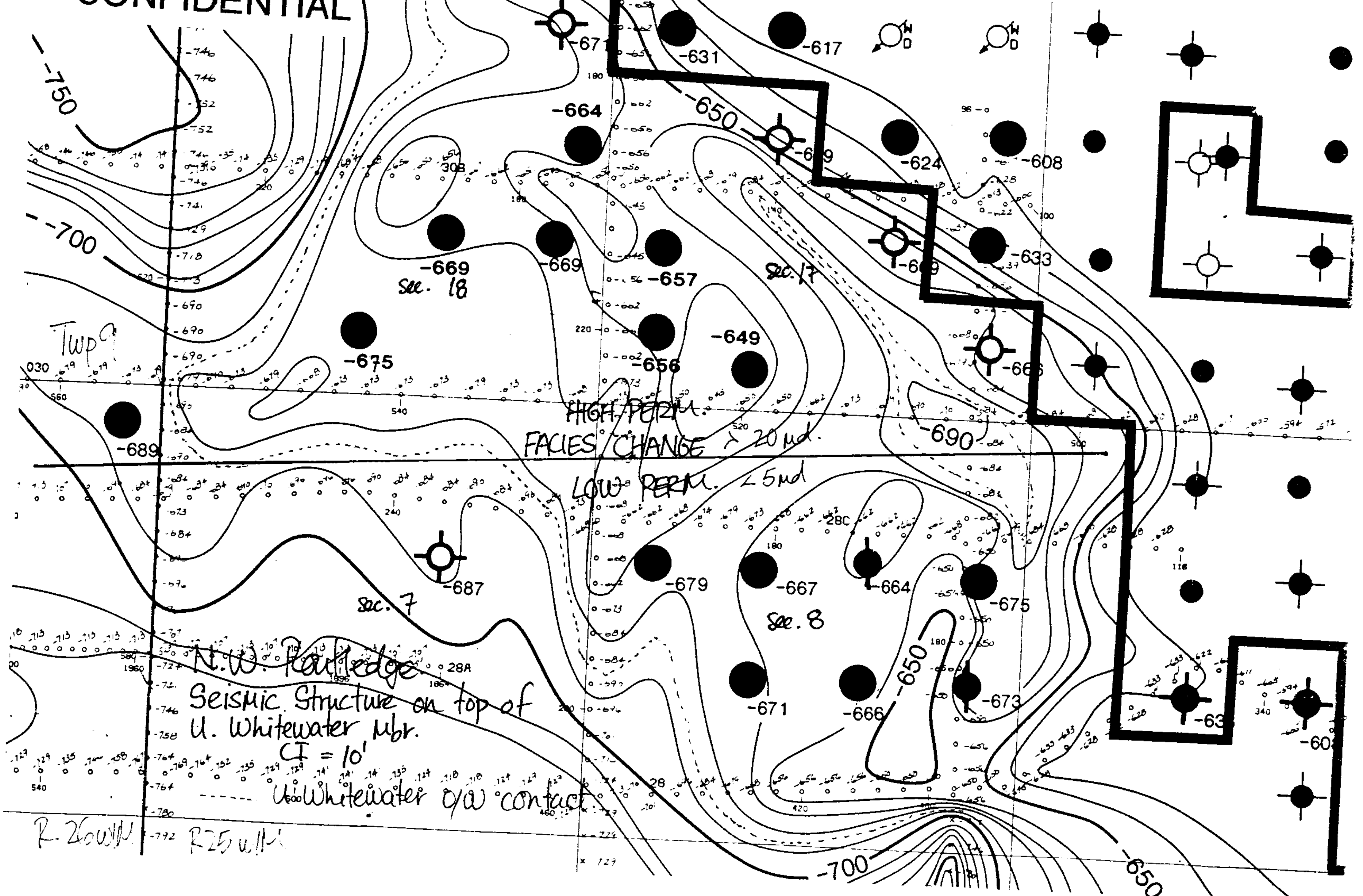
FILE 55380-87-1750
DATE 87 12 18

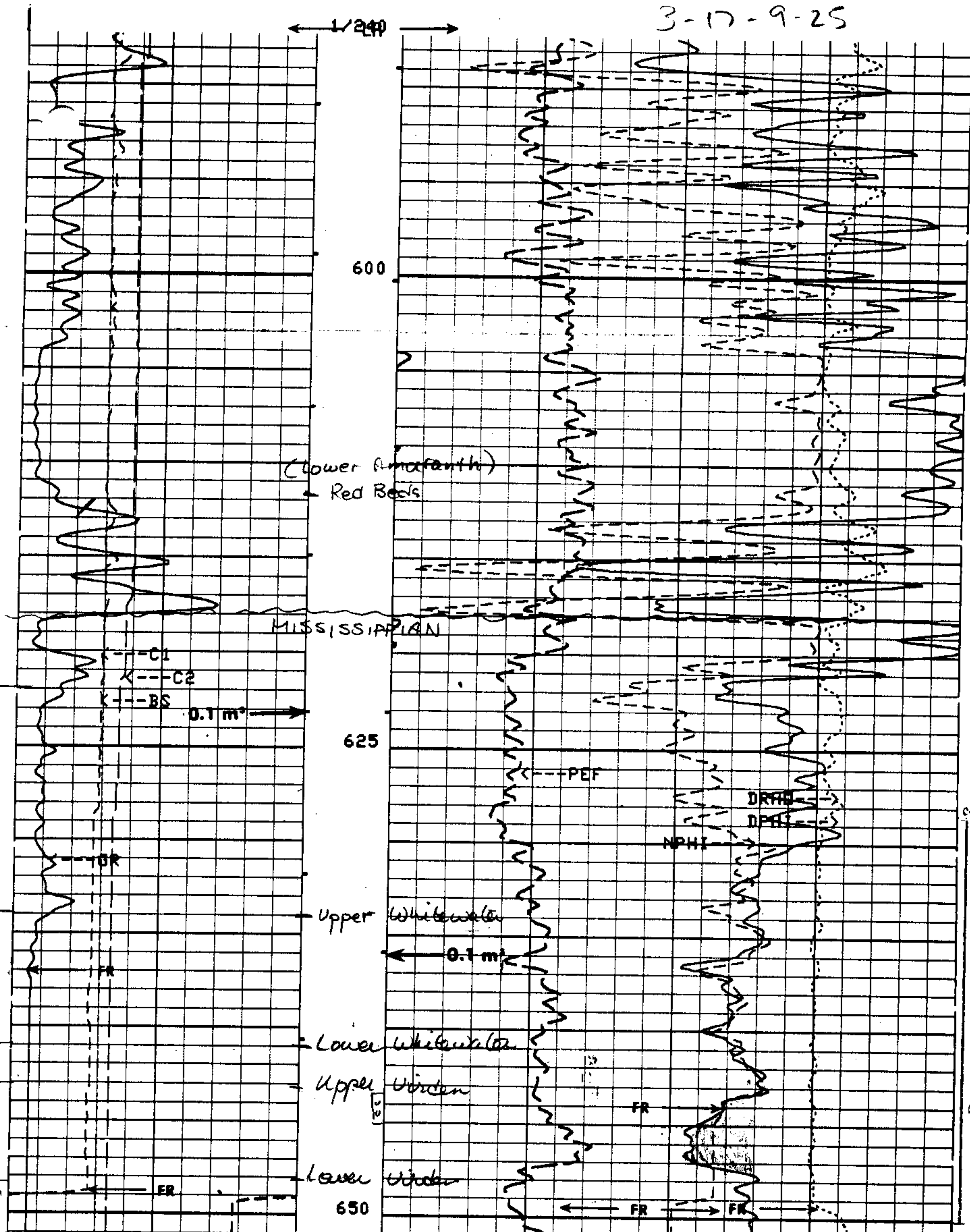
Analysis of C_{6}+ Fraction

Boiling Point Range (°C)	Component	Carbon Number	Mole Fraction	Mass Fraction
36.1- 68.9	Hexanes	C_6	0.0510	0.0235
68.9- 98.3	Heptanes	C_7	0.0524	0.0280
98.3-125.6	Octanes	C_8	0.0608	0.0371
125.6-150.6	Nonanes	C_9	0.0436	0.0299
150.6-173.9	Decanes	C_{10}	0.0472	0.0359
173.9-196.1	Undecanes	C_{11}	0.0446	0.0372
196.1-215.0	Dodecanes	C_{12}	0.0415	0.0377
215.0-235.0	Tridecanes	C_{13}	0.0417	0.0410
235.0-252.2	Tetradecanes	C_{14}	0.0362	0.0384
252.2-270.6	Pentadecanes	C_{15}	0.0347	0.0394
270.6-287.8	Hexadecanes	C_{16}	0.0304	0.0367
287.8-302.8	Heptadecanes	C_{17}	0.0241	0.0309
302.8-317.2	Octadecanes	C_{18}	0.0221	0.0300
317.2-330.0	Nonadecanes	C_{19}	0.0241	0.0346
330.0-344.4	Eicosanes	C_{20}	0.0174	0.0263
344.4-357.2	Heneicosanes	C_{21}	0.0161	0.0255
357.2-369.4	Docosanes	C_{22}	0.0144	0.0240
369.4-380.0	Tricosanes	C_{23}	0.0136	0.0236
380.0-391.1	Tetracosanes	C_{24}	0.0130	0.0234
391.1-401.7	Pentacosanes	C_{25}	0.0116	0.0218
401.7-412.2	Hexacosanes	C_{26}	0.0100	0.0195
412.2-422.2	Heptacosanes	C_{27}	0.0093	0.0190
422.2-431.7	Octacosanes	C_{28}	0.0087	0.0183
431.7-441.1	Nonacosanes	C_{29}	0.0082	0.0179
441.1 PLUS	Triacontanes Plus	C_{30}+	0.0647	0.2060
80.0	Benzene	C_6H_6	0.0008	0.0003
110.6	Toluene	C_7H_8	0.0040	0.0020
136.1-138.9	Ethylbenzene, p + m-Xylene	C_8H_{10}	0.0134	0.0076
144.4	o-Xylene	C_8H_{10}	0.0064	0.0036
169.9	1,2,4 Trimethylbenzene	C_9H_{12}	0.0062	0.0040
49.0	Cyclopentane	C_5H_{10}	0.0023	0.0009
72.2	Methylcyclopentane	C_6H_{12}	0.0160	0.0072
81.1	Cyclohexane	C_6H_{12}	0.0191	0.0086
101.1	Methylcyclohexane	C_7H_{14}	0.0200	0.0105
	TOTAL		0.8296	0.9503

68.9 PLUS	Mole Fraction of C_7+	0.7763
68.9 PLUS	Mass Fraction of C_7+	0.9259
68.9 PLUS	Calculated Relative Molecular Mass of C_7+	241
68.9 PLUS	Calculated Relative Density of C_7+	0.8843
68.9 PLUS	Calculated Density of C_7+ (kg/m^3)	883.5

The above hexanes plus values are based upon a measured mass fraction and a calculated mole fraction, and assume a total hydrocarbon recovery from the chromatographic system.


CONFIDENTIAL
N.W. Rutledge
Seismic Structure on top of
U. Whitewater Mbr.
CI = 10'
U. Whitewater O/W contact
HIGH PERM.
FACIES CHANGE > 20 md.
LOW PERM. < 5 md
Sec. 18
Sec. 17
Sec. 7
Sec. 8
Twp 9
R. 26 WM
R25 WM
-750
-700
-650
-690
-631
-617
-624
-608
-633
-664
-669
-657
-649
-656
-675
-689
-687
-679
-667
-664
-675
-671
-666
-673



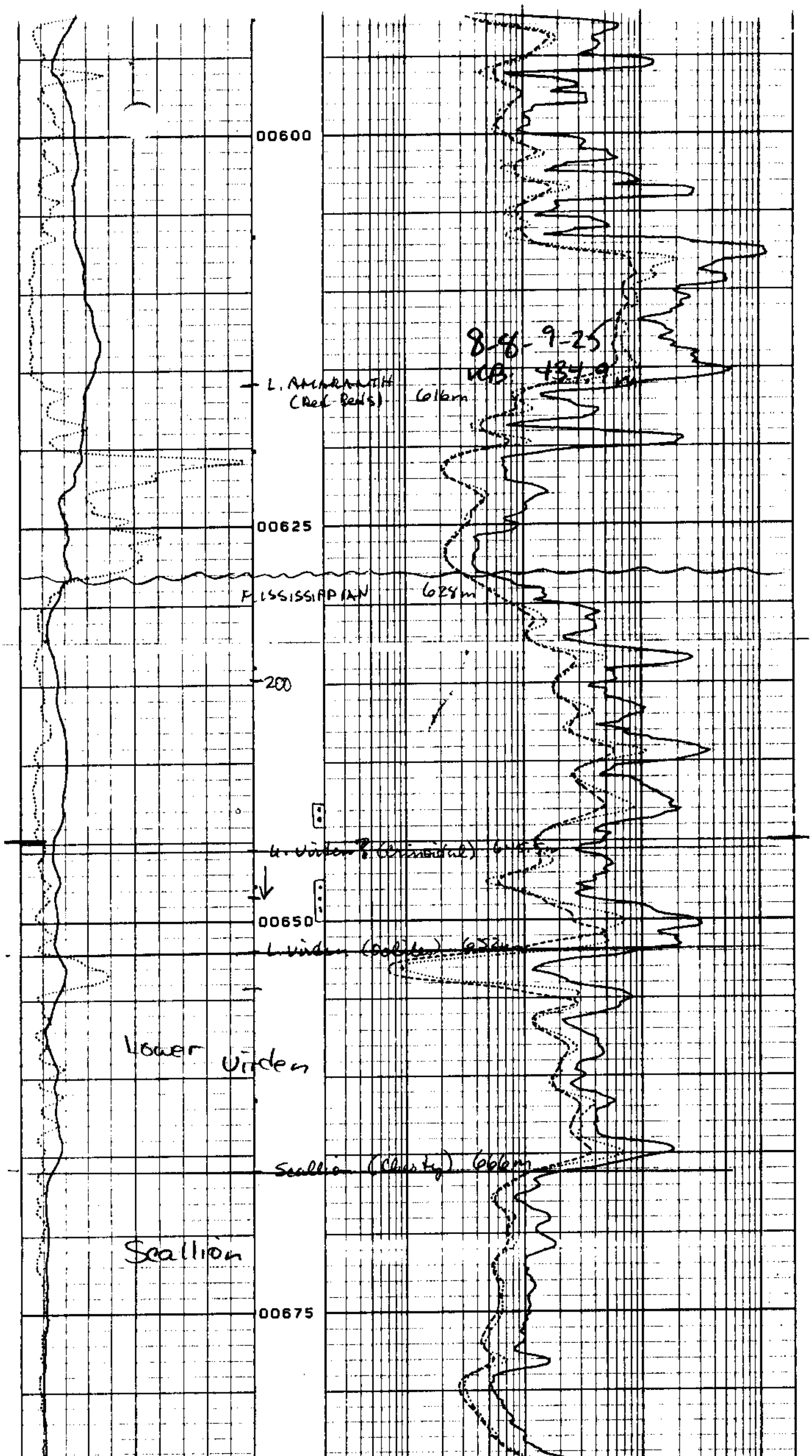
CP 32.2 FILE 16 05-NOV-1989 20:49

REPEAT SECTION
LIMESTONE

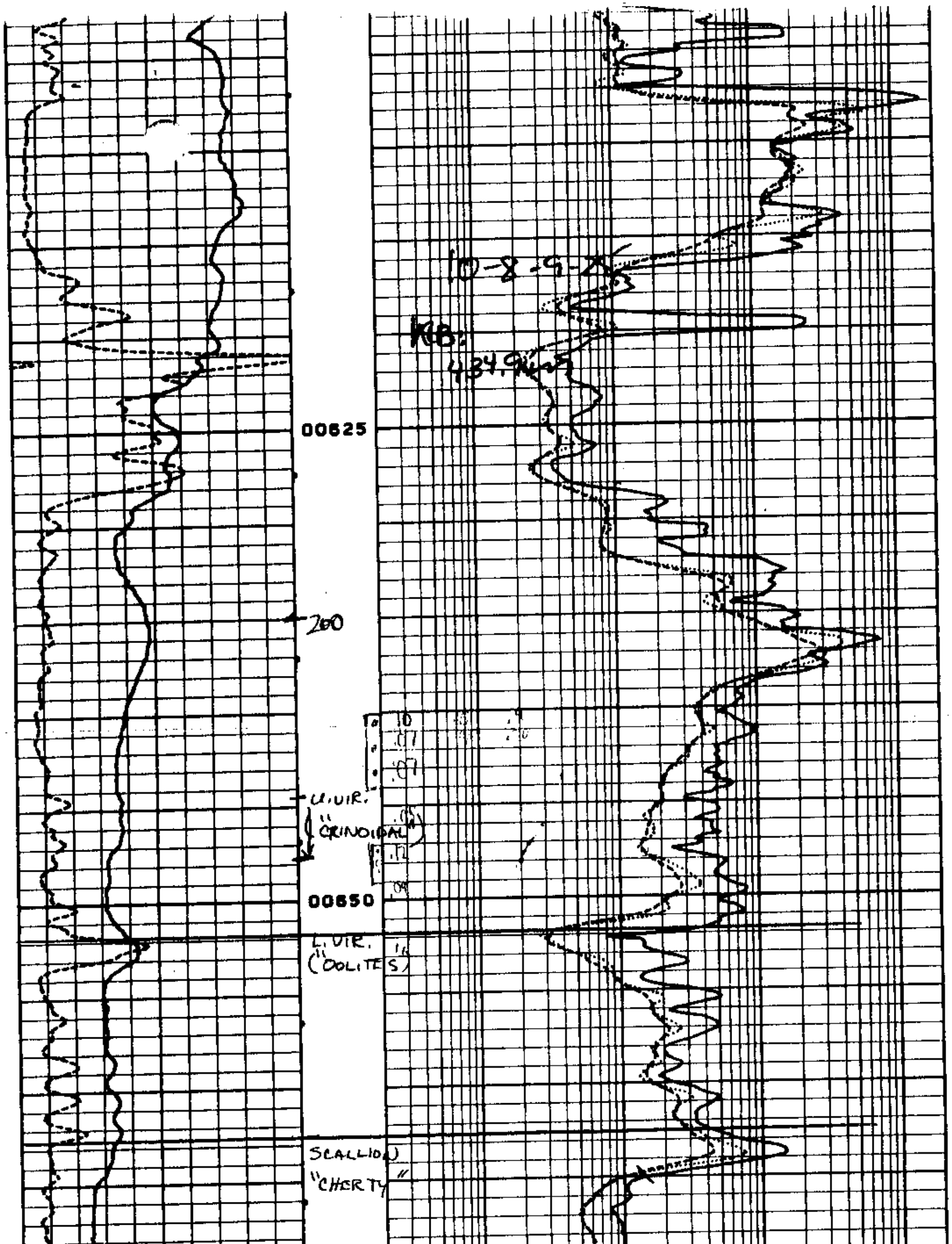
Curve	Left	Right
C1(MM)	125.00	375.00
C2(MM)	125.00	375.00
BS(MM)	125.00	375.00
GR(GAPI)	0.0	150.00
PEF	0.0	10.000
DRHO(K/M3)	-250.0	250.00
DPHI	.45000	-.1500
NPHI	.45000	-.1500

SENSOR MEASURE POINT TO TOOL ZERO

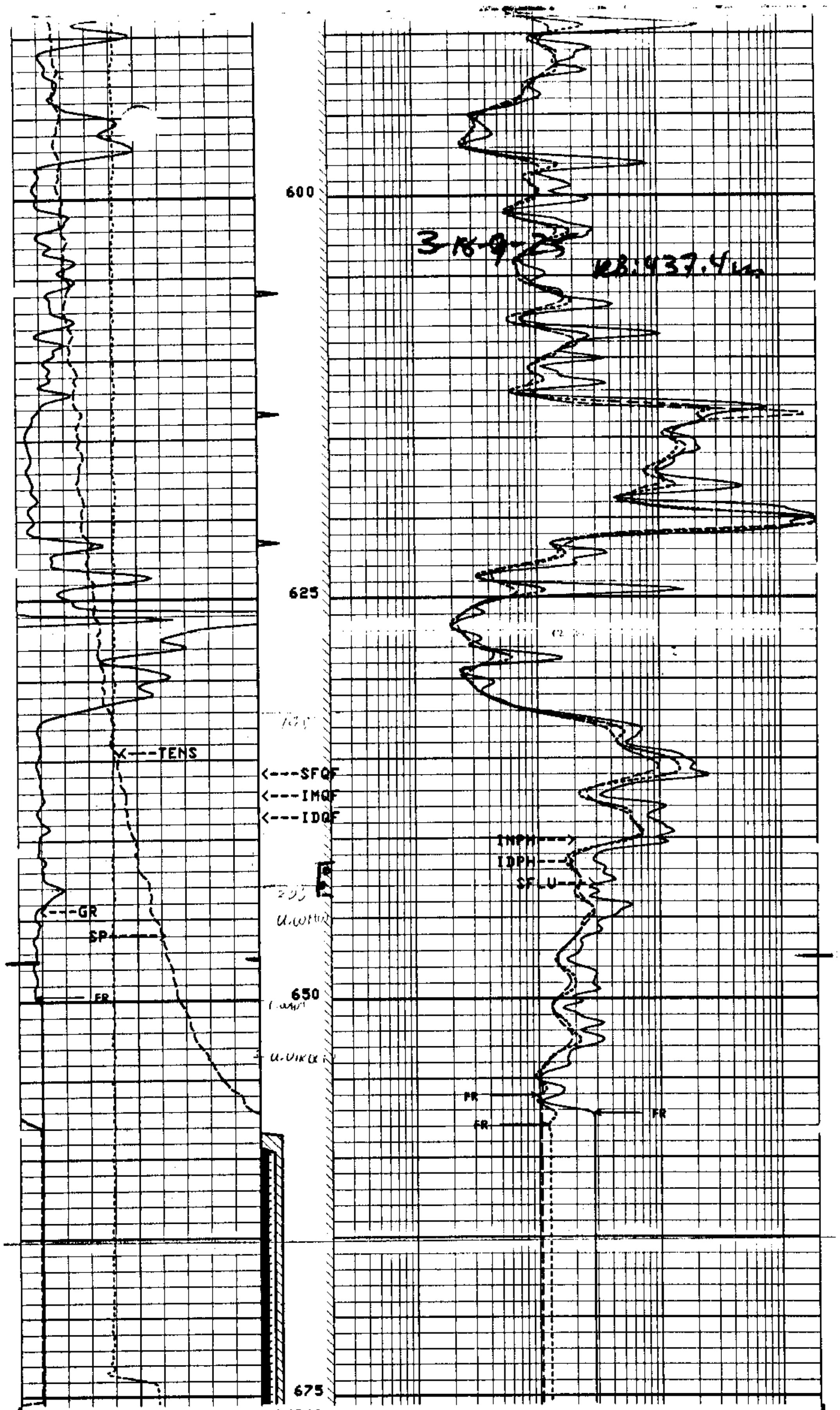
SA	13.11	METER	GR	12.65	METER
SPCD	13.11	METER	C2	9.52	METER
CNTC	5.94	METER	CFTC	6.10	METER
LL	.79	METER	LITH	.79	METER
LU	.79	METER	LS	.79	METER
SS1	.64	METER	PARI	.64	METER
DTCL	.79	METER	SS2	.64	METER
DTPL	.79	METER	DTCS	.64	METER
LLLC	.79	METER	DTPS	.64	METER
LULC	.79	METER	LLUC	.79	METER
SLLC	.64	METER	LUUC	.79	METER



00600
8-8-9-25
KB 434.9
L. AMARANTH (Red Beds) 616m
00625
MISSISSIPPIAN 628m
200
U. Virden? (Crinoidal) 645m
00650
L. Virden (Oolite) 653m
Lower Virden
Scallion (Cherty) 666m
Scallion
00675



KB:
00625
200
U. VIR.
"CRINOIDAL"
.10
.07
.07
.12
.09
00650
L. VIR.
("OOLITES")
SCALLION
"CHERTY"
00675
00700

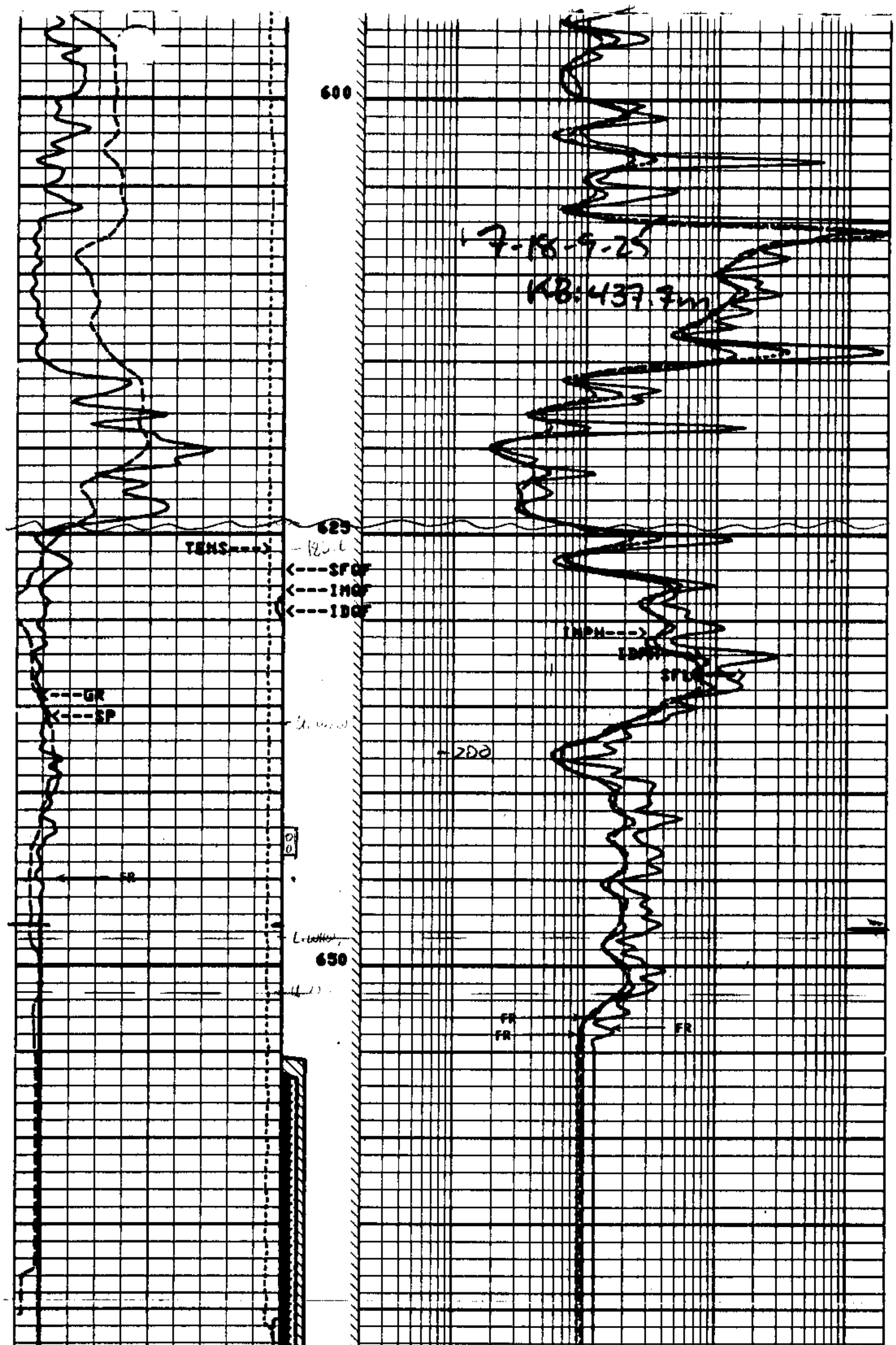


CP 32.2 FILE 20 25-OCT-1989 01:34

INPUT FILE(S) 15

DATA ACQUIRED 25-OCT-1989 00:57

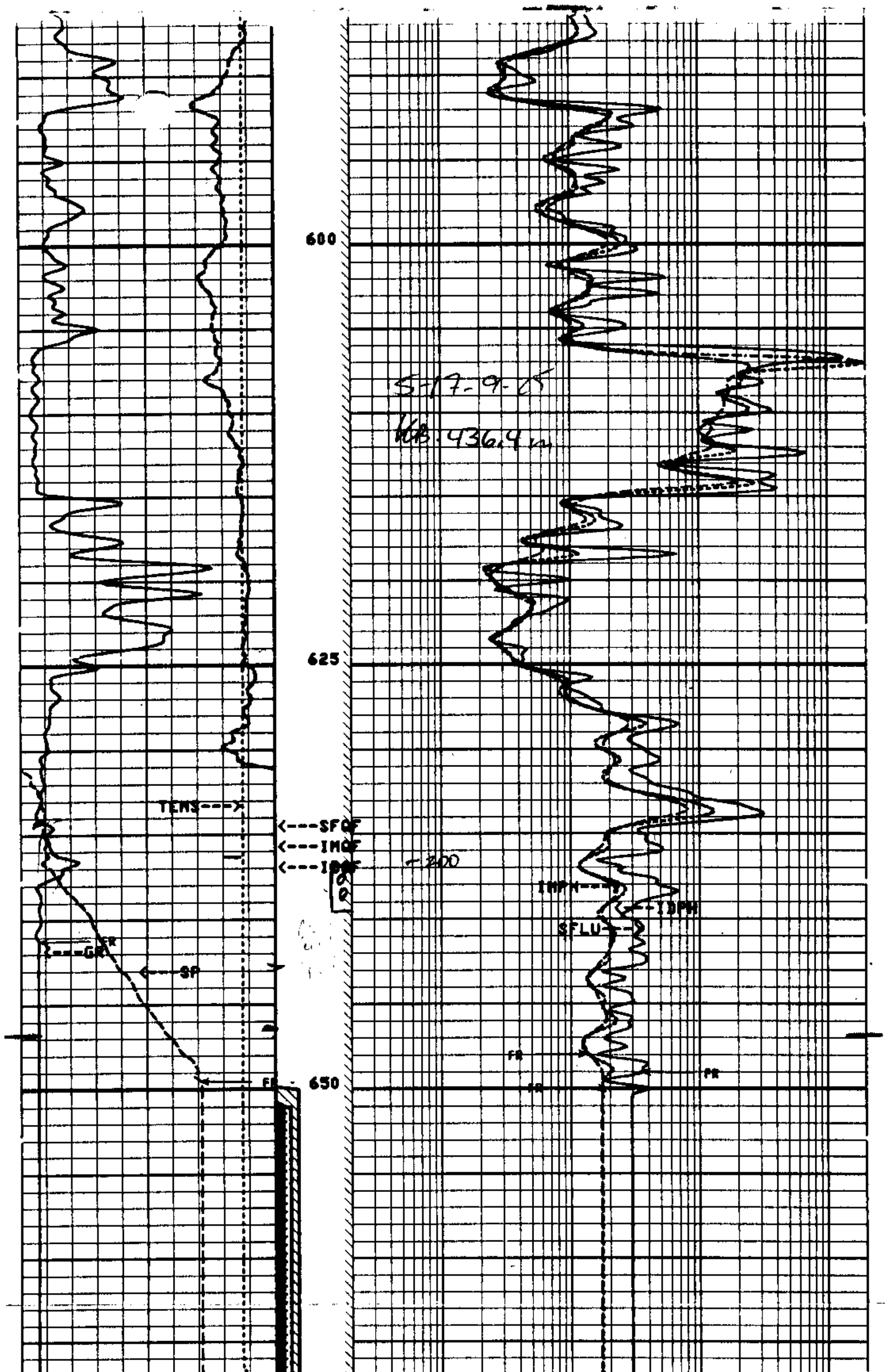
TENS(N) 10000. — 0.0		IMPH(OHMM) .20000 — 2000.0
GR (GAPI) 0.0 — 150.00		IDPH(OHMM) .20000 — 2000.0
SP (MV) -80.00 — 20.000		SFLU(OHMM) .20000 — 2000.0



CP 32.2 FILE 4 01-OCT-1989 03:53 **REPEAT SECTION**

TENS(N)		
50000.	0.0	
GR (GAPI)		
0.0	150.00	
SP (MV)		
-80.00	20.000	

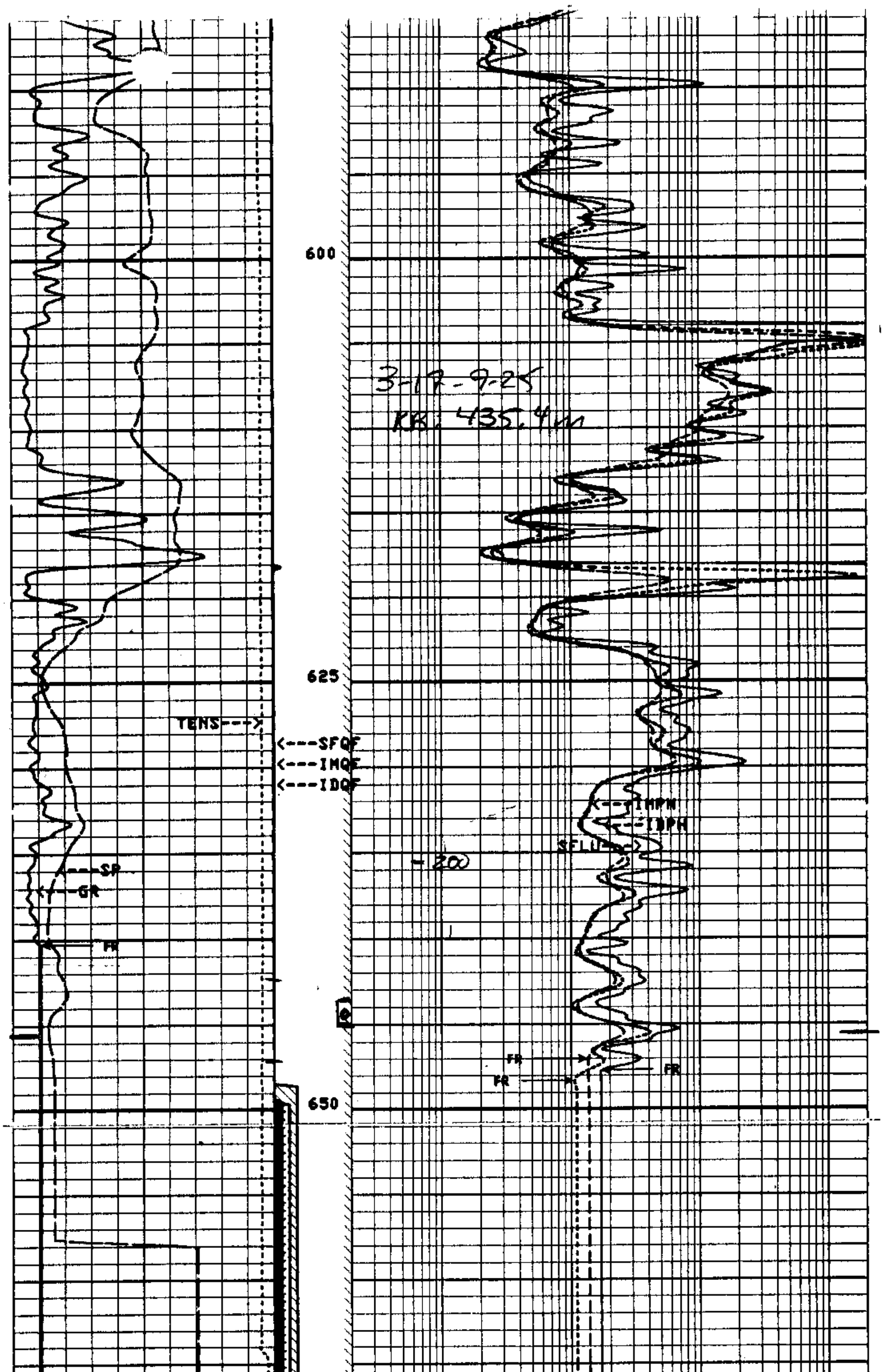
IMPH(OHMM)		
.20000	2000.0	
IDPH(OHMM)		
.20000	2000.0	
SFLU(OHMM)		
.20000	2000.0	



1/240

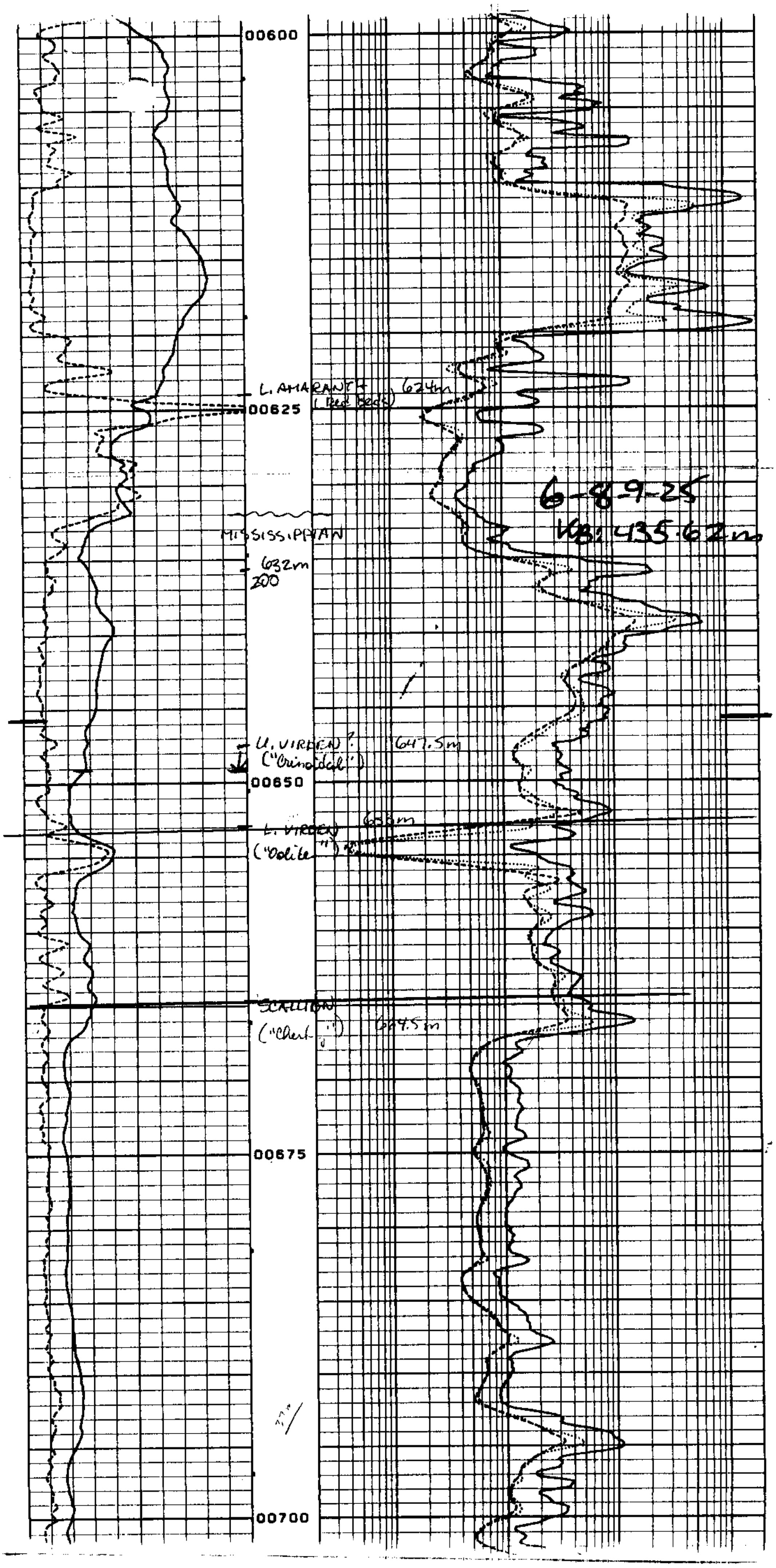
CP 32.2 FILE 9 31-OCT-1989 10:13

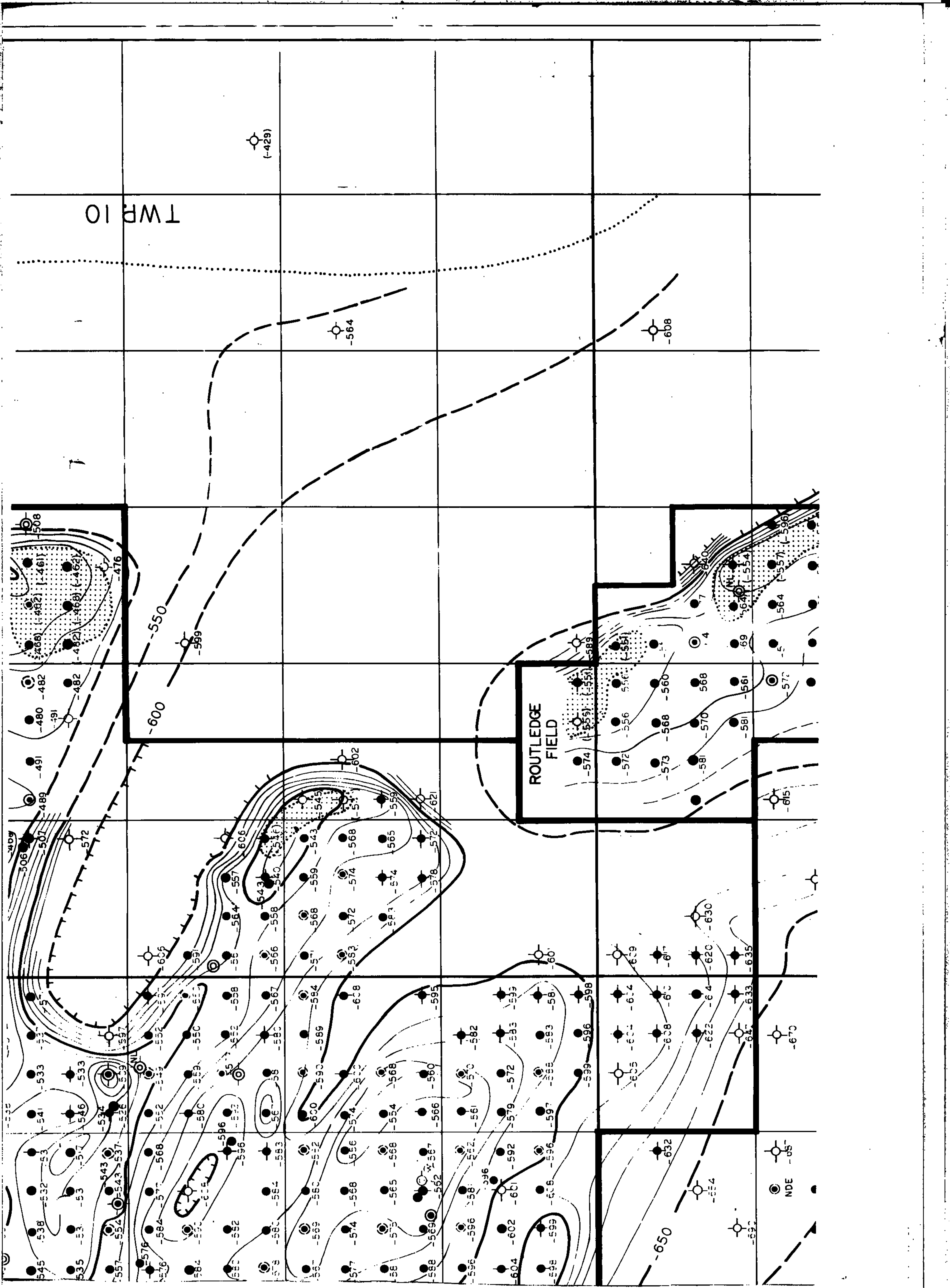
TENS(N)		IMPH(OHMM)
50000. — 0.0		.20000 — 2000.0
GR (GAPI)		IDPH(OHMM)
0.0 — 150.00		.20000 — 2000.0
SP (MV)		J(OHMM)
-80.00 — 20.000		.20000 — 2000.0



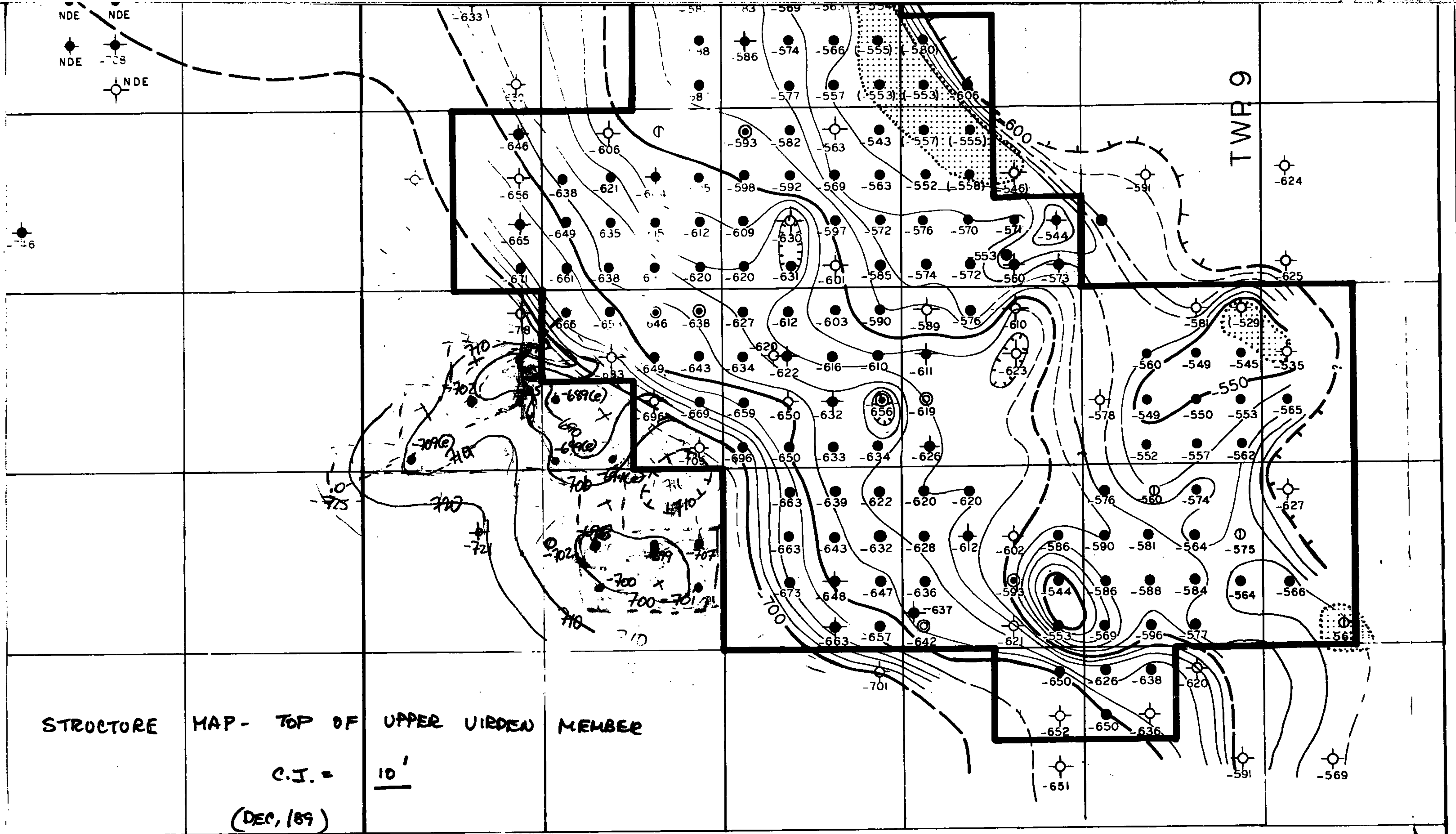
CP 32.2 FILE 9 05-NOV-1989 18:52

50000.	TENS(N)	0.0	
-80.00	SP (MV)	20.000	
0.0	GR (GAPI)	150.00	
.20000	IMPH(OHMM)	2000.0	
.20000	IDPH(OHMM)	2000.0	
.20000	SFLU(OHMM)	2000.0	


00600
L. AMARANTH (Red Beds) 624m
00625
6-8-9-25
KB: 435.62m
MISSISSIPPIAN
632m
200
U. VIRDEN? 647.5m
("Crinoidal")
00650
L. VIRDEN 653m
("Oolite")
SCALLION
("Chert") 664.5m
00675
00700



TWP 10
ROUTLEDGE FIELD
550
600
650

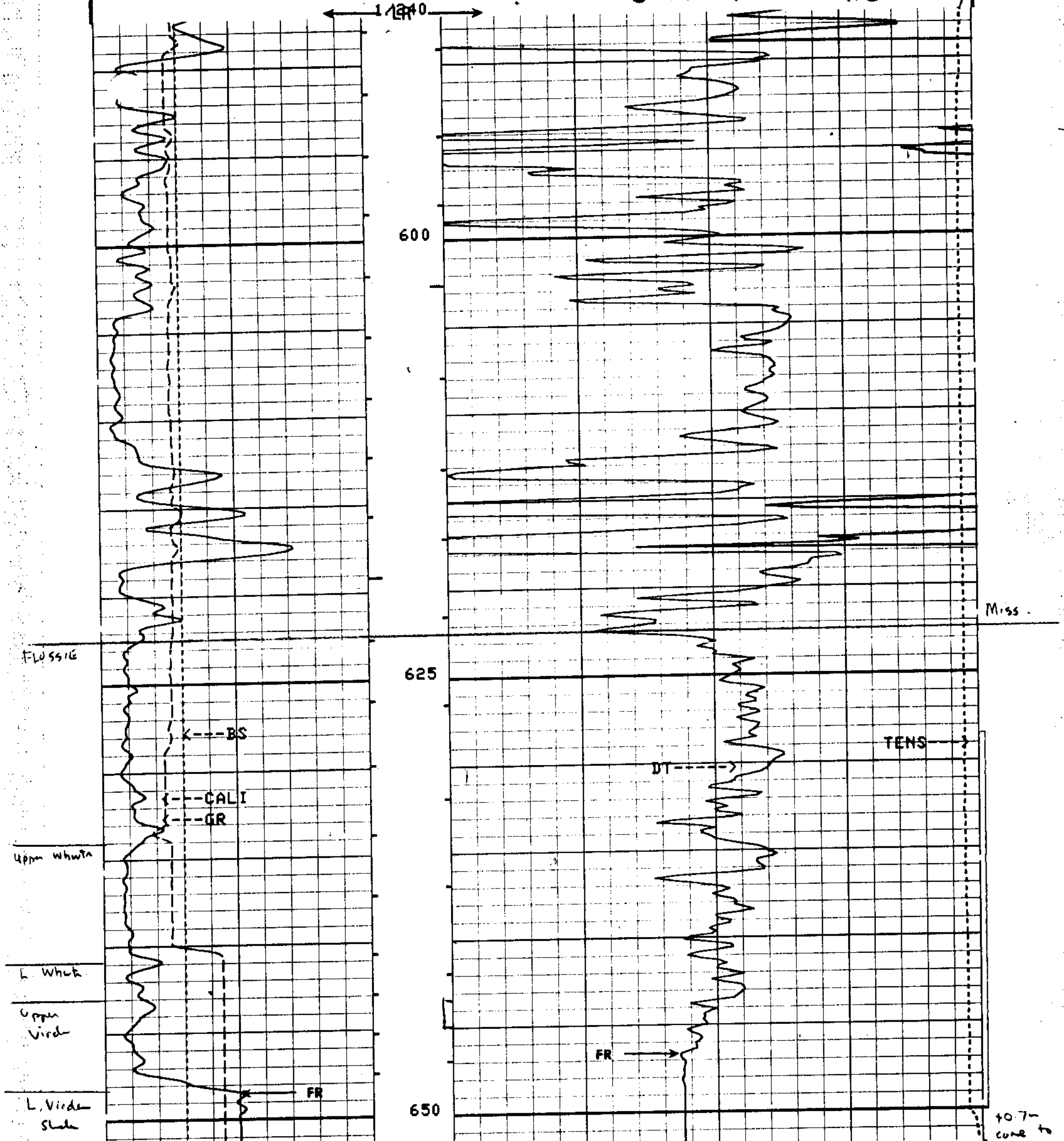


STRUCTURE MAP - TOP OF UPPER VIRDEN MEMBER

C.I. = 10'

(DEC, '89)

3-17-9-25 KB 435.4



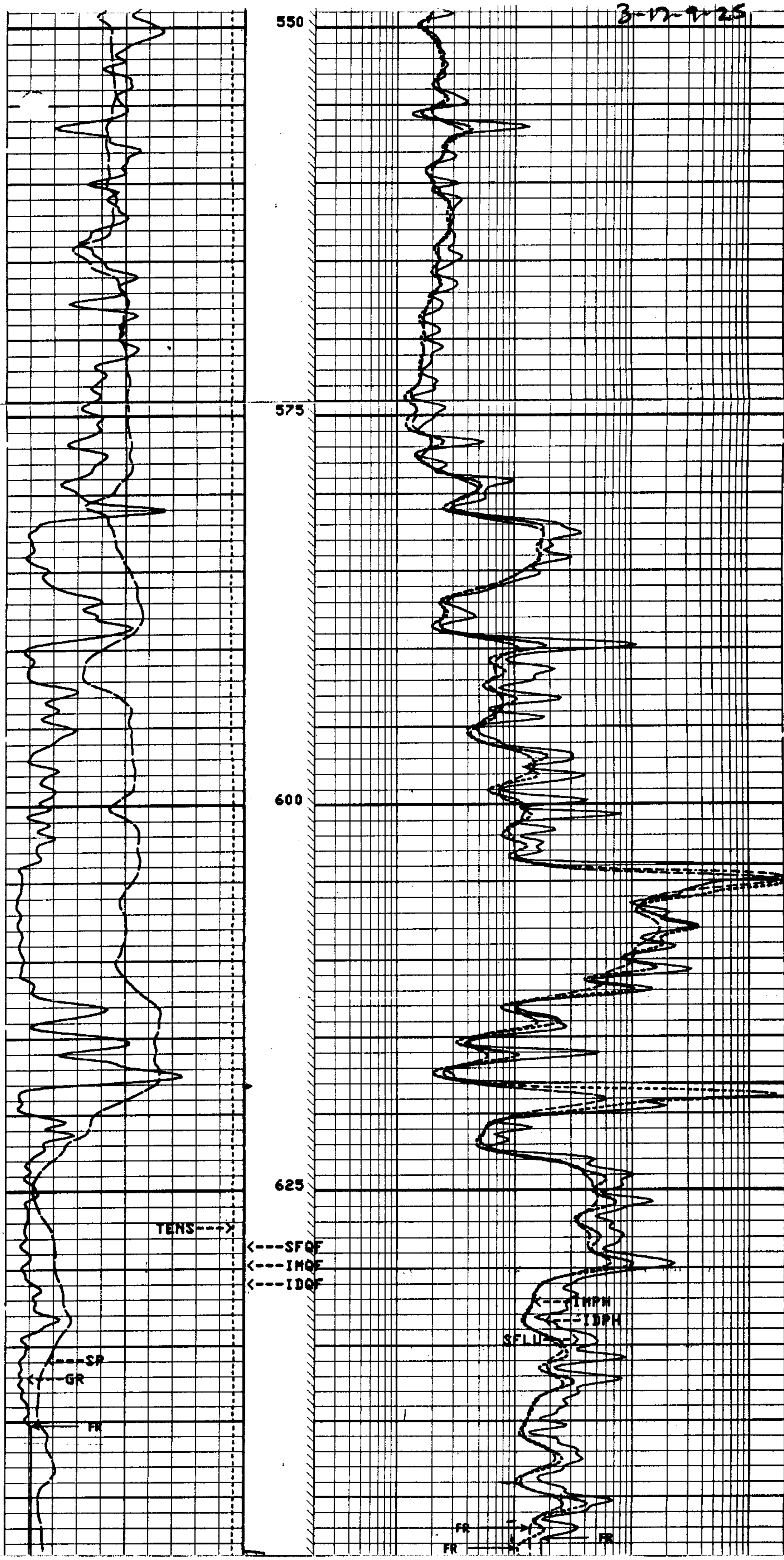
REPEAT SECTION

CP 32.2A FILE 37 06-NOV-1989 01:26

BS (MM) 125.00 375.00 CALI(MM)			TENS(N) 50000 0.0

Core 645-646.9 coarse crinoidal packstone, minor vuggy ∅

646.9-647.5 open vertical fractures

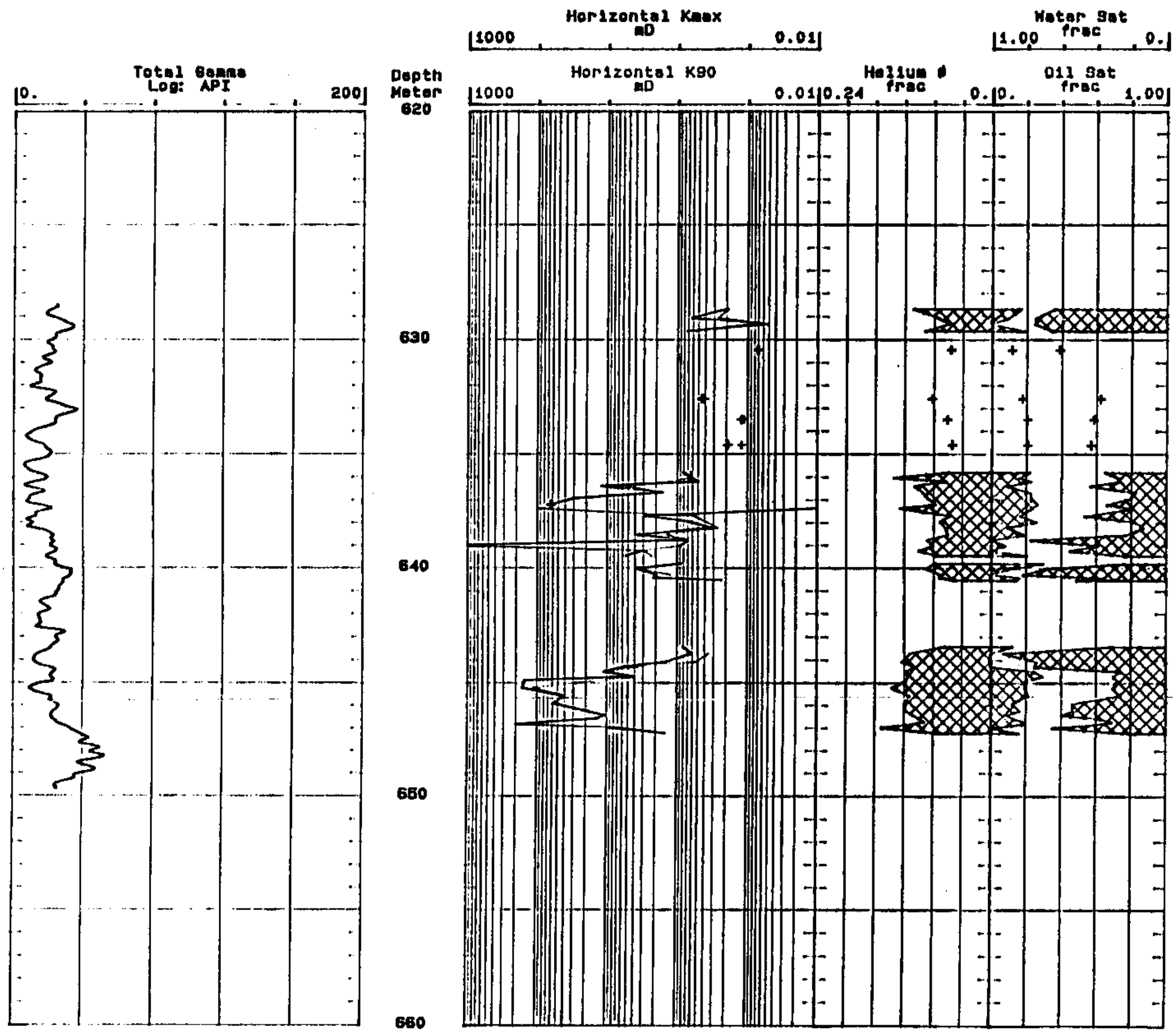

3-12-9-25
550
575
600
625
TENS--->
<---SFQF
<---IMQF
<---IDQF
<---IMPH
<---IDPH
SFLU--->
---SP
<---GR
FR
FR
FR
FR

CORRELATION COREGRAPH

CHEVRON CANADA RESOURCES LIMITED
CHEVRON VIRDEN 3-17-9-25 W1M
VIRDEN, MANITOBA
FILE NO. 52138-89-150
FORMATION: LODGEPOLE (628.50-650.00 m)

Core Laboratories 1989 11 05

Vertical Scale
10.00 cm = 24.0 meter



CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 3-17-9-25
Location : LSD XX/03-17-009-25 W1M/X
Province : MANITOBA, CANADA

Field : VIRDEN
Formation : LODGEPOLE
Coring Equip.: DIAMOND
Coring Fluid : WATER BASE MUD

File No.: 52138-89
Date : 1989 11 05
Analysts: RJH
Core Dia: 89

C O R E A N A L Y S I S R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
CORE NO.1 628.50 - 645.00m (Core Recieved 16.45m) (12Boxes)														
1	628.50- 28.81	0.31	0.11	0.20	0.19	0.05	0.062	0.108	0.034	2480.	2780.	0.167	0.639	dol i ppv anhy cht
	628.81- 28.92	0.11												anhy
2	628.92- 29.16	0.24	0.11	0.62	0.26	<.01	0.149	0.074	0.017	2630.	2830.	0.100	0.750	dol i ppv anhy shbk
3	629.16- 29.45	0.29	0.13	0.07	0.05	<.01	0.020	0.059	0.017	2690.	2860.	0.000	0.752	dol i anhy
	629.45- 29.51	0.06												anhy
4	629.51- 29.72	0.21	0.12	0.73	0.54	0.03	0.153	0.092	0.019	2530.	2790.	0.188	0.654	dol i ppv anhy cht 30 API
	629.72- 30.25	0.53												ls anhy cht
5	630.25- 30.60	0.35	0.27	0.07	0.07	<.01	0.024	0.056	0.021	2580.	2730.	0.118	0.610	ls i anhy
	630.60- 32.38	1.78												ls anhy sshy cht
6	632.38- 32.74	0.36	0.21	0.45	0.41	<.01	0.162	0.082	0.029	2480.	2700.	0.180	0.376	ls i cht sshy
	632.74- 33.38	0.64												ls cht shy
7	633.38- 33.56	0.18	0.10	0.12	0.11	0.06	0.022	0.061	0.011	2560.	2730.	0.208	0.416	ls i gyp anhy
	633.56- 34.42	0.86												ls shy anhy
8	634.42- 34.73	0.31	0.13	0.19	0.12	0.05	0.059	0.054	0.015	2560.	2700.	0.209	0.432	ls i ppv sv foss cht shbk
	634.73- 35.63	0.90												ls cht gyp sshy
9	635.63- 35.91	0.28	0.10	0.81	0.64	0.17	0.227	0.059	0.017	2520.	2680.	0.222	0.349	ls i ppv sv foss gyp anhy
10	635.91- 36.12	0.21	0.10	0.61	0.60	0.42	0.128	0.134	0.027	2320.	2680.	0.163	0.277	ls i cht gyp vfrac
SP 11	636.12- 36.23	0.11		0.50			0.055	0.063	0.007		2710.	0.233	0.259	ls i ppv sv foss
12	636.23- 36.52	0.29	0.12	11.9	5.36	0.57	3.451	0.106	0.032	2420.	2700.	0.092	0.436	ls i ppv sv foss shbk frac
13	636.52- 36.80	0.28	0.13	1.68	1.57	0.25	0.470	0.094	0.025	2440.	2690.	0.227	0.173	ls i ppv sv foss cht shbk
14	636.80- 37.01	0.21	0.09	30.1	25.9	3.19	6.321	0.087	0.019	2450.	2690.	0.233	0.202	ls i ppv sv foss gyp
	637.01- 37.12	0.11												ls gyp cht
SP 15	637.12- 37.24	0.12		63.2			7.584	0.076	0.010		2670.	0.268	0.339	ls i ppv mv foss cht
16	637.24- 37.46	0.22	0.07	*	92.4	*		0.125	0.029	2350.	2690.	0.235	0.189	ls i vug foss vfrac
17	637.46- 37.90	0.44	0.10	2.87	0.56	0.64	1.263	0.056	0.026	2540.	2690.	0.166	0.467	ls i ppv sv foss cht vfrac

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 3-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-150
Date : 1989 11 C

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) φ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
SP 18	637.90- 37.99	0.09		0.63			0.057	0.071	0.006		2700.	0.261	0.177	ls i ppv sv foss
19	637.99- 38.41	0.42	0.09	0.32	0.26	0.18	0.134	0.063	0.025	2530.	2700.	0.092	0.126	ls i gyp 30 API
20	638.41- 38.60	0.19	0.15	3.58	1.38	0.19	0.680	0.059	0.011	2520.	2680.	0.200	0.229	ls i ppv sv foss cht
21	638.60- 38.89	0.29	0.14	0.70	0.68	0.49	0.203	0.088	0.026	2480.	2720.	0.000	0.775	ls i ppv foss
22	638.89- 39.09	0.20	0.17	1850.	0.87	3.26	370.000	0.080	0.016	2500.	2720.	0.086	0.383	ls i foss pyr vfrac
23	639.09- 39.36	0.27	0.14	3.15	2.94	0.08	0.850	0.099	0.027	2440.	2700.	TRACE	0.551	ls i ppv foss gyp
24	639.36- 39.53	0.17	0.14	5.25	2.29	0.42	0.892	0.076	0.014	2500.	2710.	0.207	0.230	ls i ppv sv foss anhy
-	639.53- 39.74	0.21												ls cht gyp
SP 25	639.74- 39.83	0.09		0.87			0.078	0.078	0.007		2710.	0.298	0.236	ls i ppv sv foss
26	639.83- 40.17	0.34	0.26	3.73	3.57	0.38	1.268	0.089	0.031	2460.	2700.	0.107	0.681	ls i ppv sv foss gyp
27	640.17- 40.38	0.21	0.13	1.95	1.24	0.09	0.410	0.071	0.015	2520.	2710.	0.000	0.817	ls i ppv foss gyp cht
SP 28	640.38- 40.45	0.07		2.79			0.195	0.077	0.006		2700.	0.225	0.157	ls i ppv sv foss
SP 29	640.45- 40.58	0.13		0.23			0.030	0.050	0.007		2700.	0.143	0.512	ls i ppv foss cht
- top	640.58- 43.34	2.76												ls shy gyp cht
SP 30 uv	643.34- 43.45	0.11		0.81			0.089	0.064	0.007		2680.	0.125	0.301	ls i ppv sv foss
31	643.45- 43.93	0.48	0.11	0.60	0.35	0.11	0.288	0.112	0.053	2440.	2750.	0.000	0.928	ls i gyp anhy pyr
32	643.93- 44.18	0.25	0.22	[illegible]	0.51	0.39	0.352	0.123	0.030	2400.	2740.	0.000	0.737	ls i ppv foss anhy vfrac
33	644.18- 44.37	0.19	0.12	5.72	3.68	1.49	1.087	0.105	0.019	2430.	2710.	0.000	0.749	ls i ppv sv foss
34	644.37- 44.58	0.21	0.07	10.9	9.94	7.23	2.289	0.117	0.025	2410.	2730.	0.249	0.251	ls i ppv sv foss 31 API
35	644.58- 44.81	0.23	0.09	4.03	3.98	2.75	0.927	0.114	0.025	2430.	2740.	0.299	0.301	ls i ppv sv foss
SP 36	644.81- 44.95	0.14		150.			21.000	0.117	0.017		2690.	0.206	0.272	ls i sv foss
	644.95- 45.00	0.05												Lost core
CORE NO.2 645.00 - 650.00m (Core Recieved 4.70m) (4 Boxes)														
37	645.00- 45.38	0.38	0.26	162.	113.	49.7	61.560	0.136	0.053	2330.	2700.	0.196	0.301	ls i sv mv foss
38	645.38- 45.71	0.33	0.27	41.8	39.4	3.81	13.794	0.112	0.036	2400.	2700.	0.215	0.266	ls i ppv sv foss shbk 32 API
39	645.71- 46.09	0.38	0.27	57.8	55.6	12.4	21.964	0.119	0.046	2370.	2690.	0.124	0.533	ls i ppv sv foss
40	646.09- 46.35	0.26	0.08	20.8	18.1	0.98	5.408	0.116	0.031	2390.	2700.	0.167	0.535	ls i ppv mv foss

20392

CORE LABORATORIES

ompany : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 3-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89 0
Date : 1989 11 05

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
SP 41	646.35- 46.47	0.12		4.97			0.596	0.106	0.013		2710.	0.061	0.699	ls i ppv foss gyp shbks
SP 42	646.47- 46.63	0.16		16.9			2.704	0.100	0.016		2700.	0.125	0.340	ls i ppv sv foss
SP 43	646.63- 46.76	0.13		6.90			0.897	0.084	0.010		2700.	0.185	0.270	ls i ppv foss
SP 44	646.76- 46.86	0.10		299.			29.900	0.105	0.010		2680.	0.251	0.339	ls i sv foss
45	646.86- 47.07	0.21	0.16	8.58	7.64	5.34	1.802	0.150	0.032	2300.	2710.	0.000	0.647	ls i ppv sv foss 33 API
46	647.07- 47.34	0.27	0.21	1.48	1.45	0.36	0.400	0.074	0.019	2510.	2710.	0.163	0.210	ls i ppv foss anhy
	647.34- 49.70	2.36												ls shy cht gyp
	649.70- 50.00	0.30												Lost core

H = 3.36

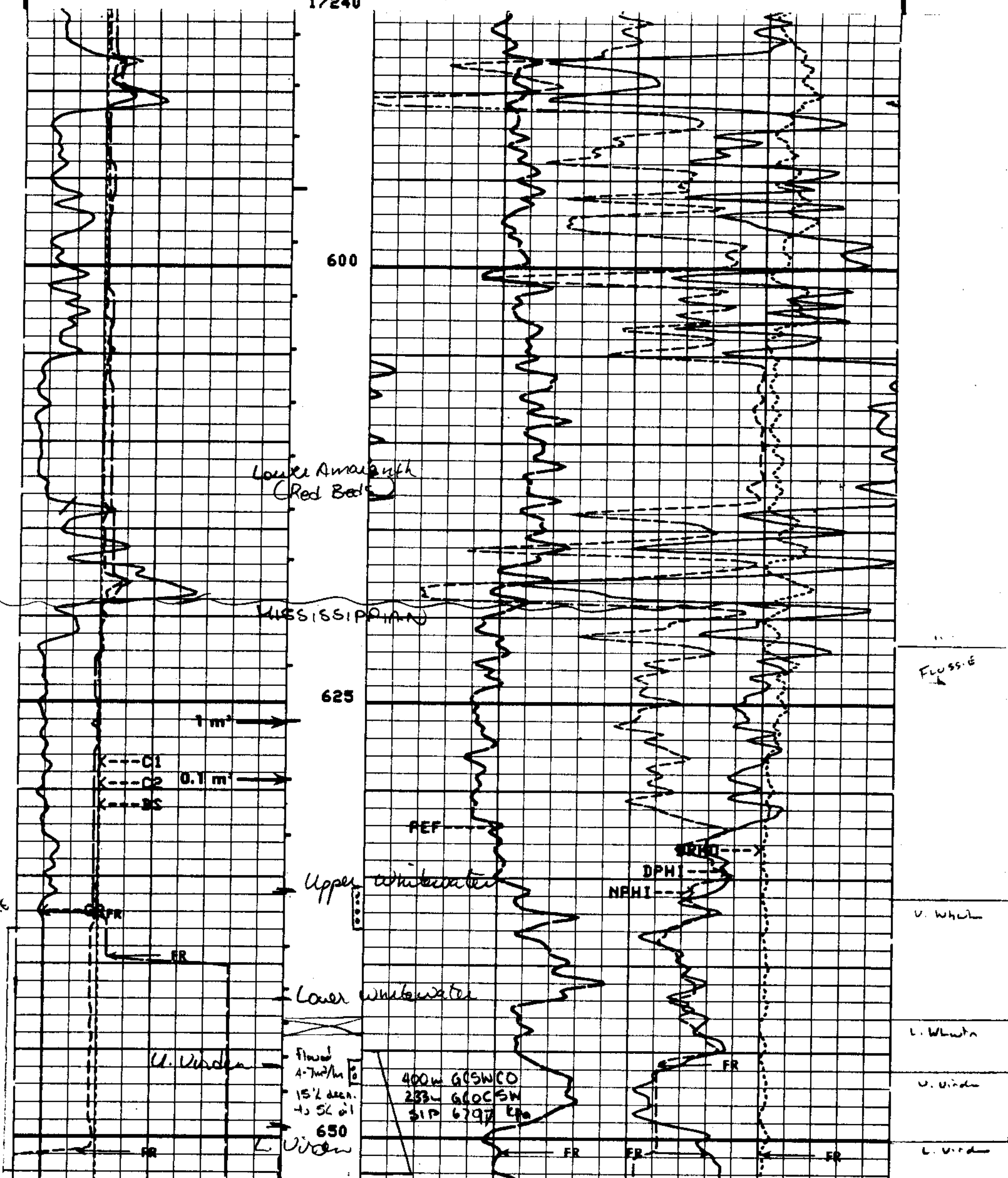
ϕ_{AVE} = 11.4 ; $\Sigma\phi H$ = .382

GR (GAPI) 0.0 150.00 | NPHI .45000 -.1500

REPEAT SECTION **REPEAT SECTION**

CP 32.2 FILE 8 07-OCT-1989 13:26

4-17-9-25 LIMESTONE



REPEAT SECTION

CP 32.2 FILE 8 07-OCT-1989 13:17

LIMESTONE

REPEAT SECTION

C1 (MM) 125.00 375.00
C2 (MM)

PEF

DRHO(K/M3)

core description
638-40.25 intercrystalline, interfossil & pp ∅, vuls
... oil stain

646.1-49.1 ... vut
frac. good staining

From DST
Rw = 0.162
@ 25°C

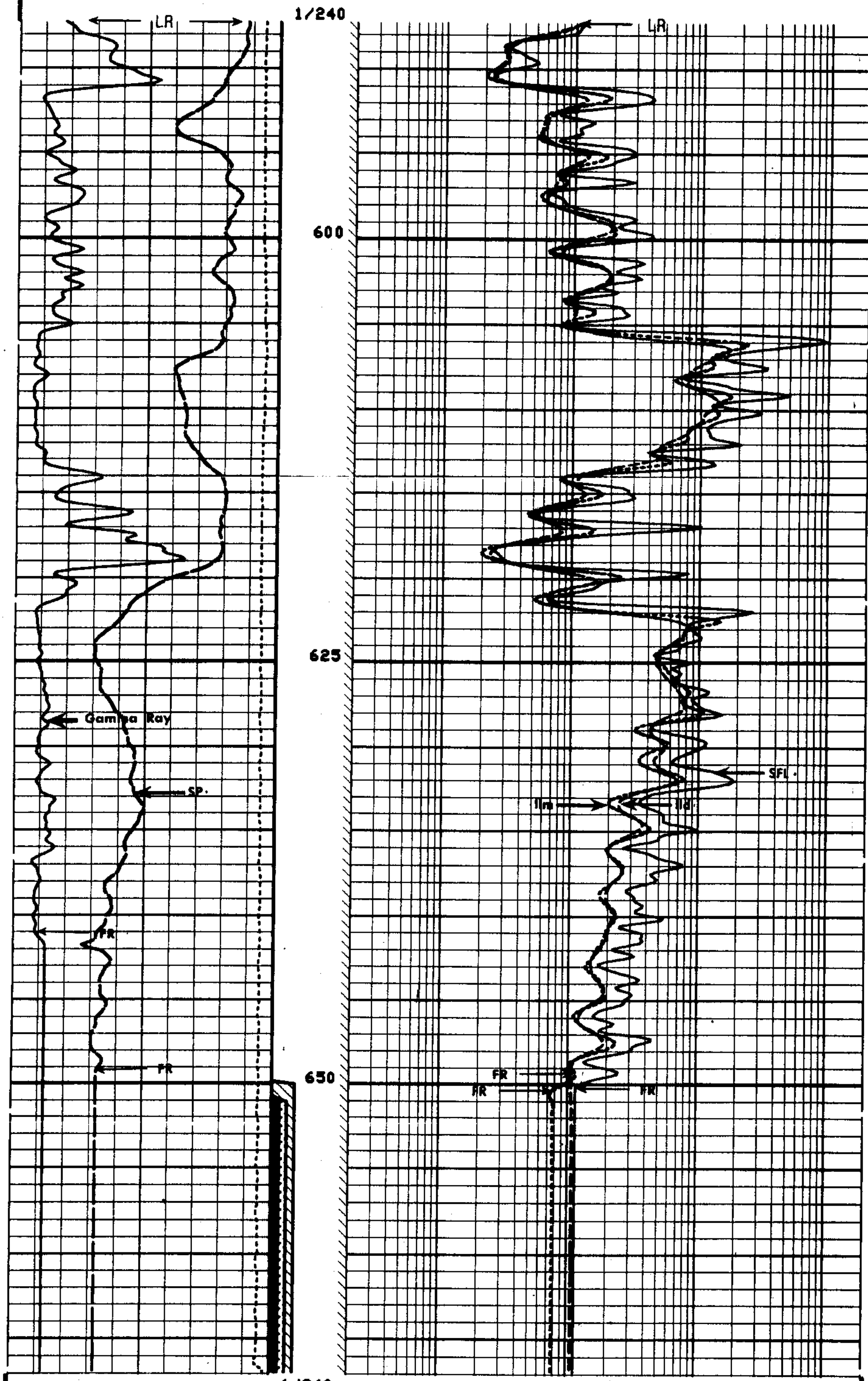
BHT = 39°C

REPEAT SECTION

CP 32.2 FILE 3 07-OCT-1989 10:49

REPEAT SECTION

4-17-9-25



REPEAT SECTION

CP 32.2 FILE 3 07-OCT-1989 10:43

REPEAT SECTION

TENS(N)		IMPH(OHMM)	
50000.	0.0	.20000	2000.0
GR (GAPI)		IDPH(OHMM)	
0.0	150.00	.20000	2000.0
-10+			
SP (MV)		SFLU(OHMM)	
-80.00	20.000	.20000	2000.0

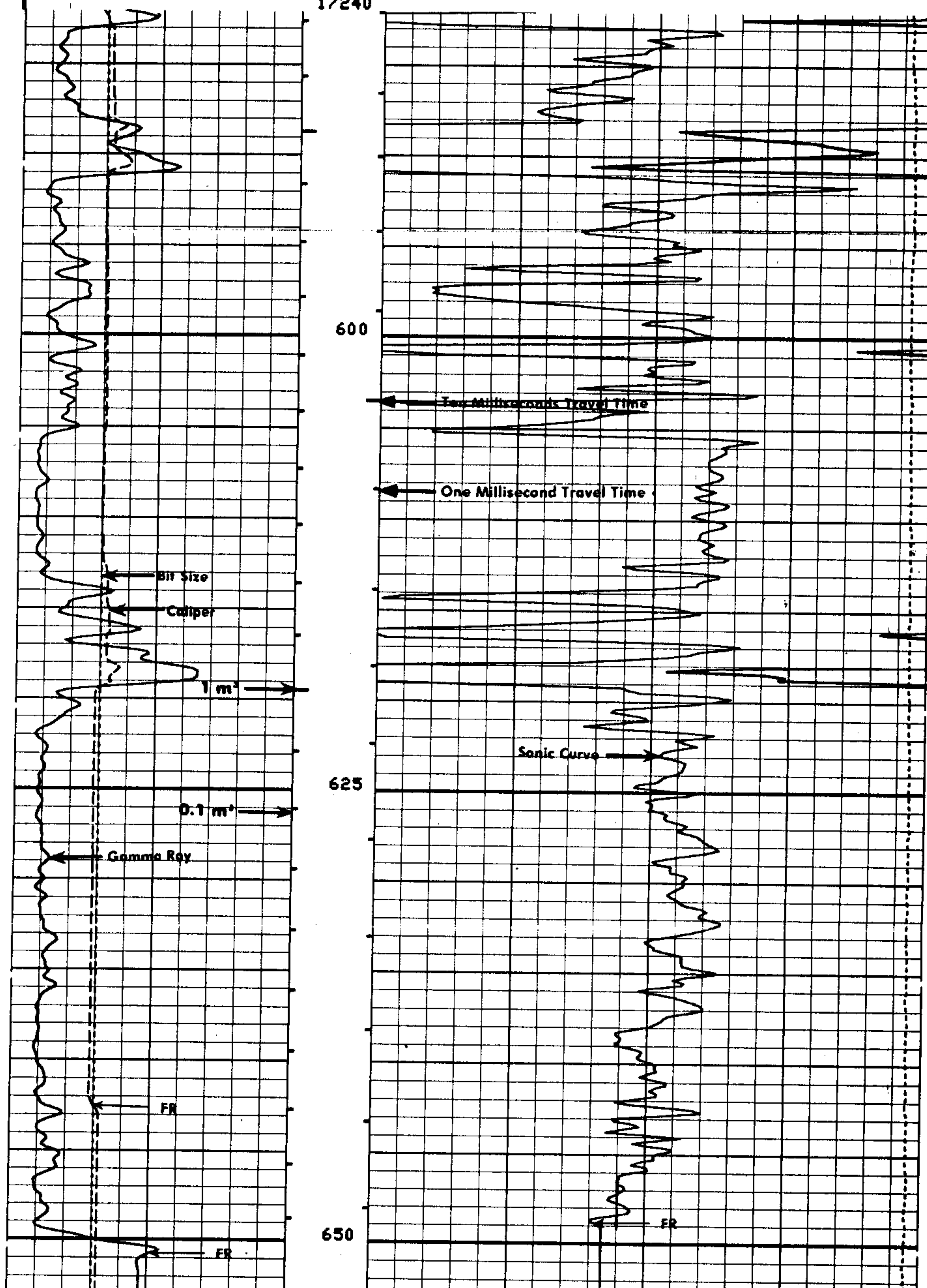
GR (GAPI) 0.0 150.00 | DT (US/M) 300.00 100.00

REPEAT SECTION REPEAT SECTION

CP 32.2A FILE 4 07-OCT-1989 16:07

4-17-9-25

KB 435.3m



1/240

REPEAT SECTION REPEAT SECTION

CP 32.2A FILE 4 07-OCT-1989 16:01

BS (MM) 125.00 375.00		TENS(N) 50000. 0.0
CALI(MM) 125.00 375.00		
GR (GAPI) 0.0 150.00	DT (US/M) 300.00 100.00	

SENSOR MEASURE POINT TO TOOL ZERO

SRAT 3.12 METER
CBFS 3.71 METER

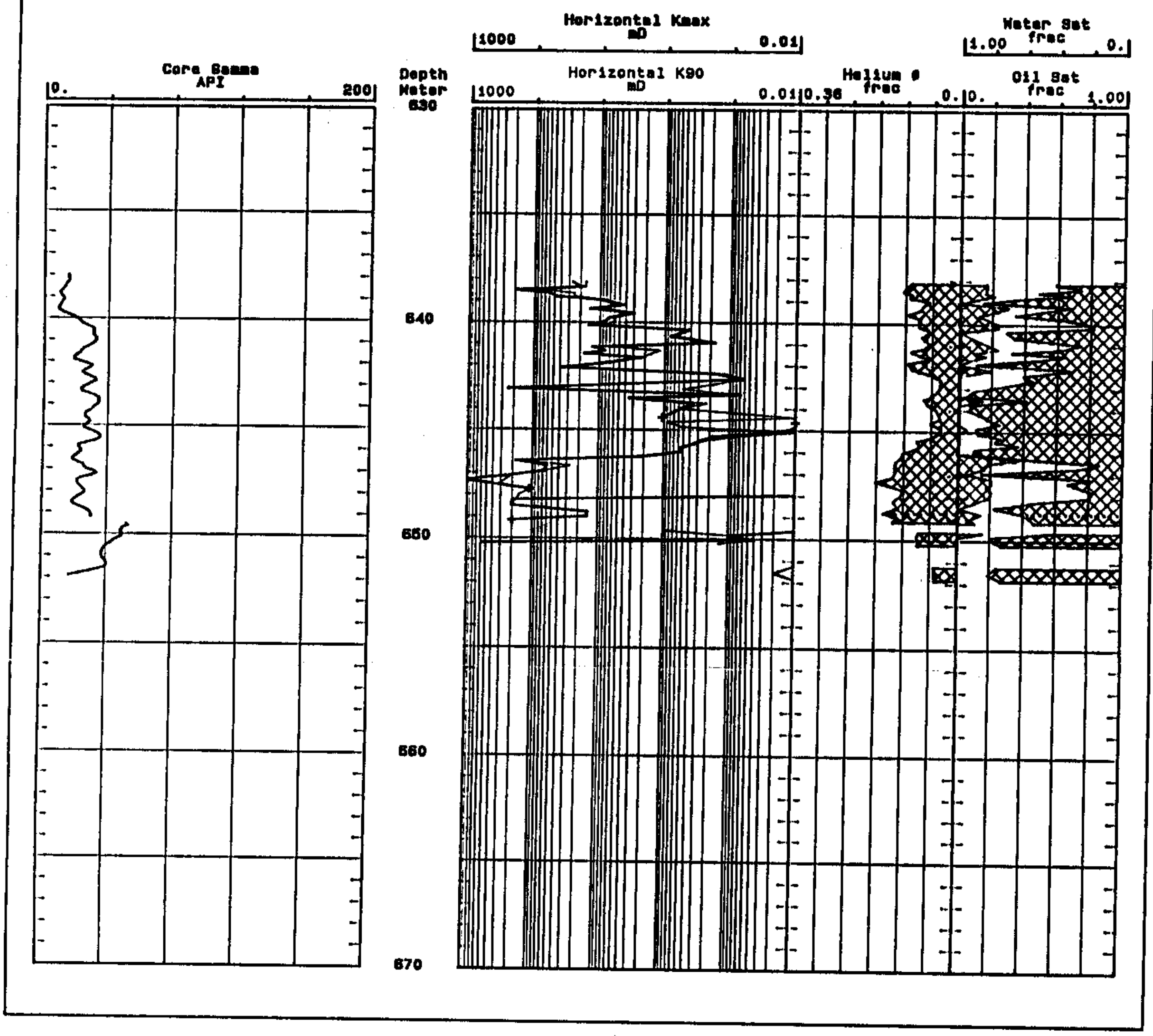
AMPL 3.73 METER
CBL 3.73 METER

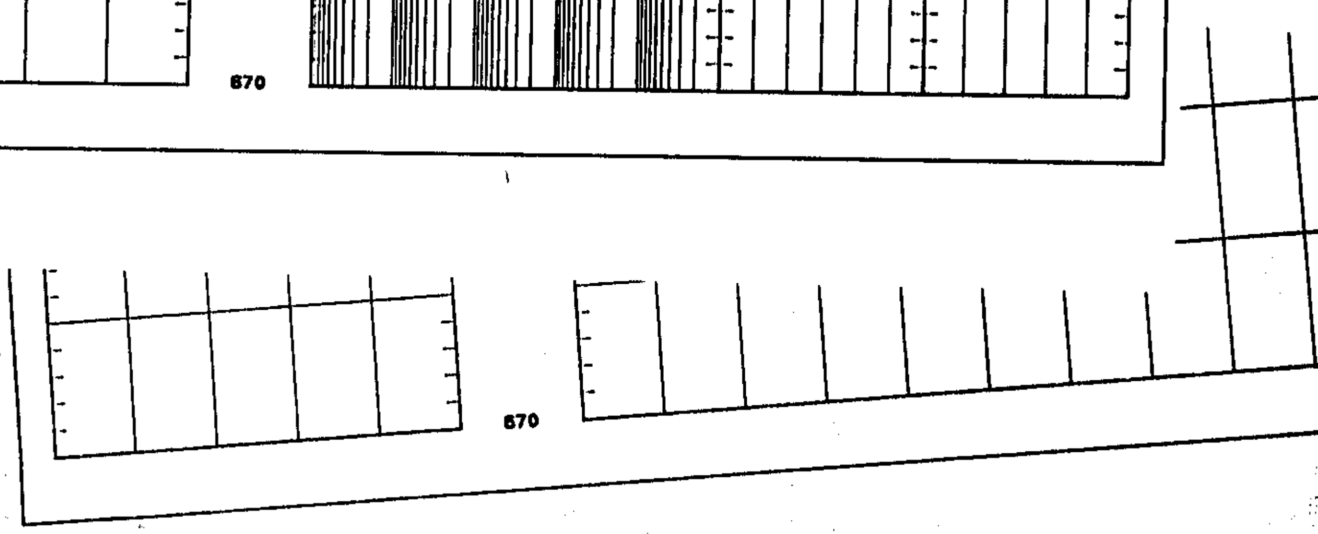
CORRELATION COREGRAPH

CHEVRON CANADA RESOURCES LIMITED
CHEVRON VIRDEN 4-17-9-25 W1M
VIRDEN, MANITOBA
FILE NO. 52138-89-133
FORMATION: LODGEPOLE (638.00-652.00 m)

Vertical Scale
10.00 cm = 24.0 meter

Core Laboratories 1989 10 07





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CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 4-17-9-25
Location : LSD XX/04-17-009-25 W1M/X
Province : MANITOBA, CANADA

Field : VIRDEN
Formation : LODGEPOLE
Coring Equip.: DIAMOND
Coring Fluid : WATER BASE MUD

File No.: 52138- 1133
Date : 1989 10 07
Analysts: SGP
Core Dia: 89

CORE ANALYSIS RESULTS

	SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
		CORE NO. 1 638.00 - 649.10m (Core Received 11.10m) (8 Boxes)													
	1	638.00- 38.25	0.25	0.21	26.9	16.7	0.16	6.725	0.107	0.027	2410.	2700.	0.160	0.415	ls i ppv sv foss gyp cht vfrac
	2	638.25- 38.45	0.20	0.14	19.6	17.1	0.76	3.920	0.120	0.024	2380.	2700.	0.160	0.260	ls i ppv sv foss gyp
	3	638.45- 38.58	0.13	0.09	321.	130.	15.5	41.730	0.137	0.018	2320.	2690.	0.112	0.728	ls i ppv sv foss gyp cht vfrac
	4	638.58- 38.71	0.13	0.10	12.9	4.36	3.76	1.677	0.093	0.012	2460.	2710.	0.258	0.164	ls i ppv sv foss gyp cht vfrac
	5	638.71- 38.89	0.18	0.10	56.2	30.5	2.00	10.116	0.125	0.023	2370.	2700.	0.113	0.668	ls i ppv mw foss gyp cht vfrac
	6	638.89- 39.07	0.18	0.14	8.59	7.88	<.01	1.546	0.067	0.013	2490.	2670.	TRACE	0.858	ls i ppv foss gyp cht
	7	639.07- 39.30	0.23	0.20	5.39	4.26	0.48	1.240	0.082	0.018	2480.	2700.	0.293	0.326	ls i ppv sv foss gyp
	8	639.30- 39.43	0.13	0.08	21.2	12.0	1.81	2.756	0.082	0.010	2470.	2700.	0.242	0.484	ls i ppv sv foss vfrac
	9	639.43- 39.68	0.25	0.20	3.22	3.01	1.40	0.805	0.113	0.027	2390.	2700.	0.116	0.661	ls i ppv gyp cht vfrac
	10	639.68- 39.88	0.20	0.16	7.49	6.20	1.42	1.498	0.089	0.018	2460.	2700.	0.176	0.328	ls i ppv mw foss
	11	639.88- 40.04	0.16	0.11	7.07	4.85	1.10	1.131	0.091	0.014	2460.	2700.	0.241	0.191	ls i ppv sv foss
	12	640.04- 40.20	0.16	0.11	15.0	9.01	2.55	2.400	0.090	0.014	2450.	2700.	0.231	0.181	ls i ppv sv foss
	13	640.20- 40.46	0.26	0.17	0.44	0.43	0.01	0.114	0.066	0.018	2530.	2710.	0.000	0.716	ls i ppv foss
	14	640.46- 40.78	0.32	0.12	0.84	0.75	0.60	0.269	0.084	0.026	2490.	2710.	0.080	0.668	ls i ppv vfrac
	15	640.78- 41.06	0.28	0.12	0.18	0.17	0.11	0.050	0.066	0.020	2540.	2720.	0.166	0.261	ls i gyp pyr
	16	641.06- 41.20	0.14	0.07	13.1	7.25	0.14	1.834	0.078	0.011	2480.	2690.	0.231	0.377	ls i ppv sv foss pyr
	17	641.20- 41.38	0.18	0.14	1.45	1.21	0.08	0.261	0.121	0.022	2370.	2690.	0.000	0.943	ls i gpy cht shbk
SP	18	641.38- 41.51	0.13		25.2			3.276	0.094	0.012		2700.	0.209	0.206	ls i ppv sv foss
	19	641.51- 41.73	0.22	0.18	2.35	2.26	0.07	0.517	0.066	0.015	2530.	2710.	0.067	0.504	ls i ppv foss
	20	641.73- 41.97	0.24	0.19	7.07	6.60	0.15	1.697	0.113	0.026	2380.	2680.	0.000	0.899	ls i ppv sv foss gyp cht
	21	641.97- 42.23	0.26	0.14	38.9	28.9	2.81	10.114	0.105	0.026	2410.	2700.	0.187	0.306	ls i ppv mw foss gyp
	22	642.23- 42.51	0.28	0.25	0.15	0.12	<.01	0.042	0.060	0.017	2550.	2710.	0.000	0.614	ls i ppv sshy gyp
	23	642.51- 42.71	0.20	0.07	0.07	0.06	0.02	0.014	0.040	0.008	2590.	2700.	TRACE	0.549	ls i ppv foss shy sh lmy
-		642.71- 42.90	0.19												
	24	642.90- 43.25	0.35	0.28	247.	0.52	<.01	86.450	0.045	0.018	2580.	2700.	TRACE	0.912	ls i sshy gyp pyr vfrac

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 4-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-8? 33
Date : 1989 10 07

C O R E   A N A L Y S I S   R E S U L T S

	SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
	25	643.25- 43.41	0.16	0.07	0.07	0.07	0.01	0.011	0.058	0.010	2550.	2710.	0.000	0.962	ls i gyp foss shbk
	26	643.41- 43.60	0.19	0.15	3.50	2.92	<.01	0.665	0.078	0.015	2480.	2690.	0.141	0.588	ls i ppv sv foss gyp
	27	643.60- 43.88	0.28	0.16	0.37	0.23	<.01	0.104	0.070	0.020	2510.	2700.	0.000	0.929	ls i ppv gyp shbk
	28	643.88- 44.11	0.23	0.18	0.58	0.58	0.01	0.133	0.050	0.012	2570.	2700.	TRACE	0.932	ls i ppv sv foss gyp
-		644.11- 44.29	0.18												ls shy shbks
	29	644.29- 44.47	0.18	0.10	1.08	0.01	3.96	0.194	0.041	0.007	2590.	2700.	TRACE	0.828	ls i sshy gyp pry vfrac
	30	644.47- 44.74	0.27	0.22	*	0.89	*		0.062	0.016	2530.	2700.	0.000	0.753	ls i ppv sv foss gyp vfrac
	31	644.74- 44.94	0.20	0.16	*	0.54	*		0.039	0.008	2610.	2720.	0.047	0.894	ls i pyr shbk vfrac
-		644.94- 44.97	0.03												sh
	32	644.97- 45.19	0.22	0.16	0.02	0.01	<.01	0.004	0.045	0.011	2610.	2730.	0.000	0.882	ls i sshy pyr
	33	645.19- 45.35	0.16	0.09	0.21	0.04	0.19	0.034	0.047	0.008	2580.	2710.	0.000	0.650	ls i ppv foss pyr vfrac
	34	645.35- 45.53	0.18	0.14	0.27	0.25	0.01	0.049	0.108	0.020	2440.	2740.	0.000	0.880	ls i foss anhy cht
	35	645.53- 45.69	0.16	0.11	0.32	0.31	0.14	0.051	0.080	0.013	2510.	2730.	0.000	0.502	ls i foss anhy
	36	645.69- 45.90	0.21	0.16	0.56	0.53	0.37	0.118	0.095	0.019	2490.	2750.	0.000	0.900	ls i ppv foss
	37	645.90- 46.10	0.20	0.17	0.59	0.56	0.26	0.118	0.123	0.024	2380.	2710.	0.000	0.914	ls i ppv foss
-	38	646.10- 46.33	0.23	0.12	2.34	2.19	0.52	0.538	0.128	0.030	2370.	2710.	0.374	0.594	ls i ppv sv foss
	39	646.33- 46.52	0.19	0.13	183.	177.	11.0	34.770	0.138	0.027	2320.	2700.	0.180	0.141	ls i ppv sv foss
uV	40	646.52- 46.76	0.24	0.16	61.2	27.1	8.92	14.688	0.141	0.034	2340.	2720.	0.154	0.268	ls i ppv sv foss vfrac
	41	646.76- 47.02	0.26	0.22	68.0	64.3	13.5	17.680	0.139	0.036	2350.	2720.	0.053	0.856	ls i ppv sv foss
	42	647.02- 47.22	0.20	0.11	261.	223.	131.	52.200	0.146	0.030	2310.	2700.	0.201	0.189	ls i ppv sv foss
A	43	647.22- 47.40	0.18	0.14	1170.			210.600	0.182	0.032	2210.	2700.	0.206	0.330	ls i ppv sv foss vfrac
	44	647.40- 47.62	0.22	0.15	333.	322.	7.70	73.260	0.145	0.031	2300.	2700.	0.169	0.254	ls i ppv mv foss shbk
	45	647.62- 47.81	0.19	0.16	112.	102.	16.6	21.280	0.119	0.023	2380.	2710.	0.205	0.180	ls i ppv mv foss vfrac
	46	647.81- 48.11	0.30	0.19	*	156.	*		0.128	0.039	2350.	2690.	0.189	0.193	ls i ppv mv foss vfrac
SP	47	648.11- 48.29	0.18		202.			36.360	0.143	0.025		2700.	0.103	0.534	ls i ppv sv foss
	48	648.29- 48.65	0.36	0.13	212.	210.	3.84	76.320	0.133	0.047	2350.	2710.	TRACE	0.778	ls i ppv sv foss vfrac
	49	648.65- 48.83	0.18	0.15	14.4	14.1	7.51	2.592	0.164	0.029	2270.	2710.	0.142	0.612	ls i ppv sv foss
	50	648.83- 49.10	0.27	0.08	14.8	14.6	11.9	3.996	0.133	0.035	2350.	2700.	0.077	0.556	ls i ppv sv foss

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 4-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-133
Date : 1989 10 07

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) φ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
CORE NO. 2 649.10 - 649.50m (Core Received 0.11m) (1 Box)														
AST 47	649.10- 49.21	0.11		202.			22.220	0.143	0.015		2700.	0.103	0.534	ls i ppv sv foss
	649.21- 49.50	0.29												Lost core
									ΣØH 0.033					
CORE NO. 3 649.50 - 652.00m (Core Received 2.45m) (2 Boxes)														
51	649.50- 49.72	0.22	0.09	*	0.96	*		0.084	0.018	2480.	2710.	0.150	0.416	ls i ppv foss vfrac
52	649.72- 49.92	0.20	0.18	0.10	0.09	0.02	0.020	0.090	0.018	2520.	2760.	0.000	0.793	ls i shy foss pyr
53	649.92- 50.12	0.20	0.15	0.04	0.04	<.01	0.008	0.083	0.016	2520.	2750.	0.000	0.780	ls i shy foss pyr gyp
54	650.12- 50.28	0.16	0.07	582.	0.14	1110.	93.120	0.088	0.014	2440.	2680.	0.000	0.730	ls i sv foss gyp cht vfrac
	650.28- 51.09	0.81												sh lmy
55	651.09- 51.35	0.26	0.13	0.01	0.01	<.01	0.003	0.051	0.013	2570.	2710.	0.000	0.760	ls i ppv foss gyp
56	651.35- 51.71	0.36	0.18	0.02	0.02	0.01	0.007	0.051	0.018	2580.	2720.	0.000	0.812	ls i shy gyp pyr
57	651.71- 51.95	0.24	0.12	0.01	0.01	<.01	0.002	0.049	0.012	2580.	2710.	0.000	0.728	ls i sshy pyr gyp
	651.95- 52.00	0.05												Lost core

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 4-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-133
Date : 1989 10 C

TABLE I

SUMMARY OF CORE DATA

ZONE AND CUTOFF DATA

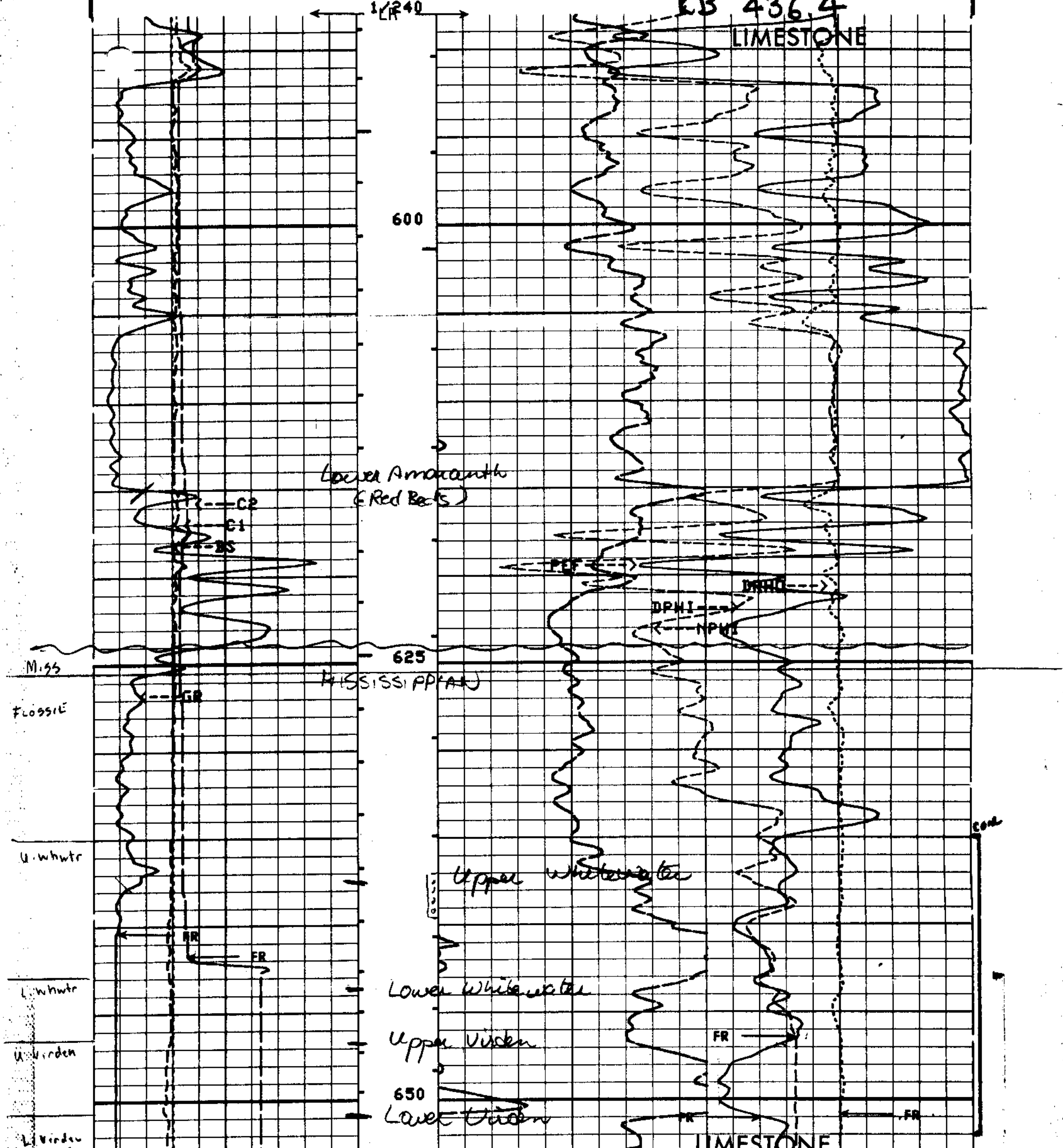
ZONE:		
Identification	LODGEPOLE	
Top Depth	638.00	m
Bottom Depth	652.00	m
Number of Samples	58	
DATA TYPE:		
Porosity	(HELIUM)	
Permeability	(MAXIMUM) Kair	
CUTOFFS:		
Porosity (Minimum)	0.000	frac
Porosity (Maximum)	1.000	frac
Permeability (Minimum)	0.0000	mD
Permeability (Maximum)	100000.	mD
Water Saturation (Maximum)	1.000	frac
Oil Saturation (Minimum)	0.000	frac
Grain Density (Minimum)	2000.	kg/m3
Grain Density (Maximum)	3000.	kg/m3
Lithology Excluded	NONE	

CHARACTERISTICS REMAINING AFTER CUTOFFS

ZONE:		
Number of Samples	58	
Thickness Represented	12.45	m
POROSITY:		
Storage Capacity	1.164	ϕ-m
Arithmetic Average	0.093	frac
Minimum	0.039	frac
Maximum	0.182	frac
Median	0.090	frac
Standard Deviation	±0.036	frac
GRAIN DENSITY:		
Arithmetic Average	2707.	kg/m3
Minimum	2670.	kg/m3
Maximum	2760.	kg/m3
Median	2700.	kg/m3
Standard Deviation	±16.	kg/m3

PERMEABILITY:		
Flow Capacity	841.40	mD-m
Arithmetic Average	73.4	mD
Geometric Average	3.63	mD
Harmonic Average	0.11	mD
Minimum	0.01	mD
Maximum	1170.	mD
Median	7.07	mD
Standard Dev. (Geom)	$K \cdot 10^{\pm 1.359}$	mD
HETEROGENEITY (Permeability):		
Dykstra-Parsons Var.	0.974	
Lorenz Coefficient	0.762	
AVERAGE SATURATIONS (Pore Volume):		
Oil	0.105	frac
Water	0.561	frac

5-17-9-25
KB 436.4



1/240

core 638-39.9 abundant open fractures, fragmental packstone vuggy & good interfragmental Ø
639.9-4? coarsely fragmental packstone, vert. fractures
647.7-50.6 coarsely fragmented grainstone, vuggy & tight frac. oil st.

CP 32.2 FILE 24 31-OCT-1989 19:04

C2 (MM)		PEF		DRHO(K/M3)	
125.00	375.00	0.0	10.000	250.00	-250.0
C1 (MM)		DPHI			
125.00	375.00	.45000			-.1500
BS (MM)		NPHI			
125.00	375.00	.45000			-.1500
GR (GAPI)					
0.0	150.00				

SENSOR MEASURE POINT TO TOOL ZERO

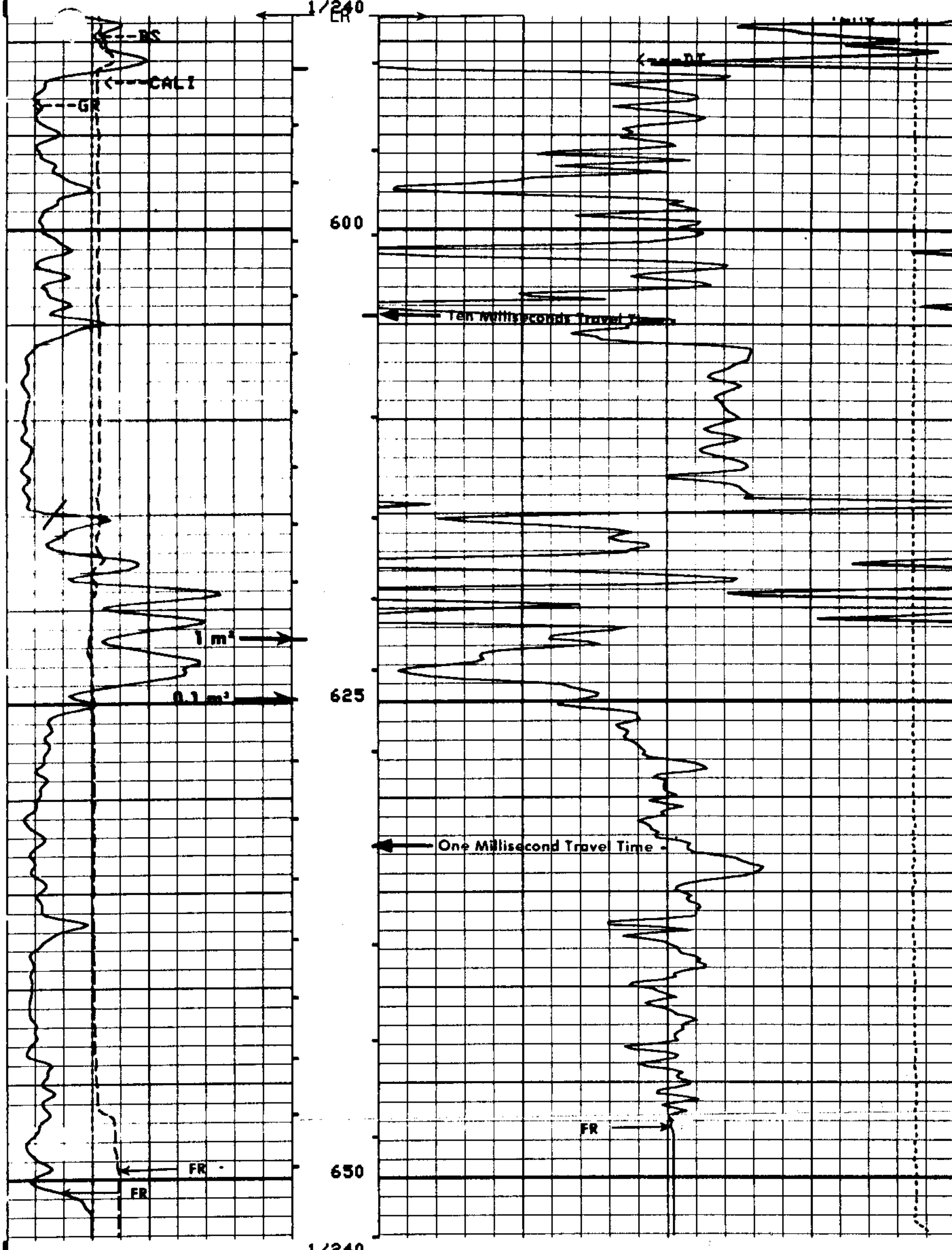
LDTD .81 METER
PCDB 13.16 METER
CNTH 6.15 METER

SGTL 12.70 METER
DTT -.28 METER

PARAMETERS

PARAMETER	VALUE	UNIT
WMUD - WEIGHT OF MUD	1310.00	K/M3

CP 32.2A FILE 15 31-OCT-1989 12:19 5-17-9-25



CP 32.2A FILE 15 31-OCT-1989 12:13

BS (MM) 125.00 375.00 CALI(MM) 125.00 375.00 GR (GAPI) 0.0 150.00	DT (US/M) 300.00 100.00	TENS(N) 50000. 0.0

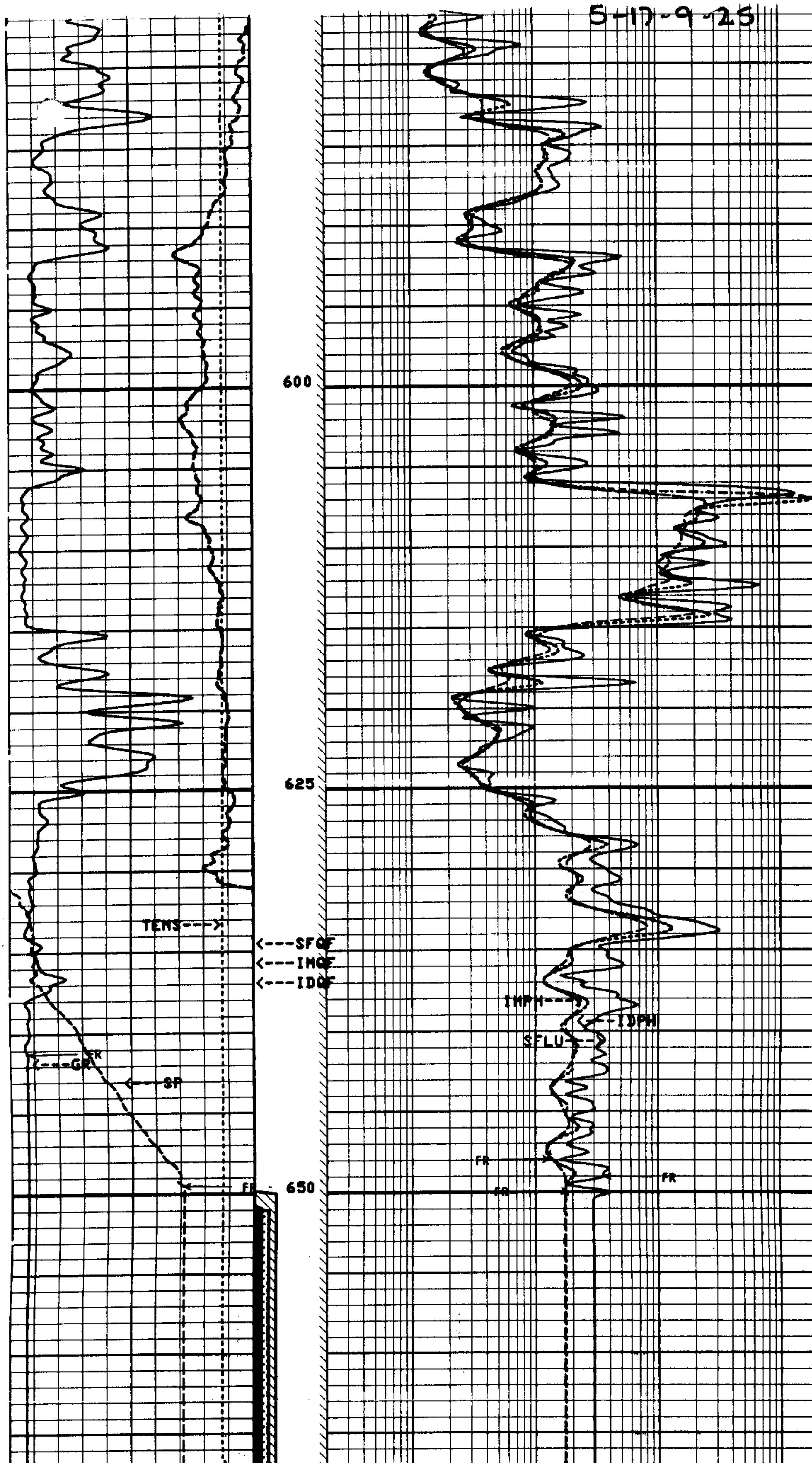
SENSOR MEASURE POINT TO TOOL ZERO

MCDB 2.44 METER SGTE 1.24 METER
SLTL 4.90 METER DTT -.28 METER

PARAMETERS

PARAMETER	VALUE	UNIT
WMUD - WEIGHT OF MUD	1310.00	K/M3
FCD - FUTURE CASING DIAMETER	139.700	MM
DWCO - DIGITIZER WORD COUNT	512	
DSIN - DIGITIZER SAMPLE INTERVAL	5	US
DDEL - DIGITIZING DELAY	200	US
DTF - DELTA-T FLUID	[illegible]	US/M

5-17-9-25



CP 32.2 FILE 9 31-OCT-1989 10:13

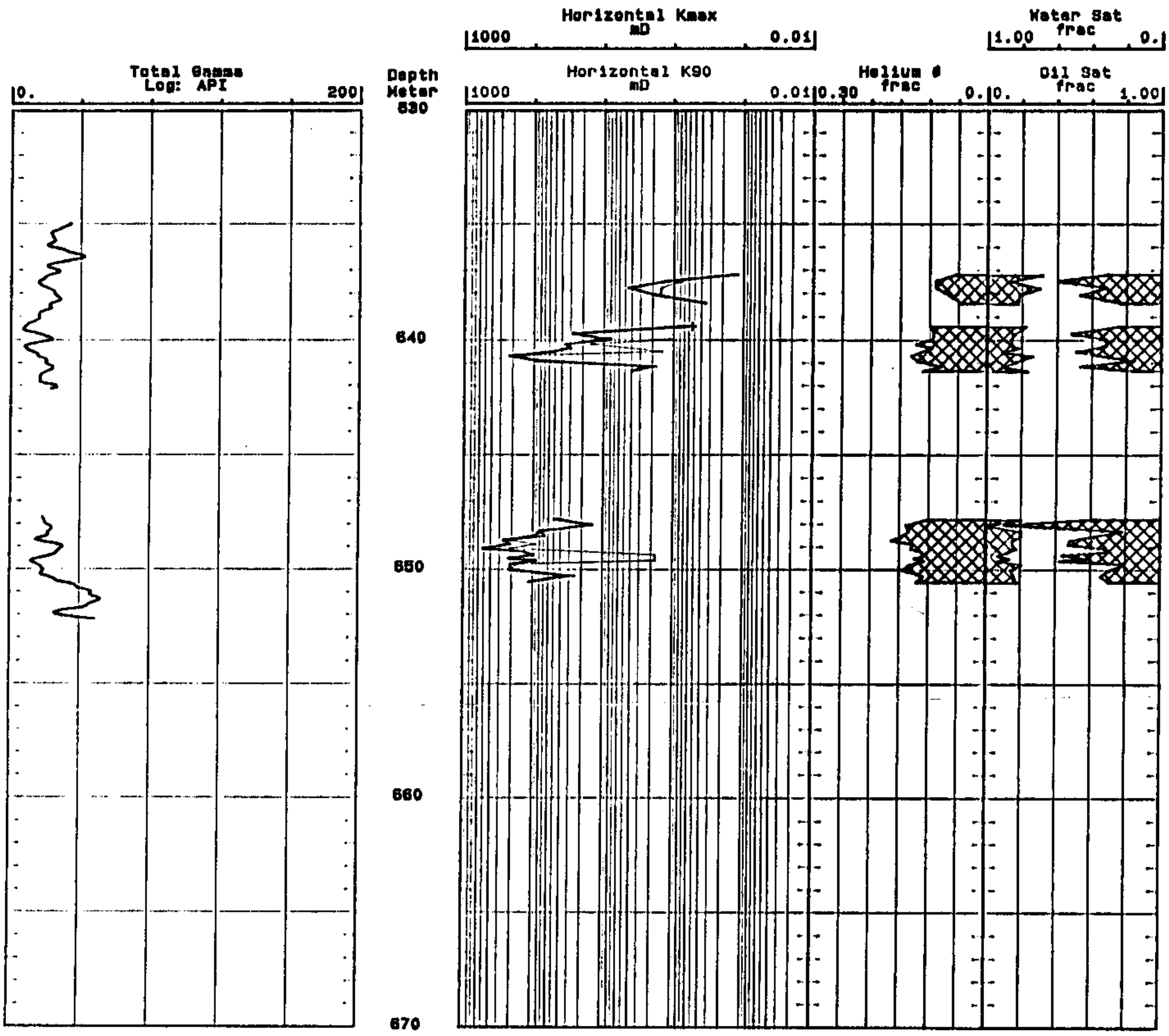
TENS(N)		IMPH(OHMM)	
50000.	0.0	.20000	2000.0
GR (GAPI)		IDPH(OHMM)	

CORRELATION COREGRAPH

CHEVRON CANADA RESOURCES LIMITED
CHEVRON VIRDEN 5-17-9-25 W1M
VIRDEN, MANITOBA
FILE NO. 52138-89-147
FORMATION: LODGEPOLE (635.00-652.00m)

Core Laboratories 1989 10 31

Vertical Scale
10.00 cm = 24.0 meter



CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 5-17-9-25
Location : LSD XX/05-17-009-25 W1M/X
Province : MANITOBA, CANADA

Field : VIRDEN
Formation : LODGEPOLE
Coring Equip.: DIAMOND
Coring Fluid : WATER BASE MUD

File No.: 52138-89-147
Date : 1989 10 31
Analysts: RJH
Core Dia: 89

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
	CORE NO.1 635.00 - 647.70m (Core Recieved 7.20m) (6 Boxes)													
-	635.00- 37.13	2.13												ls anhy shy
SP 1	637.13- 37.25	0.12		0.12			0.014	0.054	0.006		2700.	0.316	0.310	ls i
2	637.25- 37.70	0.45	0.13	1.18	0.75	0.37	0.531	0.090	0.041	2500.	2740.	0.131	0.600	ls i ppv dol pyr vfrac
3	637.70- 37.85	0.15	0.09	4.42	1.49	3.00	0.663	0.087	0.014	2480.	2720.	0.303	0.312	ls i ppv vfrac API 29.5
-	637.85- 37.99	0.14												ls shy
4	637.99- 38.17	0.18	0.12	1.76	1.56	0.13	0.317	0.065	0.011	2530.	2700.	0.184	0.469	ls i ppv sv foss gyp vfrac
-	638.17- 38.30	0.13												ls gyp cht
SP 5	638.30- 38.56	0.26		0.34			0.088	0.046	0.013		2680.	0.177	0.226	ls i ppv sv foss
-	638.56- 39.27	0.71												ls shy cht
6	639.27- 39.56	0.29	0.10	0.65	0.53	0.21	0.189	0.097	0.029	2440.	2700.	0.222	0.237	ls i ppv sv foss pyr gyp vfrac
-	639.56- 39.62	0.06												cht
SP 7	639.62- 39.84	0.22		27.5			6.050	0.091	0.020		2710.	0.158	0.518	ls i ppv
8	639.84- 40.10	0.26	0.10	7.99	1.08	0.06	2.077	0.093	0.023	2510.	2690.	0.137	0.321	ls i ppv sv foss cht
9	640.10- 40.27	0.17	0.10	35.2	15.0	0.51	5.984	0.122	0.020	2380.	2710.	0.139	0.312	ls i ppv sv foss shbks frac
SP 10	640.27- 40.41	0.14		37.5			5.250	0.079	0.011		2680.	0.259	0.302	ls i ppv sv foss
11	640.41- 40.61	0.20	0.08	1.49	1.43	0.65	0.298	0.111	0.022	2430.	2730.	TRACE	0.583	ls i ppv gyp sty frac
12	640.61- 40.78	0.17	0.10	222.	177.	2.31	37.740	0.130	0.022	2360.	2710.	0.265	0.353	ls i vug foss cht API 29.5
13	640.78- 41.05	0.27	0.10	88.6	70.2	1.80	23.922	0.120	0.032	2390.	2710.	0.178	0.155	ls i ppv sv foss gyp
14	641.05- 41.27	0.22	0.12	2.20	1.72	0.11	0.484	0.078	0.018	2500.	2710.	0.094	0.468	ls i ppv sv foss vfrac
15	641.27- 41.44	0.17	0.07	3.95	3.35	1.65	0.672	0.109	0.019	2430.	2730.	0.234	0.159	ls i ppv gyp vfrac
-	641.44- 42.20	0.76												ls cht gyp
	642.20- 47.70	5.50												Lost core

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 5-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138- ·147
Date : 1989 10 31

C O R E A N A L Y S I S R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
	CORE NO.2 647.70 - 652.00m (Core Recieved 4.55m) (4 Boxes)													
16	647.70- 47.88	0.18	0.11	49.2	43.4	0.07	8.856	0.098	0.018	2420.	2680.	0.202	0.373	ls i vug foss
17	647.88- 48.20	0.32	0.16	14.1	13.7	6.41	4.512	0.137	0.045	2370.	2740.	0.000	0.895	ls i ppv sv foss
18	648.20- 48.44	0.24	0.20	80.4	79.4	19.8	19.296	0.132	0.031	2350.	2710.	0.202	0.217	ls i ppv mv foss
19	648.44- 48.62	0.18	0.08	91.2	65.6	27.8	16.416	0.145	0.025	2310.	2700.	0.205	0.373	ls i ppv mv foss
20	648.62- 48.80	0.18	0.10	400.	337.	89.5	72.000	0.185	0.034	2210.	2710.	0.135	0.541	ls i ppv sv foss API 29.0
21	648.80- 48.98	0.18	0.10	11.5	8.96	0.69	2.070	0.106	0.020	2430.	2720.	0.140	0.603	ls i ppv sv foss shbks
22	648.98- 49.17	0.19	0.13	762.	213.	212.	144.780	0.137	0.027	2330.	2700.	0.200	0.318	ls i vug foss
SP 23	649.17- 49.26	0.09		48.2			4.338	0.109	0.010		2710.	0.148	0.128	ls i ppv sv foss
24	649.26- 49.46	0.20	0.10	3.20	1.74	0.25	0.640	0.091	0.018	2470.	2720.	0.000	0.748	ls i ppv sv sty shbks frac
SP 25	649.46- 49.56	0.10		341.			34.100	0.137	0.014		2690.	0.209	0.272	ls i ppv sv foss
AST 24	649.56- 49.66	0.10		3.20	1.74	0.25	0.320	0.091	0.009	2470.	2720.	0.000	0.748	ls i ppv sv sty shbks frac
26	649.66- 49.87	0.21	0.18	206.	166.	109.	43.260	0.130	0.027	2350.	2700.	0.210	0.204	ls i ppv sv foss vfrac
27	649.87- 50.15	0.28	0.17	216.	208.	150.	60.480	0.142	0.039	2320.	2700.	0.145	0.286	ls i ppv sv foss
28	650.15- 50.41	0.26	0.21	31.8	24.7	2.37	8.268	0.107	0.029	2420.	2700.	0.166	0.342	ls i ppv sv foss sty
29	650.41- 50.69	0.28	0.19	114.	112.	12.9	31.920	0.119	0.034	2380.	2700.	0.182	0.293	ls i ppv sv foss
-	650.69- 51.45	0.76												ls shy cht
-	651.45- 52.25	0.80												sh lmy cht

ϕ_{ave} $\Sigma\phi_h$ = 0.36

h = 2.99

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profit

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 5-17-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-147
Date : 1989 10 31

TABLE I

SUMMARY OF CORE DATA

ZONE AND CUTOFF DATA

ZONE:	
Identification --------	LODGEPOLE
Top Depth ----------------	635.00 m
Bottom Depth -------------	652.25 m
Number of Samples --------	30
DATA TYPE:	
Porosity --------------	(HELIUM)
Permeability ----------	(MAXIMUM) Kair
CUTOFFS:	
Porosity (Minimum) -------	0.000 frac
Porosity (Maximum) -------	1.000 frac
Permeability (Minimum) ---	0.0000 mD
Permeability (Maximum) ---	100000. mD
Water Saturation (Maximum)	1.000 frac
Oil Saturation (Minimum) -	0.000 frac
Grain Density (Minimum) --	2000. kg/m3
Grain Density (Maximum) --	3000. kg/m3
Lithology Excluded -------	NONE

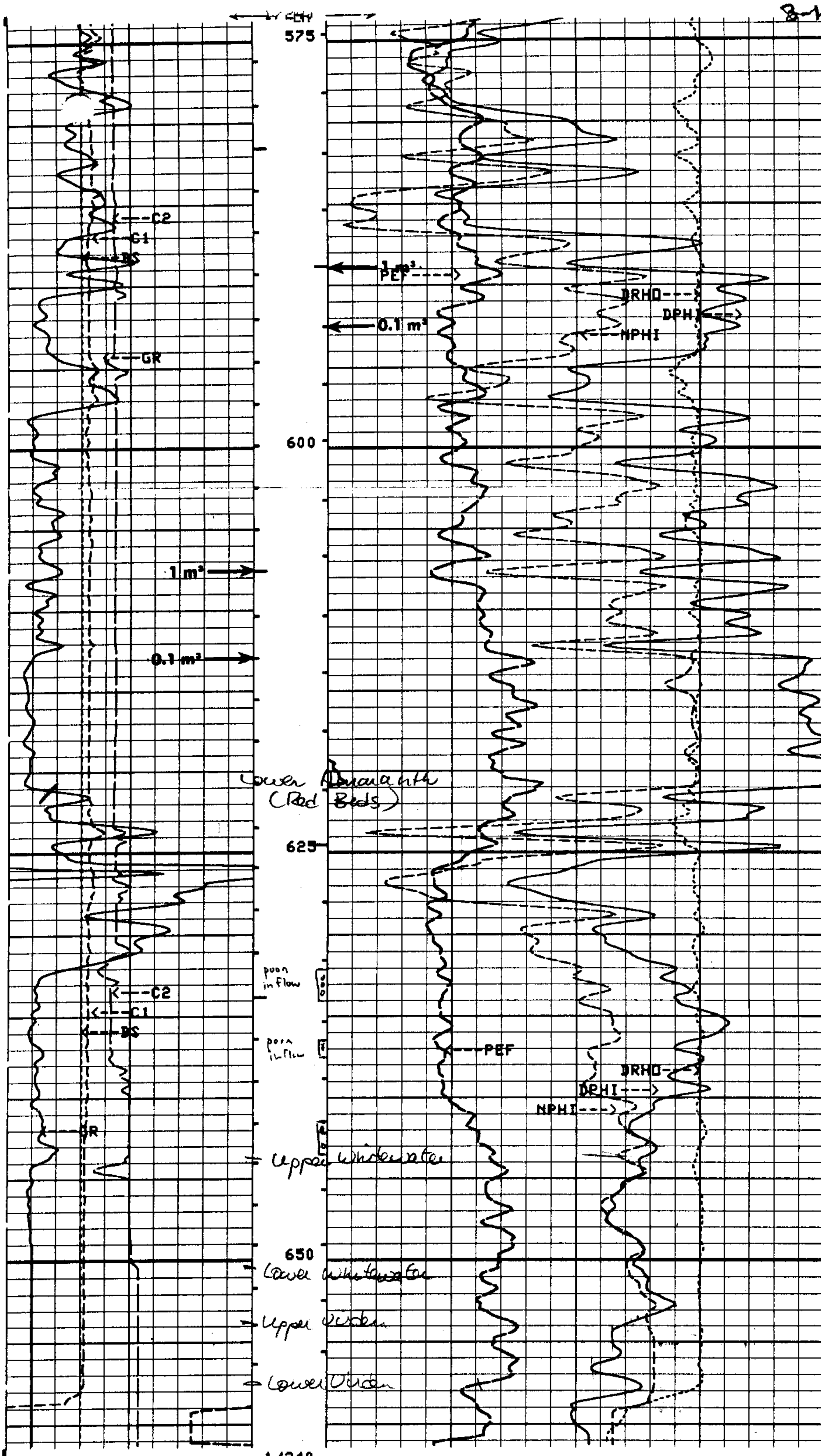
CHARACTERISTICS REMAINING AFTER CUTOFFS

ZONE:	
Number of Samples -----	30
Thickness Represented -	6.26 m
POROSITY:	
Storage Capacity ------	0.677 ϕ-m
Arithmetic Average ----	0.108 frac
Minimum ---------------	0.046 frac
Maximum ---------------	0.185 frac
Median ----------------	0.108 frac
Standard Deviation ----	±0.030 frac
GRAIN DENSITY:	
Arithmetic Average ----	2709. kg/m3
Minimum ---------------	2680. kg/m3
Maximum ---------------	2740. kg/m3
Median ----------------	2710. kg/m3
Standard Deviation ----	±16. kg/m3

PERMEABILITY:	
Flow Capacity ---------	535.54 mD-m
Arithmetic Average ----	85.6 mD
Geometric Average -----	15.3 mD
Harmonic Average ------	1.95 mD
Minimum ---------------	0.12 mD
Maximum ---------------	762. mD
Median ----------------	29.6 mD
Standard Dev. (Geom) --	$K\cdot10^{\pm0.994}$ mD
HETEROGENEITY (Permeability):	
Dykstra-Parsons Var. --	0.933
Lorenz Coefficient ----	0.666
AVERAGE SATURATIONS (Pore Volume):	
Oil -------------------	0.156 frac
Water -----------------	0.401 frac

8-18-9-25

KB
437.4 –



FLOSSIE

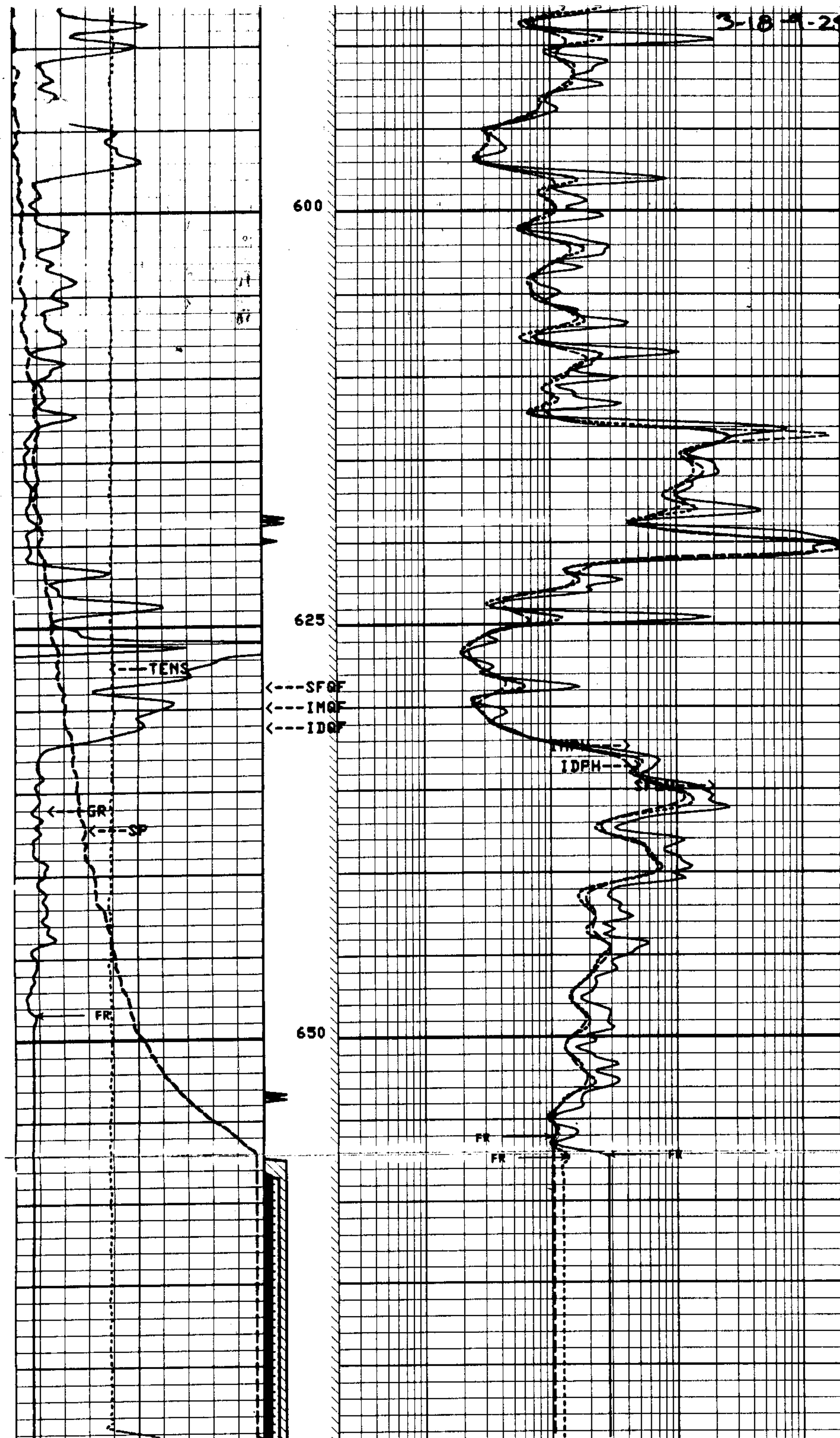
Upper White

L. White

Upper Virden

CP 32.2 FILE 33 25-OCT-1989 06:12 LIMESTONE

C2 (MM) 125.00 375.00	PEF 0.0 10.000	DRHO(K/M3) 250.00 -250.0
C1 (MM) 125.00 375.00		DPHI
BS (MM)		



CP 32.2 FILE 10 25-OCT-1989 00:25 **REPEAT SECTION**

TENS(N)		IMPH(OHMM)	
10000.	0.0	.20000	2000.0
GR (GAPI)		IDPH(OHMM)	
0.0	150.00	.20000	2000.0
SP (MV)		SFLU(OHMM)	
-80.00	20.000	.20000	2000.0

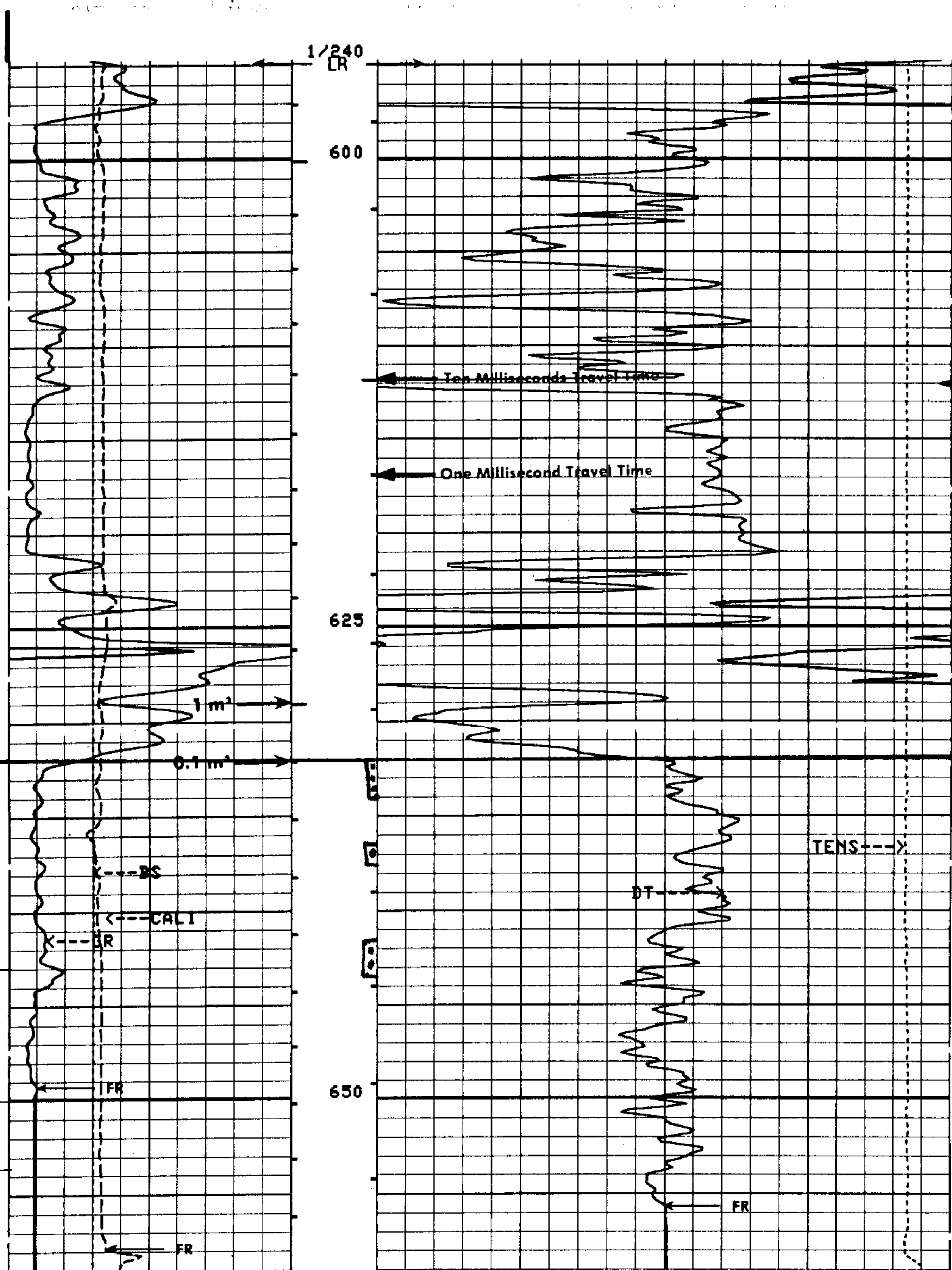
3-18-9-25
KB= 432.4 m.

Flossie
selectively swabbed
poor inflow

Upper
Whitewater

Lower
Whitewater

Upper
Virden



1/240

REPEAT SECTION

CP 32.2A FILE 21 25-OCT-1989 02:46

BS (MM) 125.00 — 375.00			
CALI(MM) 125.00 — 375.00			TENS(LBF) 10000. — 0.0
GR (GAPI) 0.0 — 150.00		DT (US/M) 300.00 — 100.00	

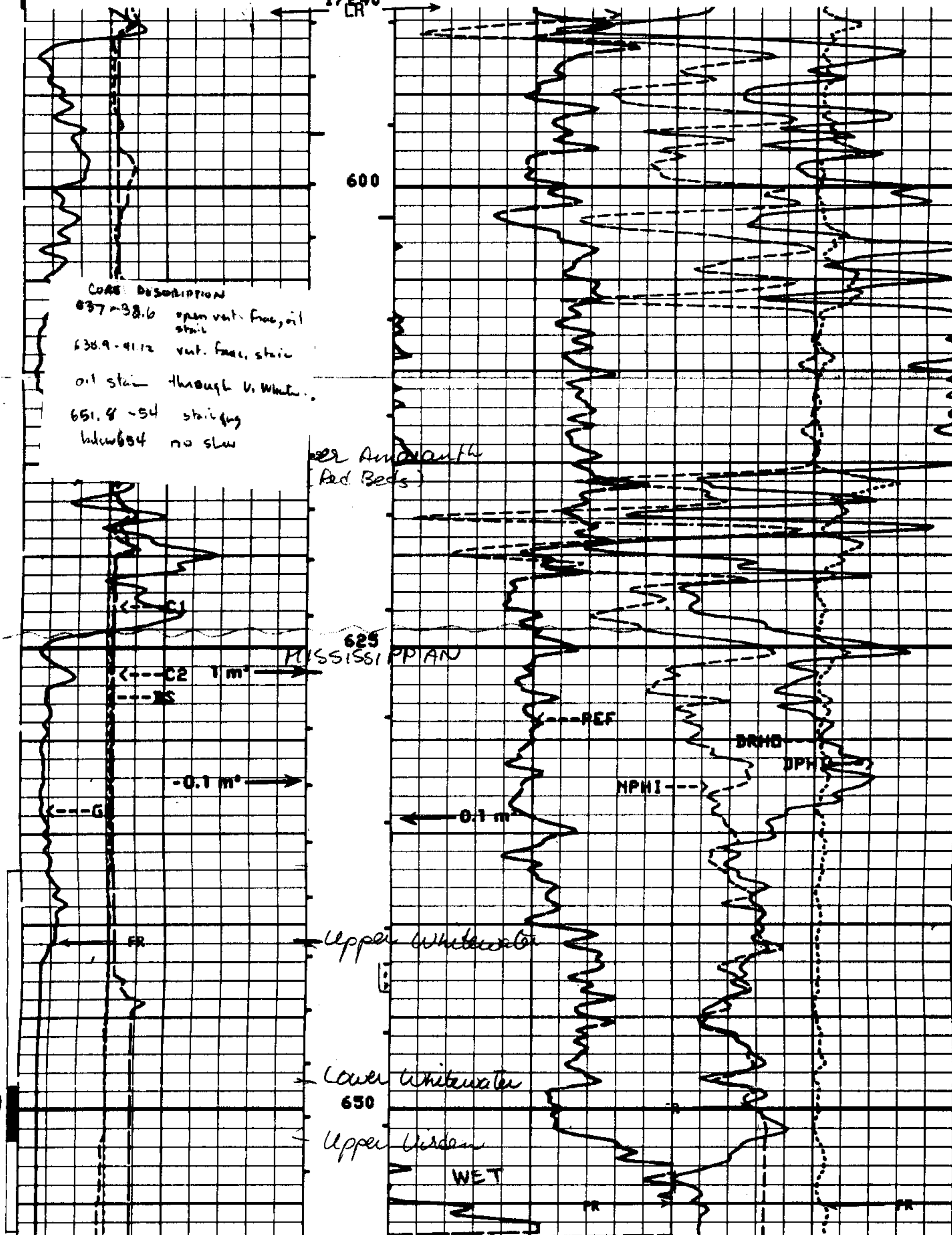
0.0 150.00 .45000 -.15

7-18-9-25

REPEAT SECTION

CP 32.2 FILE 16 01-OCT-1989 06:24

KB 437.7 LIMESTONE



1/240

REPEAT SECTION

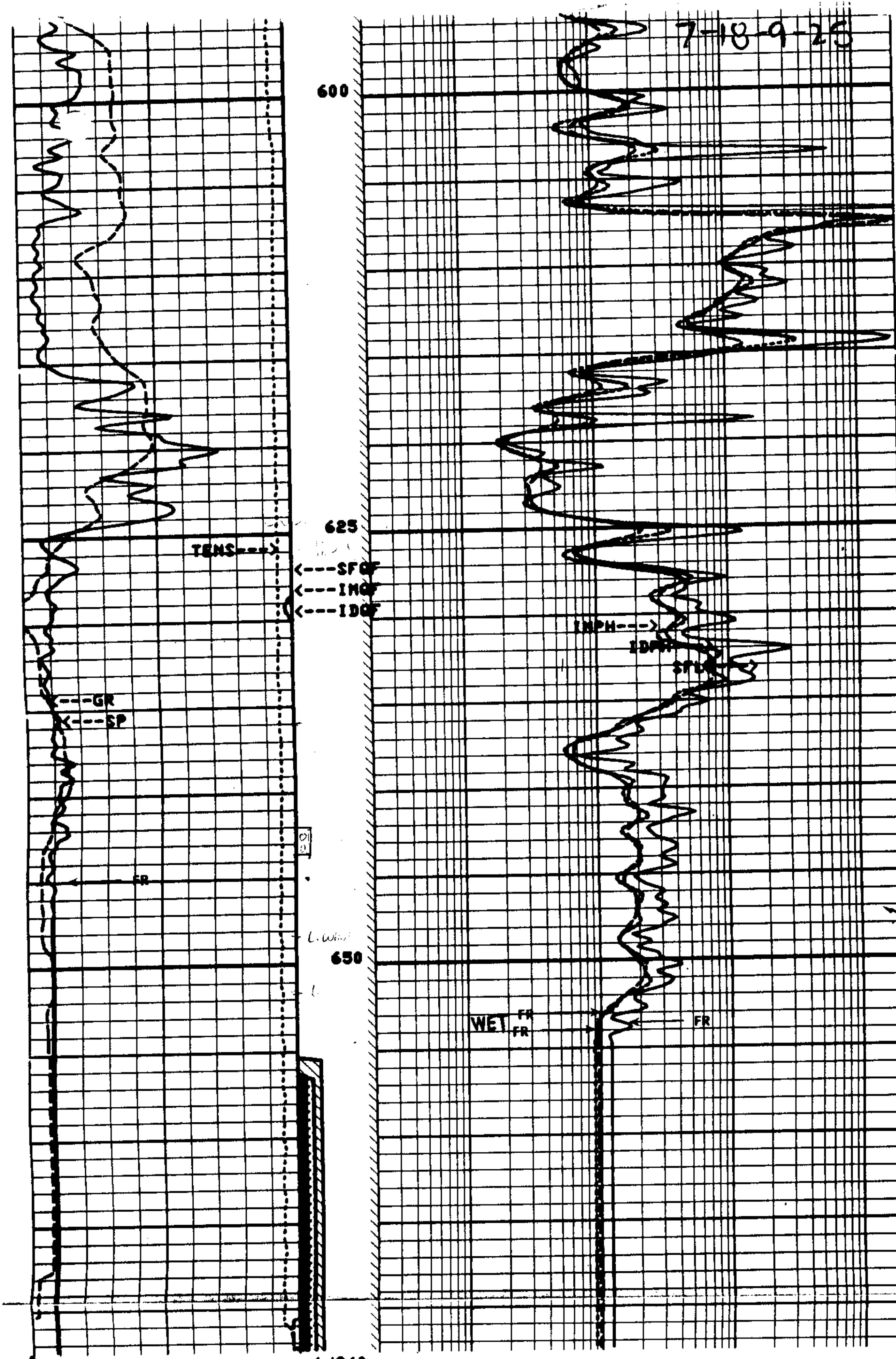
CP 32.2 FILE 16 01-OCT-1989 06:16

LIMESTONE

C1 (MM)		PEF	DRHO(K/M3)
125.00 375.00		0.0 10.000	-250.0 250.00
C2 (MM)		DPHI	
125.00 375.00		.45000 -.1500	
BS (MM)		NPHI	
125.00 375.00		.45000 -.1500	
GR (GAPI)			
0.0 150.00			

SENSOR MEASURE POINT TO TOOL ZERO

MCAL	8.71 METER	GR	14.96 METER
SA	15.42 METER	SMLT	8.71 METER
SPCD	15.42 METER	C2	11.84 METER
CNTC	5.94 METER	CFTC	6.10 METER
LL	.79 METER	LITH	.79 METER
LU	.79 METER	LS	.79 METER
SS1	.64 METER	PARI	.64 METER



CP 32.2 FILE 4 01-OCT-1989 03:53 **REPEAT SECTION**

TENS(N) 50000. — 0.0		IMPH(OHMM) .20000 — 2000.0
GR (GAPI) 0.0 — 150.00		IDPH(OHMM) .20000 — 2000.0
SP (MV) -80.00 — 20.000		SFLU(OHMM) .20000 — 2000.0

SENSOR MEASURE POINT TO TOOL ZERO

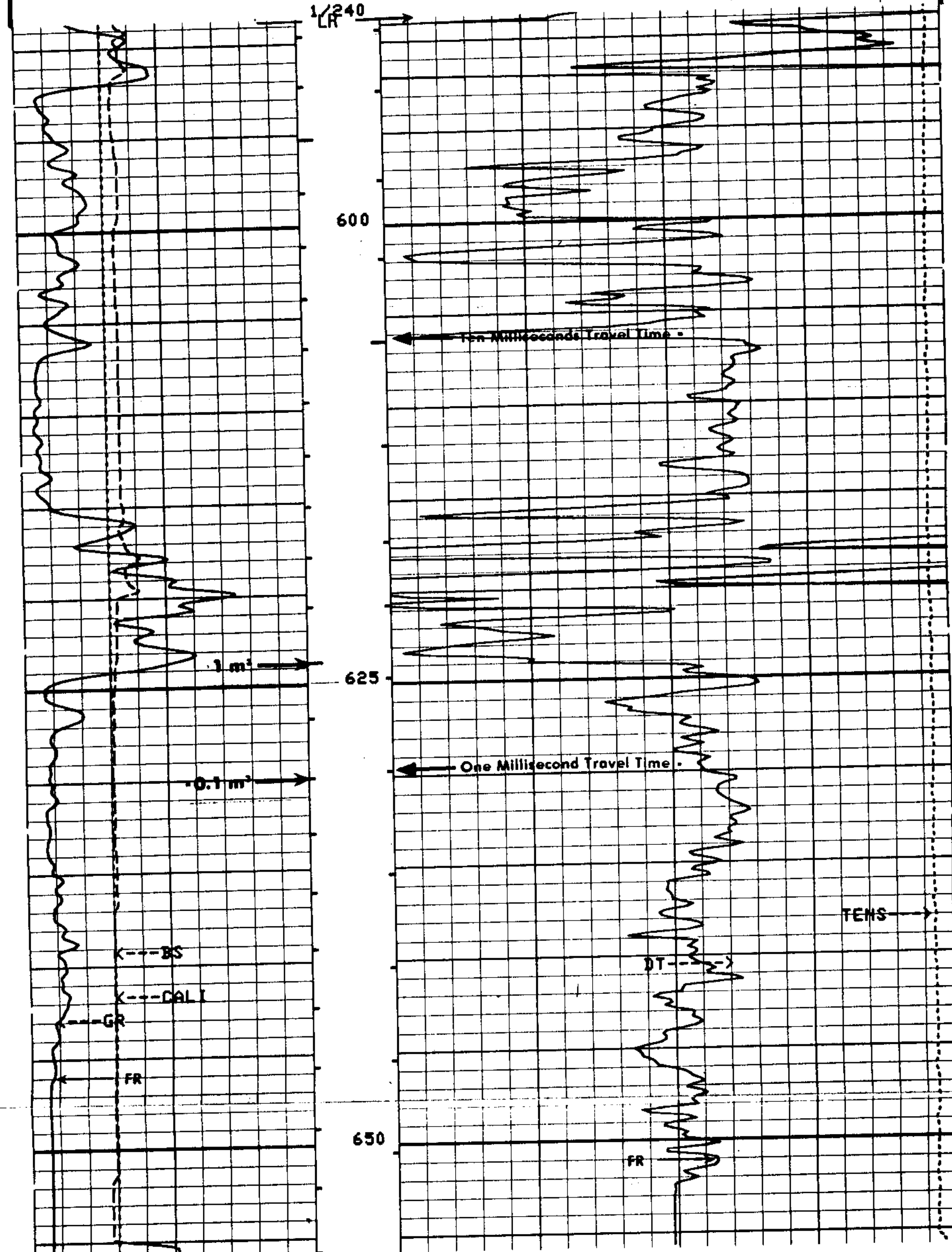
GR	10.95 METER	SP	3.15 METER
IRM	1.83 METER	IXM	1.83 METER
ITEM	1.98 METER	IXD	2.90 METER
SFB	1.98 METER	SPA	3.15 METER
SFV	1.98 METER	SFC	1.98 METER
TENS	-14.3 METER	IRD	2.90 METER

GR (GAPI)		DT (US/M)	
0.0	150.00	300.00	100.00

7-18-9-25

CP 32.2A FILE 33 01-OCT-1989 08:54 **REPEAT SECTION**

KB 437.7



CP 32.2A FILE 33 01-OCT-1989 08:47 **REPEAT SECTION**

BS (MM)			TENS(N)	
125.00	375.00		50000.	0.0
CALI(MM)				
125.00	375.00			
GR (GAPI)		DT (US/M)		
0.0	150.00	300.00		100.00

SENSOR MEASURE POINT TO TOOL ZERO

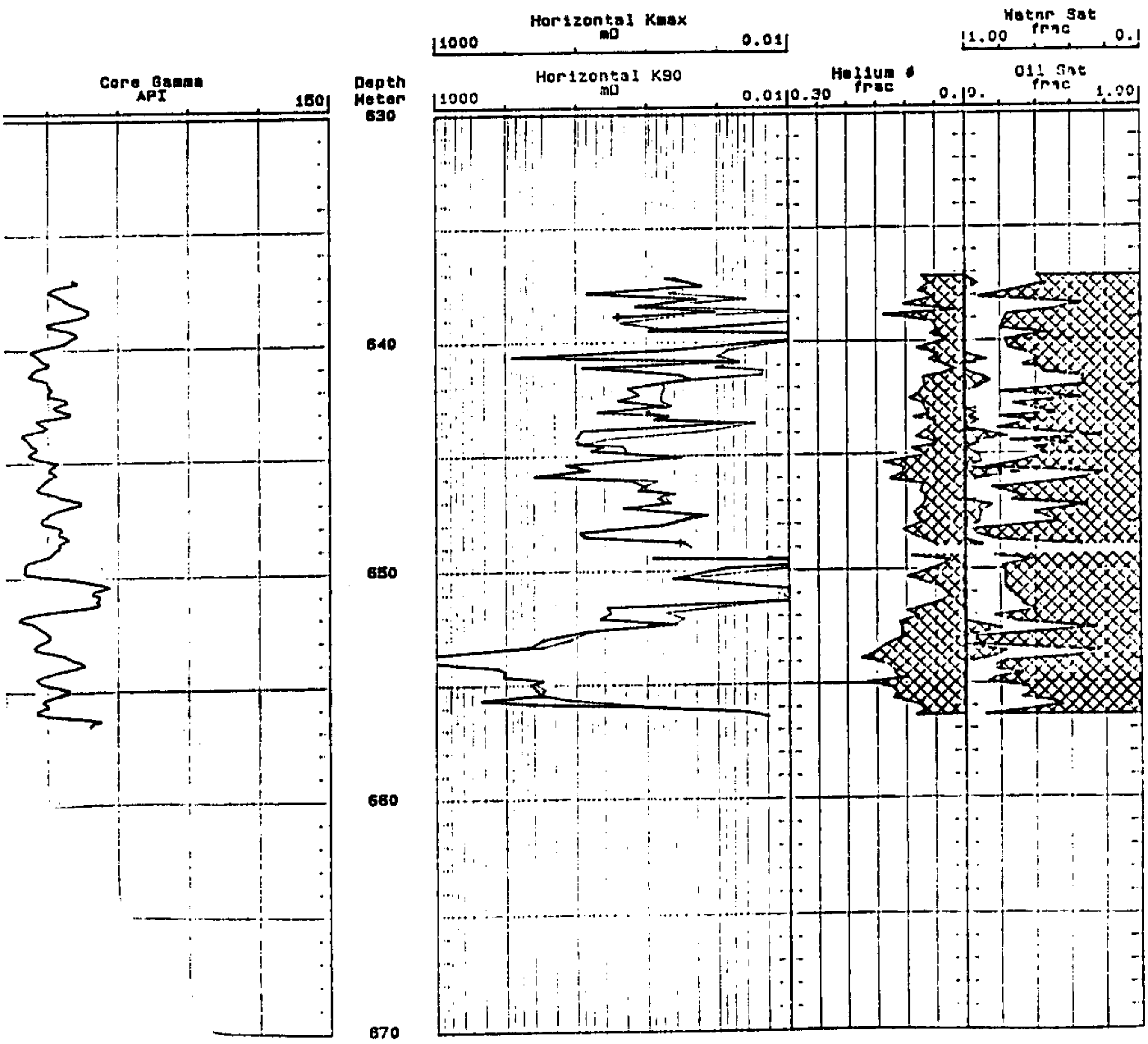
SRAT	3.68 METER	AMPL	4.29 METER
CBFS	4.27 METER	CBL	4.29 METER
TT2	4.29 METER	TT1	3.99 METER
TT4	2.84 METER	TT3	3.15 METER
TT	4.29 METER	TO	4.29 METER
CBSL	4.29 METER	TTSL	4.29 METER
CALI	.91 METER	GR	10.44 METER
		TENS	.91 METER

CORRELATION COREGRAPH

CHEVRON CANADA RESOURCES LIMITED
CHEVRON VIRDEN 7-18-9-25 W1M
VIRDEN, MANITOBA
FILE NO. 52138-89-130
FORMATION: LODGEPOLE (637.00-656.50m)

Core Laboratories 1989 10 01

Vertical Scale
10.00 cm = 24.0 meter



CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 7-18-9-25
Location : LSD XX/07-18-009-25 W1M/X
Province : MANITOBA, CANADA

Field : VIRDEN
Formation : LODGEPOLE
Coring Equip.: DIAMOND
Coring Fluid : WATER BASE MUD

File No.: 52138-89-13(
Date : 1989 10 01
Analysts: SGP
Core Dia: 89

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
	CORE NO. 1 637.00 - 651.00m (Core Received 14.00m) (11 Boxes)													
1	637.00- 37.33	0.33	0.15	0.54	0.42	0.21	0.178	0.072	0.023	2480.	2670.	0.000	0.589	ls i ppv gyp cht frac
2	637.33- 37.69	0.36	0.17	0.17	0.17	<.01	0.061	0.063	0.022	2510.	2680.	0.071	0.552	ls i sty gyp cht frac
3	637.69- 37.96	0.27	0.18	6.91	0.48	0.13	1.866	0.078	0.022	2510.	2720.	0.000	0.746	ls i ppv mv cht pyr vfrac
4	637.96- 38.23	0.27	0.18	0.20	0.04	0.02	0.054	0.051	0.014	2570.	2700.	0.000	0.921	ls i gyp pyr vfrac
5	638.23- 38.56	0.33	0.16	1.44	0.90	0.07	0.475	0.104	0.033	2400.	2670.	0.000	0.344	ls i ppv sv cht gyp frac
6	638.56- 38.76	0.20	0.16	0.11	0.01	<.01	0.022	0.018	0.004	2590.	2640.	0.000	0.511	ls i cht foss
7	638.76- 38.92	0.16	0.11	2.55	0.44	0.01	0.408	0.136	0.022	2410.	2780.	0.000	0.761	dol i ppv cht pyr hfrac
8	638.92- 39.34	0.42	0.16	*	2.37	*		0.056	0.025	2550.	2700.	TRACE	0.783	ls i gyp cht pyr vfrac
9	639.34- 39.60	0.26	0.15	0.92	0.41	0.02	0.239	0.046	0.013	2570.	2690.	0.000	0.797	ls i sv foss gyp pyr vfrac
10	639.60- 39.79	0.19	0.19	<.01	<.01	<.01	0.000	0.057	0.011	2560.	2720.	0.000	0.548	ls i sshy cht anhy
11	639.79- 40.16	0.37	0.15	0.02	0.01	<.01	0.007	0.031	0.011	2600.	2680.	TRACE	0.771	ls i cht gyp pyr vfrac
12	640.16- 40.50	0.34	0.18	0.46	0.07	0.01	0.156	0.080	0.027	2490.	2700.	0.000	0.756	ls i cht pyr foss vfrac
13	640.50- 40.70	0.20	0.16	80.3	0.10	<.01	16.060	0.045	0.010	2570.	2690.	TRACE	0.630	ls i cht pyr vfrac
14	640.70- 40.99	0.29	0.19	0.06	0.05	<.01	0.017	0.060	0.017	2550.	2710.	0.120	0.587	ls i cht pyr shbk
15	640.99- 41.14	0.15	0.11	8.07	0.11	0.01	1.211	0.033	0.004	2600.	2690.	0.000	0.669	ls i cht foss vfrac
16	641.14- 41.29	0.15	0.11	<.01	<.01	<.01	0.000	0.014	0.002	2620.	2660.	0.000	0.522	ls i cht foss
17	641.29- 41.52	0.23	0.17	<.01	<.01	<.01	0.000	0.019	0.005	2610.	2660.	0.000	0.647	ls i cht foss
18	641.52- 41.66	0.14	0.07	0.09	0.09	<.01	0.013	0.084	0.011	2520.	2750.	0.116	0.246	ls i shy pyr
19	641.66- 41.87	0.21	0.20	0.61	0.60	0.05	0.128	0.069	0.015	2520.	2710.	0.142	0.332	ls i ppv sshy vfrac
20	641.87- 42.10	0.23	0.19	1.87	0.56	0.15	0.430	0.069	0.016	2520.	2700.	0.091	0.328	ls i ppv sty vfrac
	642.10- 42.18	0.08												sh
21	642.18- 42.40	0.22	0.18	1.28	0.62	0.22	0.282	0.077	0.018	2510.	2720.	0.000	0.798	ls i ppv pyr vfrac
22	642.40- 42.66	0.26	0.14	2.58	0.65	0.21	0.671	0.092	0.023	2460.	2710.	0.000	0.350	ls i ppv sty gpy
23	642.66- 42.92	0.26	0.22	0.59	0.45	0.08	0.153	0.070	0.018	2520.	2710.	0.000	0.727	ls i ppv gyp pyr vfrac
24	642.92- 43.16	0.24	0.19	4.94	1.11	0.07	1.186	0.066	0.017	2500.	2680.	0.000	0.601	ls i ppv gyp cht vfrac

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 7-18-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-[illegible]0
Date : 1989 10 01

C O R E   A N A L Y S I S   R E S U L T S

	SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
	25	643.16- 43.28	0.12	0.07	*	0.11	*		0.043	0.005	2560.	2680.	0.105	0.293	ls i ppv sv foss cht vfrac
	26	643.28- 43.48	0.20	0.16	1.09	0.99	0.40	0.218	0.106	0.022	2410.	2700.	TRACE	0.975	ls i ppv gyp vfrac
	27	643.48- 43.64	0.16	0.11	0.06	0.03	<.01	0.010	0.049	0.008	2570.	2700.	0.077	0.607	ls i cht pyr vfrac
	28	643.64- 44.10	0.46	0.17	8.43	0.13	0.08	3.878	0.061	0.028	2560.	2720.	TRACE	0.819	ls i cht pyr vfrac
	29	644.10- 44.38	0.28	0.14	9.99	3.98	3.71	2.797	0.083	0.022	2470.	2700.	0.239	0.224	ls i ppv sv vfrac
	30	644.38- 44.50	0.12	0.06	9.50	7.39	2.77	1.140	0.053	0.006	2540.	2680.	0.065	0.745	ls i ppv sv vfrac
	31	644.50- 44.64	0.14	0.10	1.80	0.47	0.04	0.252	0.034	0.004	2590.	2680.	0.111	0.237	ls i ppv sv cht vfrac
	32	644.64- 44.86	0.22	0.11	6.22	1.94	1.75	1.368	0.089	0.020	2470.	2710.	TRACE	0.613	ls i ppv sv gyp vfrac
SP	33	644.86- 45.26	0.40		0.33			0.132	0.067	0.028		2700.	0.078	0.550	ls i ppv sv
	34	645.26- 45.47	0.21	0.16	14.0	11.6	7.02	2.940	0.136	0.029	2320.	2690.	0.092	0.690	ls i ppv sv sty gyp cht vfrac
	35	645.47- 45.76	0.29	0.10	8.26	6.56	3.93	2.395	0.102	0.029	2430.	2700.	0.000	0.883	ls i ppv sv foss vfrac
	36	645.76- 45.96	0.20	0.16	38.7	25.6	4.31	7.740	0.107	0.022	2390.	2680.	0.302	0.221	ls i ppv sv gyp cht frac
	37	645.96- 46.23	0.27	0.08	1.60	0.73	0.85	0.432	0.126	0.035	2330.	2660.	0.077	0.321	ls i ppv gyp cht vfrac
	38	646.23- 46.43	0.20	0.15	1.11	1.06	0.19	0.222	0.069	0.014	2510.	2690.	TRACE	0.579	ls i ppv sv foss vfrac
	39	646.43- 46.58	0.15	0.12	1.79	1.38	0.28	0.269	0.073	0.010	2490.	2680.	0.000	0.962	ls i ppv sv cht gyp vfrac
	40	646.58- 46.73	0.15	0.09	0.14	0.14	0.07	0.021	0.078	0.012	2490.	2700.	0.000	0.767	ls i cht gyp
	41	646.73- 46.95	0.22	0.17	0.70	0.55	0.17	0.154	0.067	0.015	2520.	2700.	TRACE	0.682	ls i ppv sv shbks pyr vfrac
	42	646.95- 47.16	0.21	0.14	0.53	0.46	0.45	0.111	0.066	0.015	2490.	2670.	0.000	0.734	ls i ppv cht gyp
	43	647.16- 47.38	0.22	0.18	2.14	2.08	0.10	0.471	0.072	0.015	2510.	2710.	0.153	0.306	ls i ppv sshy pyr
	44	647.38- 47.78	0.40	0.27	0.19	0.14	0.06	0.076	0.086	0.036	2480.	2720.	0.091	0.610	ls i gyp cht pyr shbk
	45	647.78- 48.21	0.43	0.26	0.60	0.54	0.28	0.258	0.074	0.030	2500.	2700.	0.079	0.469	ls i ppv shbks gyp frac
	46	648.21- 48.40	0.19	0.12	8.88	8.42	0.97	1.687	0.103	0.019	2430.	2700.	0.000	0.963	ls i ppv gyp
	47	648.40- 48.63	0.23	0.19	7.74	7.43	0.57	1.780	0.089	0.021	2460.	2700.	0.000	0.933	ls i ppv sv gyp vfrac
	48	648.63- 48.89	0.26	0.12	0.34	0.30	0.03	0.088	0.065	0.016	2540.	2720.	0.000	0.810	ls i ppv foss shbk
	49	648.89- 49.05	0.16	0.10	*	0.24	*		0.046	0.008	2580.	2700.	0.097	0.350	ls i ppv gyp vfrac
		649.05- 49.30	0.25												ls shy shbks
	50	649.30- 49.56	0.26	0.16	0.82	0.02	<.01	0.213	0.090	0.023	2470.	2710.	0.000	0.835	ls i gyp cht frac
	51	649.56- 49.68	0.12	0.07	<.01	<.01	<.01	0.000	0.026	0.004	2620.	2690.	0.000	0.620	ls i cht gyp
	52	649.68- 50.08	0.40	0.07	0.08	0.01	<.01	0.032	0.043	0.016	2590.	2700.	0.000	0.790	ls i cht gyp shbk

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 7-18-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-130
Date : 1989 10 01

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH	INTVL REP	SAMPLE LENGTH	PERMEABILITY			CAPACITY (MAXIMUM) Kair	POROSITY (HELIUM)	CAPACITY (HELIUM)	BULK DENSITY	GRAIN DENSITY	SATURATION (PORE VOLUME)		DESCRIPTION
				(MAXIMUM) Kair	(90 DEG) Kair	(VERTICAL) Kair						OIL	WATER	
	m	m	m	mD	mD	mD	mD-m	fraction	ϕ-m	kg/m3	kg/m3	frac	frac	
53	650.08- 50.56	0.48	0.11	0.43	0.32	0.03	0.206	0.097	0.048	2420.	2680.	0.000	0.773	ls i gyp cht vfrac
54	650.56- 51.00	0.44	0.20	0.01	0.01	<.01	0.004	0.043	0.018	2600.	2720.	0.000	0.773	ls i shbk
	CORE NO. 2 651.00 - 656.50m (Core Received 5.50m) (4 Boxes)													
55	651.00- 51.30	0.30	0.16	<.01	<.01	<.01	0.000	0.026	0.009	2640.	2710.	0.000	0.739	ls i shbk anhy
56	651.30- 51.45	0.15	0.11	0.03	0.02	<.01	0.004	0.037	0.006	2610.	2710.	0.000	0.685	ls i ppv sv sty gyp anhy vfrac
57	651.45- 61.70	0.25	0.17	3.68	0.10	0.05	0.920	0.062	0.015	2550.	2720.	0.000	0.673	ls i ppv sv shbks vfrac
58	651.70- 51.94	0.24	0.13	3.28	0.55	0.32	0.787	0.098	0.024	2460.	2730.	0.000	0.600	ls i ppv gyp
59	651.94- 52.19	0.25	0.19	4.70	0.31	2.27	1.175	0.080	0.020	2520.	2740.	0.000	0.832	ls i ppv gyp vfrac
60	652.19- 52.43	0.24	0.21	0.46	0.40	0.13	0.110	0.112	0.026	2430.	2740.	TRACE	0.706	ls i ppv sv
61	652.43- 52.80	0.37	0.19	7.61	7.04	1.76	2.816	0.107	0.041	2420.	2710.	0.202	0.256	ls i ppv mw foss
62	652.80- 53.12	0.32	0.23	29.8	12.0	10.6	9.536	0.108	0.035	2400.	2690.	0.000	0.935	ls i foss
63	653.12- 53.48	0.36	0.18	47.5	30.9	5.73	17.100	0.136	0.050	2350.	2720.	0.000	0.948	ls i foss
64	653.48- 53.77	0.29	0.24	1200.	1200.	356.	348.000	0.153	0.043	2280.	2690.	0.225	0.270	ls i foss
65	653.77- 53.96	0.19	0.08	1590.	1590.	952.	302.100	0.176	0.034	2210.	2680.	0.167	0.366	ls i foss
66	653.96- 54.15	0.19	0.10	360.	331.	15.2	68.400	0.137	0.027	2320.	2690.	0.000	0.872	ls i foss
67	654.15- 54.29	0.14	0.08	16.6	11.4	1.23	2.324	0.126	0.018	2360.	2710.	0.000	0.852	ls i ppv sv shbks
68	654.29- 54.52	0.23	0.18	106.	106.	16.6	24.380	0.121	0.028	2370.	2690.	0.000	0.826	ls i foss
69	654.52- 54.70	0.18	0.13	111.	111.	52.8	19.980	0.118	0.022	2370.	2680.	0.000	0.679	ls i foss
70	654.70- 54.86	0.16	0.10	0.76	0.73	0.21	0.122	0.086	0.014	2480.	2710.	0.000	0.871	ls i ppv sv shbks
71	654.86- 55.05	0.19	0.11	45.2	37.8	12.9	8.588	0.165	0.032	2250.	2700.	0.000	0.865	ls i ppv sv foss gyp
72	655.05- 55.29	0.24	0.17	37.7	28.7	5.57	9.048	0.123	0.029	2370.	2700.	0.000	0.645	ls i ppv sv foss shbks
73	655.29- 55.54	0.25	0.20	32.4	32.4	10.4	8.100	0.114	0.027	2390.	2700.	0.000	0.628	ls i foss
74	655.54- 55.73	0.19	0.14	226.	13.5	16.5	42.940	0.121	0.023	2370.	2700.	0.000	0.677	ls i foss vfrac
75	655.73- 55.87	0.14	0.11	2.72	0.73	0.36	0.381	0.096	0.014	2460.	2720.	0.000	0.501	ls i ppv sv foss lam
76	655.87- 56.10	0.23	0.18	0.66	0.66	0.21	0.152	0.074	0.016	2510.	2710.	0.000	0.451	ls i ppv sv foss
77	656.10- 56.29	0.19	0.15	0.04	0.04	<.01	0.008	0.069	0.013	2570.	2760.	0.000	0.659	ls i ppv sv sshy pyr
78	656.29- 56.50	0.21	0.14	0.02	0.02	<.01	0.004	0.082	0.017	2520.	2750.	0.000	0.881	ls i ppv sv shy pyr

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 7-18-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138- -130
Date : 1989 10 01

TABLE I

SUMMARY OF CORE DATA

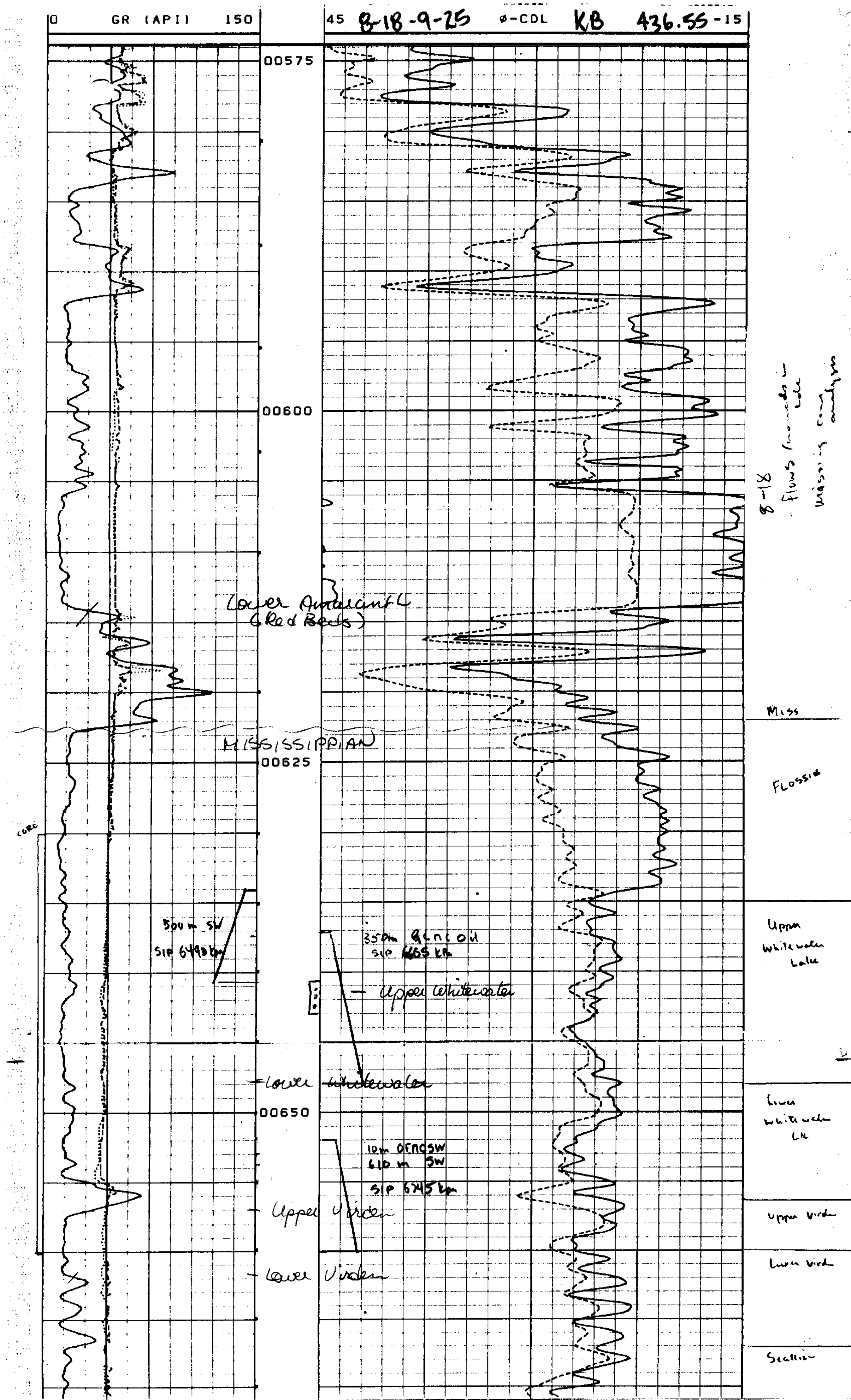
ZONE AND CUTOFF DATA

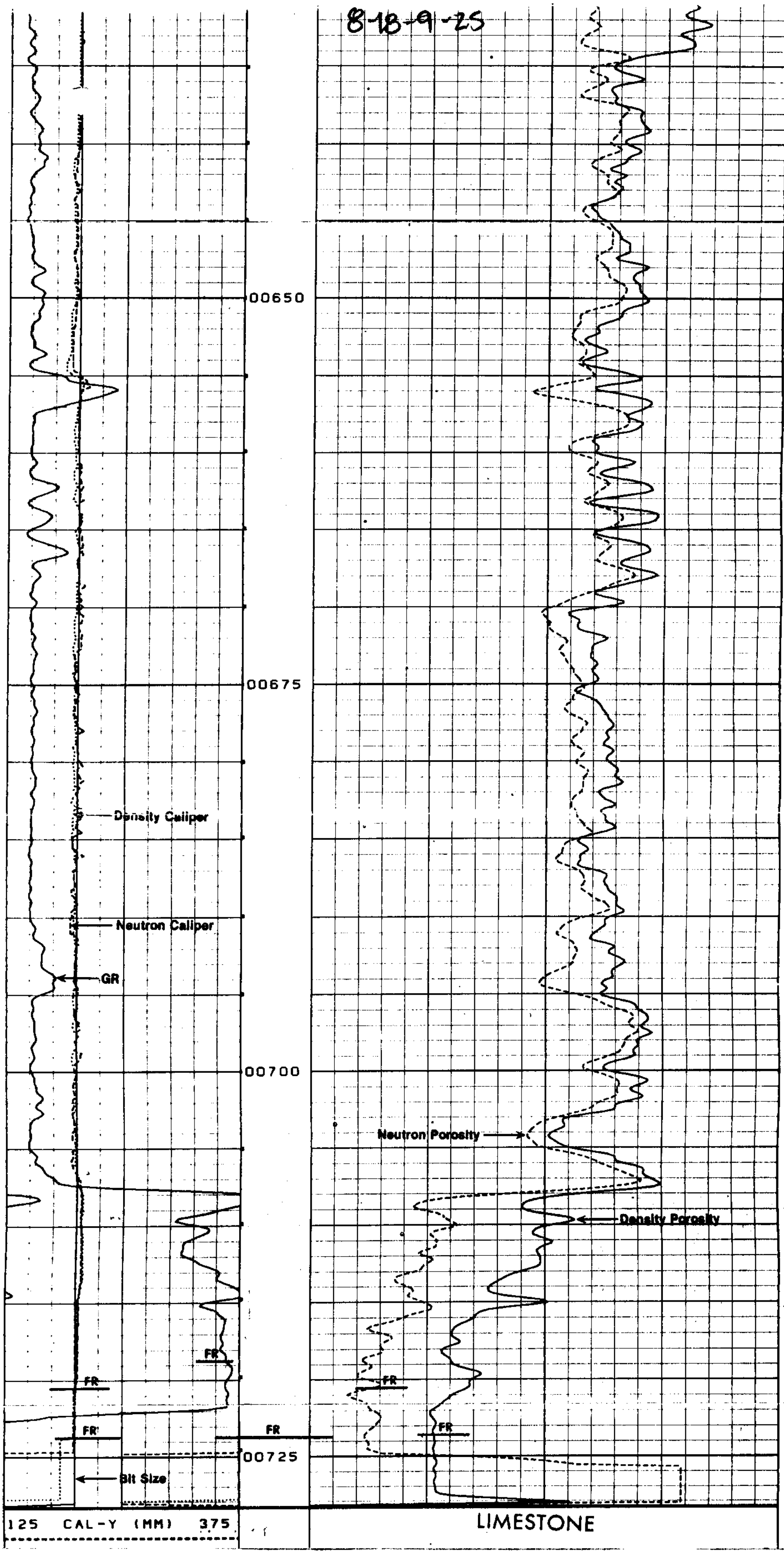
ZONE:	
Identification	LODGEPOLE
Top Depth	637.00 m
Bottom Depth	656.50 m
Number of Samples	78
DATA TYPE:	
Porosity	(HELIUM)
Permeability	(MAXIMUM) Kair
CUTOFFS:	
Porosity (Minimum)	0.000 frac
Porosity (Maximum)	1.000 frac
Permeability (Minimum)	0.0000 mD
Permeability (Maximum)	100000. mD
Water Saturation (Maximum)	1.000 frac
Oil Saturation (Minimum)	0.000 frac
Grain Density (Minimum)	2000. kg/m3
Grain Density (Maximum)	3000. kg/m3
Lithology Excluded	NONE

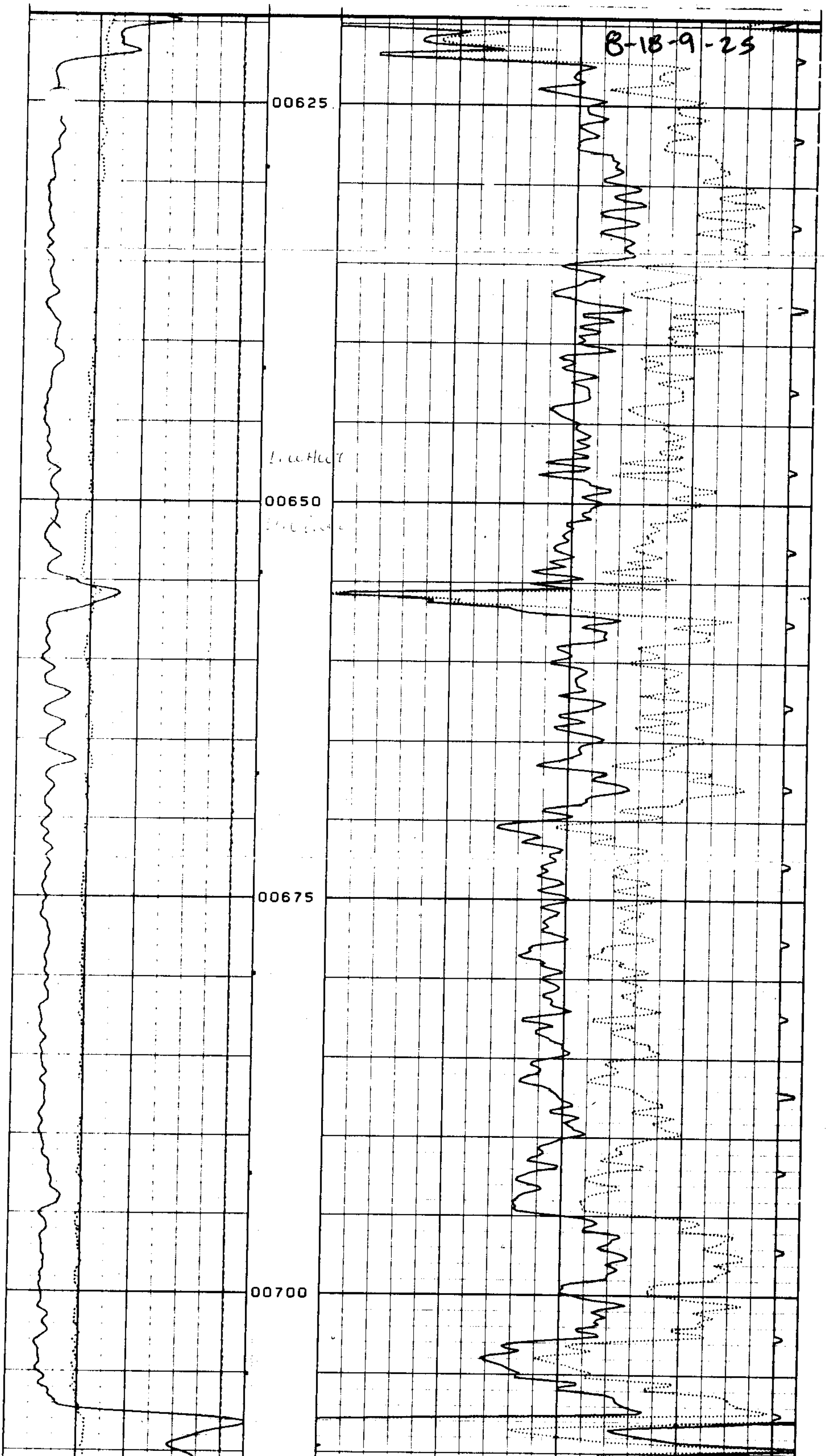
CHARACTERISTICS REMAINING AFTER CUTOFFS

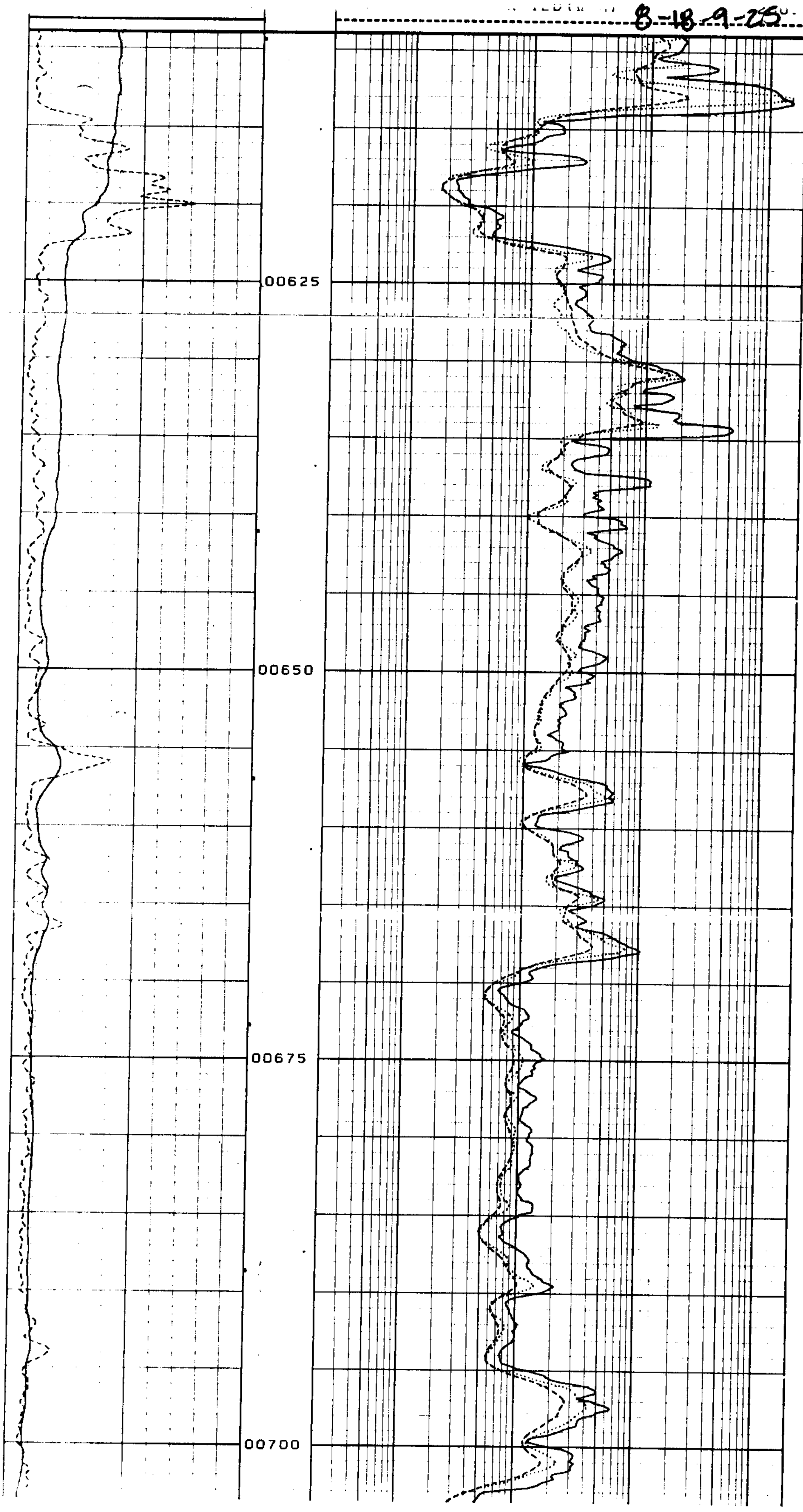
ZONE:	
Number of Samples	78
Thickness Represented	19.17 m
POROSITY:	
Storage Capacity	1.538 ϕ-m
Arithmetic Average	0.080 frac
Minimum	0.014 frac
Maximum	0.176 frac
Median	0.075 frac
Standard Deviation	±0.035 frac
GRAIN DENSITY:	
Arithmetic Average	2701. kg/m3
Minimum	2640. kg/m3
Maximum	2780. kg/m3
Median	2700. kg/m3
Standard Deviation	±23. kg/m3

PERMEABILITY:	
Flow Capacity	919.54 mD-m
Arithmetic Average	49.8 mD
Geometric Average	1.18 mD
Harmonic Average	0.02 mD
Minimum	0.00 mD
Maximum	1590. mD
Median	1.44 mD
Standard Dev. (Geom)	$K \cdot 10^{\pm 1.377}$ mD
HETEROGENEITY (Permeability):	
Dykstra-Parsons Var.	0.931
Lorenz Coefficient	0.882
AVERAGE SATURATIONS (Pore Volume):	
Oil	0.041 frac
Water	0.647 frac


0 GR (API) 150
45 8-18-9-25 ø-CDL KB 436.55 -15
00575
00600
00625
00650
Lower Amaranth
(Red Beds)
MISSISSIPPIAN
CORE
500 m SW
SIP 6493 kPa
350m GCNC oil
SIP 6665 kPa
Upper Whitewater
Lower Whitewater
10m OFMCSW
610 m SW
SIP 6745 kPa
Upper Virden
Lower Virden
Miss
Flossie
Upper Whitewater Lake
Lower Whitewater Lk
Upper Vird
Lower Vird
Scallion


8-18-9-25
00650
00675
00700
00725
Density Caliper
Neutron Caliper
GR
Neutron Porosity
Density Porosity
FR
Bit Size
125 CAL-Y (MM) 375
LIMESTONE


B-18-9-25
00625
00650
00675
00700


8-18-9-25
00625
00650
00675
00700

A & A CORING SERVICES LTD.
(DRILL STEM TEST)

COMPANY NAME: Chevron Canada Resources Limited
WELL NAME: Chevron Virden — KB ELV 436.55m
LOCATION 8-18-9-25-W1 — GR ELV 432.40m
INTERVAL 651.81 m TO 660.00 m — TOTAL DEPTH 660.00m

DATE: 89-01-03
T# 10386 DST # Two
FORMATION: Lodgepole
TEST TYPE: Bottom Hole

TIME: PF 10 1SI 30, 2FL 90, 2SI 135, 3FL ___, 3SI ___

[CONVENTIONAL]

RECORDER DATA ALL MEASUREMENTS ARE 'SI'

REC.#	13712	13710	13711			
RANGE	40851	33611	33611			
CLOCK	24 Hr.	12 Hr.	24 Hr.	Hr.	Hr.	Hr.
DEPTH	639.89	646.98	652.71			
	KPAG	KPAG	KPAG	KPAG	KPAG	KPAG
A IHD	-	8194	8282			
B PF	206	2341	2569			
B1 EPF	1857	3321	3156			
C 1SI	2033	6879	3809			
D 2F	2229	3490	3641			
E E2F	6345	6569	6439			
F 2SI	6447	6879	6944			
G FHD	-	8320	8387			
D1 3F						
E1 E3F						
F1 3SI						
O/I	FLUID	INSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE

PO Sub	.30
XO Sub	.25
Rec. # 13712	1.52
Shut-In Tool	1.60
Sampler	.91
Hydraulic Tool	1.65
Jars	1.41
Rec. # 13710	1.52
Safety Joint	.51
PACKER	1.85
TOTAL TOOL ABOVE INTERVAL	12.47m
PACKER	.95
DEPTH	651.31m
STUB	.90
Rec. # 13711	1.52
Perfs.	5.17
STUB	
PACKER	
DEPTH	___ m
TOTAL INTERVAL	___ m
PACKER	
BULL NOSE	.60
TOTAL DEPTH	660.00m
TOTAL INTERVAL	8.19m
TOTAL TEST TOOL	20.66m
CUSTOMER REP.	W. Marsh
TESTER	R. Mokelky /G06

HOLE and TEST DESCRIPTION — MUD DATA

T STARTED	05:45 Hr.	HOLE SIZE	200 mm	MUD TYPE	Gel Chem
T ON BTM.	07:00 Hr.	BTM. CHOKE	19.05 mm	WEIGHT	1340
T OPENED	07:15 Hr.	D.COLL ID	63.50 mm	VIS	54
T PULLED	11:40 Hr.	D.PIPE ID	97.20 mm	W.LOSS	9.2
T OUT	13:30 Hr.	D.C.LENG	132.64 m	F.CAKE	1.59
TOOL WT.	___ daN	D.P.LENG	510.66 m	MUD DROP	NO
WT. SET	15 000 daN	WT. PULLED	25 000 daN	AMT of FILL	Nil m
INIT WT	22 000 daN	FINAL WT	24 500 daN	POROSITY	___ %
HOLE COND	Good	BTM. H. TEMP.	31 C	Fld.CUSHION	___ m
COMPRESS.RCK.	___	NET PAY	___ m	TYPE	___

SAMPLES TO:

RECOVERY FLUID

TOTAL 620.00m of 132.64 m in D.C. & 487.36 m in D.P.
10.00m of Oil flecked water cut drilling mud
610.00m of Salt water 47 850 PPM NaCl
29 000 Chloride ions

GAS - Measured with:

TIME	ORIFICE	PRESSURE	RATE
min.	mm	kPa	m^3/Day

REMARKS:
PREFLOW: Fair air blow increasing to very good in 1 minute.

SECONDFLOW: Very good air blow, steady throughout.

TEST SUCCESSFUL

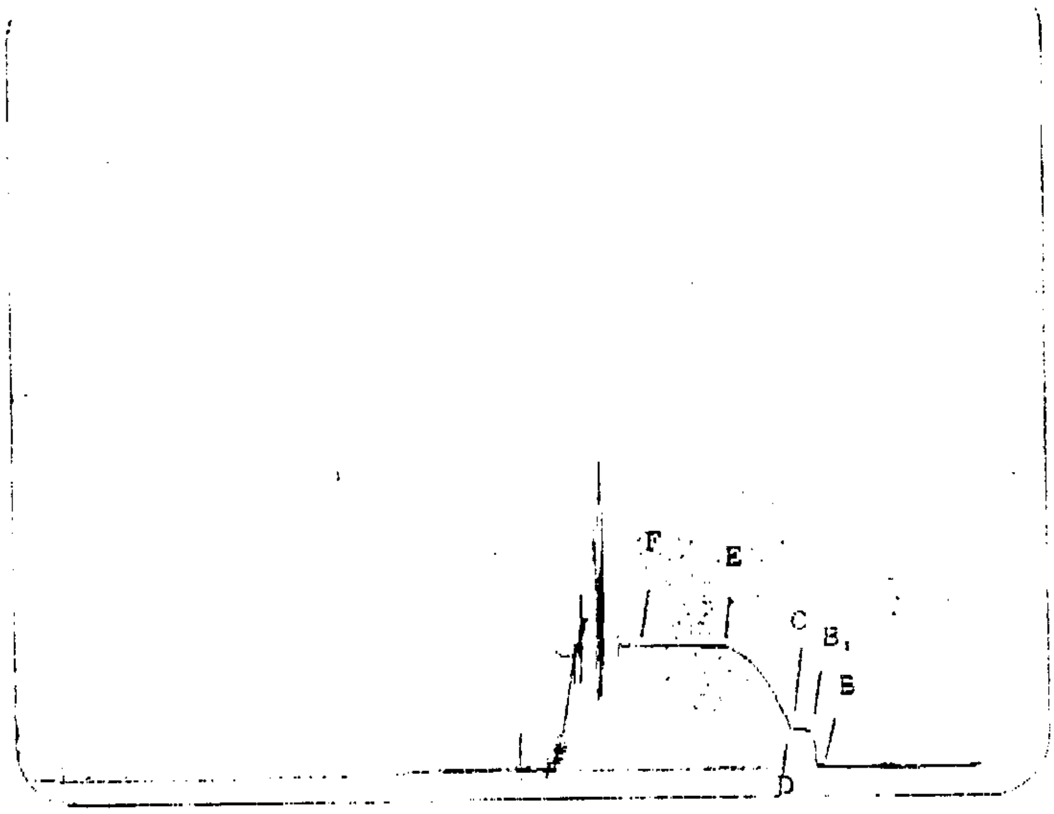
WELL NAME Chevron Virden 8-18-9-25-W1 TICKET NO. 0386 D.S.T. NO. Two

A & A CORING SERVICES LTD.
(DRILL STEM TEST)

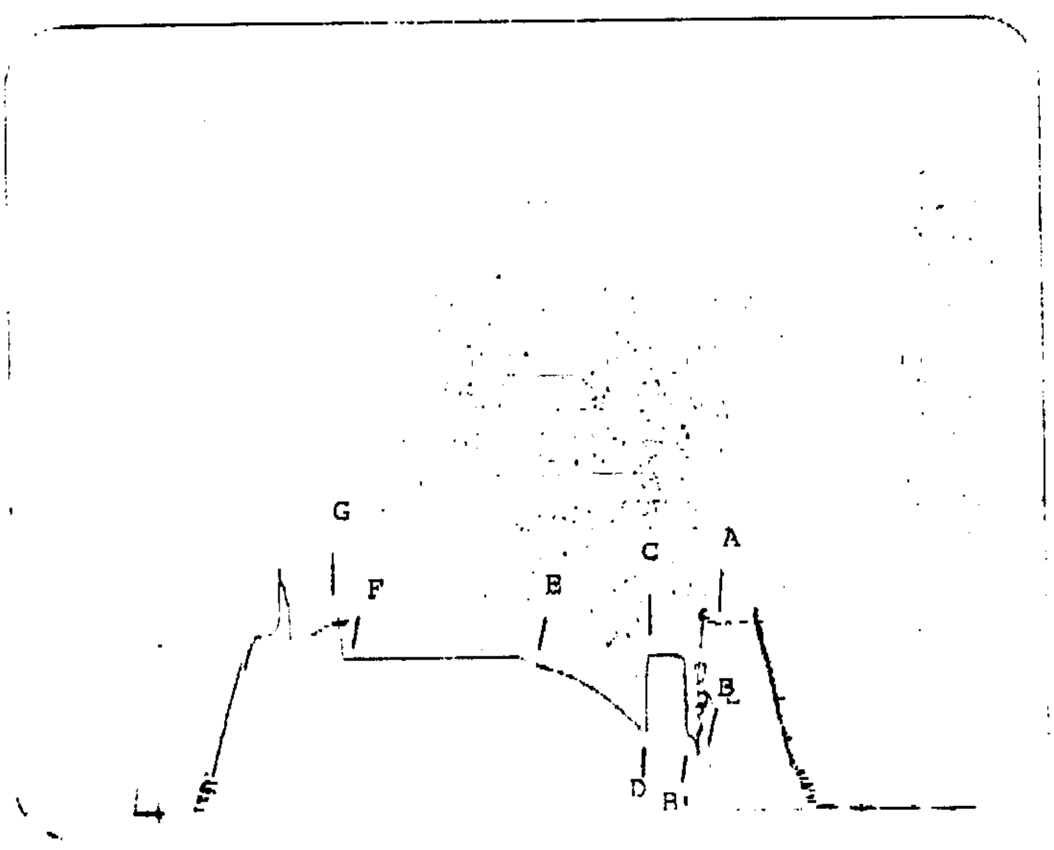
Well Name :Chevron Virden
Location :8-18-9-25-W1

Ticket #:10386
DST # :Two

Recorder	:13712	
Depth	:639.89	
Clock	:24 hr.	
A	IN Hydrostatic :	0.0
B	Preflow :	206.0
B1	End Preflow :	1857.0
C	First Shutin :	2033.0
D	Second flow :	2229.0
E	End 2nd flow :	6345.0
F	Second Shutin :	6447.0
G	FL Hydrostatic :	0.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0



Recorder	:13710	
Depth	:646.38	
Clock	:12 hr.	
A	IN Hydrostatic :	8194.0
B	Preflow :	2341.0
B1	End Preflow :	3321.0
C	First Shutin :	6879.0
D	Second flow :	3490.0
E	End 2nd flow :	6569.0
F	Second Shutin :	6873.0
G	FL Hydrostatic :	8320.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0



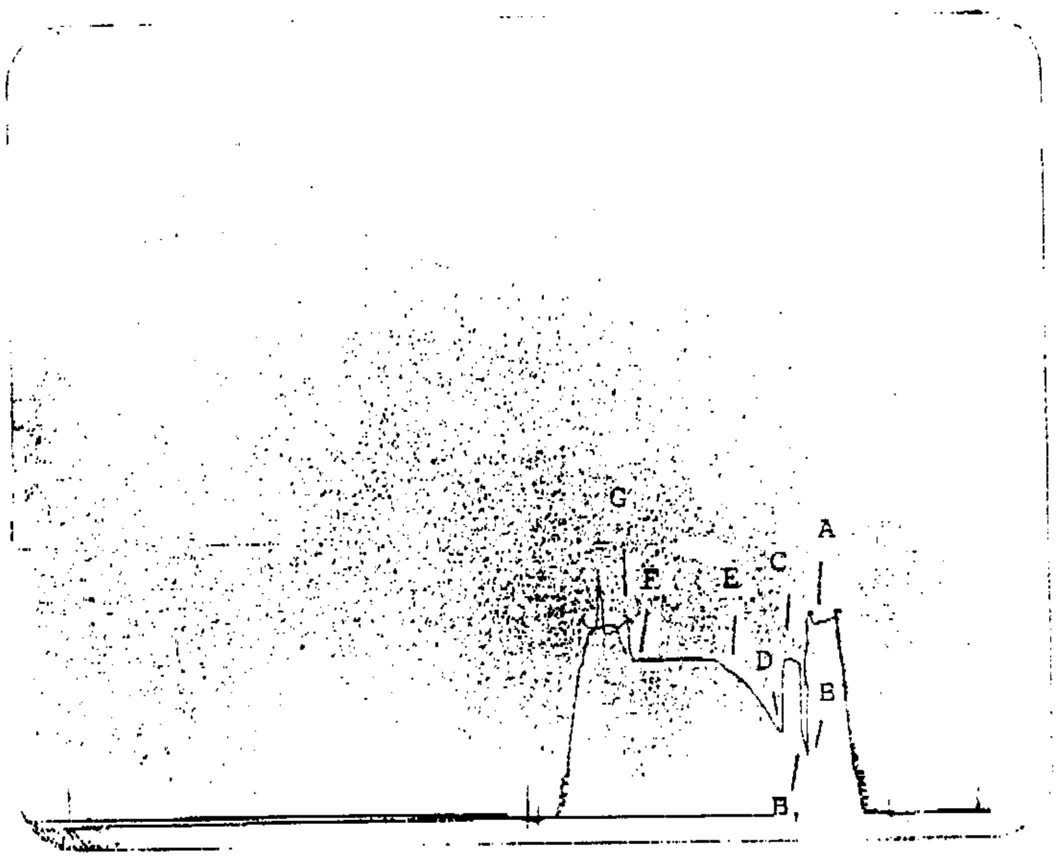
A & A CORING SERVICES LTD.
(DRILL STEM TEST)

Well Name :Chevron Virden
Location :8-18-9-25-W1

Ticket #:10386
DST # :Two

Recorder :13711
Depth :652.71
Clock :24 hr.

A	IN Hydrostatic :	8282.0
B	Preflow :	2563.0
B1	End Preflow :	3156.0
C	First Shutin :	6809.0
D	Second flow :	3641.0
E	End 2nd flow :	6439.0
F	Second Shutin :	6944.0
G	FL Hydrostatic :	8382.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0



A & A CORING SERVICES LTD.
(DRILL STEM TEST)

OMPANY E: Chevron Canada Resources Limited
ELL NAME: Chevron Virden KB ELV 436.55m
OCATION 8-18-9-25-W1 GR ELV 432.45m
NTERVAL 633.98 m TO 640.44 m TOTAL DEPTH 724.00m
IME: PF 10 1SI 30, 2FL 90, 2SI 135, 3FL ___, 3SI ___

DATE: 89-01-05
T# 10387 DST # Three
FORMATION: Lodgepole
TEST TYPE: Straddle

[CONVENTIONAL]

ECORDER DATA ALL MEASUREMENTS ARE 'SI'

EC.#	13713	13710	13711	13712		
ANGE	40851	33611	33611	40851		
LOCK	24 Hr.	12 Hr.	24 Hr.	24 Hr.	Hr.	Hr.
EPTH	622.06	629.15	634.88	643.14		
	KPAG	KPAG	KPAG	KPAG	KPAG	KPAG
A IHD	-	8194	8256	8342		
B PF	10	735	1037	6569		
1 EPF	889	1698	1522	6376		
C 1SI	1012	6652	6607	6651		
D 2F	1206	2020	2220	6417		
E E2F	5206	5605	5446	6345		
F 2SI	5359	6669	6683	6681		
G FHD	-	8161	8231	8321		
1 3F						
1 E3F						
1 3SI						
O/I FLUID	INSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	

OLE and TEST DESCRIPTION MUD DATA

T STARTED 05:20 Hr.	HOLE SIZE 200 mm	MUD TYPE	Gel Chem
T ON BTM. 06:30 Hr.	BTM. CHOKE 19.05 mm	WEIGHT	1360
T OPENED 06:40 Hr.	D.COLL ID 63.50 mm	VIS	57
T PULLED 11:05 Hr.	D.PIPE ID 97.20 mm	W.LOSS	9.4
T OUT 13:15 Hr.	D.C.LENG 56.22 m	F.CAKE	1.6
TOOL WT. ___ daN	D.P.LENG 567.45 m	MUD DROP	No
WT. SET 12 000 daN	WT. PULLED 27 000 daN	AMT of FILL	Nil m
INIT WT 22 000 daN	FINAL WT 24 000 daN	POROSITY	___ %
HOLE COND Good	BTM. H. TEMP. 32 C	Fld.CUSHION	___ m
COMPRESS.RCK. ___	NET PAY ___ m	TYPE	___

SAMPLES TO:

ECOVERY FLUID

TOTAL 500.00m of 56.22 m in D.C. & 443.78 m in D.P.
350.00m of Dirty salt water(24 750 PPM Nacl & 15 000 PPM Cl.)
100.00m of Oil flecked salt water
50.00m of Slightly water cut mud

NOTE: There was a slight leak around the bottom packers.

EMARKS:
PREFLOW: Fair air blow increasing to very good in 5 minutes.

SECONDFLOW: Fair air blow increasing to very good in 3 minutes. Steady throughout.
TEST SUCCESSFUL

PO Sub	.30
XO Sub	.25
Rec. # 13713	1.52
Shut-in Tool	1.60
Sampler	.91
Hydraulic Tool	1.65
Jars	1.41
Rec. # 13710	1.52
Safety Joint	.51
PACKER	1.85
TOTAL TOOL ABOVE INTERVAL	12.47m
PACKER	.95
DEPTH	633.98m
STUB	.90
Rec. # 13711	1.52
Perfs.	2.74
Blank	.30
STUB	1.00
PACKER	.85
DEPTH	640.44m
TOTAL INTERVAL	6.46m
PACKER	1.85
Rec. # 13712	1.52
Perfs.	1.82
XOS	.25
Drill Collars	76.42
XOS	.25
BULL NOSE	.60
TOTAL DEPTH	724.00m
TOTAL TAIL PIPE	83.56m
TOTAL TEST TOOL	26.07m

CUSTOMER REP. W. Marsh
TESTER R. Mokelky /G11

WELL NAME Chevron Virden 8 18 9 25 W1
TICKET NO 10387
D.S.T. NO. Three

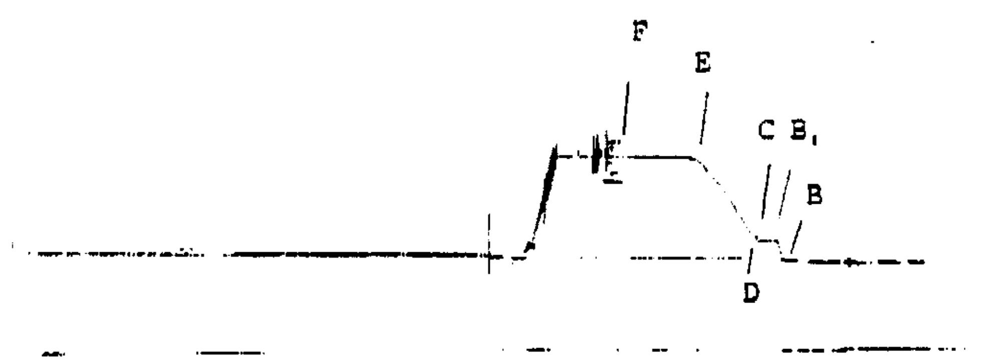
A & A CORING SERVICES LTD.
(DRILL STEM TEST)

Well Name :Chevron Virden
Location :8-18-9-25-W1

Ticket #:10387
DST # :Three

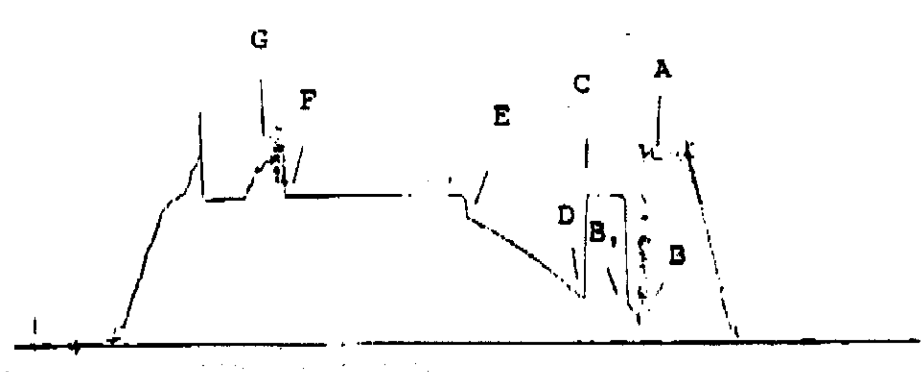
Recorder :13713
Depth :622.06
Clock :24 hr.

A	IN Hydrostatic :	0.0
B	Preflow :	10.0
B1	End Preflow :	869.0
C	First Shutin :	1012.0
D	Second flow :	1205.0
E	End 2nd flow :	5206.0
F	Second Shutin :	5359.0
G	FL Hydrostatic :	0.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0



Recorder :13710
Depth :629.15
Clock :12 hr.

A	IN Hydrostatic :	8134.0
B	Preflow :	735.0
B1	End Preflow :	1699.0
C	First Shutin :	6652.0
D	Second flow :	2020.0
E	End 2nd flow :	5605.0
F	Second Shutin :	6669.0
G	FL Hydrostatic :	8161.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0



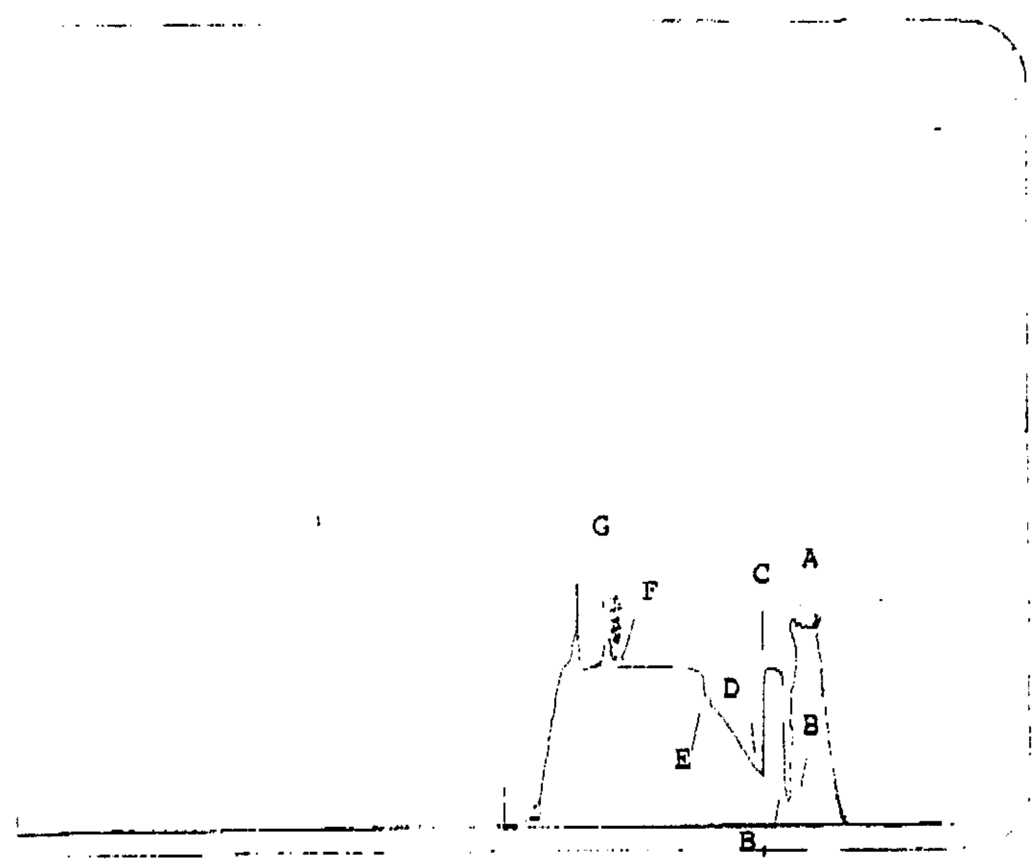
A & A CORING SERVICES LTD.
(DRILL STEM TEST)

Well Name :Chevron Virden
Location :8-18-9-25-W1

Ticket #:10387
DST # :Three

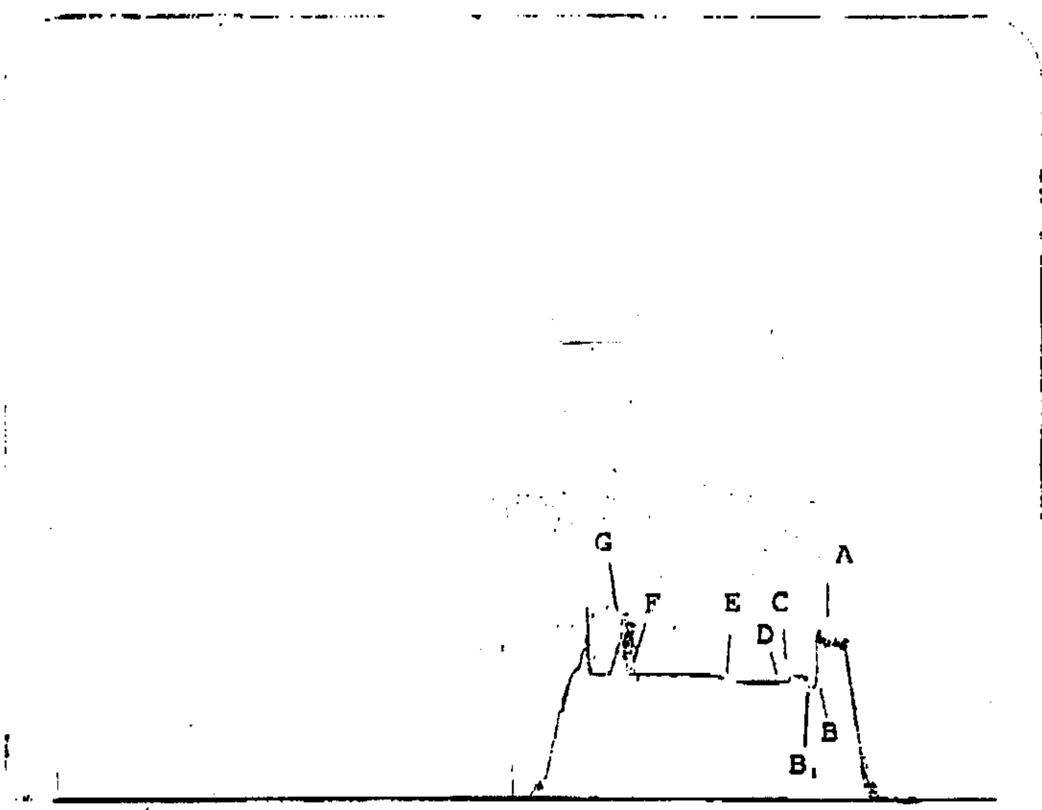
Recorder :13711
Depth :634.88
Clock :24 hr.

A	IN Hydrostatic	:	8255.0
B	Preflow	:	1037.0
B1	End Preflow	:	1522.0
C	First Shutin	:	6607.0
D	Second flow	:	2220.0
E	End 2nd flow	:	5446.0
F	Second Shutin	:	6683.0
G	FL Hydrostatic	:	8231.0
D1	Third flow	:	0.0
E1	End third Flow	:	0.0
F1	Third Shutin	:	0.0



Recorder :12712
Depth :643.14
Clock :24 hr.

A	IN Hydrostatic	:	8342.0
B	Preflow	:	6369.0
B1	End Preflow	:	6376.0
C	First Shutin	:	6651.0
D	Second flow	:	6417.0
E	End 2nd flow	:	6345.0
F	Second Shutin	:	6681.0
G	FL Hydrostatic	:	8321.0
D1	Third flow	:	0.0
E1	End third Flow	:	0.0
F1	Third Shutin	:	0.0



A & A CORING SERVICES LTD.
(DRILL STEM TEST)

COMPANY NAME: Chevron Canada Resources Limited
WELL NAME: Chevron Virden
LOCATION 8-18-9-25-W1
INTERVAL 632.06 m TO 648.00 m

KB ELV 436.55m
GR ELV 432.40m
TOTAL DEPTH 648.00m

DATE: 89-01-02
T# 9624 DST # One
FORMATION: Lodgepole
TEST TYPE: Bottom Hole

TIME: PF 10 1SI 35, 2FL 90, 2SI 135, 3FL ___, 3SI ___

[CONVENTIONAL]

RECORDER DATA ALL MEASUREMENTS ARE 'SI'

REC.#	13873	13874	13875	13876		
RANGE	40679	42575	27387	22588		
CLOCK	24 Hr.	24 Hr.	12 Hr.	24 Hr.	Hr.	Hr.
DEPTH	619.53	626.77	633.42	634.94		
	KPAG	KPAG	KPAG	KPAG	KPAG	KPAG
A IHD	-	7976	8050	8135		
B PF	30	1067	1146	1124		
B1 EPF	986	1206	1428	1505		
C 1SI	1159	6531	6639	6664		
D 2F	1393	1974	1799	1762		
E E2F	3274	3372	3502	3531		
F 2SI	3396	6574	6653	6670		
G FHD	-	7879	8119	8180		
D1 3F						
E1 E3F						
F1 3SI						
O/I FLUID	INSIDE	OUTSIDE	OUTSIDE	OUTSIDE	OUTSIDE	

PO Sub	.30
XO Sub	.25
Rec. # 13873	1.52
Shut-in Tool	1.60
Sampler	.90
_.__	
Hydraulic Tool	1.65
_.__	
Jars	1.57
Rec. # 13874	1.52
_.__	
Safety Joint	.51
	_.__
	_.__
	_.__
PACKER	1.85

TOTAL TOOL ABOVE
INTERVAL 13.12m
PACKER 1.45
DEPTH 632.06m

STUB	.45
Perfs.	.91
Rec. # 13875	1.52
Rec. # 13876	1.52
Perfs.	.91
	_.__
XOS	.25
	_.__
	_.__
STUB	_.__
PACKER	_.__
DEPTH	___.__m
TOTAL INTERVAL	__.__m
PACKER	_.__
Drill Collar	9.51
	_.__
XOS	.25
	_.__
BULL NOSE	.62

TOTAL DEPTH 648.00m
TOTAL INTERVAL 15.94m
TOTAL TEST TOOL 19.55m
CUSTOMER REP. W. Marsh
TESTER A. Arndt /GC6

HOLE and TEST DESCRIPTION

T STARTED 05:10 Hr.	HOLE SIZE 200 mm		
T ON BTM. 06:15 Hr.	BTM. CHOKE 19.05 mm		
T OPENED 07:05 Hr.	D.COLL ID 63.50 mm		
T PULLED 11:35 Hr.	D.PIPE ID 97.20 mm		
T OUT 13:15 Hr.	D.C.LENG 123.62 m		
TOOL WT. _ ___ daN	D.P.LENG 501.24 m		
WT. SET 12 000 daN	WT. PULLED 24 000 daN		
INIT WT 21 000 daN	FINAL WT 22 000 daN		
HOLE COND Good	BTM. H. TEMP. 32 C		
COMPRESS.RCK. ___	NET PAY __ m		

MUD DATA

MUD TYPE	Gel Chem
WEIGHT	1330
VIS	47
W.LOSS	9.2
F.CAKE	1.59
MUD DROP	No
AMT of FILL	Nil m
POROSITY	___ %
Fld.CUSHION	___ m
TYPE	___

SAMPLES TO:

RECOVERY FLUID
TOTAL 350.00m of 123.62 m in D.C. & 226.38 m in D.P.
350.00m of Gas cut mud cut oil
Pumped out.

GAS - Measured with:

TIME min.	ORIFICE mm	PRESSURE kPa	RATE m^3/Day

REMARKS:
PREFLOW: Weak air blow increasing to fair air blow in 3 minutes.

SECONDFLOW: Fair air blow decreasing after 50 minutes to weak air blow at the end of the flow.
TEST SUCCESSFUL

WELL NAME Chevron Virden 8-18-9-25 W1
TICKET NO. 9624
D.S.T. NO. One

A & A CORING SERVICES LTD.
(DRILL STEM TEST)

Well Name :Chevron Virden
Location :8-18-9-25-W1
Recorder #:13875

Ticket #:5624
DST # :One
Depth :633.42

TIME	DEFLEC	PSIG.	kPa	kPa^2	TIME	T+ dT	DEFLEC	PSIG.	kPa	kPa^2	d PSI
	Initial Flow						Initial Shut In				
0.0	0.1670	166.2	1146	1.313	0.0	0.00	0.2080	207.1	1428	2.039	0.0
5.0	0.1726	171.9	1185	1.404	5.0	3.00	0.9483	946.2	6524	42.563	739.1
10.0	0.2080	207.1	1428	2.039	10.0	2.00	0.9598	957.7	6603	43.600	750.6
					15.0	1.66	0.9630	960.9	6625	43.891	753.8
					20.0	1.50	0.9644	962.3	6635	44.023	755.2
					25.0	1.40	0.9647	962.6	6637	44.050	755.5
					30.0	1.33	0.9649	962.8	6638	44.063	755.6
					35.0	1.28	0.9650	962.9	6639	44.076	755.8
	Second Flow						Second Shut In				
0.0	0.9650	962.9	6639	44.076	0.0	0.00	0.5100	507.9	3502	12.264	0.0
5.0	0.2622	261.1	1800	3.240	5.0	21.00	0.9490	947.0	6529	42.628	439.0
10.0	0.2677	266.6	1838	3.378	10.0	11.00	0.9601	958.0	6605	43.626	450.1
15.0	0.2836	282.4	1947	3.791	15.0	7.66	0.9636	961.5	6629	43.944	453.5
20.0	0.3020	300.7	2073	4.297	20.0	6.00	0.9649	962.8	6638	44.063	454.8
25.0	0.3197	318.4	2195	4.818	25.0	5.00	0.9650	962.9	6639	44.076	455.0
30.0	0.3354	334.0	2303	5.304	30.0	4.33	0.9652	963.2	6641	44.103	455.3
35.0	0.3510	349.5	2410	5.808	35.0	3.85	0.9654	963.3	6642	44.116	455.4
40.0	0.3687	367.2	2532	6.411	40.0	3.50	0.9655	963.5	6643	44.129	455.6
45.0	0.3850	383.3	2643	6.985	45.0	3.22	0.9655	963.5	6643	44.129	455.6
50.0	0.3993	397.7	2742	7.519	50.0	3.00	0.9656	963.5	6643	44.129	455.6
55.0	0.4125	410.7	2832	8.020	55.0	2.81	0.9660	963.9	6646	44.169	456.0
60.0	0.4258	424.1	2924	8.550	60.0	2.66	0.9660	963.9	6646	44.169	456.0
70.0	0.4540	452.1	3117	9.716	70.0	2.42	0.9661	964.1	6647	44.183	456.1
80.0	0.4822	480.2	3311	10.963	80.0	2.25	0.9661	964.1	6647	44.183	456.1
90.0	0.5100	507.9	3502	12.264	90.0	2.11	0.9664	964.4	6649	44.209	456.4
					100.0	2.00	0.9664	964.4	6649	44.209	456.4
					110.0	1.90	0.9667	964.6	6651	44.236	456.7
					120.0	1.83	0.9668	964.8	6652	44.249	456.9
					130.0	1.76	0.9663	964.8	6652	44.249	456.9
					135.0	1.74	0.9670	964.9	6653	44.262	457.0

A & A CORING SERVICES LTD.
(DRILL STEM TEST)

Well Name :Chevron Virden
Location :8-18-9-25-W1
Recorder #:13875

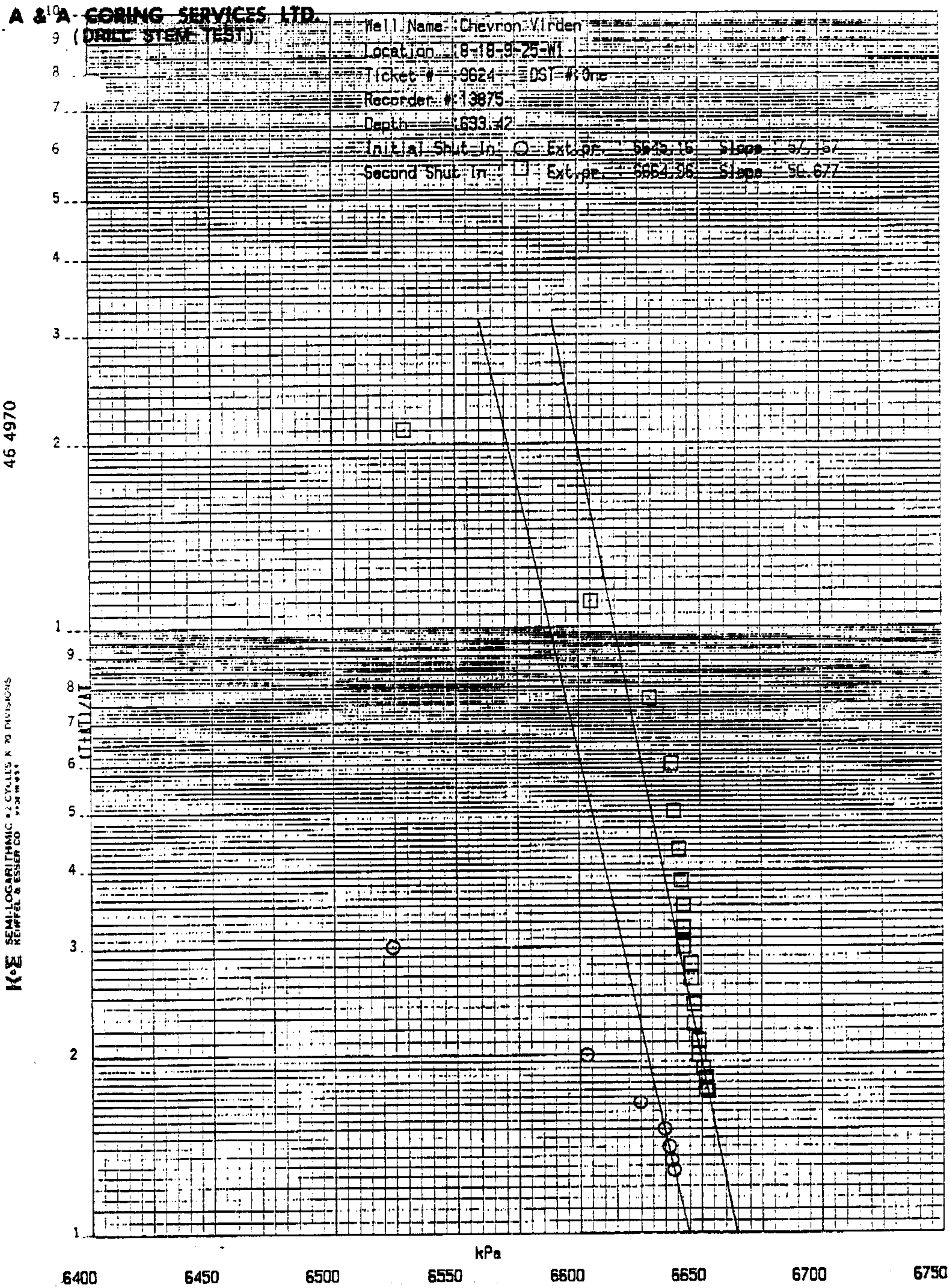
Ticket #:9624
DST #:One
Depth :633.42

	INITIAL SHUT IN	SECOND SHUT IN	
No. of Increments------------	7	20	
No. of Points Extrapolated---	4	7	
Slope of Extrapolated Line---	57	51	kPa/Cycle
Extrapolated Pressure--------	6645	6665	kPa

Draw Down Factor-------------N/A Final Shutin is greater than Initial Shutin

Comments:

Computations by RHYASON CONSULTANTS
PH: (403) 230-0524

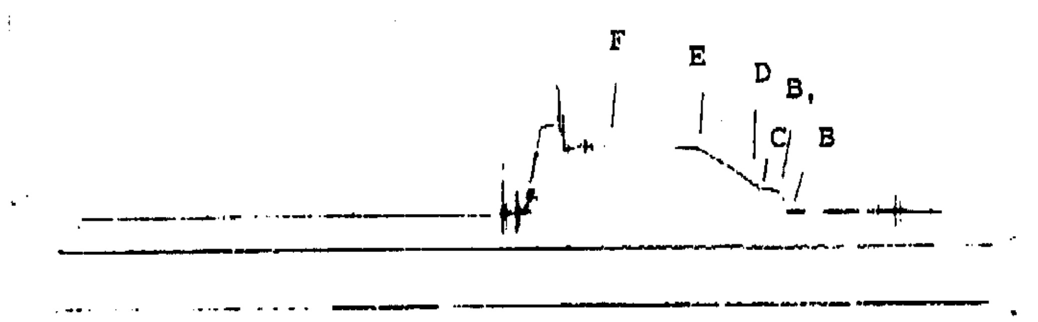

A & A CORING SERVICES LTD.
(DRILL STEM TEST)
Well Name : Chevron Virden
Location : 8-18-9-25-W1
Ticket # : 9624   DST # : One
Recorder # : 13875
Depth : 633.42
Initial Shut-In ○ Ext. pe. Slope
Second Shut In □ Ext. pe. Slope
(T+ΔT)/ΔT
kPa
6400
6450
6500
6550
6600
6650
6700
6750
46 4970
K+E SEMI-LOGARITHMIC 2 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO.

A & A CORING SERVICES LTD.
(DRILL STEM TEST)

Well Name :Chevron Virden　　　　Ticket #:9624
Location :8-18-9-25-W1　　　　DST # :One

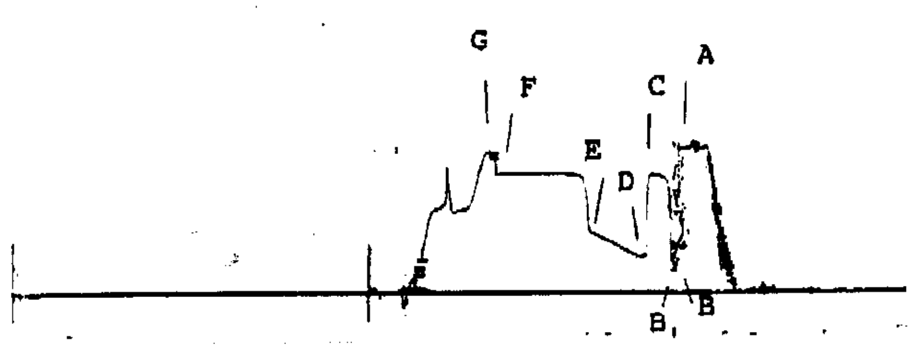
Recorder :13873
Depth :1619.53
Clock :24 hr.

A	IN Hydrostatic :	0.0
B	Preflow :	30.0
B1	End Preflow :	986.0
C	First Shutin :	1159.0
D	Second flow :	1393.0
E	End 2nd flow :	3274.0
F	Second Shutin :	3396.0
G	FL Hydrostatic :	0.0
D1	Third flow :	0.0
E1	End third flow :	0.0
F1	Third Shutin :	0.0



Recorder :13874
Depth :1626.77
Clock :24 hr.

A	IN Hydrostatic :	7976.0
B	Preflow :	1067.0
B1	End Preflow :	1206.0
C	First Shutin :	6531.0
D	Second flow :	1974.0
E	End 2nd flow :	3372.0
F	Second Shutin :	6574.0
G	FL Hydrostatic :	7879.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0

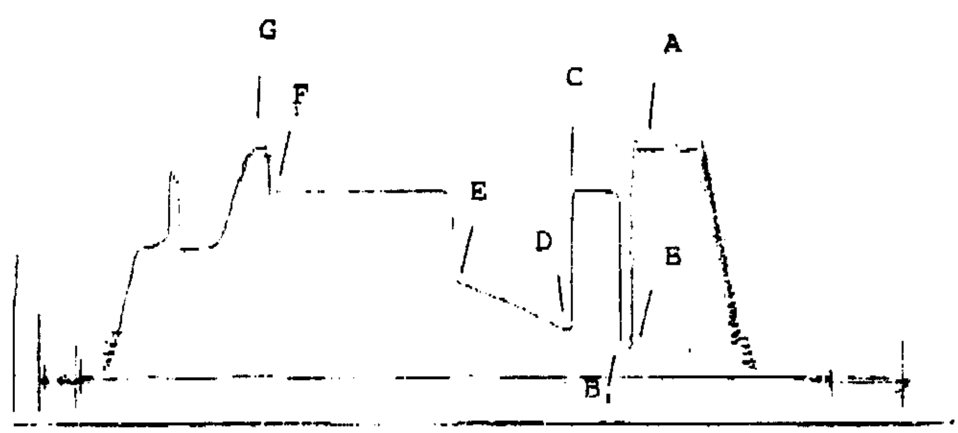


A & A CORING SERVICES LTD.
(DRILL STEM TEST)

Well Name :Chevron Virden	Ticket #:9624
Location :8-18-9-25-W1	DST # :One

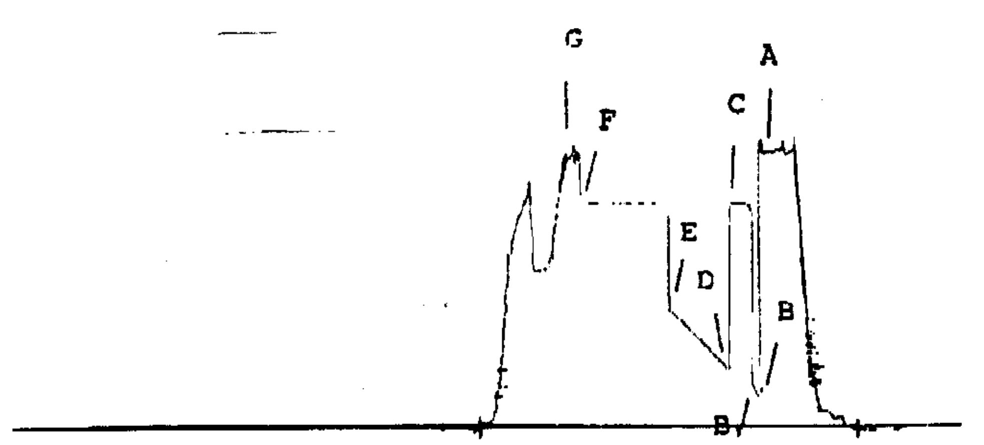
Recorder :13875
Depth :633.42
Clock :12 hr.

A	IN Hydrostatic :	8050.0
B	Preflow :	1146.0
B1	End Preflow :	1428.0
C	First Shutin :	6639.0
D	Second flow :	1739.0
E	End 2nd flow :	3502.0
F	Second Shutin :	6653.0
G	FL Hydrostatic :	8119.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0



Recorder :13876
Depth :634.94
Clock :24 hr.

A	IN Hydrostatic :	8135.0
B	Preflow :	1124.0
B1	End Preflow :	1505.0
C	First Shutin :	6664.0
D	Second flow :	1762.0
E	End 2nd flow :	3531.0
F	Second Shutin :	6670.0
G	FL Hydrostatic :	8180.0
D1	Third flow :	0.0
E1	End third Flow :	0.0
F1	Third Shutin :	0.0



CHEMICAL & GEOLOGICAL LABORATORIES LTD.

COMPANY : CHEVRON CANADA RESOURCES
WELL NAME: CHEVRON VIRDEN A-18-9-25 W1
FORMATION: LODGEPOLE
CORED INTERVAL: 630.00 - 660.00

LAB NO: S89-375
PAGE : 7
DATE : 1989-02-08

CORE ANALYSIS DATA REPORT

SAMPLE NUMBER	INTERVAL, M TOP	INTERVAL, M BASE	REP THICK	SAMPLE LENGTH	GAS PERMEABILITY, MD KMAX	GAS PERMEABILITY, MD K90	GAS PERMEABILITY, MD KV	POROSITY	DENSITY, KG/M3 BULK	DENSITY, KG/M3 GRAIN	RESIDUAL SATURATION FRAC OF PORE VOLUME OIL	RESIDUAL SATURATION FRAC OF PORE VOLUME WATER	VISUAL EXAMINATION
				CORE NO. 1	630.00 -	648.00	RECEIVED IN LAB	17.55 METRES					
DE	630.00	632.75	2.75	-	-	-	-	-	-	-	-	-	LAM DOL/ANHY
1	632.75	632.90	0.15	0.08	0.70	0.45	0.03	0.099	2550	2840	0.438	0.337	DOL,LAM/MNR ANHY,INTXL POR
2	632.90	633.00	0.10	0.10	0.90	0.47	0.02	0.098	2530	2810	0.442	0.340	DOL,LAM,INTXL,MNR PP POR
3	633.00	633.15	0.15	0.09	1.20	0.96	0.26	0.104	2500	2790	0.417	0.321	DOL,MAS,INTXL POR
DE	633.15	633.30	0.15	-	-	-	-	-	-	-	-	-	ANHY,MAS
4	633.30	633.45	0.15	0.09	0.19	0.16	0.02	0.111	2470	2780	0.182	0.661	DOL,LAM,ARG,INTXL POR
5	633.45	633.65	0.20	0.16	0.19	0.16	0.06	0.076	2590	2800	0.216	0.784	DOL/MNR BBG,INTXL POR
6	633.65	633.90	0.25	0.12	0.56	0.51	<.01	0.077	2580	2790	0.157	0.843	DOL,MAS,ARG,INTXL POR
DE	633.90	634.00	0.10	-	-	-	-	-	-	-	-	-	ANHY,MAS,MNR DOL
7	634.00	634.10	0.10	0.08	0.30	0.25	0.03	0.082	2580	2810	0.157	0.843	DOL/MNR ANHY,INTXL POR

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

COMPANY : CHEVRON CANADA RESOURCES
WELL NAME: CHEVRON VIRDEN 8-18-9-25 W1
FORMATION: UPPER WHITEWATER
CORED INTERVAL: 630.00 - 660.00

LAB NO: S89-375
PAGE : 8
DATE : 1989-02-08

CORE ANALYSIS DATA REPORT

	SAMPLE NUMBER	INTERVAL, M TOP	INTERVAL, M BASE	REP THICK	SAMPLE LENGTH	GAS PERMEABILITY, MD KMAX	GAS PERMEABILITY, MD K90	GAS PERMEABILITY, MD KV	POROSITY	DENSITY, KG/M3 BULK	DENSITY, KG/M3 GRAIN	RESIDUAL SATURATION FRAC OF PORE VOLUME OIL	RESIDUAL SATURATION FRAC OF PORE VOLUME WATER	VISUAL EXAMINATION
	8	634.10	634.50	0.40	0.14	0.02	0.02	0.02	0.005	2590	2600	Trace	0.444	LS,FOS/MNR SIL,INTXL POR
	9	634.50	634.75	0.25	0.10	<.01	<.01	<.01	0.015	2560	2600	Trace	0.148	LS,FOS/MNR SIL,INTXL POR
DE		634.75	637.65	2.90	-	-	-	-	-	-	-	-	-	LS/MNR CHT,TR FOS
	10	637.65	638.25	0.60	0.10	0.08	0.08	0.02	0.056	2550	2700	0.163	0.837	LS,LAM,INTXL,MNR VUG POR
	11	638.25	638.75	0.50	0.08	0.03	0.03	<.01	0.035	2570	2670	0.163	0.837	LS,FOS/LAM,INTXL POR
	12	638.75	639.15	0.40	0.12	0.08	0.03	<.01	0.039	2590	2700	0.148	0.570	LS/MNR SHY LAM,INTXL POR
DE		639.15	640.50	1.35	-	-	-	-	-	-	-	-	-	LS,LOC FOS
SP	13	640.50	640.90	0.40	-	0.04	-	-	0.035	-	2680	Trace	0.444	LS/TR FOS,INTXL,VUG POR
	14	640.90	641.20	0.30	0.14	1.60	1.50	0.21	0.066	2530	2710	0.131	0.438	LS,LAM/MNR PYR,INTXL POR
	15	641.20	641.45	0.25	0.17	0.44	0.22	0.07	0.050	2570	2700	0.173	0.578	LS/MNR LAM,INTXL POR
	16	641.45	641.65	0.20	0.09	2.10	1.50	<.01	0.059	2550	2710	0.245	0.301	LS,LAM/MNR PYR,INTXL POR
	17	641.65	642.00	0.35	0.17	1539.00	1377.00	31.00	0.064	2530	2710	0.226	0.278	LS/MNR BDG,INTXL POR,RF
	18	642.00	642.40	0.40	0.15	0.59	0.56	<.01	0.049	2540	2670	Trace	0.999	LS/FOS,CHT,INTXL POR
	19	642.40	642.55	0.15	0.13	15.00	13.00	0.12	0.065	2510	2680	0.311	0.171	LS,PRED FOS,VUG POR
	20	642.55	642.75	0.20	0.11	12.00	10.00	0.05	0.097	2420	2680	0.208	0.115	LS/CHT,INTXL POR
DE		642.75	643.20	0.45	-	-	-	-	-	-	-	-	-	LS/MNR CHT
	21	643.20	643.50	0.30	0.13	9.60	0.46	0.21	0.061	2530	2700	0.000	1.000	LS/SHY LAM,INTXL POR,VF
SP	22	643.50	643.60	0.10	-	39.00	-	-	0.073	-	2670	0.277	0.122	LS,FOS,INTGRAN,VUG POR
	23	643.60	643.80	0.20	0.10	19.00	7.40	7.50	0.067	2480	2660	0.302	0.133	LS,FOS,INTGRAN,VUG POR
	24	643.80	644.15	0.35	0.10	46.00	36.00	13.00	0.085	2460	2690	0.068	0.235	LS,FOS,INTGRAN,VUG POR
SP	25	644.15	644.35	0.20	-	161.00	-	-	0.116	-	2700	0.199	0.287	LS,FOS,INTGRAN,VUG POR
	26	644.35	644.60	0.25	0.08	20.00	16.00	5.30	0.119	2340	2650	0.194	0.280	LS,FOS/CHT,INTGRAN POR
SP	27	644.60	644.85	0.25	-	3.20	-	-	0.071	-	2710	0.203	0.282	LS,INTXL POR
	28	644.85	645.25	0.40	0.11	19.00	18.00	19.00	0.093	2420	2670	0.155	0.215	LS/MNR CHT,INTXL POR,VF
	29	645.25	645.65	0.40	0.18	7.90	7.80	0.98	0.073	2500	2690	0.158	0.213	LS,SL ARG,INTXL POR
DE		645.65	646.20	0.55	-	-	-	-	-	-	-	-	-	LS/MNR CHT,PYR
SP	30	646.20	646.50	0.30	-	9.00	-	-	0.093	-	2710	0.155	0.143	LS,FOS,INTGRAN POR
DE		646.50	647.20	0.70	-	-	-	-	-	-	-	-	-	LS/MNR CHT,SH LAM
	31	647.20	647.40	0.20	0.08	0.54	0.48	0.47	0.056	2550	2700	0.103	0.357	LS/MNR LAM,INTXL POR,VF

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

COMPANY : CHEVRON CANADA RESOURCES
WELL NAME: CHEVRON VIRDEN 8-18-9-25 W1
FORMATION: UPPER WHITEWATER
CORED INTERVAL: 630.00 - 660.00

LAB NO: 589-375
PAGE : [illegible]
DATE : 1989-02-08

CORE ANALYSIS DATA REPORT

SAMPLE NUMBER	INTERVAL, M TOP	INTERVAL, M BASE	REP THICK	SAMPLE LENGTH	GAS PERMEABILITY, MD KMAX	GAS PERMEABILITY, MD K90	GAS PERMEABILITY, MD KV	POROSITY	DENSITY, KG/M3 BULK	DENSITY, KG/M3 GRAIN	RESIDUAL SATURATION FRAC OF PORE VOLUME OIL	RESIDUAL SATURATION FRAC OF PORE VOLUME WATER	VISUAL EXAMINATION
SP 32	647.40	647.55	0.15	-	18.00	-	-	0.086	-	2710	0.134	0.336	LS,FOS,INTGRAN POR
LC	647.55	648.00	0.45	-	-	-	-	-	-	-	-	-	
CORE NO. 2					648.00 -	660.00	RECEIVED IN LAB		11.50 METRES				
DE	648.00	649.80	1.80	-	-	-	-	-	-	-	-	-	
33	649.80	650.20	0.40	0.14	35.00	0.32	115.00	0.026	2630	2700	0.000	1.000	LS/MNR CHT,VF LS,MAS,INTXL POR,VF
34	650.20	650.50	0.30	0.11	424.00	3.20	2.30	0.068	2500	2680	0.000	0.588	LS,FOS,INTGRAN POR,VF

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

COMPANY : CHEVRON CANADA RESOURCES
WELL NAME: CHEVRON VIRDEN 8-18-9-25 W1
FORMATION: VIRDEN
CORED INTERVAL: 630.00 - 660.00

LAB NO: S89-375
PAGE : 10
DATE : 1989-02-08

CORE ANALYSIS DATA REPORT

SAMPLE NUMBER	INTERVAL, M TOP	INTERVAL, M BASE	REP THICK	SAMPLE LENGTH	GAS PERMEABILITY, MD KMAX	GAS PERMEABILITY, MD K90	GAS PERMEABILITY, MD KV	POROSITY	DENSITY, KG/M3 BULK	DENSITY, KG/M3 GRAIN	RESIDUAL SATURATION FRAC OF PORE VOLUME OIL	RESIDUAL SATURATION FRAC OF PORE VOLUME WATER	VISUAL EXAMINATION
35	650.50	651.20	0.70	0.20	0.53	0.52	0.21	0.106	2450	2740	Trace	0.692	LS,FOS/MNR LAM,INTXL POR
36	651.20	651.35	0.15	0.11	7.20	4.90	1.20	0.096	2440	2700	Trace	0.764	LS,FOS,INTGRAN,VUG POR
37	651.35	651.55	0.20	0.13	7.30	5.00	1.20	0.100	2420	2690	Trace	0.733	LS,FOS/MNR CHT,INTXL POR
38	651.55	651.80	0.25	0.11	226.00	217.00	7.20	0.142	2310	2690	0.020	0.329	LS,FOS,INTGRAN POR
39	651.80	651.95	0.15	0.18	7.90	7.00	3.40	0.105	2430	2710	0.000	0.952	LS,FOS,INTGRAN POR
40	651.95	652.15	0.20	0.12	7.40	7.20	3.10	0.121	2400	2730	0.000	0.826	LS,FOS,INTGRAN POR
41	652.15	652.35	0.20	0.14	11.00	11.00	7.40	0.109	2410	2710	0.000	0.917	LS,FOS,INTGRAN POR
42	652.35	652.60	0.25	0.18	370.00	261.00	243.00	0.142	2300	2680	Trace	0.376	LS,FOS,INTGRAN,VUG POR
43	652.60	652.95	0.35	0.11	8.30	7.40	1.40	0.116	2390	2700	0.000	0.613	LS,FOS/STYL,INTGRAN POR
44	652.95	653.30	0.35	0.16	35.00	35.00	26.00	0.116	2380	2690	0.000	0.613	LS,FOS,INTGRAN,VUG POR
45	653.30	653.70	0.40	0.08	48.00	47.00	9.80	0.112	2390	2690	0.000	0.635	LS,FOS,INTGRAN,VUG POR
46	653.70	654.00	0.30	0.19	15.00	14.00	9.70	0.095	2430	2690	0.000	0.982	LS,FOS,INTGRAN,VUG POR
47	654.00	654.30	0.30	0.18	52.00	50.00	42.00	0.120	2360	2690	0.000	0.778	LS,FOS,INTGRAN,VUG POR
BE	654.30	657.55	3.25	-	-	-	-	-	-	-	-	-	LS,LOC SHY

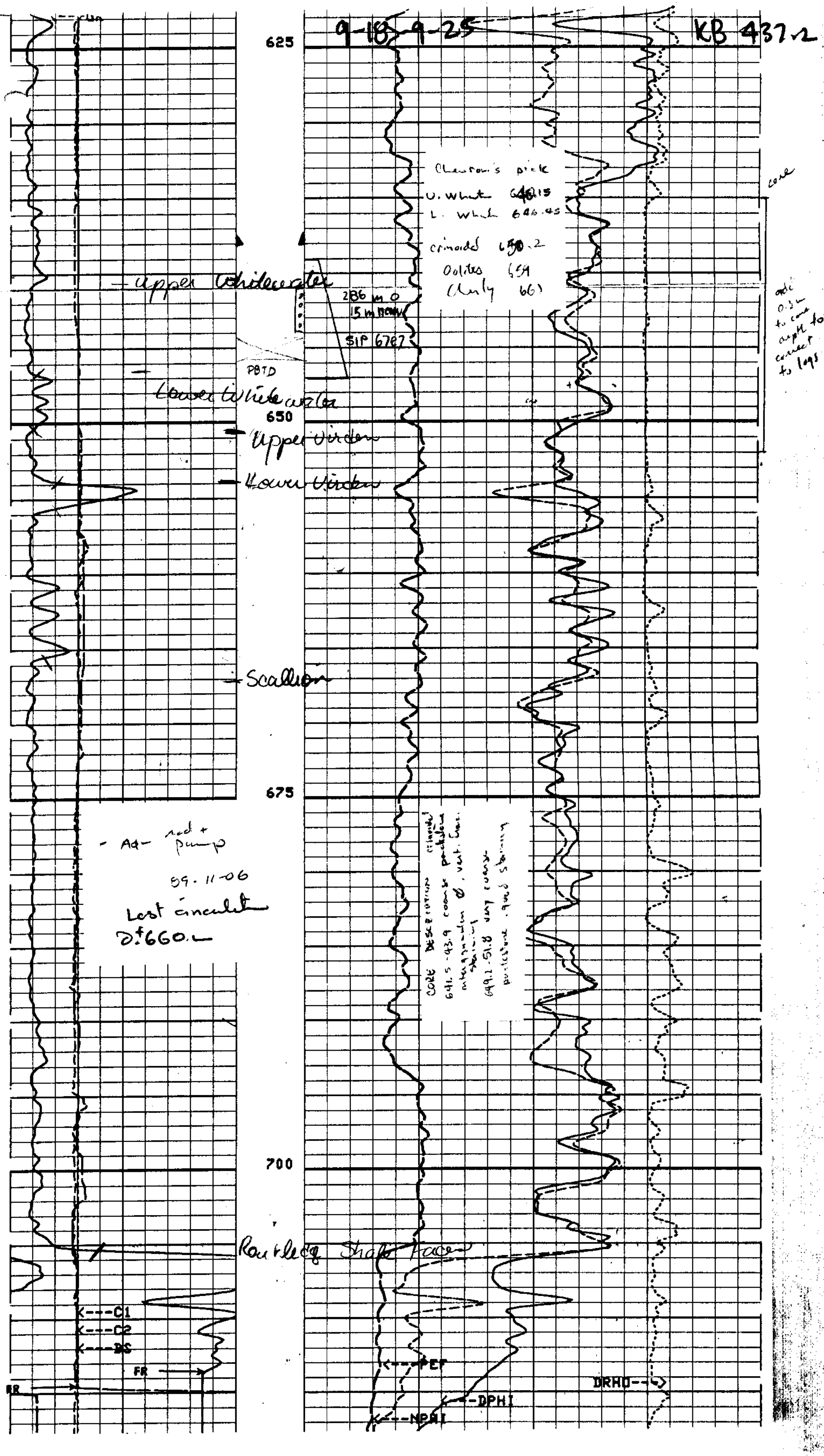
CHEMICAL & GEOLOGICAL LABORATORIES LTD.

COMPANY : CHEVRON CANADA RESOURCES
WELL NAME: CHEVRON VIRDEN 8-18-9-25 W1
FORMATION: OOLITES
CORED INTERVAL: 630.00 - 660.00

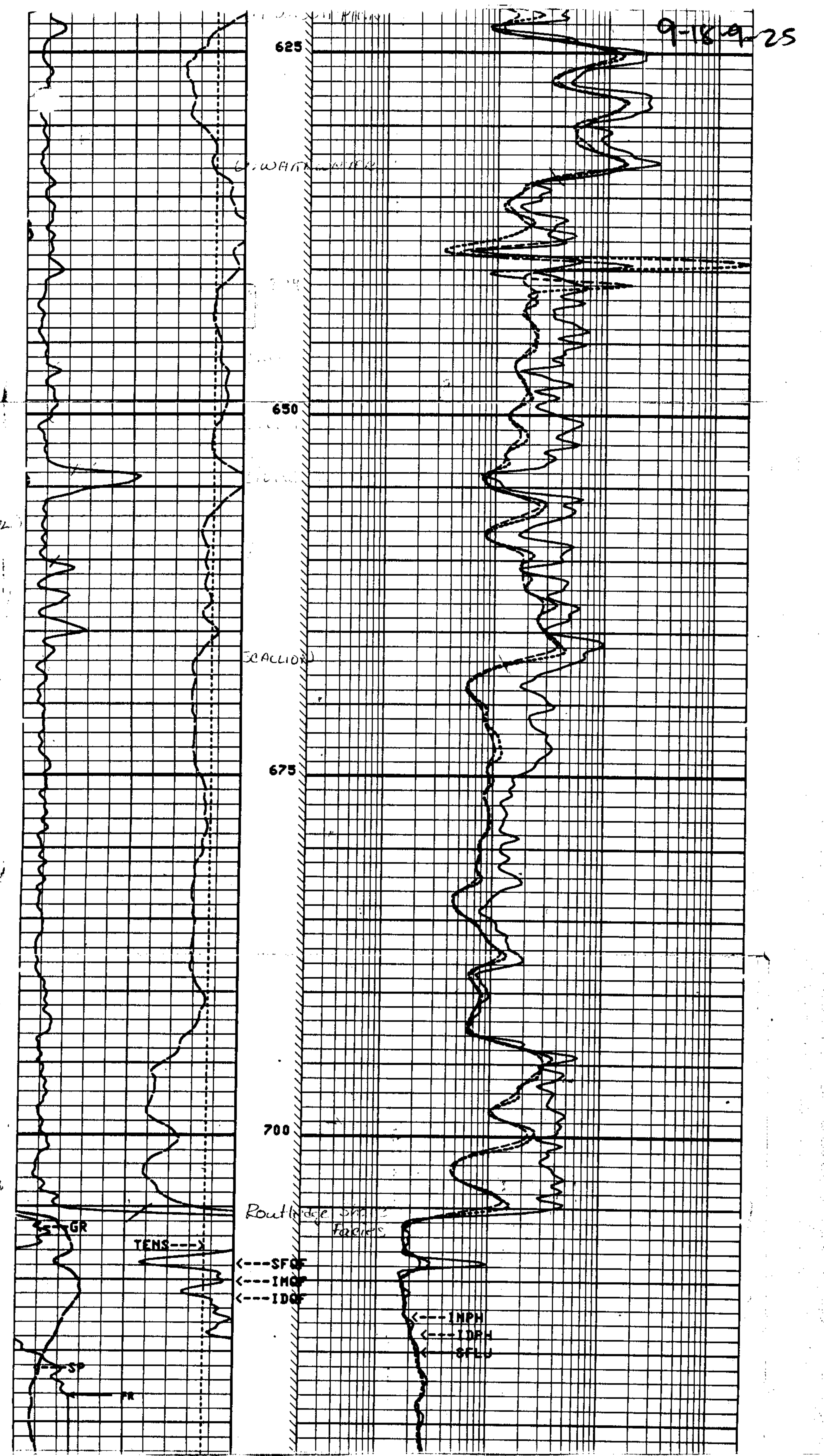
LAB NO: 589-375
PAGE : 11
DATE : 1989-02-08

CORE ANALYSIS DATA REPORT

SAMPLE NUMBER	INTERVAL, M TOP	INTERVAL, M BASE	REP THICK	SAMPLE LENGTH	GAS PERMEABILITY, MD KMAX	K90	KV	POROSITY	DENSITY, KG/M3 BULK	GRAIN	RESIDUAL SATURATION FRAC OF PORE VOLUME OIL	WATER	VISUAL EXAMINATION
DE	657.55	658.50	0.95	-	-	-	-	-	-	-	-	-	LS, LOC SHY
48	658.50	658.80	0.30	0.08	13.00	12.00	5.50	0.135	2340	2700	0.000	0.658	LS, OOL, INTOOL POR
49	658.80	659.20	0.40	0.20	16.00	14.00	19.00	0.121	2380	2700	0.000	0.735	LS, OOL/STYL, INTOOL POR, VF
50	659.20	659.50	0.30	0.20	8.90	8.80	3.50	0.119	2380	2700	0.000	0.747	LS, OOL, INTOOL POR
LC	659.50	660.00	0.50	-	-	-	-	-	-	-	-	-	



Upper Whitewater
9-18-9-25
KB 437.2
625
Chevron's pick
U. White 646.15
L. White 646.45
crinoidal 650.2
Oolites 654
Chuly 661
core
add 0.3m to core depth to correct to logs
Upper Whitewater
286 m O
15 m new
SIP 6787
PBTD
Lower Whitewater
650
Upper Virden
Lower Virden
Scallion
675
Ad - rod + pump
59-11-06
Lost circulation @ 660m
CORE DESCRIPTION (Chevron)
641.5 - 43.9 coarse packstone, intergranular Ø, vert. frac. staining
649.2 - 51.8 very coarse packstone, good staining
700
Routledge Shale Facies
C1
C2
DS
FR
FR
PEF
NPHI
DPHI
DRHO


9-18 9-25
625
650
675
700
Routledge
Facies
GR
TENS--->
<---SFOF
<---IMOF
<---IDOF
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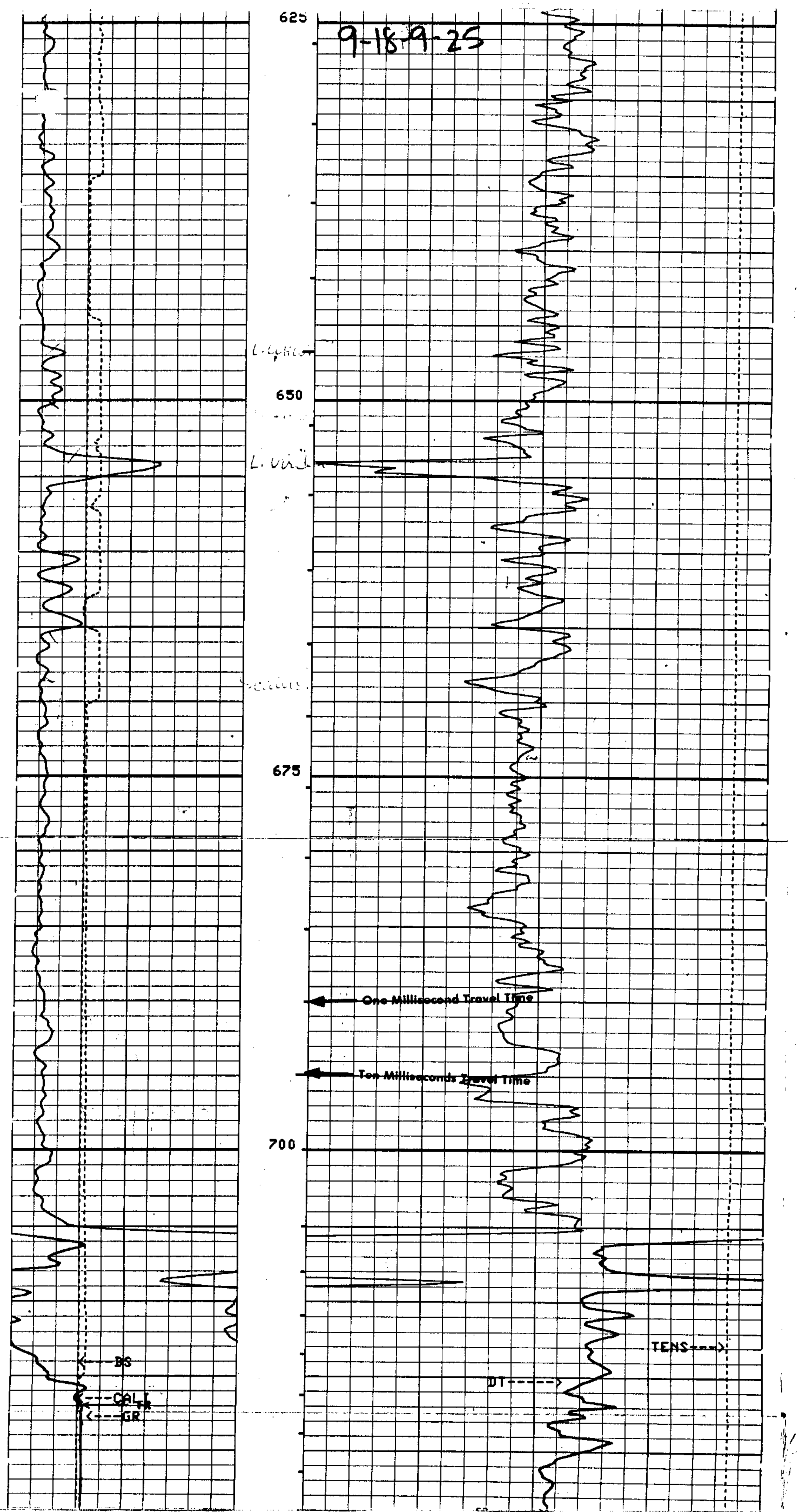
<---SFLU
SP
FR



9-18-9-25
625
650
675
700
One Millisecond Travel Time
Ten Milliseconds Travel Time
BS
CALI
GR
DT
TENS

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN PROV. 9-18-9-25
Location : LSD XX/09-18-009-25 W1M/X
Province : MANITOBA, CANADA

Field : VIRDEN
Formation : LODGEPOLE
Coring Equip.: DIAMOND
Coring Fluid : WATER BASE MUD

File No.: 52138-89-102
Date : 1989 08 06
Analysts: NV
Core Dia: 89

C O R E A N A L Y S I S R E S U L T S

SAMPLE NUMBER	DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
CORE NO. 1 635.00 - 652.00m (Core Received 16.90m) (13 Boxes)														
NA	635.00- 38.65	3.65												ls shy
1	638.65- 38.93	0.28	0.22	0.02	0.01	<.01	0.006	0.018	0.006	2610.	2660.	0.000	0.662	ls i foss cht
2	638.93- 39.19	0.26	0.11	0.53	0.33	0.06	0.138	0.061	0.016	2550.	2710.	0.544	0.348	ls i ppv sv vfrac
3	639.19- 39.35	0.16	0.07	0.78	0.67	0.15	0.125	0.076	0.013	2510.	2720.	0.513	0.349	ls i ppv anhy vfrac
SPR 4	639.35- 39.58	0.23		43.5			10.005	0.119	0.028		2710.	0.206	0.280	ls i ppv
-	639.58- 39.71	0.13												dol shy
5	639.71- 39.96	0.25	0.07	1.84	0.76	0.87	0.460	0.067	0.018	2520.	2700.	0.101	0.197	ls i ppv gyp vfrac
SPR 6	639.96- 40.06	0.10		9.14			0.914	0.094	0.009		2710.	0.229	0.279	ls i ppv
7	640.06- 40.55	0.49	0.13	*	0.49	*		0.080	0.039	2490.	2710.	0.143	0.425	ls i ppv mv gyp vfrac
8	640.55- 40.78	0.23	0.15	0.64	0.52	0.01	0.147	0.029	0.007	2600.	2680.	0.107	0.297	ls i sv cht foss
9	640.78- 41.13	0.35	0.24	0.63	0.49	<.01	0.221	0.050	0.018	2570.	2710.	0.169	0.252	ls i ppv mv shbks gyp vfrac
10	641.13- 41.65	0.52	0.19	4.29	2.98	0.02	2.231	0.066	0.036	2530.	2710.	0.126	0.214	ls i ppv mv foss gyp cht
SP 11	641.65- 41.80	0.15		1.09			0.163	0.052	0.007		2670.	0.163	0.174	ls i ppv sv foss
SPR 12	641.80- 41.95	0.15		7.85			1.178	0.082	0.012		2720.	0.220	0.256	ls i
SP 13	641.95- 42.28	0.33		4.14			1.366	0.079	0.026		2710.	0.173	0.159	ls i ppv foss
SP 14	642.28- 42.49	0.21		0.72			0.151	0.045	0.010		2710.	0.484	0.141	ls i
SP 15	642.49- 42.63	0.14		43.3			6.062	0.089	0.013		2710.	0.134	0.142	ls i ppv sv foss
SPR 16 NET	642.63- 42.79	0.16		50.0			8.000	0.108	0.018		2700.	0.238	0.227	ls i ppv sv foss
17 9P-Y	642.79- 43.12	0.33	0.13	7.77	3.96	2.57	2.564	0.103	0.033	2410.	2690.	0.159	0.304	ls i ppv gyp vfrac
18	643.12- 43.30	0.18	0.11	30.7	18.1	0.65	5.526	0.087	0.016	2450.	2690.	0.739	0.215	ls i ppv sv foss vfrac
SPR 19	643.30- 43.40	0.10		48.6			4.860	0.115	0.012		2700.	0.145	0.422	ls i ppv sv foss
20	643.40- 43.84	0.44	0.15	8.89	6.26	1.25	3.912	0.094	0.040	2460.	2720.	0.164	0.182	ls i ppv sv foss gyp
SPR 21	643.84- 43.92	0.08		78.1			6.248	0.146	0.012		2700.	0.225	0.258	ls i ppv sv foss
SP	643.92- 44.00	0.08		21.2			1.696	0.075	0.006		2690.	0.194	0.221	ls i ppv foss
[illegible]	644.00- 44.34	0.34	0.10	0.37	0.31	0.06	0.126	0.057	0.020	2550.	2710.	0.000	0.561	ls i shbk

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN PROV. 9-18-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-102
Date : 1989 08 06

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER		DEPTH m	INTVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD-m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ-m	BULK DENSITY kg/m3	GRAIN DENSITY kg/m3	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
	24	644.34- 44.53	0.19	0.13	0.43	0.35	0.11	0.082	0.052	0.009	2550.	2690.	0.122	0.203	ls i ppv sv foss cht gyp
	25	644.53- 44.83	0.30	0.14	0.17	0.17	0.08	0.051	0.061	0.018	2560.	2720.	0.000	0.465	ls i sshy foss pry
SPR	26	644.83- 44.94	0.11		6.08			0.669	0.076	0.009		2710.	0.207	0.428	ls i ppv sv foss
	27	644.94- 45.44	0.50	0.12	0.15	0.12	0.02	0.075	0.060	0.030	2550.	2710.	0.157	0.333	ls i sshy foss gyp pyr
	28	645.44- 45.72	0.28	0.20	1.75	1.66	0.11	0.490	0.063	0.017	2540.	2710.	0.000	0.444	ls i ppv foss
SPR	29	645.72- 45.82	0.10		21.9			2.190	0.093	0.009		2700.	0.183	0.278	ls i ppv foss
	30	645.82- 46.00	0.18	0.06	11.9	9.94	1.35	2.142	0.123	0.022	2380.	2710.	0.145	0.176	ls i ppv sv foss gyp
SPR	31	646.00- 46.11	0.11		17.6			1.936	0.096	0.011		2690.	0.140	0.221	ls i ppv sv foss
	32	646.11- 46.59	0.48	0.24	0.36	0.21	0.08	0.173	0.047	0.024	2580.	2710.	TRACE	0.766	ls i ppv foss gyp
-		646.59- 47.44	0.85												ls shy gyp
	33	647.44- 47.97	0.53	0.23	1.32	0.49	0.05	0.700	0.064	0.032	2530.	2700.	0.000	0.692	ls i ppv gyp foss
SPR	34	647.97- 48.08	0.11		0.07			0.008	0.041	0.004		2700.	TRACE	0.796	ls i
-		648.08- 48.98	0.90												ls gyp pyr
	35	648.98- 49.34	0.36	0.26	2.85	0.03	0.04	1.026	0.044	0.014	2600.	2720.	0.000	0.614	ls i foss pyr shbk vfrac
	36	649.34- 49.64	0.30	0.20	0.87	0.68	0.22	0.261	0.104	0.030	2440.	2730.	0.000	0.847	ls i gyp foss pyr cht
	37	649.64- 50.05	0.41	0.30	0.54	0.50	0.31	0.221	0.103	0.041	2450.	2740.	0.000	0.949	ls i foss
	38	650.05- 50.39	0.34	0.27	19.4	18.0	3.26	6.596	0.100	0.034	2430.	2700.	0.471	0.320	ls i ppv sv foss
	39	650.39- 50.64	0.25	0.14	22.0	21.7	7.68	5.500	0.109	0.027	2410.	2700.	TRACE	0.777	ls i ppv sv foss
	40	650.64- 50.82	0.18	0.12	14.5	13.4	9.39	2.610	0.129	0.023	2360.	2710.	0.272	0.422	ls i ppv sv foss
SPR	41	650.82- 50.96	0.14		293.			41.020	0.152	0.021		2700.	0.210	0.199	ls i ppv sv foss
	42	650.96- 51.20	0.24	0.13	281.	165.	12.9	67.440	0.123	0.029	2360.	2690.	0.285	0.312	ls i ppv sv foss
	43	651.20- 51.43	0.23	0.08	10.6	8.52	2.47	2.438	0.112	0.025	2400.	2710.	TRACE	0.717	ls i ppv foss
	44	651.43- 51.61	0.18	0.08	22.5	18.6	11.3	4.050	0.108	0.020	2400.	2690.	TRACE	0.417	ls i ppv sv foss
SPR	45	651.61- 51.74	0.13		182.			23.660	0.132	0.017		2690.	0.228	0.242	ls i ppv sv foss
	46	651.74- 51.90	0.16	0.11	185.	182.	168.	29.600	0.123	0.019	2350.	2680.	0.265	0.404	ls i ppv mw foss
		651.90- 52.00	0.10												Lost core

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN PROV. 9-18-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-89-102
Date : 1989 08 06

TABLE I

SUMMARY OF CORE DATA

ZONE AND CUTOFF DATA

ZONE:	
Identification	LODGEPOLE
Top Depth	635.00 m
Bottom Depth	652.00 m
Number of Samples	46
DATA TYPE:	
Porosity	(HELIUM)
Permeability	(MAXIMUM) Kair
CUTOFFS:	
Porosity (Minimum)	0.000 frac
Porosity (Maximum)	1.000 frac
Permeability (Minimum)	0.0000 mD
Permeability (Maximum)	100000. mD
Water Saturation (Maximum)	1.000 frac
Oil Saturation (Minimum)	0.000 frac
Grain Density (Minimum)	2000. kg/m3
Grain Density (Maximum)	3000. kg/m3
Lithology Excluded	NONE

CHARACTERISTICS REMAINING AFTER CUTOFFS

ZONE:	
Number of Samples	46
Thickness Represented	11.37 m
POROSITY:	
Storage Capacity	0.903 ϕ-m
Arithmetic Average	0.079 frac
Minimum	0.018 frac
Maximum	0.152 frac
Median	0.084 frac
Standard Deviation	±0.032 frac
GRAIN DENSITY:	
Arithmetic Average	2706. kg/m3
Minimum	2660. kg/m3
Maximum	2740. kg/m3
Median	2710. kg/m3
Standard Deviation	±15. kg/m3

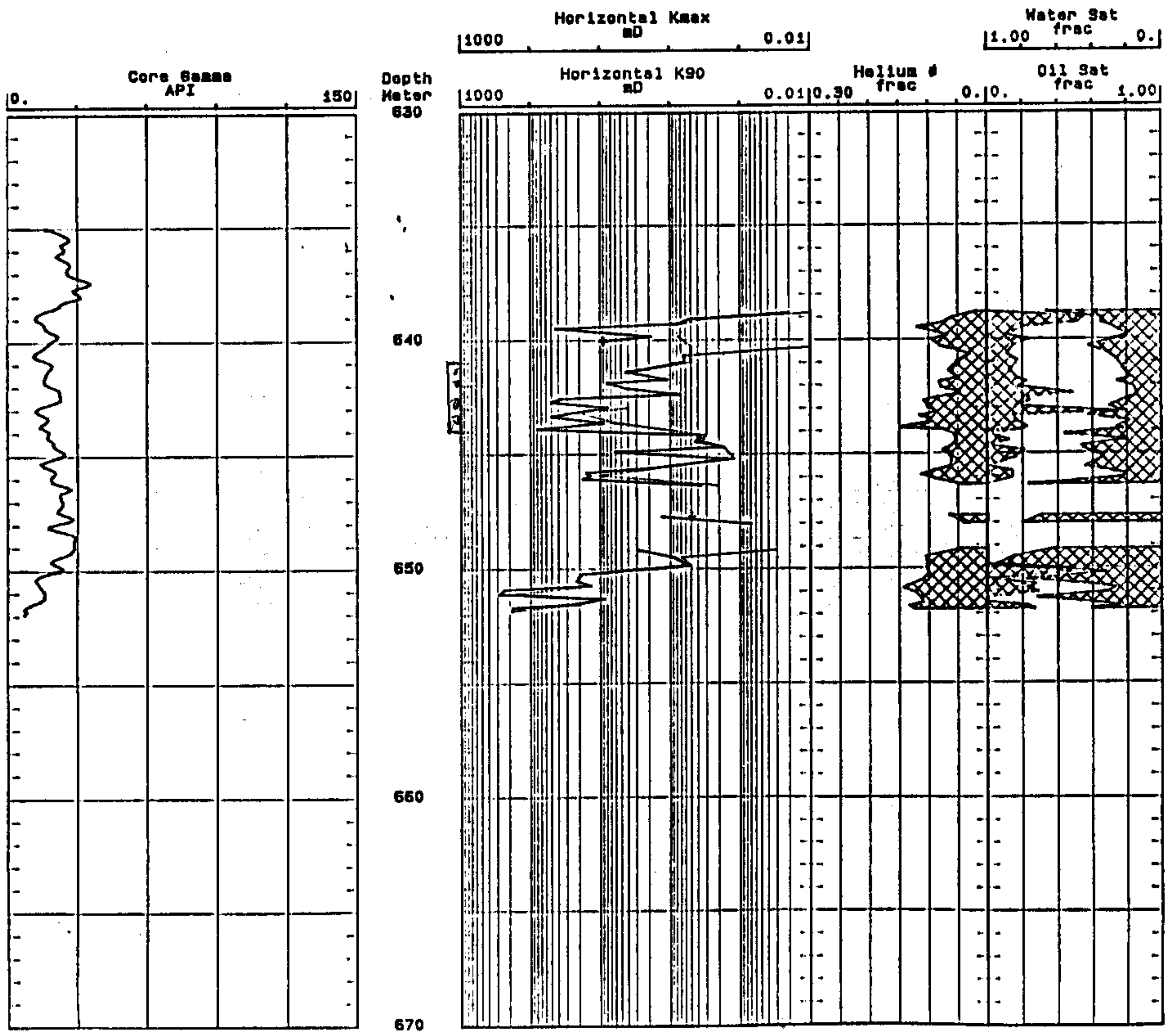
PERMEABILITY:	
Flow Capacity	249.04 mD-m
Arithmetic Average	22.9 mD
Geometric Average	2.87 mD
Harmonic Average	0.39 mD
Minimum	0.02 mD
Maximum	293. mD
Median	7.77 mD
Standard Dev. (Geom)	$K\cdot10^{\pm1.023}$ mD
HETEROGENEITY (Permeability):	
Dykstra-Parsons Var.	0.924
Lorenz Coefficient	0.745
AVERAGE SATURATIONS (Pore Volume):	
Oil	0.160 frac
Water	0.409 frac

CORRELATION COREGRAPH

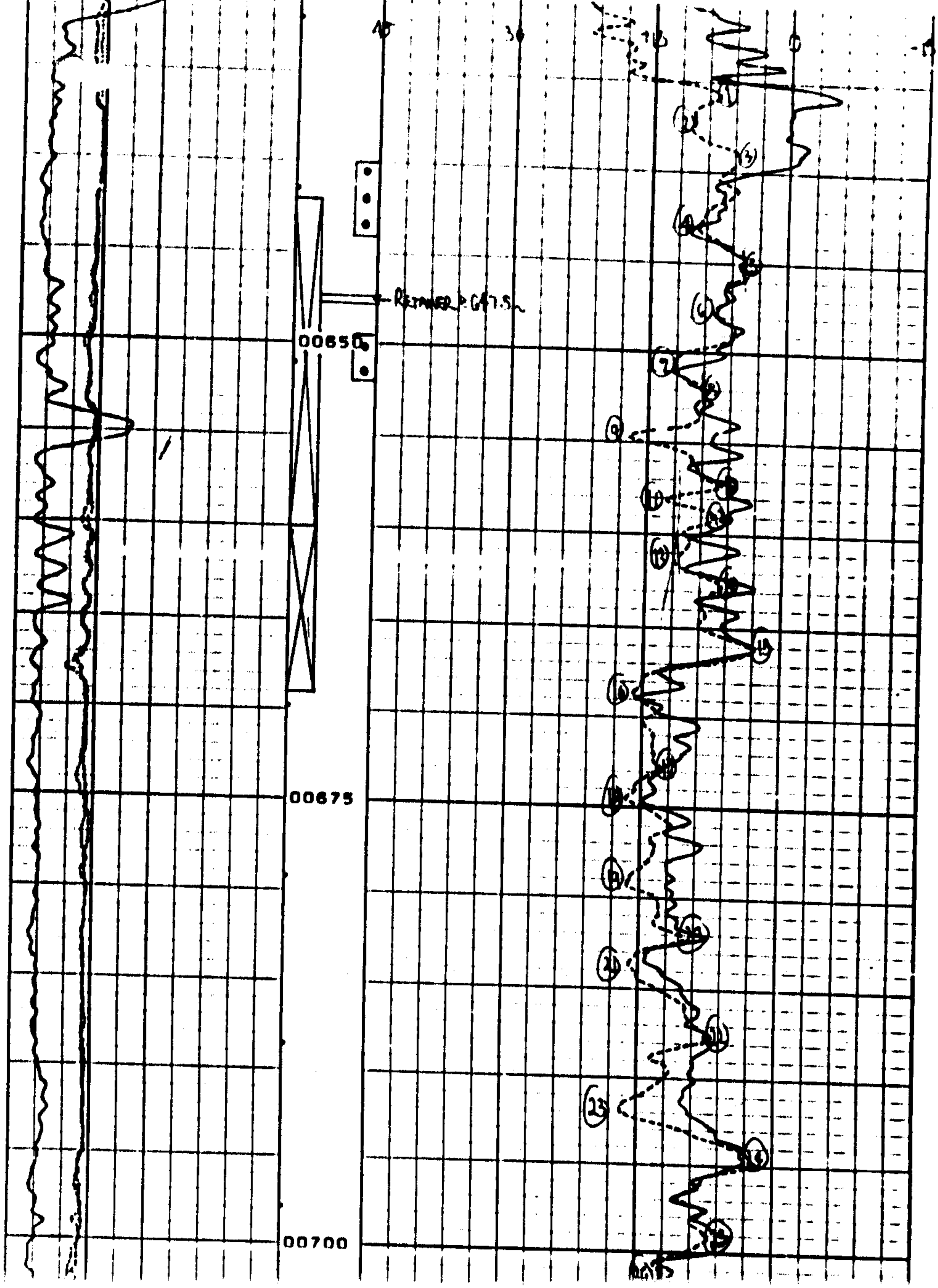
CHEVRON CANADA RESOURCES LIMITED
CHEVRON VIRDEN PROV. 9-18-9-25 W1M
VIRDEN, MANITOBA
FILE NO. 52138-89-102
FORMATION: LODGEPOLE (635.00-652.00m)

Core Laboratories 1989 08 06

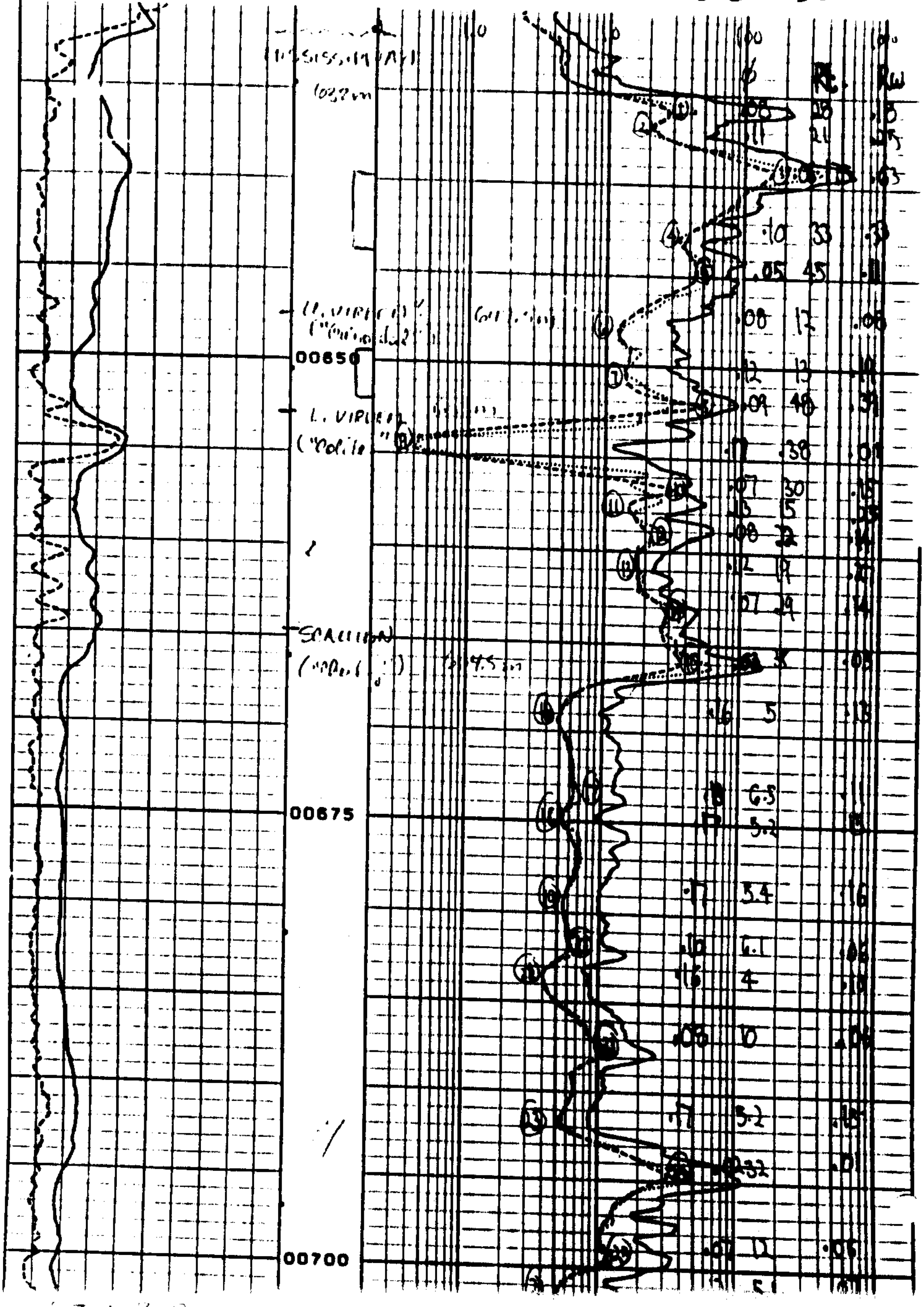
Vertical Scale
10.00 cm = 24.0 meter

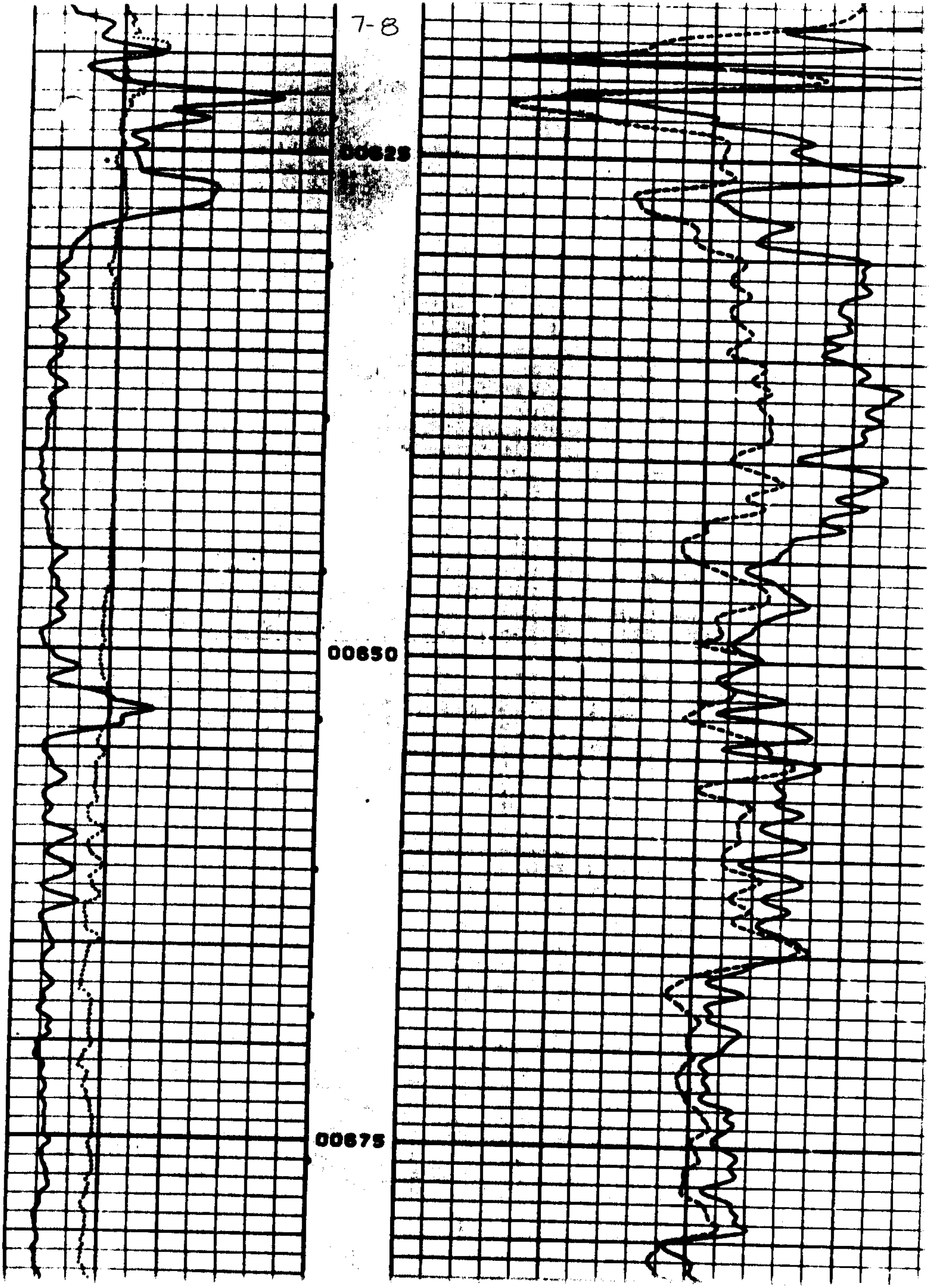


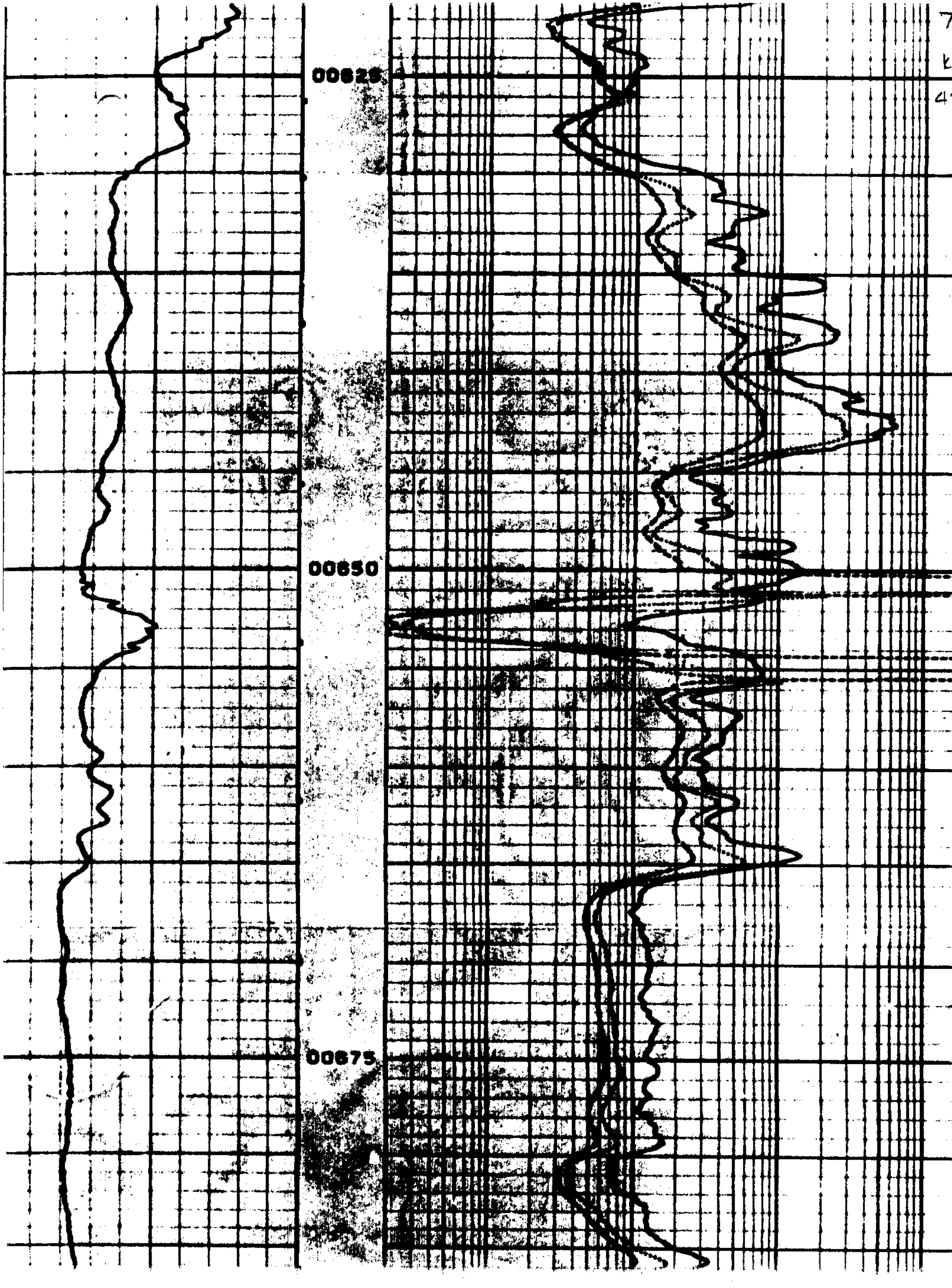
6-8-9-25 KB 435.62



6-8-9-25




7-8
00625
00650
00675



7-8
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435.1

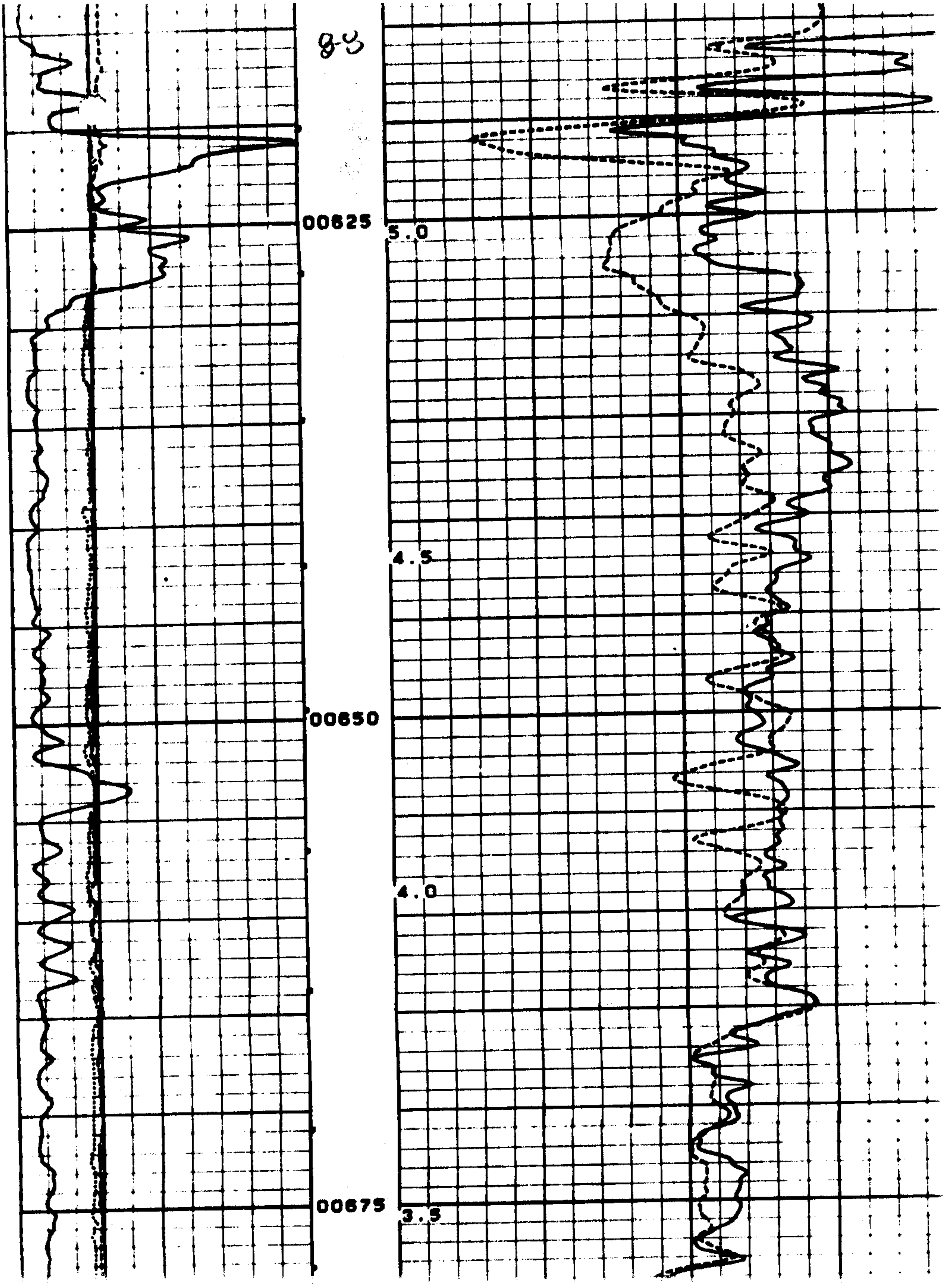
CHEMICAL & GEOLOGICAL LABORATORIES LTD.

COMPANY : CHEVRON CANADA RESOURCES LIMITED
WELL : CHEVRON ET AL VIRDEN 7-8-9-25 W1
FORMATION: LODGEPOLE
CORED INTERVAL: 636.00 - 654.00

LAB NO:
PAGE :
DATE :

CORE ANALYSIS DATA REPORT

SMPL NO.	INTERVAL TOP M	INTERVAL BASE M	REP THICK M	SAMPLE LENGTH M	GAS PERMEABILITY - Md KMAX	K90	KV	PORO-SITY	DENSITY,KG/M3 BULK	GRAIN	RESIDUAL SAT. FRAC OF PV OIL	WATER	VISUA EXAMI
23	645.55	645.80	0.25	0.13	0.30	0.26	0.11	0.069	2530	2720	0.499	0.501	LS,ANHY
DE	645.80	647.40	1.60										LS,ANHY,(
24	647.40	648.00	0.60	0.13	0.72	0.39	0.09	0.093	2510	2770	0.249	0.717	LS,ANHY
25	648.00	648.40	0.40	0.08	2.10	1.90	0.20	0.099	2450	2720	0.263	0.471	LS,MNR A
26	648.40	648.60	0.20	0.15	7.00	6.30	0.57	0.095	2440	2690	0.274	0.491	LS,MNR A
27	648.60	648.75	0.15	0.07	44.00	30.00	7.00	0.111	2390	2690	0.260	0.641	LS,MNR A
28	648.75	648.95	0.20	0.14	320.00	317.00	4.00	0.133	2330	2690	0.217	0.535	LS,MNR A
29	648.95	649.20	0.25	0.07	296.00	258.00	4.90	0.138	2340	2720	0.209	0.515	LS,MNR A
30	649.20	649.50	0.30	0.19	50.00	49.00	25.00	0.126	2370	2710	0.298	0.564	LS,MNR A
31	649.50	649.90	0.40	0.17	2.80	0.09	0.09	0.040	2550	2650	0.346	0.654	LS,CHT,P-
32	649.90	650.15	0.25	0.16	17.00	12.00	0.41	0.096	2450	2710	0.421	0.463	LS,MNR A
33	650.15	650.35	0.20	0.13	94.00	44.00	62.00	0.111	2390	2680	0.364	0.400	LS,MNR A
34	650.35	650.60	0.25	0.13	1150.00	1120.00	141.00	0.134	2330	2690	0.302	0.332	LS,MNR A
35	650.60	650.90	0.30	0.11	1.40	0.93	0.17	0.074	2510	2710	0.390	0.511	LS,MNR A
36	650.90	651.20	0.30	0.18	46.00	40.00	22.00	0.121	2370	2700	0.239	0.275	LS,MNR A
37	651.20	651.40	0.20	0.15	67.00	62.00	11.00	0.109	2410	2700	0.265	0.306	LS,MNR A
38	651.40	651.60	0.20	0.09	583.00	527.00	62.00	0.150	2300	2700	0.231	0.400	LS,MNR A
39	651.60	651.85	0.25	0.12	3.00	2.40	0.52	0.076	2500	2710	0.366	0.634	LS,MNR A
DE	651.85	654.00	2.15										LS,MNR A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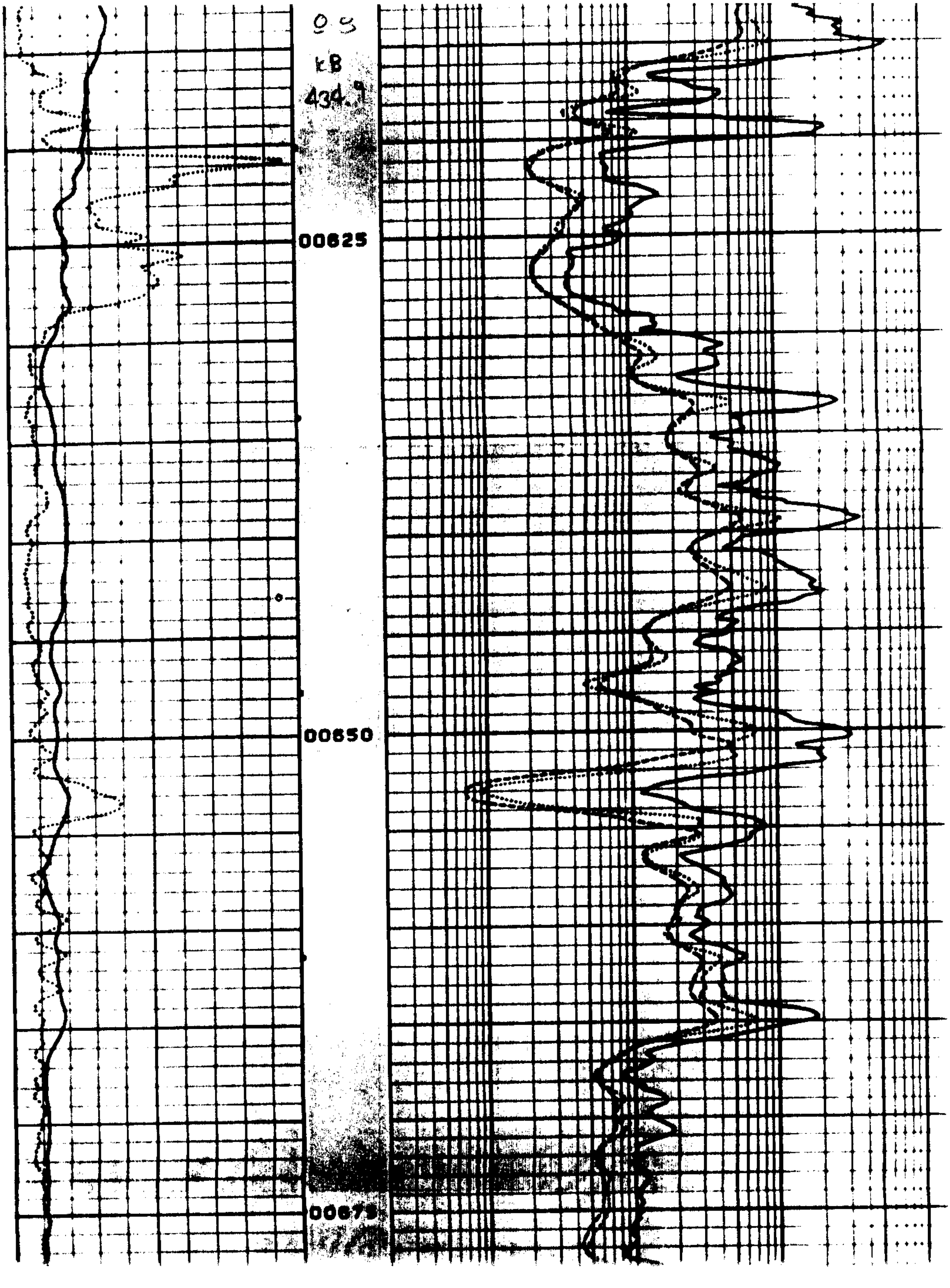
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434.9
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Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 8-8-9-25

Field : VIRDEN
Formation : LODGEPOLE

File No.: 52138-88-21
Date : 1988 01 18

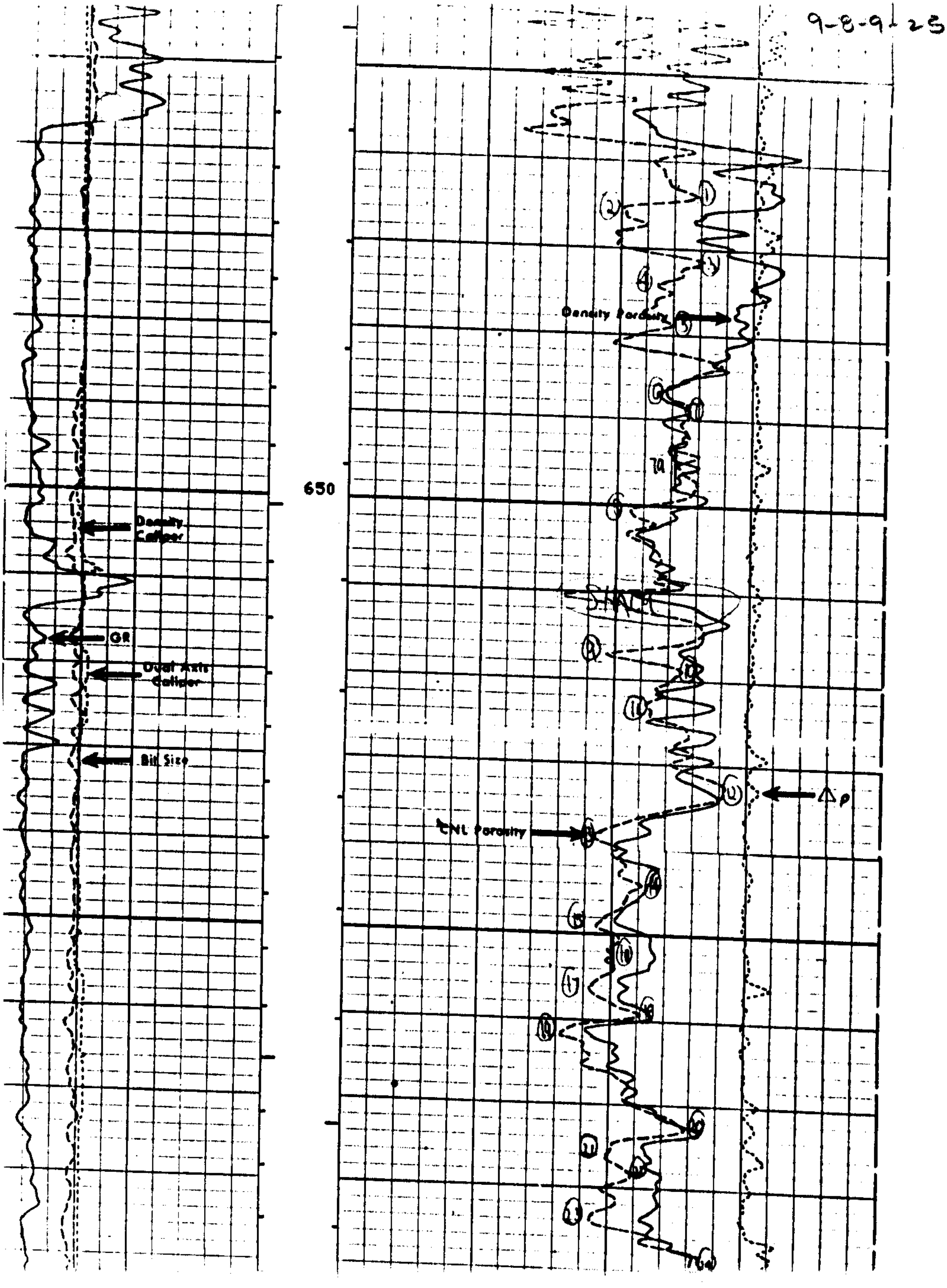
C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER		DEPTH m	INIVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ m	BULK DENSITY kg/m³	GRAIN DENSITY kg/m³	SATURATION (PORE VOLUME) OIL frac	SATURATION (PORE VOLUME) WATER frac	DESCRIPTION
	26	643.79- 44.29	0.50	0.18	0.08	0.04	0.05	0.040	0.041	0.020	2610.	2720.	0.080	0.814	ls i ppv gyp v frac
	27	644.29- 44.69	0.40	0.17	0.80	0.01	0.05	0.320	0.025	0.012	2640.	2710.	0.069	0.515	ls i ppv
	28	644.69- 45.44	0.75	0.23	0.26	0.20	0.02	0.195	0.051	0.038	2580	2720.	0.000	0.826	ls i ppv dol cht
	29	645.44- 45.89	.45	0.21	0.15	0.11	0.06	0.068	0.056	0.027	2560.	2710.	TRACE	0.712	ls i gyp anhy v frac
	30	645.89- 46.23	0.34	0.17	0.59	0.51	0.04	0.201	0.065	0.020	2510.	2710.	0.050	0.498	ls i gyp pyr
	31	646.23- 46.84	0.61	0.28	0.52	0.05	<.01	0.317	0.046	0.031	2590	2710.	0.160	0.544	ls i gyp pyr
	32	646.84- 47.35	0.51	0.13	1.31	0.39	0.01	0.668	0.035	0.020	2610.	2710.	0.000	0.699	ls i ppv anhy
	33	647.35- 47.88	0.53	0.19	0.63	0.63	0.28	0.334	0.117	0.064	2450	2770.	0.070	0.580	ls i ppv anhy cht
	34	647.88- 48.35	0.47	0.20	0.71	0.63	0.31	0.334	0.126	0.061	2430.	2780.	0.000	0.754	ls i ppv anhy
	35	648.35- 48.55	0.20	0.08	1.71	1.60	0.14	0.342	0.072	0.014	2490.	2690	0.113	0.441	ls i ppv anhy foss
	36	648.55- 48.79	0.24	0.19	45.2	43.6	18.8	10.848	0.092	0.022	2450.	2700.	0.281	0.132	ls i ppv
	37	648.79- 48.93	0.14	0.10	9.17	7.67	1.65	1.284	0.071	0.010	2510	2700.	0.196	0.196	ls i ppv
	38	648.93- 49.09	0.16	0.16	21.4	21.1	0.65	3.424	0.083	0.013	2470.	2700	0.249	0.217	ls i ppv mv foss v frac
	39	649.09- 49.30	0.21	0.08	13.9	10.5	8.07	2.919	0.095	0.019	2450.	2700.	0.241	0.153	ls i ppv
SP	40	649.30- 49.55	0.25	-	14.8	.	-	3.700	0.147	0.038	-	2890.	0.275	0.072	ls i ppv anhy API 27.0
	41	649.55- 49.79	0.24	0.23	12.3	0.03	<.01	2.952	0.047	0.012	2530.	2650.	0.294	0.378	ls i ppv cht v frac
	42	649.79- 50.09	0.30	0.14	0.87	0.43	<.01	0.261	0.020	0.006	2650.	2710.	0.000	0.414	ls i ppv anhy
	43	650.09- 50.30	0.21	0.11	10.3	9.38	32.5	2.163	0.070	0.015	2500.	2690.	0.208	0.231	ls i ppv v frac
	44	650.30- 50.78	0.48	0.11	2.55	1.29	0.11	1.224	0.031	0.014	2610.	2700.	0.000	0.328	ls i ppv sty
	45	650.78- 51.14	0.36	0.30	152.	85.6	18.3	54.720	0.079	0.029	2480.	2690.	0.238	0.207	ls i ppv
	46	651.14- 51.40	0.26	0.15	*	9.80	*	-	0.050	0.013	2530.	2700.	0.265	0.147	ls i ppv v frac
SP	47	651.40- 51.53	0.13	-	1.11	.	-	0.144	0.054	0.007	-	2700	0.314	0.232	ls i ppv anhy
	48	651.53- 51.77	0.24	0.11	*	0.23	*	-	0.069	0.017	2510.	2690.	0.119	0.347	ls i ppv foss
-		651.77- 54.30	2.53												sh shy dol anhy

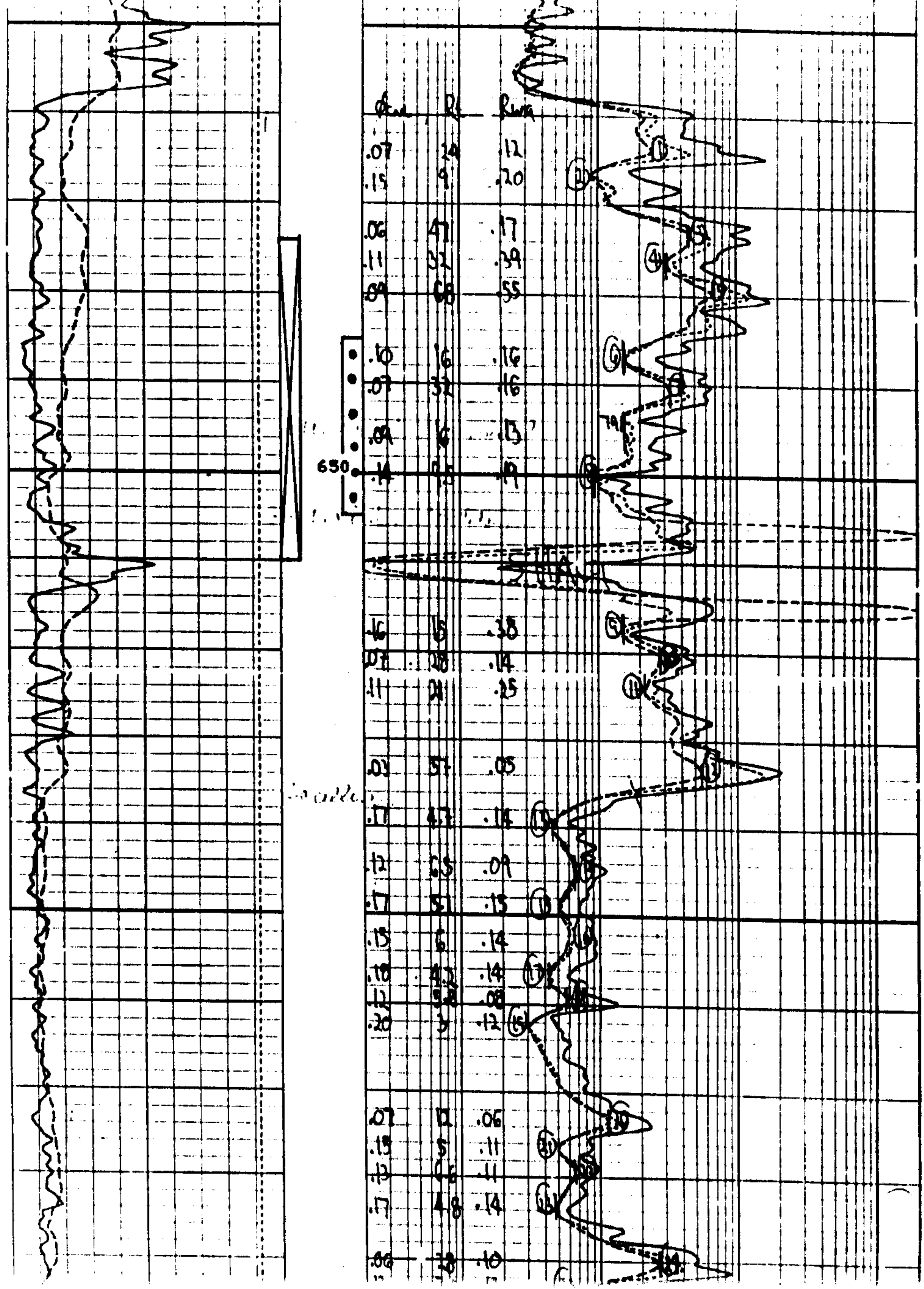
CORE NO. 2 654.00 m - 663.00 m (Core Received 9.00 m) (7 Boxes)

SAMPLE NUMBER	DEPTH m	INIVL REP m	SAMPLE LENGTH m	PERMEABILITY (MAXIMUM) Kair mD	PERMEABILITY (90 DEG) Kair mD	PERMEABILITY (VERTICAL) Kair mD	CAPACITY (MAXIMUM) Kair mD m	POROSITY (HELIUM) fraction	CAPACITY (HELIUM) ϕ m	BULK DENSITY kg/m³	GRAIN DENSITY kg/m³	SATURATION OIL frac	SATURATION WATER frac	DESCRIPTION
49	654.30- 54.96	0.66	0.15	0.12	0.08	<.01	0.079	0.091	0.059	2550	2810.	0.000	0.507	ls i ppv dol anhy
50	654.96- 55.21	0.25	0.12	43.8	2.07	0.24	10.950	0.055	0.013	2560	2710	0.000	0.514	ls i ppv v frac

9-8-9-25


650
Density Caliper
GR
Dual Axis Caliper
Bit Size
Density Porosity
CNL Porosity
Δρ

9-8-9-25



Φ R Rwa
.07 14 .12
.15 9 .20
.06 47 .17
.11 32 .39
.09 68 .55
.10 16 .16
.07 32 .16
.09 16 .13
650 .14 15 .19
.16 15 .38
.07 28 .14
.11 21 .15
.03 57 .05
.17 4.7 .14
.12 6.5 .09
.17 5.1 .15
.15 6 .14
.10 4.2 .14
.12 5.8 .08
.20 3 .12
.07 12 .06
.15 5 .11
.13 6.6 .11
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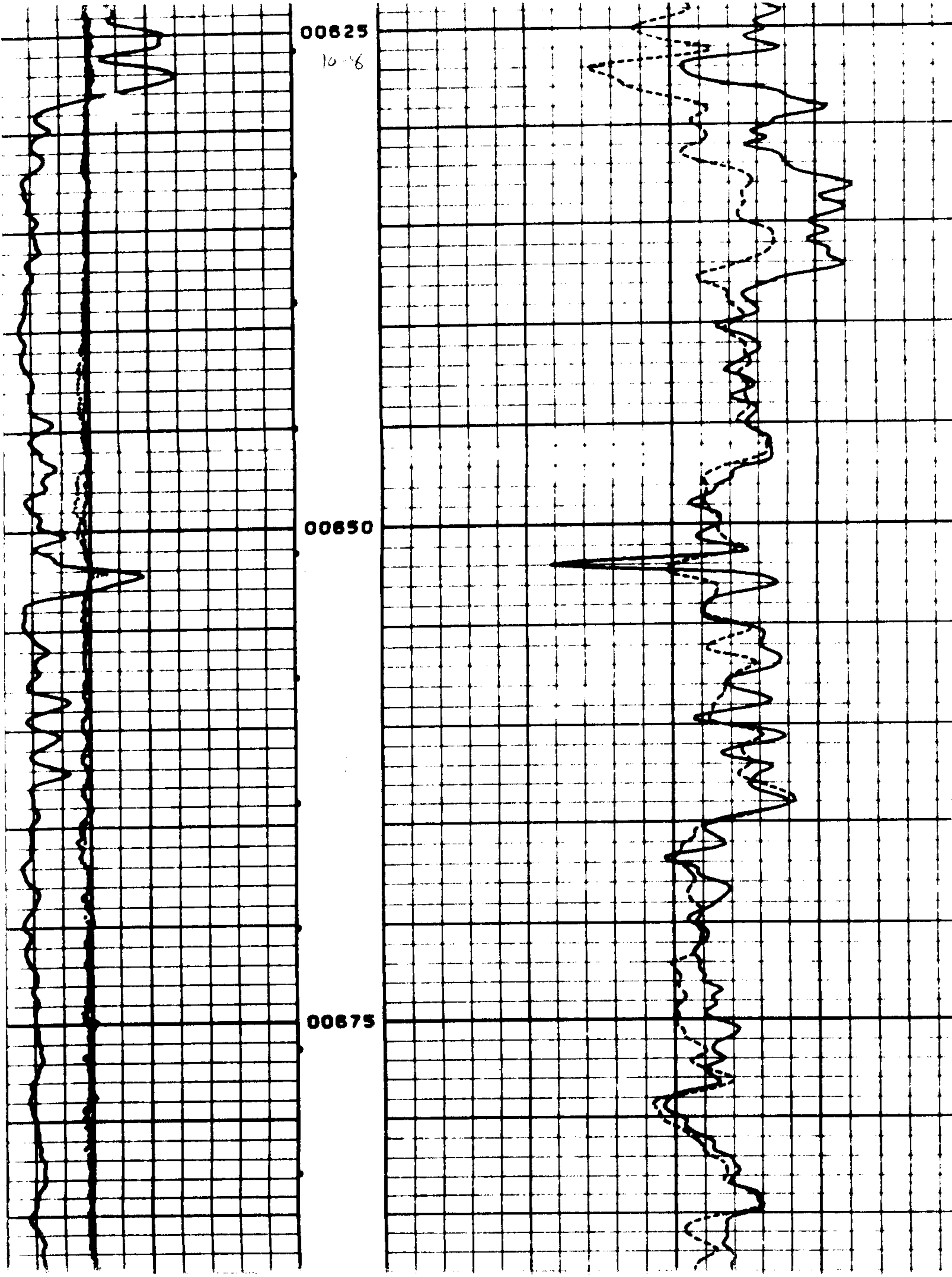
.06 38 .10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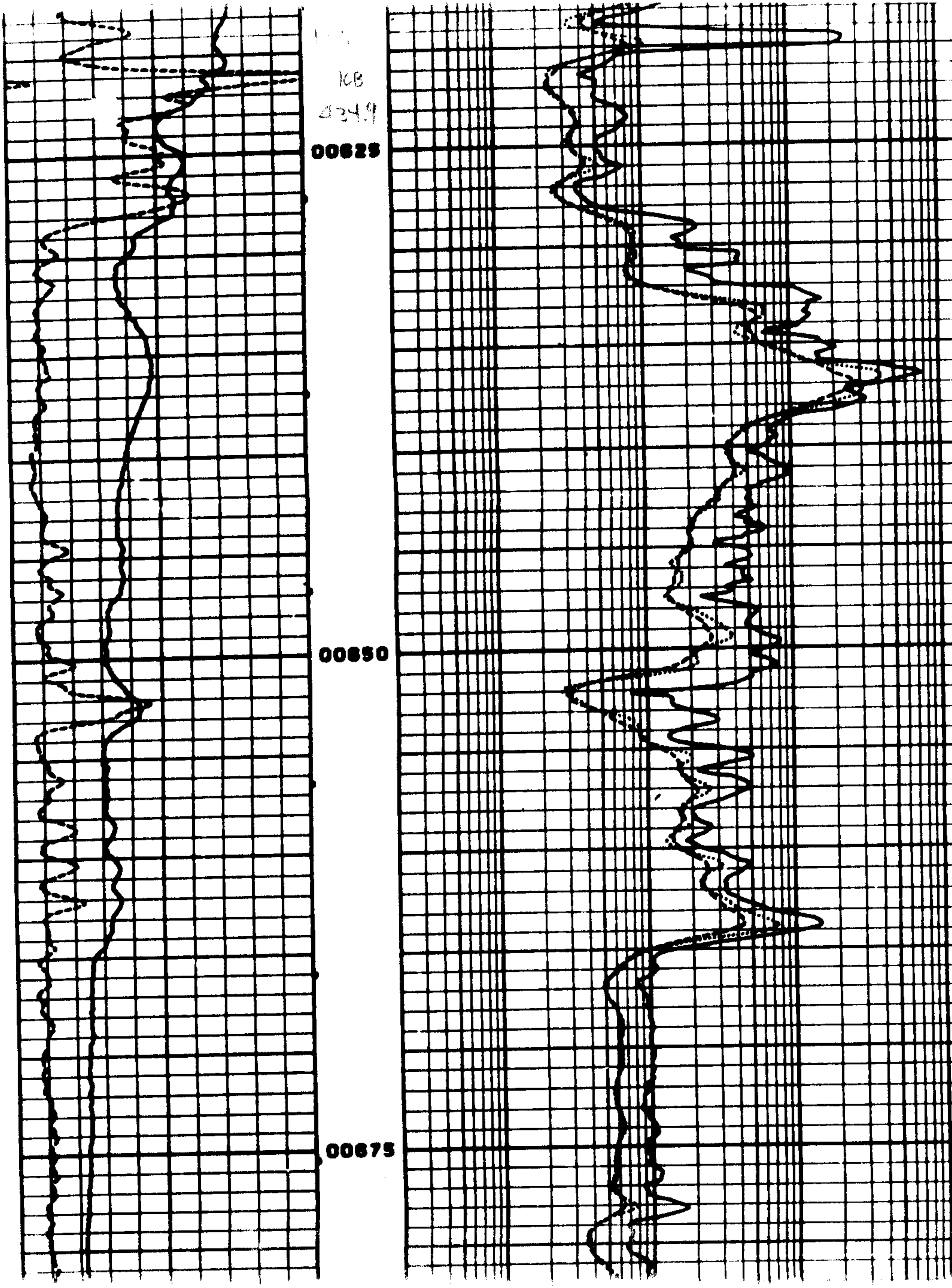
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10-8-9-25 W1

Chevron Virden 10-8-9-25

FIELD OR AREA: Virden

POOL OR ZONE:

NAME OF SAMPLER:

COMPANY: A & A Coring

TEST TYPE: DST NO: 2

MULTIPLE RECOVERY: Y [ ] N [X]

TEST RECOVERY: 420 m frothy gassy oil / 211 m salt water

SAMPLING POINT: 620 m From Surface

AMT & TYPE OF CUSHION:

MUD RESISTIVITY: @ 25°C

TEST INTERVAL (metres): 644.98 - 653.80

PERFORATIONS (metres):

TYPE OF PRODUCTION: PUMPING / FLOWING / GAS LIFT / SWAB

PRODUCTION RATES: WATER m³/d / OIL m³/d / GAS 10³m³/d

	SEPARATOR	TREATER	RESERVOIR	SOURCE	SAMPLED	RECEIVED
GAUGE PRESSURE kPa						
TEMPERATURE °C						

DATE SAMPLED (Y-M-D): 1986-12-13

DATE RECEIVED (Y-M-D): 1986-12-15

DATE REPORTED (Y-M-D): 1986-12-22

ANALYST: G. Hansen

OTHER INFORMATION: TIGHT HOLE

ION	Mg/l	Mass Fraction	Meq/l
Na	13 330	0.2939	579.86
K	1 626	0.0358	41.63
Ca	1 201	0.0265	59.93
Mg	510	0.0112	41.92
Ba			
Sr			
Fe	PRESENT		

ION	Mg/l	Mass Fraction	Meq/l
Cl	23 700	0.5225	668.34
Br			
I			
HCO_3	1 159	0.0255	19.01
SO_4	3 837	0.0846	79.81
CO_3	0	0.0000	0.00
OH	0	0.0000	0.00
H_2S	PRESENT		

TOTAL SOLIDS Mg/l

EVAPORATED @ 110°C: 45 660

EVAPORATED @ 180°C:

AT IGNITION: 41 890

CALCULATED: 45 363

ORGANICS: TRACE

RELATIVE DENSITY: 1.033 @ 15°C

REFRACTIVE INDEX: 1.3406 @ 25°C

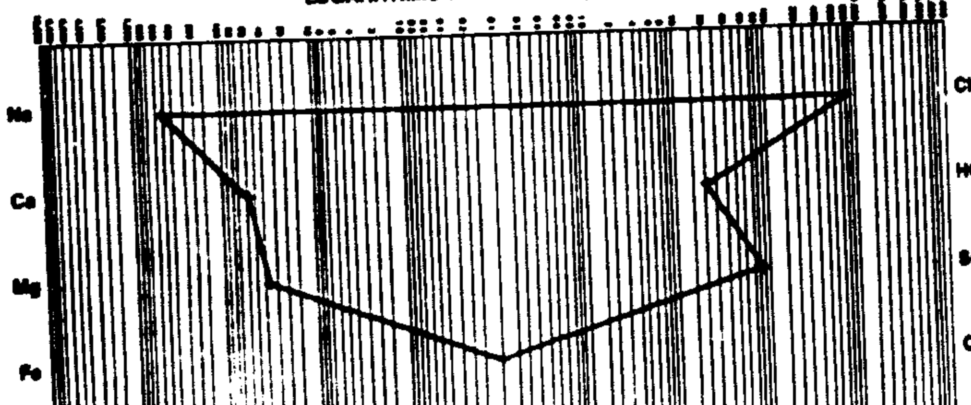
OBSERVED pH: 6.8 @ 22°C

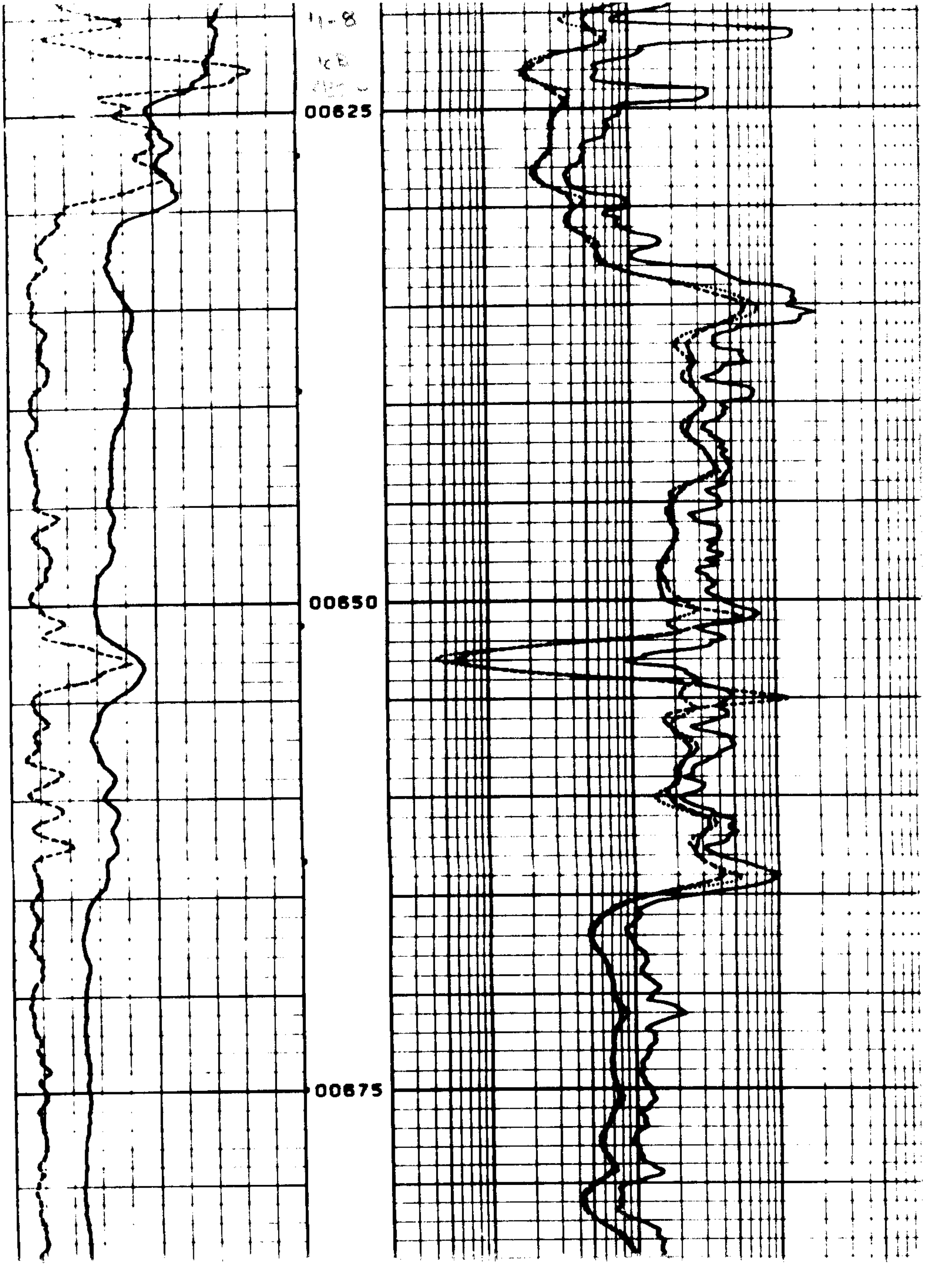
RESISTIVITY (Ohm·m): 0.162 @ 25°C

REMARKS

Clear, colorless filtrate recovered from a sample containing a trace sediment, a trace of hydrocarbons and hydrogen sulfide.

LOGARITHMIC PATTERN Meq/l





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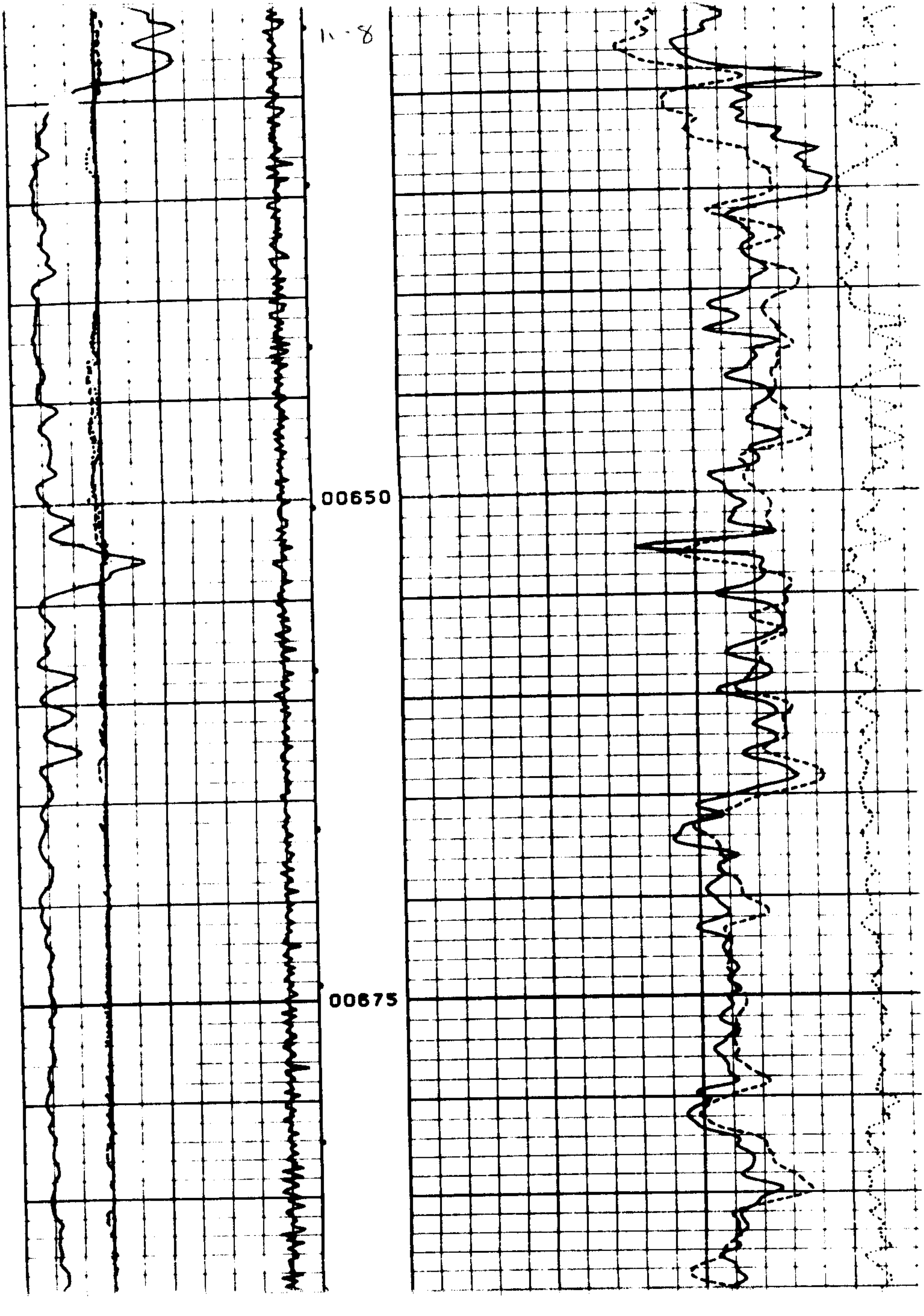
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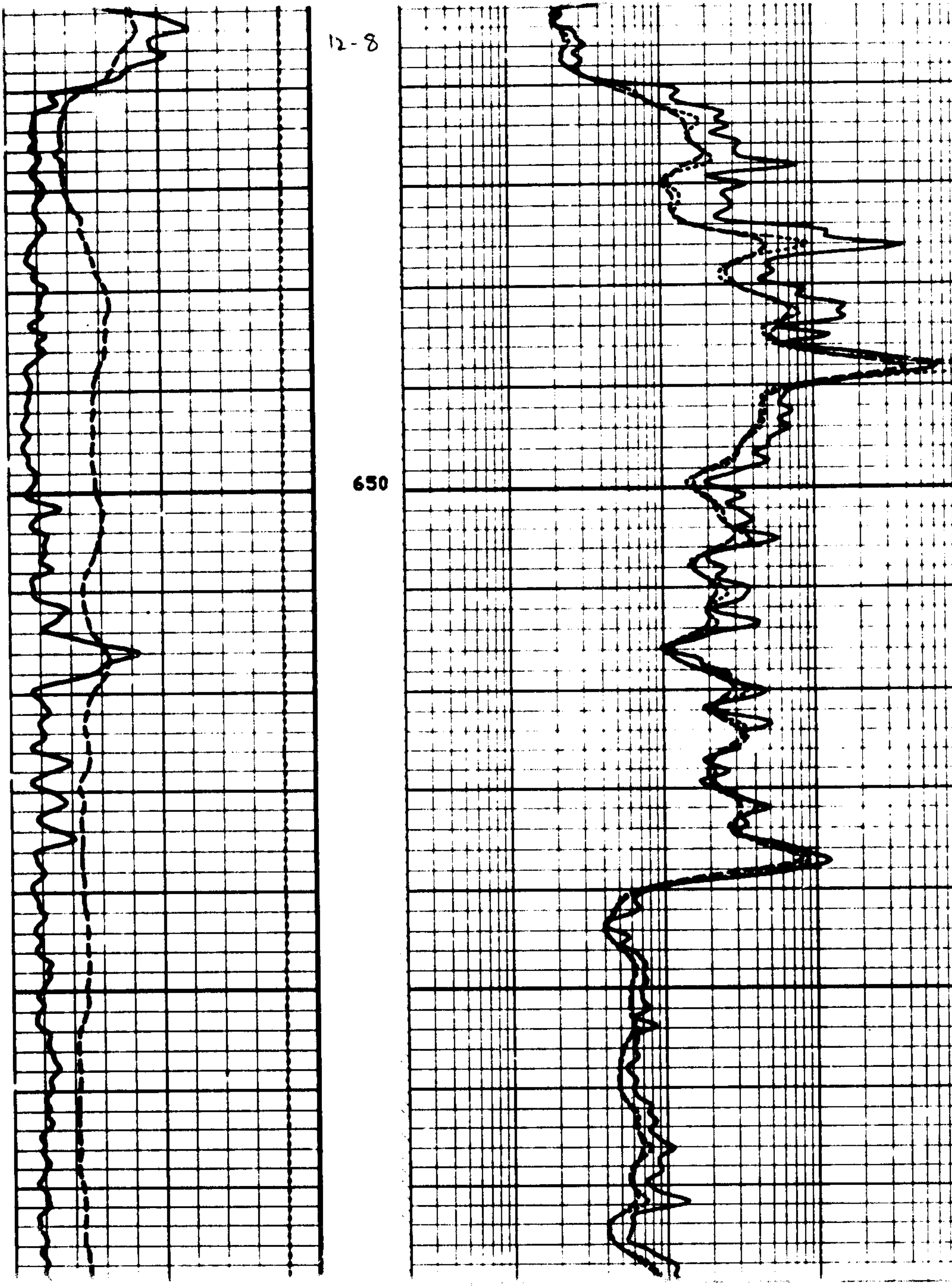
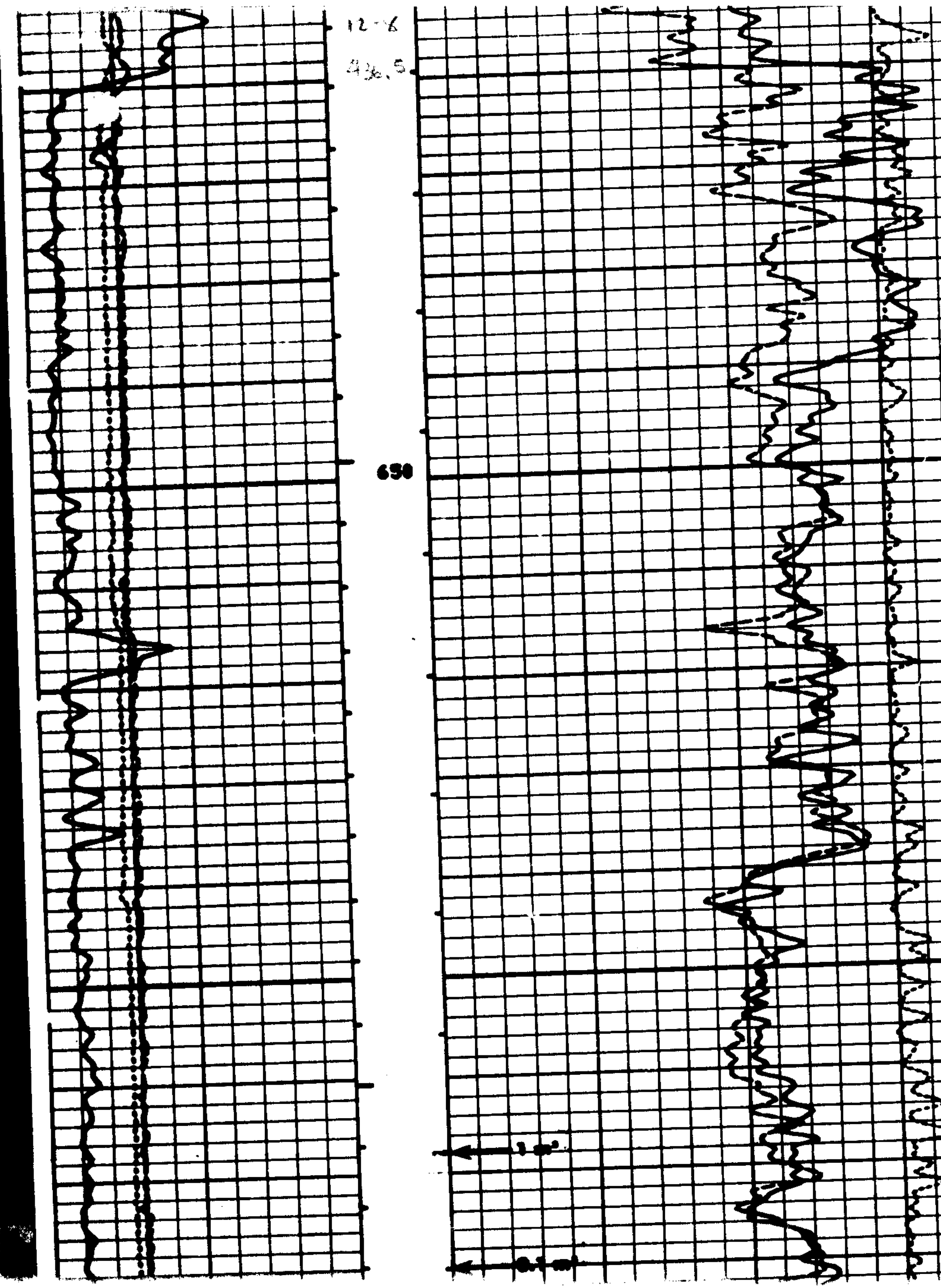

12-8
650



12-6
436.5
650

CORE LABORATORIES

Company : CHEVRON CANADA RESOURCES LIMITED
Well : CHEVRON VIRDEN 12-8-9-25

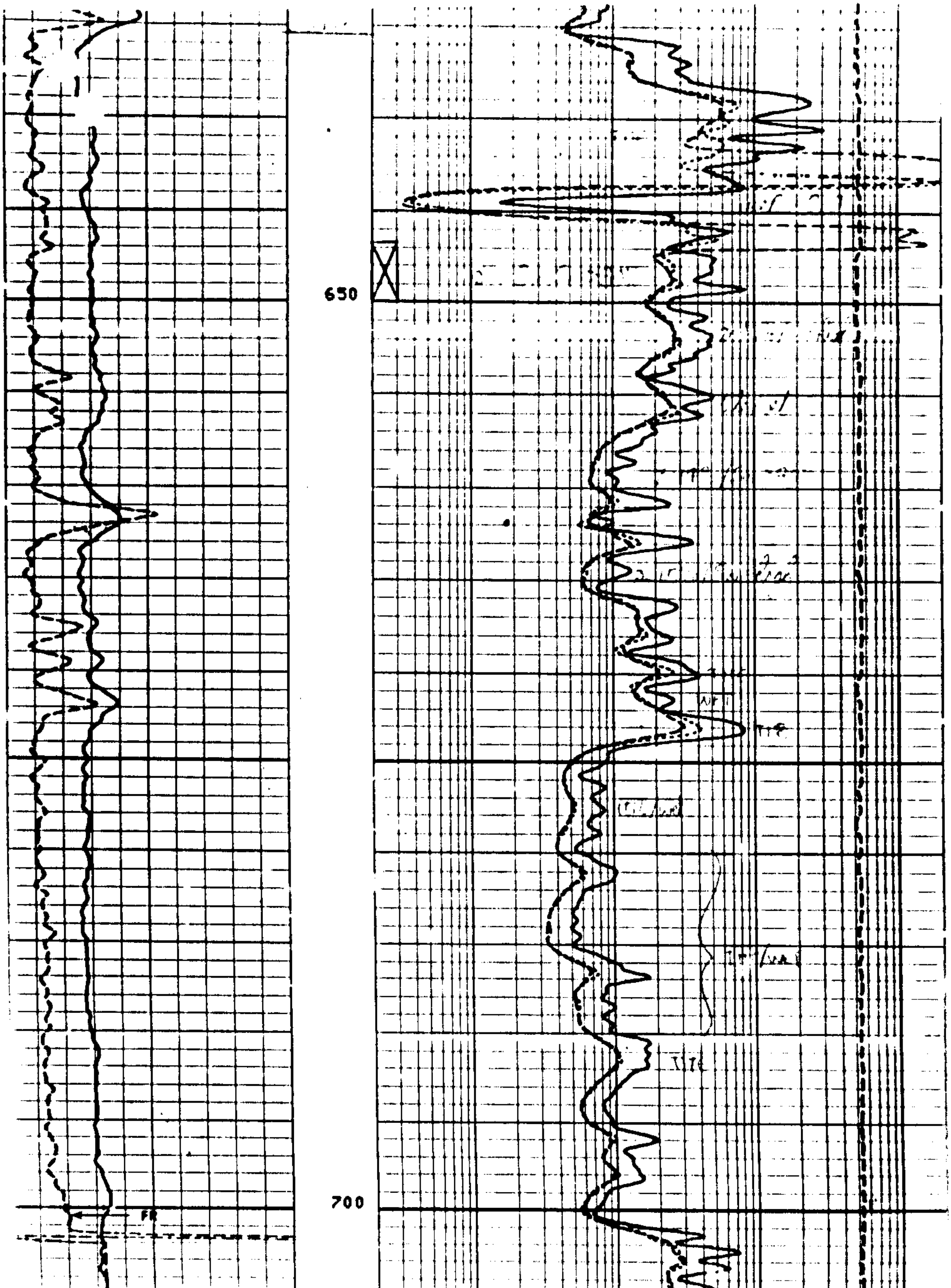
Field : VIRDEN
Formation : LODGEPOLE

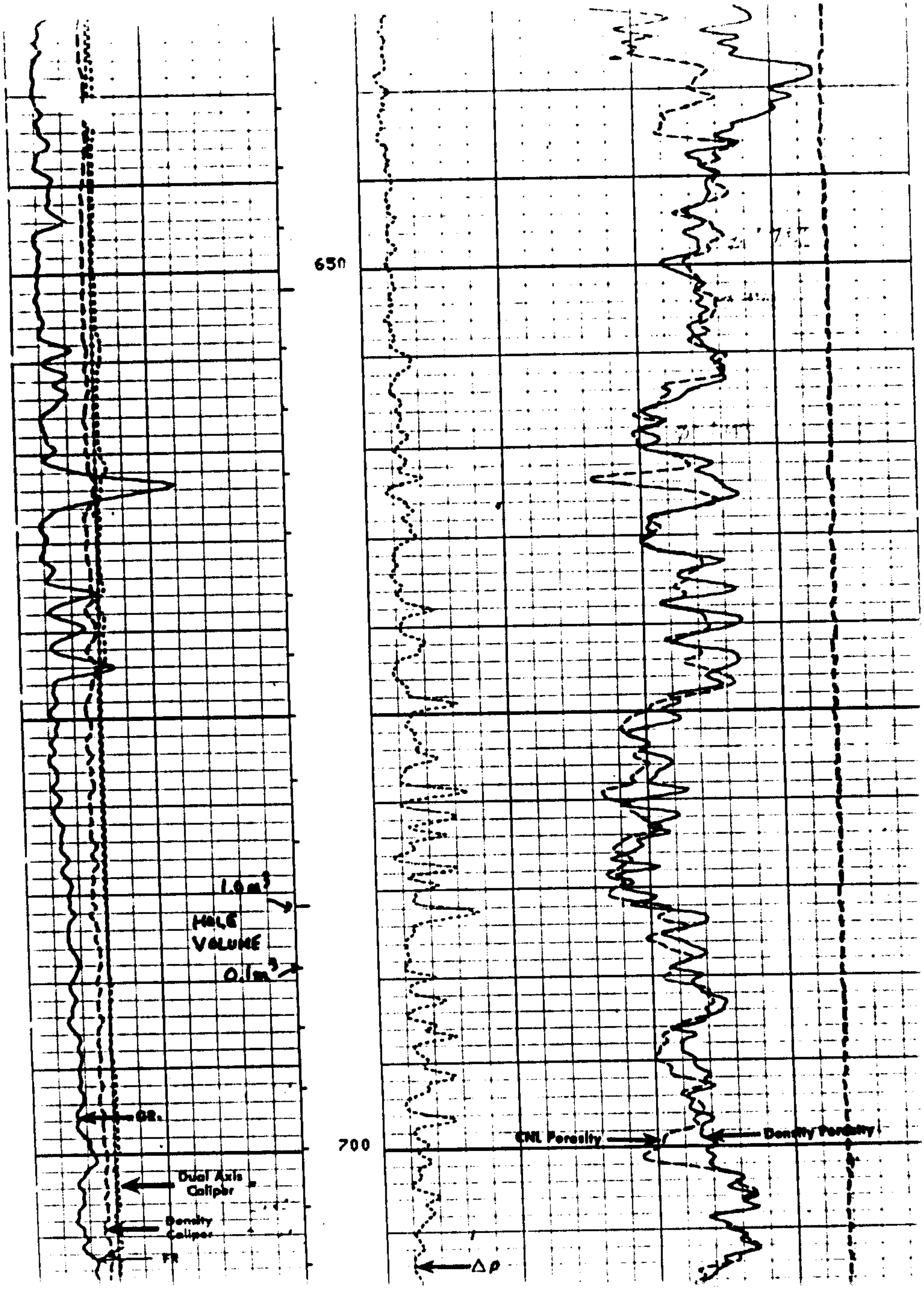
File No.: 52138-88-19
Date : 1988 06 09

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH	INTVL REP	SAMPLE LENGTH	PERMEABILITY (MAXIMUM) Kair	PERMEABILITY (90 DEG) Kair	PERMEABILITY (VERTICAL) Kair	CAPACITY (MAXIMUM) Kair	POROSITY (HELIUM)	CAPACITY (HELIUM)	BULK DENSITY	GRAIN DENSITY	SATURATION (PORE VOLUME) OIL	SATURATION (PORE VOLUME) WATER	DESCRIPTION
	m	m	m	mD	mD	mD	mD-m	fraction	ϕ-m	kg/m3	kg/m3	frac	frac	
43	651.41- 51.66	0.25	0.14	0.56	0.45	0.01	0.140	0.062	0.015	2580.	2750.	0.000	0.848	ls i ppv dol cht
44	651.66- 51.99	0.33	0.21	0.06	0.03	0.03	0.020	0.060	0.020	2560.	2720.	0.000	0.844	ls i dol gyp cht vfrac
45	651.99- 52.13	0.14	0.09	0.03	0.01	*	0.004	0.057	0.008	2610.	2760.	0.000	0.723	ls i dol gyp vfrac
46	652.13- 52.32	0.19	0.08	0.05	0.04	0.03	0.009	0.068	0.013	2580.	2770.	0.000	0.864	ls i ppv dol gyp
47	652.32- 52.65	0.33	0.07	1.26	1.18	0.35	0.416	0.077	0.026	2510.	2720.	0.000	0.730	ls i ppv sv dol gyp cht
48	652.65- 53.03	0.38	0.16	0.53	0.50	0.32	0.201	0.096	0.038	2500.	2770.	0.000	0.933	ls i ppv dol
49	653.03- 53.15	0.12	0.09	0.36	0.36	0.13	0.043	0.122	0.014	2440.	2780.	0.000	0.865	ls i dol foss
50	653.15- 53.36	0.21	0.07	16.1	13.1	2.05	3.381	0.127	0.027	2400.	2750.	0.000	0.747	ls i ppv foss anhy
51	653.36- 53.63	0.27	0.15	13.3	12.9	1.09	3.591	0.115	0.032	2420.	2730.	0.000	0.548	ls i ppv foss
52	653.63- 53.88	0.25	0.15	4.68	4.37	2.08	1.170	0.108	0.027	2430.	2720.	0.000	0.913	ls i ppv foss gyp vfrac
53	653.88- 54.15	0.27	0.24	43.8	40.9	3.76	11.826	0.129	0.035	2370.	2720.	0.000	0.925	ls i ppv foss gyp
54	654.15- 54.34	0.19	0.12	156.	156.	2.42	29.640	0.130	0.025	2350.	2710.	0.000	0.766	ls i ppv sv foss
55	654.34- 54.53	0.19	0.10	61.5	57.1	16.3	11.685	0.110	0.021	2410.	2700.	0.000	0.658	ls i ppv sv foss
56	654.53- 54.78	0.25	0.10	17.8	16.1	1.47	4.450	0.123	0.030	2380.	2710.	0.000	0.755	ls i ppv sv foss
57	654.78- 55.12	0.34	0.19	20.2	19.6	7.57	6.868	0.094	0.031	2440.	2700.	0.000	0.652	ls i ppv sv foss gyp
58	655.12- 55.32	0.20	0.14	0.66	0.59	0.11	0.132	0.082	0.016	2500.	2720.	0.000	0.554	ls i mv sv sh bk foss gyp
59	655.32- 55.54	0.22	0.17	4.43	3.96	0.46	0.975	0.096	0.022	2450.	2710.	0.000	0.773	ls i ppv foss sh bk
60	655.54- 55.88	0.34	0.09	5.74	5.19	1.25	1.952	0.109	0.037	2410.	2700.	0.000	0.826	ls i ppv foss sty
61	655.88- 56.11	0.23	0.15	13.4	10.4	3.61	3.082	0.101	0.023	2440.	2710.	0.000	0.748	ls i ppv foss gyp vfrac
62	656.11- 56.36	0.25	0.09	2.58	2.46	0.64	0.645	0.089	0.023	2470.	2720.	0.000	0.761	ls i ppv foss
63	656.36- 56.63	0.27	0.10	0.08	0.08	0.05	0.022	0.076	0.022	2520.	2730.	0.000	0.590	ls i ppv foss anhy
64	656.63- 56.85	0.22	0.13	0.03	0.03	0.02	0.007	0.098	0.022	2500.	2780.	0.000	0.753	ls i dol anhy
	656.85- 57.05	0.20	0.17	0.06	0.05	0.02	0.012	0.068	0.014	2540.	2730.	0.000	0.791	ls i ppv dol vfrac
66	657.05- 57.33	0.28	0.08	0.05	0.04	0.03	0.014	0.143	0.039	2410.	2810.	0.000	0.841	dol i h frac
67	657.33- 57.62	0.29	0.21	0.04	0.04	0.03	0.012	0.123	0.035	2430.	2780.	0.000	0.887	dol i lmy foss
68	657.62- 57.85	0.23	0.09	0.02	0.02	0.01	0.005	0.087	0.021	2520.	2760.	0.000	0.810	ls i dol foss
	657.85- 58.00	0.15												Lost core

16-12-9-26 KB 436





650
1.0 m³
HOLE
VOLUME
0.1 m³
GR
700
CNL Porosity
Density Porosity
Dual Axis
Caliper
Density
Caliper
FR
Δρ

IPR - 8-18-9-25

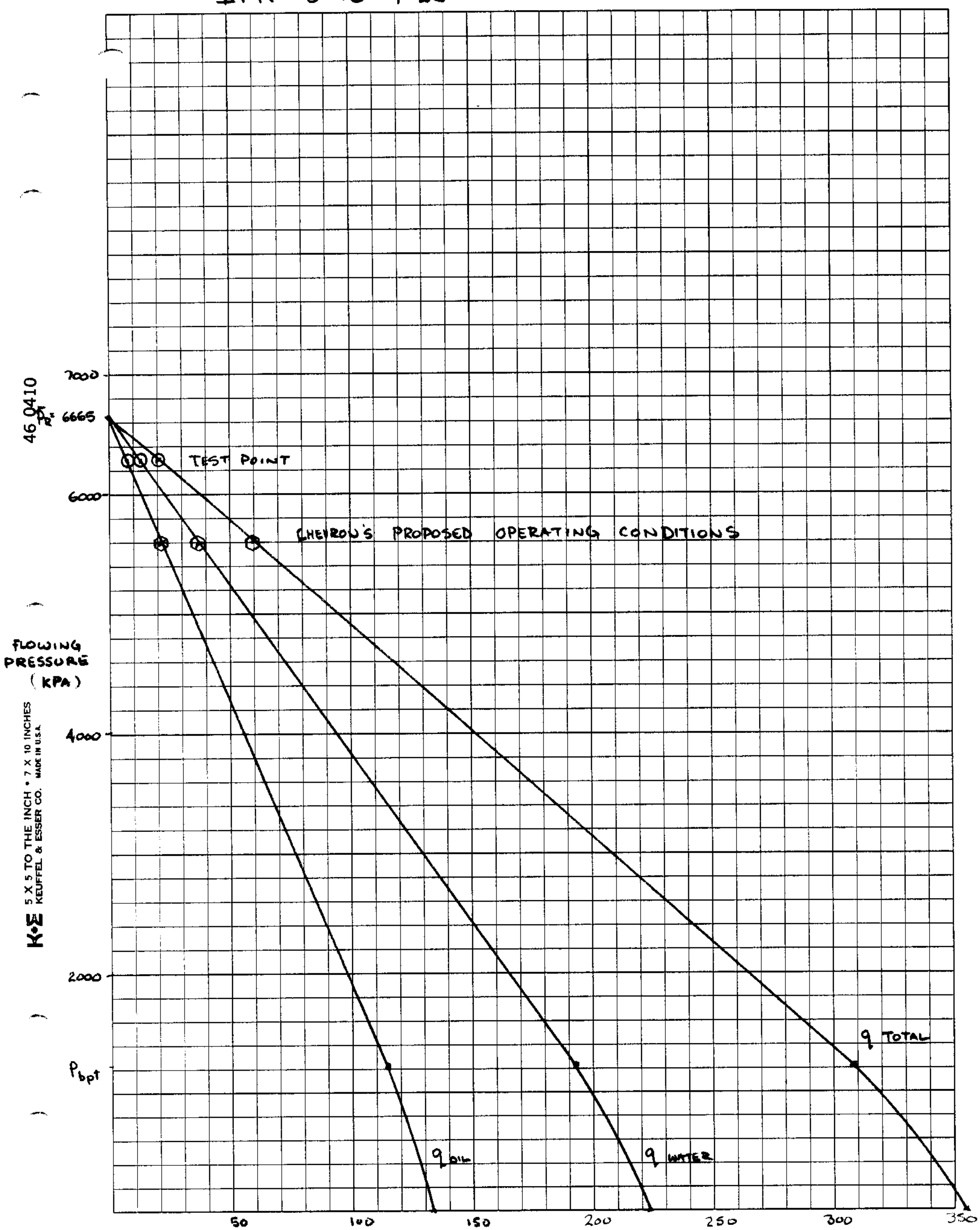


FIG. 2

IPR - 9-18-9-25

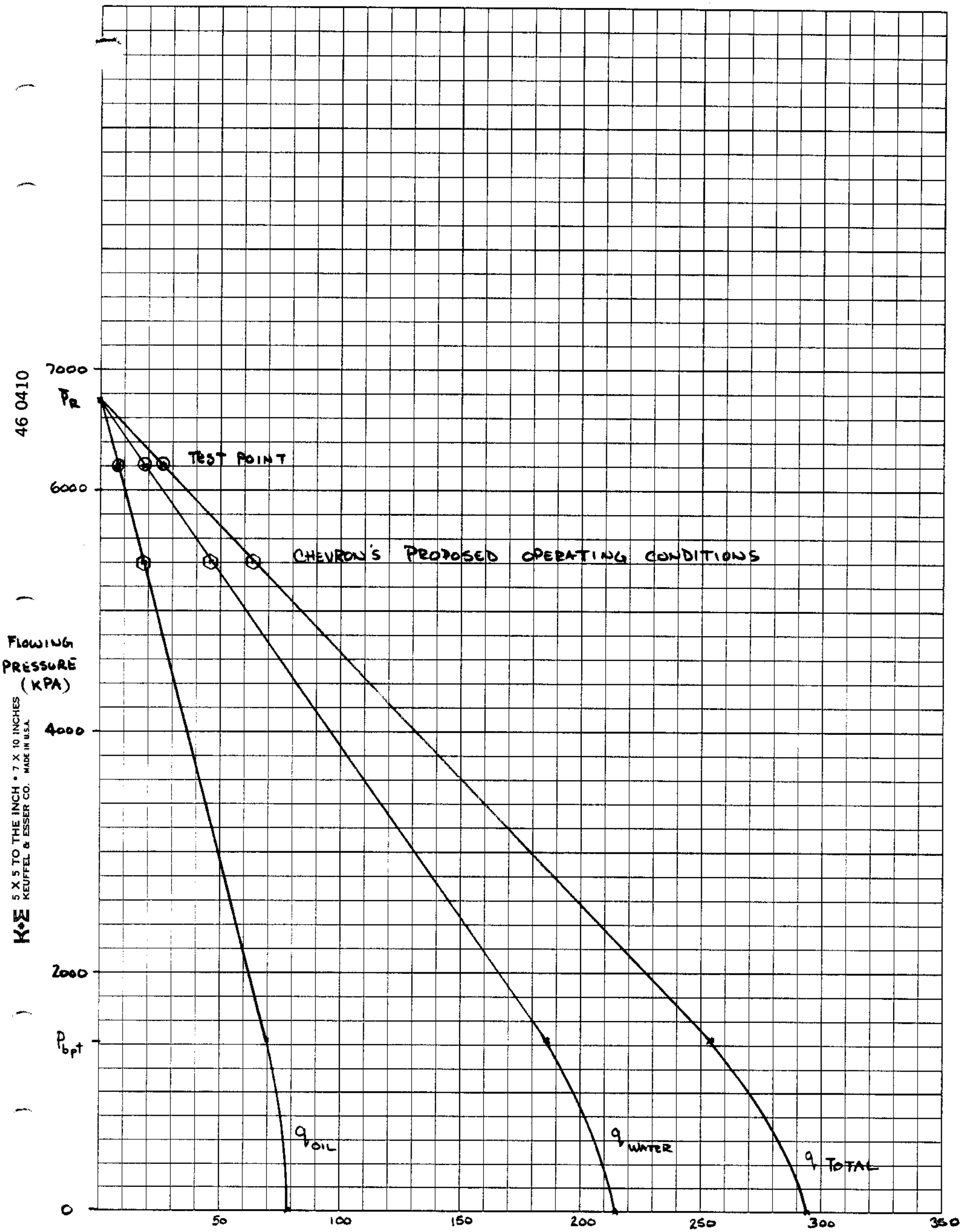


FIG. 3

(0) 07-08-009-25 W1M (0)

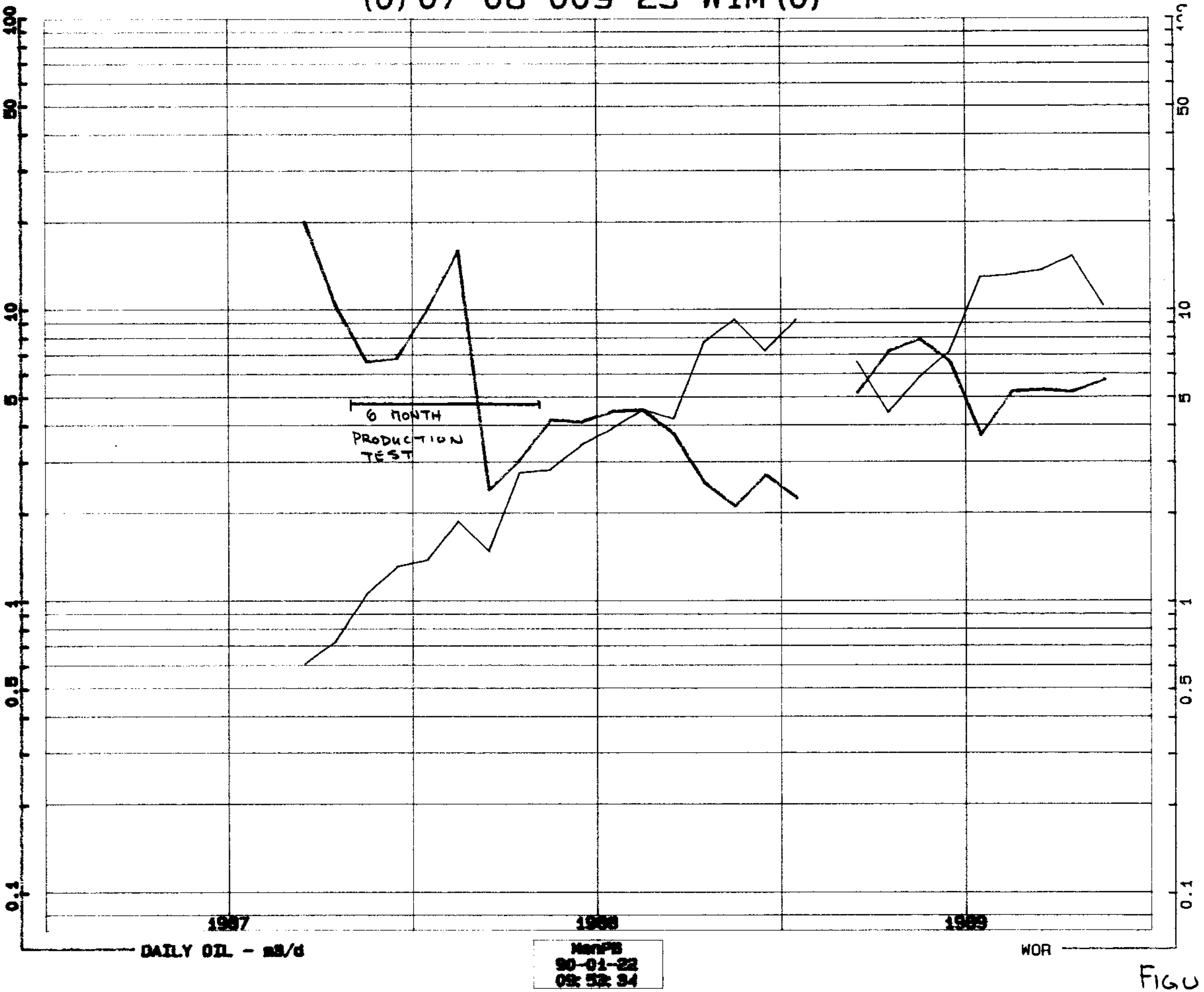


FIGURE 5

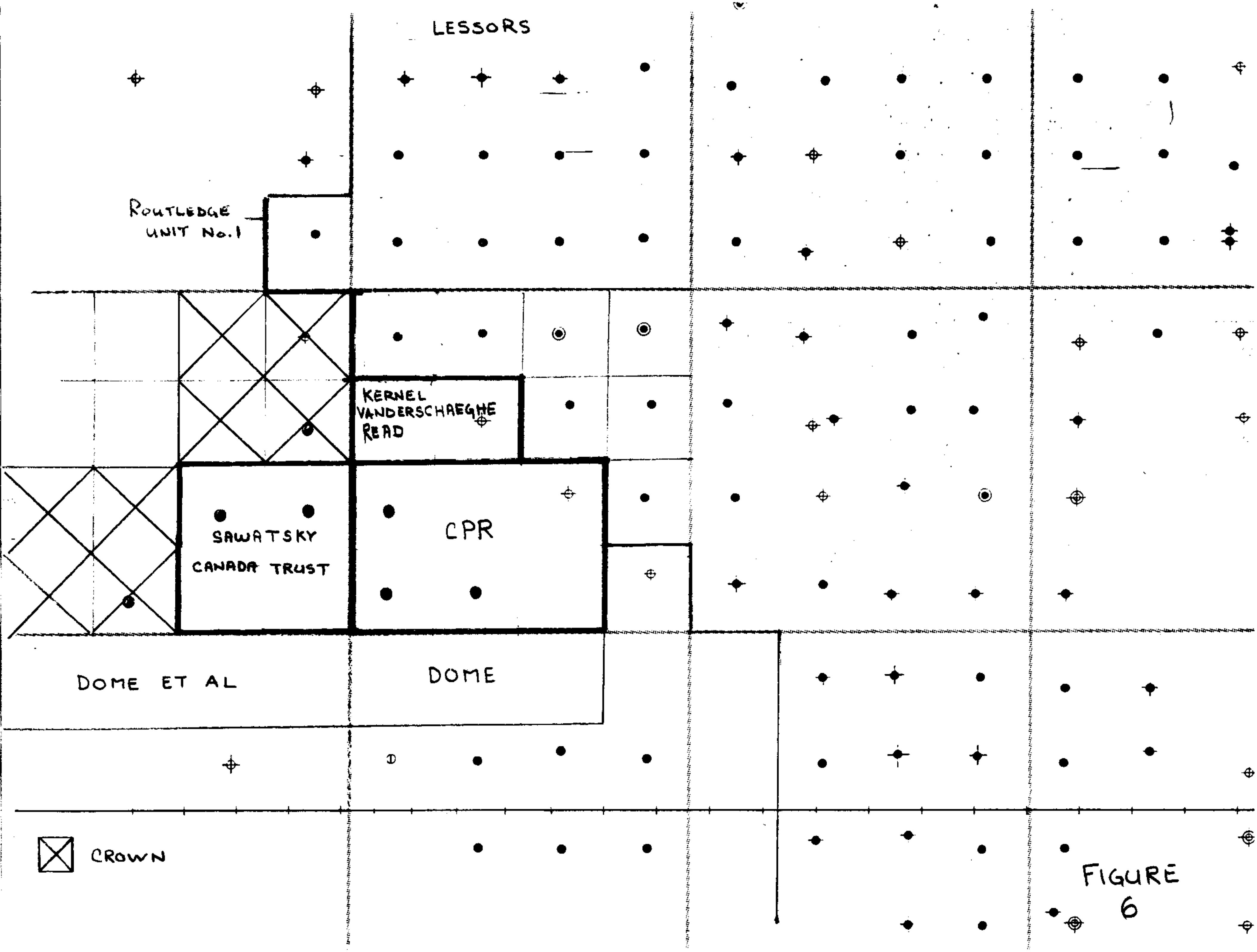

LESSORS
ROUTLEDGE
UNIT No. 1
KERNEL
VANDERSCHAEGHE
READ
SAWATSKY
CANADA TRUST
CPR
DOME ET AL
DOME
CROWN

FIGURE 6

LESSEES

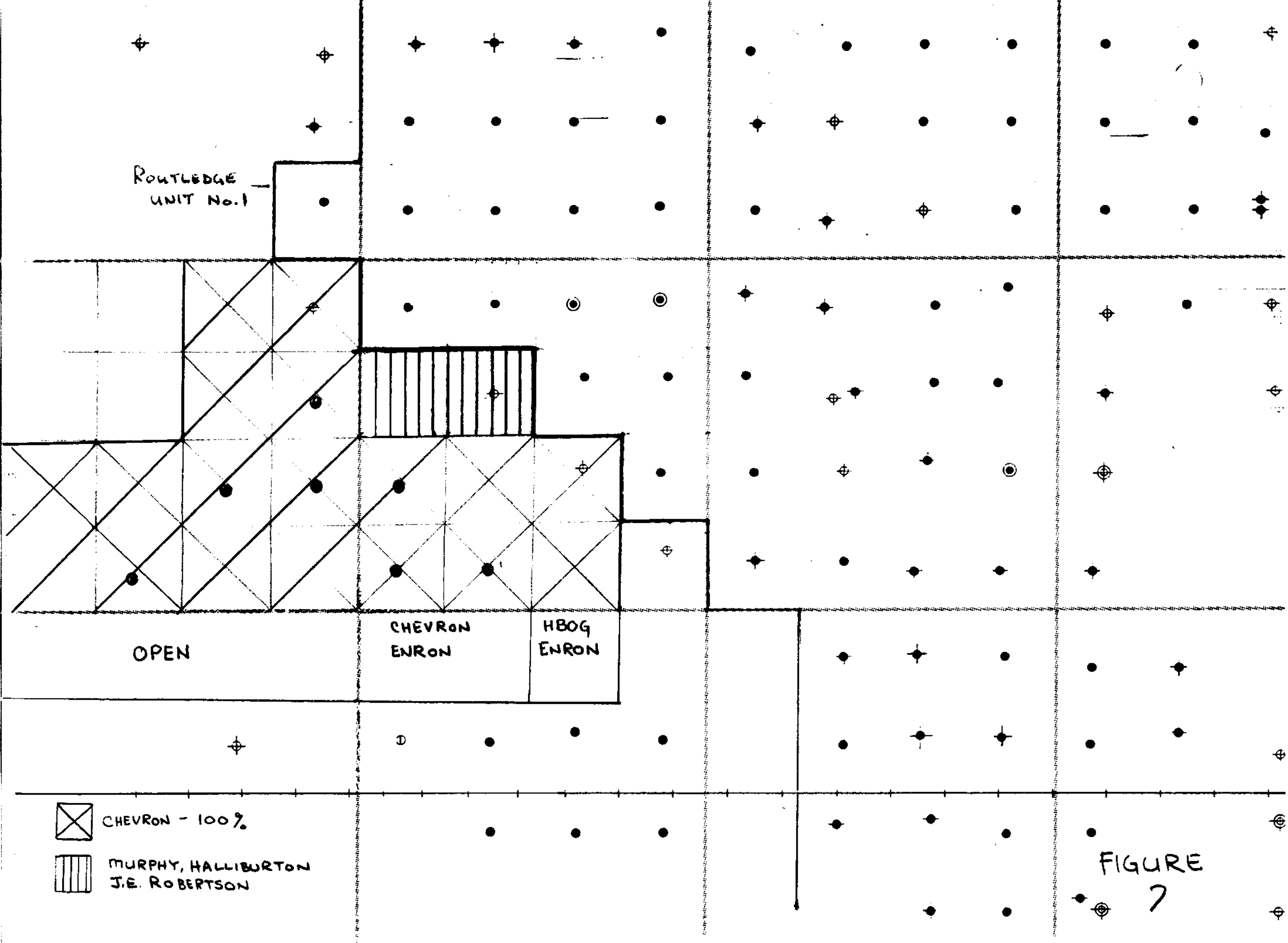
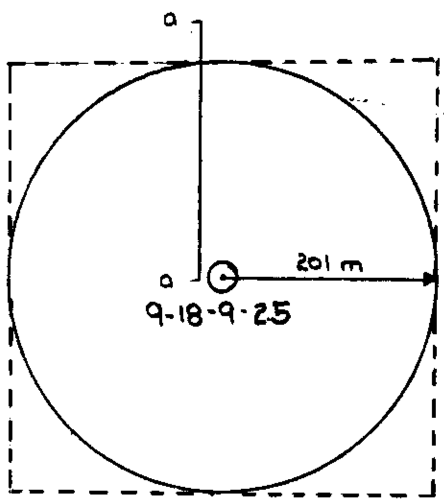


FIGURE 7

PROPOSED PRODUCING CONDITIONS



SINGLE WELL IN 16 HA
SPACING UNIT

PRESSURE DISTRIBUTION
IN RESERVOIR

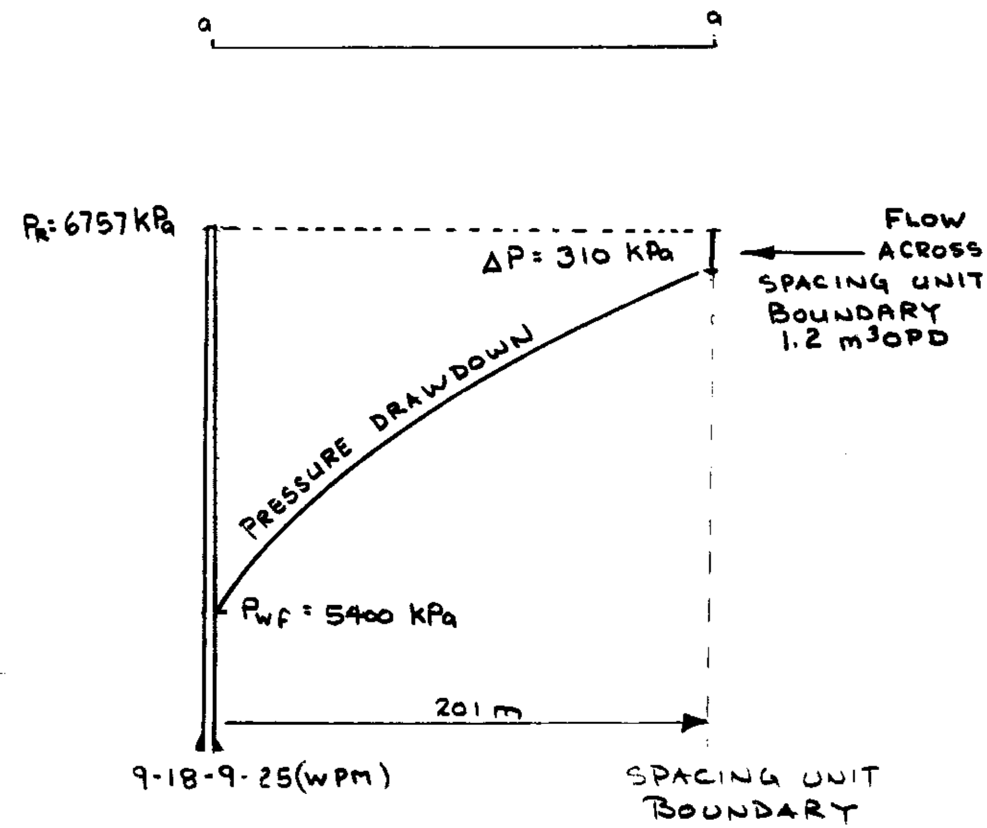


FIGURE 8

POTENTIAL DRAINAGE

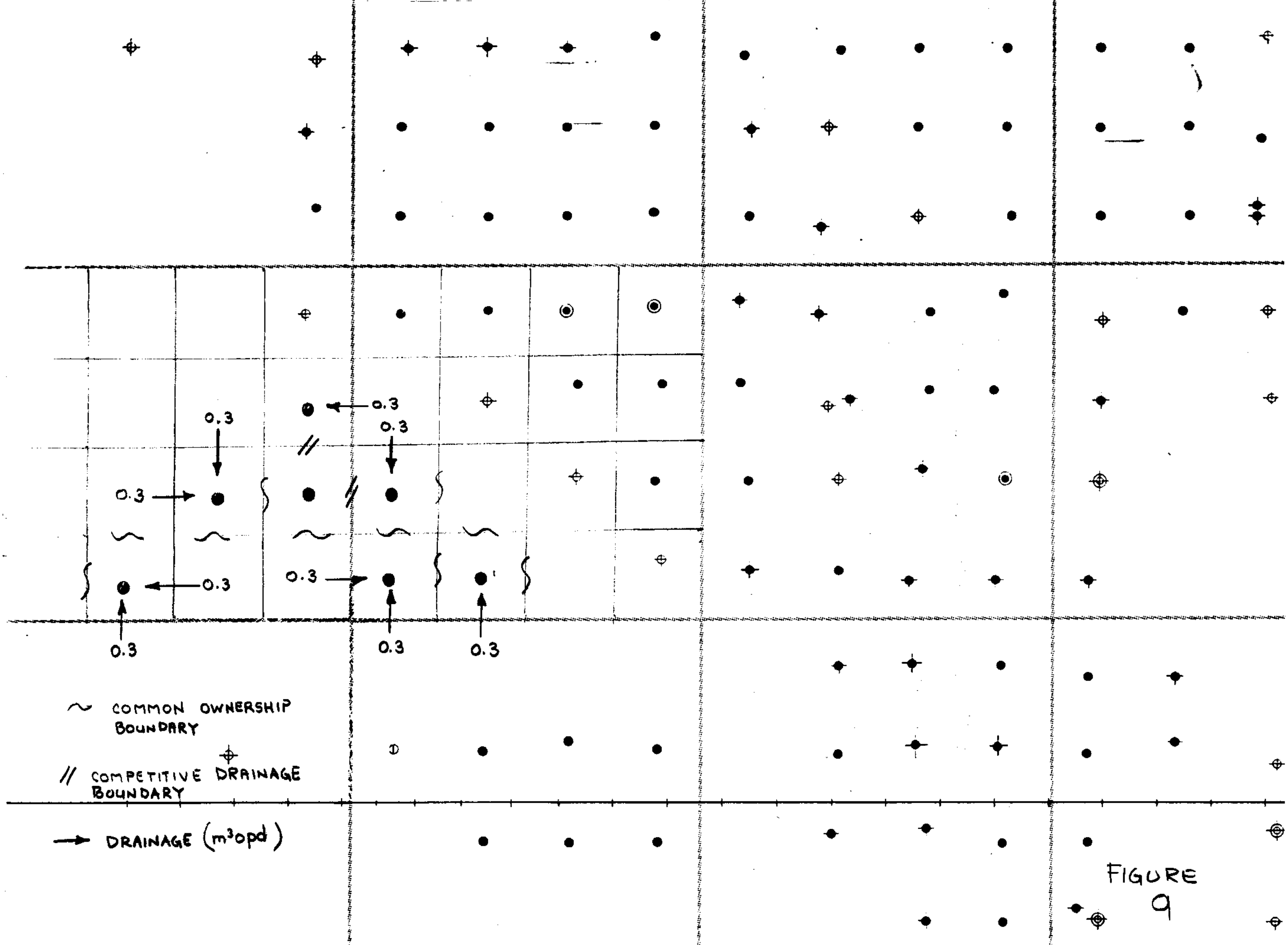


FIGURE 9

Chevron

Chevron Canada Resources
500 - Fifth Avenue S.W., Calgary, Alberta T2P 0L7
Phone (403) 234-5000 Fax (403) 234-5947

K.E. Godard
Chief Engineer

1990-01-30

FEB 5
PETROLEUM BRANCH

CONFIDENTIAL

Routledge Field
Sec. 17, 18-9-25 W1M
Lodgepole Production
Application to Amend MPPR
Additional Information

Manitoba Energy and Mines
Petroleum Branch
Eaton Place
555, 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3

Attention: Mr. John Fox

Gentlemen:

At your request, a structure map on the top of the Upper Whitewater Formation is being sent to you herewith. It is understood the map will be maintained in confidence. In addition, the following information on the seven wells is provided.

Well	Date	Recent Production Oil (m^3/d)	Recent Production Water (m^3/d)	W.C. (%)	Estimated Flowing Bottomhole Pressure (kPa)
3-17-9-25 WPM	1989-12	10.0	0.6	6	5 700
4-17-9-25 WPM	1989-12	10.0	3.0	23	5 900
5-17-9-25 WPM	1989-12	10.0	0.6	6	5 700
3-18-9-25 WPM	1990-01	6.3	25.2	80	6 700
7-18-9-25 WPM	1989-12	9.0	9.0	50	6 300
8-18-9-25 WPM	1990-01	10.2	18.1	64	6 500
9-18-9-25 WPM	1990-01	13.1	52.4	80	6 600

The estimated bottomhole pressure values are very approximate. Noting the initial reservoir pressure is 6 757 kPa as determined at the 9-18-9-25 WPM well, it is obvious the reservoir drawdown is minimal. The proposed rate increase will be very small in terms of the total possible rate increase and is therefore expected to have a minor impact on drawdown.

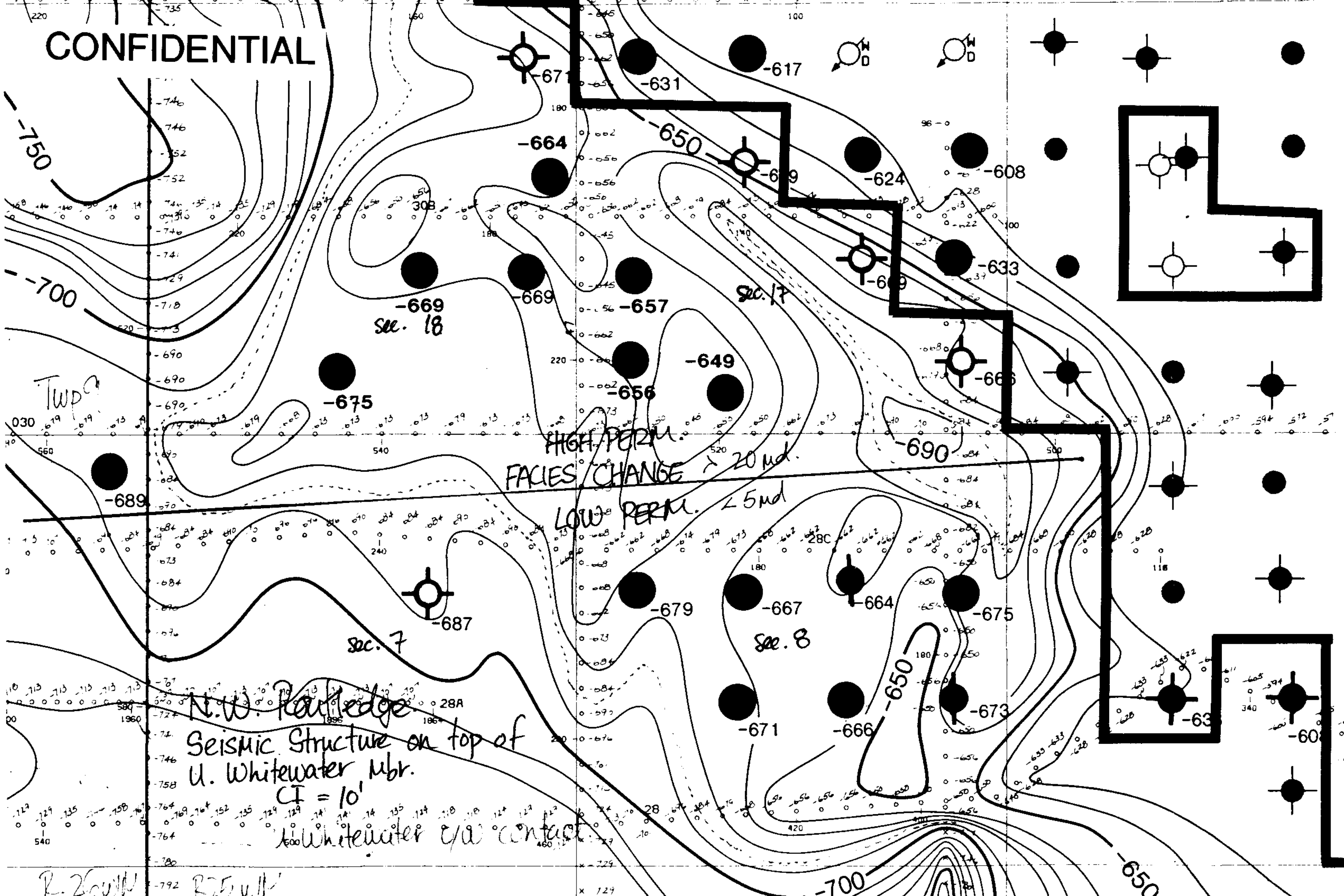
Please contact Scott Robinson (403-234-~~5388~~ 5026) if you have any further questions.

Yours very truly,

Scott Robinson

for C. G. FOLDEN, P.Eng.
Manager
Reservoir Engineering

DSR/kt
Attach.


CONFIDENTIAL
N.W. Rutledge
Seismic Structure on top of
U. Whitewater Mbr.
CI = 10'
Whitewater o/w contact
HIGH PERM.
FACIES CHANGE
LOW PERM.
> 20 md.
< 5 md
Sec. 18
Sec. 17
Sec. 7
Sec. 8
Twp ?
-750
-700
-650
-690
-617
-631
-624
-608
-633
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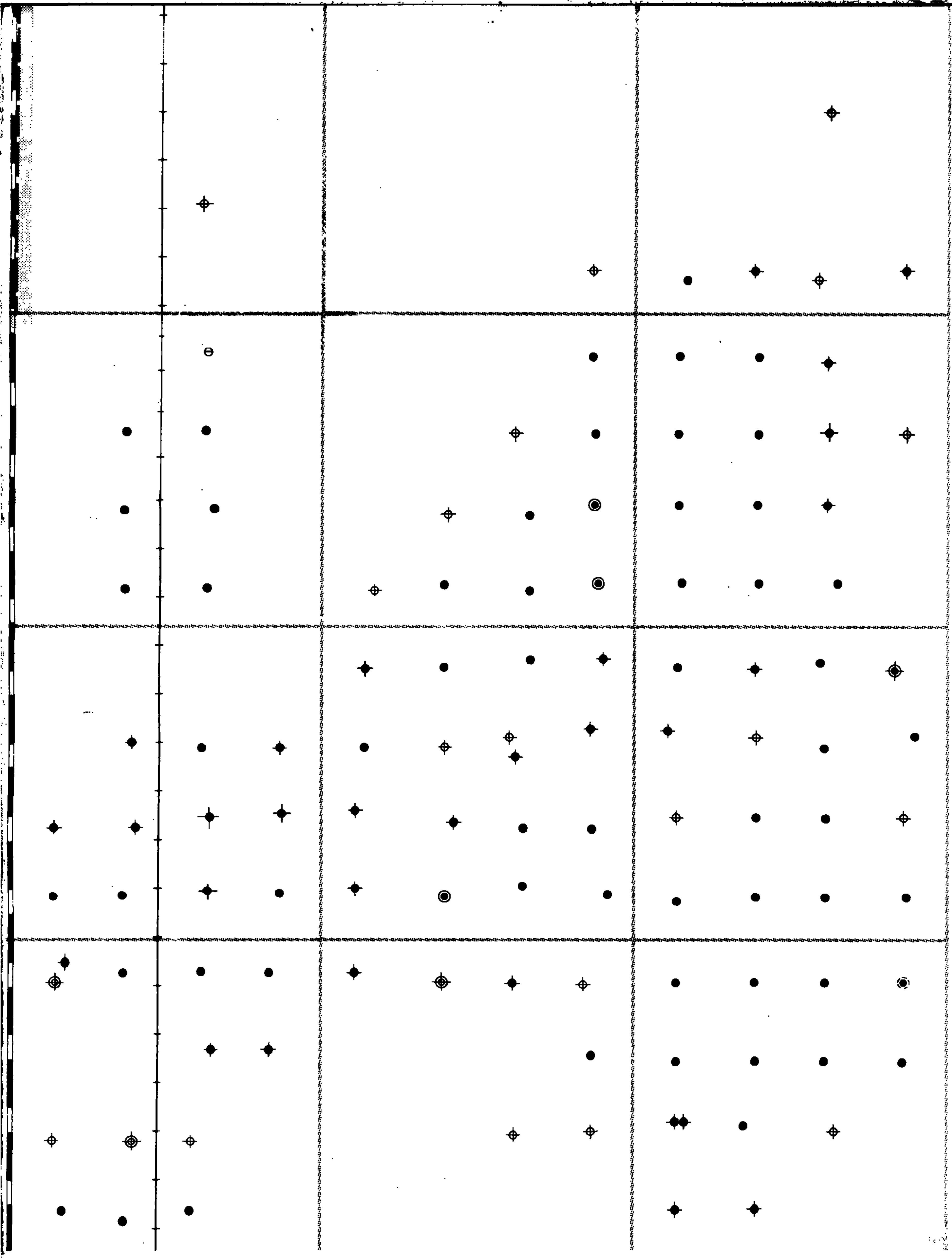


Chevron

Chevron Canada Resources

500 - Fifth Avenue S.W., Calgary, Alberta T2P 0L7
Phone (403) 234-5000 Fax (403) 234-5947

K.E. Godard
Chief Engineer

1989-12-11

Routledge Field
Sec. 17, 18-9-25 W1M
Lodgepole Production
Application to Amend
Maximum Permissible Production Rate

Oil and Natural Gas Conservation Board
Room 309
Legislative Building
Winnipeg, Manitoba
R3C 0V8

Attention: Mr. H. C. Moster, Deputy Chairman

Gentlemen:

Chevron Canada Resources, a Partnership by its managing partner, Chevron Canada Resources Limited, hereby applies pursuant to Subsection 51(3) and in accordance with Section 121 of the Manitoba Petroleum Regulations for exemption from the Maximum Permissible Production Rate of 290 m^3/month for seven wells producing from the Lodgepole formation in Sections 17 and 18-9-25 W1M. Provided approval is granted, Chevron would produce from each well approximately 20 m^3/d of oil. Strong pressure support from a downdip, edge water drive aquifer to the southwest and high well inflow capabilities suggest a 20 m^3/d oil production rate could easily be sustained.

The following information is included in support of this application:

1. Attachment 1 contains a list of wells included in the application.

2. Attachment 2 contains a list of mineral owners and lessees for the area including the subject wells.

3. A production plot for the well at 8-18-9-25 W1M is attached. This well has the longest producing history amongst the group. The well at 9-18-9-25 W1M has two months of production at approximately 9.0 m^3 opd. Both wells are flowing. The estimated current bottomhole pressure and the estimated rate for each well in a pumped off condition (500 kPag) are tabulated below:

		Current Conditions		Proposed Conditions		Pumped Off	
Well	Reservoir Pressure (kPag)	Bottomhole Pressure (kPag)	Fluid Rate (m^3/d)	Bottomhole Pressure (kPag)	Fluid Rate (m^3/d)	Bottomhole Pressure (kPag)	Fluid Rate (m^3/d)
8-18-9-25 W1M	N/A	~6 270	22	5 600	45	500	165
9-18-9-25 W1M	6 757	~6 200	25	5 400	50	500	150

Estimates are made using a simple Vogel productivity calculation method. Attachment 3A is a copy of the Vogel productivity curve.

The other five wells included in the application do not yet have a stabilized production history but are expected to have similar capabilities.

4. a) The proposed rate change is expected to have a negligible effect on the correlative rights of offset mineral owners and lessees.

   b) The producing characteristics of the wells included in the application are expected to remain unchanged as a result of the rate increase. As outlined in (3) above, the wells have a significant amount of excess capability. Therefore, production of 20 m^3/d oil from each well should be easily attainable.

   The reservoir mechanism is regarded as edge-water drive with strong aquifer advance from the southwest. Based on production performance to date, it appears the aquifer is very capable of supporting the reservoir pressure in the area. Early water production from existing wells is attributed to transition zone type pay with initial water saturations above the connate level. Sealing shales below the Upper Whitewater prevent bottom-water encroachment. Attachment 4 is a cross-section for the area showing the general relationship of the various strata. No coning effects are expected.

   c) The ultimate recovery of oil-in-place for the application area is expected to increase slightly with the proposed rate increase. The additional wellbore drawdown will increase formation pressure drop resulting in improved vertical continuity. Less permeable sections of the highly stratified Lodgepole formation which are not productive under the current drawdown will become capable of production. From the standpoint of areal sweep, the rate increase will have no effect. It will simply accelerate the drainage process.

5. An increase in individual well production rates is justified on the basis of both increased and accelerated reserve recovery as well as increased present worth.

   The Crown will benefit in three ways:

   a) The rate increase will result in higher royalty and mineral tax rates.
   b) The reserve additions will translate into more royalty and mineral tax payments.
   c) The accelerated recovery will yield a higher present worth for the Crown.

The Board is reminded of a similar project undertaken by Chevron in Section 8-9-25 W1M. That project involved increasing production from the 7-8-9-25 W1M well during 1988-02. As it turned out, no detrimental effect to recovery was evident at the higher production rate (16 m^3 opd). Attachment 5 is the production history for the well. It is evident from the production plot that no abnormal trend in WOR was established during and after the rate increase in 1988-02. On the contrary, as is evident in Figure 6, the WOR trend has followed a normal, depletion related trend (linear log WOR versus cumulative oil production relationship).

Provided approval is granted, Chevron plans a stepwise and gradual increase in the production rate for each of the subject wells. Depending on battery capacity, as few as two or as many as all the wells will be increased. Sufficient data will be gathered with each increase to ensure the reservoir is performing as expected.

Please contact Scott Robinson (403-234-5388) if you have any questions regarding this application.

Yours very truly,

Scott Robinson

for C. G. FOLDEN, P.Eng.
Manager
Reservoir Engineering

DSR/kt
Attach.

Attachment 1
Well List

8-18-9-25 W1M	- on production
9-18-9-25 W1M	- on production
7-18-9-25 W1M	- being completed
4-17-9-25 W1M	- being completed
3-18-9-25 W1M	- being completed
5-17-9-25 W1M	- being completed
3-17-9-25 WPM	- being completed

Attachment 2

List of Mineral Owners and Lessees

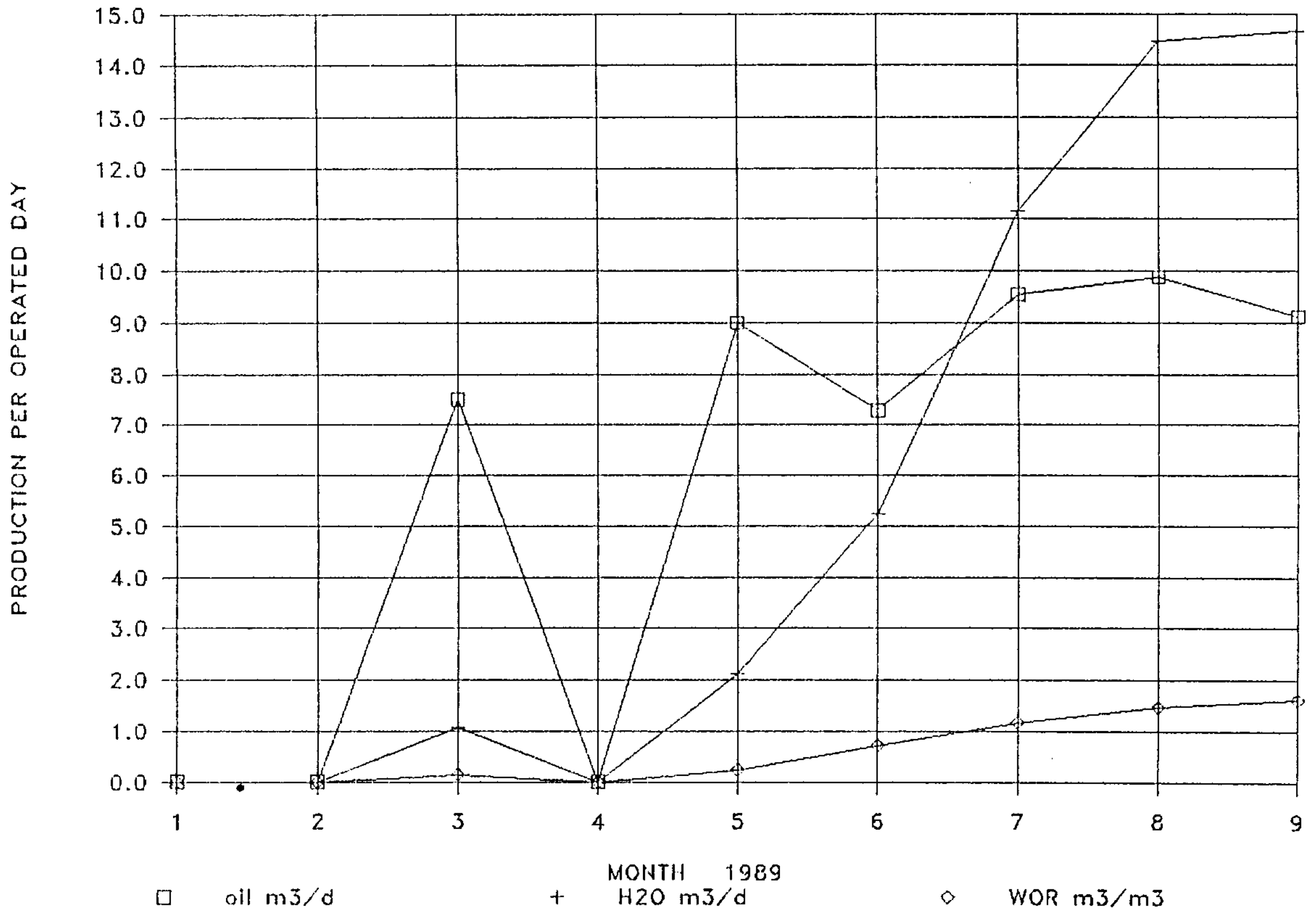
Land	Mineral Owner	Lessee
13-07-9-26 W1M	50% - Dome 25% - Toronto General Trusts Corp. 25% - Virden and District Elderly Persons Housing Corp. - Western Manitoba Nursing Home Inc. - Hospital District #10 - Anglican Church	Open
14-07-9-25 W1M	Same as above	Open
15-07-9-25 W1M	Same as above	Open
16-07-9-25 W1M	Same as above	Open
13-08-9-25 W1M	100% - Dome	93.75% Chevron 6.25% Encor
14-08-9-25 W1M	Same as above	
15-08-9-25 W1M	100% - Dome	87.5% HBOG 12.5% Encor
02-17-9-25 W1M	100% - CPR	100% Chevron
03-17-9-25 W1M	100% - CPR	100% Chevron
04-17-9-25 W1M	100% - CPR	100% Chevron
05-17-9-25 W1M	100% - CPR	100% Chevron
06-17-9-25 W1M	100% - CPR	100% Chevron
07-17-9-25 W1M	100% - CPR	100% Chevron
11-17-9-25 W1M	33-1/3% H.V.L. Vanderschaeghe 33-1/3% M.M.R. Read 33-1/3% B.G.A. Kernel	Murphy Halliburton J. E. Robertson
12-17-9-25 W1M	Same as above	
13-17-9-25 W1M	Same as above	
01-18-9-25 W1M	75% N. Sawatsky 25% Canada Trust	100% Chevron
02-18-9-25 W1M	Crown	100% Chevron
03-18-9-25 W1M	Crown	100% Chevron
04-18-9-25 W1M	Crown	100% Chevron
05-18-9-25 W1M	Crown	100% Chevron
06-18-9-25 W1M	Crown	100% Chevron

Attachment 2 (cont'd)

Land	Mineral Owner	Lessee
07-18-9-25 W1M	75% N. Sawatsky 25% Canada Trust	100% Chevron
08-18-9-25 W1M	Same as above	
09-18-9-25 W1M	Crown	100% Chevron
10-18-9-25 W1M	Crown	100% Chevron
15-18-9-25 W1M	Crown	100% Chevron
16-18-9-25 W1m	Crown	100% Chevron

ATTACHMENT 3

WELL 8-18-9-25 W1



ATTACHMENT 3A

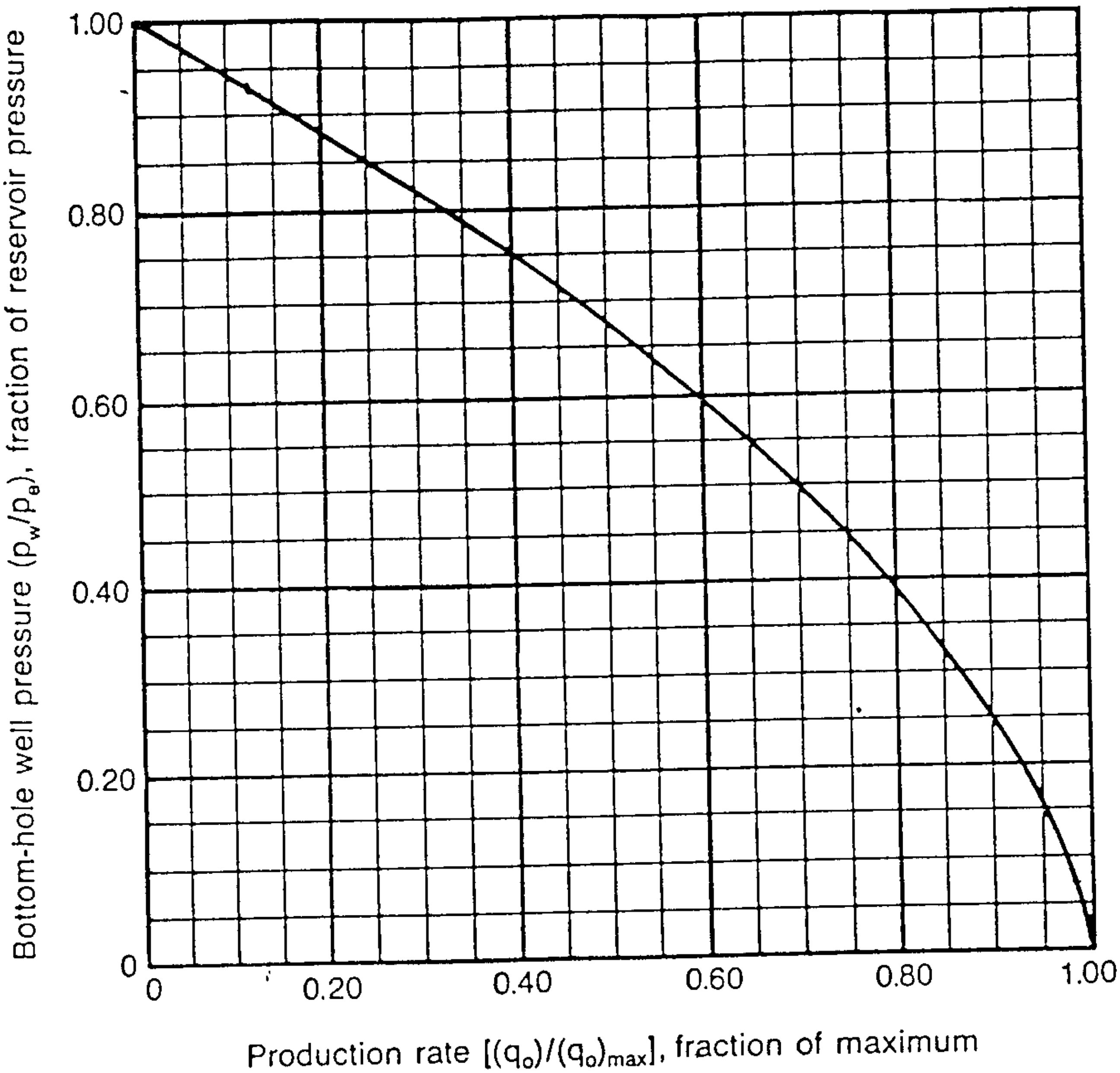
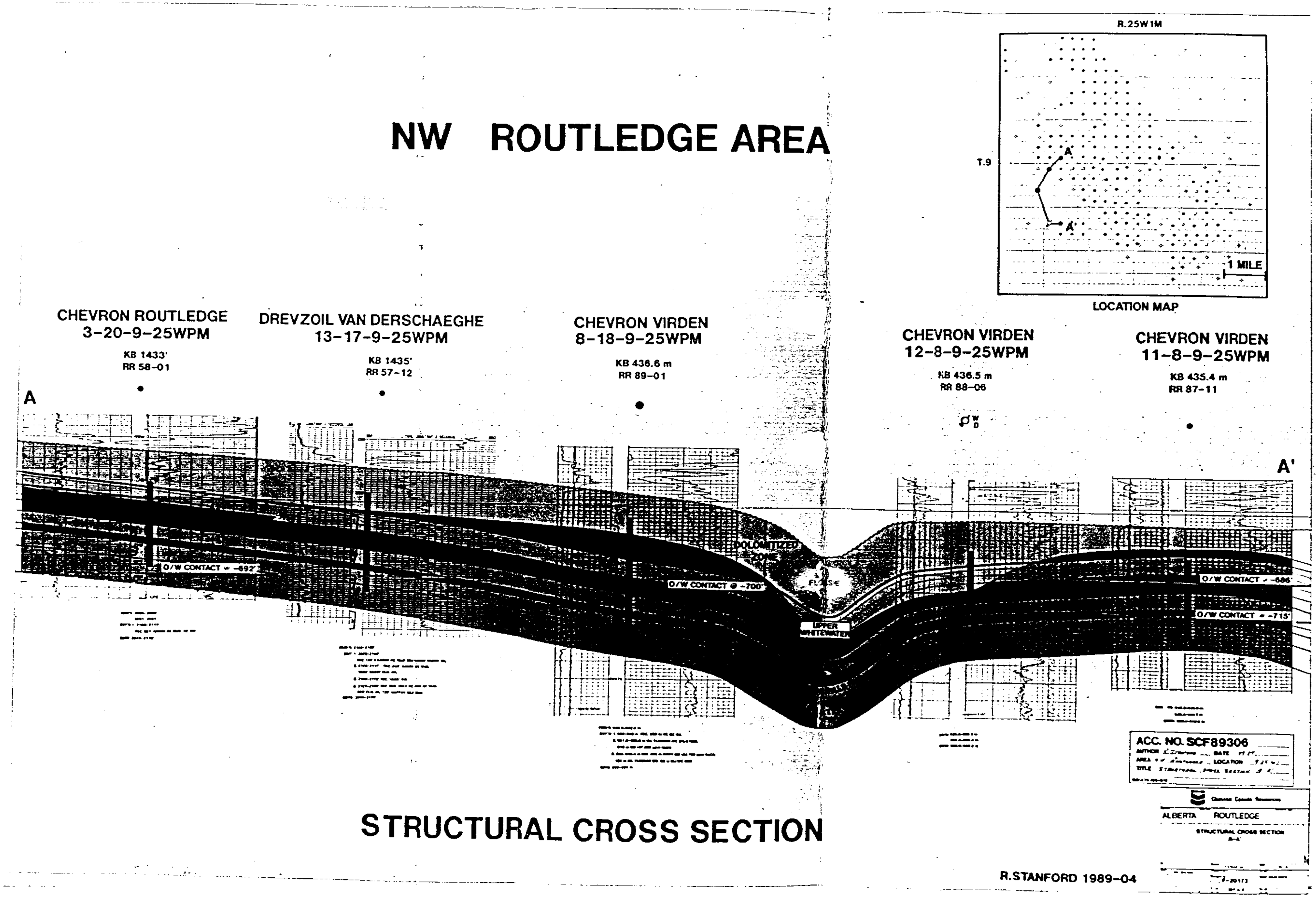


Fig. 4–3 Dimensionless inflow performance relationship for solution-gas-drive reservoirs (after Vogel, "Inflow Performance Relationships for Solution-Gas Drive Wells," courtesy *JPT*, January 1968, © SPE-AIME)

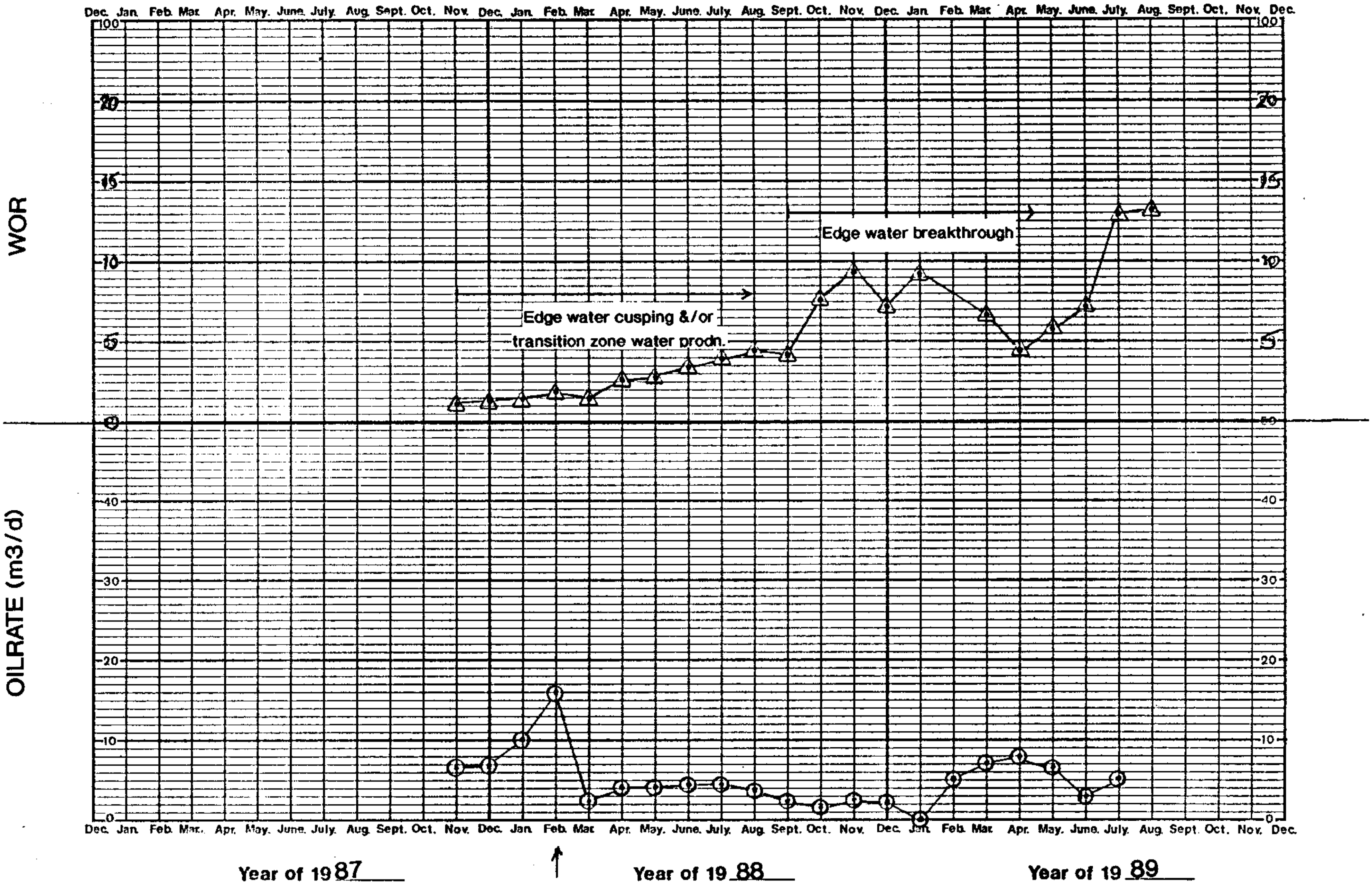
ATTACHMENT 4



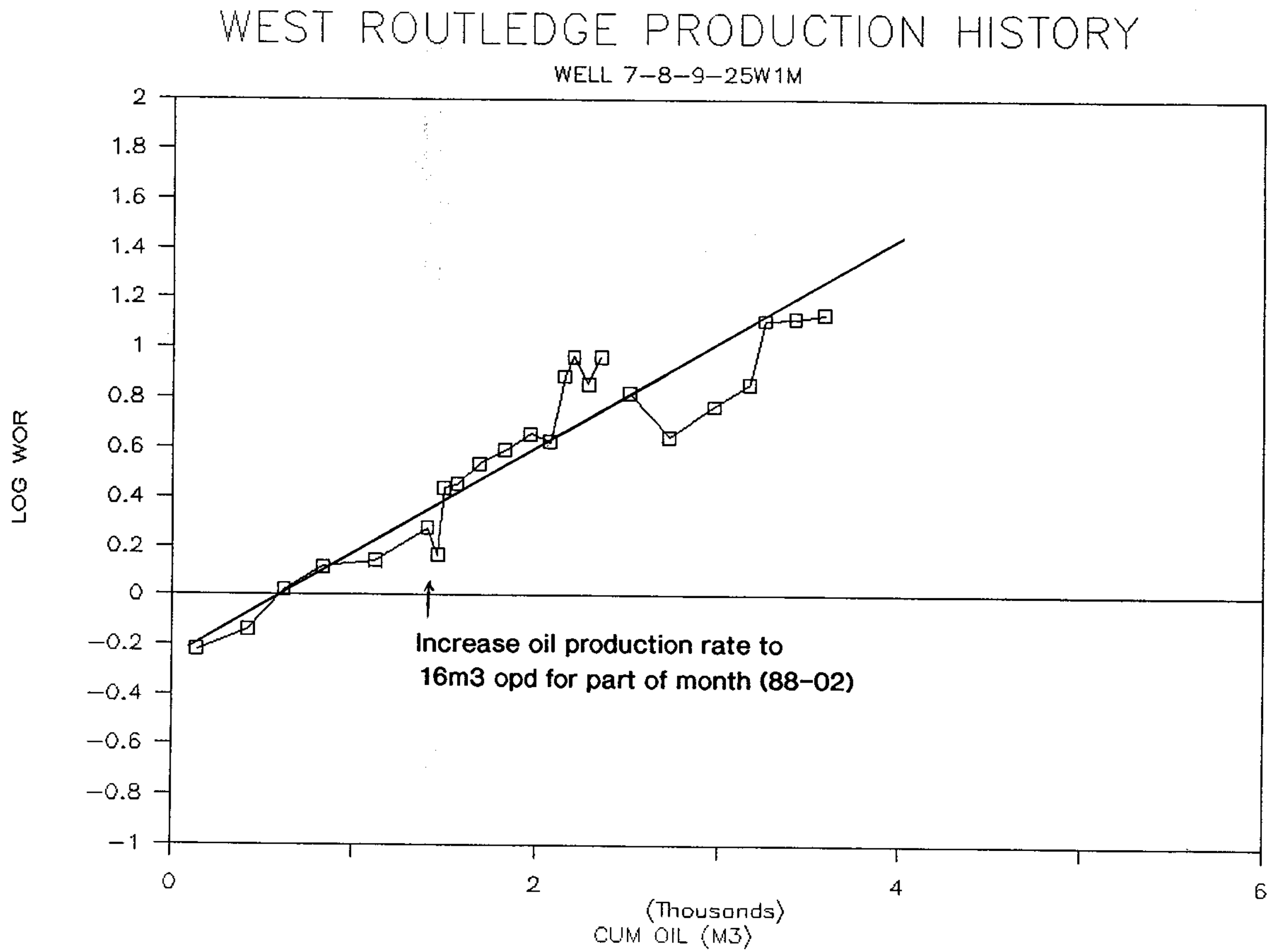
GC-66 Three Years by MonthsX 100 Divisions

GRAPHIC CONTROLS CANADA LTD. MADE IN CANADA

ATTACHMENT 5



ATTACHMENT 6



PAGE NO. 1 *** S T O R E *** ManPB

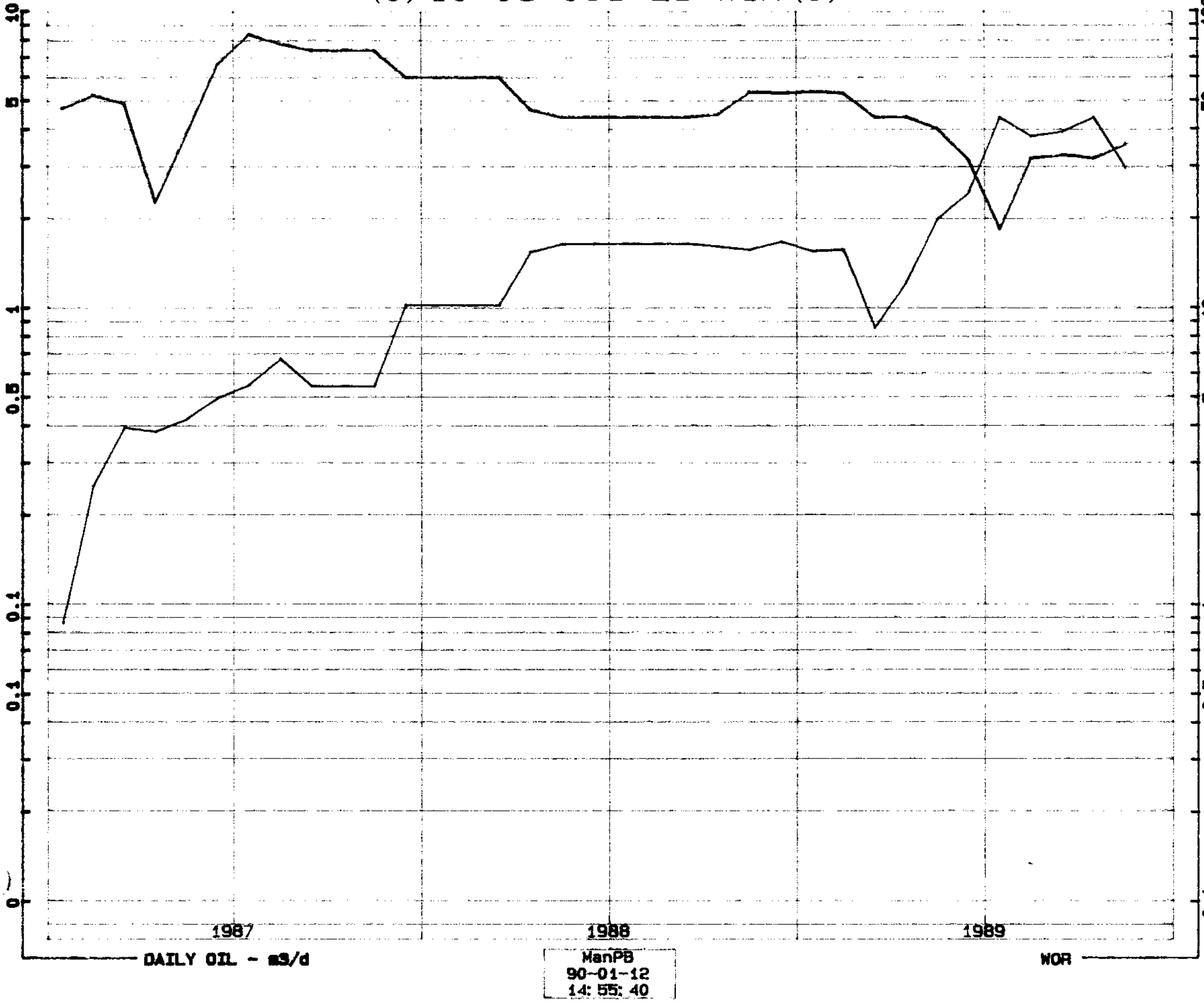
VIRDEN7 90-01-12

WELL (0)10-08-009-25 W1M(0) 15:07:23

FIELD	5	PROVINCE MAN.		LAND#1	1
POOL	59	WORKING INTEREST	0.00000%	LAND#2	0
BLOCK	9	ON PRDN 1987-01-15		LAND#3	3907
ACCTG	0	ON INJN NOT ON YET			

MONTH	OIL m3/D	WOR	HOURS
1987-01	2.6	0.86	408
1987-02	5.1	2.49	648
1987-03	3.2	3.93	480
1987-04	0.2	3.79	72
1987-05	3.9	4.20	744
1987-06	5.3	4.95	576
1987-07	7.9	5.47	696
1987-08	7.8	6.71	744
1987-09	7.4	5.41	720
1987-10	7.4	5.41	744
1987-11	7.4	5.39	720
1987-12	6.0	10.17	744
1988-01	6.0	10.17	744
1988-02	6.0	10.17	696
1988-03	6.0	10.17	744
1988-04	4.7	15.36	720
1988-05	4.4	16.40	744
1988-06	4.4	16.40	720
1988-07	4.4	16.41	744
1988-08	4.4	16.40	744
1988-09	4.4	16.40	720
1988-10	4.5	15.99	744
1988-11	5.0	15.60	672
1988-12	5.3	16.68	744
1989-01	5.2	15.43	720
1989-02	5.1	15.68	648
1989-03	4.4	8.49	744
1989-04	4.4	12.14	720
1989-05	3.5	19.82	648
1989-06	3.0	24.43	696
1989-07	1.4	43.77	576
1989-08	3.2	37.68	744
1989-09	3.3	39.17	720
1989-10	3.2	43.80	744
1989-11	3.6	29.53	720

(0) 10-08-009-25 W1M (0)



VIRDEN7 90-01-12
WELL (0)13-17-009-25 W1M(0) 15:07:23

FIELD 5 PROVINCE MAN. LAND#1 1
POOL 59 WORKING INTEREST 0.00000% LAND#2 0
BLOCK 3 ON PRDN 1957-12-19 LAND#3 1572
ACCTG 1 ON INJN NOT ON YET

MONTH	OIL m3/D	WOR	HOURS
1979-01	4.8	0.48	744
1979-02	4.7	0.49	672
1979-03	4.6	0.48	744
1979-04	4.7	0.45	720
1979-05	4.4	0.49	744
1979-06	4.4	0.47	720
1979-07	4.6	0.47	744
1979-08	4.4	0.47	744
1979-09	4.5	0.44	720
1979-10	4.4	0.49	744
1979-11	4.4	0.54	720
1979-12	4.3	0.48	744
1980-01	4.2	0.55	744
1980-02	4.3	0.53	696
1980-03	4.3	0.55	744
1980-04	4.3	0.54	720
1980-05	4.6	0.52	744
1980-06	4.0	0.29	720
1980-07	4.8	0.23	744
1980-08	4.4	0.23	744
1980-09	4.3	0.28	720
1980-10	4.3	0.29	744
1980-11	4.4	0.29	720
1980-12	4.5	0.28	744
1981-01	4.1	0.30	744
1981-02	4.2	0.29	672
1981-03	4.2	0.30	744
1981-04	4.2	0.29	720
1981-05	3.8	0.30	672
1981-06	4.2	0.31	720
1981-07	4.2	0.31	744
1981-08	3.8	0.33	744
1981-09	3.9	0.33	720
1981-10	4.3	0.29	744
1981-11	4.1	0.30	720
1981-12	3.9	0.30	744
1982-01	3.9	0.30	744
1982-02	4.0	0.30	672
1982-03	4.2	0.29	744
1982-04	4.2	0.29	720
1982-05	4.7	0.29	744
1982-06	3.7	0.84	696
1982-07	3.7	0.90	744

VIRDEN7 90-01-12

WELL (0)13-17-009-25 W1M(0) 15:07:23

FIELD 5 PROVINCE MAN. LAND#1 1

POOL 59 WORKING INTEREST 0.00000% LAND#2 0

BLOCK 3 ON PRDN 1957-12-19 LAND#3 1572

ACCTG 1 ON INJN NOT ON YET

MONTH	OIL m3/D	WOR	HOURS
1982-08	3.4	0.93	672
1982-09	3.7	0.91	720
1982-10	3.7	0.88	744
1982-11	3.7	0.91	720
1982-12	3.7	0.90	744
1983-01	3.7	0.92	744
1983-02	3.7	0.92	672
1983-03	3.7	0.92	744
1983-04	3.6	0.97	720
1983-05	3.4	1.03	744
1983-06	3.6	0.98	720
1983-07	3.5	0.97	720
1983-08	4.0	1.01	744
1983-09	3.8	0.92	672
1983-10	4.2	1.05	744
1983-11	4.1	0.98	720
1983-12	4.1	0.94	744
1984-01	3.9	1.00	744
1984-02	3.9	0.97	696
1984-03	3.9	1.01	744
1984-04	3.9	1.00	720
1984-05	4.2	0.99	744
1984-06	4.6	0.83	720
1984-07	5.0	0.75	744
1984-08	4.9	0.79	744
1984-09	5.0	0.78	720
1984-10	5.0	0.77	744
1984-11	4.8	0.78	720
1984-12	4.9	0.78	744
1985-01	4.8	0.77	744
1985-02	4.8	0.78	672
1985-03	4.8	0.78	744
1985-04	4.7	0.76	720
1985-05	5.3	0.70	744
1985-06	5.1	0.71	720
1985-07	4.8	0.77	720
1985-08	4.8	0.73	744
1985-09	5.1	0.72	720
1985-10	4.8	0.75	744
1985-11	4.8	0.72	720
1985-12	5.0	0.69	744
1986-01	5.0	0.66	744
1986-02	4.8	0.67	672

VIRDEN7 90-01-12
WELL (0)13-17-009-25 W1M(0) 15:07:23

FIELD 5 PROVINCE MAN. LAND#1 1
POOL 59 WORKING INTEREST 0.00000% LAND#2 0
BLOCK 3 ON PRDN 1957-12-19 LAND#3 1572
ACCTG 1 ON INJN NOT ON YET

MONTH	OIL m3/D	WOR	HOURS
1986-03	4.4	0.74	744
1986-04	4.6	0.75	720
1986-05	5.0	0.76	744
1986-06	5.0	0.73	720
1986-07	4.8	0.75	744
1986-08	4.7	1.14	744
1986-09	4.9	1.11	720
1986-10	4.7	1.11	744
1986-11	4.7	1.25	720
1986-12	4.8	1.25	744
1987-01	4.8	1.23	744
1987-02	4.8	1.23	672
1987-03	4.7	1.29	744
1987-04	4.6	1.28	720
1987-05	4.6	1.33	744
1987-06	4.7	1.37	720
1987-07	4.8	1.41	744
1987-08	4.6	1.36	744
1987-09	4.6	1.43	720
1987-10	4.7	1.33	744
1987-11	4.6	1.39	720
1987-12	4.6	1.34	744
1988-01	4.7	1.43	744
1988-02	4.6	1.39	696
1988-03	2.7	3.63	744
1988-04	4.7	1.94	720
1988-05	5.0	2.10	744
1988-06	4.5	2.00	720
1988-07	4.9	2.08	744
1988-08	5.3	1.90	744
1988-09	5.2	1.94	720
1988-10	5.3	1.86	744
1988-11	5.2	1.90	720
1988-12	5.3	1.77	744
1989-01	5.2	1.88	744
1989-02	5.0	1.94	672
1989-03	5.2	1.91	744
1989-04	5.3	1.91	720
1989-05	6.0	1.63	744
1989-06	5.7	1.66	720
1989-07	5.9	1.60	744
1989-08	5.7	1.75	744
1989-09	5.9	1.73	720

VIRDEN7 90-01-12
WELL (0)13-17-009-25 W1M(0) 15:07:23

FIELD 5 PROVINCE MAN. LAND#1 1
POOL 59 WORKING INTEREST 0.00000% LAND#2 0
BLOCK 3 ON PRDN 1957-12-19 LAND#3 1572
ACCTG 1 ON INJN NOT ON YET

MONTH	OIL m3/D	WOR	HOURS
1989-10	5.9	1.75	744
1989-11	5.6	1.75	720

(0) 13-17-009-25 W1M (0)

ManPB
90-01-12
14:57:33

- not enough production information available to accurately predict the IPR for the 7 wells, only the 8-18 & 9-18 wells have more than 2 mons production data

- IPR data provided for the 8-18 & 9-18 wells indicates the wells have a high production capacity but no information is available wrt to oil productivity vs water cut

- drawing on the experience of 7-8-9-25 which was granted a 6 mon daily MPR of 40 m³OPD – the well water cut climbed constantly over the 6 mon ~~test~~ period until the well could not longer meet the Virden Field MPR of 11 m³OPD

- 7-8-9-25 is in the Virden Lodgepole I Pool which like the appl'n area is downdip of Routledge Unit No. 1 and close to the regional oil/water contact for the Upper Virden (-670') and the Whitewater (-710')

-204m

-216m

- can't accumulate any more information of these wells inflow performance unless Chevron is granted an increase in the daily MPR

  - if the daily MPR is increased to 20 m3OPD Chevron could ~~test~~ the wells @ higher flow rates

    - to avoid Chevron having to SI certain wells while others are tested at higher rates it is recommended that the monthly allowable for the 7 wells combined by increased from 2030 m3/mo to 3150 m3OPM - this would allow 1/2 the wells to be produced @ 20 m3OPD while the other 1/2 produced at or below the present allowable of 11 m3OPD

- calculated the drawdown at the 16 ha SU boundary assuming increased production of 20 m3OPD & a no flow boundary
  Δp = 45 psig ≈ 4.6 % of $\bar{P}_R$ which equates to a flow across of the boundary of 1.3 m3OPD or 232 m3 over a 6 mo period

- I think after the 6 mo test period there will be enough information to determine if there is technical merit in increasing the MPR permanently

Note: Crown's interest 2 wells 7 locations

- at that time the application should be advertised to give that offset owners a chance to object - if the application were advertised now I don't believe there is enough technical evidence for or against to make a proper decision

- wrt to ultimate recovery - I don't believe a program of carefully increasing the production rate to 20 m3OPD will adversely effect the ultimate recovery for the following

① the wells are in close proximity to the aquifer & if the Lodgepole I Pool performance is any indication you may recover more oil by increasing the drawdown

② the shale at the base of the producing interval $K_v < 0.1$ md will prevent water coning from the wet Lower Virden

(3) the increased drawdown may result in increased productivity from the tighter layers in the reservoir

permeability distribution Lorenz coeff of heterogeneity
0 homogeneous
1 heterogeneous
.666-.882

MPR's - VIRDEN FIELD - ALL POOLS

11 m^3/d 290 m^3/mon

7 wells in appl'n area

daily allowable 77 m^3OPD

monthly allowable 2030 m^3OPM

CHEVRON'S REQUEST

DAILY ALLOWABLE 140 m^3OPD (20 m^3OPD/well)
MONTHLY ALLOWABLE (30.4 days) 4258 m^3OPM

ALLOWABLE RANGE FOR 6 MONTH

TEST 2030 - 4258 m^3OPM
3144 m^3OPM

- ½ wells @ 20 m^3OPD + ½ wells @ 11 m^3OPD equates to a monthly allowable of 3300 m^3OPM

- use 15 m^3OPD * 30 days/mon * 7 wells = 3150 m^3OPM

CHEVRON MPR EXEMPTION APPLICATION SEC 17 & 18-9-25 WPM

- MPR 20 m3 OPD / well (approx.)
  - strong pressure support from a downdip, edge wtr. drive aquifer to SW

  - well's have high inflow capability

8-18 + 9-18 flowing - used Vogel to predict productivity vs BHP

- MPR exemption - negligible effect on correlative rights of offset owners - accelerate drainage

- wtr production from transition zone in Upper Whitewater with mobile water

- shales @ base of Upper Whitewater prevent bottom-water encroachment / coning

— slight increase ult. rec expected from increase prod. rate
  - increase drawdown - improve vertical continuity / sweep
  ϕ & k cut-off — permeability analysis to determine layer contrasts

- benefits Crown - inc. rate - higher royalties + taxes, inc. recovery, higher NPV
  Freehold Mineral Owner - inc + accelerated royalties
  Chevron - accelerated cash flow, higher NPV

- review 7-8-9-25 Board allowed increased production with no detrimental effect on recovery

7-8-9-25 — 16 BOPD — no abnormal increase in WOR

- Chevron appears willing to slowly increase rate & monitor performance

① PREPARE WELL LOGS
- completion interval
- core interval
- DST Results
- Datum
- pressure data

- Twp Map of Area

Water Influx

- maximum rate will occur when the BHP = 0

- proximately of aquifer o/w contact

- calculated the rate of water influx on the assumption the boundary pressure varies as a fn of drawdown

Chapter 6

Reservoir Heterogeneity

A thorough discourse of the various types of reservoir heterogeneities, their cause, and their measurement would fill a thick volume indeed. So at the outset let us define our objectives. This chapter will be divided into two sections, the first dealing with a general description of all types of reservoir heterogeneities and the second concerned with measures of the degree of vertical permeability stratification. In both these sections the discussion will proceed with the practicing reservoir engineer in mind and wherever possible the emphasis will be upon quantitative measures of reservoir heterogeneity.

6.1 Types of Reservoir Heterogeneities

The geologists tell us that most reservoirs are laid down in a body of water by a long-term process, spanning a variety of depositional environments, in both time and space. As a result of subsequent physical and chemical reorganization, such as compaction, solution, dolomitization, and cementation, the reservoir characteristics are further changed. Thus the heterogeneity of reservoirs is, for the most part, dependent upon the depositional environments and subsequent events, as well as on the nature of particles constituting the sediment. However, we would, in general, expect a reservoir to have some lateral similarity; that is, at an elevation corresponding to a given deposition period, the same basic particle size range should exist over wide areal expanses.[1] The variation in rock properties with elevation would be largely due to differing depositional environments or to segregation of differently sized or constituted sediments into layers, or to both.

In a sandstone reservoir, the development of properties such as porosity and permeability is mostly physical —that is, the properties depend on the nature of the sediment, on the environment of deposition, and generally on subsequent compaction and cementation. In a carbonate reservoir, on the other hand, the development of porosity is more complex. In addition to forming in the same manner as it does in sandstones, carbonate porosity may develop after consolidation or deposition through selective solution, replacement, recrystallization, dolomitization, etc.

In both carbonate and sandstone reservoirs, gross rock movements can result in faulting and, even more important to the reservoir engineer, in the development of both large and small reservoir fractures.

Our discussion of the types of reservoir heterogeneities will be divided into three categories: areal variations, vertical variations, and reservoir-scale fractures. It is obvious that the reservoir may be nonuniform in all intensive properties such as permeability, porosity, pore size distribution, wettability, connate water saturation and crude properties. However, we will primarily discuss the most important of these factors: permeability.

Areal Permeability Variations

Since the early stages of oil production, engineers have recognized, although the fact is sometimes obscured by the effect of different well completion techniques, that most reservoirs vary in permeability in the lateral direction. The first attempt to quantify these areal permeability distributions from observed differences in well production history was that of Kruger[2] in 1961. Using a mathematical model described by McCarty and Barfield,[3] he developed and illustrated a numerical technique. Others[4,5] continued the development of this approach, the latter[5] developing a regression analysis technique for determining a two-dimensional reservoir description from well pressure interference tests. All of these techniques require an electric analyzer or digital computer to handle the time-consuming calculations.

Arnold *et al.*[6] and Greenkorn *et al.*[7] devoted their attention to directional permeability effects — that is, permeability anisotropy. Using both pressure data from surrounding wells and core sample permeabilities, techniques were demonstrated for determining the direction and degree of directional permeability. These analyses also require the use of digital computers.

Groult *et al.*[8] suggested techniques for describing both lateral and vertical inhomogeneities from observations at the formation outcrop and by production logging techniques. Perhaps the simplest approach suggested to date is that described by Johnson *et al.*[9] and termed "pulse testing". In this procedure a series of producing rate changes or pulses is made at one well with the response being measured at adjacent wells by a differential pressure gauge having a sensitivity of about 0.001 psi. This technique shows promise for providing a measure of the formation flow capacity (kh) and storage capacity (ϕh). In addition, the method can be used qualitatively to measure communication across faults and between zones as well as the direction and magnitude of fracture trends.

A variety of pressure transient techniques has been suggested to provide a measure of (1) the distance to a fault or other impermeable barrier, (2) lateral permeability variations, and (3) the presence, direction and magnitude of natural fracture systems. For a thorough discussion of these, refer to the first Monograph[10] in this series.

Vertical Permeability Stratification

In his 1959 paper, Hutchinson[11] presents an excellent discussion on reservoir nonuniformities. In the section dealing with stratified formations he traces the growth in the concept of layered reservoirs. The attraction of the layered reservoir concept is twofold: it is readily visualized and its reservoir engineering treatment is relatively simple.

In 1963, Elkins and Skov[12] showed that the concept of parallel-layer flow could be used to match the past performance of two gas condensate cycling projects and an enriched gas drive project. Bennion and Griffiths[13] and Testerman[14] have discussed the concept of reservoir stratification and have developed techniques for determining the best description of stratification properties. These will be discussed in detail in a later portion of this chapter.

Several authors[15,16] have suggested that formation outcrops be examined to obtain information on the degree of stratification, lateral extent of shale breaks and continuity of zones of specific permeability. This is no doubt an excellent way for an engineer to actually see the type of formation he is flooding. However, its quantitative usefulness is doubtful. One can never be sure that the depositional environment and subsequent porosity change in the actual reservoir were duplicated in the outcrop portion of the formation.

Reservoir-Scale Fractures and Directional Permeability

Reservoir fractures or closed fracture planes are not uncommon in oil reservoirs. The Spraberry Trend in West Texas is typical of formations so thoroughly penetrated by reservoir-scale fractures that their presence and effect are obvious. Elkins and Skov[17] inferred the orientation of these fractures from pressure transient analysis. Aerial photography also can be helpful here.[18,19] Reservoir engineers recognize that fractures of this type would have an overpowering effect on any attempted waterflood. The engineer should also be cognizant that reservoirs having little indication of fractures during primary depletion may have incipient fractures or "planes of weakness" that manifest themselves when water injection pressure is applied.[20] Their effect can be just as severe as the effect of Spraberry-type fractures. The preponderance of evidence shows that these fractures are not horizontal but generally have a near-vertical orientation, so that they can present highly directional short circuits for the injected water to bypass the oil in much of the matrix rock.

Although directional permeability has been discussed for many years, its effect is generally small in comparison with that of regional variations in permeability, or "permeability trends". The effect of directional permeability can frequently be neglected for practical purposes.

6.2 Quantitative Descriptions of Permeability Stratification

Conformance Factor

One of the earliest measures of reservoir nonuniformities was termed "conformance". Introduced by Patton[21] in 1947, it represents the portion of the reservoir contacted by the injected fluid and, as such, combines areal sweep and vertical sweep effects. The term still finds some use today when engineers use it qualitatively to describe reservoirs as "high conformance" or "low conformance" and thus to indicate the degree of areal and vertical permeability variations. In this sense, conformance implies the fraction of the idealized performance realized.

Positional Approach

In 1947, Miller and Lents[22] presented a means of using core permeabilities for determining layer properties. This approach we have termed the "positional approach". Core data from each well in the Bodcaw Reservoir, Cotton Valley Field Cycling Project were plotted as a function of percent of sand thickness, and the permeabilities were averaged at each percent of sand thickness. This method is equivalent to dividing each well's core analysis into a specified number of vertical segments and determining for each segment in all wells the average permeability and thickness.

Miller and Lents reported that the gas cycling performance of the Bodcaw reservoir agreed closely with that calculated using this layering technique. Elkins and Skov[12] also report success using this approach in match-

TABLE 6.1 — CORE ANALYSIS FOR HYPOTHETICAL RESERVOIR
Cores from 10 Wells, A Through J; Each Permeability Value (md) Represents 1 ft of Pay

Depth (ft)	A	B	C	D	E	F	G	H	I	J
6,791	2.9	7.4	30.4	3.8	8.6	14.5	39.9	2.3	12.0	29.0
6,792	11.3	1.7	17.6	24.6	5.5	5.3	4.8	3.0	0.6	99.0
6,793	2.1	21.2	4.4	2.4	5.0	1.0	3.9	8.4	8.9	7.6
6,794	167.0	1.2	2.6	22.0	11.7	6.7	74.0	25.5	1.5	5.9
6,795	3.6	920.0	37.0	10.4	16.5	11.0	120.0	4.1	3.5	33.5
6,796	19.5	26.6	7.8	32.0	10.7	10.0	19.0	12.4	3.3	6.5
6,797	6.9	3.2	13.1	41.8	9.4	12.9	55.2	2.0	5.2	2.7
6,798	50.4	35.2	0.8	18.4	20.1	27.8	22.7	47.4	4.3	66.0
6,799	16.0	71.5	1.8	14.0	84.0	15.0	6.0	6.3	44.5	5.7
6,800	23.5	13.5	1.5	17.0	9.8	8.1	15.4	4.6	9.1	60.0

ing the performance of a number of fluid injection projects.

To illustrate the use of this technique as well as other measures of permeability stratification, consider the core analysis permeabilities for a hypothetical reservoir shown in Table 6.1. The table shows 10 wells, A through J, with 10 values of permeability per well, each value representing 1 ft of pay.

Arranging these values in order from maximum to minimum, we can obtain the plot shown in Fig. 6.1. This plot relates the portion of the cumulative flow capacity to the portion of the total formation thickness. It is used widely to indicate the contrast in permeabilities, the greater contrast indicated by the increased divergence from a 45° line.

Shown on Table 6.2 are the average layer permeabilities determined for the hypothetical reservoir by the positional approach. These average permeabilities are obtained by taking the geometric average of the permeabilities in each row (i.e., at each depth). This approach has the advantage that it considers both the permeability and the location of a rock sample in determining layer properties.

In Table 6.2, the layers have equal thickness. There are advantages, however, to selecting layer properties so that each layer has the same permeability-thickness product. This will be discussed in Section 7.7.

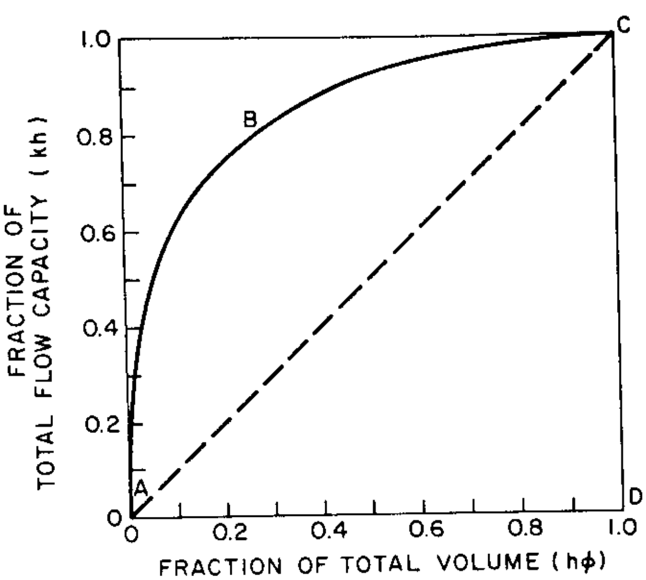


Fig. 6.1 Flow capacity distribution, hypothetical reservoir.

Coefficient of Permeability Variation

Law[23] showed that rock permeabilities usually have a log normal distribution. This means that plotting the number of samples in any permeability range against the values of log permeability will yield the familiar bell-shaped curve. Fig. 6.2 shows this distribution for the permeability values listed in Table 6.1.

In the first use of core analysis data to measure the effect of permeability stratification on waterflood predictions, Dykstra and Parsons[24] made use of the commonly found log normal permeability distribution of reservoir rock. Their term "coefficient of permeability variation" is frequently shortened to simply "permeability variation". Statistically, the coefficient of variation, V, is defined as

$$V = \frac{\sigma}{\overline{X}}, \qquad (6.1)$$

where

σ = standard deviation

$\overline{X}$ = mean value of X

In a normal distribution the value of σ is such that 15.9 percent of the samples have values of X less than $(\overline{X} - \sigma)$ and 84.1 percent of the samples have values of X less than $(\overline{X} + \sigma)$.

Dykstra and Parsons proposed that permeability values taken from core analyses be arranged in descending order. The percent of the total number of permeability

TABLE 6.2 — LAYER PROPERTIES BY PERMEABILITY ORDERING AND POSITIONAL APPROACH

	Average Layer Permeability (md)	
Layer	Permeability Ordering	Positional Approach
1	84.0	10.0
2	37.0	6.8
3	23.5	4.7
4	16.5	10.4
5	12.0	20.5
6	8.9	12.1
7	6.5	8.6
8	4.6	18.4
9	3.0	14.3
10	1.5	10.9

Arithmetic average permeability 28.2 md
Mean permeability 10.0 md
Ratio of maximum to minimum layer permeability:
Permeability ordering 84.0/1.5 = 56.0
Positional approach 20.5/4.7 = 4.37

values exceeding each tabulated entry is computed. These values are then plotted on log probability paper (Fig. 6.3). The best straight line is drawn through the points, with the central points weighted more heavily than the more distant points. The permeability variation is then

$$V = \frac{\bar{k} - k\sigma}{\bar{k}}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6.2)$$

where

$\bar{k}$ = mean permeability = permeability value with 50 percent probability

$k\sigma$ = permeability at 84.1 percent of the cumulative sample.

The possible values of permeability variation range from zero to one, with a completely uniform system having a value of zero.

For those mathematically inclined readers, we should point out that in the true statistical sense, Eq. 6.2 is incorrect. It should read

$$V = \frac{\log \bar{k} - \log k\sigma}{\log \bar{k}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6.3)$$

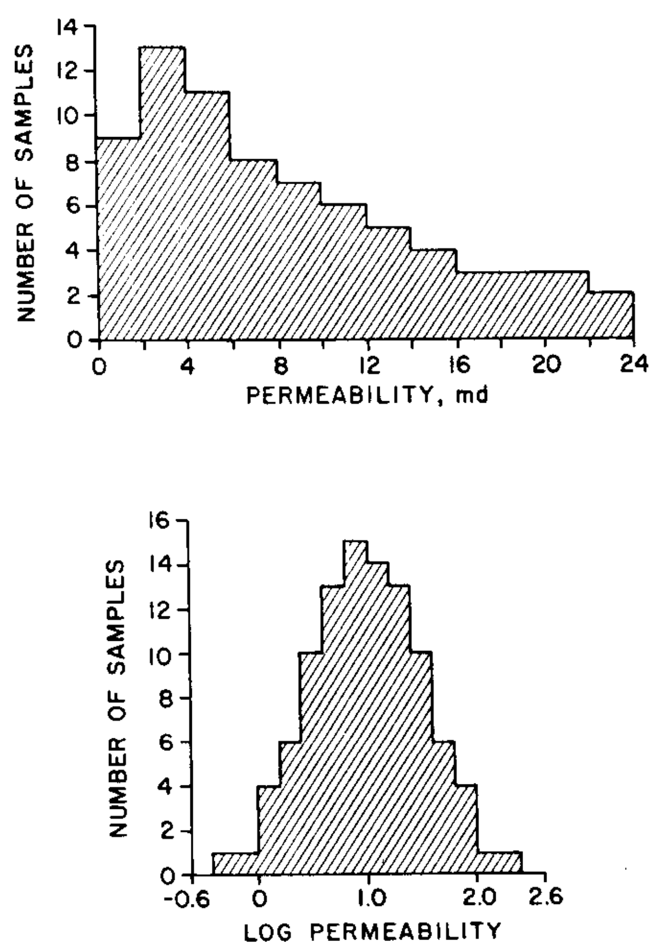


Fig. 6.2 Permeability distribution, hypothetical reservoir.

However, reservoir engineering usage has been with Eq. 6.2.

Dykstra and Parsons went on to correlate their value of permeability variation with expected waterflood performance. This performance prediction technique will be discussed in Chapter 8.

Permeability Ordering

In an early use of core analysis data, Stiles[25] arranged the permeabilities in order from maximum to minimum and then used this distribution in some waterflooding calculations. To differentiate between the method of treating core permeabilities and the performance calculation method, we shall call the former "permeability ordering" and the latter "the Stiles method".

Table 6.2 shows the results of taking the permeability values of Table 6.1, arranging them in order from maximum to minimum, then dividing them in order into 10 equal-sized groups. These groups then represent the average permeabilities within each of the 10 layers of the reservoir, as determined from the permeability ordering method. These averages are those permeabilities, taken from Fig. 6.3, at 10-percent increments, beginning at 5 percent of the total sample. A less severe contrast in layer permeabilities is noted using the positional approach than using the permeability ordering method.

Lorenz Coefficient

In 1950, Schmalz and Rahme[26] proposed a single term for characterizing the permeability distribution within a pay section. Using Fig. 6.1, they defined the Lorenz coefficient of heterogeneity as

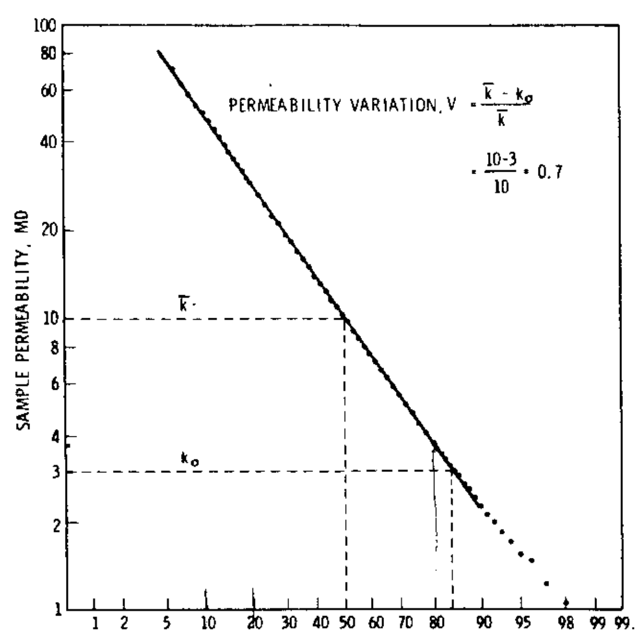


Fig. 6.3 Log normal permeability distribution.

$$\text{Lorenz coefficient} = \frac{\text{area } \overline{ABCA}}{\text{area } \overline{ADCA}}$$

The value of the Lorenz coefficient ranges from zero to 1, a uniform permeability reservoir having a Lorenz coefficient of zero.

The Lorenz coefficient is not a unique measure of reservoir nonuniformity. Several different permeability distributions can yield the same value of Lorenz coefficient.

Fig. 6.4 shows the relation of the permeability variation and Lorenz coefficient for log normal permeability distributions.[27]

Averaging Permeabilities

Warren and Price[27] showed experimentally that the most probable behavior of a heterogeneous system approaches that of a uniform system having a permeability equal to the geometric mean. The geometric mean is:

$$\overline{k} = \sqrt[n]{k_1 \times k_2 \times k_3 \times k_4 \times \ldots \times k_n} \quad . \quad (6.4)$$

It can also be shown analytically that the mean of a log normal distribution is the geometric mean. The geometric mean is the recommended single value of permeability with which to characterize a formation. The value of 10.0 md shown on Table 6.2 is the geometric mean. Calculating the geometric mean (Eq. 6.4) for the permeability values in each layer of Table 6.1, we arrive at the values shown in Table 6.2 for the positional approach.

Permeabilities in series are averaged as follows:

$$\frac{n}{\overline{k}} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \frac{1}{k_4} + \ldots + \frac{1}{k_n}, \quad \ldots\ldots\ldots\ldots (6.5)$$

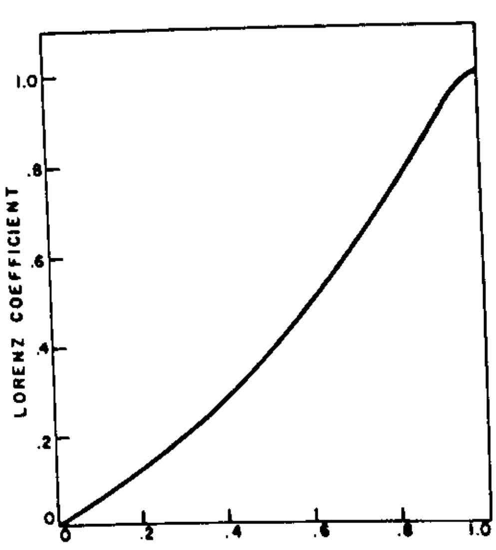


Fig. 6.4 Correlation of Lorenz coefficient and permeability variation.[27]

which assumes that each permeability value represents a unit length.

Permeabilites in parallel are averaged as follows:

$$\overline{k} = \frac{k_1 + k_2 + k_3 + k_4 + \ldots + k_n}{n} \quad . \quad . \quad (6.6)$$

Statistical Reservoir Zonation Technique

In 1962, Testerman[14] presented the best available statistical technique for determining layer properties. The technique uses a set of permeability data from a single well showing permeability at various elevations. This set is divided into zones so that the variation in permeability within any one zone is minimized and the contrast between zones is maximized. Statistical criteria are used to determine whether the data will support partitioning into additional zones. These zones are then traced from well to well to obtain a reservoir layer description. This technique has the advantage of providing an unbiased specification of the number and location of reservoir layers, but it does require access to a computer.

Geological Zonation

The previously discussed techniques involve no property of the rock other than permeability. The best method for characterizing the permeability stratification of a reservoir should include also any available geological information.

What I consider to be the superior approach was demonstrated by Alpay.[1] He had available considerable information on wells in a lease covering approximately 7½ sq miles in the south-central portion of the Pembina field, Alberta. This information included core analyses, well log responses and core lithological analyses. With this information and the concept that sands are deposited in sheet-like layers that have varying thickness and similar lithological properties, he correlated a number of zones through that portion of the Cardium sandstone reservoir. A typical result shown in Fig. 6.5 depicts the lateral continuity and varying thickness of a subzone in the Cardium reservoir. Fig. 6.6 shows a stratigraphic breakdown of the Cardium reservoir as given by the gamma ray log, core lithology, and core permeabilities.

Such a study is time-consuming, requiring much detail in core-logging and core-lithology information. It appears that our greatest need today in the area of reservoir performance prediction is a quick, cheap means for obtaining an estimate of the interwell permeability distribution, both areal and vertical.

Crossflow Between Layers

Many methods for predicting the oil recovery performance of waterfloods assume that the layers in the reservoir are each continuous from well to well, uniform in properties, and insulated from each other except at the wellbores. We generally visualize such a reservoir as a layer cake, with icing between each layer serving as the insulating material.

From what we know, very few reservoirs satisfy the concept of shale streaks or impermeable beds acting as the material insulating each layer from the other. Of course, we have known of reservoirs composed of a series of thin sand stringers, each of which could be correlated from well to well. Elkins[12,28] points out that even in clean sands the macroscopic vertical permeability can be several orders of magnitude (100-fold or more) lower than the horizontal permeability. As a result the reservoir can in effect perform as one in which little or no crossflow, or flow between the layers, occurs.

Obviously actual reservoirs will range all the way from those having no crossflow to those having complete vertical transparency to flow. Some reservoir engineers follow the philosophy of considering each reservoir to be composed of insulated layers. As we shall see in the next chapter, this generally provides a conservative estimate of waterflood performance.

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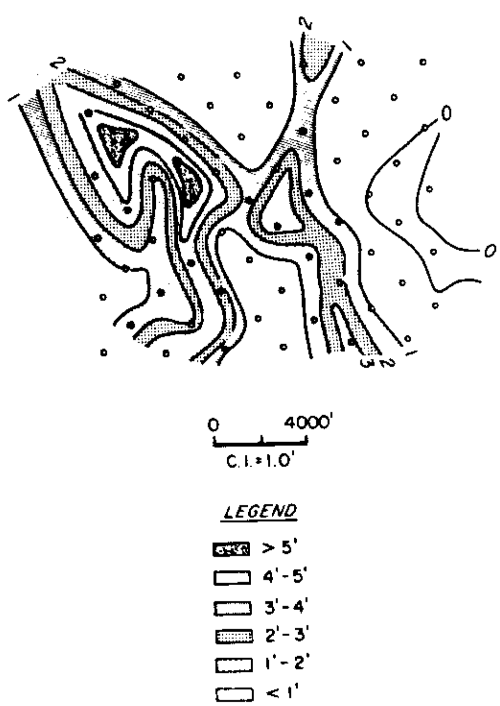

Fig. 6.5 Lateral continuity of Subzone-b, Zone-I portion of Pembina field, Alberta (after Ref. 1).

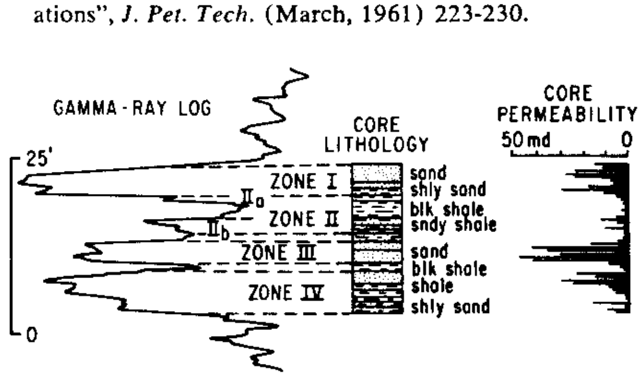

Fig. 6.6 Stratigraphic breakdown in the Pembina Cardium reservoir as given by the gamma ray log, core lithology and core permeability (after Ref. 1).

IPR CALCULATION 8-18-9-25

① Above the bubble pt. the PI eq'n applies

$\bar{P}_R = 6665$ kPa (DST #1)
$P_{wf} = 6270$
$q_o = 8.16$ m3OPD (Oct/89 aver) WOR = 1.69 m3/m3 (Oct/89 aver)
$P_b = 1427$ kPa (PVT 7-8-9-25)

$$PI = \frac{q}{\bar{P}_R - P_{wf}}$$

$PI_o = .022$ m3/d / kPa

$PI_w = .037$ m3/d / kPa

$PI_T = .059$

② IPR at the bubble pt. from Vogel

$$\frac{q_b}{q_c} = 1.8\left(\frac{\bar{P}_R - P_b}{P_b}\right)$$

$$\frac{q_b}{q_c} = 1.8\left(\frac{6665 - 1427}{1427}\right) = 6.61$$

$q_{b_{oil}} = .022(6665-1427) = 115.2$ m3OPD $q_{c_{oil}} = 17.4$ m3OPD

$q_{b_{wtr}} = .037(6665-1427) = 193.8$ m3WPD $q_{c_{wtr}} = 29.3$ m3WPD

$q_{total} = 309$ m3FPD $q_{c\ total} = 46.7$ m3FPD

(3) IPR below the bubble pt from Vogel's Eq-

$$\frac{q}{q_c} = 1.8\frac{P_R}{P_B} - 0.8 - 0.2\left(\frac{P_{wf}}{P_b}\right) - 0.8\left(\frac{P_{wf}}{P_b}\right)^2$$

IPR @ $P_{wf} = 500$ kPa

$$\frac{q}{q_c} = 1.8\left(\frac{6665}{1427}\right) - 0.8 - 0.2\left(\frac{500}{1427}\right) - 0.8\left(\frac{P_{wf}}{P_b}\right)^2$$

$$\frac{q}{q_c} = 7.45$$

q_{oil} @ 500 kPa $= 129.6$ m³OPD q_{wtr} @ 500 kPa $= 218.3$ m³WPD

q_{total} @ 500 kPa $= 347.9$ m³FPD

$q_{max_{oil}} = 132.6$ m³OPD

$q_{max_{wtr}} = 223.1$ m³WPD

$q_{max_{total}} = 355.7$ m³FPD

IPR CALCULATION 9-18-9-25

P_{bpt} = 1427 kPa (PVT 7-8-9-25)

(1) Above the bubble point the PI Eq^n applies

$$PI = \frac{q}{\bar{P}_R - P_{wf}}$$

q_{oil} = 7.1 m³OPD (Nov/89)
q_{wtr} = 19.5 m³WPD (Nov/89)

$\bar{P}_R$ = 6757 kPa
P_{wf} = 6200 kPa.

$$PI_{oil} = \frac{7.1}{6757-6200} = .013 \text{ m}^3/d/kPa$$

$$PI_{wtr} = \frac{19.5}{6757-6200} = .035 \text{ m}^3/d/kPa$$

$PI_{\substack{TOTAL\\FLUID}}$ = .048 m³/d/kPa

(2) IPR at the bubble pt. from Vogel's Eq^n

$$\frac{q_b}{q_c} = 1.8\left(\frac{\bar{P}_R - P_b}{P_b}\right)$$

$$\frac{q_b}{q_c} = 1.8\frac{(6757-1427)}{1427} = 6.72$$

q_{boil} = .013 (6757 - 1427) = 69.3 m³OPD ∴ q_{bwtr} = 186.6 m³WPD

q_{total} = 255.9 m³ FPD

$$q_{c_{oil}} = \frac{69.3}{6.72} = 10.3 \text{ m}^3\text{OPD}$$

$$q_{c_{wtr}} \quad \frac{186.6}{6.72} = 27.8 \text{ m}^3\text{WPD}$$

$$q_{c\,total} = \frac{255.9}{6.72} = 38.1 \text{ m}^3\text{FPD}$$

$$q_{max} = q_b + q_c$$

$q_{max_{oil}} = 79.6$ m³OPD

$q_{max_{wtr}} = 214.4$ m³WPD

$q_{max_{total}} = 294$ m³FPD

③ INFLOW AT $P_{wf} = 500$ KPA from Vogel

$$\frac{q}{q_c} = \left[1.8\left(\frac{\bar{P}_R}{P_b}\right) - 0.8 - 0.2\left(\frac{P_{wf}}{P_b}\right) - 0.8\left(\frac{P_{wf}}{P_b}\right)^2\right]$$

$$= 1.8\left(\overset{4.64}{\frac{6757}{1457}}\right) - 0.8 - 0.2\left(\overset{.34}{\cancel{\frac{500}{1457}}}\right) - 0.8\left(\overset{.12}{\cancel{\frac{500}{1457}}}\right)^2$$

$$= 7.39$$

q_{oil} @ 500 kPa = 76.1 m³/d

q_{water} @ 500 kPa = 205.4 m³/d

q_{total} @ 500 kPa = 281.5 m³/d

RADIAL FLOW EQ'N 9-18 - 9-25

$$q_{sc} = \frac{7.08\, kh\, (P_e - P_w)}{\mu B_o \ln(r_e/r_w)}$$

. FLOW ACROSS AN EXTERNAL BOUNDARY

PI

rearrange $$\frac{q_{sc}}{(P_e - P_w)} = \frac{7.08\, kh}{\mu B_o \ln(r_e/r_w)}$$

WHERE

$\bar{P}_R = 6757$ kPa = 980 psi
P_w : 6200 : 899 psi
q_{sc} : 25 m^3/d 157.3 B/D

μ = 4.4 cp (7-8 PVT μ = 4.164 cp)

B_o = 1.097 (7-8 PVT)

r_w = 0.23'
r_e = 660' 16 ha spacing

Solve for kh

$$\frac{157.3}{980 - 899} = \frac{7.08\, kh}{4.4 * 1.097 * \ln\left(\frac{660}{0.23}\right)}$$

$$kh = 10.54 \text{ d·ft}$$

ASSUME A NO FLOW BOUNDARY AT THE EDGE OF THE SPACING UNIT

$$q_{sc} = \frac{7.08\, kh\, (P_e - P_w)}{\mu\, B_o \left(\ln(r_e/r_w) - 1/2 \right)}$$

$P_w = 5400$ kPa $= 783$ psi

$q_{sc} = 50\ m^3$ FPD $= 314.5$ B/D

SOLVING FOR P_e

$$314.5 = \frac{7.08 \times 16.54\, (P_e - 783 \text{ psi})}{4.4 * 1.097 \times \left(\ln\left(\frac{660}{0.23}\right) - 1/2 \right)}$$

$P_e - 783 = 151.79$

$P_e = 934.79$ psia

∴ DRAWDOWN AT SPACING UNIT BOUNDARY

$\Delta P = \bar{P}_R - P_e = 980 - 935 = 45$ psi

% DRAWDOWN $= \frac{980-935}{980} * 100 = 4.6\ \%$

ESTIMATE FLOW ACROSS SPACING UNIT BOUNDARY

$(\bar{P}_R - P_e) = 50$ psi

$$PI = \frac{q}{\bar{P}_R - P_{wf}} = \frac{157.3}{980 - 899} = 1.94 \text{ B/D/psi}$$

$$q_{50} = \frac{\bar{P}_R - \bar{P}_e}{PI} = \frac{50}{1.94} = 25.75 \text{ B/D FLUID}$$

ASSUMING WATER-CUT, WC = 68 %

NOTE 9-18 WC = 73%
8-18 WC = 63%

DAILY OIL VOLUME FLOWING ACROSS SPACING UNIT BOUNDARY

$25.75 \times .32 = 8$ B/D

OVER 6 MONS 1460 BBLs = 232 m^3 oil

drained by a particular well sometimes necessitates their use as independent parameters in order to explain observed facts concerning the well's performance.

It is important to recognize that for an individual well there are two variables, the effects of which have to be studied separately: these are the gross production rate at a particular stage in the well's history and the cumulative production taken from the well.

2-2 Radial Flow of a Liquid

Suppose a well is producing liquid at the rate q bbl/day (stock-tank oil), i.e., qB_o bbl/day of reservoir liquid, from a horizontal, homogeneous reservoir of net pay thickness h ft and infinite areal extent; and suppose that the flow conditions do not change with time (i.e., steady-state flow). Under such circumstances, and on the assumption that the liquid produced has a low and constant compressibility, it is possible to derive a formula relating the pressure in the formation at a particular point to the distance of the point from the well bore and to the liquid production rate. (For a proof of the relationship for the case in which the liquid is incompressible, see, for example, Pirson, ref. 1, p. 392.)

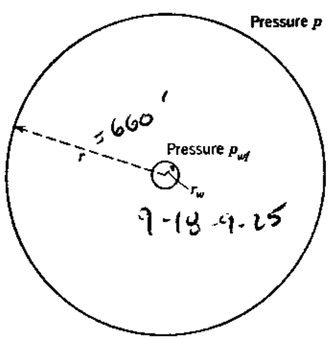

Fig. 2-1 Single well in an infinite homogeneous reservoir.

Let the radius of the well bore be r_w ft and let the pressure at the sand face be p_{wf} psi. If the liquid has viscosity μ centipoises, the pressure p (psi) in the formation at the radius r ft from the center line of the well bore (see Fig. 2-1) is approximately

$$p = p_{wf} + \frac{qB_o\mu}{0.007082kh} \ln\left(\frac{r}{r_w}\right) \qquad (2\text{-}1)$$

where k is the formation permeability, md.

Equation (2-1) is evidently unrealistic for large values of r, since it implies that p becomes very large as r increases, whereas in practice p tends to p_e, the static pressure of the reservoir. If r_e is the value of r which makes the right-hand side of Eq. (2-1) equal to p_e, then the equation gives a reasonably good approximation to the actual pressure distribution for values of r less than r_e (Fig. 2-2).

The value r_e is called the *drainage radius* of the well; evidently it has no physical significance for one well in an infinite reservoir.

Example 2-1 A field is drilled up on a rectangular 80-acre spacing. If the reservoir pressure is 1000 psi, the permeability k is 50 md, the net sand thickness h is 20 ft, the oil viscosity μ is 3 centipoises, and the oil formation volume factor B_o is 1.25, and

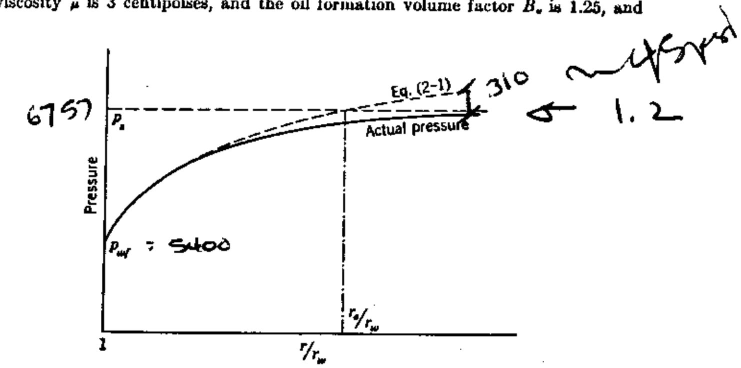

Fig. 2-2 Pressure distribution in the formation.

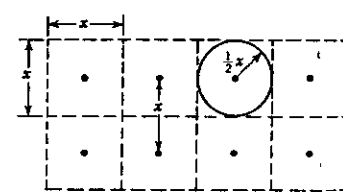

Fig. 2-3 Regular 80-acre spacing pattern.

if the wells are completed with 7-in. casing, what is the production rate per well when the producing pressure at the bottom of the well is 500 psi?

Let x (ft) be the distance between adjacent wells, as shown in Fig. 2-3.

Since 1 acre is 43,560 sq ft,

$$x^2 = 80 \times 43{,}560$$

or

$$x = 1864 \text{ ft}$$

That is, as a first approximation, each well drains a circle of 932-ft radius.

Since r_w is $3\frac{1}{2}$ in., or $\frac{7}{24}$ ft, r_e/r_w is 3200 and

$$\ln\left(\frac{r_e}{r_w}\right) = 8.06$$

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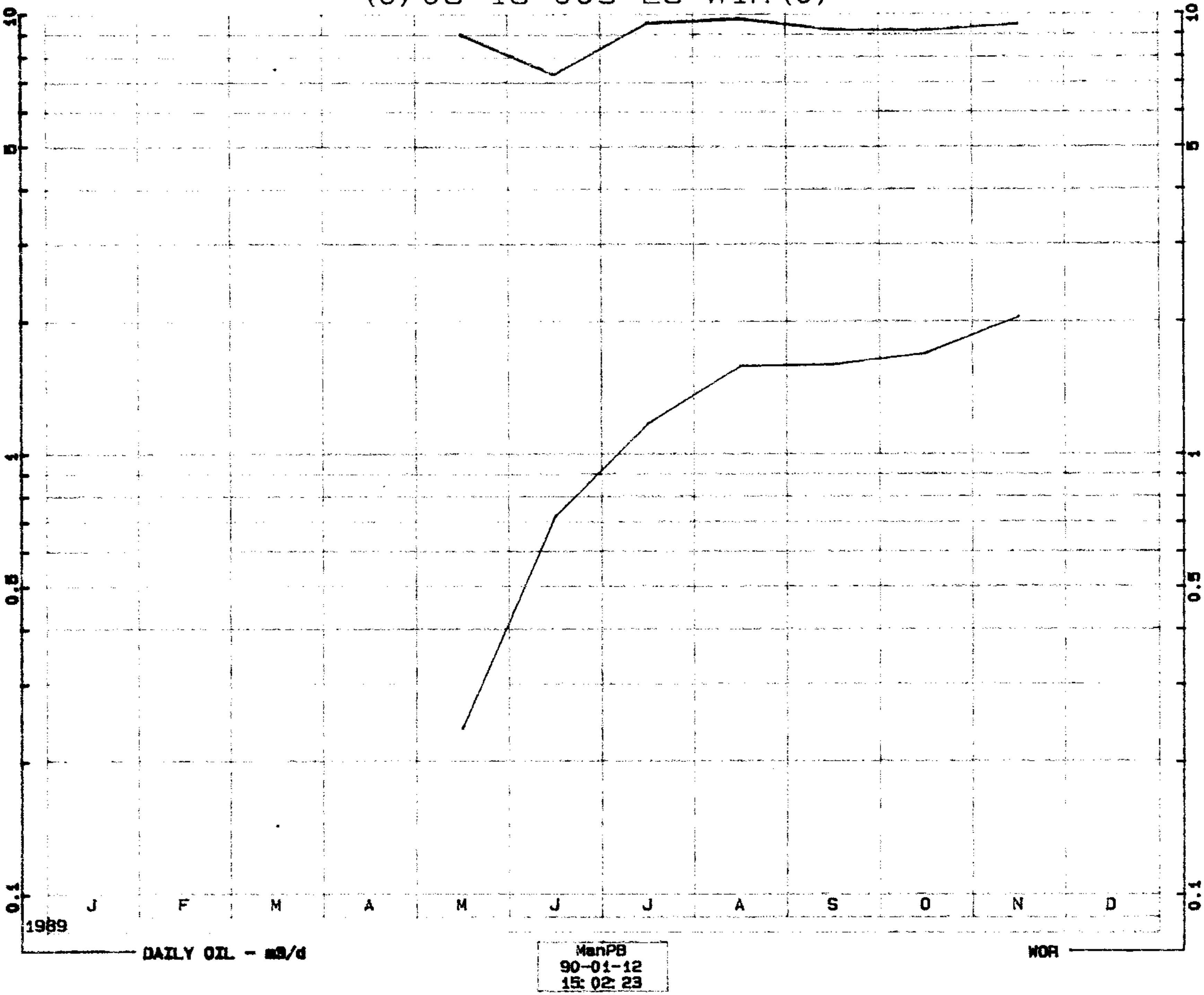

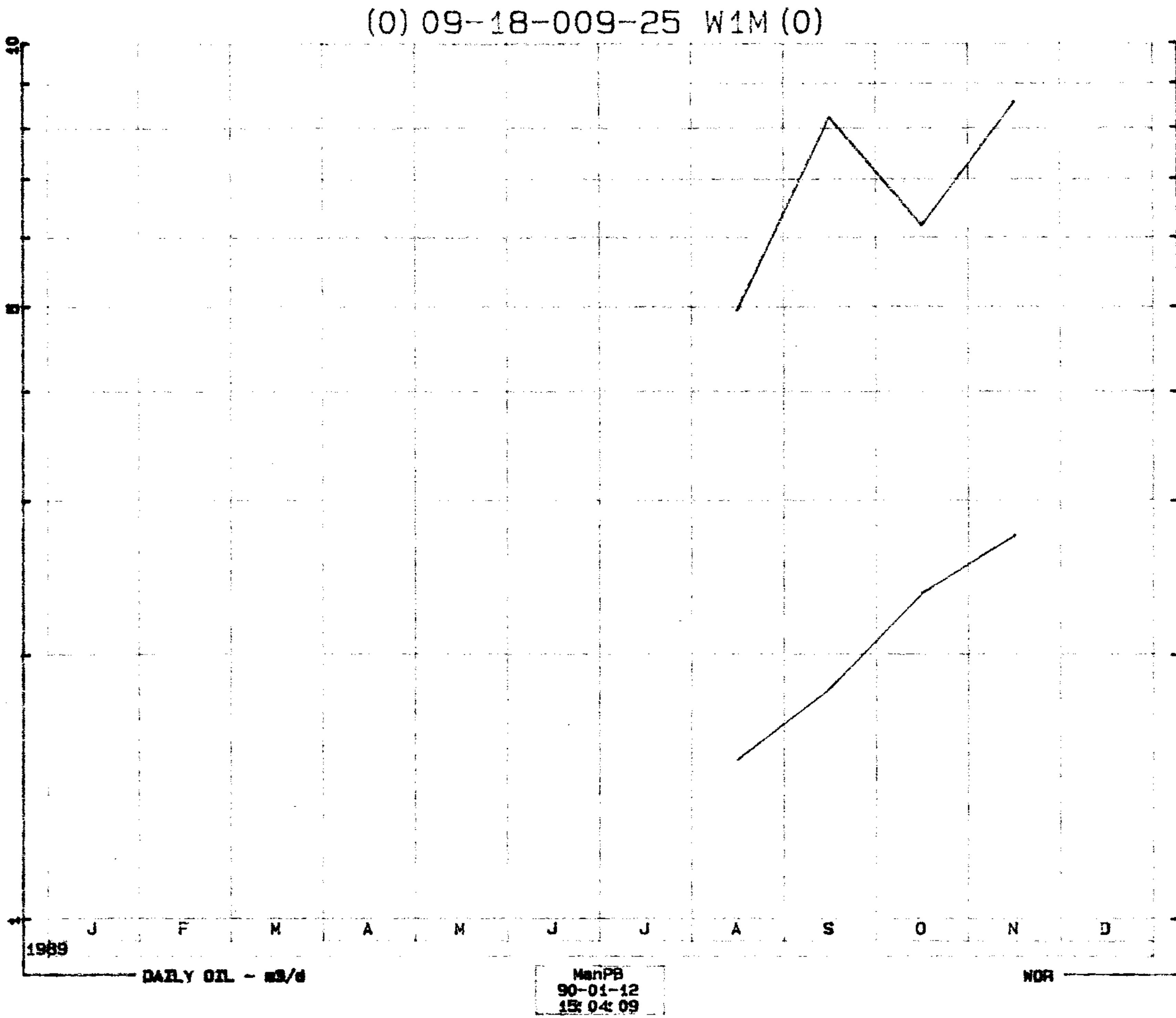
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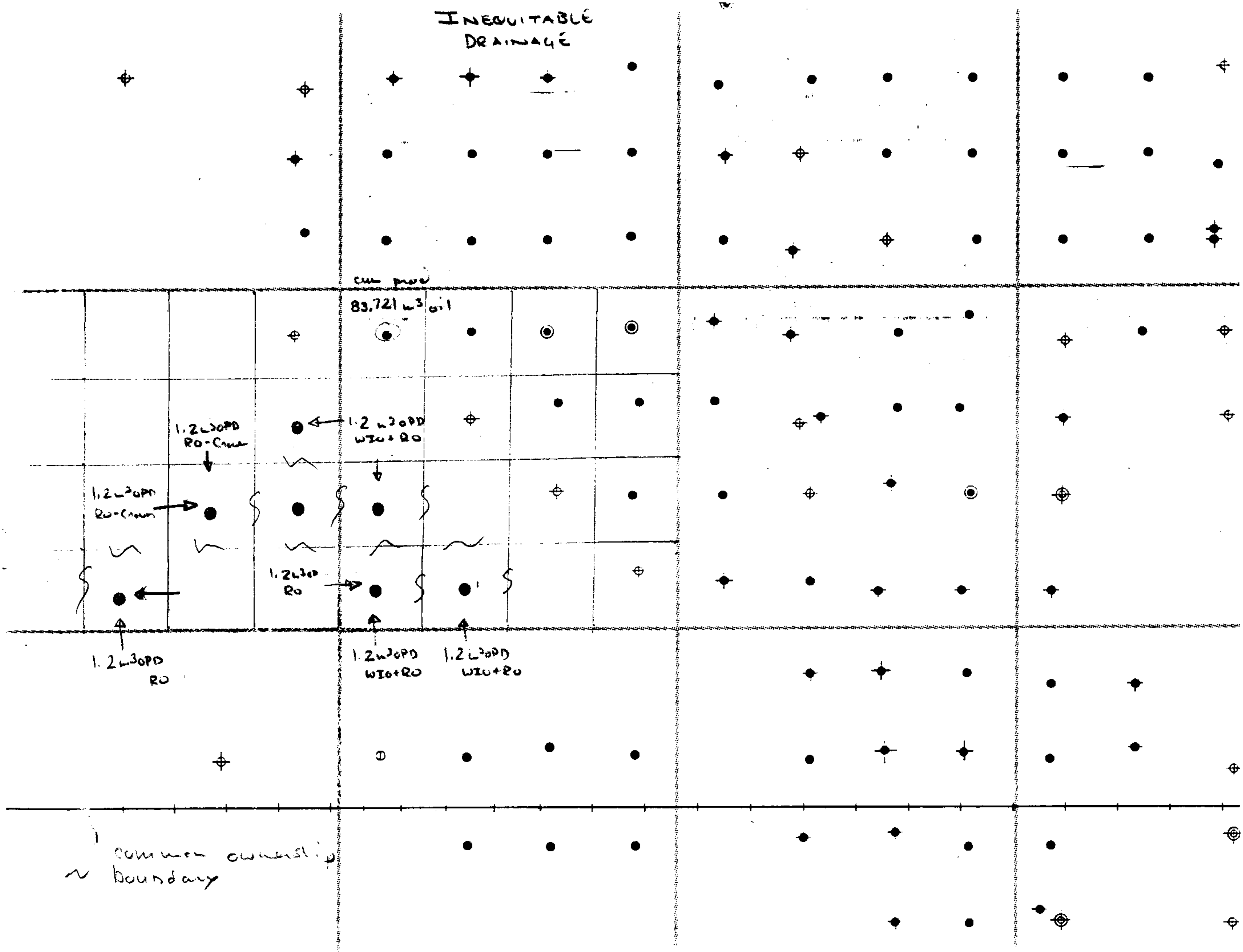
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1.2 m3OPD WIC+RO
1.2 m3OPD RO-Crown
1.2 m3OPD RO-Crown
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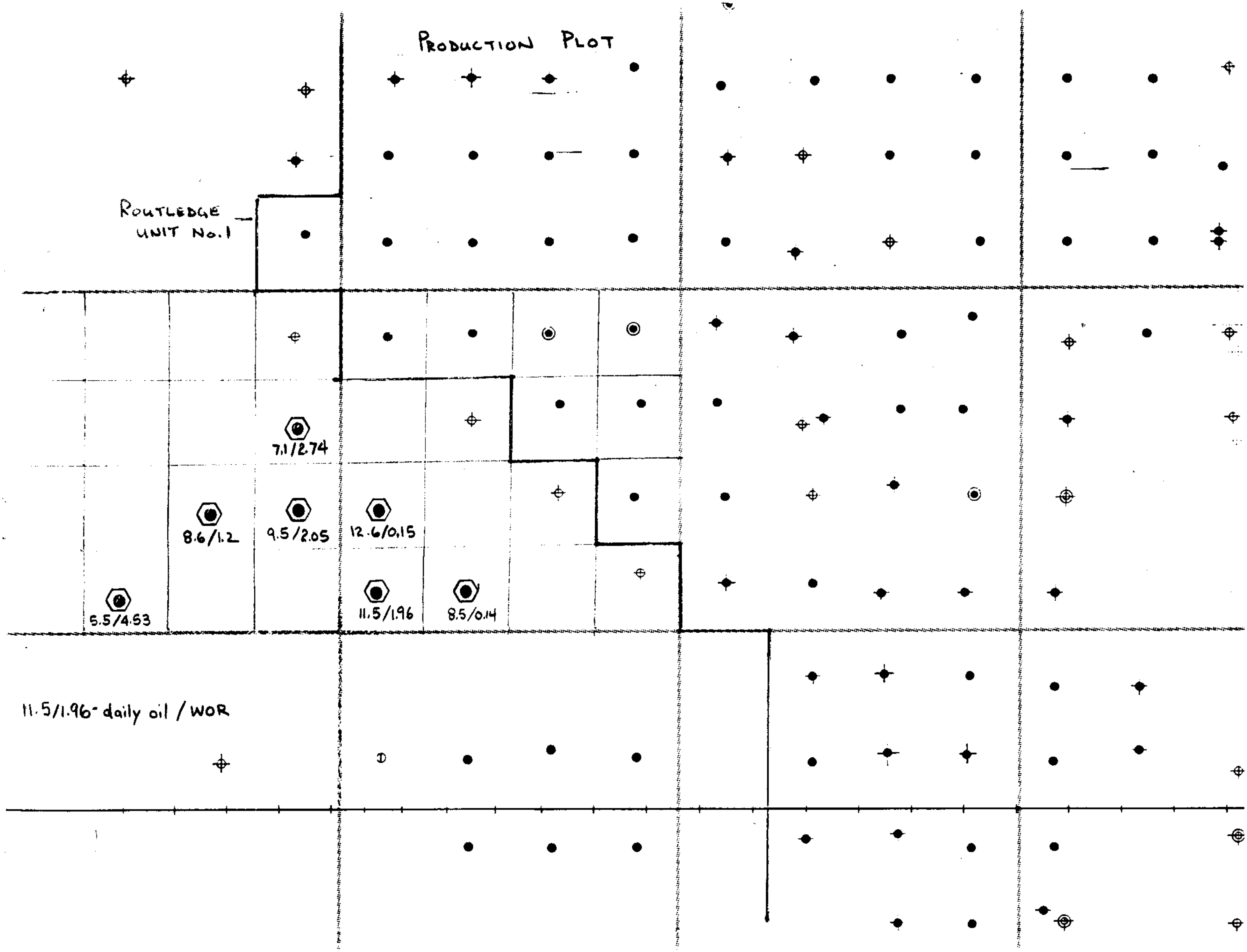
PRODUCTION PLOT
ROUTLEDGE UNIT No. 1
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8.6/1.2
9.5/2.05
12.6/0.15
5.5/4.53
11.5/1.96
8.5/0.14
11.5/1.96 - daily oil / WOR