December 10, 1990

Mr. Dan Barchyn, P. Eng.
Exploration Manager
Tundra Oil and Gas Ltd.
1313 One Lombard Place
Winnipeg, Manitoba
R3B 0X3

Dear Sir:

RE: Maximum Wellhead Injection Pressure
Tundra Daly WIW 16-14-10-29 (WPM)

Your application dated December 3, 1990 for an increase in the maximum wellhead injection pressure for the subject well to 7000 kPa is hereby approved.

Yours respectfully,

ORIGINAL SIGNED BY
H. CLARE MOSTER

H. Clare Moster
Deputy Chairman

December 10, 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: Maximum Wellhead Injection Pressure
Tundra Daly WIW 16-14-10-29 (WPM)

Tundra Oil and Gas Ltd. has applied for an increase in the maximum wellhead injection pressure for the subject well, from 6000 kPa to 7000 kPa.

RECOMMENDATION

It is recommended that the application be approved. The proposed Board letter of approval is attached.

DISCUSSION

The injection pressure at the 16-14-10-29 well has increased to the point it is impossible to replace voidage in North Ebor Unit No. 1. Section 5 of Board Order No. PM 62 provides the Board with the flexibility to change the maximum wellhead injection pressure. Tundra's proposed maximum wellhead injection pressure of 7000 kPa is less than the 9000 kPa wellhead fracture pressure observed during the original completion.

ORIGINAL SIGNED BY
JOHN N. FOX

John N. Fox

Original Signed By
L. R. DUBREUIL

Approved by: ______________________
L.R. Dubreuil, Director

Tundra
oil and gas ltd.

December 3, 1990

Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3

ATTENTION: Mr. John Fox
Chief Petroleum Engineer

Dear John:

RE: NORTH EBOR UNIT #1

Further to our conversations regarding the above Unit, we are continuing to inject at the 16-14 well at or near the maximum allowable pressure of 6000 kPa. We are in the process of conducting a pressure fall off test to determine reservoir pressure and/or skin damage at this location. Early indications are that skin damage is not a problem at this well. Therefore, in order to meet our voidage replacement targets, it may become necessary to increase our injection pressure.

When this well was fracture stimulated (gelled KCL water) an annular pressure of 9000 kPa was observed at breakdown (see attached completion report). It therefore appears that injection at surface pressures less than 9000 kPa does not pose a risk of fracturing the formation. Recognizing the need for an adequate margin of safety, we now request that the maximum allowable injection pressure for the 16-14 well be increased to 7000 kPa from the current maximum of 6000 kPa.

If you have any questions regarding this request, please contact the undersigned.

Sincerely,

Dan Barchyn

Dan Barchyn

DB/src

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3
Telephone: (204) 934-5850 Fax: (204) 934-5820

MOGC DALY 16-14-10-29

FRAC REPORT

1989 02 06: Moved L.J. Rig #1 onto location and rigged up. Pressure tested pump to 3500 kPa. Pulled pump and rods. (Rods were clean and no evidence of corrosion.) Pulled 5 joints tubing and relanded in dognut at 816.0 m K.B. Made up wellhead and S.D.F.N.

1989 02 07: Rigged in Nowsco frac pumper, blender and iron truck. Fraced well down tubing, while monitoring annulus, with 5 tonnes 20/40 sand in gelled fresh 3% KCl water with the following additives:

WS-60 @ 2L/m3	(Non Emulsifying Surfactant)
KCl @ 30 kg/m3	(Non Clay Swelling Agent)
LSR-1-NB	(Gelling Agent)
NOWPHIX-6X @ 1 kg/m3	(Buffer for PH Control)
RIDOXL @ 0.5 L/m3	(Oxygen Scavenger)
NOWCIDE 308 @ 0.1 L/m3	(Bacteriacide)
Breaker F @ 0.2 kg/m3	(Gel Breaker)

Frac details were as follows:

Injection rate		0.9 m3/min
Initial Concentration		200 kg/m3
Final Concentration		1000 kg/m3
Pressures (annular)	Breakdown	9000 kPa
	Minimum	7000 kPa
	Maximum	13000 kPa
Instantaneous Shut in		7000 kPa
15 Minute shut in		5000 kPa

Shut in wellhead and rigged out frac equipment. Pumped 0.1 m3 oil down annulus and tubing with rig pump to keep wellhead from freezing. Shut in wellhead to allow frac to heal.

1989 02 08: Weather -- -28° C. Wind Chill -- 2000
Started and warmed up rig. Checked wellhead pressures:
Casing - Vacuum; Tubing - Vacuum
Rigged in pump and circulated well to oil down casing. Installed JU type preventer and ran tubing in hole to PBTD and circulated out excess sand. Recovered approximately 1.0 m3 sand. Circulated on bottom for ½ hour to clean up well. Removed JU and relanded tubing at 862.9 m KB. Rigged up to and swabbed. Pulled a total of 13 swabs for a recovery of 6.83 m3. Final fluid level was 630 m. Final water cut - 50%.

Total oil recovered:	5.50 m3
Total Water recovered:	1.33 m3
Remaining oil to recover:	10.2 m3
Remaining water to recover:	9.8 m3

Shut in wellhead and S.D.F.N.

(NOTE: Gel appears to have broken well with no evidence of emulsion or precipitates.)

Page 2...

1989 02 15: Weather -- 1 22° C.
Started and warmed up rig. Checked wellhead pressures: Casing: 350 kPa; Tubing: 100 kPa.
Run in hole with swab bar and tagged fluid at 270 m. Fluid inflow overnight of 3.3 m3. Pulled 1 swab for a recovery of 1.2 m3. Water cut - 90%. Attempted to run in hole but swab cups plugged with sand. Rigged in pump and circulated to bottom. Circulated on bottom for ½ hour to clean up hole. Rigged up to and swabbed. Swabbed a total of 10.4 m3 fluid. In last 2 hours of swabbing pulled 6 swabs for a recovery of 2.2 m3 total fluid. Average water cut - 20%. Fluid level dropped from 630 m to 700 m in final 2 hours of swabbing.
Remaining oil to recover: 0 m3.
Remaining water to recover: 6.0 m3.
Run in hole and tagged sand at 868.0 m KB. Relanded tubing at 862.9 m KB. Ran pump and rods.

Pump - LTV #204-88 2 x 1½ x RWAC x 10 x 3 with 10 cup plunger. Rod details as before. Pressure tested pump to 3500 kPa. Made up wellhead and rigged out.

1989 02 11: Well stopped pumping. Rigged in pump truck to 16-14-10-19. Circulated 11.1 m3 produced salt water down casing and through pump. Pressure tubing to 3500 kPa to seat pump valves. Well resumed pumping. Rigged out.

1989 02 13: Well stopped pumping. Moved in L.J. #1 and rigged up. Pulled pump and rods. Installed JU Preventor, rigged up pump and circulated to P.B.T.D. Circulated on bottom for 1 hour to clean out well. Recovered approximately 0.1 m3 sand. Rigged up to and ran reconditioned **pump LTV #23-87 2 x 1½ x RWAC x 10 x 3** - cup type plunger. Rod details as before. Filled tubing and pressure tested pump to 3500 kPa. Made up wellhead and rigged out. Returned to production.

T.B. Howell
P. Eng. - 1989 01 15

TBH/bep

16-14-10-29

FRAC PRESSURE 9000 kPa (surface)

mPP = 857 m

$$\frac{9000 \text{ kPa}}{857 \text{ m}} + 9.95 \frac{\text{kPa}}{\text{m}} \text{ (fluid gradient)} = 20.5 \text{ kPa/m}$$

(0.9 psi/Ft)

PROPOSED INJECTION PRESSURE - 7000 kPa (surface)

injection gradient 18.1 kPa/m

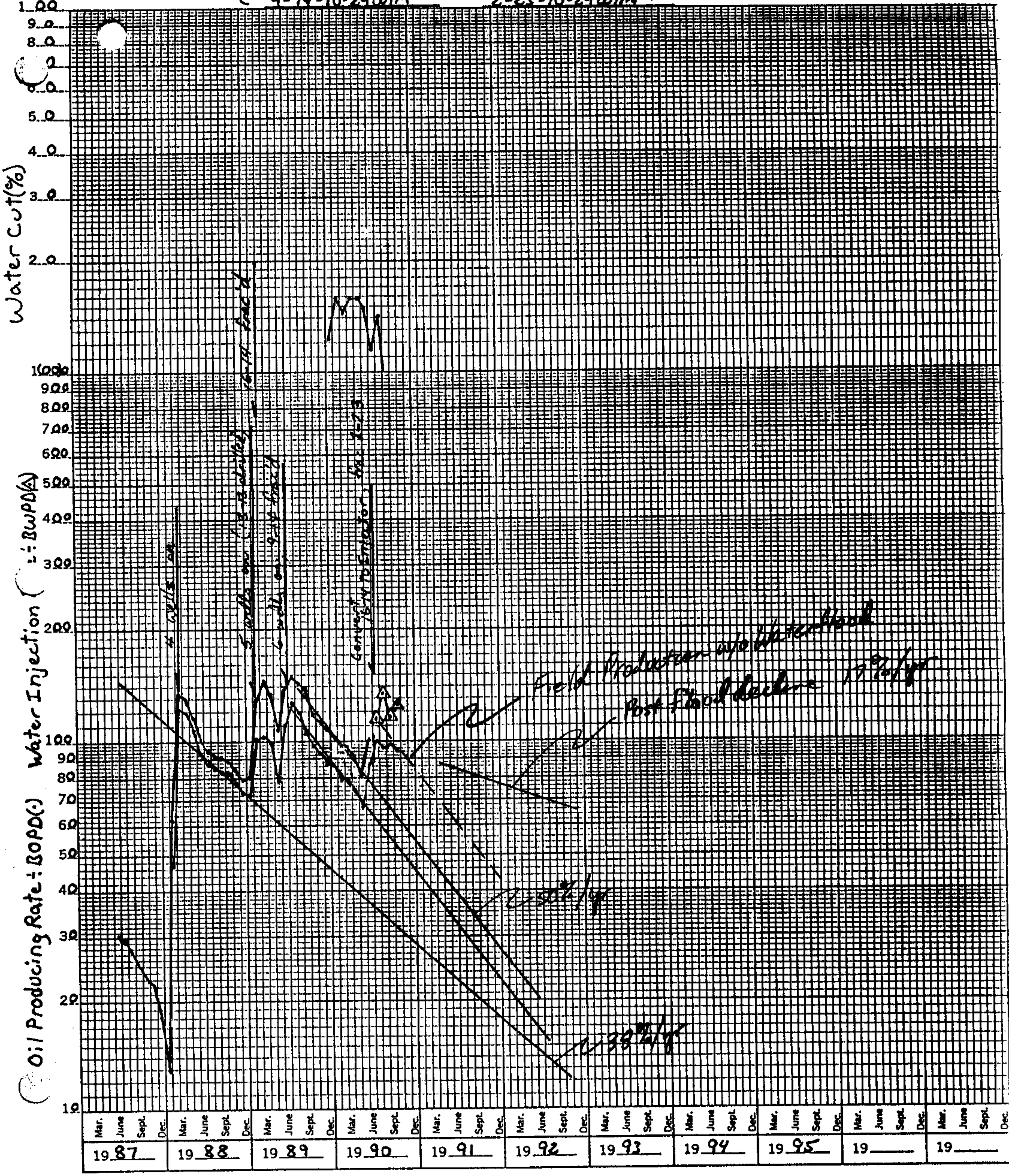
$$\frac{18.1}{20.5} = 88\% \text{ of frac gradient}$$

TUNDRA N. EBOR BAKKEN Waterflood: 16 14-10-29W1M (Injector)

Non Injectors { 12-13-10-29W1M, 13-13-10-29W1M, 9-14-10-29W1M, 15-14-10-29W1M, 1-23-10-29W1M, 2-23-10-29W1M

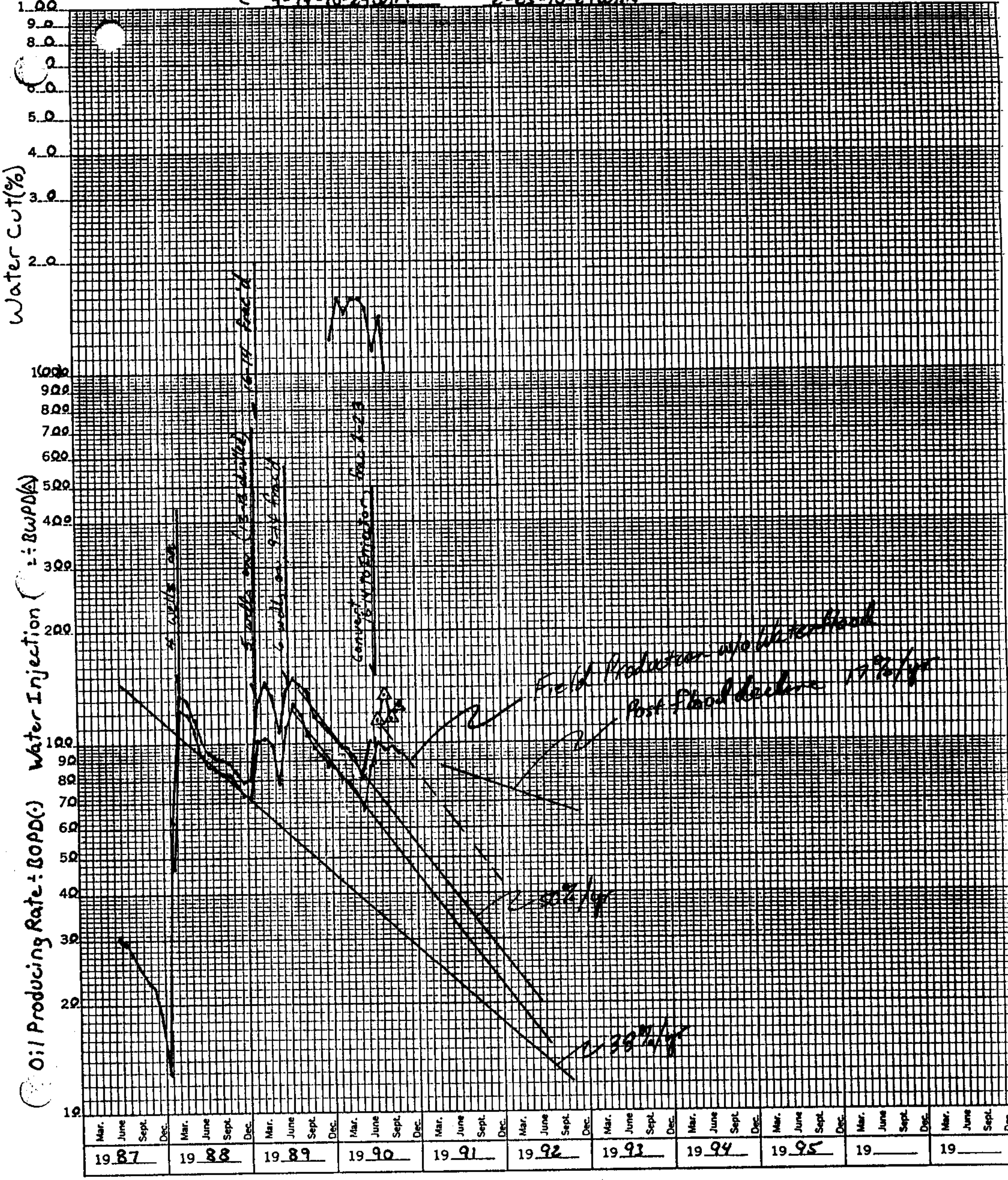
INCLUDING 16-14

NON-INJECTORS ONLY



TUNDRA N. EBOR BAKKEN Waterflood: 16 14-10-29W1M (Injetor)

Non Injectors { 12-13-10-29W1M, 13-13-10-29W1M, 9-14-10-29W1M, 15-14-10-29W1M, 1-23-10-29W1M, 2-23-10-29W1M



Date: November 15, 1989

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: Application for an Injectivity Test
MOGC Daly Prov. 15-11-10-29 (WPM)

Tundra Oil and Gas Ltd. has applied to conduct an injectivity test using the well, MOGC Daly Prov. 15-11-10-29 (WPM). The purpose of the injectivity test is to help assess the feasibility of waterflooding the Bakken Formation.

Recommendations

It is recommended that the Board approve Tundra's application to conduct an injectivity test in the Daly Bakken D Pool using the well, MOGC Daly Prov. 15-11-10-29 (WPM). Due to the limited duration of the proposed injectivity test a salt water disposal order is considered unnecessary and instead it is recommended that the Board use the discretionary powers provided by subsection 54(1) of the Petroleum Drilling and Production Regulation to approve the test. The proposed Board letter of approval is attached.

Discussion

Tundra Oil and Gas Ltd. is presently assessing the feasibility of waterflooding the Bakken Formation. As part of this assessment Tundra has applied to conduct an injectivity test in the Daly Bakken D Pool using the well MOGC Daly Prov. 15-11-10-29 (WPM) to determine if fines migration poses a serious problem to the successful waterflooding of the Bakken Formation. To date no company has attempted to waterflood the Bakken Formation in Manitoba, Saskatchewan or North Dakota.

Tundra considers the Daly Bakken D Pool to be the best candidate for a pilot waterflood project because this pool has the best primary performance of all the Bakken pools and there is evidence of reservoir continuity and pressure depletion within the pool. Table 1 lists the reservoir properties of the Daly Bakken D Pool. If the injectivity test is successful, waterflooding the Bakken which typically has a primary recovery of less than 10% should result in a substantial increase in recovery.

The 15-11-10-29 well is a good candidate for the injectivity test. The well is located on the down dip edge of the pool and is remote from the main part of the pool (Figure 1). The 15-11 well is also a relatively poor producer averaging 0.8 m^3 OPD at a WOR of 0.6 m^3/m^3. Figure 2 shows the daily oil and cumulative production from the wells in the pool.

Tundra proposes to inject approximately 1 500 m^3 of produced water into the 15-11-10-29 well over a 30 day period. The injection rate will be slowly increased over the duration of the test to a maximum rate of 50 m^3 WPD and the injection pressure monitored for evidence of fines migration. The proposed maximum wellhead injection pressure is 6 000 kPa well below the estimated fracture pressure of 10 000 kPa. Though unsophisticated this method of evaluating the injectivity test results should allow a qualitative interpretation of the injectivity performance of the Bakken Formation.

The radius of the flood front after the injectivity test is estimated to be 66 m from the 15-11 well. The nearest potential Bakken producer is 16-11-10-29 (this well is being deepened to test the Bakken) and the well is over 300 m away. Even if some fingering of the injected water occurs it will have no effect on offset oil production.

Section 11-10-29 (WPM) is Crown land, the N/2 is leased to MOGC (Tundra) and the S/2 is leased to Newscope. Tundra is the sole operator in the Bakken D Pool and the nearest offset producers not operated by Tundra, are the 2-11-10-29 and 5-12-10-29 wells both completed in the Daly Lodgepole D Pool and operated by Newscope. Figure 3 shows the land status in the area of application.

The surface owner has consented to the temporary installation of injection facilities (water tank and injection pump) at the wellsite and use of the well for disposal. Because Tundra has the consent of the mineral and surface owner and the injectivity test will not affect any other parties, publication of notice of this application is considered unnecessary.

Due to the nature of Tundra's request and the fact that the company plans to return the 15-11-10-29 well to production after the injectivity test is complete, it is considered appropriate under the circumstances for the Board to use the discretionary powers provided it under subsection 54(1) of the Regulation to approve the application without issuing a salt water disposal order of limited duration. Subsection 54(1) of the Regulation reads as follows:

> 54(1) All salt water produced in conjunction with oil production shall be reinjected into an underground formation in accordance with the terms of a valid Salt Water Disposal or Pressure Maintenance Order issued under subsection 62(9) of the Act unless otherwise specified by the board.

ORIGINAL SIGNED BY
JOHN N. FOX

John N. Fox
Chief Petroleum Engineer

JNF/dah/sml

attach

Approved by: ______________________
L. R. Dubreuil, Director

TABLE 1

Daly Bakken D Pool

Reservoir Properties

Area (ha)	253
Net Pay (m)	2.0
Porosity (%)	15
Water Saturation (%)	46
Shrinkage (1/Bo:)	.893
Original Oil In Place	336.4
Primary Recovery Factor %	11
Primary Recoverable Reserves ($10^3 m^3$)	37.0
Cumulative Production (89-09-01) $10^3 m^3$	10.9

FIGURE 1

DALY BAKKEN D POOL

OOIP / UNIT AREA

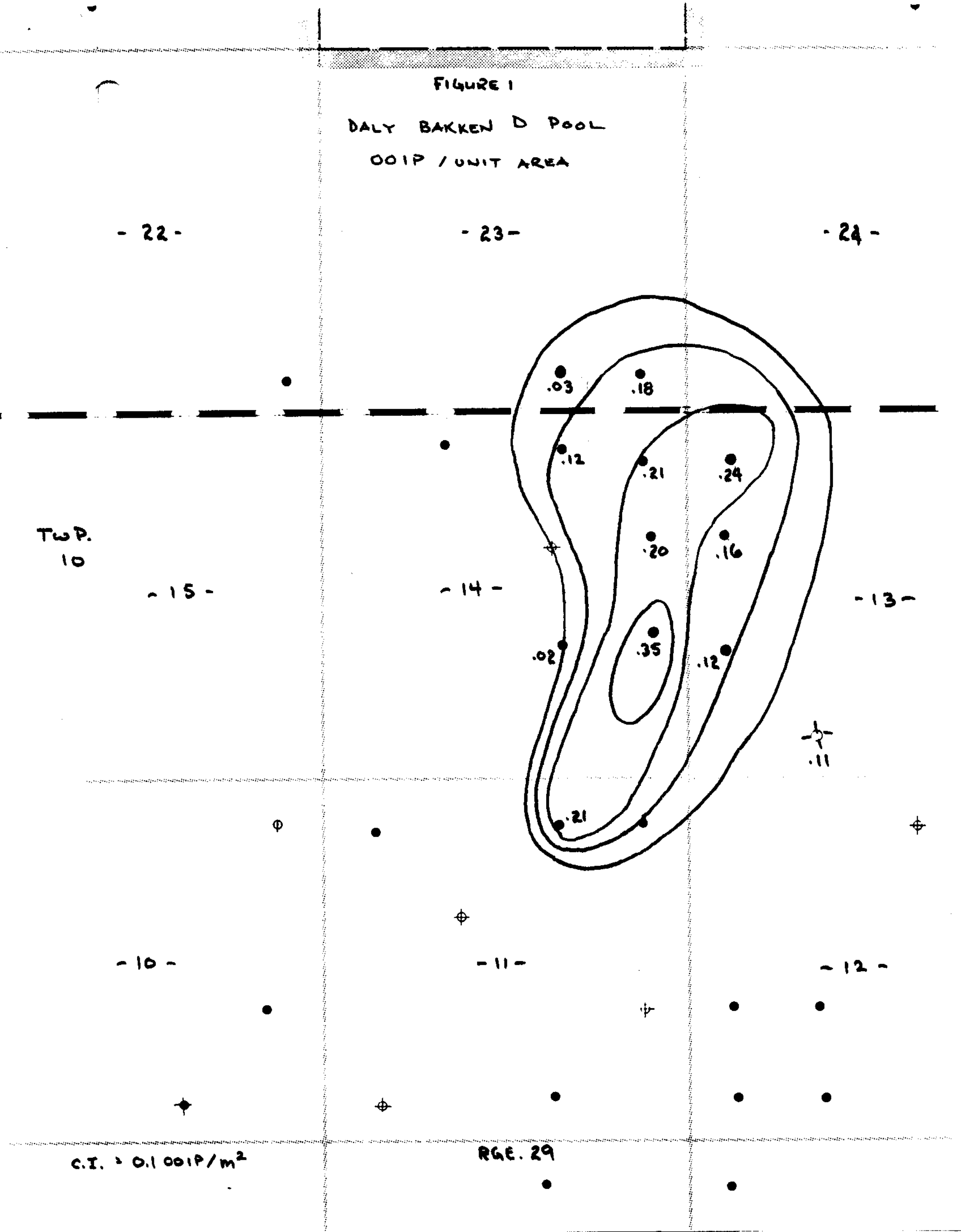


FIGURE 2

DALY BAKKEN D POOL

DAILY & CUMULATIVE OIL PRODUCTION

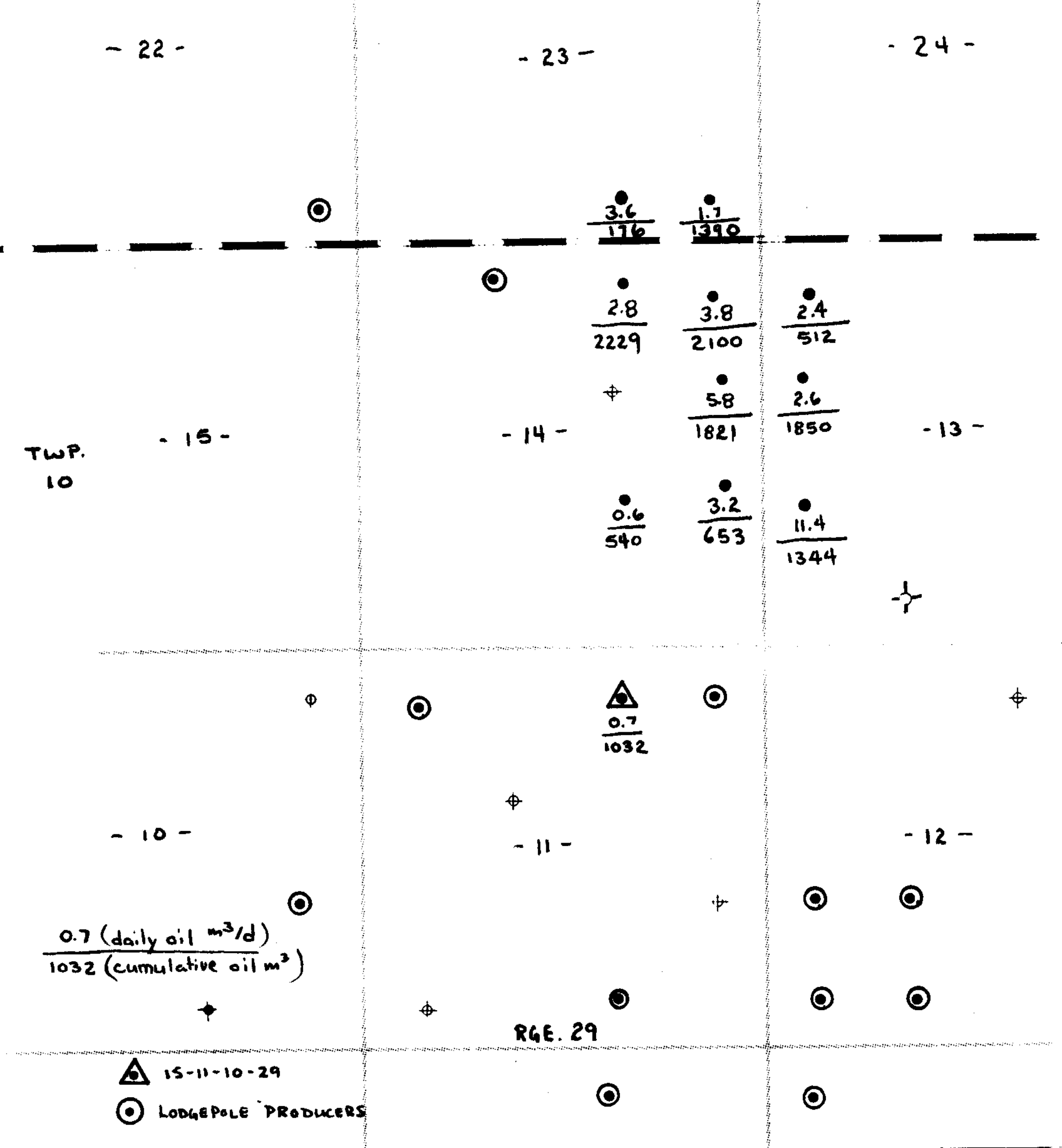
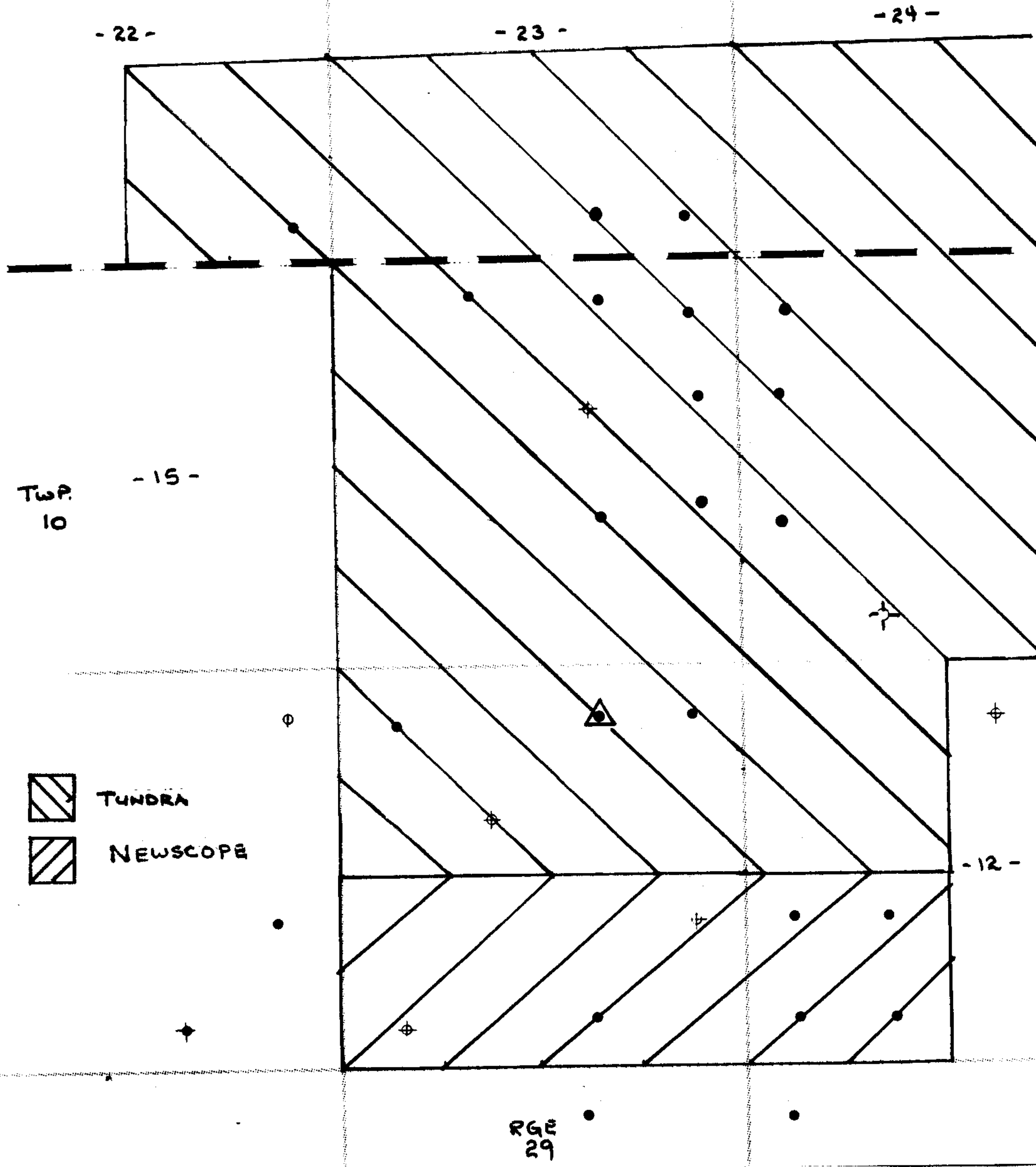


FIGURE 3
DALY BAKKEN D POOL
LAND STATUS



Tundra oil and gas ltd.

October 10, 1989

DEPARTMENT OF ENERGY AND MINES
OCT 12 19..
PETROLEUM BRANCH

Mr. John Fox
Chief Petroleum Engineer
Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4A5

Dear John:

RE: Tundra Daly Prov. 15-11-10-29 WPM Injectivity Test

Further to my letter of September 19, 1989 regarding the above and your request for further information, the following information is submitted:

1) Application form MG416 (in triplicate) along with a diagram of the proposed surface facility.

2) We propose to conduct the test without the use of a packer and, therefore, request exemption from this requirement under Section 40(3) of the regulations. Given the short duration of the test, we do not foresee a problem with the integrity of the downhole equipment.

3) Letters informing the surface owners of our intentions and asking for their approval have been sent. Copies will be forwarded to your attention when approvals are obtained.

4) Assuming:

	Net pay	= 1.5 m
	Porosity	= .20
	SW	= .50
	Injected volume	= 1430 m^3 (300 BWPD for 30 days)
	Displacement efficiency	= .50

Radius of the flood front = 78 m

5) Fracture pressure = 10 000 KPa (from completion report)

... 2

6) The test will be conducted by starting injection at a low rate (5-10 m^3 per day) and monitoring injection pressure for a few days. If no significant increase is seen, the injection rate will be increased and pressure again monitored. These stages will be repeated until a sudden dramatic increase in pressure, indicative of a fines migration problem, is seen or the maximum rate of 300 BWPD ~48 m^3/d is reached. If injection rates of 200+ BWPD can be achieved without observing a fines migration problem, the test will be considered successful. 32 m^3/d

7) Once this test has been completed, the 15-11 well will be returned to production from the Bakken Zone.

If you require any further information, please call.

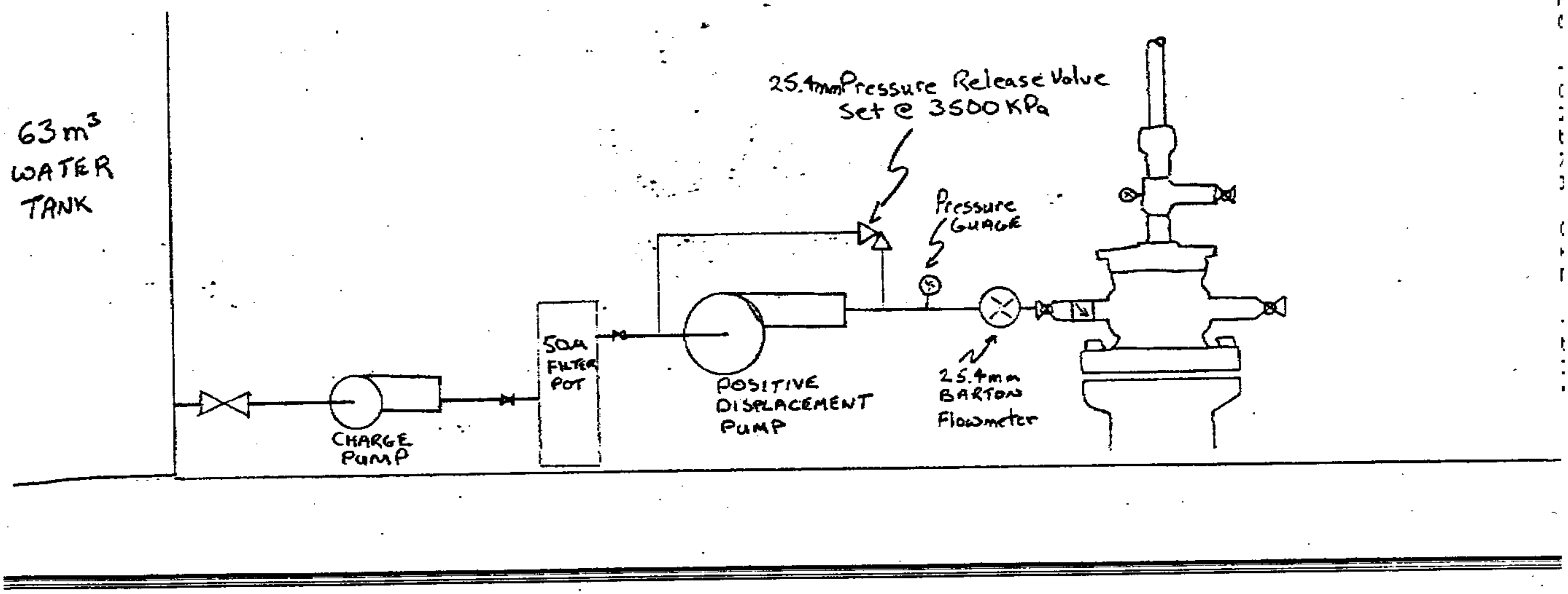
Sincerely,

Dan Barchyn

Dan Barchyn, P. Eng.
Exploration Manager

DB/ck

TUNORA 15-11-10-29 WATER INJECTION FACILITY (TEMPORARY)



Tundra
oil and gas ltd.

DEPARTMENT OF ENERGY AND MINES
SEP 21 1989
PETROLEUM BRANCH

September 19, 1989

Mr. Bob Dubreuil
Director, Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4A5

RE: Tundra Daly Prov. 15-11-10-29 WPM Injectivity Test

Dear Bob:

As part of our assessment of the feasability of water flooding the Bakken sand, Tundra Oil and Gas Ltd. hereby requests permission to conduct a water injectivity test on the currently producing Bakken well at 15-11-10-29 WPM. The duration of the test will not exceed 30 days and the injection rate will not exceed 300 BWPD. Injection pressure will not exceed 6000 KPa.

Our analysis has indicated that there is potential for a severe fines migration problem in the Bakken at the rates required for waterflooding. This may be a constraint on the feasability of flooding this zone. The severity of this problem has to be determined experimentally in the field. Given the risk of permanently losing all effective permeability near the wellbore, the 15-11 well, being marginally economic, has been chosen for this test. If this test indicates that permeability is not reduced at the required injection rates, we will then move towards implementing a pilot water flood in the main part of the reservoir.

For the duration of this test we intend to truck Bakken water to a tank at 15-11 from our 9-14-10-29 battery. A tri-plex injection pump and filters will be used at 15-11. If you have any questions, please call.

Sincerely,

Dan Barchyn

Dan Barchyn, P. Eng.
Exploration Manager

DB/ck

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

OCT-17-89 TUE 10:50 TUNDRA OIL & GAS WPG P.02

P.02

10-17-89 TUE 10:30 TUNDRA OIL VDN.

RECEIVED
OCT 17 1989
TUNDRA OIL & GAS

P.O. Box 1960
Virden, Manitoba
ROM 2C0
October 5, 1989

Keith Elliott sold his interest to the others

Mr. Darrel Ellis Elliot
RR #1
Cromer, Manitoba
ROM 0J0

Dear Sir:

Tundra Oil and Gas Limited is currently in the process of determining whether a waterflood would be economically feasible to stimulate production in Sections 13 & 14-10-29. To attempt to evaluate the feasibility of water injection, we would like to install a temporary pumping facility at well 15-11-10-29, to inject a volume of 8 to 15 m3/day of clean salt water to assist in determining the projected pressures and volumes involved with the actual waterflood. This test would run a maximum of 60 days, and upon termination of the trial injection the well shall be returned to normal production.

We request that you signify your consent to the above by signing one copy of this letter and returning same to our Virden office in the envelope provided.

Should you have any further questions, please contact the undersigned at 748-3095.

Yours truly,

T.B. Howell, P. Eng.
Drilling Manager

TBH/mlc

PERMISSION TO INSTALL A TEMPORARY WATER INJECTION FACILITY (MAXIMUM OF 60 DAYS) FOR TEST PURPOSES HEREBY GRANTED THIS 16th DAY OF October A.D. 1989.

Florence Elliott
Witness

Darrell Elliott
Darrel Ellis Elliot

oil and gas

P.O. Box 1960
Virden, Manitoba
ROM 2CO
October 5, 1989

Mr. & Mrs. E.L. Elliot
RR #1
Cromer, Manitoba
ROM OJO

Dear Sir:

Tundra Oil and Gas Limited is currently in the process of determining whether a waterflood would be economically feasible to stimulate production in Sections 13 & 14-10-29. To attempt to evaluate the feasibility of water injection, we would like to install a temporary pumping facility at well 15-11-10-29, to inject a volume of 8 to 15 m3/day of clean salt water to assist in determining the projected pressures and volumes involved with the actual waterflood. This test would run a maximum of 60 days, and upon termination of the trial injection the well shall be returned to normal production.

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Should you have any further questions, please contact the undersigned at 748-3095.

Yours truly,

T.B. Howell

T.B. Howell, P. Eng.
Drilling Manager

TBH/mlc

PERMISSION TO INSTALL A TEMPORARY WATER INJECTION FACILITY (MAXIMUM OF 60 DAYS) FOR TEST PURPOSES HEREBY GRANTED THIS 16 DAY OF Oct A.D. 1989.

Darrell Elliott
Witness

Ellis Elliot
Ellis Lotridge Elliot

Darrell Elliott
Witness

Florence Elliott
Florence Annette Margaret Elliot

-

- TUNDRA indicated (89-07-27) D Pool best candidate for pilot WF project - better primary performance, evidence of reservoir continuity, significant pressure drawdown

- Sec 11-10-29 is Crown - mineral owner consent is not an issue

- Tundra is sole operator in Bakken D Pool, nearest producer not operated by Tundra 5-12-10-29 (Newscope) Daly Lodgepool D Pool

- Bakken pools stratigraphically controlled - lateral pinchout of basal sandstones + upward fining into tight sand

  - best reservoir development in paleotopographic lows (Devonian)

  - fines microcrystalline dolomite fines, illite clay

Bakken D Pool

ϕ_{rge} = 9% - 21% ϕ_{avg} : 15%
- porosity decreases east to west
S_{wavg} : 33% @ eastern edge of pool & increases from east to west

D Pool - OOIP = 231,000 m^3

ADDITIONAL INFORMATION

- recommend under S. 62(9) of Act using Board discretion to avoid SWD order "unless otherwise specified"

- Tundra is the sole operator in the Bakken D Pool, nearest non-operated well 5-12-10-29 operated by Newscape which own the S/2-11-10-29 & SW/4-12-10-29 (Daly Lodgepole D Pool)
- Does Tundra have a lease on NW/4-11-10-29
- conversion application req'd (n646) – there is a provision under 40(3) for waiver of requirement for a packer

- diagram of the surface facilities

- Crown land - no consent req'd

- notify surface owner & in accordance with Tundra's surface lease "Clause 3 Restriction in Use - prior written approval for use of the well for disposal

- provided inj. rate 300 BWPD * 30 days = 9000 bbls.
- estimated extent/radius of flood front from the 15-11

- estimated frac pressure of Bakken
  breakdown pressures 2000 - 10000 KPa surface

FLOOD FRONT RADIUS

15-11-10-29

$\phi = 16\%$ $\quad$ $1/B_{oi} = .893$ $\quad$ $1/B_w = 1.0$

$S_w = 56\%$ $\quad$ $A = 16$ ha.

$h = 3.4$ m $\quad$ $q_i = 30$ day $*$ 50 m³/d $= 1500$ m³

$E_D = 0.5$

$$V = 10000\, A\, h\, \phi (1 - S_w)\ 1/B_{oi} \times E_D$$

Solve for radius of flood front

$$1500 = \overset{10000Ah}{\cancel{\pi r^2 h}} \times .16 \times .42 \times 1.0 \times 0.5$$

$$r^2 = \frac{1500}{\pi \times 3.4 \times .16 \times .42 \times 1.0 \times .05} = 4181 \therefore r = 64.7 \text{ m}$$

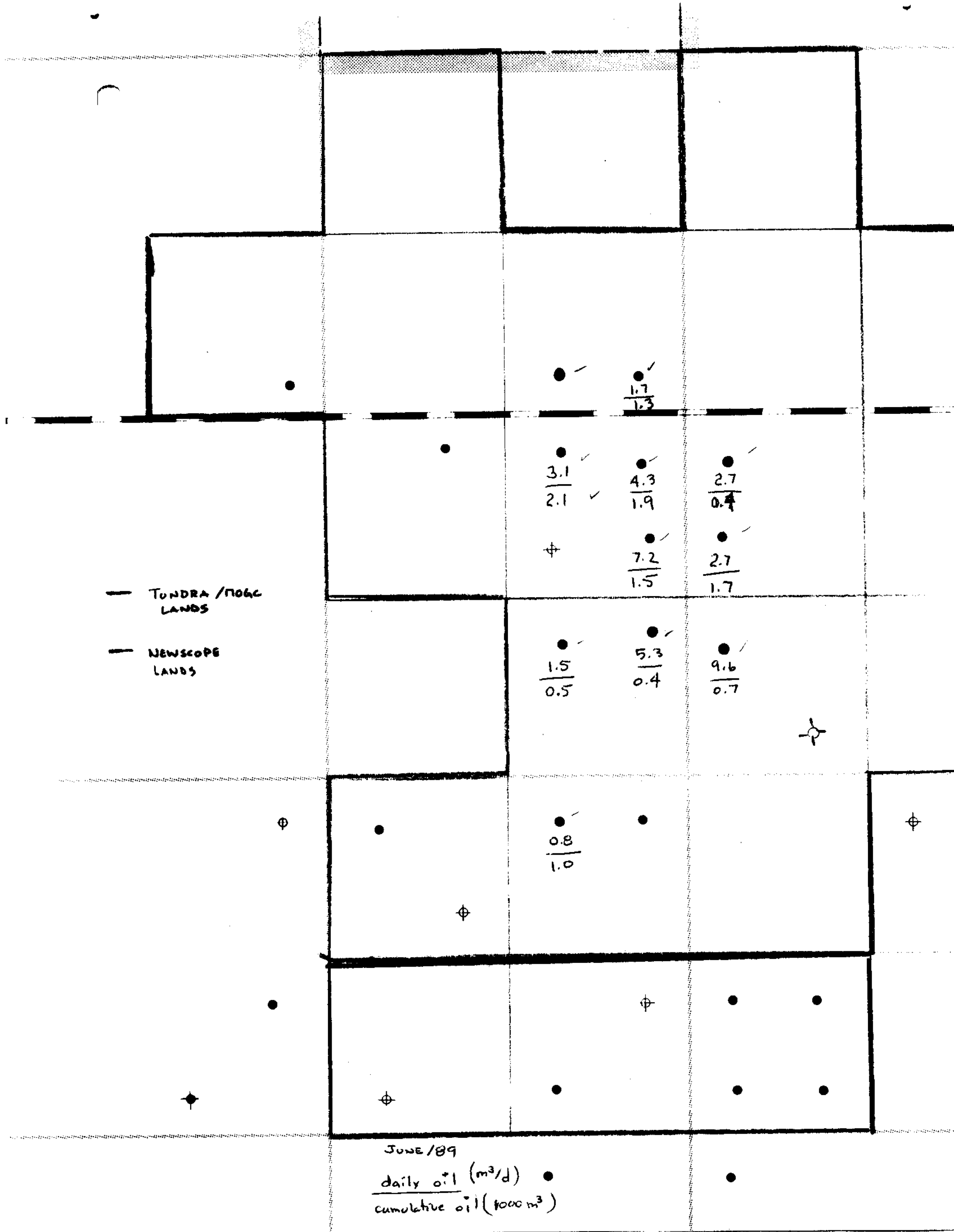
D Pool recovery factor = 11% based on 24% exp. decline @ 15-11 , ROIP = 25742 m³

- recovery mechanism low energy natural water drive

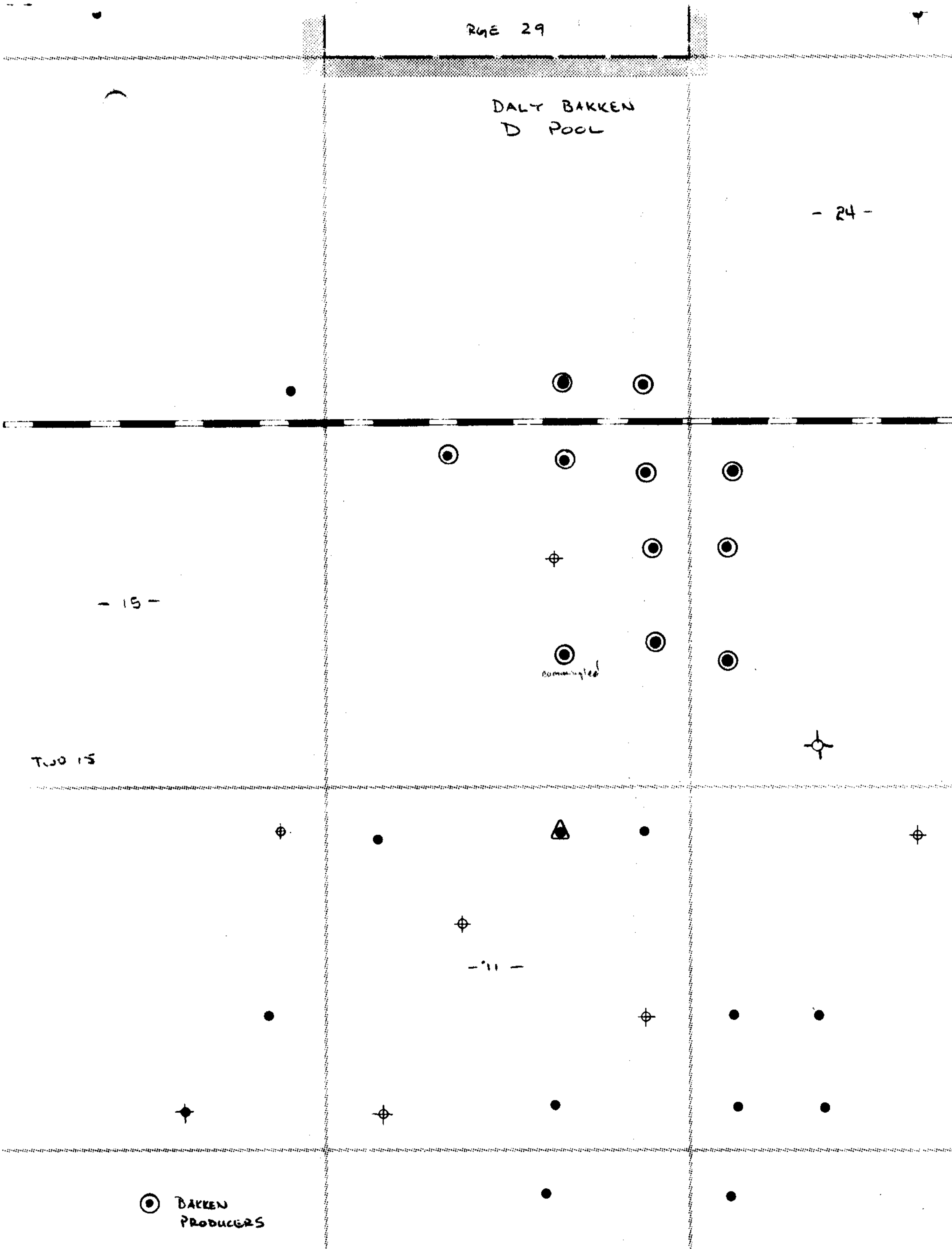
Reservoir Parameters 15-11-10-29

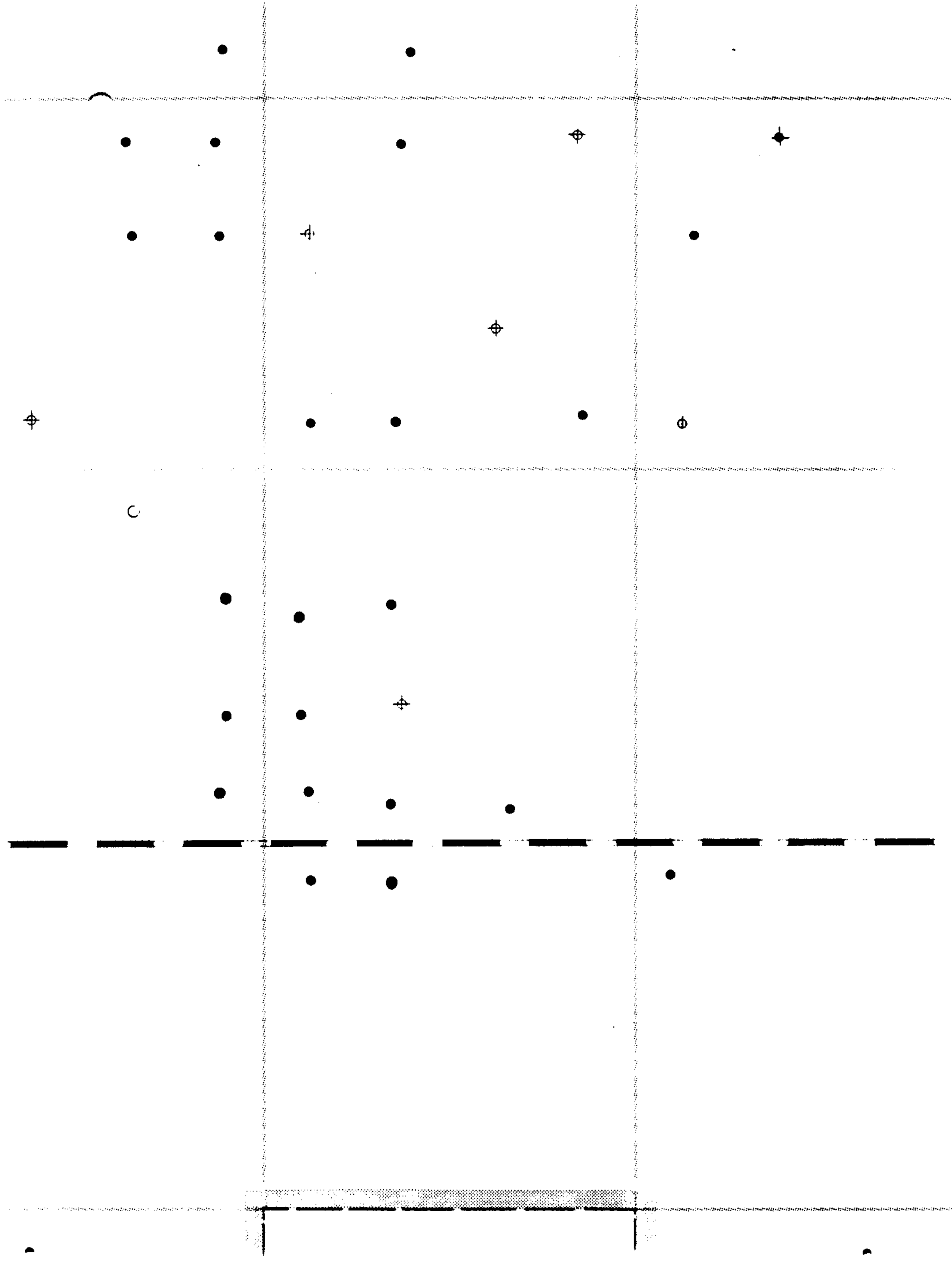
$\phi_T = 16$
$S_w = 56$

D Pool cumulative prod. 11461.9 oil
to 89-07-01 24747 wtr



TUNDRA / MOGC LANDS
NEWSCOPE LANDS
1.7
1.3
3.1
2.1
4.3
1.9
2.7
0.4
7.2
1.5
2.7
1.7
1.5
0.5
5.3
0.4
9.6
0.7
0.8
1.0
JUNE/89
daily oil (m³/d)
cumulative oil (1000 m³)

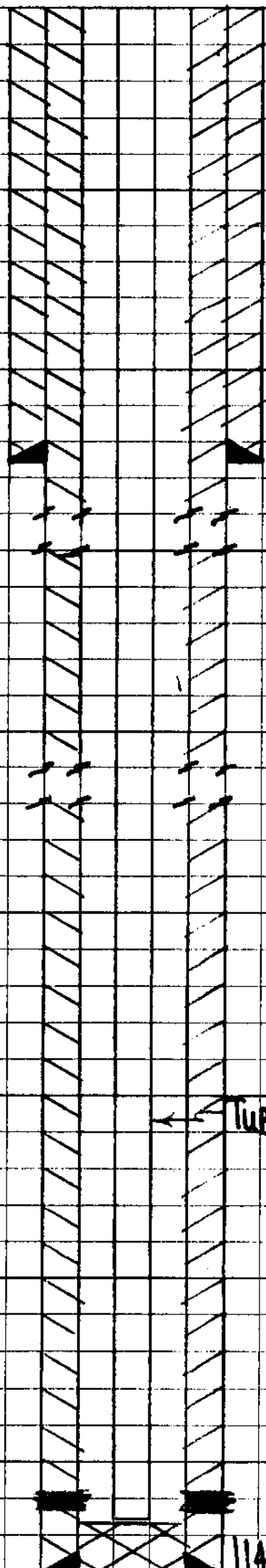

RGE 29
DALY BAKKEN
D POOL
- 24 -
- 15 -
commingled
TWP 15
- 11 -
BAKKEN
PRODUCERS



Lic.# 3909
NOGC DALY PROV.
15-11-10-29
K.B. - 528.65m
G.L. - 524.30m

DATE ON PROD - DEC. 24/86

D.S.T.'S:



100

219.1mm - 35.72 kg/m @ 120.0m w/ 15t + 3% $CaCl_2$ - RETURNS (2.5m³)

BLAIR - 550

CORES: NONE

D.S.T.'S: #1 - 855.0m - 865.0m VO 15/45 SI 60/120 - REC. 59m GCOFDM STP 8240/8275 Horner

#2 - 824.0m - 830.0m VO 10/45 SI 60/120 - REC. 10m MUD

PERFORATIONS: DEC. 17/86 - 858.5m - 863.0m w/ 13 SPM

DEPTH (METRES)

700

TUBING - 60.3mm @ 865.41m

UPPER MISS. DALY

STIMULATION: DEC. 17/86 - 1.5 m³ 15% MDA ACID

DEC. 18/86 - SANDFRAC w/ 5t. SAND
breakdown pressure 10000 kPa

800

CRAMER SHALE

2

BASAL LAST.

BAKKEN

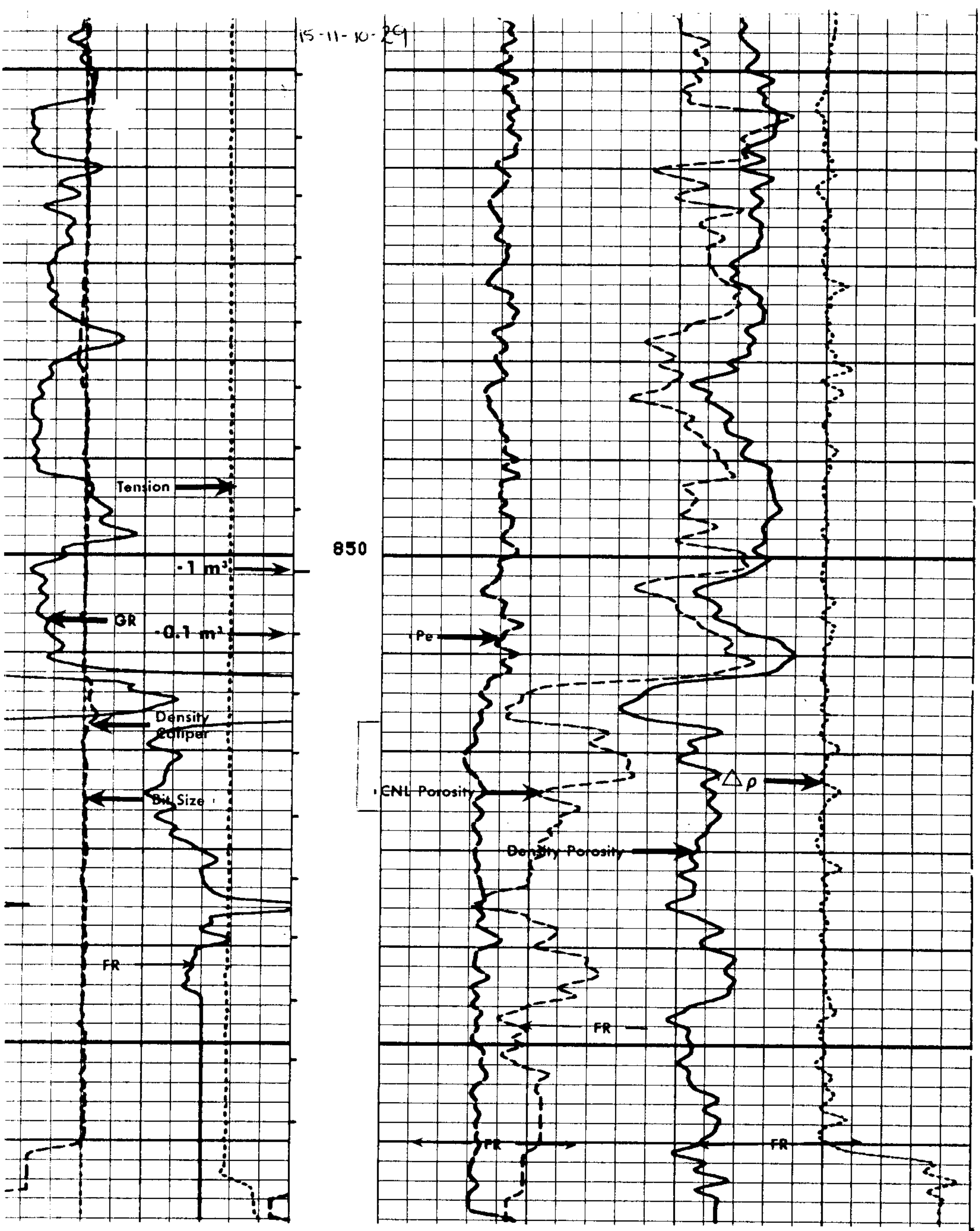
1

114.3mm - 14.14 kg/m @ 880.5m w/ 23t. 2:1 POZ + 8% GEL + 7t. - RETURNS (7m³)

Daly Bakken D Pool
1989 aver. prod. 0.75 m³OPD WOR = 0.6
cumulative production
oil 992 m³
wtr 693 m³

900

T.D. - 881.0m
PBTD - 866.54m



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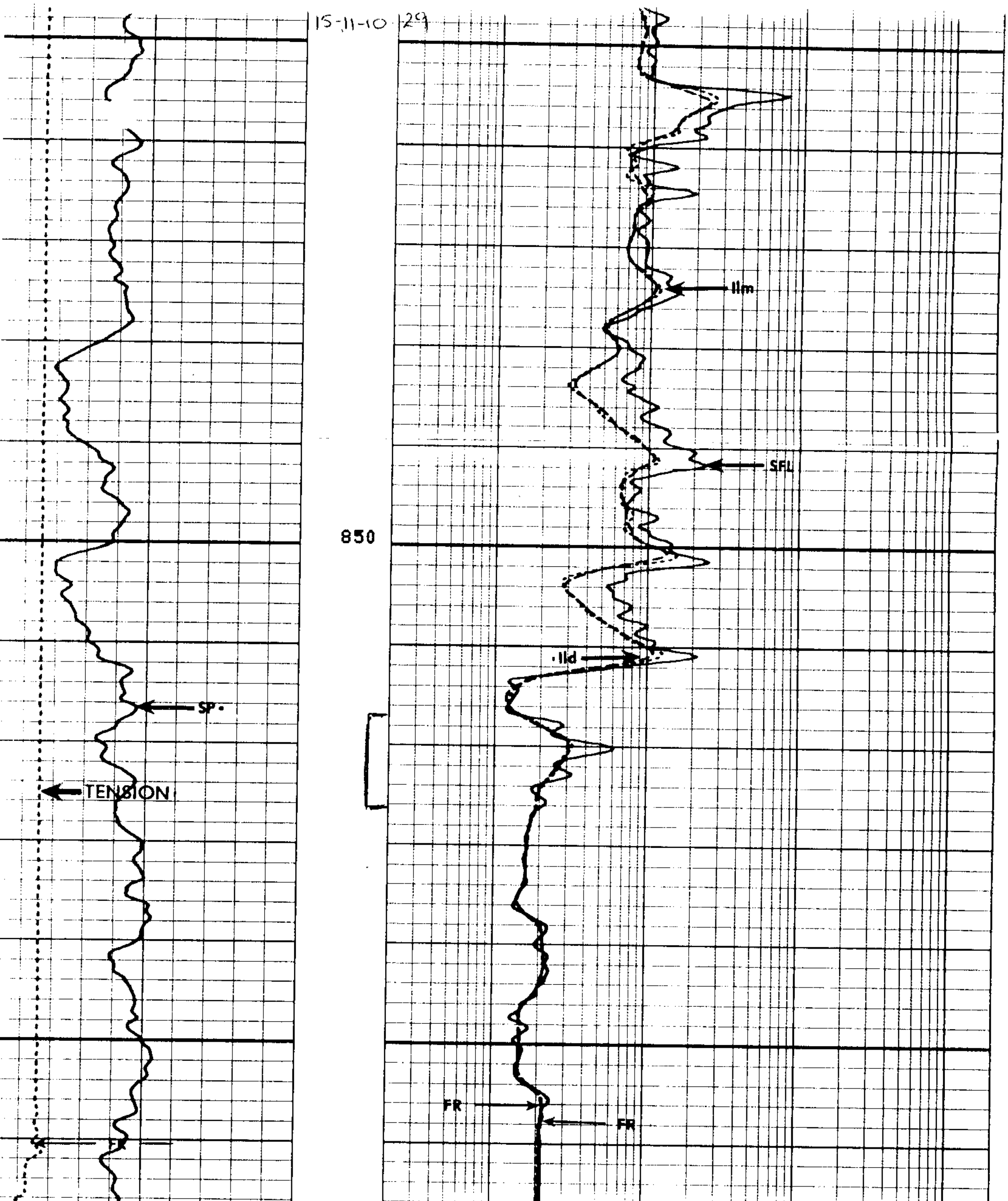
LIMESTONE

CALI(MM)	PEF	DRHO(K/M3)
125.00 375.00	0.0 10.000	-250.0 250.00
GR (GAPI)	DPHI	
0.0 150.00	.45000 -.1500	
BS (MM)	NPHI	
125.00 375.00	.45000 -.1500	
TENS(LB)		
10000. 0.0		

SENSOR MEASURE POINT TO TOOL ZERO

STSG	-.28 METER	GR	11.25 METER
SMLT	8.81 METER	MCAL	8.81 METER
NCNL	6.20 METER	FCNL	6.45 METER
LITH	.79 METER	SCNL	-.28 METER
LS	.79 METER	LL	.79 METER
SS1	.64 METER	LU	.79 METER



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TENS(LB) 0.0 — 10000.	ILD (OHMM) .20000 — 2000.0
SP (MV) -80.00 — 20.000	ILM (OHMM) .20000 — 2000.0
	SFLU(OHMM) .20000 — 2000.0

SENSOR MEASURE POINT TO TOOL ZERO

ILM	1.75 METER	ILD	2.87 METER
SP	.76 METER	SFL	1.96 METER
TENS	.76 METER	SPAR	.76 METER

PARAMETERS

NAME	VALUE	UNIT	NAME	VALUE	UNIT
SBR	1.00000	OHMM	DSEC	4.00000	MMHO
FPHI	SPHI		MSEC	4.90000	MMHO

- Bakken Fm -

Location	VCLAY calc.	Total Porosity	SWT WAXMAN	SWT MODIF. ARCHIE	OOIP/m² area
5-13-10-29:					
859-860.8	>100%				
860.8-861.5	>100%				
861.5-862.5	53%	11%	78%	78%	.02
862.5-863.6	8%	15%	40%	44%	.10
863.6-866	31%	12%	100%	cruddy stuff	
13-13-10-29:					
849.2-850.2	>100%	14%	63%	63%	.05
850.2-852	73%	16%	36%	40%	.19
8-14-10-29:					
860.2-861.7	22%	16%	57%	57%	.10
861.7-863.5	5%	20%	32%	35%	.25
3-13-10-29:					
858.0-860.0	>100%	12%	79	80	.05
860.0-862.0	>100%	12%	73	75	.06
2-23-10-29: GR/VCLAY		~~8%~~			
852.0-853.80	112 >100%	8%	100%	100%	0.00
854.3-855.70	100 >100%	11%	81%	80%	0.03
forcefit to 10% CLAY	75/ 9%	8%	same results.		
	75/ 9%	11%			

Well	h	h·Sw	h·φ	OOIP m^3/m^2
15-11-10-29	3.4	1.9	.54	.21
5-13-10-29	1.0	.78	.11	.12
	1.1	.44	.17	
12-13-10-29	1.5	.51	.27	.16
13-13-10-29	1.0	.63	.14	.24
	1.8	.65	.29	
7-14-10-29	4.4	4.22 (Sw=96%)	.44	.02
8-14-10-29	1.5	.86	.24	.35
	1.8	.58	.36	
9-14-10-29	1.0	.59	.15	.20
	1.3	.51	.27	
15-14-10-29	1.3	.53	.22	.12
16-14-10-29	1.0	.58	.15	.21
	1.3	.39	.25	
1-23-10-29	3.0	2.19	.36	note: well not completed over this interval
	2.2	.73	.31	.18
2-23-10-29	1.4	1.13 (Sw=81%)	.15	.03
TOTAL	30 m.	17.22	4.42	

Average Sw excluding 7-14, 1-23 top 3.0 m interval & 2-23

$$Sw_{aver} = \frac{h \cdot Sw}{h} = \frac{9.68}{21.2} = .46$$

Average ϕ excluding 1-23 top 3.0 m interval

$$\phi_{aver} = \frac{h \cdot \phi}{h} = \frac{4.06}{27} = .15$$

DALY BAKKEN D POOL - OOIP

C.I. (OOIP/m^3)	Measured Units	Area* (ha)	ΔV**
0	638	253	
			20.74
.1	417	165	
			11.71
.2	190	75	
			3.75
.3	26	10	
			.44
.4	$\varnothing$	$\varnothing$	
			36.64

* 1 section (259 ha) = 653 units

** $\Delta V = \frac{h}{3}\left(A_n + A_{n+1} + \sqrt{A_n A_{n+1}}\right)$

$$OOIP = 10000 \times 36.64 = 366{,}400 \ m^3$$

Average net pay $h = \dfrac{366400}{10000 \times 253 \times .15 \times (1 - .46) \times .893} = 2.0 \ m$

ESTIMATE FRAC PRESSURE

frac gradient = 1.0 psi/ft
depth = 860 m

$(1.0 - .45)\ \text{psi/ft} \times 3.281\ \frac{\text{ft}}{\text{m}} \times 860\ \text{m} \times 6.895\ \frac{\text{kPa}}{\text{psi}} = 10700\ \text{kPa}$

note: this compares favourably with actual breakdown pressure experienced during well completion

DST RESULTS

WELL	INTERVAL	RECOVERY	SIP	DATE
Twp 10-29(W4M)				
15-11	855-865	59m GCOFM	7981/8162	86-12-12
7-14	855-862	3m OCM; 18m O stained M	7746/7764	87-02-07
9-14	855-863	42m OCM; 27 $\overset{\text{gassy}}{\text{GOCM}}$; 39m MCO; 9 GMCO	7614/7595	88-01-30
14-14	NO DST			
15-14	854-860	29^{m} GOCM; 9m Gassy O	7180/7215	88-02-08
6-14	NO DST			
5-13	858-865	84.6 m G OCM	7506/7506	89-02-26
12-13	855-865	30m GOCM; 10m oil; 6m OCM	7827/7914	88-03-09
13-13	848-855	56m OCM	6698/6345	89-02-20
1-23	NO DST			
2-23	853.4-57.9	40m GO; 40m OCM; 30 MCO	5247/5159	87-06-19
8-14	NO DST			

extrapolated SIP

FALL-OFF TESTS

- pressure fall-off analysis — injection capacity of fm
  - formation damage

note: Fluid mobility & compressibility ahead of the flood front are considerably different & should be observed by a change in shape of the pressure fall-off curve.

- if decline of wellhead press. to rapid need BHP gauges

- recommend continuous injection @ constant rate of 1 wk. = stabilization

- observe fall-off @ given intervals - detect plugging
  a. constant injection rate @ increased injection pres.
  & effect of volume of wtr injected on static reservoir pres.

- early time data for calculation of skin.

- Volume injected $300 \text{ bbl/d} \times 30 \text{ day} = 9000 \text{ bbl} = 1430 \text{ m}^3$

Manitoba

Memorandum

Date: April 7, 1993

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

From: John N. Fox
Chief Petroleum Engineer

Telephone

Subject: **Daly Bakken D Pool - Application to Increase the Maximum Wellhead Injection Pressure**

Tundra Oil and Gas Ltd. has applied to increase the maximum wellhead injection pressure established under Board Order No. PM 67, from 8000 to 9000 kPa.

RECOMMENDATIONS

It is recommended that the Board approve Tundra's application. Tundra should be requested to submit a report on the technical and economic feasibility of converting an additional well(s) to injection in the Daly Bakken D Pool. A copy of the proposed Board letter of approval is attached.

DISCUSSION

Figure 1 is a plot of the injectivity index (m^3/d/MPa) for the injection wells 8-14 & 16-14-10-29. The plot shows steadily decreasing injectivity.

In December 1992, injection pressure at the 8-14 and 16-14 wells was 8425 kPa and 8275 kPa, respectively, slightly above the maximum injection pressure approved by the Board. Voidage-replacement during 1992 in the (2) inverted 9-spot injection patterns in the Bakken D Pool was 8-14; 1.43 rm^3/rm^3 and 16-14; 1.29 rm^3/rm^3 (Figure 2). If the wells in N. Ebor Unit No. 2 outside the 8-14 injection pattern are included in the voidage-replacement calculation the Unit No. 2 VRR drops to 1.01 rm^3/rm^3.

In July 1992, the Board approved an increase in injection pressure from 7000 to 8000 kPa. The Board's approval requested Tundra, prior to making application for a further increase in injection pressure, review the feasibility of
(1) converting an additional well(s) to injection,
(2) restimulating the 8-14-10-29 well, and
(3) conducting a fines stabilization treatment.

Tundra in its application indicated the company is conducting relative permeability analysis on Bakken core to determine the end-point fluid saturations and relative permeability curves. Once this data is available, the company can more accurately predict waterflood recovery and meaningfully

First | Fold

review the feasibility of converting an additional well(s) to injection well.

Tundra also indicated in its application that if the wellhead injection pressure exceeds 9000 kPa, (95% of fracture pressure) the company will consider re-stimulating the two injection wells 8-14 & 16-14-10-29. The 16-14 well was re-fractured in Nov/91 but the treatment was only successful in temporarily increasing injectivity, as shown in Figure 1.

The Branch believes it is critical for the success of the waterflood that a VRR of at least 1.0 be maintained. Injectivity can be temporarily increased by increasing the injection pressure or by re-fracturing the wells. The risk of out of zone injection exists whether the injection pressure is increased or the wells are re-fractured. Therefore it is recommended that the Board approve an increase in the maximum wellhead injection pressure from 8000 to 9000 kPa. As a long term solution Tundra should be requested to submit a report on the technical and economic feasibility of converting an additional well(s) to injection.

John N. Fox

Approved by: ______________________
L.R. Dubreuil, Director

JNF/hw

FIGURE 1 - INJECTIVITY INDEX

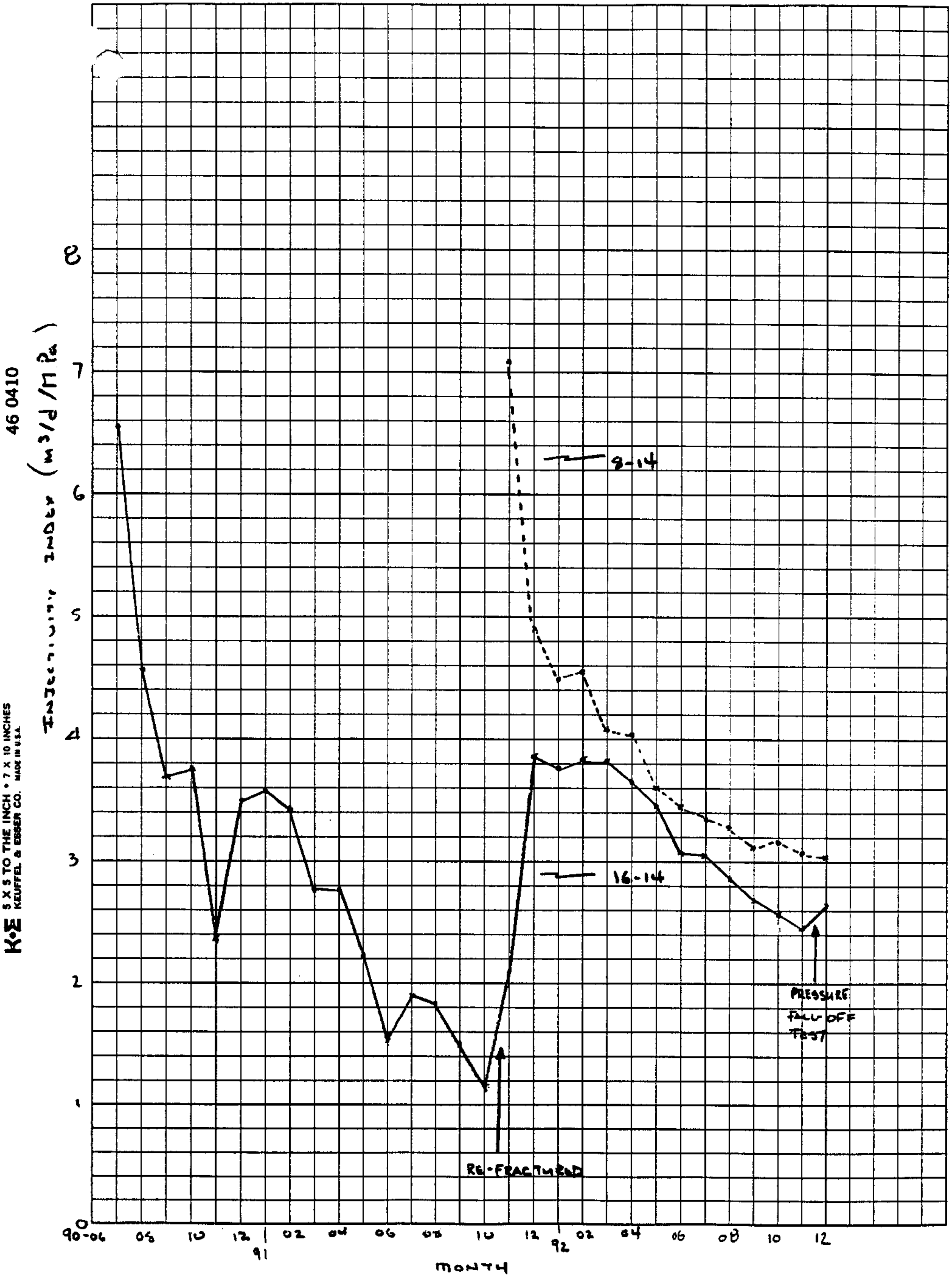
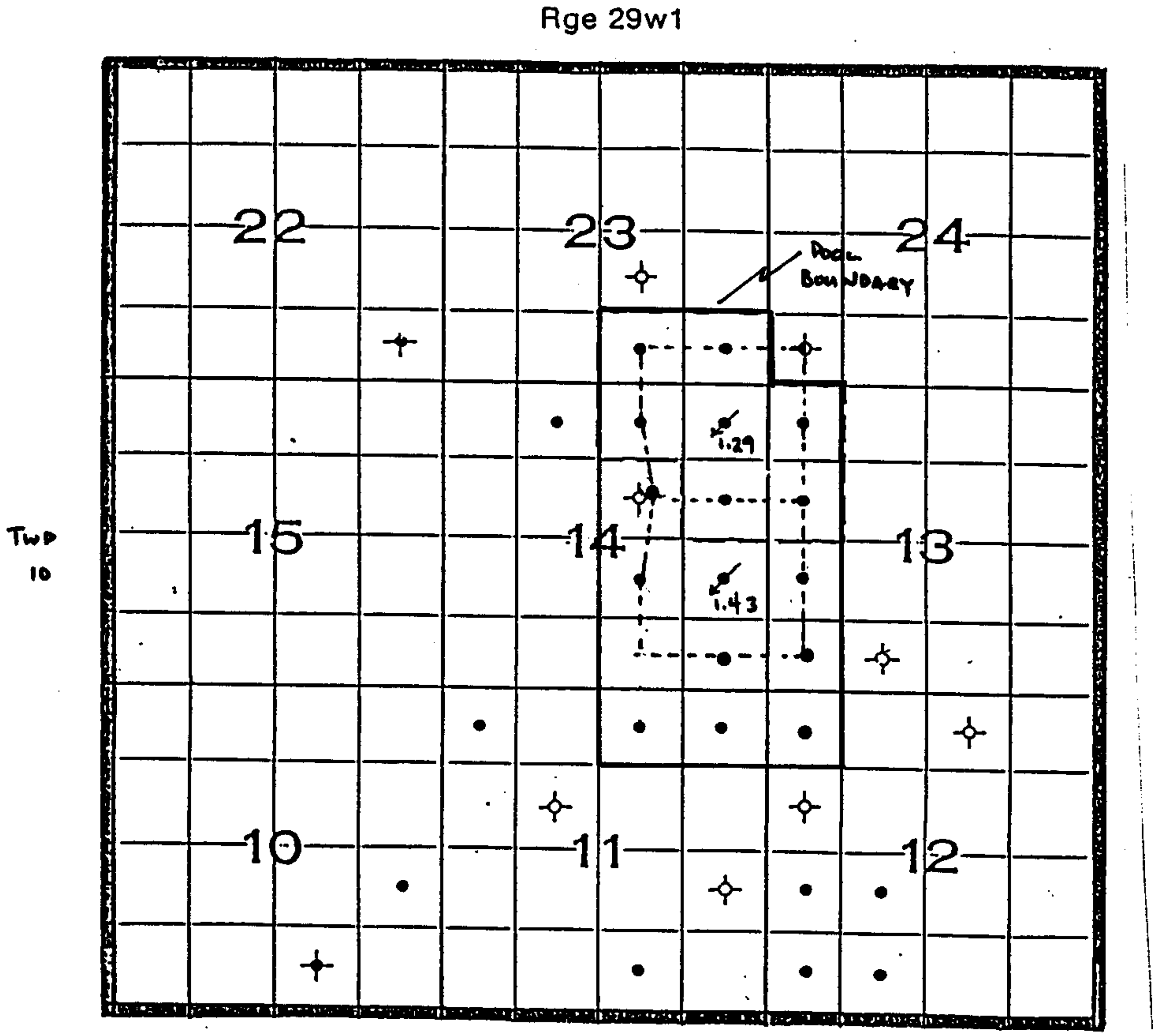


FIGURE 2

DALY BAKKEN D POOL



1992
1.29 - VOIDAGE-REPLACEMENT RATIO

Manitoba

he Oil and Natural Gas
Conservation Board

555 — 330 Graham Avenue
Winnipeg MB R3C 4E3
CANADA

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

April 7, 1993

Mr. G. Czyzewski, P.Eng.
Senior Reservoir Engineer
Tundra Oil and Gas Ltd.
1111 - One Lombard Place
Winnipeg MB R3B 0X4

Dear Mr. Czyzewski:

Re: Daly Bakken D Pool - Application to Increase the Maximum Wellhead Injection Pressure

The Board hereby approves your application to increase the maximum wellhead injection pressure under Section 5 of Board Order No. PM 67, from 8000 to 9000 kPa.

Tundra indicated in its recently submitted progress reports that decreasing injectivity is a result of fines migration and the reservior's low water-oil mobility ratio. These problems are expected to continue and probably become more severe with continued injection. Therefore Tundra is requested to prepare a report on the technical and economic feasibility of converting an additional well(s) to injection in the Daly Bakken D Pool. The report should incorporate the new Bakken relative permeability data, a copy of which is to be filed with the Branch. The Board expects the report to be submitted by September 1, 1993.

If you have any questions in respect of this matter, please contact John N. Fox, Chief Petroleum Engineer at 945-6574.

Yours respectfully,

H. Clare Moster
Deputy Chairman

Tundra
oil and gas ltd.

March 31, 1993

Mr. John Fox, P. Eng.
Chief Petroleum Engineer
Manitoba Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, MB
R3C 4E3

Dear John:

Re: North Ebor Unit No. 1
Application to Increase Wellhead Injection Pressure

Tundra Oil and Gas Ltd. herein makes application to increase the surface injection pressure at injection well 16-14-10-29 WPM from the current board approval of 7000 kPa to 9000 kPa. The 1992 North Ebor Unit No. 1 Progress Report is attached in support of our application.

Approval of the higher wellhead injection pressure is required, in order to maintain voidage replacement at the current injection rate of 21 m^3 per day. Surface injection pressures have currently stabilized at 8,600 kPa at 16-14-10-29.

Tundra has estimated that a surface injection pressure in excess of 9,270 kPa would be required, in order to propagate the existing fracture at 16-14 (refer to attached calculation). Therefore, with a surface injection pressure limitation of 9,000 kPa, Tundra Oil and Gas Ltd. does not envision any detrimental effects in the waterflood operation. Should the injection pressures exceed 9,000 kPa, Tundra Oil and Gas Ltd. will either refracture 16-14 or convert another well to injection service.

Should you have any questions, I can be reached at 934-5853.

Yours truly,

TUNDRA OIL AND GAS LTD.

G. Czyzewski

G. Czyzewski, P. Eng.
Senior Reservoir Engineer

GC/bp

cc Tim Howell

1111 - One Lombard Place, Winnipeg, Manitoba R3B 0X4 Telephone: (204) 934-5850 Fax: (204) 934-5820

CALCULATION OF MAXIMUM ALLOWABLE INJECTION PRESSURE

1. Calculation of Fracture Propagation Pressure

- Instantaneous Shut-in Pressure: 9,500 kPa (16-14 Frac)
- Frac Fluid Gradient (3% kCl Water): 9.93 kPa/m
- Centre of Perforations: 857 metres
- Fracture Propagation Pressure = Instantaneous Shut-in Pressure & Hydrostatic Head Pressure
  = 9,500 kPa + 857 (9.93 kPa/m)
  = 18,010 kPa

2. Calculation of Maximum Allowable Surface Injection Pressure

- Maximum Allowable Surface Injection Pressure =
  Fracture Propagation Pressure - Hydrostatic Head Pressure

- Injection Water Gradient = 10.2 kPa/m

- Maximum Allowable Surface Injection Pressure
  = 18,010 kPa - 10.2 kPa/m (857 m)
  = 9,270 kPa

Tundra
oil and gas ltd.

March 31, 1993

APR 2 1993
PETROLEUM BRANCH
DEPARTMENT OF ENERGY AND MINES

Mr. John Fox, P. Eng.
Chief Petroleum Engineer
Manitoba Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, MB
R3C 4E3

Dear John:

Re: North Ebor Unit No. 2
Application to Increase Wellhead Injection Pressure

Tundra Oil and Gas Ltd. herein makes application to increase the surface injection pressure at injection well 8-14-10-29 WPM from the current board approval of 7000 kPa to 9000 kPa. The 1992 North Ebor Unit No. 2 Progress Report is attached in support of our application.

Approval of the higher wellhead injection pressure is required, in order to maintain voidage replacement at the current injection rate of 25 m^3 per day. Surface injection pressures have currently stabilized at 8,500 kPa at 8-14-10-29.

Tundra has estimated that a surface injection pressure in excess of 9,530 kPa would be required, in order to propagate the existing fracture at 8-14 (refer to attached calculation). Therefore, with a surface injection pressure limitation of 9,000 kPa, Tundra Oil and Gas Ltd. does not envision any detrimental effects in the waterflood operation. Should the injection pressures exceed 9,000 kPa, Tundra Oil and Gas Ltd. will either refracture 8-14 or convert another well to injection service.

Should you have any questions, I can be reached at 934-5853.

Yours truly,

TUNDRA OIL AND GAS LTD.

G. Czyzewski

G. Czyzewski, P. Eng.
Senior Reservoir Engineer

GC/bp

cc Tim Howell

1111 - One Lombard Place, Winnipeg, Manitoba R3B 0X4 Telephone: (204) 934-5850 Fax: (204) 934-5820

CALCULATION OF MAXIMUM ALLOWABLE INJECTION PRESSURE

1. Calculation of Fracture Propagation Pressure

   - Instantaneous Shut-in Pressure: 9,500 kPa (16-14 Frac)
   - Frac Fluid Gradient (3% kCl Water): 9.93 kPa/m (16-14)
   - Centre of Perforations: 862 metres (8-14)
   - Fracture Propagation Pressure = Instantaneous Shut-in Pressure & Hydrostatic Head Pressure
     = 9,500 kPa + 862 (9.93 kPa/m)
     = 18,060 kPa

2. Calculation of Maximum Allowable Surface Injection Pressure

   - Maximum Allowable Surface Injection Pressure =
     Fracture Propagation Pressure - Hydrostatic Head Pressure

   - Injection Water Gradient = 9.9 kPa/m

   - Maximum Allowable Surface Injection Pressure
     = 18,060 kPa - 9.9 kPa/m (862 m)
     = 9,530 kPa

July 10, 1992

Mr. R. Puchniak, President
Tundra Oil and Gas Ltd.
1313 Richardson Building
One Lombard Place
WINNIPEG, Manitoba
R3B 0X3

Dear Mr. Puchniak:

Re: Daly Bakken D Pool - Application to Increase the Maximum Wellhead Injection Pressure

The Board has reviewed your application for an increase to 8500 kPa in the maximum wellhead injection pressure established under Section 5 of Board Order No. PM 67.

The Board is concerned that an increase in the maximum wellhead injection pressure to 8500 kPa (92% of the fracture propagation pressure based on the fracture treatment at 16-14-10-29) will significantly increase the potential for out of zone injection. However, the Board also recognizes the importance of maintaining a voidage-replacement ratio in excess of 1.0 to maximize the ultimate recovery from the pool. Therefore, the Board will approve an increase in the maximum wellhead injection pressure to 8000 kPa. In any application to increase the maximum wellhead injection pressure above 8000 kPa, Tundra is to submit a review of the feasibility of the following alternatives:

(a) convert a third well in the pool to injection;

(b) restimulate the 8-14-10-29 well; or

(c) conduct a fines stabilization treatment on both injectors.

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

Yours respectfully

H. Clare Moster,
Deputy Chairman

Tundra
oil and gas ltd.

April 5, 1993

Mr. John Fox, P. Eng.
Chief Petroleum Engineer
Manitoba Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, MB
R3C 4E3

Dear John:

Re: North Ebor Unit No. 1
Injection History
Well 16-14-10-29

Please find enclosed the injection history that you requested on April 5, 1993 for the referenced well.

Should you have any questions, I can be reached at 934-5853.

Yours truly,

TUNDRA OIL AND GAS LTD.

G. Czyzewski

G. Czyzewski, P. Eng.
Senior Reservoir Engineer

GC/bp

Enclosure

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
90	6			17.2	30
	7		18.5	589.8	408
	8		21	1241.5	666
	9		18.5	1796.6	729
	10		21.4	2461.2	825
	11		14	2881.1	856
	12		20.8	3525.2	859
91	1		23.1	4241.9	933
	2		23.1	4889.6	980
	3		19.8	5505.4	1039
	4		20.5	6120	1066
	5		17.1	6649	1079
	6		11.4	6990	1049
	7		1.4	7032.1	1075
	8		12.9	7432.7	1027
	9		10.8	7756.9	1052
	10		8.3	8015.1	1016
	11		11.3	8353.8	783
	12		20.6	8991.9	773
92	1		19.4	9583.2	746
	2		19.8	10166.1	766
92	3	1	20.4	10186.5	790
		2	21	10207.5	790
		3	21.5	10229	790
		4	20.8	10249.8	790
		5	21.3	10271.1	790
		6	20.1	10291.2	790
		7	20.5	10311.7	780
		8	17.2	10328.9	780
		9	20.6	10349.5	780
		10	21.3	10370.8	790
		11	21.6	10392.4	790
		12	21.3	10413.7	800
		13	21.6	10435.3	800
		14	21.4	10456.7	800
		15	21.1	10477.8	800
		16	21.9	10499.7	800
		17	21.1	10520.8	800
		18	20.6	10541.4	800
		19	20.7	10562.1	800

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
		20	21.8	10583.9	800
		21	21.1	10605	800
		22	21.2	10626.2	800
		23	21.6	10647.8	800
		24	21.2	10669	800
		25	21.2	10690.2	810
		26	21	10711.2	820
		27	22.2	10733.4	820
		28	20.4	10753.8	820
		29	21.6	10775.4	820
		30	21	10796.4	820
		31	21.6	10818	820
92	4	1	21.5	10839.5	820
		2	20.4	10859.9	820
		3	21.3	10881.2	820
		4	20.5	10901.7	820
		5	20.9	10922.6	820
		6	20.9	10943.5	830
		7	21	10964.5	820
		8	21.5	10986	820
		9	20.7	11006.7	830
		10	21.3	11028	840
		11	21.8	11049.8	840
		12	20.9	11070.7	840
		13	21.1	11091.8	840
		14	20.7	11112.5	840
		15	21.6	11134.1	840
		16	21	11155.1	840
		17	20.7	11175.8	840
		18	21.5	11197.3	840
		19	22	11219.3	840
		20	20.4	11239.7	840
		21	21	11260.7	850
		22	21.7	11282.4	850
		23	21.6	11304	850
		24	21.4	11325.4	860
		25	20.7	11346.1	860
		26	21.6	11367.7	860
		27	21.2	11388.9	860
		28	21.3	11410.2	850
		29	21	11431.2	860

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
		30	20.8	11452	860
92	5	1	21.7	11473.7	860
		2	20.9	11494.6	860
		3	21.1	11515.7	860
		4	21.2	11536.9	860
		5	21.3	11558.2	860
		6	20.8	11579	860
		7	21.3	11600.3	860
		8	18.7	11619	880
		9	20.6	11639.6	860
		10	21.7	11661.3	860
		11	21.3	11682.6	870
		12	22	11704.6	870
		13	22	11726.6	870
		14	20.9	11747.5	880
		15	20.7	11768.2	880
		16	21.1	11789.3	880
		17	21.3	11810.6	890
		18	21.4	11832	890
		19	21.1	11853.1	890
		20	21.4	11874.5	890
		21	19	11893.5	900
		22	22.2	11915.7	900
		23	20.4	11936.1	850
		24	20.1	11956.2	890
		25	21.2	11977.4	900
		26	20	11997.4	900
		27	21	12018.4	900
		28	16.2	12034.6	900
		29	21.3	12055.9	880
		30	21	12076.9	890
		31	21.6	12098.5	900
92	6	1	19.1	12117.6	900
		2	20.4	12138	900
		3	21.5	12159.5	900
		4	21.3	12180.8	900
		5	21.3	12202.1	900
		6	16	12218.1	900
		7	19.2	12237.3	900
		8	21.2	12258.5	900
		9	14.7	12273.2	900

20.9
880

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
		10	20.8	12294	900
		11	19.7	12313.7	900
		12	21.3	12335	930
		13	15	12350	930
		14	18.1	12368.1	910
		15	20.2	12388.3	880
		16	14.8	12403.1	900
		17	0	12403.1	0
		18	15.2	12418.3	880
		19	17.7	12436	880
		20	20.4	12456.4	860
		21	21.8	12478.2	880
		22	21.5	12499.7	900
		23	19.9	12519.6	900
		24	20.7	12540.3	900
		25	17.2	12557.5	900
		26	20.9	12578.4	905
		27	20.4	12598.8	897
		28	13.2	12612	910
		29	20.4	12632.4	900
		30	19.3	12651.7	880
92	7	1	13.4	12665.1	900
		2	17.6	12682.7	850
		3	19.4	12702.1	880
		4	19.2	12721.3	840
		5	21.2	12742.5	920
		6	20.5	12763	920
		7	21.3	12784.3	940
		8	19.7	12804	940
		9	21.2	12825.2	950
		10	20	12845.2	960
		11	21.2	12866.4	980
		12	22	12888.4	970
		13	20	12908.4	980
		14	21.5	12929.9	980
		15	20.9	12950.8	980
		16	21.6	12972.4	980
		17	20.7	12993.1	980
		18	21.3	13014.4	980
		19	21.7	13036.1	980
		20	22	13058.1	1000

19.1 / 900

20.6 / 915

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
		21	19.5	13077.6	1000
		22	21.1	13098.7	1000
		23	21.6	13120.3	1010
		24	21.8	13142.1	1010
		25	20	13162.1	1020
		26	21.2	13183.3	1010
		27	21.4	13204.7	1015
		28	21.1	13225.8	1010
		29	21.2	13247	1030
		30	21.4	13268.4	1030
		31	21.1	13289.5	1030
92	8	1	22.1	13311.6	1040
		2	20.9	13332.5	1040
		3	21.1	13353.6	1040
		4	21.3	13374.9	1050
		5	20.6	13395.5	1050
		6	21	13416.5	1050
		7	20.1	13436.6	1050
		8	19.8	13456.4	1050
		9	20.4	13476.8	1050
		10	21.2	13498	1040
		11	22.4	13520.4	1060
		12	21.2	13541.6	1060
		13	21.2	13562.8	1060
		14	21.6	13584.4	1070
		15	20.7	13605.1	1080
		16	21.6	13626.7	1070
		17	21.1	13647.8	1070
		18	20.9	13668.7	1080
		19	20.8	13689.5	1080
		20	20	13709.5	1080
		21	21.4	13730.9	1090
		22	21.4	13752.3	1090
		23	21	13773.3	1000
		24	21	13794.3	1000
		25	21.3	13815.6	1000
		26	19.6	13835.2	1100
		27	21.2	13856.4	1100
		28	20.7	13877.1	1100
		29	20.9	13898	1110
		30	23	13921	1100

~~920~~ 1030

~~1040~~ ~~1100~~

21.1
1070

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
		31	21	13942	1100
92	9	1	21.6	13963.6	1100
		2	21.4	13985	1100
		3	20.6	14005.6	1130
		4	21.1	14026.7	1120
		5	21.4	14048.1	1130
		6	21.1	14069.2	1140
		7	20.8	14090	1140
		8	21.3	14111.3	1140
		9	20.7	14132	1160
		10	21.2	14153.2	1150
		11	21.5	14174.7	1150
		12	20.9	14195.6	1150
		13	19.8	14215.4	1150
		14	21	14236.4	1140
		15	19.9	14256.3	1140
		16	21	14277.3	1140
		17	21.5	14298.8	1150
		18	20.7	14319.5	1160
		19	21.5	14341	1160
		20	20.4	14361.4	1160
		21	20	14381.4	1130
		22	21	14402.4	1150
		23	21.5	14423.9	1140
		24	21	14444.9	1150
		25	20.9	14465.8	1160
		26	20.5	14486.3	1160
		27	21.4	14507.7	1160
		28	20.8	14528.5	1160
		29	20.6	14549.1	1160
		30	20	14569.1	1160
92	10	1	20.7	14589.8	1160
		2	20.4	14610.2	1170
		3	21	14631.2	1180
		4	22	14653.2	1180
		5	20.4	14673.6	1170
		6	21.5	14695.1	1170
		7	21	14716.1	1170
		8	21.1	14737.2	1180
		9	20.5	14757.7	1180
		10	21.2	14778.9	1180

20.9
1130

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
		11	21.2	14800.1	1180
		12	21.3	14821.4	1180
		13	20.6	14842	1180
		14	20.9	14862.9	1180
		15	21.5	14884.4	1190
		16	21.2	14905.6	1190
		17	20.9	14926.5	1200
		18	20.3	14946.8	1200
		19	21.5	14968.3	1200
		20	21	14989.3	1200
		21	19.9	15009.2	1200
		22	20.7	15029.9	1200
		23	21.3	15051.2	1200
		24	20.9	15072.1	1200
		25	21.9	15094	1200
		26	20.6	15114.6	1200
		27	20.7	15135.3	1200
		28	21.2	15156.5	1210
		29	19.9	15176.4	1210
		30	21.3	15197.7	1210
		31	21	15218.7	1210
92	11	1	20.1	15238.8	1220
		2	21.2	15260	1230
		3	20.7	15280.7	1230
		4	20.7	15301.4	1230
		5	20.8	15322.2	1230
		6	21	15343.2	1230
		7	20.5	15363.7	1230
		8	21.5	15385.2	1230
		9	20.5	15405.7	1230
		10	19.7	15425.4	1230
		11	20.3	15445.7	1230
		12	15	15460.7	1230
		13	21.2	15481.9	1200
		14	21	15502.9	1210
		15	20.5	15523.4	1220
		16	21	15544.4	1220
		17	4.2	15548.6	1220
		18	0	15548.6	500
		19	0	15548.6	425
		20	0	15548.6	375

21.0
1185

20.6
1220

HALLPLOT.XLS

	NORTH EBOR UNIT NO.1				
	INJECTION WELL 16-14-10-29				
	INJECTION HISTORY				
					WELLHEAD
YEAR	MONTH	DAY	DAILY INJECTION	CUM. Winj.	Pinj.
			(m3/day)	(m3)	(psig)
		21	0	15548.6	340
		22	0	15548.6	300
		23	0	15548.6	250
		24	0	15548.6	240
		25	0	15548.6	235
		26	0	15548.6	225
		27	0	15548.6	225
		28	0	15548.6	220
		29	0	15548.6	205
		30	0	15548.6	185
92	12	1	0	15548.6	170
		2	0	15548.6	160
		3	0	15548.6	150
		4	0	15548.6	140
		5	0	15548.6	130
		6	0	15548.6	120
		7	0	15548.6	110
		8	4.6	15553.2	300
		9	20.8	15574	820
		10	18.7	15592.7	890
		11	22.7	15615.4	950
		12	21.1	15636.5	990
		13	21.6	15658.1	1020
		14	21.4	15679.5	1040
		15	20.5	15700	1050
		16	21.3	15721.3	1070
		17	21.4	15742.7	1080
		18	22.3	15765	1090
		19	21.3	15786.3	1100
		20	21.6	15807.9	1120
		21	21.6	15829.5	1120
		22	21.7	15851.2	1130
		23	20.8	15872	1140
		24	21.1	15893.1	1140
		25	21.6	15914.7	1150
		26	21.1	15935.8	1150
		27	21.7	15957.5	1160
		28	22.2	15979.7	1160
		29	19.4	15999.1	1160
		30	20.9	16020	1160
		31	21.1	16041.1	1170

$\frac{21.4}{1170}$

Manitoba

Memorandum

Date: July 3, 1992

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

From: [redacted]
Chief Petroleum Engineer

Telephone:

Subject:

First | Fold

Re: Daly Bakken D Pool - Application to Increase the Maximum Wellhead Injection Pressure

Tundra Oil and Gas Ltd. has applied to increase the maximum wellhead injection pressure established under Board Order No. PM 67, from 7000 to 8500 kPa.

Recommendations

It is recommended that the Board approve a maximum wellhead injection pressure of 8000 kPa. The proposed Board letter of approval requests Tundra address other alternatives to increase injection into the Daly Bakken D Pool including conversion of another well to injection, a fines stabilization treatment and restimulation of the 8-14-10-29 well.

Discussion

Prior to waterflooding the Bakken, there was some concern that fines migration would cause injectivity problems. Fines mobilization tests on core from the 9-14-10-29 well indicated an 82% reduction in permeability due to fines migration, after the injection at low flow rates of 21 pore volumes of water. The injection pressure at the two injectors has steadily increased since injection commenced. Currently the injection pressures are: 8-14-10-29, 6778 kPa and 16-14-10-29, 6054 kPa slightly less than the maximum wellhead injection pressure of 7000 kPa established by Board Order No. PM 67. Figure 1 which is a plot of the injectivity index ($m^3/d/MPa$) for the wells illustrates this trend of decreasing injectivity. The 16-14 was refractured in Nov/91 and the treatment was successful in increasing injectivity.

A review of the literature indicates for a waterflood with an unfavourable mobility ratio (M>1), injectivity should increase with increasing areal sweep of the injected fluid. Therefore it is suggested that fines migration is detrimentally affecting injectivity as predicted by the core flooding experiments.

The combined voidage-replacement ratio (VRR) for North Ebor Unit No.'s 1 & 2 (Figure 2) for the 1st Qu/92 was 1.33. However, if the wells outside the two injection patterns, 15-11-10-29, 16-11-10-29 and 13-12-10-29 are included the pool VRR is only 0.92 (VRR calculations assume 80% of the water production from 16-11 and 13-12 from the Lodgepole).

Tundra has requested an increase in the maximum wellhead injection pressure from 7000 to 8500 kPa. Section 5 of Board Order No. PM 67 which establishes the maximum wellhead injection pressure also gives the Board the discretion to vary the injection pressure. An injection pressure of 8500 kPa is equivalent to 71% of the fracture initiation pressure and 92% of the fracture propagation pressure (based on the 16-14 well frac job). The principle concern in approving an increase in injection pressure is the possibility of out of zone injection detrimentally effecting the waterflood. This concern must be balanced against continued injection at a less than ideal VRR < 1.0.

Tundra has the following options to maintain a VRR of 1.0 or greater:

(a) increase injection pressure, which does not address the underlying cause of reduced injectivity - fines migration;

(b) convert a third well in the pool to injection, as recommended by Tundra in its 1991 pressure maintenance progress report;

(c) restimulate the 8-14-10-29 well; or

(d) conduct a fines stabilization treatment on both injectors.

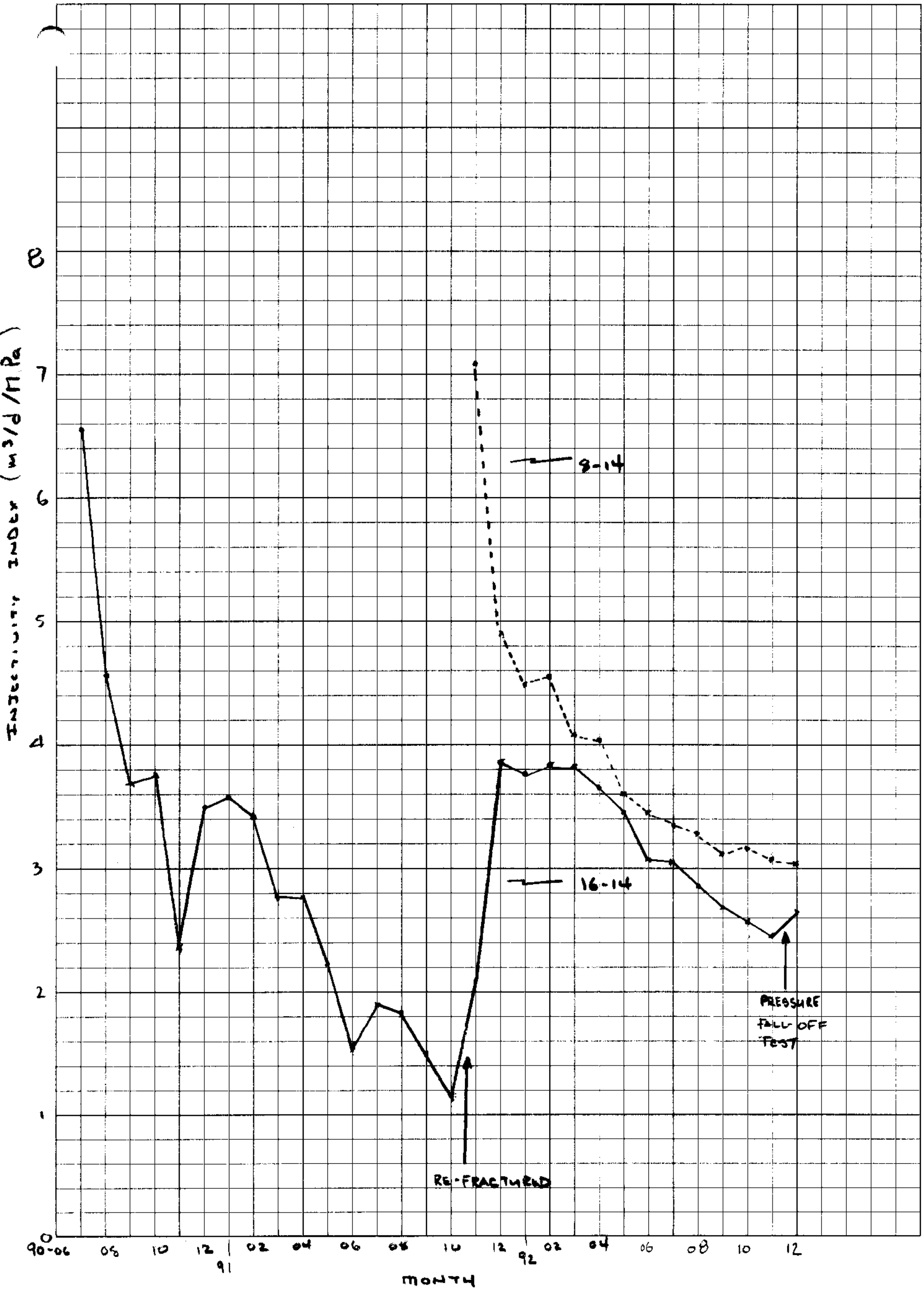
It is recommended that the Board approve an increase in the injection pressure from 7000 to 8000 kPa, 500 kPa less than requested by Tundra. The lower injection pressure will provide a greater safety factor against out of zone propagation of fractures. In the Board letter of approval Tundra should be requested to review the feasibility of the alternatives listed above, prior to reapplying for a further increase in the maximum wellhead injection pressure.

ORIGINAL SIGNED BY
JOHN N. FOX

John N. Fox
Chief Petroleum Engineer

APPROVED BY: ______________________________
L.R. Dubreuil, Director
Petroleum

FIGURE 1 - INJECTIVITY INDEX



K+E 5 X 5 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0410

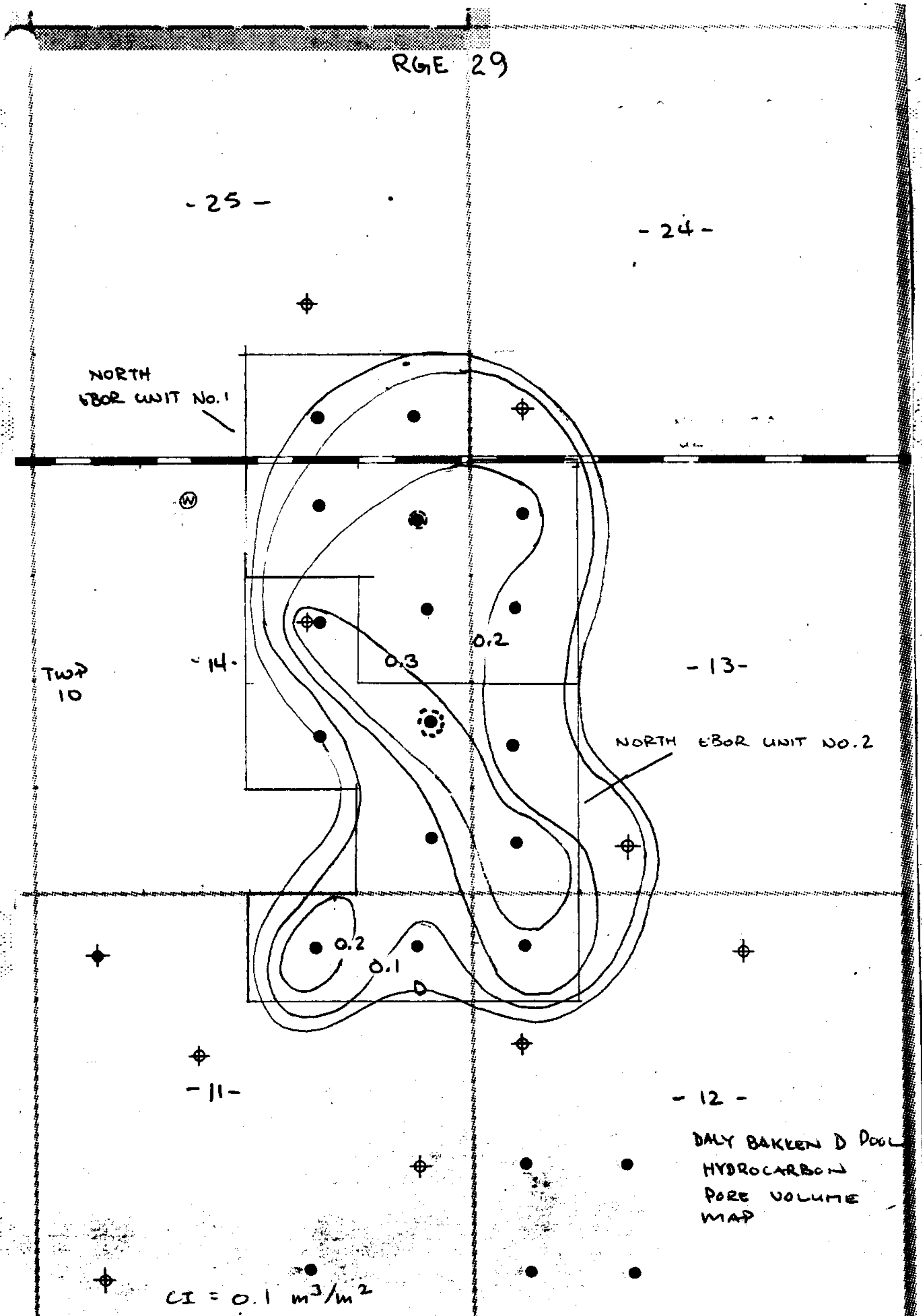

RGE 29
- 25 -
- 24 -
NORTH
EBOR UNIT No. 1
TWP
10
- 14 -
- 13 -
0.3
0.2
NORTH EBOR UNIT NO. 2
0.2
0.1
- 11 -
- 12 -
DALY BAKKEN D POOL
HYDROCARBON
PORE VOLUME
MAP
CI = 0.1 m³/m²

FIGURE 2

Manitoba

Energy and Mines

Petroleum

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

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

July 3, 1992

Mr. R. Puchniak, President
Tundra Oil and Gas Ltd.
1313 Richardson Building
One Lombard Place
WINNIPEG, Manitoba
R3B 0X3

Dear Mr. Puchniak:

Re: Daly Bakken D Pool - Application to Increase the Maximum Wellhead Injection Pressure

The Board has reviewed your application for an increase to 8500 kPa in the maximum wellhead injection pressure established under Section 5 of Board Order No. PM 67.

The Board is concerned that an increase in the maximum wellhead injection pressure to 8500 kPa (92% of the fracture propagation pressure based on the fracture treatment at 16-14-10-29) will significantly increase the potential for out of zone injection. However, the Board also recognizes the importance of maintaining a voidage-replacement ratio in excess of 1.0 to maximize the ultimate recovery from the pool. Therefore, the Board will approve an increase in the maximum wellhead injection pressure to 8000 kPa. In any application to increase the maximum wellhead injection pressure above 8000 kPa, Tundra is to submit a review of the feasibility of the following alternatives:

(a) convert a third well in the pool to injection;

(b) restimulate the 8-14-10-29 well; or

(c) conduct a fines stabilization treatment on both injectors.

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

Yours respectfully

H. Clare Moster,
Deputy Chairman

JOHN

Tundra
oil and gas ltd.

Dept of Energy & Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4E3
June 5, 1992

DEPARTMENT OF ENERGY AND MINES
JUN 11 1992
PETROLEUM BRANCH

ATTENTION: John Fox
Chief Petroleum Engineer

Dear Sir:

RE: Maximum Allowable Injection Pressure
Tundra Daly 16 & 8-14-10-29 W1M

Tundra Oil and Gas Ltd. hereby applies to increase the current maximum allowable injection pressure of 7000 kPa to a new limit of 8500 kPa.

Current rates and pressures are as follows:

LOCATION	INJ. RATE (m3/day)	PRESSURE
16-14-10-29	21.5	6200 kPa
08-14-10-29	26.5	6950 kPa

In order to maintain a voidage replacement ratio over 1.0 the current injection rate must be continued. Both wells are showing a trend of injection pressure increases of approximately 250 kPa per month at existing injection rates. We hope that this trend will decrease and perhaps an equilibrium condition will be reached at a point below the maximum injection pressure. Otherwise, the injection rates may have to be reduced, or the wells refraced.

In regards to the formation fracture propagation pressure, based upon the refrac of well 16-14, it is calculated that a surface injection pressure of 9270 kPa would be required to propagate the existing fracture (see attachments for 16-14 frac report and calculations). Therefore, with the pressure limitation at 8500 kPa, we would be approaching 92% of frac propagation pressure.

If any further information is required, please contact the undersigned at 748-3095.

Yours truly,

T.B. Howell, P. Eng

TBH/bep

Att.

Tundra oil and gas ltd.

CALCULATION OF MAXIMUM ALLOWABLE INJECTION PRESSURE

Instanteous Shut in Pressure: 9500 kPa (See 16-14 frac report - attached)

Frac Fluid Gradient (3% KCl Water): 9.93 kPa/m

Centre of Perforations: 857 m.

Fracture Propagation Pressure = Instantaneous Shut In Pressure + Hydrostatic Head Pressure

= 9500 kPa + 857 m (9.93 kPa/m)

= 18,010 kPa

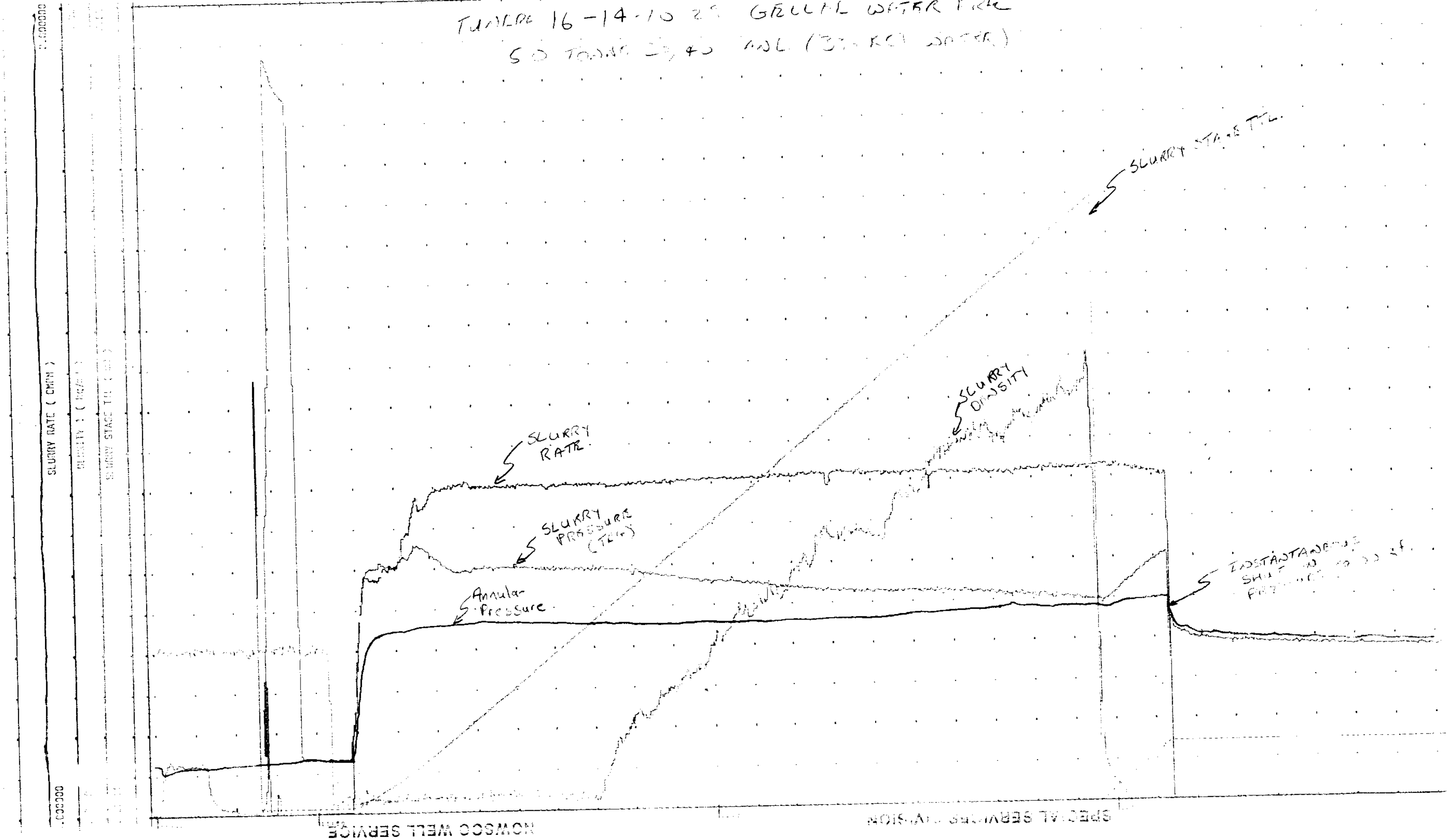
Maximum Allowable Surface Injection Pressure =

Fracture Propagation Pressure - Hydrostatic Head Pressure

Injection Water Gradient = 10.2 kPa/m

Maximum Allowable Surface Injection Pressure = 18010 kPa - 10.2 $\frac{kPa}{m}$ (857 m)

= **9270 kPa**


SLURRY RATE (CMPM)
SLURRY STAGE TTL
SLURRY RATE
SLURRY PRESSURE (TBG)
Annular Pressure
SLURRY DENSITY
NOWSCO WELL SERVICE
SPECIAL SERVICES DIVISION

REVIEW OF FRAC JOBS

16-14 FRAC GRADIENT (BREAKDOWN) 23.7 kPa/m (1.06 psi/ft)
FRAC PROPAGATION - 21 kPa/m (0.93 psi/ft)

PROPOSED INJ. PRESS 4500 kPa 92% of propagation press.
71% of breakdown press.

13-12 BREAKDOWN PRESS - 5800 kPa
PROPAGATION PRESS - 5500 kPa

1-14 BREAKDOWN PRESS - 8200 kPa
INSTANTANEOUS SIP - 4800 kPa

A10-14 BREAKDOWN PRESS 4500 kPa
INSTANTANEOUS SIP - 4000 kPa

1-23 (REFRAC) BREAKDOWN PRESS 6000 kPa
INSTANTANEOUS SIP - 3800 kPa

* NOTE: NO CHARTS FOR OTHER WELLS ON FILE

5-13 BREAKDOWN 11500 kPa
INSTANTANEOUS SIP 7500 kPa

12-13 BREAKDOWN 10000 kPa
INSTANTANEOUS SIP 8000 kPa

8-14 BREAKDOWN 11500 kPa
INSTANTANEOUS SIP 8500 kPa

VOIDAGE - REPLACEMENT

16-14 PATTERN

VOIDAGE 1420.8 rm³ (9 SPOT INJ. JAN to MAR/92)
REPLACEMENT 1825.7 rm³
VRR = 1.28

8-14 PATTERN

VOIDAGE 1652 rm³ VRR = 1.37
REPLACEMENT 2259.4 rm³

15 & 16-11 + 13-12 VOIDAGE 2898 rm³

$$\text{POOL TOTAL VRR} = \frac{2259.4 + 1825.7}{2898 + 1652 + 1420.8} = 0.68$$

POOL URR if 80% of water production from 16-11 & 13-12 is assumed to be from the LODGEPOLE

$$\text{POOL URR} \quad \frac{4085}{4435} = 0.92$$

Tundra
oil and gas ltd.

June 29, 1992

Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4A5

ATTENTION: MR. JOHN FOX

Dear Mr. Fox:

RE: Injection Pressures - North Ebor
Unit 1 & 2, Daly Bakken "D" Pool

As per your request, enclosed please find the historical injection pressure data for North Ebor Units 1 & 2 (Daly Bakken "D" Pool).

Should you require any more information, please do not hesitate to contact us.

Sincerely,

S.M. Chen

Shing-Ming Chen,
Senior Reservoir Engineer

SMC/kp

Enclosure

cc: Robert G. Puchniak

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 934-5850 Fax (204) 934-5820

ATTACHMENT 1: INJECTION PRESSURES - NORTH EBOR
UNITS 1 & 2, DALY BAKKEN 'D' POOL

	08-14 Pinj. (psig)		16-14 Pinj. (psig)		
Month	1991	1992	1990	1991	1992
1	-	800	-	933	746
2	-	830	-	980	766
3	-	876	-	1039	800
4	-	941	-	1066	840
5	-	983	-	1079	878
6	-		30	1049	
7	-		408	1075	
8	-		666	1027	
9	-		729	1052	
10	166		825	1016	
11	530		856	783	
12	744		859	773	

Remarks:-

1. 1990.06: Water injection commenced in 16-14-10-29 WPM in North EBOR Unit #1.
2. 1991.10: Water injection commenced in 08-14-10-29 WPM in North EBOR Unit #2.
3. 1991.11: A frac job was conducted in 16-14-10-29 WPM to improve the injectivity.

June 19, 1990

Tundra Oil and Gas Ltd.
1313 Richardson Building
One Lombard Place
Winnipeg, Manitoba
R3B 0X3

Attention: Mr. Dan Barchyn

Dear Sir:

RE: Daly Bakken D Pool
Pressure Maintenance

Your application to initiate pressure maintenance operations in a portion of the subject pool ("the pilot area") by conversion of the well Tundra Daly 16-14-10-29 (WPM) to water injection is hereby approved. Pressure maintenance operations in the pilot area will be governed by the provisions of Board Order No. PM 62.

Please note that commencement of injection is not authorized prior to approval by the Board of the proposed North Ebor Unit No. 1 Unit Agreement.

Yours sincerely,

ORIGINAL SIGNE
JOHN N. FO.

John N. Fox
Chief Petroleum Engineer

MARC

Manitoba

Action / Route Slip

Date: June 7, 1990

To: IAN HAUGH

From: H. CLARE MOSTER

CC: L.R. Dubreuil

Telephone: 1111

- [ ] Take Action
- [ ] Per Your Request
- [ ] Circulate, Initial and Return
- [x] For Approval and Signature
- [ ] Make ____ Copies
- [ ] May We Discuss
- [ ] For Your Information
- [ ] Return With Comments or Revisions
- [ ] Draft Reply for Signature
- [ ] Please File

Comments: RE: BOARD ORDER No. PM 62

Attached for your signature and the Minister's approval are two (2) copies of the subject Order.

Please return signed copies directly to Petroleum (L.R. Dubreuil).

Attachments

MG-1296 PS-I-182 8840100871

Manitoba

Memorandum

June 6, 1990

To

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

From

Marc J. Arbez
Petroleum Engineer
Petroleum Branch

Subject

Telephone

First | Fold

RE: Daly Bakken D Pool
North Ebor Unit No. 1 - Pressure Maintenance

Tundra Oil and Gas Ltd. has made application to initiate pressure maintenance operations in a portion of the subject pool (the pilot area) (see Figure 1). It is proposed that the well Tundra Daly 16-14-10-29 (WPM) be converted to a water injection well. Notice of the application was published in the Manitoba Gazette (May 5, 1990) and the Virden Empire Advance (May 2, 1990). In addition, copies of the notice were sent to all working interest and royalty owners within the pool. No objections to or intreventions in the application have been received.

Recommendations:

It is recommended that the application be approved and that Board Order PM 62 be issued.

Discussion:

The Bakken Formation is a thin clastic unit which consists of three members: a lower shale, a middle siltstone to medium-grained sandstone and an upper shale. The Bakken is conformably overlain by limestones of the Mississippian Lodgepole Formation. It is underlain by the dolomitic shales and siltstones of the Upper Devonian Three Forks (Lyleton) Formation. The middle siltstone/sandstone is the productive Bakken zone.

The primary recovery mechanism for the Daly Bakken D Pool is fluid expansion drive. Reservoir pressures have dropped from an initial value of 8600 kPa to 5400 kPa in June, 1989 (Figure 2), but is still above saturation or bubble point pressure of 2000 kPa. Bakken oil has a gravity of 41^{o} API (15^{o}C) and a viscosity of 1.3 cp (at the original reservoir pressure of 8600 kPa). The low energy conditions and rapid pressure depletion along with good oil mobility in the Bakken make the D Pool a good candidate for waterflooding.

A waterflood sensitivity study was conducted on Bakken core and connate water (MOGC Daly 9-14-10-29 WPM). The study shows that waterflooding may initiate a fines migration problem in the reservoir (Figure 1). A water injectivity test was conducted on the well 15-11-10-29 WPM from December 5, 1989 to January 21, 1990. Injection volumes increased from roughly 11 m^3/D (at 4100 kPa) over a period of one month to approximately 15m^3/D (4500 kPa) over the last ten days of the test. The total volume of water injected during the test was 489 m^3. Tundra proposes to inject 20 m^3/D at a maximum injection pressure of 6 000 kPa (which is well below reservoir fracture conditions) for 6 months. At this point, Tundra will evaluate the waterflood performance in the pilot area and consider expansion of the project. This low rate of injection should help reduce a fines migration problem. The proposed pilot area is a good choice for a waterflood site because the Bakken Formation is continuous and has good porosity development in the area.

Tundra estimates that the proposed 7-well pilot area has an original oil-in-place of 151 084 m^3. Figure 4 is a Bakken porosity thickness map for the pilot area. Figure 5 is an oil production rate versus time plot for the Bakken Formation in the pilot area. Original oil-in-place figures for each of the seven wells are shown in Figure 1. Under primary recovery, it is predicted that 41 564 m^3 oil or 27.5% of the oil-in-place will be recovered. As of February 1, 1990, 12 682 m^3 oil or 8.4% of the oil-in-place has been recovered from the pilot area. Tundra predicts that waterflooding the pilot area will yield 73 304 m^3 oil or 48.5% of the oil-in-place. To arrive at these numbers, Tundra assumed that the 1991 production rate under waterflooding would be 30% higher than the projected 1991 primary production rate, followed by a decline matching the primary forecast decline rate. Waterflooding was initiated in the Bakken Formation in Rocanville, Saskatchewan in June 1988. A 41% increase in oil production has been observed to date. A 30% increase in production over a one year period due to waterflooding in the Bakken D Pool seems reasonable. Since the Bakken Formation has never been waterflooded in the Province, a pilot project is a good way to assess the effectiveness of waterflooding this formation.

In order to control wellbore corrosion at the proposed injector 16-14-10-29(WPM), the annulus will be circulated to fresh inhibited water, then isolated with a 114.3mm epoxy-coated tension packer. Internal tubing corrosion will be controlled with a chemical inhibitor. Flowlines are fiberglass constructed and all major surface facility components are designed for salt water application.

Injection water supply will be provided from produced water (Bakken and Lodgepole) from the area. Compatibility tests show no adverse scaling tendency. The volume of injected water will be metered on the discharge pump at 16-14-10-29 (WPM).

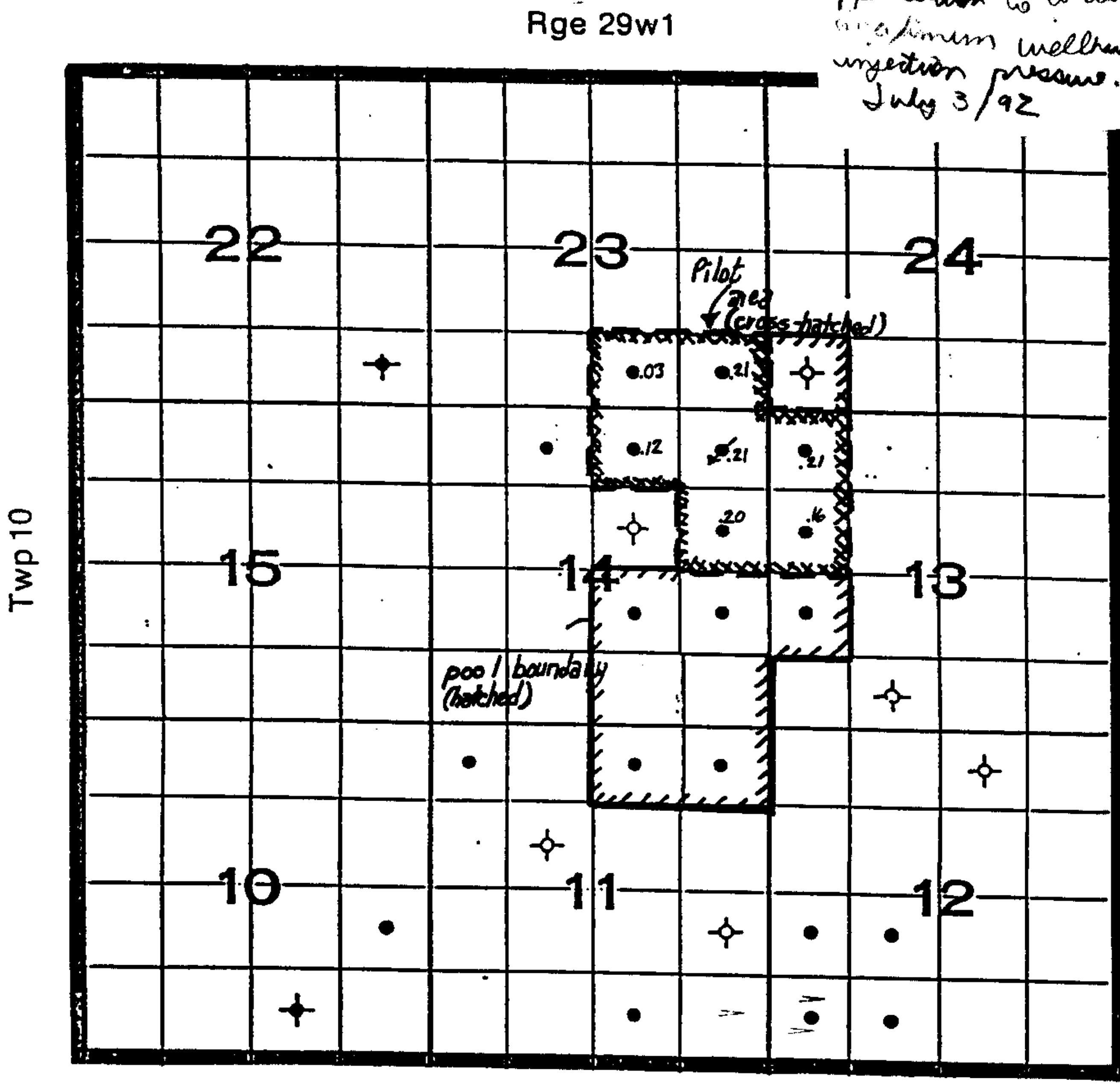
Marc Arbez

MA:cvs

Approved By: L.R. Dubreuil, Director

TUNDRA OIL AND GAS

M.E.M
Daly Bakken D Pool
application to increase
maximum wellhead
injection pressure.
July 3/92



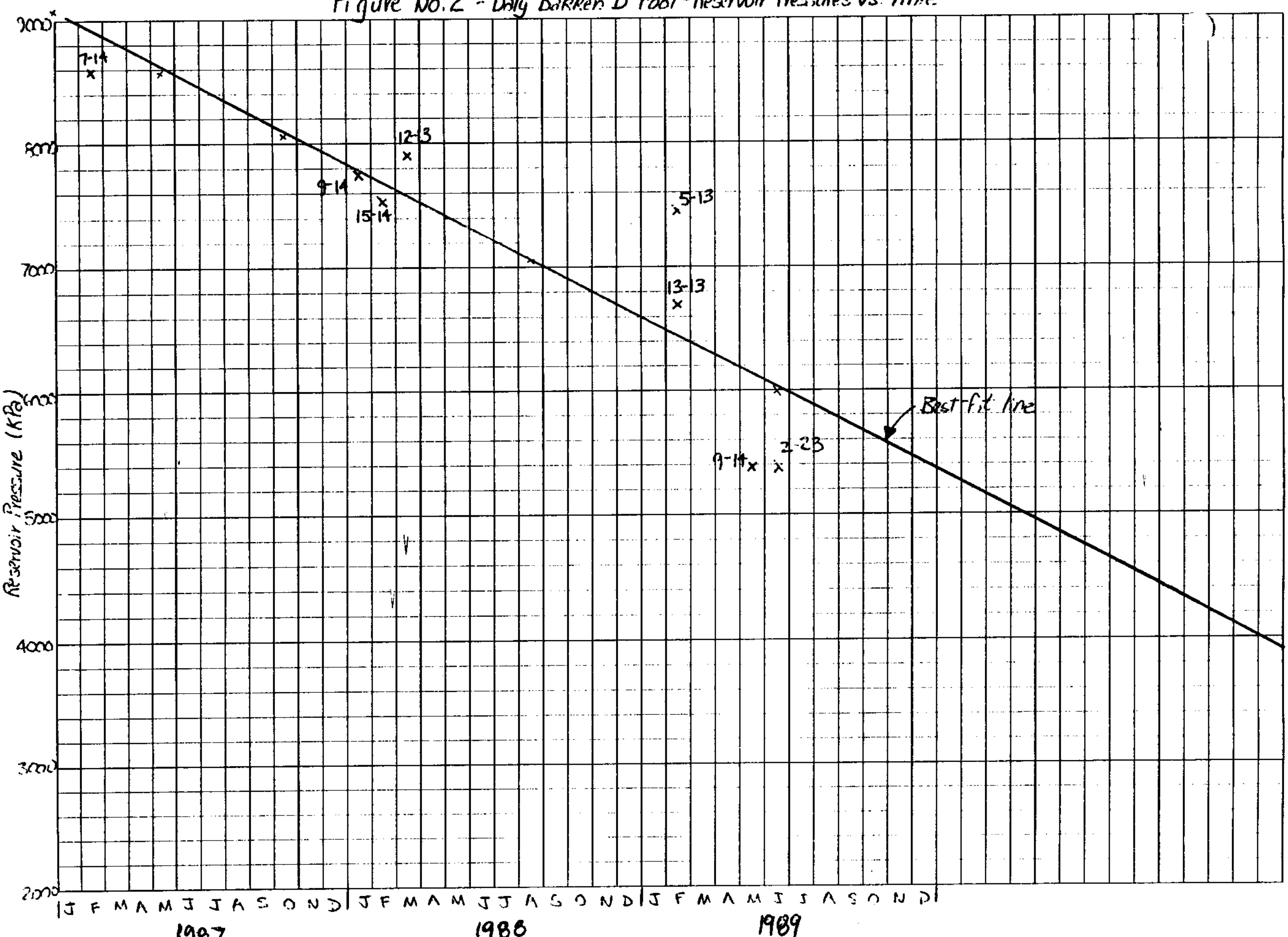
.12 OOIP/m² area

N. EBOR PILOT WATERFLOOD

FIGURE NO.1

K•E 5 X 5 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0410

Figure No. 2 - Daly Bakken D Pool - Reservoir Pressures vs. Time



COMPANY: TUNDRA OIL AND GAS LTD.
WELL NAME: HOGC DALY
LOCATION: 9-14-10-29W1

GEOTECH

DATE: AUG 04, 1989
FILE: 89-GC-253

FINES MOBILIZATION
STANDARD PLOT

BAKKEN FORMATION

SAMPLE # 2

Depth : 859.66 m
Gas Permeability (k) : 40.14 md
Porosity (phi) : 20.1 %
Grain Density (rho) : 2687 kg/m^3

Pore Volume : 4.48 cc
Critical Velocity (U_c) : .0294cm/min
Injection Water : Jurassic

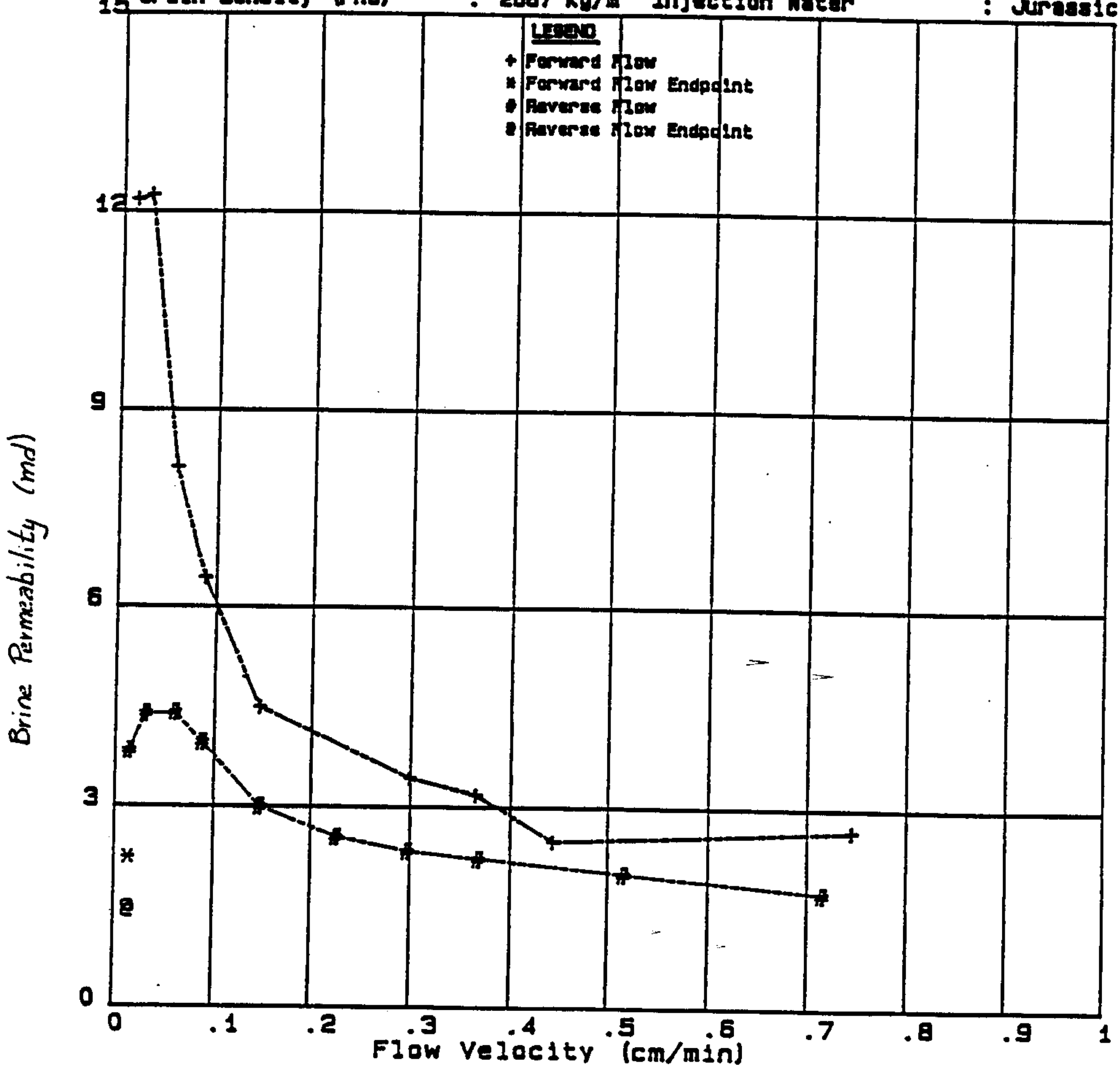
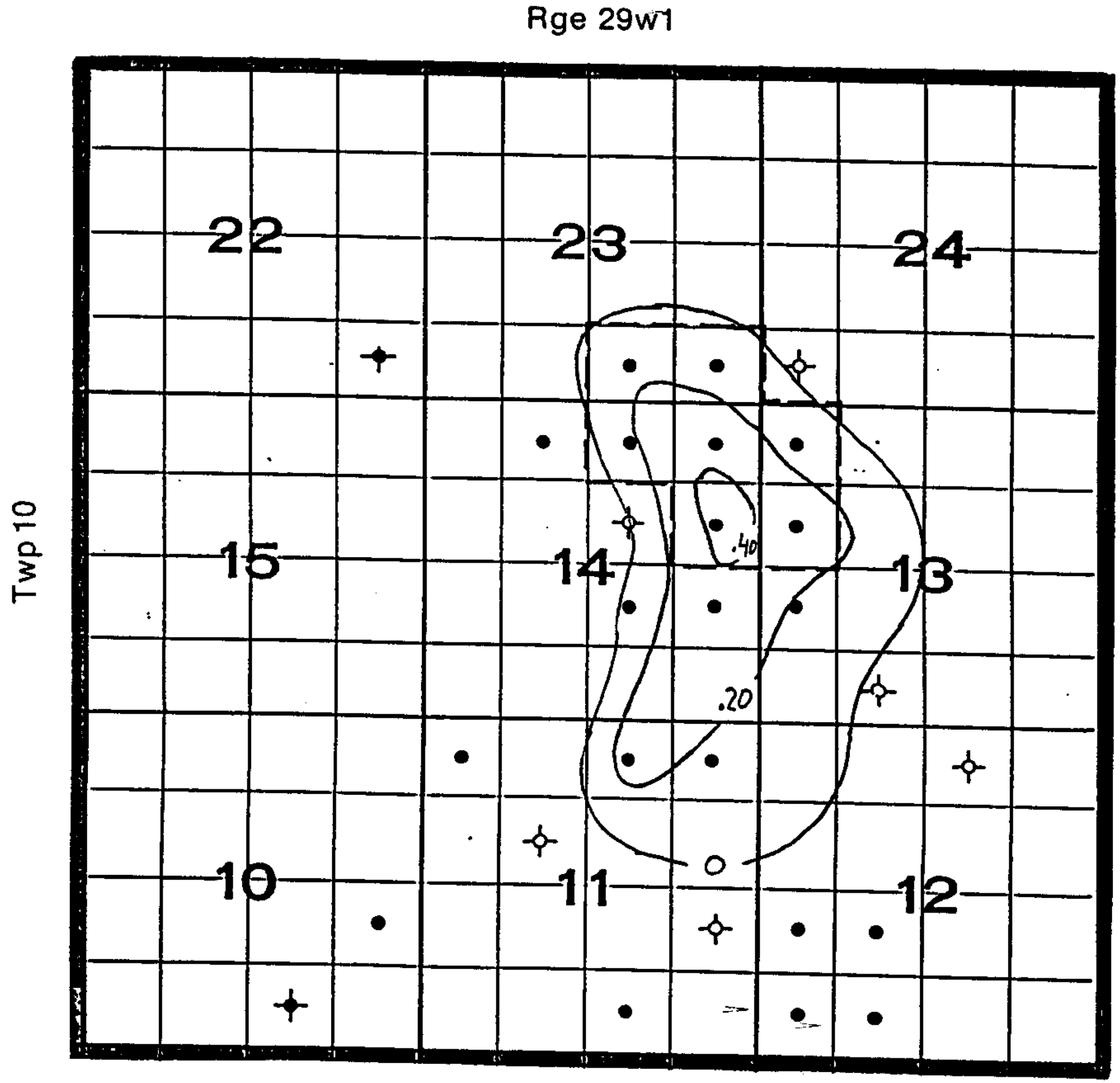


FIGURE 3

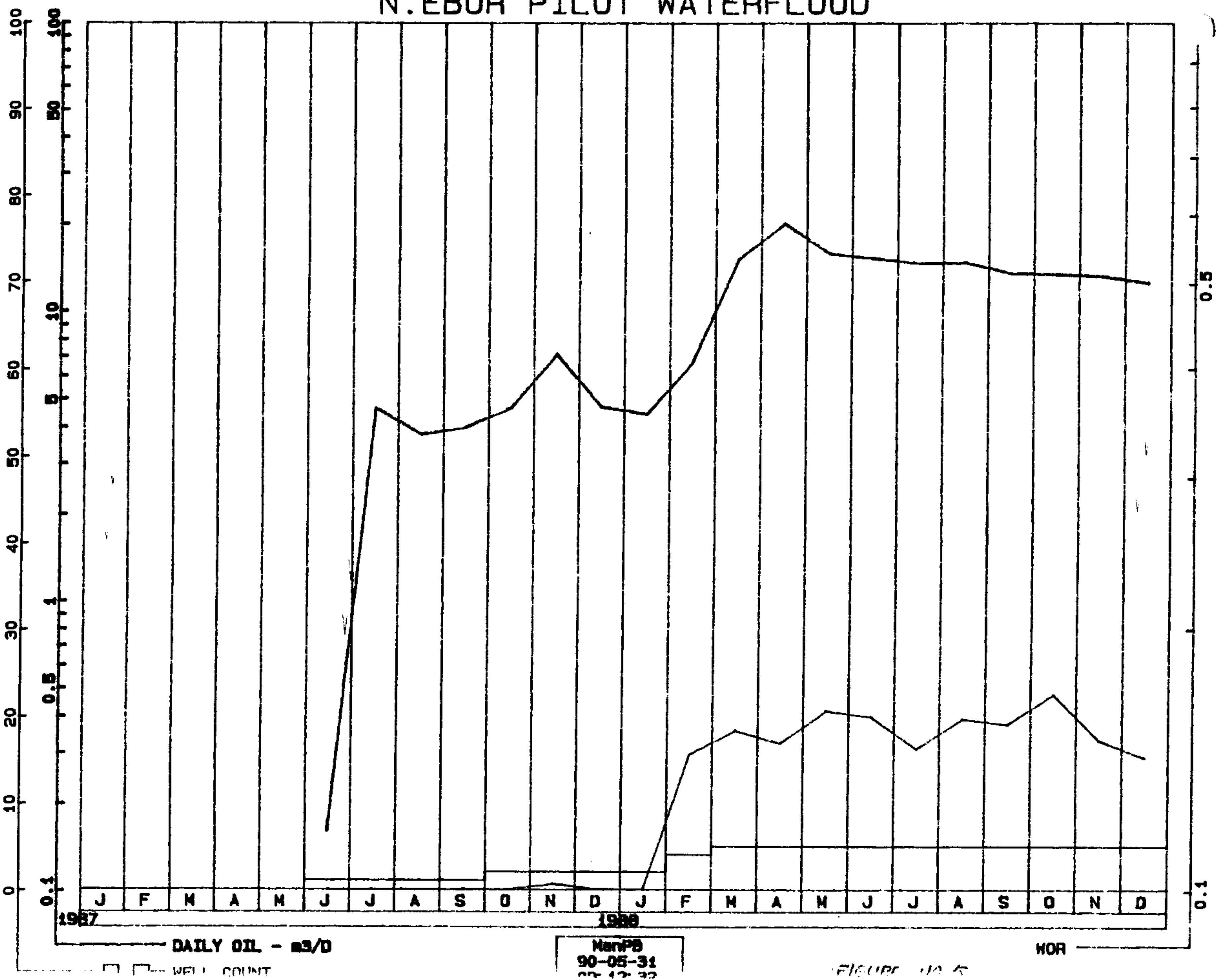
TUNDRA OIL AND GAS



N. EBOR PILOT WATERFLOOD

FIGURE NO. 4
Øh MAP

N.EBOR PILOT WATERFLOOD



Manitoba

The Oil and Natural Gas
Conservation Board

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

(204) 945-3130

Order No. PM 62

An Order Pertaining to Pressure Maintenance by Water Flooding
Daly Bakken D Pool

WHEREAS, subsection(9)(d) of Section 62 of "The Mines Act", Cap. M160, of the Revised Statutes of Manitoba, provides as follows:

> "62(9) Without restricting the generality of subsection (8) the board, with the approval of the minister, may make orders
>
> (d) requiring the repressuring, recycling, or pressure maintenance, of any pool or portion thereof where it is econonomical so to do, and for that purpose where necessary requiring the introduction or injection into any pool or portion thereof of gas, air, water, or other substance;"

AND WHEREAS, the Board received an application dated March 15, 1990 from Tundra Oil and Gas Ltd. for approval of a project to inject water into the Daly Bakken D Pool ("the pool") in the proposed North Ebor Unit No. 1 in Manitoba.

AND WHEREAS, notice of the application was published in the Manitoba Gazette on May 5, 1990 and the Virden Empire Advance on May 2, 1990.

AND WHEREAS, the Board has received no objections or interventions with respect to the application by Tundra Oil and Gas Ltd.

AND WHEREAS, Tundra Oil and Gas Ltd. is the proposed unit operator of the proposed North Ebor Unit No. 1 ("the unit area").

AND WHEREAS, upon due consideration of the said application, the Board has found it is reasonable and desirable to convert the said well to water injection.

NOW THEREFORE, the Board orders that:

1. The unit operator shall conduct pressure maintenance operations by the injection of water into the pool underlying the unit area.

2. The pressure maintenance operation shall be in accordance with, and subject to, the following rules:

PRESSURE MAINTENANCE RULES

1(1) Water shall be injected into the pool through the well:

Tundra Daly WIW 16-14-10-29 (WPM)

and such other wells in the unit area as the Board may approve.

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

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

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

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

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

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

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

3(4) Within 30 days of the completion of the surveys described in subsections (1), (2) and (3) the unit operator shall submit the details of the surveys including:

(a) a list of wells surveyed,
(b) the measurement technique used,
(c) the shut in period for each well,
(d) the static reservoir pressure data obtained from the survey corrected to the pool datum depth, and;
(e) a discussion of the survey results and pressure distribution within the unit area.

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

5 The maximum wellhead pressure at which water is injected into the wells referred to in subsection 1(1) shall not exceed 6 000 kPa or such other maximum pressure as the Board may prescribe and the Board may, from time to time, prescribe a maximum or minimum rate at which water shall be injected into any well in the unit area.

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

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

(a) a tabulation of total oil, total water and total water and total gas produced;
(b) a tabulation of the number of producing wells and injection wells which were active;
(c) the results of at least one twenty-four hour production test on each producing well in the unit area including volumes of oil, gas and water produced during the test; and
(d) a summary of any remedial operations carried out on any well in the unit area.

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

H.C. Moster
Deputy Chairman

I. Haugh
Chairman

OIL AND NATURAL GAS CONSERVATION BOARD ORDER NO. PM 62 APPROVED THIS DAY OF A.D., AT THE CITY OF WINNIPEG.

APPROVED:

H. Neufeld
Minister of Energy and Mines

Tundra
oil and gas ltd.

DEPARTMENT OF ENERGY AND MINES
MAY 22 1990
PETROLEUM BRANCH

May 18, 1990

Mr. John Fox
Chief Petroleum Engineer
Department of Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 4A5

Dear Sirs:

RE: Proposed North Ebor Unit No. 1

As mentioned in our telephone conversation of this date figure #2, as enclosed with our original application, contained an error. Penner Farms Ltd. is the owner of an undivided 25% interest in mines and minerals underlying the South East Quarter of Section 23, Township 10, Range 29 WPM, not E. Klassen as shown.

I have also enclosed a revised listing of working interest and royalty interest owners' addresses to reflect this correction.

I trust you will find the above to be in order.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosures

Manitoba

Message

To John Foy

Person calling Cindy

Of Tundra —

- [x] Telephoned
- [ ] Will call again
- [ ] Called to see you
- [x] Please call
- [ ] Returned your call
- [ ] Will return

Telephone No. 949-1195	Time 9:5

Message LSD 1&2 23-10-29

LESSOR - PENNER FARMS LTD. - KLASSEN

BOX 42, KOLA MB.

R0M 1B0

ED PENNER — 748-1400

- notified as surface owner

Date —/6 Message taken by

PS-f-36

08/01 58/B/90 — Johnston & Company o/b/o B. Coyle & H. Beaton

An application for a permit for Two (2) Additions to an Existing Dwelling (Residential) adjacent to P.T.H. No. 10, S.E. ¼, Section 9-24-19 West, R.M. of Dauphin.

09/020/065/A/90 — Elizabeth Rivard

An application for a permit to Relocate an Existing Access Driveway (Residential) onto P.T.H. No. 20, S.W. ¼, Section 20-35-22 West, L.G.D. of Mountain (Cowan).

The Highway Traffic Board will be prepared to consider all submissions written or oral on the above applications by contacting the Secretary prior to or at the hearing.

A. POLTARUK, MMM CD
Secretary,
The Highway Traffic Board.

6514—18

UNDER THE MINES ACT

DALY OIL FIELD

Tundra Oil and Gas Ltd. has made application under The Mines Act to conduct a pilot waterflood project in the Bakken Formation in that portion of the Daily Field described as follows: Lsd's 12 and 13 of Section 13-10-29 (WPM), Lsd's 9, 15 and 16 of Section 14-10-29 (WPM) and Lsd's 1 and 2 of Section 23-10-29 (WPM).

It is proposed to convert the well, Tundra Daly 16-14-10-29 (WPM) to water injection.

If no valid objection or intervention in writing is received by The Oil and Natural Gas Conservation Board at 555-330 Graham Avenue, Winnipeg, Manitoba, R3C 4E3 within 14 days of the publication of this notice, the Board may approve the application.

Copies of the application may be obtained from Tundra Oil and Gas Ltd., 1313-One Lombard Place, Winnipeg, Manitoba, R3B 0X3.

Dated at Winnipeg this 20th day of April, 1990.

H. C. MOSTER,
Deputy Chairman.

6489—18

UNDER APPLICATION TO THE LEGISLATURE

Applicants for Private Bills properly the subject of the Legislative Assembly of Manitoba should take notice of the following rule:

Notice of Application for Private Bill

107(1) Every petitioner for a Private Bill shall publish, within twelve months prior to the presentation of the petition for the Private Bill.

(a) in one issue of the Manitoba Gazette; and

(b) at least once in each of two weeks during the twelve month period aforementioned in an issue of a newspaper published in the English language or the French language and having a general circulation in the area of the province in which the persons or a majority of the persons, who would be interested in or affected by the Private Bill reside;

a notice, in the form set out in Schedule "A-1", signed by or on behalf of the petition and clearly and distinctly specifying the nature and object of the petition and any exceptional provision proposed to be inserted in the Bill.

For further particulars, apply to the Clerk of the Legislative Assembly, Legislative Building, Winnipeg, Manitoba, R3C 0V8.

6300—18

DEMANDES À LA LÉGISLATURE

Quiconque demande à l'Assemblée législative du Manitoba la présentation d'un projet de loi privé devrait prendre connaissance de la règle suivante:

Avis relatifs aux demandes de projet de loi privé

107(1) Les pétitionnaires publient, dans les 12 mois précédant la remise de la pétition, un avis rédigé selon la formule figurant à l'annexe A-1 et signé par eux ou en leur nom qui précise la nature et l'objet de la pétition, ainsi que les dispositions particulières à insérer dans le projet de loi. Cet avis est publié:

a) dans une édition de la Gazette du Manitoba;

b) au moins une fois toutes les deux semaines durant ladite période de 12 mois dans une édition d'un journal publié soit en langue française, soit en langue anglaise, et distribué de façon générale dans la région de la province dans laquelle résident l'ensemble ou la majorité des personnes intéressées ou touchées par le projet de loi privé.

Pour de plus amples renseignements, veuillez vous adresser au greffier de l'Assemblée législative, Palais législatif, Winnipeg, Manitoba, R3C 0V8.

6300—18

osse employee retires after 17 years

Fort La Bosse School Division No. 41 has given approval for all departments and schools to enter into a recycling program with Bridge Street ...

to their degree of readiness.

Betty Capple, Dennis Eirikson and a teacher will be attending a major curriculum conference in Winnipeg on May 10 and 11.

In other news:

—Mrs. Steffie Campbell, a bus driver from Sinclair, was granted a one-year leave of absence to allow her to continue with her education at Brandon University.

—The resignation of Mr. Peter Wiebe, head custodian at Kola School ... was accepted ... employed as a spare custodian.

—Mrs. Laura Maxwell, division office secretary, was granted maternity leave beginning August 1, 1990.

—Trustee Dunc Elliott and the division office support staff were to attend an office seminar in Brandon on April 27.

—Cheryl Bartel, a teacher assistant at Sinclair, has tendered her resignation. She plans to pursue her figure skating teacher certification.

—A committee representing all employee groups and the board of trustees has been established to develop an Employee Assistance Program and a Sexual Harassment Policy.

—The Board accepted the tender from Ivey's No. 1 Manufacturing for a 20-foot five-wheeler trailer.

—Approval was given to enter into an agreement with Johnson Controls for the supply and installation of computerization energy management equipment for Elkhorn, Virden Junior High, Reston Elemen...

tary, and ...

—The Division ... secretarial ... as a ... July 1, ...

Joyce A. Heaman, Reporter

...dy Hutchison, in Elkhorn.

Sympathy is extended to the relatives and family of the late Adeline ...elson (Heaman), who passed away Monday, April 23, and also her husband, Kai Nielsen, who passed away this ...

Congratulations to Ken Rhodes and Deborah (Debbie) Hatch of Oak Lake, who were married ... at the Oxford Assembly in Virden. All the Rhodes family, except Delmar ...nson of Delta, B.C., were home with Mr. and Mrs. Cecil Rhodes for the happy event.

Those from the area who attended the Rhodes-Hatch wedding were Mr. and Mrs. Lyle Simpson, Mr. and Mrs. Don George, Mr. and Mrs. ... George, Mr. Art Rhodes, and Mr. and Mrs. Ernie Hey.

Congratulations to Mr. Norman ...llett, who celebrated his ... birthday on Sunday, April ... at the ...ve Community Centre.

...orma Heaman of ... spent a few days at the home of her parents, Alvin and Joyce Heaman.

On Sunday, Gwen Heaman of Yorkton, and Ray Moore were supper guests with the Heaman family.

U.C.W. Tea

The Hargrave U.C.W. ... than usual. The guest book was attended by Mrs. Ines Perrin, and the door prize was a fruitcake.

The tea tables were centred with African violets donated by M. A. Heaman. The bake table was loaded with goodies. The silent auction table had many interesting items, and the highest bid was the winner of each item.

Tea and coffee were served with a choice of ... the door prize ... man. Winners of the African violet table decorations were Betty Grant, Ida Robinson, Louise Smith, Ruth Cameron, Ed Wadham, Isabel Zorn, Evelyn ..., Carol Gabrielle, Kathy Heaman, Anne Lamb..., and Kayla and Jacy Fisher.

All in all, it proved to be a ...

...trict

...

...to this past year.

...s Millie Scott of Winnipeg ... to her home on Monday after ... with Miss Margaret Scott ... Mr. and Mrs. George Hendry ... past 10 days.

... and Mrs. John Pidhorny of ... visited on Sunday at the ...

Manitoba

The Oil and Natural Gas
Conservation Board

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

(204) 945-3130

NOTICE

Under The Mines Act
Daly Oil Field

Tundra Oil and Gas Ltd. has made application under The Mines Act to conduct a pilot waterflood project in the Bakken Formation in that portion of the Daly Field described as follows: Lsd's 12 and 13 of Section 13-10-29 (WPM), Lsd's 9, 15 and 16 of Section 14-10-29 (WPM) and Lsd's 1 and 2 of Section 23-10-29 (WPM).

It is proposed to convert the well, Tundra Daly 16-14-10-29 (WPM) to water injection.

If no valid objection or intervention in writing is received by The Oil and Natural Gas Conservation Board at 555-330 Graham Avenue, Winnipeg, Manitoba, R3C 4E3 within 14 days of the publication of this notice, the Board may approve the application.

Copies of the application may be obtained from Tundra Oil and Gas Ltd., 1313-One Lombard Place, Winnipeg, Manitoba, R3B 0X3.

Dated at Winnipeg this day of , 1990.

H. C. Moster
Deputy Chairman.

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Copies of the application may be obtained from Tundra Oil and Gas Ltd., 1313-One Lombard Place, Winnipeg, Manitoba, R3B 0X3.

Dated at Winnipeg this   day of   , 1990.

H. C. Moster
Deputy Chairman.

April 20, 1990

The Oil and Natural Gas
Conservation Board
I. Haugh, Chairman
H.C. Moster, Deputy Chairman
Wm. McDonald, Member

John N. Fox
Chief Petroleum Engineer
Petroleum Branch

RE: Pilot Pressure Maintenance Project - Daly Bakken D Pool

Tundra Oil and Gas Ltd. has made application to conduct a pilot waterflood project in a portion of the subject pool. The project area is outlined in Figure No. 1 attached.

It is recommended that notice of the application be published in the Manitoba Gazette and the Virden Empire Advance. A copy of the proposed notice is attached.

It is also recommended that the working interest and royalty owners within the Daly Bakken D Pool boundary be notified of the application directly by the Board. Tundra has been asked to provide the addresses of the lessors and lessees within the subject pool. When the addresses are available, the proposed letters of notification will be forwarded to the Board.

A technical review of the application is also underway and recommendations will be forwarded to the Board when the review is completed.

ORIGINAL SIGNED BY
JOHN N. FOX

John N. Fox

Att'd.

ORIGINAL SIGNED BY
JOHN N. FOX

Approved by: ______________________
L.R. Dubreuil, Director

WORKING INTEREST OWNERS

Albert D. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Harry B. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
John C. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Joseph H. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Morley M. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Leasam Holdings Limited	1370 Sony Place Winnipeg, Manitoba R3C 3C3
James D. MacDonald	C/O P.O. Box 278 Winnipeg, Manitoba R3C 2G9
R. Barry Talbot	98 Shier Drive Winnipeg, Manitoba R3R 2H8
Louie Tolaini	486 Henderson Hwy. Winnipeg, Manitoba R2K 2H8

ROYALTY OWNERS

Rose Minnie Muir
273 Church Street
Comox, B.C.
V6G 2R8

Rosella Mary Shepherd
P.O. Box 411
Virden, Manitoba
R0M 2C0

Penner Farms Ltd.
P.O. Box 42
Kola, Manitoba
R0M 1B0

Ogilvie Enterprises Ltd.
P.O. Box 66
Elkhorn, Manitoba
R0M 0N0

Lloyd Alexander Duncan
P.O. Box 1502
Taber, Alberta
T0K 2G0

Canada Trust
C/O Montreal Trust
411 - 8th Avenue S.W.
Calgary, Alberta
T2P 1E7
Attention: Oil Royalties

MINERAL OWNERS OUTSIDE UNIT

Edith Hannah Bolam
C/O P.O. Box 754
Virden, Manitoba
R0M 2C0

Laura May Day
C/O P.O. Box 754
Virden, Manitoba
R0M 2C0

Doreen Perron
C/O P.O. Box 754
Virden, Manitoba
R0M 2C0

Mervin Roach
P.O. Box 754
Virden, Manitoba
R0M 2C0

K8 Resources Ltd.
P.O. Box 101
Kola, Manitoba
R0M 1B0

Wasyl Investments Ltd.
C/O 1598 Sixth Avenue
Prince George, B.C.
V2L 5G7

Canadian Northwest
Energy Limited
2700 - 300 - 5 Avenue S.W.
Calgary, Alberta
T2P 3C4

Wilma Diane Leslie
C/O William Ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

Joseph Huculak
C/O William Ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

Ella Huculak
C/O William Ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

John Douglas Walker
C/O William ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

Ruth Marie Jacobson
226 - 11810 Macleod Trail
Calgary, Alberta
T2J 2V8

SW 14-10-28-9

Estate of Blanche Russell
P.O. Box 667
Hudson Bay, Saskatchewan
S0E 0Y0

Eileen Sarah Scott
Lot 6, Pleasant Road
Box 5, Group 2, R.R. 1
Anola, Manitoba
R0E 0A0

Estate of J. B. O'Connor
C/O Mrs. Thelma Roy
229 - 10th Avenue N.E.
Calgary, Alberta
T2E 0X1

C

Estate of Harold Good
205 - 1400 East 11th Avenue
Vancouver, B.C.
V5N 1Y5

Lyle Muir
Executor of the Estate
of J. A. D. Muir
21976 Lougheed Highway
Maple Ridge, B.C.
V2X 2S5

C

Phyllis Madeline Dalby
2100 Randless Lane
R. R. 3
Sidney B. C.
V8L 3X9

C

Estate of Edith Swann
431 Main Street
Penticton, B.C.
V2A 5C4
Attention: Bill Swann

C

William John Russell
address unkown

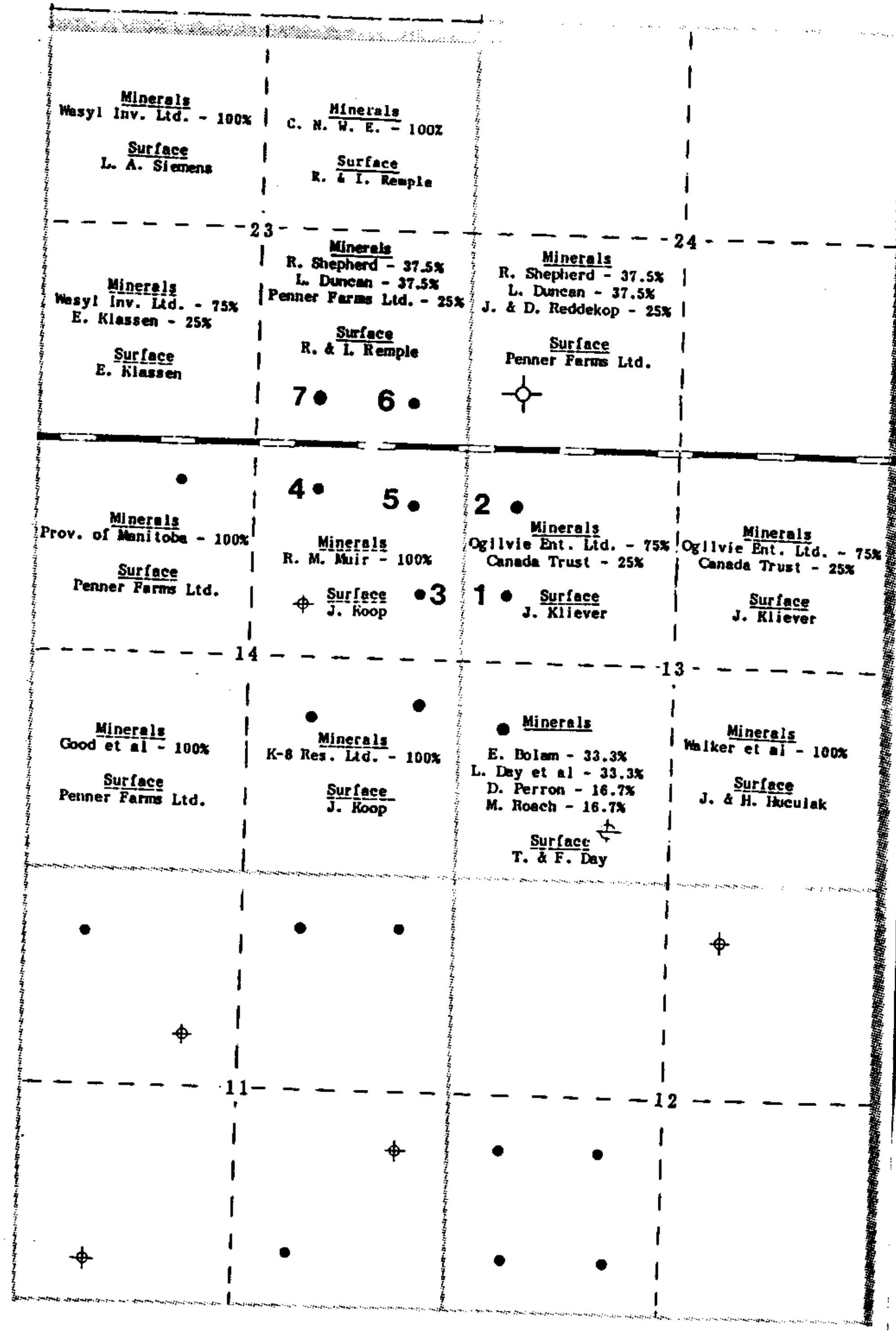
C

James Douglas Reddekop & Doreen Dueck Reddekop
P.O. Box 3123
Steinbach, Manitoba
R0A 2A0

PROPOSED NORTH EBOR UNIT NO. 1

LESSEES

LANDS	LESSEES	
Tract No. 1	Tundra	100.000000
Tract No. 2	A. D. Cohen	2.083334
	H. B. Cohen	2.083333
	J. C. Cohen	2.083333
	J. H. Cohen	2.083333
	M. M. Cohen	2.083333
	Leasam	2.083334
	MacDonald	4.166667
	Talbot	4.166667
	Tolaini	4.166666
	Tundra	75.000000
Tract No. 3	Tundra	100.000000
Tract No. 4	Tundra	100.000000
Tract No. 5	Tundra	100.000000
Tract No. 6	Tundra	100.000000
Tract No. 7	A. D. Cohen	2.083334
	H. B. Cohen	2.083333
	J. C. Cohen	2.083333
	J. H. Cohen	2.083333
	M. M. Cohen	2.083333
	Leasam	2.083334
	MacDonald	4.166667
	Talbot	4.166667
	Tolaini	4.166666
	Tundra	75.000000
NE¼ 13	Tundra	25.000000
	Open	75.000000
SE¼ 13	Open	100.000000
SW¼ 13	Tundra	100.000000
NW¼ 13 - LSD's 11 & 14	Tundra	100.000000
NE¼ 14 - LSD 10	Tundra	100.000000
SE¼ 14	Tundra	100.000000
SW¼ 14	Tundra	75.000000
	Open	25.000000
NW¼ 14	Tundra	100.000000
NE¼ 23	Open	100.000000
SE¼ 23 - LSD's 7 & 8	Tundra	100.000000
SW¼ 23	Tundra	25.000000
	Open	75.000000
NW¼ 23	Open	100.000000
NE¼ 24	Tundra	100.000000
SE¼ 24	Tundra	100.000000
SW¼ 24	Open	100.000000
NW¼ 24	Open	100.000000



Twp. 10, Rge. 29

WORKING INTEREST OWNERS

Albert D. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Harry B. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
John C. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Joseph H. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Morley M. Cohen	1370 Sony Place Winnipeg, Manitoba R3C 3C3
Leasam Holdings Limited	1370 Sony Place Winnipeg, Manitoba R3C 3C3
James D. MacDonald	C/O P.O. Box 278 Winnipeg, Manitoba R3C 2G9
R. Barry Talbot	98 Shier Drive Winnipeg, Manitoba R3R 2H8
Louie Tolaini	486 Henderson Hwy. Winnipeg, Manitoba R2K 2H8

ROYALTY OWNERS

Rose Minnie Muir
273 Church Street
Comox, B.C.
V6G 2R8

Rosella Mary Shepherd
P.O. Box 411
Virden, Manitoba
R0M 2C0

Erna Klassen
14728 Deer Ridge Drive S.E.
Calgary, Alberta
T2J 6B5

Ogilvie Enterprises Ltd.
P.O. Box 66
Elkhorn, Manitoba
R0M 0N0

Lloyd Alexander Duncan
P.O. Box 1502
Taber, Alberta
T0K 2G0

Canada Trust
C/O Montreal Trust
411 - 8th Avenue S.W.
Calgary, Alberta
T2P 1E7
Attention: Oil Royalties

MINERAL OWNERS OUTSIDE UNIT

Edith Hannah Bolam
C/O P.O. Box 754
Virden, Manitoba
R0M 2C0

Laura May Day
C/O P.O. Box 754
Virden, Manitoba
R0M 2C0

Doreen Perron
C/O P.O. Box 754
Virden, Manitoba
R0M 2C0

Mervin Roach
P.O. Box 754
Virden, Manitoba
R0M 2C0

K8 Resources Ltd.
P.O. Box 101
Kola, Manitoba
R0M 1B0

Wasyl Investments Ltd.
C/O 1598 Sixth Avenue
Prince George, B.C.
V2L 5G7

Canadian Northwest
Energy Limited
2700 - 300 - 5 Avenue S.W.
Calgary, Alberta
T2P 3C4

Wilma Diane Leslie
C/O William Ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

Joseph Huculak
C/O William Ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

Ella Huculak
C/O William Ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

John Douglas Walker
C/O William ogilvie
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

Ruth Marie Jacobson
226 - 11810 Macleod Trail
Calgary, Alberta
T2J 2V8

Estate of Blanche Russell
P.O. Box 667
Hudson Bay, Saskatchewan
S0E 0Y0

Eileen Sarah Scott
Lot 6, Pleasant Road
Box 5, Group 2, R.R. 1
Anola, Manitoba
R0E 0A0

Estate of J. B. O'Connor
C/O Mrs. Thelma Roy
229 - 10th Avenue N.E.
Calgary, Alberta
T2E 0X1

Estate of Harold Good
205 - 1400 East 11th Avenue
Vancouver, B.C.
V5N 1Y5

Lyle Muir
Executor of the Estate
of J. A. D. Muir
21976 Lougheed Highway
Maple Ridge, B.C.
V2X 2S5

Phyllis Madeline Dalby
2100 Randless Lane
R. R. 3
Sidney B. C.
V8L 3X9

Estate of Edith Swann
431 Main Street
Penticton, B.C.
V2A 5C4
Attention: Bill Swann

William John Russell
address unkown

James Douglas Reddekop & Doreen Dueck Reddekop
P.O. Box 3123
Steinbach, Manitoba
R0A 2A0

March 28, 1990

Dear :

RE: Notice of Application for Salt Water Disposal
NE 1/4 of Section 10-10-18 (WPM)

Attached please find a copy of the notice advertising an application filed with The Oil and Natural Gas Conservation Board by Canadian Occidental Petroleum Ltd. for approval of underground salt water disposal using a well to be located in Legal Subdivision 16, Section 10, Township 10, Range 18 WPM.

This application is part of the company's proposal for expansion of its existing sodium chlorate manufacturing plant. The proposed plant expansion and application for underground salt water disposal are being reviewed jointly by the Manitoba Energy and Mines and Manitoba Environment.

As a registered mineral owner within one-half kilometre of the proposed disposal well, this letter is to notify you of the subject application. If you have any questions in respect of the application, the attached notice indicates whom you can contact for further information.

Yours truly,

Wm. McDonald
Member

JNF/ibj
Att'd.

Tundra oil and gas ltd.

March 15, 1990

Chairman,
The Oil and Natural Gas Conservation Board
309 Legislative Building
Winnipeg, Manitoba
R3C 0H8

Attention: Dr. Ian Haugh

Dear Sir:

RE: N. EBOR PILOT WATERFLOOD PROJECT

Pursuant to Section 64 of the Manitoba Oil and Gas Regulations, Tundra Oil and Gas Ltd., as Operator, hereby makes application for approval of a scheme to enhance oil recovery from the Daly Bakken D Pool by water injection. We are proposing to conduct a pilot project by converting one current producer to injection and monitoring the response in the offsetting producers. If the response is favourable, our intention is to expand the project to include offsetting production.

In support of this application, we submit the following:

1. The N. Ebor Pilot Waterflood scheme area is shown in Figure 1 and includes the following tracts:

   12-13-10-29 WPM
   13-13-10-29 WPM
   9-14-10-29 WPM
   15-14-10-29 WPM
   16-14-10-29 WPM
   1-23-10-29 WPM
   2-23-10-29 WPM

2. The mineral rights owners, lessees and surface owners within and adjoining the waterflood scheme are shown on Figure 2.

3. The status and completion zone of each well within and adjoining the scheme area is shown in Figure 3.

. . . /2

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

4. Pore volume and permeability capacity maps for the Bakken D Pool showing the Pool boundaries are attached as Figures 4 and 5.

5. The well at 16-14 will be converted to injection. A schematic wellbore cross-section showing the proposed recompletion is shown in Figure 6.

6. A diagram of the configuration of surface facilities are shown in Figure 7.

7. Details of the source and treatment of injection water and corrosion control are described in Appendix A.

8. Copies of letters to the surface owners notifying them of our intentions are included in Appendix B.

9. A tabulation of original oil in place, primary recovery predictions and recovery predictions under waterflood are included in Appendix C.

10. A reservoir fluid study was not conducted. We feel that the fluid is identical to that of the Daly Bakken A Pool and the results of the fluid study conducted for that pool by Newscope Resources Limited are applicable to this pool.

11. A tabulation of reservoir pressure data is presented in Appendix D.

12. A tabulation of the results of an injectivity test conducted at 15-11-10-29 are presented in Appendix E, along with a copy of a Waterflood Sensitivity Study undertaken by Geotech on core from the 9-14 well and reservoir waters from the Jurassic, Lodgepole and Bakken Formations.

In summary, we feel that due to the fluid properties and the low reservior energy conditions seen in the Daly Bakken D Pool, it would make an excellent candidate for significant incremental oil recovery through waterflooding. We feel that the proposed pilot project is the best way to assess the applicability of waterflooding of this pool. We hope to be able to commence injection by May 1, 1990. Our intention is to

. . . /3

inject at an approximate rate of 20 m^3/D for a period of approximately 6 months. This represents a 1:1 voidage replacement ratio. At that time, we will review the production response and assess questions relating to the flood efficiency, voidage replacement rates and possible expansion of the unit.

If you have any questions or require any further information pending approval of this application, please contact the undersigned.

Sincerely,

Dan Barchyn

Dan Barchyn, P. Eng.
Exploration Manager

DB/ck

Enclosures

Figure 2:

NORTH EBOR UNIT NO. 1

LESSEES

LANDS	LESSEES	
Tract No. 1	Tundra	100.000000
Tract No. 2	A. D. Cohen	2.083334
	H. B. Cohen	2.083333
	J. C. Cohen	2.083333
	J. H. Cohen	2.083333
	M. M. Cohen	2.083333
	Leasam	2.083334
	MacDonald	4.166667
	Talbot	4.166667
	Tolaini	4.166666
	Tundra	75.000000
Tract No. 3	Tundra	100.000000
Tract No. 4	Tundra	100.000000
Tract No. 5	Tundra	100.000000
Tract No. 6	Tundra	100.000000
Tract No. 7	A. D. Cohen	2.083334
	H. B. Cohen	2.083333
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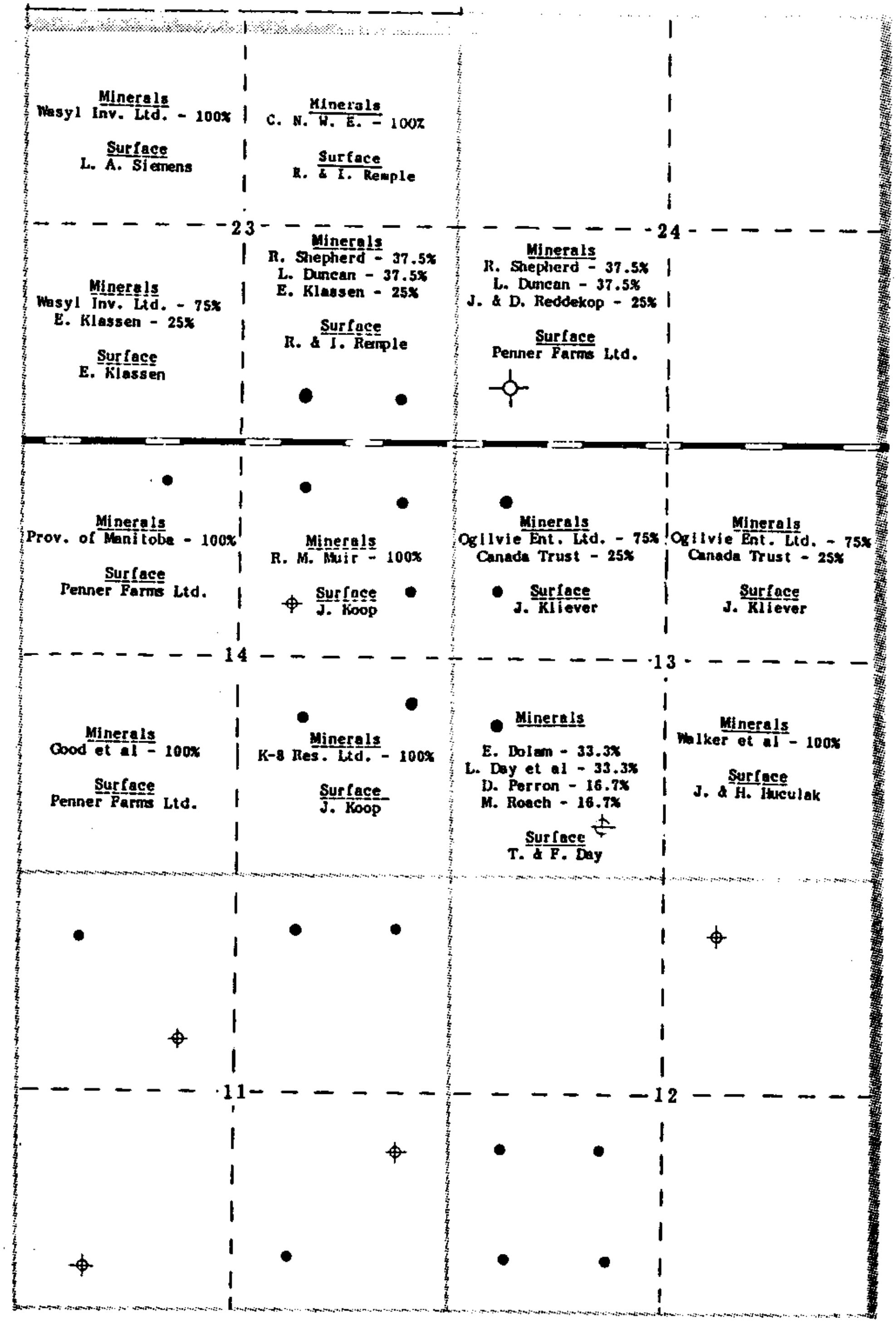
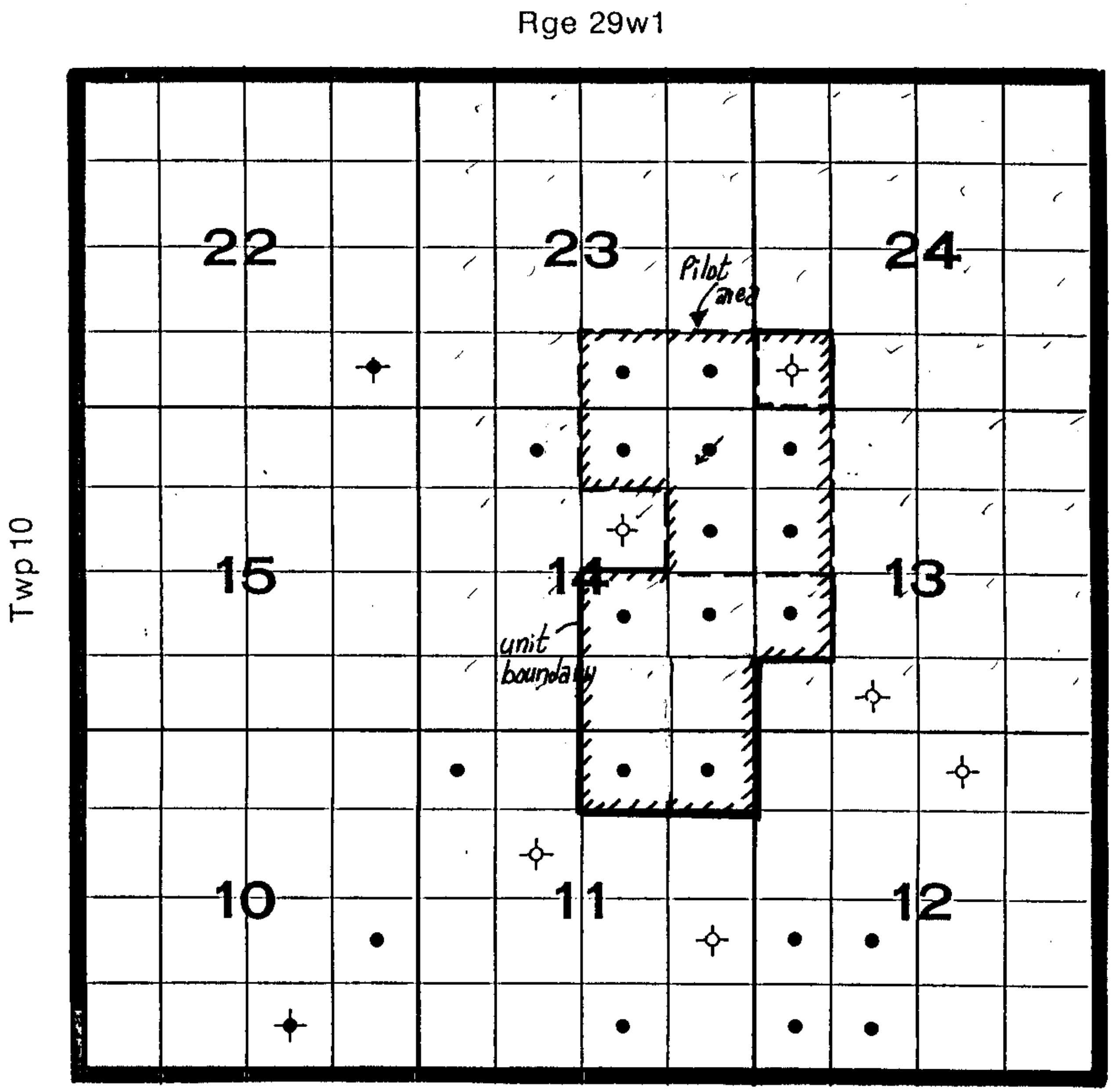
	J. H. Cohen	2.083333
	M. M. Cohen	2.083333
	Leasam	2.083334
	MacDonald	4.166667
	Talbot	4.166667
	Tolaini	4.166666
	Tundra	75.000000
NE¼ 13	Tundra	25.000000
	Open	75.000000
SE¼ 13	Open	100.000000
SW¼ 13	Tundra	100.000000
NW¼ 13 - LSD's 11 & 14	Tundra	100.000000
NE¼ 14 - LSD 10	Tundra	100.000000
SE¼ 14	Tundra	100.000000
SW¼ 14	Tundra	75.000000
	Open	25.000000
NW¼ 14	Tundra	100.000000
NE¼ 23	Open	100.000000
SE¼ 23 - LSD's 7 & 8	Tundra	100.000000
SW¼ 23	Tundra	25.000000
	Open	75.000000
(23	Open	100.000000
NE¼ 24	Tundra	100.000000
SE¼ 24	Tundra	100.000000
SW¼ 24	Open	100.000000
NW¼ 24	Open	100.000000



Twp. 10, Rge. 29

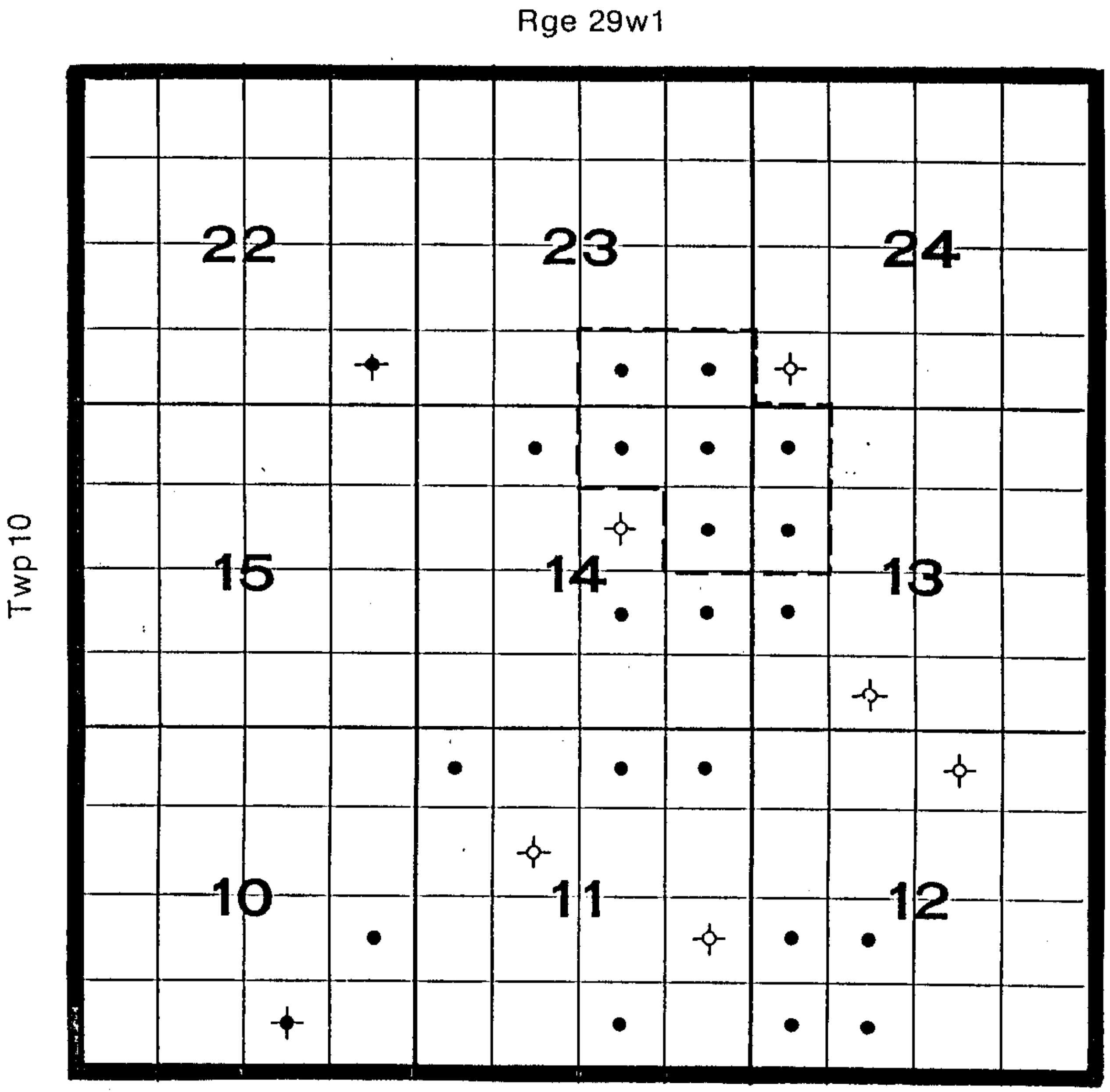
TUNDRA OIL AND GAS



N. EBOR PILOT WATERFLOOD

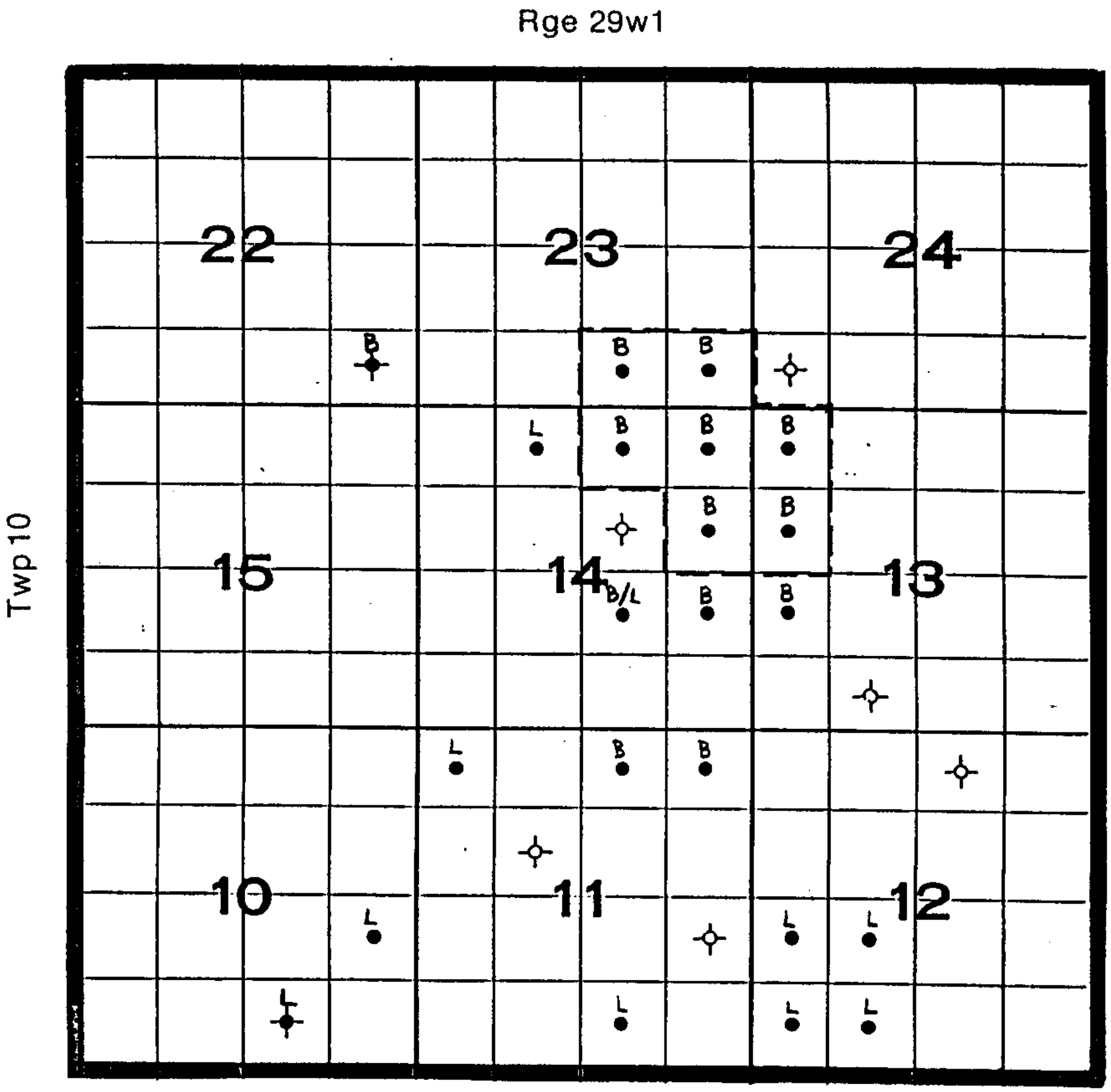
Figure 1

TUNDRA OIL AND GAS



N. EBOR PILOT WATERFLOOD

TUNDRA OIL AND GAS

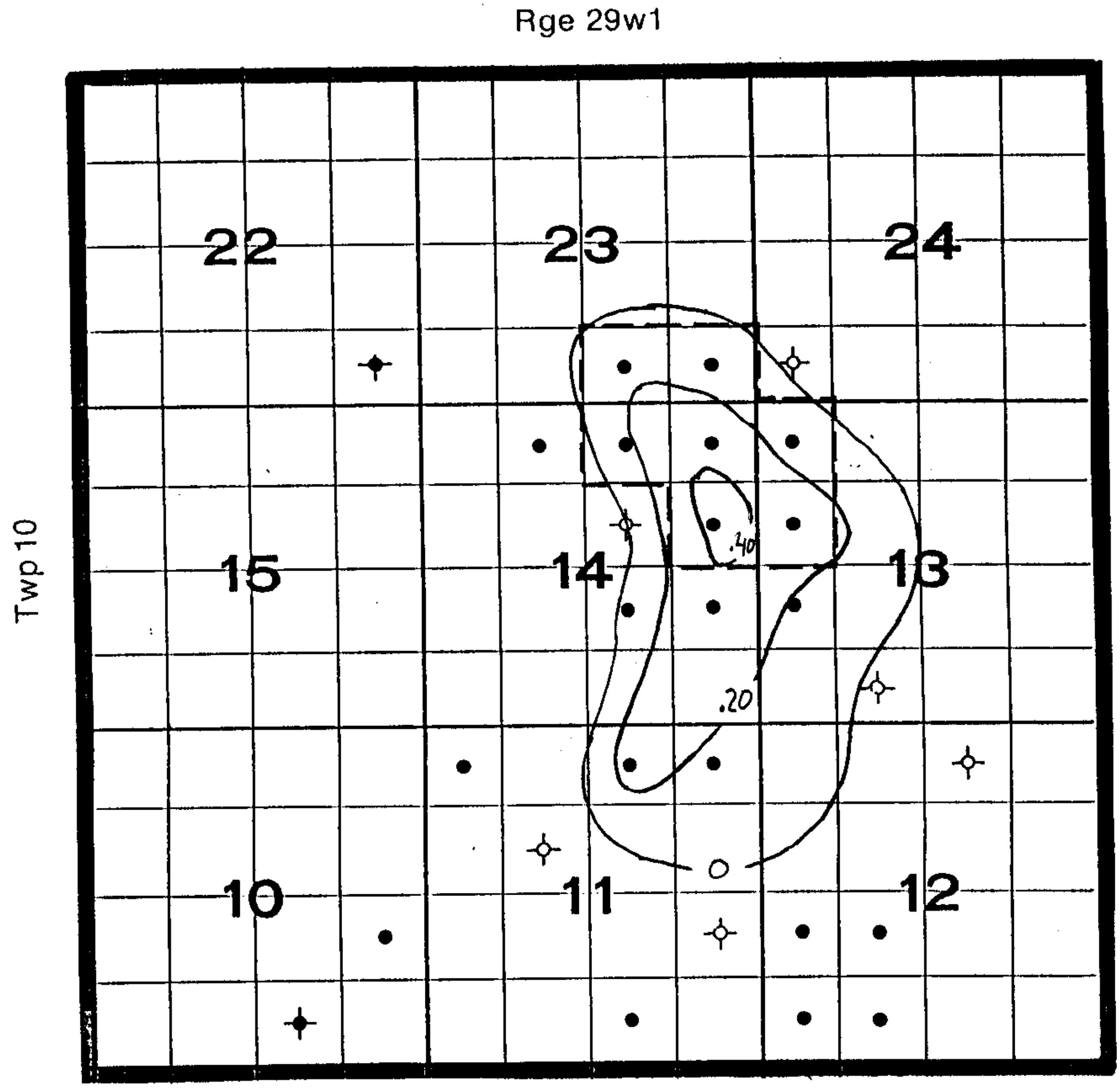


N. EBOR PILOT WATERFLOOD

Completion: B = Bakken
L = Lodgepole

Figure 3

TUNDRA OIL AND GAS

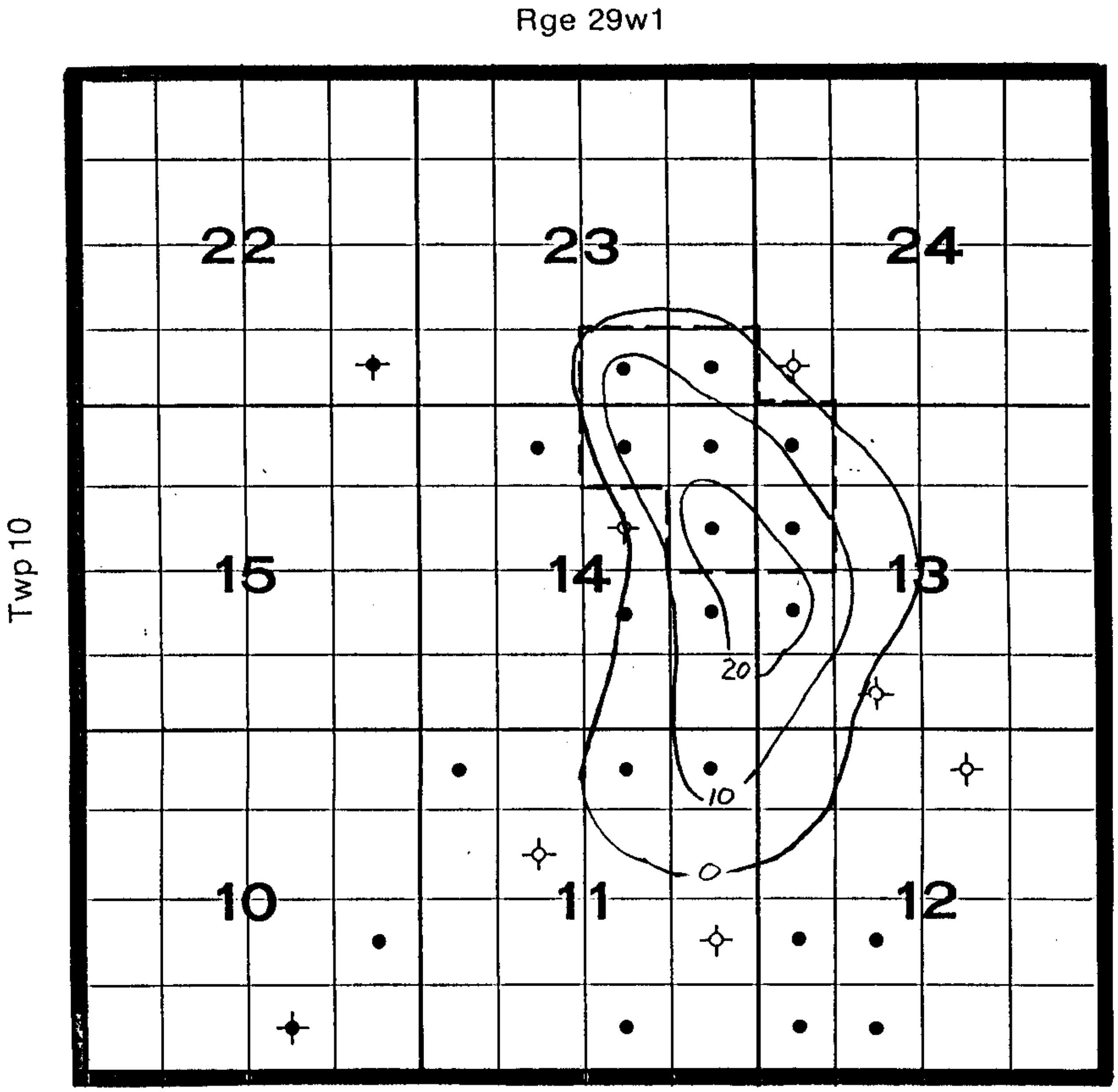


N. EBOR PILOT WATERFLOOD

Pore Volume ϕh

Figure 4

TUNDRA OIL AND GAS



N. EBOR PILOT WATERFLOOD

Permeability Capacity kh (md-m)

Figure 5

TUNDRA 16-14-10-29 INJECTION WELL COMPLETION

NOTE: Annulus circulated to fresh inhibited water.

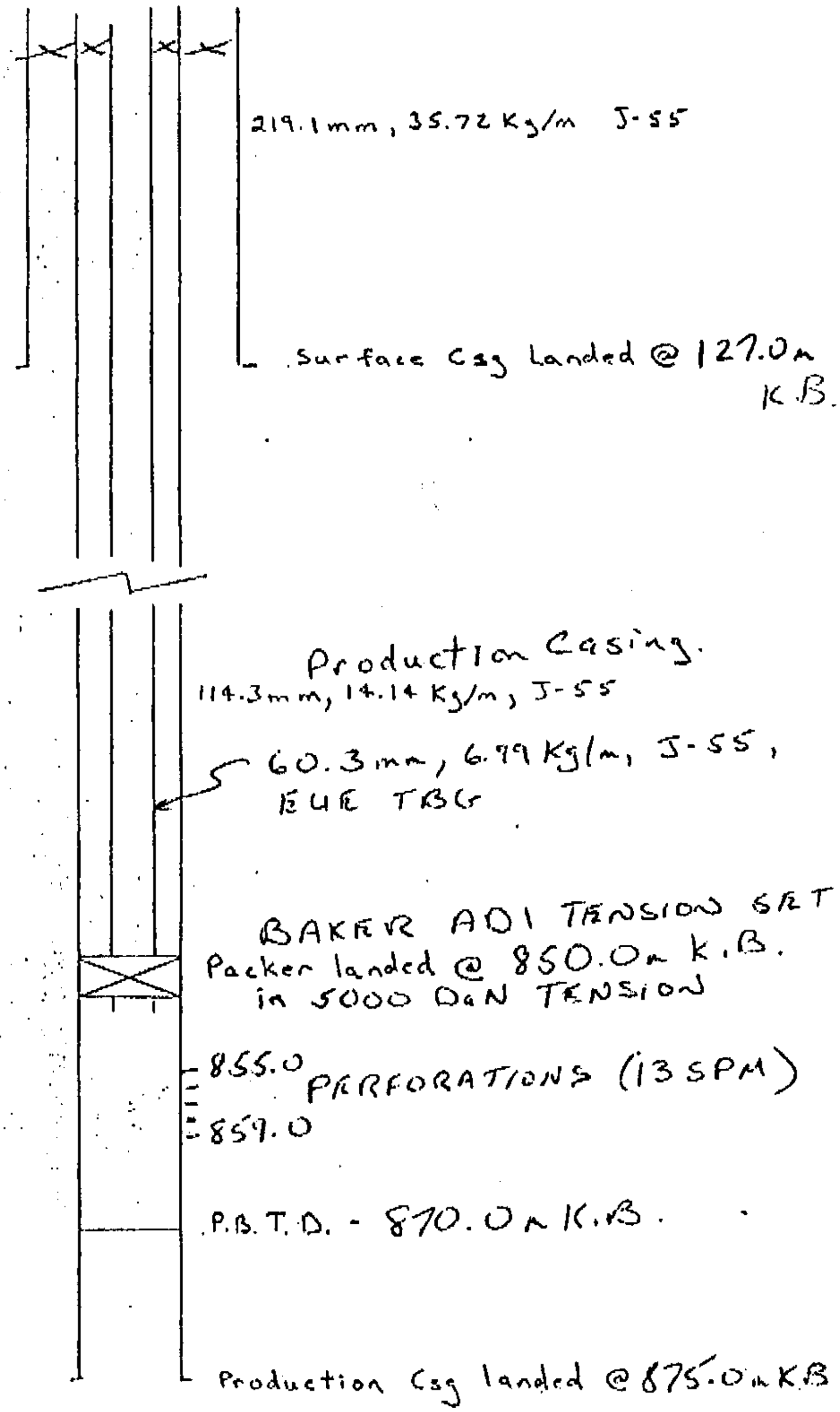
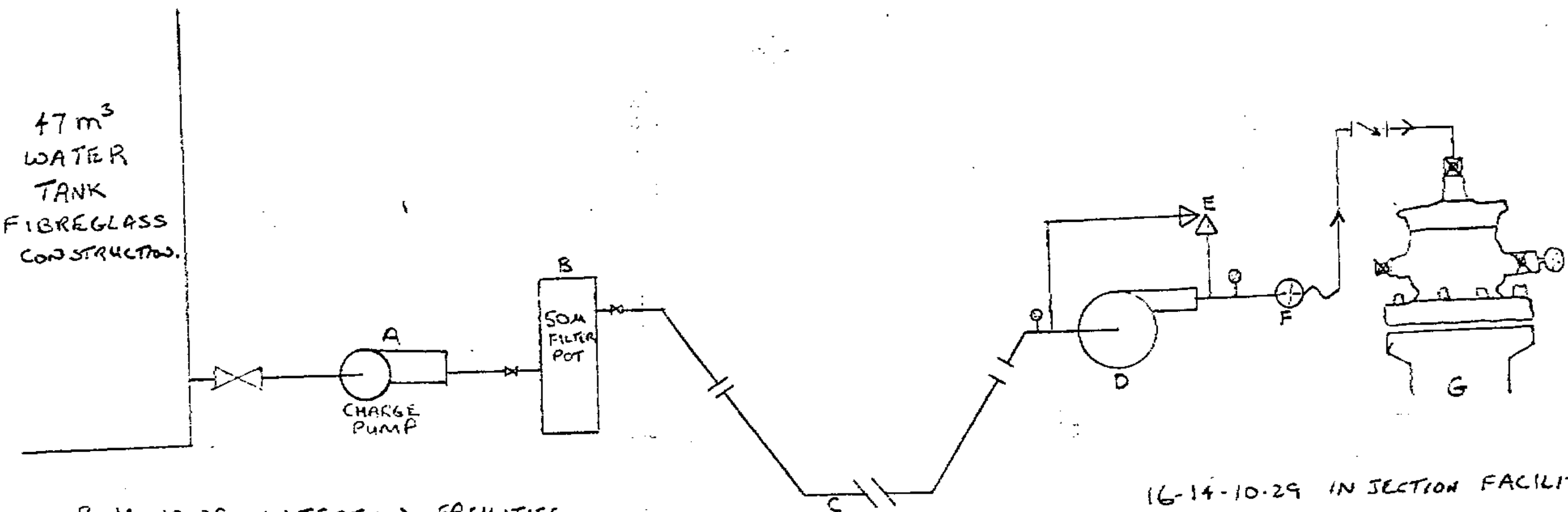


Figure 6

Figure 7:

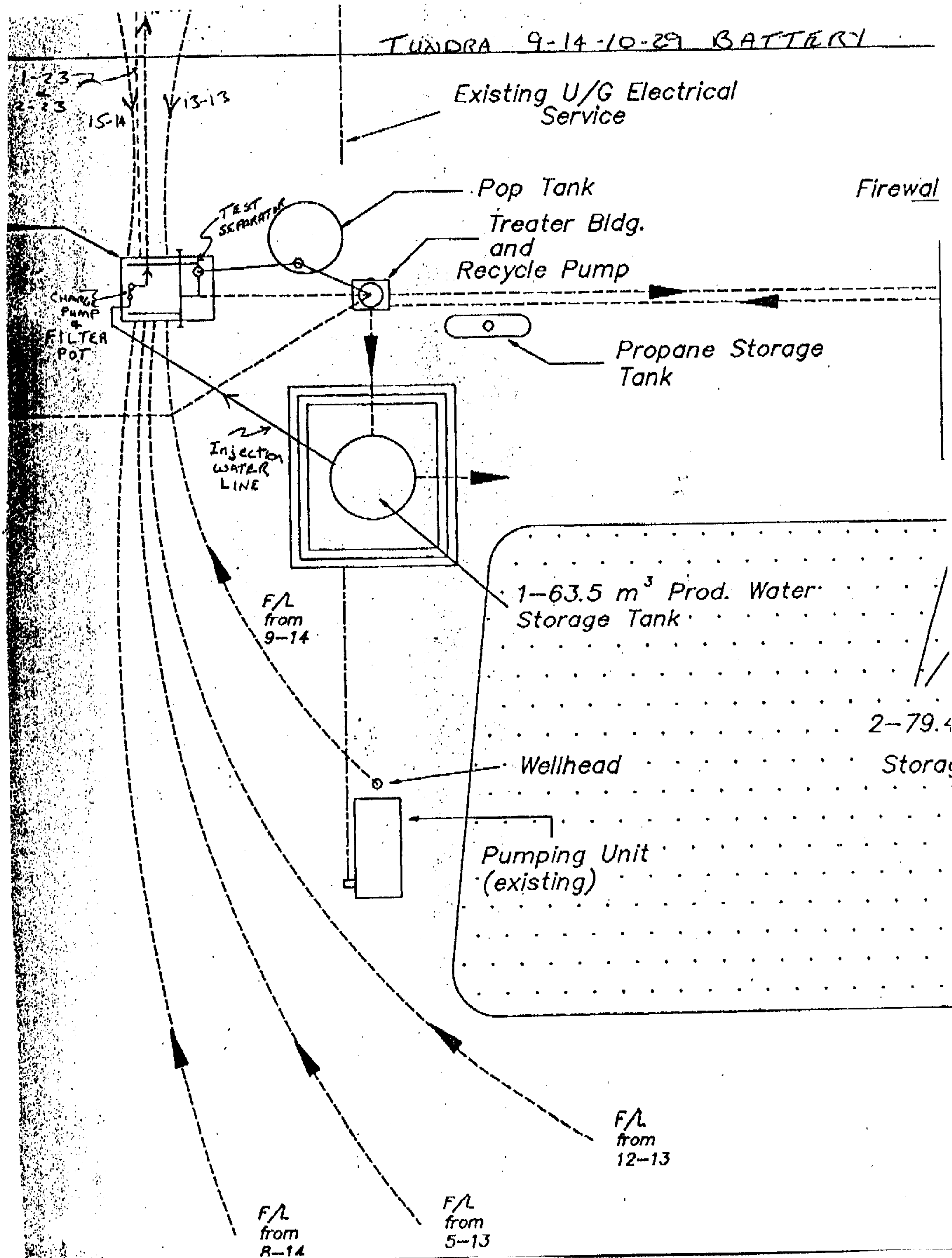
TUNDRA NORTH EBOR PILOT WATERFLOOD INJECTION FACILITIES



9-14-10-29 INJECTION FACILITIES

16-14-10-29 INJECTION FACILITIES

(SEE ATTACHED EQUIPMENT DETAIL)


TUNDRA 9-14-10-29 BATTERY
1-23 & 2-23
15-14
13-13
Existing U/G Electrical Service
Pop Tank
TEST SEPARATOR
Treater Bldg. and Recycle Pump
Firewal
CHARGE PUMP & FILTER POT
Propane Storage Tank
Injection WATER LINE
1–63.5 m³ Prod. Water Storage Tank
F/L from 9–14
2–79.
Wellhead
Storag
Pumping Unit (existing)
F/L from 12–13
F/L from 8–14
F/L from 5–13

Appendix A: **TUNDRA NORTH EBOR PILOT WATERFLOOD INJECTION FACILITIES**

EQUIPMENT DETAILS:

A. - Viking 1-1A540 Centrifugal Pump complete with 1.5 HP X-Proof Motor.
- S.S. Trim with Bronze Impeller.
- Maximum Discharge Pressure - 275 kPa.

B. - Peco Model 55-5-336 Filter Pot;
- Complete with 50 Micron "Filter-Tex" Sock-Type Elements;
- Maximum Working Pressure: 1900 kPa.
- Internally Epoxy Coated.

C. - A.O. Smith Red Thread II Fiberglass Flowline;
- O.D. - 60.3 mm;
- W.T. - 1.78 mm;
- Bell & Spigot Couplings - Adhesive Bonded ("Tab Jt").
- R.W.P. - Static - 3100 kPa
  - Cyclic - 2070 kPa

D. - Wheatley Model P-50A Simplex Pump;
- Complete with 31.75 mm Ceramic Plunger - 55.5 mm S.L.;
- S.S. Trim;
- 10 H.P. TEFC Motor;
- Maximum Working Pressure - 11,400 kPa.

E. - Baird Model 7601-1-TB - 25.4 mm Pressure Relief Valve;
- Set at 5170 kPa;
- AL-BRZ complete with S.S. Ball & Seat.

F. - Barton "Flow-Trac" 25.4 mm Water Meter;
- M.W.P. - 34.4 MPa.

G. - Crown Streamflo H Series S.O. Casing Bowl;
- Complete with FCR Tubing Head Complete with 2 - 2" LPSO;
- M.W.P. - 14.0 MPa.

NOTES: 1) All Steel Fittings - Forged Steel, Threaded;
14.0 MPa Working Pressure.

2) All Valves Upstream of Injection Pump
W.P. - 4100 kPa
S.S. Trim

3) All Valves Down Stream of Injection Pump
W.P. - 14,000 kPa (or greater)
S.S. Trim

4) All Piping - Schedule 40 Steel

5) Fiberglass - Steel x-over Accomplished with steel ANSI 150 R.F.
Threaded Flange to 150 Series Fiberglass Flange.
M.W.P. = 1965 kPa.

Page 2...

CORROSION CONTROL:

Wellbore: As shown on the well completion diagram the annulus shall be isolated by means of 114.3 mm epoxy coated tension packer. Prior to setting packer the annulus shall be circulated to fresh inhibited water. Internal tubing corrosion shall be controlled by chemical corrosion inhibitor. If positive results are obtained the existing tubing shall be replaced with either fiberglass or internally epoxy coated tubing.

Flowlines: All flowlines are fiberglass construction.

Surface Facilities: As shown on the equipment detail, all major components shall be designed for a salt water corrosive application. All minor components and piping shall be epoxy coated wherever possible.

SOURCE WATER TREATMENT, CONDITIONING & MEASUREMENT:

Make-up water for injection shall be supplied from existing area production test tanks and batteries. Water shall be either Bakken or Lodgepole in composition. Compatibility tests have been performed and are available upon request.

The water shall be filtered by 50 micron cartidge type filters. Biocide and oxygen scavenging treatment is not planned at present due to the very low quantities of Hydrogen Sulphide gas present and relatively small volume of water injected.

The water volume shall be metered on the discharge of the pump located at 16-14-10-29.

APPENDIX B: LETTERS TO SURFACE OWNERS

Tundra
oil and gas ltd.

March 5, 1990

T. & F. Day
P.O. Box 1683
Virden, Manitoba
R0M 2C0

Dear Mr. & Mrs. Day:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

Tract No.	Well Name	Location
1	Tundra Daly	12-13-10-29 WPM
2	Tundra Daly	13-13-10-29 WPM
3	Tundra Daly	9-14-10-29 WPM
4	Tundra Daly	15-14-10-29 WPM
5	Tundra Daly	16-14-10-29 WPM
6	Tundra Daly	1-23-10-29 WPM
7	Tundra Daly	2-23-10-29 WPM

I've enclosed a map outlining the boundary of the proposed unit for your perusal. You will note the well located in LSD 16 of Section 14, Township 10, Range 29 WPM will be converted to an Injection well under the plan.

Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

Tundra oil and gas ltd.

March 5, 1990

R. & I. Remple
P.O. Box 10
Kola, Manitoba
R0M 1B0

Dear Mr. & Mrs. Remple:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

Tract No.	Well Name	Location
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4	Tundra Daly	15-14-10-29 WPM
5	Tundra Daly	16-14-10-29 WPM
6	Tundra Daly	1-23-10-29 WPM
7	Tundra Daly	2-23-10-29 WPM

I've enclosed a map outlining the boundary of the proposed unit for your perusal. You will note the well located in LSD 16 of Section 14, Township 10, Range 29 WPM will be converted to an Injection well under the plan.

Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

Tundra oil and gas ltd.

March 5, 1990

L. A. Siemens
1513 - 10th Street
Brandon, Manitoba
R7A 4H8

Dear Sir:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

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4	Tundra Daly	15-14-10-29 WPM
5	Tundra Daly	16-14-10-29 WPM
6	Tundra Daly	1-23-10-29 WPM
7	Tundra Daly	2-23-10-29 WPM

I've enclosed a map outlining the boundary of the proposed unit for your perusal. You will note the well located in LSD 16 of Section 14, Township 10, Range 29 WPM will be converted to an Injection well under the plan.

Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

Tundra oil and gas ltd.

March 5, 1990

Mrs. E. Klassen
14728 Deer Ridge Drive S.E.
Calgary, Alberta
T2J 6B5

Dear Mrs. Klassen:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

Tract No.	Well Name	Location
1	Tundra Daly	12-13-10-29 WPM
2	Tundra Daly	13-13-10-29 WPM
3	Tundra Daly	9-14-10-29 WPM
4	Tundra Daly	15-14-10-29 WPM
5	Tundra Daly	16-14-10-29 WPM
6	Tundra Daly	1-23-10-29 WPM
7	Tundra Daly	2-23-10-29 WPM

I've enclosed a map outlining the boundary of the proposed unit for your perusal. You will note the well located in LSD 16 of Section 14, Township 10, Range 29 WPM will be converted to an Injection well under the plan.

Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

Tundra oil and gas ltd.

March 5, 1990

Mr. J. D. Koop
Box 101
Kola, Manitoba
R0M 1B0

Dear Sir:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

Tract No.	Well Name	Location
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6	Tundra Daly	1-23-10-29 WPM
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Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

Tundra oil and gas ltd.

March 5, 1990

Mr. J. Kliever
P.O. Box 374
Elkhorn, Manitoba
R0M 0N0

Dear Mr. Kliever:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

Tract No.	Well Name	Location
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2	Tundra Daly	13-13-10-29 WPM
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4	Tundra Daly	15-14-10-29 WPM
5	Tundra Daly	16-14-10-29 WPM
6	Tundra Daly	1-23-10-29 WPM
7	Tundra Daly	2-23-10-29 WPM

I've enclosed a map outlining the boundary of the proposed unit for your perusal. You will note the well located in LSD 16 of Section 14, Township 10, Range 29 WPM will be converted to an Injection well under the plan.

Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

Tundra
oil and gas ltd.

March 5, 1990

Penner Farms Ltd.
Attn: Les Penner
P.O. Box 82
Kola, Manitoba
R0M 1B0

Dear Sirs:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

Tract No.	Well Name	Location
1	Tundra Daly	12-13-10-29 WPM
2	Tundra Daly	13-13-10-29 WPM
3	Tundra Daly	9-14-10-29 WPM
4	Tundra Daly	15-14-10-29 WPM
5	Tundra Daly	16-14-10-29 WPM
6	Tundra Daly	1-23-10-29 WPM
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Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

Tundra
oil and gas ltd.

March 5, 1990

Penner Farms Ltd.
Attn: Edgar Penner
P.O. Box 42
Kola, Manitoba
R0M 1B0

Dear Sirs:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

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Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

Tundra oil and gas ltd.

March 5, 1990

J. & H. Huculak
P.O. Box 147
Elkhorn, Manitoba
R0M 0N0

Dear Mr. & Mrs. Huculak:

Tundra Oil and Gas Ltd. intends to implement a waterflood and unitization scheme in the North Ebor area of Manitoba during the second quarter of 1990.

Pursuant to 126(d) of the Petroleum Regulations of the Province of Manitoba, as a Surface owner in the vicinity of the wells involved, you are hereby notified of the proposed unit. The wells included in the plan are as follows:

Tract No.	Well Name	Location
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I've enclosed a map outlining the boundary of the proposed unit for your perusal. You will note the well located in LSD 16 of Section 14, Township 10, Range 29 WPM will be converted to an Injection well under the plan.

Should you have any questions, please do not hesitate to contact me at 949-1195.

Yours truly,

Cindy V. Marchant

Cindy V. Marchant
Landman

CVM/ck

Enclosure

1313-One Lombard Place, Winnipeg, Manitoba, Canada R3B 0X3 Telephone: (204) 949-1195 Fax: (204) 956-1282

APPENDIX C: DALY BAKKEN D POOL - RESERVE ESTIMATES

Tract	Oil in Place M3	Primary Recovery (M3)1	%	Recovery Under Waterflood (M3) 2	%
12-13	29,643	5,787	19.5		
13-13	16,447	6,010	36.5		
9-14	39,110	7,697	19.7		
15-14	18,551	5,782	31.1		
16-14	27,061	7,343	27.1		
1-23	8,032	4,290	53.4		
2-23	12,240	4,655	38.0		
	151 084	41,564	27.5	73,304	48.5

1) Reserves estimated by extrapolating the current production decline to the economic limit.

2) Reserves estimated by assuming that the 1991 rate under waterflood would be 30% higher than the projected 1991 oil rate under primary and then decline at the lowest rate used in the primary forecast.

APPENDIX D: DALY BAKKEN D POOL - RESERVOIR PRESSURES

Well	Date	Type of Test	Prime (Kpa)
7-14-10-29	Feb./87	DST	8,591
9-14-10-29	Jan./88	DST	7,763
15-14-10-29	Feb./88	DST	7,537
12-13-10-29	Mar./88	DST	7,914
13-13-10-29	Feb./89	DST	6,719
5-13-10-29	Feb./89	DST	7,426
9-14-10-29	May/89	Fluid Level	5,392
2-23-10-29	June/89	DST	5,353

APPENDIX E: 15-11-10-29 WATER INJECTION DETAILS

DATE	VOLUME INJECTED (m^3)	PRESSURE (kPa)	CUMULATIVE VOLUME	COMMENTS
Dec 05	1.9	1100	3.0	
06	1.0	1100	4.1	Elec. Problems
07	5.0	1380	9.1	
08	1.5	1380	10.6	
09	6.1	1380	16.7	
10	1.9	1380	18.6	
11	0.0	--	18.6	System Froze
12	10.75	2760	28.9	(Increased Rate
13	11.38	3100	40.2	To avoid Freeze-up
14	10.50	3100	50.7	
15	11.83	4000	62.6	
16	10.12	3450	72.7	
17	8.32	3860	81.0	
18	0.0	--	81.0	Frozen
19	10.99	3450	92.0	
20	0.0	--	92.0	Frozen
21	0.0	--	92.0	Frozen
22	0.0	--	92.0	Frozen
23	8.88	3500	100.9	
24	12.92	3600	113.79	
25	10.69	3620	124.5	
26	12.14	3620	136.6	
27	11.68	3720	148.3	
28	12.24	3790	160.5	
29	12.13	3790	172.7	
30	11.32	3860	183.9	
31	11.94	3930	195.9	
Jan 01	11.62	4068	207.6	
02	11.35	4068	218.9	
03	11.73	4137	230.6	
04	11.85	4137	242.5	
05	11.50	4068	254.0	
06	11.72	4068	265.7	
07	13.20	4068	278.9	

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..-11-10-29 Water Injection Details
Page 2

DATE	VOLUME INJECTED (m^3)	PRESSURE (kPa)	CUMULATIVE VOL.	COMMENTS
Jan 08	10.09	4137	289.0	
09	11.38	3861	300.4	
10	11.93	3930	312.3	
11	13.94	4137	326.2	
12	14.55	4137	340.8	
13	15.69	4309	356.5	
14	15.79	4413	372.3	
15	15.61	4482	387.9	
16	17.08	4482	405.0	
17	15.84	4482	420.8	
18	16.93	4482	437.7	
19	17.71	4482	455.4	
20	16.59	4482	472.0	
21	16.98	4482	489.0	