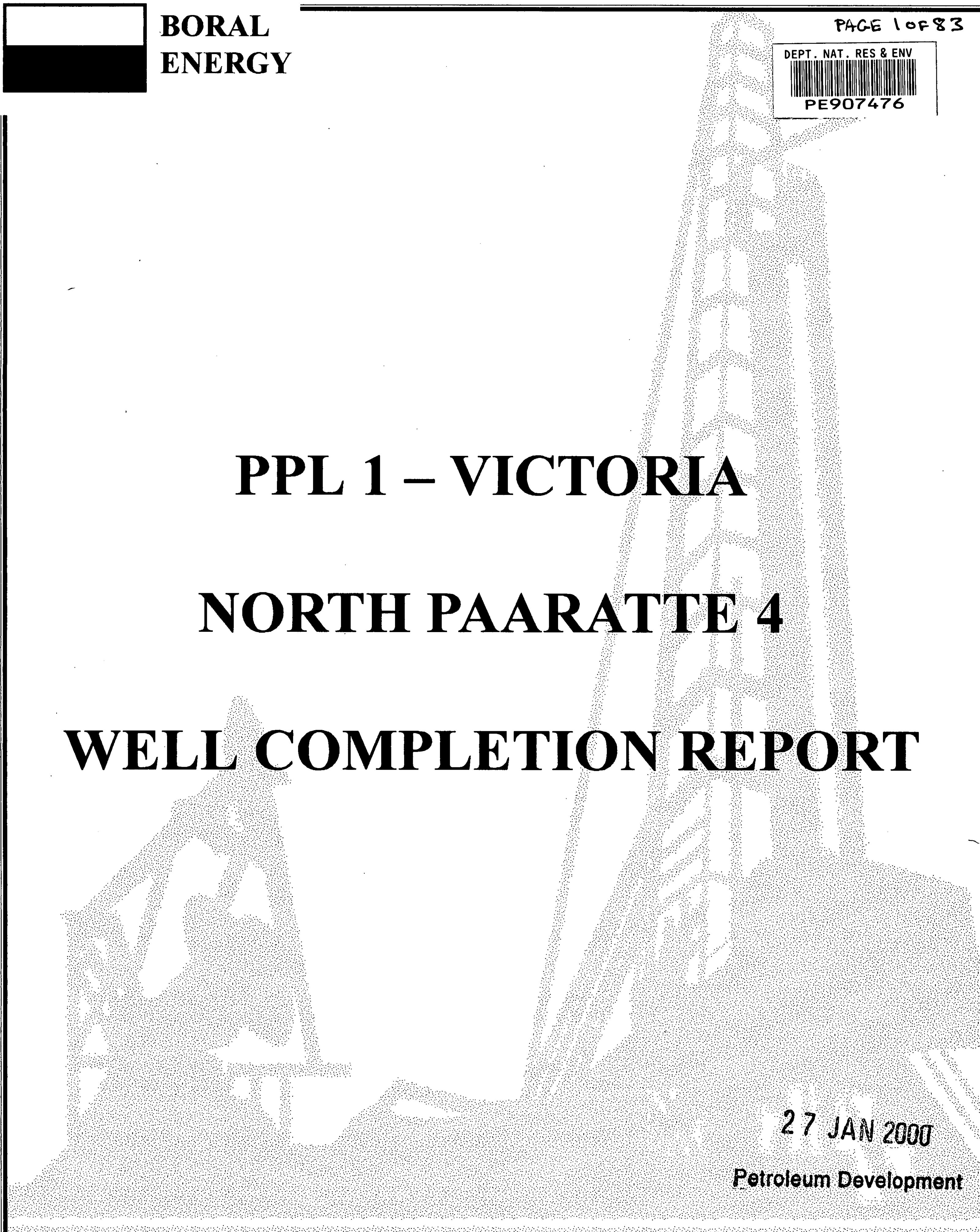
BOARAL
ENERGY







# PPL 1 – VICTORIA

# NORTH PAARATTE 4

# WELL COMPLETION REPORT

907476 002

# BORAL ENERGY PETROLEUM PTY. LTD.

# WELL COMPLETION REPORT

# NORTH PAARATTE 4

# PPL 1 - VICTORIA

# OTWAY BASIN


**Authors:**

**S F Simeone**

**D A Short**

Boral Energy Petroleum Pty. Ltd

1 King William Street

ADELAIDE SA 5000


*December 1999*

907476 003

# TABLE OF CONTENTS

TABLE OF CONTENTS Contd.

# TABLE OF ATTACHMENTS

## LIST OF FIGURES



## LIST OF TABLES



## LIST OF APPENDICES



## LIST OF ENCLOSURES (Pocket)

907476 006



| | | |
|---|---|---|
| Location: | Latitude: | 38°33'09.92"S |
| | Longitude: | 142°57'13.70"E |
| | Station: | CDP 2480 |
| | Line: | 8075 |
| Elevation: | GL: | 92.9 metres |
| | KB: | 98.4 metres |
| Map: | Colac | 1 : 250000 |
| Grid: | Easting: | 670 251.32 |
| | Northing: | 5 731 028.38 |
| Date Spudded: | 03/04/1999 | 2300 hours |
| Reached TD | 09/04/1999 | 0230 hours |
| Date rig release: | 11/04/1999 | 0930 hours |
| Type Structure: | Anticline | |

| | | |
|---|---|---|
| Status: | Gas Well | |
| Rig: | Century 2 | |
| Total Depth: | Driller: | 1651.0m. |
| | Logger: | 1651.0m. (Extrap) |
| Plugs: | | |
| Casing : | Size | Shoe |
| (a) Surface | 244mm | 401.1m |
| (b) Production | 178mm | 1606.5m |

## STRATIGRAPHIC UNITS PENETRATED

| AGE | FORMATION | K.B. Depths | TVD Depths | MSL Depths | Thickness |
|---|---|---|---|---|---|
| E-L. Miocene | Port Campbell Ls. | 5.5 | 5.5 | 92.9 | 75.5 |
| Oligocene | Gellibrand Marl | 81.0 | 81.0 | 17.4 | 247.0 |
| E. Oligocene | Clifton Fm. | 328.0 | 328.0 | -216.6 | 27.0 |
| L. Eocene | Narrawaturk Marl | 355.0 | 355.0 | -256.6 | 30.5 |
| L. Eocene | Mepunga Fm. | 385.5 | 385.5 | -287.1 | 40.5 |
| M. Eocene | Dilwyn Fm. | 426.0 | 426.0 | -327.6 | 247.6 |
| E. Eocene | Pember Mudstone | 680.0 | 673.6 | -575.2 | 58.8 |
| E–L. Palaeocene | Pebble Point Fm. | 745.0 | 732.4 | -634.0 | 72.1 |
| L. Cretaceous | Paaratte Fm. | 825.0 | 804.5 | -706.1 | 308.2 |
| L. Cretaceous | Skull Creek Mbr. | 1165.0 | 1112.7 | -1014.3 | 130.8 |
| L. Cretaceous | Nullawarre Greensand | 1307.5 | 1243.5 | -1145.1 | 77.4 |
| L. Cretaceous | Belfast Fm. | 1393.0 | 1320.9 | -1222.5 | 104.8 |
| L. Cretaceous | Waarre Fm. (Unit C) | 1509.0 | 1425.7 | -1327.3 | 65.5 |
| L. Cretaceous | Eumeralla Fm. | 1581.0 | 1491.2 | -1392.8 | 64.4 |
| | T.D. (Logs) | 1651.0 | 1555.6 | -1457.2 | |

## WIRELINE LOGS

| Type Log | Run | Interval | BHT / Time |
|---|---|---|---|
| HLLS/HLLD – GR - SP - CAL | 1 | 1648 - 401m | 57°C after 7.3 hours |
| RXOZ | 1 | 1645 - 401m | |
| BHCS - GR | 1 | 1634 - 401m | |
| RHOZ | 1 | 1645 - 401m | |
| TNPHI | 1 | 1641 – 401m | |
| | | | |
| (PEX – All logs recorded on 1 run) | | | |
| | | | |

## FORMATION TESTS

| No | Interval / Formation (metres) | Periods (mins) | EMP IP/FP (psi) | EMP FSIP (psi) | Fluid to surface (mins) | Surface Press. (max) (psi) | TC. mm. | BC. mm. | Rev. Out | Result. |
|---|---|---|---|---|---|---|---|---|---|---|
| | None | | | | | | | | | |
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## FULL HOLE CORES

| No. | Interval | Formation | Cut (m) | Rec.(m) |
|---|---|---|---|---|
| | None | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
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## PERFORATIONS

| Interval | Formation | Shots / ft. |
|---|---|---|
| 1509 – 1515m. | Waarre Fm. Unit "C" | 12 |
| | | |

| Interval | Formation | Shots / ft. |
|---|---|---|
| | | |
| | | |

## LOG INTERPRETATION

| Interval (MSL Depths) | Sand (m) | Net Pay (m) | Porosity (%) | Sw (%) |
|---|---|---|---|---|
| -1326.4 – -1344.6 | 18.2 | 18.1 | 0.223 | 0.453 |
| -1350.3 – -1351.9 | 1.6 | 1.5 | 0.145 | 0.932 |
| -1351.9 – -1354.8 | 2.9 | 1.7 | 0.170 | 0.995 |
| -1354.8 – -1359.7 | 4.9 | 4.3 | 0.159 | 1.038 |
| -1360.4 – -1362.4 | 2.0 | 1.9 | 0.160 | 1.091 |
| -1362.4 – -1363.7 | 1.3 | 0.8 | 0.172 | 0.976 |
| -1363.7 – -1365.2 | 1.5 | 1.4 | 0.236 | 0.887 |
| -1365.2 – -1369.7 | 4.4 | 3.9 | 0.245 | 0.974 |

## SIDEWALL CORES

| Depth (m) | Lithology |
|---|---|
| None | |
| | |
| | |
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| Depth (m) | Lithology |
|---|---|
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## SUMMARY

North Paaratte-4 was drilled as a development well in the North Paaratte Field, PPL-1, onshore Otway Basin. The primary objective for the well was the upper Cretaceous Waarre Formation of the Sherbrook Group where the reservoir, the Unit "C" sandstone, will be used as a swing producer to meet peak gas demand.

North Paaratte-4 was a deviated gas development well located approximately 8km north of the town of Port Campbell in PPL-1, Victoria, Relative to the closest well North Paaratte-1 (1979) the location was about 35 metres south at surface and about 430 metres north northwest at the top of the Waare Formation.

North Paaratte-2 (1981) is located approximately 1.6km to the east, in the same field / fault block and is also a gas producer. North Paaratte-3 is located further to the east in a separate fault block but the reservoir sands are water saturated.

The primary objective for the well was the upper Cretaceous Waarre Formation of the Sherbrook Group where the reservoir, the Unit "C" sandstone, will be used as a swing producer to meet peak gas demand. The North Paaratte Field is currently shut-in due to high water cut and two wells are required to restore gas production

North Paaratte-4 intersected a normal Otway Basin (Port Campbell embayment) sequence and stratigraphic control was generally good with the top of the primary objective, the Waarre Unit "C" sandstone being 14 metres low to prognosis.

North Paaratte-4 spudded on the 03rd of April, 1999 and the surface hole (311mm) was drilled to 406m. Surface casing (244mm) was set at 401.1m. A 216mm hole (deviated below 500m) was then drilled to a total depth of 1651.0m (driller & logger). Total depth was reached on 09th April 1999.

A strong gas show (200 units max.) was recorded in the Unit "C" sand of the Waarre Formatiion. No other significant gas shows or fluorescence were encountered while drilling.

After logging and evaluation the well was cased (178mm) to 1606.5m and the rig released to completion operations on the 11th of April 1999.

**Wellsite Geologist:** D.A. Short **Card Prepared by:** D.A. Short / S.F.Simeone **Date:** 12/99

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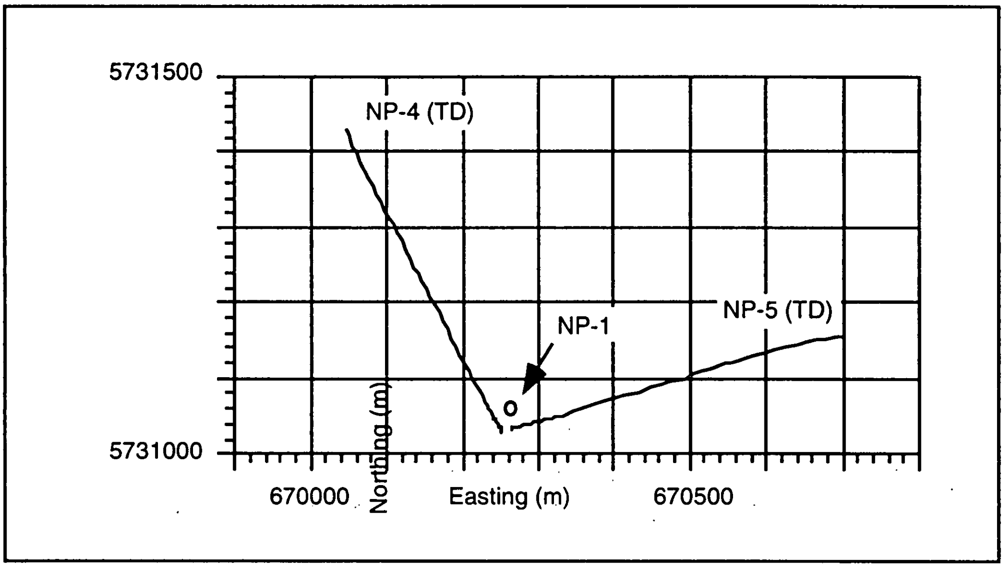


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# OTWAY BASIN - WELL LOCATIONS

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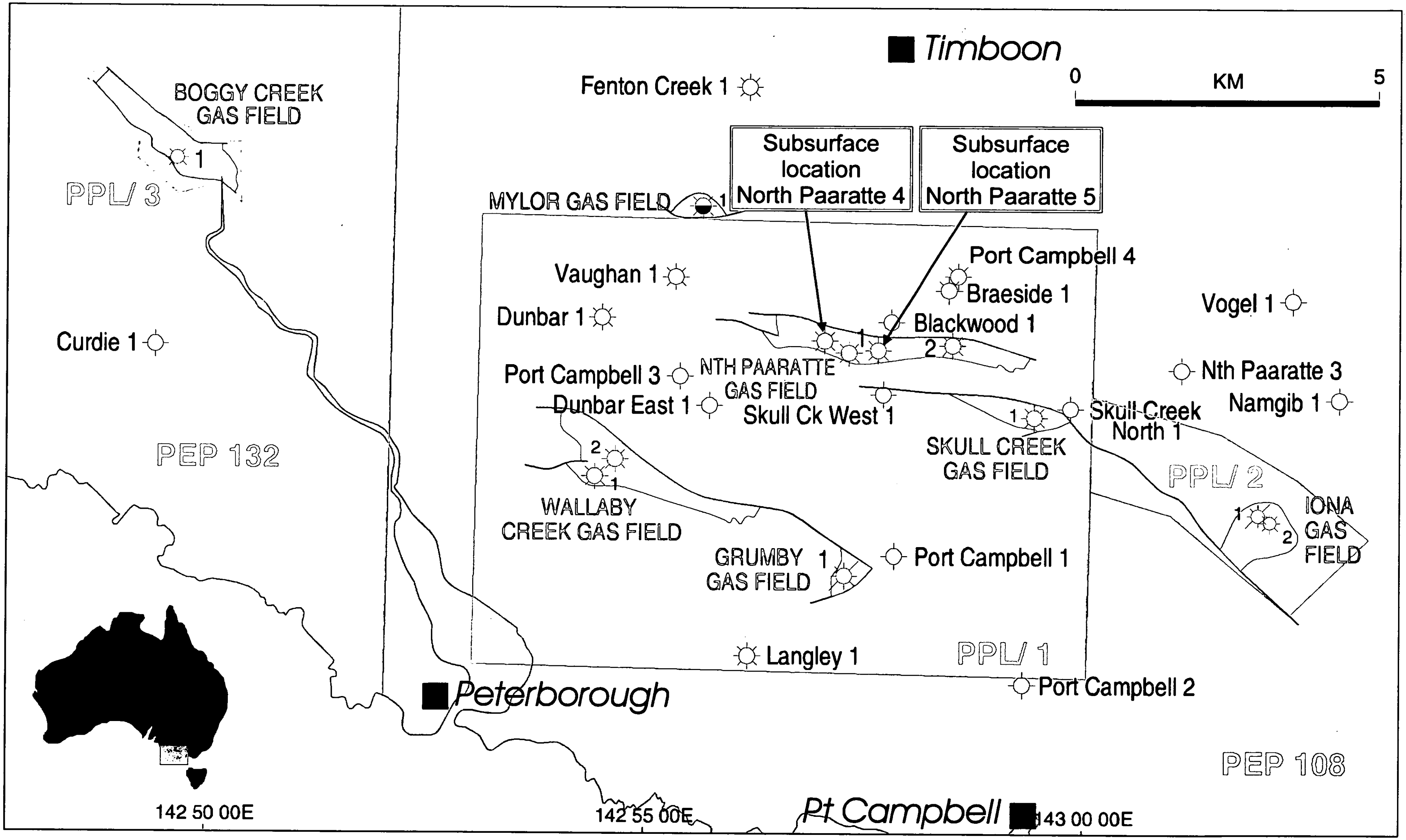


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Figure 1

# 2.0 WELL HISTORY

## 2.1 General Data

| | | | | |
|---|---|---|---|---|
| 2.1.1 | Well Name and Number | : | North Paaratte 4 | |
| 2.1.2 | Location | : | Latitude : | 38°33'09.92"S |
| | | | Longitude : | 142°57'13.70"E |
| | | | Easting : | 670 251.32 |
| | | | Northing : | 5 731 028.38 |
| | | | Seismic : | Station CDP 2480<br>Inline 8075 |
| 2.1.3 | Elevations | : | G.L. : | 92.9m A.S.L. |
| | | | K.B. : | 98.4m A.S.L. |
| 2.1.4 | Petroleum Tenement | : | PPL 1 | |
| 2.1.5 | Permit Operator | : | BORAL ENERGY PETROEUM PTY LTD<br>A.C.N. 010 728 962<br>60 Hindmarsh Square,<br>ADELAIDE SA 5000 | |
| 2.1.6 | Drilling Manager | : | OIL COMPANY OF AUSTRALIA LIMITED<br>A.C.N. 001 646 331<br>1st Floor, North Court,<br>John Oxley Centre,<br>339 Coronation Drive,<br>MILTON Qld 4064 | |
| 2.1.7 | Date Drilling Commenced | : | 2300 hours 03nd April, 1999 | |
| 2.1.8 | Date Drilling Completed | : | 0230 hours 09th April, 1999 | |
| 2.1.9 | Date Rig Released | : | 0930 hours 11th April, 1999 | |
| 2.1.10 | Drilling Time to T.D. | : | 5.15 days total (3.06 days rotating) | |
| 2.1.11 | Total Depth | : | Driller : | 1651.0m |
| | | | Logger : | 1651.0m (Extrap) |
| 2.1.12 | Status | : | Completed Gas Well. | |

## 2.2 Rig Data

| | |
|---|---|
| Drilling Contractor: | Century Drilling Limited<br>172 Fullarton Road<br>DULWICH SA 5065 |
| Drawworks: | Ideco Hydrair H-44-CSC single drum drilling hoist mounted on an Ideco Model BIR-7585 carrier. |
| Substructure: | Ideco 260 ton telescoping substructure (capacity 320,000 pounds on rotary beams and 200,000 pounds on setback area, loaded concurrently). Height: 11ft for transport, telescopes to provide 16ft high substructure with 13'9" between ground and bottom of rotary beam. |
| Engines: | Two (2) Caterpillar 3408-DITA diesel engines with Allison model 5860 torquematic transmission. |
| Brake: | V80 Parmac hydromatic. |
| Mast: | Ideco KM-117-358AH kwik-lift telescoping. 117ft clear height from ground to underside of crown. Static hook capacity with 10 lines 358,000 pounds. |
| Catheads: | Hydraulic make up and break out unit, mounted in mast. |
| Travelling Block/Hook: | Ideco model UTB-265 capacity 265 tons with 5 x 42" sheaves grooved for 1.1/8" line. |
| Winches: | One hydraulic winch Braden model PD-12A. One hydraulic service winch PD-10. |
| Swivel: | Ideco TL-200 ton capacity. |
| Rig Lighting: | Electrical Power Systems, lighting system with fluorescent lights for mast, floor, pipe rack area, cellar, engine, pump and mud tank area. Explosion proof light. |
| Kelly Drive: | Varco 27 HDP pin drive with rollers to suit 5.1/4" and 3.1/2" hexagonal kellies. |
| Mud Pumps: | No.1 National 8-P-80 Triplex – 8.1/2" Stroke. Independently driven by Caterpillar D398TA diesel engine and complete with 1 only Warman 6" x 4" charging pump.<br><br>No.2 National 8-P-80 Triplex – 8.1/2" Stroke. Independently driven by Caterpillar D398TA diesel engine and complete with 1 only Warman 6" x 4" charging pump. |

| | |
|---|---|
| Mixing Pump: | One (1) Harrisburg 6" x 8" Centrifugal Pump powered by a 60 H.P. 1800 R.P.M. electric motor. |
| Mud Agitators: | Three (3) Duck 5 H.P. (2 suction, 1 shaker). |
| Shale Shaker: | Two (2) DFE Linear Motion with 84 and 110 mesh screens |
| Degasser: | Drilco mud gas separator capable of handling a maximum of 700 G.P.M. of fluid. |
| Mud Cleaner: | Combination Mud Cleaner/Desilter powered by 5 H.P. electric motor charged with Harrisburg 6 x 8 Centrifugal Pump driven by 60 H.P. 1800 R.P.M. Electric Motor. |
| Desander: | Harrisburg DSN 1000 unit with 2 x 10" cones charged with a 6 x 8 Centrifugal Pump with a 10" impellor and a 60 H.P. 1800 R.P.M. Electric Motor. |
| Generators: | Two (2) Caterpillar 3406TA, 250 Kw prime, 300 Kw standby, 60 Hz 230/460 generating sets. |
| B.O.P's & Accumulators: | One (1) 13 5/8" x 5000 Shaffer LWS Ram type double studded hydraulic B.O.P. with 7", 5.1/2", 5",4.1/2", 3.1/2", 2.7/8", 2.3/8", and C.S.O. Rams.<br><br>One (1) 13 5/8" x 5000 Hydril GK Spherical Annular B.O.P. studded top and flange bottom.<br><br>One (1) Koomey Accumulator model 120 LS type 80 3000 psi 120 gallon capacity (10 bottles). |
| Kelly Cock(Upper): | Hydril 5000 psi upper kelly cock with 6.5/8" reg. LH connections. |
| Kelly Cock(Lower): | Hydril Kelly Guard 5000 psi lower kelly cock with 4.1/2" IF connections. |
| Drill Pipe Safety Valve: | 1 x 4.1/2" IF Inside BOP (Gray)<br>1 x 4.1/2" IF Full Opening Stabbing Valve, 2 13/16" ID |
| Air Compressors & Receivers: | One (1) Gardner Denver 30 HP compressor, 100 cfm @ 125 psi.<br>One (1) Worthington 20 HP compressor, 80 cfm @ 125 psi. |
| Power Tongs: | Weatherford Model 16 - 18 hydraulic unit complete with jaws to suit 13.3/8", 9.5/8", 7", 5.1/2" operated from rig hydraulic system. |

| | | |
|---|---|---|
| Spools: | One (1) DSAF 13-5/8" - 5000 psi x 13-5/8" - 3000 psi.<br>One (1) DSAF 13-5/8" - 5000 psi x 11" 5000 psi<br>One (1) DSAF 13-5/8" - 5000 psi x 11" 3000 psi<br>One (1) DSAF 13-5/8" - 5000 psi x 7-1/16" 5000 psi<br>One (1) DSAF 13-5/8" - 5000 psi x 7-1/16" 3000 psi<br>One (1) flanged spool 13-5/8" - 5000 psi x 13-5/8" – 5000 psi with 2 1/16" - 5000 psi x 3 1/8" - 5000 psi outlets (23" high)<br>One (1) flanged spacer spool 13.5/8" - 5000 psi (23" high). | |
| Mud Tanks (3) : | Dimension<br>L x W x H | Capacity |
| Shaker Tank: | 39' x 10' x 6' | 414 bbls |
| Sand Trap | | 81 bbls |
| Desander | | 47 bbls |
| Desilter | | 55 bbls |
| Reserve | | 231 bbls |
| Suction Tank: | 40' x 10' x 6' | 400 bbls |
| Suction | | 360 bbls |
| Pill | | 40 bbls |
| Trip Tank: | One 25 bbls capacity with 2" & 1.1/2" electric pumps | |
| Kill Line Valve: | 2 x 2" - 5000 psi gate valve manual CIW | |
| Choke Line Valves: | 1 x 3" - 5000 psi gate valve manual CIW<br>1 x 3" - 5000 psi hydraulic gate valve CIW | |
| Choke Manifold: | 1 x 3" 5000psi. unit with 2 x 3" adjustable chokes - CIW | |
| Drill Pipe: | 8,500' 16.6 lb/ft. Grade E 4.1/2" OD 18 degree taper with 6.3/8" OD tool joints and 4" IF connections. | |
| Pup Joints: | 1 x 10' – 4.1/2" OD with 4" IF connections<br>1 x 5' – 4.1/2" OD with 4" IF connections | |
| Hevi-Wate Drill Pipe: | 22 only 4.1/2" OD with 4" IF connections | |
| Drill Collars: | 4 only 150 lb/ft 8" OD (2.813" ID) Drill Collars with 6.5/8" Reg. connections.<br><br>30 only 92 lb/ft 6.1/4" (2.813" ID) OD Drill Collars slip recessed and hardbanded with 4" IF connections.<br><br>1 only 92 lb/ft 6.1/4" (2.813" ID) OD pony Drill Collars | |
| Kellies: | 1 only 5.1/4" Hexagonal 38' working space (40' overall) with 6.5/8" reg. LH box x 4" IF Pin. | |

| | |
|---|---|
| Roller Reamers & Stabilisers: | 1 only 12.1/4" OD Gearhart Ezy-Change Stabiliser with 6-5/8" Reg connections<br><br>1 only 8.1/2" OD Gearhart Modular stabiliser- 4" IF box x 4.1/2" Reg box<br><br>3 only 8.1/2" OD Gearhart Modular stabiliser- 4" IF connections<br><br>1 only 8.1/2" OD Gearhart NB "Redback" roller reamer- 4" IF box x 4.1/2" Reg box connections |
| Fishing Tools: | 1 only Bowen 6.1/4" OD type Z Hydraulic Jar<br>1 only Bowen 9.5/8" series 150 FS Overshot<br>1 only Bowen 8.1/8" series 150 FS Overshot<br>1 only 7.7/8" Reverse Circulating Junk Basket<br>1 only Junk Sub - 8.1/2" hole<br>1 only flat bottom mill for 8.1/2" hole<br>1 only Magnet for 8.1/2" hole |
| Wireline Survey Unit: | 1-Bronco Model BS-15-RH Remote Hydraulic Powered Unit complete with 12,000' 0.092" diameter line. |
| Subs: | 3 only 4" IF saver subs.<br>2 only 6-5/8" Reg lifting subs<br>12 only 4" IF lifting nubbins.<br>2 only 6-5/8" Reg double box bit sub (5F-6R float recess).<br>2 only 4" IF box x 4.1/2" Reg. box bit sub (4R float recess).<br>1 only 4.1/2" Reg pin x 4.1/2" FH pin 4" long<br>2 only 6-5/8" Reg pin x 4" IF box.<br>2 only 4.1/2" IF box x 4" IF pin.<br>1 only 4" IF pin x 2" LP pin (circulating) 12" long.<br>1 only 3.1/2" IF pin x 2" LP pin (circulating) 12" long. |
| Handling Tools: | 1 set AAX tongs complete with hangers Range 2.7/8" - 13.3/8"<br>1 set forged elevator links 108" x 2.3/4" capacity 250 tons<br>1 set 13.3/8" H150 Casing Elevators<br>1 set 13.3/8" Single Joint Elevators<br>1 set 13.3/8" CMSXL Casing Slips<br>1 set 9.5/8" H150 Casing Elevators<br>1 set 9.5/8" Single Joint Elevators<br>1 set 9.5/8" CMSXL Casing Slips<br>1 set 7" H150 Casing Elevators<br>1 set 7" Single Joint Elevators<br>1 set 7" CMSXL Casing Slips<br>1 set 5.1/2" H150 Casing Elevators<br>1 set 5.1/2" Single Joint Elevators |

| | |
|---|---|
| | 1 set 5.1/2" SDL-M Casing Slips<br>2 sets 4.1/2" T200 Drill Pipe Elevators<br>2 sets 4.1/2" SDL-M Drill Pipe Slips<br>1 set 6.3/4" - 8.1/4" DSC-L Drill Collar Slips<br>1 set 5.1/2" - 7" DSC-L Drill Collar Slips<br>1 Safety Clamp 6.3/4" - 8.1/4" type MP-R<br>1 Quick Lift Drill Collar System - 100 ton capacity, with 42" links<br>1 only 6.1/2" HD-100 Drill Collar Elevator<br>1 only 8" HD-100 Drill Collar Elevator |
| Casing/Tubing Drifts: | 1 – 9.5/8" - 36.0 ppf<br>1 – 7" - 26.0 ppf<br>1 – 7" - 23.0 ppf<br>1 – 5.1/2" - 15.5 ppf<br>1 – 5.1/2" - 17.0 ppf |
| Thread Protectors: | 3 x 9.5/8" Klampon Style<br>3 x 7" Klampon Style<br>3 x 5.1/2" Klampon Style |
| Kelly Spinner: | Foster Model 77 Hydraulic Kelly Spinner operated by rig hydraulic system |
| Pipe Spinner: | Weatherford Lamb model 13000-J-29 spinner- hawk |
| Welding Equipment: | 1 - Lincoln 400AS Diesel powered Welder<br>1 - Oxy-Acetylene Welder and cutting set |
| Doghouse: | 1 steel unit 7' x 12' x 7' 6" high |
| Generator House: | 1 steel unit to accommodate the generators, switch gear and workshop (45' L x 10' W) |
| Utility House: | 1 steel unit to accommodate accumulators and storeroom |
| Catwalks: | 1 set incorporating junk rack 48' L x 5' W x 42" H |
| Pipe Racks: | 1 set of 6 tumble type each 28' x 42" high |
| Day Fuel Tank: | 1 tank 10' x 8' 6" x 2' (4870 litres capacity) |
| Water/Fuel Tank: | 1 unit 23' L x 9' 6" W x 8' H (300 bbls) with fuel storage tank (capacity 5600 gallons) |
| Oil Storage: | 1 skid mounted oil storage unit. |
| Drilling Rate Recorder: | Totco 6 pen record-o-graph (penetration, weight, pump pressure, rotary torque and rotary RPM) |
| Deviation Recorder: | 1 only Totco Double Recorder 0 - 8 degree |

| | |
|---|---|
| Instruments & Indicators: | Martin Decker F.S. Weight Indicator<br>National F.S. deadline anchor complete with E160 load cell<br>Totco DCT-25 tong torque indicator<br>Totco Rotary Torque Unit (Relative Indicator)<br>Totco Stroke rate meter complete with limit switches for No. 1 and No.2 pump accumulated strokes<br>Totco RPM tachometer system<br>Totco Mud Flow Unit model F<br>Totco Pitometer model L2<br>Totco Trip Tank Monitor<br>Totco "Drill Master" automatic driller<br>BOP Pressure Recorder and Chart, 0-5000 psi |
| Communications: | Westinghouse Model S100 Satellite telephone and Sharp F0355 fax m/c |
| Mud Testing: | 1 only Baroid Mud Field Test Kit |
| Rathole Driller: | Wichita Engineering rat hole driller for 5.1/4" kelly |
| Mud Saver: | Harrisburg Unit with 4.1/2" sealing rubbers |
| Cellar Pump: | 1 only Pacific diaphragm unit 3" with 3 H.P. explosion proof electric motor |
| Water Pump: | 1 only Flex-Tool fully submersible Model 212, driven by 3 phase electric motor. Capacity 61,000 ltrs/hour. |
| Sump Pump: | 1 only 3" Regent Centrifugal sump pump driven by diesel motor complete with hoses, foot valve etc. |
| Fire Extinguishers: | 1 set as required by State Mining Regulations for rig and camp. |
| Pipe Bins: | 4 only 36' L x 10' W x 42" H. |
| Cup Tester: | Cameron Type 'F' cup tester mandrel with 4" IF connections. |

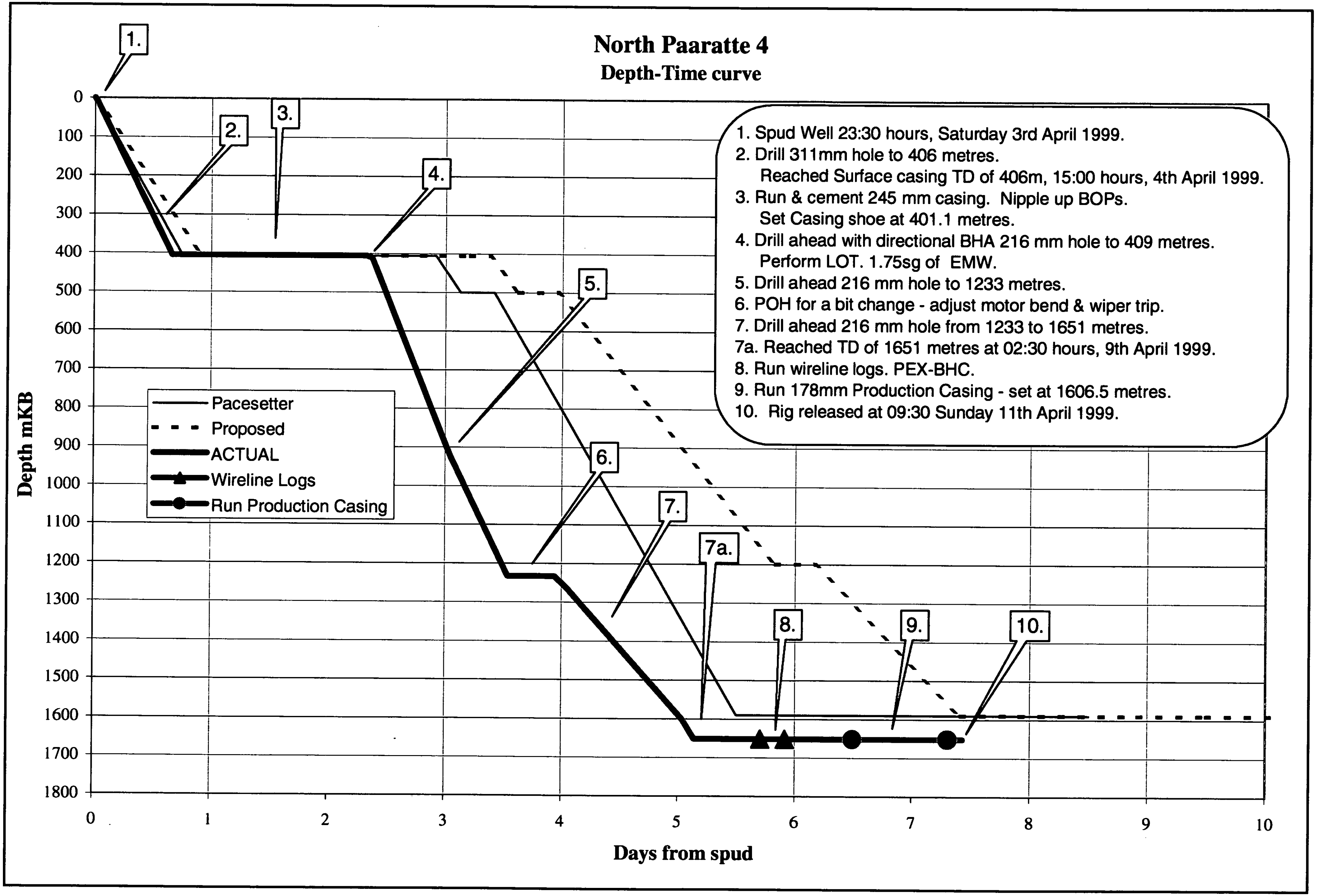
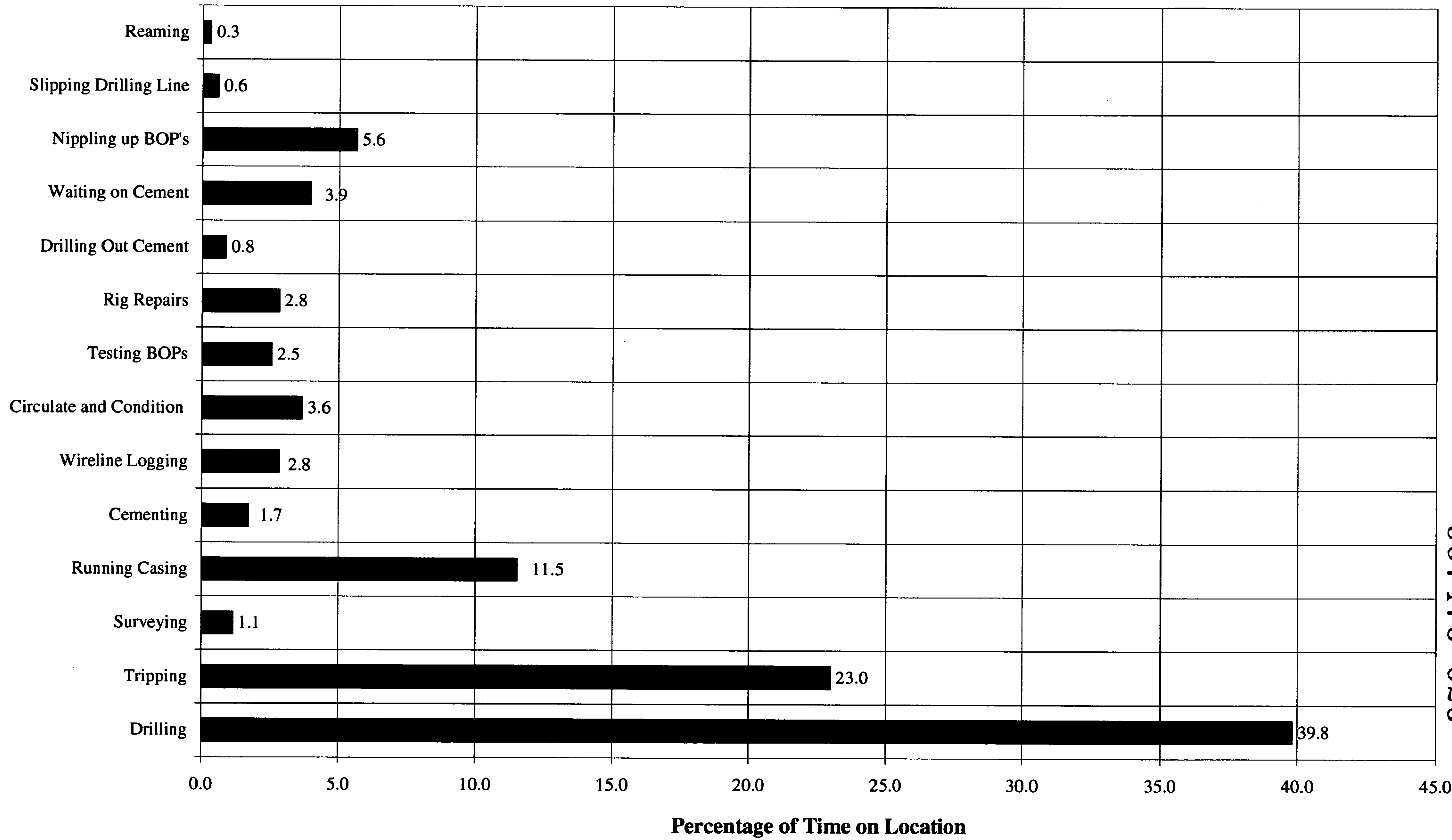

North Paaratte 4
Depth-Time curve
Depth mKB
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
Days from spud
0
1
2
3
4
5
6
7
8
9
10
Pacesetter
Proposed
ACTUAL
Wireline Logs
Run Production Casing
1. Spud Well 23:30 hours, Saturday 3rd April 1999.
2. Drill 311mm hole to 406 metres.
Reached Surface casing TD of 406m, 15:00 hours, 4th April 1999.
3. Run & cement 245 mm casing. Nipple up BOPs.
Set Casing shoe at 401.1 metres.
4. Drill ahead with directional BHA 216 mm hole to 409 metres.
Perform LOT. 1.75sg of EMW.
5. Drill ahead 216 mm hole to 1233 metres.
6. POH for a bit change - adjust motor bend & wiper trip.
7. Drill ahead 216 mm hole from 1233 to 1651 metres.
7a. Reached TD of 1651 metres at 02:30 hours, 9th April 1999.
8. Run wireline logs. PEX-BHC.
9. Run 178mm Production Casing - set at 1606.5 metres.
10. Rig released at 09:30 Sunday 11th April 1999.
1.
2.
3.
4.
5.
6.
7.
7a.
8.
9.
10.

Figure 2

North Paaratte No.4
Time Analysis




907476 020

Figure 3

## 2.3 Drilling Data

2.3.1 The following is the daily operations summary for North Paaratte-4 compiled from the tour sheets and daily drilling reports. Onsite drilling supervision for Oil Company of Australia Limited was by B. Beetson. Further details are provided in the time/depth curve (Figure 2) and the time analysis chart. (Figure 3).

The depths in the following summary are those reached at 2400 hours on each day with the operations given for the previous 24 hour period.

| Date | Depth | Operation |
|---|---|---|
| 03.04.99 | 22.0m | Drill 311mm hole to 22m. |
| 04.04.99 | 406.0m | Drill 311mm hole with surveys to 406m. - Circulate hole clean prior to wiper trip. - Wiper trip, SLM out (no change) RIH hole good. - Circulate and condition hole for casing. - POH, layout 8" drill collars. - Rig up and run casing. |
| 05.04.99 | 406.0m | Continue to run 245mm casing - Head up Howco, circulate and reciprocate casing - Cement casing, displaced with 99bbls water, bumped - plugs, floats not holding, re-bump, floats holding - WOC - Nipple up BOP's - Pressure test casing and blind rams to 250lo-2000hi - leak developed from casing bowl thread to stub connection (correct torque had been applied), weld on casing bowl - Continue pressure test, all OK - Makeup and test Directional BHA |
| 06.04.99 | 922.0m | Continue to makeup Directional assembly and test - RIH with BHA, attempt check survey at 183m – (Misrun due to vibration inside casing) - Tag cement at 381m - Pressure test pipe rams and Hydril, kelly cocks and stabbing valve to OCA specifications - Drill out cement - Drill 3metres of new hole, displace hole to new mud - Formation Integrity test to 420 psi, 1.75sg equivalent - Drill 216mm hole to 922m |
| 07.04.99 | 1263.0m | Directionally drill 216mm hole to 1233m - Circulate B.U., pump slug - P.O.H. - Change bit and straighten motor bend, R.I.H. to shoe - Slip drill line - R.I.H. (break circulate. at 768m), continue to RIH to 1128m - Bridge at 1149m, wash and light ream to 1149m - Continue to RIH - Directionally drill to 1263m |

| | | |
|---|---|---|
| 08.04.99 | 1603.0m | Directionally drill 216mm hole to 1603m. |
| 09.04.99 | 1651.0m | Driectionally drill to 1651metres - Circulate. and condition hole - Flow check, wiper trip to 1071m, hole tight from 1525-1487m. and 1412-1355m – Pick up kelly at 1071m, clean bit RIH to bottom , hole - O.K. - Circulate and condition for logging - POH to log, layout directional assembly - Rigup Schlumberger, safety meeting - Logging, ran PEX, GR,BHC,SP - Makeup bit and RIH - Slip drill line - RIH |
| 10.04.99 | 1651.0m | Continue to RIH, precautionary wash to TD - Circulate and condition hole - Layout drill string - Service break kelly - Layout BHA - Rig to run 7" production casing - Safety meeting, run 7" production casing to 1202mtr - Hole tight, unable to continue, rig up circulating swage and wash down to 1438m |
| 11.04.99 | 1651.0m | Continue to work casing and wash down from 1438m to 1606m (planned shoe depth) - Circulate. and reciprocate casing, condition for cementing - Safety meeting, cement with Howco, good returns throughout, bumped plug, floats holding - Set 7" casing slips with 75k - Nipple down BOP's, lift , rough cut and layout landing joint. Rig released at 0930hrs 11th 1999 |

2.3.2 Hole Sizes and Depths :

311mm to 406.0m
216mm to 1651.0m (TD.)

2.3.3 Casing and Cementing :

<u>Surface</u>

| | |
|---|---|
| Size - | 9 5/8" / 244mm |
| Weight - | 36 lb/ft, 53.6 kg/m |
| Grade - | K55 (33 Joints) |
| Shoe Setting Depth - | 401.1m |
| Cement (lead) - | 308 sacks 'G' + 2.3 % gel & 0.2% CFR3 |
| Cement (tail) - | 283 sacks 'G' |
| Interval Cemented - | To surface |

<u>Production</u>

| | |
|---|---|
| Size - | 7" / 178 mm |
| Weight - | 26 lb/ft, 38.77 kg/m |
| Grade - | K55 (136 joints) |
| Shoe Setting Depth - | 1606.5m |
| Quantity of Cement - | 500 sacks "G" + 1% HALAD 322 |
| Interval Cemented - | TD to 600m |

2.3.4 Deviation Surveys :

| Depth (metres) | Deviation (degrees) | Depth (metres) | Deviation (degrees) | Depth (metres) | Deviation (degrees) |
|---|---|---|---|---|---|
| 58 | 0.00 | 104 | 0.25 | 213 | 0.75 |
| 317 | 0.25 | 394 | 0.75 | | |

Directional surveys are listed in Appendix 6.

2.3.5 Drilling Fluid :

| | | |
|---|---|---|
| (a) Spud - 406m | Fluid - | Fresh water - Gel |
| | Additives - | M-I Bar, Trugel, Caustic. |
| (b) 406 - TD | Fluid - | KCl - PHPA |
| | Additives - | M-I Gel, Glute 25, M-I Bar, Duovis, C-122 Fluid Loss, C-121 Viscosifier, Caustic Soda, Sodium Suplhite, KCl, Polyplus, Soda Ash, |

2.3.6 Physical Mud Properties :

| Date | Depth | SG | Vis. | WL | pH | FC | Sand | Solid | K+ | Cl- |
|---|---|---|---|---|---|---|---|---|---|---|
| 03/04 | 22 | 1.02 | 43 | nc | 10 | | tr | | | |
| 04/04 | 406 | 1.07 | 41 | nc | 10 | 1 | 0.25 | 5 | | 6000 |
| 05/04 | 406 | 1.03 | 47 | nc | 10 | 1 | 0 | 6 | | 25000 |
| 06/04 | 922 | 1.09 | 43 | 6.5 | 9 | 1 | 0.25 | 7 | 4% | 23000 |
| 07/04 | 1263 | 1.12 | 47 | 6.2 | 10 | 1 | 0.25 | 8 | 4% | 24000 |
| 08/04 | 1603 | 1.12 | 48 | 5.8 | 9 | 1 | 0.25 | 8 | 5% | 26000 |
| 09/04 | 1651 | 1.15 | 56 | 5.8 | 9 | 1 | 0.25 | 9 | 5% | 25000 |
| 10/04 | 1651 | 1.15 | 56 | 5.8 | 9 | 1 | 0.25 | 9 | 5% | 25000 |

Chemicals Used :

| Product | Units | | Amount | |
|---|---|---|---|---|
| M-I Gel | 12 | Sack | 300 | kg |
| Glute 25 | 2 | Drum | 50 | li |
| M-I Bar | 190 | Sack | 4750 | kg |
| Trugel | 80 | Sack | 2000 | kg |
| C-122 Fluid Loss | 6 | Sack | 150 | kg |
| C-121 Viscosifier | 9 | Sack | 225 | kg |
| Caustic Soda | 4 | Drum | 100 | kg |
| KCl | 470 | Sack | 11750 | kg |
| Soda Ash | 10 | Sack | 250 | kg |
| Sodium Suplhite | 6 | Sack | 150 | kg |
| Poly Plus | 47 | Sack | 1175 | kg |
| Duovis | 10 | Sack | 250 | kg |

2.3.7 Water Supply :

Water was trucked from a mains supply 2 km from the lease.

2.3.8 Perforation Record :

1509.0 - 1515.0m. 114mm. (4.5") 12 spf Ø=45° 21.3gm.

2.3.9 Plugging and Cementing :

Nil

## 2.4 Logging and Testing

2.4.1 Wellsite Geologist :

D. A. Short

2.4.2 Mudlogging :

Mudlogging services were provided by Geoservices Overseas SA. Cuttings gas was monitored from surface casing shoe to total depth using a hot-wire gas detector and a FID gas chromatograph. A mudlog recording lithology, penetration rate, mud gas and other data was prepared and is an enclosure to this report.

2.4.3 Ditch Cutting Samples :

Cuttings were collected at 10m intervals from the surface to 1470m, then at 3m intervals to T.D. The cutting samples and sets were:

| Sample Type | No. Sets |
|---|---|
| Unwashed (BORAL) | 1 |
| Washed (VDME(2) / BORAL(1)) | 3 |
| Samplex Trays (BORAL) | 1 |

2.4.4 Coring :

None.

2.4.5 Sidewall Cores :

None.

2.4.6 Testing :

None

2.4.7 Wireline Logs :

One suite of logs (PEX) was run by Schlumberger

| Type Log | Interval (base) m. | Interval (top) m. |
|---|---|---|
| RXOZ / HLLS-HLLD | 1645 / 1648 | 401 / 401 |
| BHCS / GR | 1634 / 1639 | 401 / 25 |
| RHOZ / TNPH | 1645 / 1641 | 401 / 401 |

2.4.8 Temperature Surveys :

Wireline logging recorded the following bottom hole temperature:-
1. 57°C / 7.3 hours after circulation ceased.

2.4.9 Velocity Survey :

None.

# 3.0 GEOLOGY

## 3.1 Reasons for Drilling

Introduction

North Paaratte-4 was proposed as a development well in the North Paaratte Field, PPL-1, onshore Otway Basin. Primary objective for the well was the upper Cretaceous Waarre Formation of the Sherbrook Group, and the reservoir will be used as a swing producer to meet peak gas demand.

The non-crestal North Paaratte-1&2 wells have shown high water cut and strong water drive in the field demands that additional wells be located as high as possible on the structure. Depth structure mapping at the top Waarre 'C' unit shows two crestal locations and North Paaratte-4 was targeted the western high approximately 0.4km north north-west of North Paaratte-1. North Paaratte-4 was prognosed to penetrate in excess of 40m of gas-bearing sandstone above the original field GWC (1365mSS).

North Paaratte-4 was drilled directionally from a surface location approximately 43m south south-west of North Paaratte-1, using the existing gas field site. The proposed TD would enable evaluation of reservoir sand development at the top of the Eumeralla Formation and would allow sufficient rathole to perforate the Waarre Ss. reservoir and junk the perforating subs at the bottom of the hole.

Field History

The North Paaratte-1 discovery well was drilled in 1979 by Beach Petroleum NL. North Paaratte-1 was located on the southern flank of an elongate, east-west trending faulted anticline in the Port Campbell embayment of the Otway Basin and intersected gas in the Waarre Sandstone member of the Upper Cretaceous Sherbrook Group. Subsequent testing flowed GTS at rates up to 9.5 MMcfd and confirmed a new field discovery. North Paaratte-2 was drilled in 1981 approximately 1.6 km to the east and intersected a similar high-deliverability reservoir in the Waarre Sandstone. North Paaratte-3 was located further to the east but intersected a separate fault block below the gas-water contact.

North Paaratte-4 is proposed as a development well approximately 400 metres north northwest of North Paaratte-1 to restore gas production from the field. The primary objective is the Waarre Formation Unit 'C' sand which is the sole reservoir in the field and North Paaratte-4 will be used to provide high deliverability gas during periods of peak demand in the Victorian gas system. High flow rates will lead to rapid reservoir depletion but such pressure loss will be offset in the long term by planned use of the Waarre sandstone as a gas storage reservoir.

The North Paaratte field was incorporated in a 1993 3-D seismic survey and the structure was reinterpreted. North Paaratte-1 was shown to be on the southern flank of an east-west trending anticlinal structure sealed by a down to the north normal fault. North Paaratte-2 is 8 metres structurally higher than North Paaratte-1 and drains the eastern region of the accumulation. Reservoir development is superior in the eastern region and production testing suggests a potential AOFP in North Paaratte-2 of 95 MMcfd.

Despite the structural elevation of both wells above the original GWC North Paaratte-2 has produced a significant water cut (up to 27 bbl/MMcf, March 1998) and elevation of the gas water contact due to strong water drive is likely to limit the ultimate recovery from both wells. RFT data indicates an original gas-water contact at –1365m SS, 12 metres below the top 'C' unit in North Paaratte-1, and up to 50m closure remains up dip of the discovery well. In view of this fact North Paaratte-4 is proposed near the crest of a culmination which lies against the major east-west trending fault in the western region of the field and the top 'C' unit is prognosed at –1313m SS.

Production to June 1998 totals 4.9 PJ. This volume of gas is interpreted as being sourced from the lower region of the North Paaratte structure due to strong water drive and concomitant rapid replacement of gas in the reservoir by influx of water. In view of such strong vertical movement of water within the closure attic gas is unlikely to be produced unless the respective culmination is penetrated by a well.

The original GWC is placed at -1365m SS based on RFT data and production is therefore likely to have raised the free water level to the elevation of North Paaratte-1 (-1353m SS). The GIP remaining in the structure is heavily dependent upon the ultimate rock volume above the current water level and North Paaratte-4 will be located to maximise gas recovery from the western crest of the structure.

## Regional Geology

The Otway Basin is approximately 500km long and extends both onshore and offshore west-northwest from the Victorian Mornington Peninsula in the east to Cape Jaffa, South Australia, in the west. The North Paaratte field, PPL 1, is located in the Victorian portion of the onshore Otway Basin approximately 50km northwest of Cape Otway. The field lies in the Port Campbell embayment, which is bounded to the east by erosion along the emergent Otway Ranges and to the north and west by erosional thinning and pinch-out.

Formation of the Otway Basin commenced in the late Jurassic with the initiation of rifting between Australia and Antarctica. Depositional growth occurred as superimposed sedimentary sequences each laid down during different phases of the separation of the Antarctic continental landmass from Australia's southern margin. The oldest strata comprise the Early Cretaceous Crayfish subgroup and overlying Eumeralla Formation, the latter comprising lithic-rich, volcanogenic sandstones with generally poor reservoir potential. Following deposition of the Eumeralla Formation widespread uplift and erosion occurred and this has been interpreted to be due to the onset of sea floor spreading.

The Sherbrook Group was deposited on the resulting unconformity as a condensed sandstone sequence onshore, whilst offshore it can be subdivided into formations representing the various facies of a delta system. The basal member, the Waarre Formation, comprises sands and shales with marine and shoreface facies, which have been subdivided into four units. Unit 'C' constitutes the objective gas reservoir in the gas fields in PPL 1 and 2. The Waarre Formation is overlain by the Belfast Mudstone, a sequence of massive siltstones interpreted to represent offshore pro-deltaic facies, and the time equivalent Nullawarre Greensand. The Skull Creek Mudstone and Paaratte Formation, an interbedded sand and shale sequence, comprise the upper members of the Sherbrook Group.

Fault movements during deposition of the Sherbrook Group are apparent in seismic sections but fault throws diminish above the Belfast Mudstone: the eventual large reduction in the number of faults by the top of the Paaratte Formation indicates relative quiescence by the end of the Cretaceous.

The basal Tertiary section is defined by an unconformity with the Cretaceous and consists of sandstones and claystones of the Wangerrip Group probably deposited onshore in a fluvial-deltaic setting. The basal transgressive sandstone unit is the Pebble Point Formation which comprises conglomeratic and commonly ferruginous sands. Pro-delta muds and silts of the Pember Mudstone Member grade into the overlying sands and shales of the Dilwyn Formation which represent a series of stacked transgressive-regressive deltaic cycles.

The rate of sea floor spreading appears to have increased markedly during the upper Eocene resulting in a major marine transgression in the Otway Basin. The Tertiary sequence unconformably overlying the Dilwyn Formation is dominated by marine marls and limestones as a result of this inundation.

The tectonic framework of the Otway Basin is dominated by extensional processes that produced a series of normal fault blocks. Continued block faulting and subsidence during the lower Cretaceous led to the development of an extensive rift valley system throughout southeast Australia. Pull-apart tectonics continued until the late upper Cretaceous and faulting, recognised as 'down to the basin' movement, represented reactivation of the initial rift system faults. By the Late Eocene drifting rates increased and a period of out-building occurred; subsidence was slow and tectonic activity became relatively quiet, resulting in a relatively undeformed carbonate sequence.

During Late Cretaceous and possibly continuing to Early Tertiary times a right lateral couple was applied resulting in the formation of a series of northeast-trending anticlines (e.g. Port Campbell Anticline). The structural grain generated as a result of this couple produced the combination fault and three-way dip closures targeted by drilling in the Port Campbell Embayment.

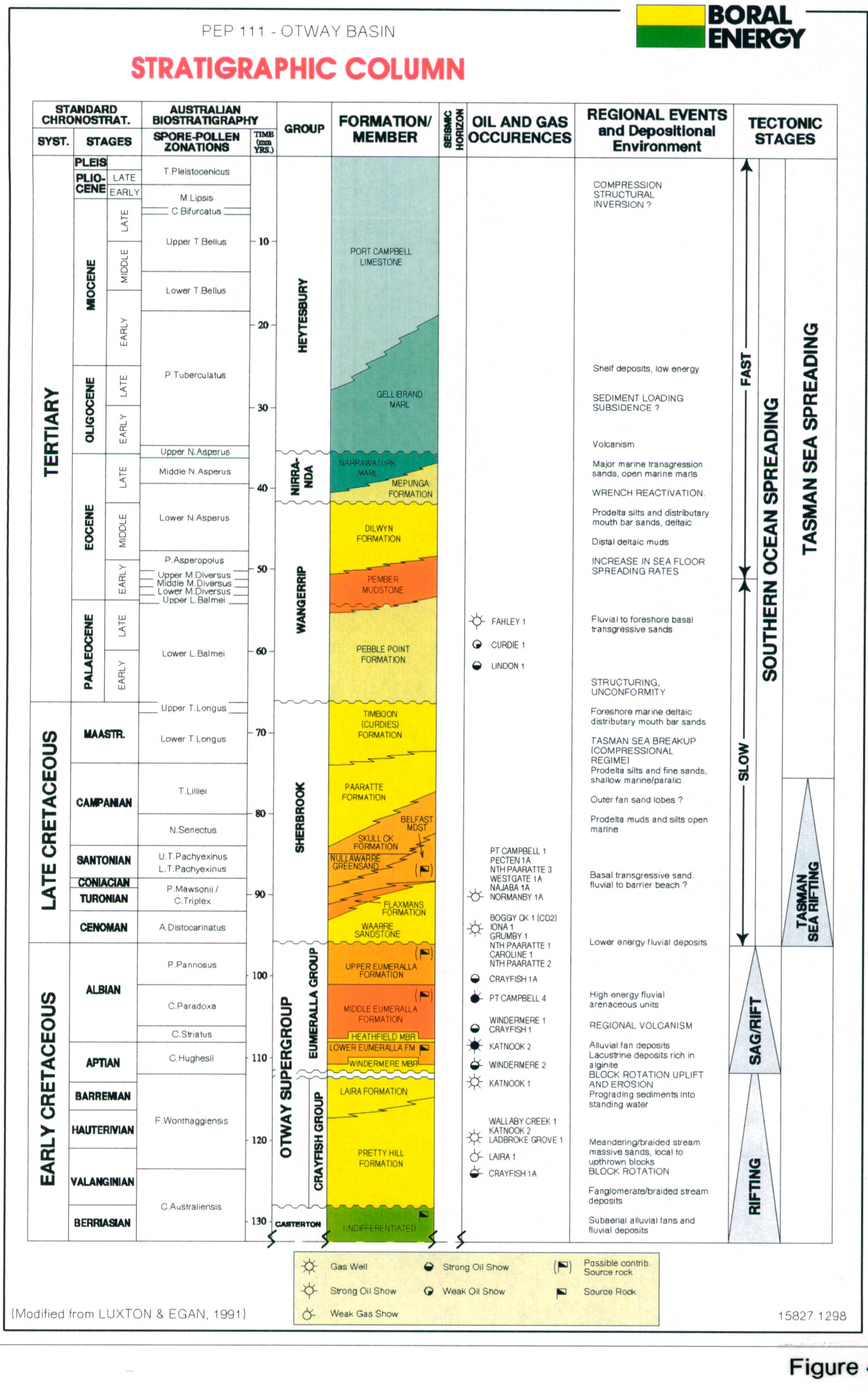
Waarre Formation

The Waarre Formation is interpreted to be an open marine facies with sandstones deposited in the upper to middle shoreface. The sequence of interbedded sand

and shale has led to an informal sub-division of the formation into the A (basal), B, C and D (top) units. The Unit 'A' sand and Unit 'B' shale units tend to be out of closure and therefore unprospective and exploration potential is highest in the unit 'C' sandstones.

Unit 'C' sandstones were deposited in the highest energy, shallow marine upper shoreface environment and comprise medium to coarse grainsize. Core 2, North Paaratte-2, recovered poorly consolidated sands from this interval with porosity and permeability ranging up to 26.5% and 1026 md respectively. The typically porous and permeable sandstone in Unit 'C' is ubiquitous in PPL-1 and is regarded as a low risk play. The thickness of the sand, however, shows some variation and the thick section penetrated in North Paaratte-2 may not be repeated in the up-structure North Paaratte-4 well.

Palaeorelief has potential to influence shoreface sands but the marine shale facies of Unit 'B', which incorporates an interpreted maximum flooding surface, should offer an essentially flat substrate onto which the Unit 'C' sands prograded during a period of relative base level fall. In view of this interpretation variation in net sand caused by syn-depositional relief should not be significant.



PEP 111 - OTWAY BASIN
STRATIGRAPHIC COLUMN
BORAL ENERGY
STANDARD CHRONOSTRAT.
SYST.
STAGES
AUSTRALIAN BIOSTRATIGRAPHY
SPORE-POLLEN ZONATIONS
TIME (mm YRS.)
GROUP
FORMATION/ MEMBER
SEISMIC HORIZON
OIL AND GAS OCCURENCES
REGIONAL EVENTS and Depositional Environment
TECTONIC STAGES
TERTIARY
LATE CRETACEOUS
EARLY CRETACEOUS
PLEIS
PLIO-CENE
LATE
EARLY
MIOCENE
MIDDLE
OLIGOCENE
EOCENE
PALAEOCENE
MAASTR.
CAMPANIAN
SANTONIAN
CONIACIAN
TURONIAN
CENOMAN
ALBIAN
APTIAN
BARREMIAN
HAUTERIVIAN
VALANGINIAN
BERRIASIAN
T.Pleistocenicus
M.Lipsis
C.Bifurcatus
Upper T.Bellus
Lower T.Bellus
P.Tuberculatus
Upper N.Asperus
Middle N.Asperus
Lower N.Asperus
P.Asperopolus
Upper M.Diversus
Middle M.Diversus
Lower M.Diversus
Upper L.Balmei
Lower L.Balmei
Upper T.Longus
Lower T.Longus
T.Lilliei
N.Senectus
U.T.Pachyexinus
L.T.Pachyexinus
P.Mawsonii / C.Triplex
A.Distocarinatus
P.Pannosus
C.Paradoxa
C.Striatus
C.Hughesii
F.Wonthaggiensis
C.Australiensis
10
20
30
40
50
60
70
80
90
100
110
120
130
HEYTESBURY
NIRRA-NDA
WANGERRIP
SHERBROOK
OTWAY SUPERGROUP
EUMERALLA GROUP
CRAYFISH GROUP
CASTERTON
PORT CAMPBELL LIMESTONE
GELLIBRAND MARL
NARRAWATURK MARL
MEPUNGA FORMATION
DILWYN FORMATION
PEMBER MUDSTONE
PEBBLE POINT FORMATION
TIMBOON (CURDIES) FORMATION
PAARATTE FORMATION
BELFAST MDST
SKULL CK FORMATION
NULLAWARRE GREENSAND
FLAXMANS FORMATION
WAARRE SANDSTONE
UPPER EUMERALLA FORMATION
MIDDLE EUMERALLA FORMATION
HEATHFIELD MBR
LOWER EUMERALLA FM
WINDERMERE MBR
LAIRA FORMATION
PRETTY HILL FORMATION
UNDIFFERENTIATED
FAHLEY 1
CURDIE 1
LINDON 1
PT CAMPBELL 1
PECTEN 1A
NTH PAARATTE 3
WESTGATE 1A
NAJABA 1A
NORMANBY 1A
BOGGY CK 1 (CO2)
IONA 1
GRUMBY 1
NTH PAARATTE 1
CAROLINE 1
NTH PAARATTE 2
CRAYFISH 1A
PT CAMPBELL 4
WINDERMERE 1
CRAYFISH 1
KATNOOK 2
WINDERMERE 2
KATNOOK 1
WALLABY CREEK 1
KATNOOK 2
LADBROKE GROVE 1
LAIRA 1
CRAYFISH 1A
COMPRESSION STRUCTURAL INVERSION ?
Shelf deposits, low energy
SEDIMENT LOADING SUBSIDENCE ?
Volcanism
Major marine transgression sands, open marine marls
WRENCH REACTIVATION.
Prodelta silts and distributary mouth bar sands, deltaic
Distal deltaic muds
INCREASE IN SEA FLOOR SPREADING RATES
Fluvial to foreshore basal transgressive sands
STRUCTURING, UNCONFORMITY
Foreshore marine deltaic distributary mouth bar sands
TASMAN SEA BREAKUP (COMPRESSIONAL REGIME)
Prodelta silts and fine sands, shallow marine/paralic
Outer fan sand lobes ?
Prodelta muds and silts open marine
Basal transgressive sand. fluvial to barrier beach ?
Lower energy fluvial deposits
High energy fluvial arenaceous units
REGIONAL VOLCANISM
Alluvial fan deposits
Lacustrine deposits rich in alginite
BLOCK ROTATION UPLIFT AND EROSION
Prograding sediments into standing water
Meandering/braided stream massive sands, local to upthrown blocks
BLOCK ROTATION
Fanglomerate/braided stream deposits
Subaerial alluvial fans and fluvial deposits
FAST
SLOW
SOUTHERN OCEAN SPREADING
TASMAN SEA SPREADING
TASMAN SEA RIFTING
SAG/RIFT
RIFTING
Gas Well
Strong Oil Show
Possible contrib. Source rock
Strong Oil Show
Weak Oil Show
Source Rock
Weak Gas Show
(Modified from LUXTON & EGAN, 1991)
15827.1298


Figure 4

### 3.2 Stratigraphic Prognosis

The stratigraphic prognosis was made utilising the results of nearby wells and the available seismic coverage.
A comparison between prognosed and actual formation tops is given below.

| Formation | Predicted TVD (m KB) | Actual TVD (m KB) | Difference (m) |
|---|---|---|---|
| Port Campbell Ls. | 5.5 | 5.5 | 0.0 |
| Gellibrand Marl | 77.8 | 81.0 | -3.2 |
| Clifton Fm. | 322.8 | 328.0 | -5.2 |
| Narrawaturk Marl | 352.8 | 355.0 | -2.2 |
| Mepunga Fm. | 388.3 | 385.5 | 2.8 |
| Dilwyn Fm. | 425.8 | 426.0 | -0.2 |
| Pember Mudstone | 659.3 | 673.6 | -14.3 |
| Pebble Point Fm. | 738.8 | 732.4 | 6.4 |
| Paaratte Fm. | 777.6 | 804.5 | -26.9 |
| Skull Creek Mbr. | 1150.7 | 1112.7 | 38.0 |
| Nullawarre Greensand | 1245.7 | 1243.5 | 2.2 |
| Belfast Fm. | 1320.0 | 1320.9 | -0.9 |
| Waarre Fm. (Unit C) | 1411.4 | 1425.7 | -14.3 |
| Eumeralla Fm. | | 1491.2 | |
| T.D. (Logs) | 1497.3 | 1555.6 | -58.3 |

### 3.3 Stratigraphy

The following stratigraphic summary describes the formations drilled at North Paaratte-4. The depths in brackets are true vertical depths (TVD) and thicknesses are true vertical thickness.

**PORT CAMPBELL LIMESTONE**

5.5 - 81.0 metres (5.5 – 81.0m. TVD) Thickness : 75.5 metres

| | |
|---|---|
| 5.5 - 81.0m<br>(5.5 - 81.0m.) | CALCARENITE, light to medium grey, (some white to pale yellow at top – weathered & iron stained), very fine to fine, sub-angular to sub-rounded, moderate to well sorted quartz grains, minor fossil fragments, trace dark yellowish green to black spherical glauconite pellets, trace pyrite, argillaceous matrix, calcite cement, friable to moderately hard, poor to occasional fair porosity. |

**GELLIBRAND MARL**

81.0 - 328.0 metres (81.0 – 328.0m. TVD) Thickness : 247.0 metres

| | |
|---|---|
| 81.0 - 328.0m<br>(81.0 - 328.0m) | MARL, light to moderate grey, becoming darker bluish grey with depth, soft, dispersive with abundant white to pinkish brown fossil fragments (predominantly forams & bryozoa) and grades to coquina in part, occasional medium to dark green glauconite, rare pyrite and very fine to fine sub-rounded loose, quartz grains. |

**CLIFTON FORMATION**

328.0 - 355.0 metres (328.0 – 355.0m. TVD) Thickness : 27.0 metres

| | |
|---|---|
| 328.0 - 355.0m<br>(328.0 - 355.0m) | SANDSTONE, clear to translucent white, translucent yellow-brown, dark lustrous brown-black, very fine to medium, occasionally coarse, sub-rounded to well rounded quartz and ironstone grains, abundant green to black glauconite pellets, moderate sorted, loose, minor pyrite nodules, good porosity. |

**NARRAWATURK MARL**

355.0 - 385.5 metres (355.0 – 385.5m. TVD) Thickness : 30.5 metres

| | |
|---|---|
| 355.0 - 385.5m<br>(355.0 - 385.5m) | MARL, moderate to dark grey to grey-brown, soft, dispersive silty and argillaceous, abundant pinkish white fossil fragments, minor quartz, ironstone and glauconite grains, abundant pyrite in places. |

**MEPUNGA FORMATION**

385.5 - 426.0 metres (385.5 – 426.0m. TVD) Thickness : 40.5 metres

385.5 - 426.0m CLAYSTONE with interbedded SANDSTONE.

(385.5 - 426.0m) CLAYSTONE, medium to dark grey-brown, occasional light to medium bluish grey, soft, dispersive, silty and grading to very fie sandstone in part, common white to pink-white fossil fragments, abundant pyrite and dark green to black glauconite. SANDSTONE, dark green, fine to coarse, sub-rounded to rounded, moderate sorted, loose glauconite pellets.

**DILWYN FORMATION**

426.0 - 680.0 metres (426.0 – 673.6m. TVD) Thickness : 247.6 metres

426.0 - 680.0m SANDSTONE with interspersed and interbedded SILTSTONE.

(426.0 - 673.6m) SANDSTONE, clear to translucent white, some pale translucent yellow-brown, fine to very coarse, polished, sub-angular to well rounded, poor to moderate sorted loose quartz grains, brown, dispersive silty clay matrix in part, fair to predominantly good porosity.

SILTSTONE, moderate to dark brown, soft, dispersive, sandy in part, very argillaceous and grades to claystone.

**PEMBER MUDSTONE**

680.0 - 745.0 metres (673.6 – 732.4m. TVD) Thickness : 58.8 metres

680.0 - 745.0m CLAYSTONE with minor SANDSTONE.

(673.6 – 732.4m) CLAYSTONE, moderate to dark grey-brown, light to dark grey, light brown, soft, dispersive, silty in part.

SANDSTONE, white, very fine to fine, sub-angular to sub-rounded, moderate to well sorted loose quartz grains, common glauconite, trace pyrite, sand grains are probably dispersed within the claystone.

## PEBBLE POINT FORMATION

745.0 - 825.0 metres (732.4 – 804.5m. TVD) Thickness : 72.1 metres

| | |
|---|---|
| 745.0 - 764.5m<br>(732.4 – 750.0m) | SANDSTONE with interbedded CLAYSTONE.<br>SANDSTONE, clear to translucent, fine to coarse, sub-angular to sub-rounded, poor to moderate sorted, trace pyrite and glauconite, clay matrix, fair inferred porosity.<br>CLAYSTONE, grey to light brown, soft, sticky. |
| 764.5 - 797.0m<br>(750.0 – 779.3m) | SANDSTONE, clear to translucent light yellow, fine to coarse, sub-angular to rounded, moderate sorted loose quartz grains, dispersive brown clay matrix, occasional silty ironstone nodules, glauconitic and pyritic, good porosity. |
| 797.0 - 825.0m<br>(779.3 – 804.5m) | CLAYSTONE with minor SANDSTONE interbeds.<br>CLAYSTONE, moderate to dark brown, grey-brown, soft to occasional firm, dispersive.<br>SANDSTONE, clear to translucent yellow, fine to coarse, angular to sub-angular, poor to moderate sorted, loose quartz grains, trace glauconite, occasional silty ironstone nodules, minor dispersive brown, clay matrix, poor to fair porosity. |

## PAARATTE FORMATION

825.0 - 1165.0 metres (804.5 – 1112.7m. TVD) Thickness : 130.8 metres

| | |
|---|---|
| 825.0 - 1165.0m<br>(804.5 – 1112.7) | SANDSTONE with minor SILTSTONE and rare COAL.<br>SANDSTONE, clear to translucent white, fine to coarse, angular to sub-rounded, poor to moderate and occasionally well sorted loose quartz grains, rare lithic / quartzite grains, trace to occasionally abundant pyrite, rare carbonaceous material, occasional glauconite, trace dispersive grey silty clay matrix, fair to predominantly very good porosity.<br>SILTSTONE, moderate to dark grey to grey-brown, light to moderate brown, soft, argillaceous, dispersive, trace coal / carbonaceous material.<br>COAL, brown-black, dull, lignitic. |

**SKULL CREEK MEMBER**

1165.0 - 1307.5 metres (1112.7 – 1243.5m. TVD) Thickness : 77.4 metres

| | |
|---|---|
| 1165.0 - 1307.5m | SILTSTONE with interbedded SANDSTONE. |
| (1112.7 – 1243.5m) | SILTSTONE, light to moderate grey, grey-brown, soft, dispersive, very argillaceous and grades to claystone in part, trace dark brown to black lignitic / carbonaceous material.<br>SANDSTONE, white to pale yellow, very fine to coarse, sub-angular to sub-rounded, poor to moderate sorted, trace to occasionally abundant pyrite, trace glauconite and carbonaceous material, silty dispersive clay matrix, strong calcite cement in part, predominantly loose, poor to fair inferred porosity. |

**NULLARWARRE GREENSAND**

1307.5 - 1393.0 metres (1243.5 – 1320.9m. TVD) Thickness : 77.4 metres

| | |
|---|---|
| 1307.5 -1393.0m | SANDSTONE with minor SILTSTONE. |
| (1243.5 – 1320.9m) | SANDSTONE, clear to translucent greenish white, pale yellow, very fine to coarse, sub-angular to rounded, loose, moderate to well sorted, common to abundant moderate to dark green glauconite, trace pyrite, greenish white dispersive glauconitic silty clay matrix, good porosity.<br>SILTSTONE, white to grey-green, soft to firm, sandy and very glauconitic in part, argillaceous, dispersive, grades to claystone in part. |

**BELFAST FORMATION**

1393.0 - 1509.0 metres (1320.9 – 1425.7m. TVD) Thickness : 104.8 metres

| | |
|---|---|
| 1393.0 -1509.0m | SILTSTONE with minor SANDSTONE. |
| (1320.9 – 1425.7m) | SILTSTONE, moderate grey to grey-green, soft, dispersive, very argillaceous and grades to claystone in part, trace glauconite.<br>SANDSTONE, clear to translucent white, pale yellow, very fine to medium, occasionally coarse, sub-rounded, moderate sorted loose quartz grains, abundant rounded glauconite pellets, trace pyrite, silty dispersive clay matrix, poor inferred porosity. |

**WAARRE FORMATION (Unit 'C' sand)**

1509.0 - 1581.0 metres (1425.7 – 1491.2m. TVD) Thickness : 65.5 metres

| | |
|---|---|
| 1509.0 – 1528.0m. (1425.7 – 1442.9m) | SANDSTONE, clear to translucent white, fine to coarse, minor very coarse, sub-angular to sub-rounded, poor to moderate sorted, predominantly loose, quartz grains, trace to abundant pyrite, trace glauconite, occasional silty interbeds / laminae, trace dispersive clay matrix, good porosity. |
| 1528.0 - 1549.5m. (1442.9 – 1462.4m) | SILTSTONE with SANDSTONE interbeds. SILTSTONE, pale grey to brownish grey, soft, dispersive, very argillaceous and grades to claystone. SANDSTONE, clear fine to coarse, loose, sub-angular to sub-rounded, moderate sorted, pyritic, loose quartz grains; also greyish white to pale green, silty to very fine, greenish white clay matrix, poor porosity. |
| 1549.5 - 1555.0m. (1462.4 - 1467.5m) | SANDSTONE, clear to white, very fine to medium, occasionally coarse to very coarse, sub-angular to sub-rounded, moderate sorted loose quartz grains, trace pyrite and glauconite, minor silty interbeds, dispersive clay matrix, fair inferred porosity. |
| 1555.0 – 1581.0m. (1467.5 – 1491.2m) | SILTSTONE, moderate grey to grey-brown, occasionally grey-green, soft, dispersive, very argillaceous and grades to claystone. |

**EUMERALLA FORMATION**

1581.0 - 1651.0 metres (1491.2 – 1555.6m. TVD) Thickness : 64.4 metres

| | |
|---|---|
| 1581.0 - 1651.0m. (1491.2 – 1555.6m) | Interbedded SANDSTONE and SILTSTONE.. SANDSTONE, white to green, very fine to medium, sub-rounded, moderate to well sorted, loose quartz and grey-green to dark green (minor pinkish red) lithic / quartzite grains, minor white to greenish white dispersive clay matrix, fair inferred porosity. SILTSTONE, light to moderate grey, light to moderate brown, greenish grey to green, very soft, argillaceous, dispersive and grades to claystone. |

**TOTAL DEPTH**

| | | |
|---|---|---|
| Driller: | 1651.0 metres | (1555.6m. TVD) |
| Logger: | 1651.0 metres (Extrapolated) | (1555.6m. TVD) |

**Table 1 : NORTH PAARATTE-4 - STRATIGRAPHIC TABLE**

| AGE | FORMATION | K.B. Depths | TVD Depths | MSL Depths | Thickness |
|---|---|---|---|---|---|
| E-L. Miocene | Port Campbell Ls. | 5.5 | 5.5 | 92.9 | 75.5 |
| Oligocene | Gellibrand Marl | 81.0 | 81.0 | 17.4 | 247.0 |
| E. Oligocene | Clifton Fm. | 328.0 | 328.0 | -216.6 | 27.0 |
| L. Eocene | Narrawaturk Marl | 355.0 | 355.0 | -256.6 | 30.5 |
| L. Eocene | Mepunga Fm. | 385.5 | 385.5 | -287.1 | 40.5 |
| M. Eocene | Dilwyn Fm. | 426.0 | 426.0 | -327.6 | 247.6 |
| E. Eocene | Pember Mudstone | 680.0 | 673.6 | -575.2 | 58.8 |
| E–L. Palaeocene | Pebble Point Fm. | 745.0 | 732.4 | -634.0 | 72.1 |
| L. Cretaceous | Paaratte Fm. | 825.0 | 804.5 | -706.1 | 308.2 |
| L. Cretaceous | Skull Creek Mbr. | 1165.0 | 1112.7 | -1014.3 | 130.8 |
| L. Cretaceous | Nullawarre Greensand | 1307.5 | 1243.5 | -1145.1 | 77.4 |
| L. Cretaceous | Belfast Fm. | 1393.0 | 1320.9 | -1222.5 | 104.8 |
| L. Cretaceous | Waarre Fm. (Unit C) | 1509.0 | 1425.7 | -1327.3 | 65.5 |
| L. Cretaceous | Eumeralla Fm. | 1581.0 | 1491.2 | -1392.8 | 64.4 |
| | T.D. (Logs) | 1651.0 | 1555.6 | -1457.2 | |

## 3.4 Hydrocarbon Shows

The only significant gas shows encountered while drilling North Paaratte-4 were from the Unit "C" sand of the Waarre Formation and from thin sands in the Upper Eumeralla Formation.

Waarre Formation.

At North Paaratte-4 Unit "C" of the Waarre Fm. consists of an upper sand interval from 1509 to 1528m, a middle siltstone interval from 1528 to 1555m with sandstone interbeds and a lower siltstone interval from 1555 to 1581m.

A maximum of 200 units of gas (94/5/1) was recorded at 1510m (1426.6m TVD) while drilling the top Unit "C" sand. From there to the base of the sand at 1528m (1442.9m TVD) the gas readings decreased steadily to 20 units. Log evaluation of the sand indicates it to be gas saturated over the whole of this interval.

The actual present gas water contact determined from log analysis on North Paaratte-5 is between 1452.4 and 1454.5m. TVD (=1538.5-1540.8m in NP-4).

Within the middle siltstone interval there was a sand from 1534.5 to 1536.0m (1448.8-1450.1m TVD) which had fair porosity and is probably gas saturated. At the base of this interval there are two sands developed between 1549.5 and 1555.0m (1462.4-1467.5m TVD) which are separated by a small "shale" break. Log analysis of these sands indicate both of them to have good porosity with the upper sand having some gas saturation and the lower sand being 100% water saturated. The upper sand had gas readings up to 90 units while the lower sand had very low gas readings. It is probably that the upper sand was at or above the original field gas water contact of –1365m sub-sea (= 1550.6m MD / 1463.4m TVD and it has probably retained some of its original gas in place. Field gas production has subsequently raised the gas water contact to a current depth of about –1354m sub-sea (= 1548.6m MD / 1452.4m TVD)

Gas readings stayed low (< 10 units) throughout the lower siltstone of Unit "C".

Eumeralla Formation

Gas readings up to 50 units were recorded from poor to fair porosity sands in the Eumeralla Formation, but log analysis confirms their poor reservoir character and indicates them to be water saturated.

## 4.0 DISCUSSION AND CONCLUSIONS

North Paaratte-4 achieved its objective of establishing gas reserves in the Waarre "C" sandstone and confirmed the excellent reservoir character of the sandstone.

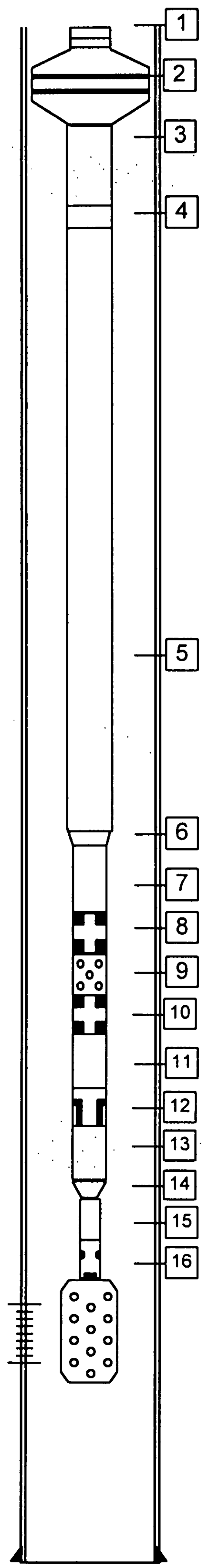
These results indicate that the North Paaratte structure should be suitable for gas production and re-injection and as a swing producer to meet peak gas demand.

No significant problems were encountered while drilling and the well was drilled in approximately 7.5 days compared to a budgeted time of 10.5 days.

BEPL

# Downhole Installation Diagram

**Well:** North Paaratte #4




**PBTD: 1592 mKB**

| Ite No. | Description | Length (m) | Depth (m KB) | Min ID (in) |
|---|---|---|---|---|
| 1 | KB to top of tubinghead spool | 4.50 | | |
| 2 | Hanger, 6" x 4-1/2" EUE box x box | 0.39 | 4.50 | 4.000 |
| 3 | 1jts 4-1/2" EUE, 12.75ppf,J55, R2 tbg | 9.62 | 4.89 | 3.958 |
| 4 | 4-1/2" pup joints | 4.24 | 14.51 | |
| 5 | 153 jts, 4-1/2" EUE, 12.75 ppf, J55, R2 tbg | 1463.11 | 18.75 | |
| 6 | Crossover, 4-1/2" EUE x 3-1/2" EUE | 0.39 | 1481.86 | |
| 7 | Pup joint, 10' x 3-1/2" | 3.08 | 1482.25 | |
| 8 | X nipple, 3-1/2" EUE, (2.750 X) | 0.43 | 1485.33 | 2.750 |
| 9 | Pup joint, 8' x 3-1/2" perforated | 2.43 | 1485.76 | |
| 10 | XN nipple, 3-1/2" EUE, (2.750 X, 2.635 NoGo) | 0.44 | 1488.19 | 2.635 |
| 11 | Pup joint, 8' x 3-1/2" | 2.43 | 1488.63 | |
| 12 | 3-1/2" EUE Gun Release sub | 1.1 | 1491.06 | 2.965 |
| 13 | Pup joint, 6' x 3-1/2" | 2 | 1492.16 | |
| 14 | Crossover, 3-1/2" EUE x 2-3/8" EUE | 0.15 | 1494.16 | |
| 15 | One joint x 2-3/8" EUE, 4.7 ppf, J55, R2 tbg | 9.53 | 1494.31 | |
| 16 | 2-3/8" EUE open firing Head | 1.51 | 1503.84 | |
| 17 | 4-1/2" TCP Guns (Safety spacer) | 3.63 | 1505.35 | |
| | **Top Shot** | | 1508.98 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| PERFORATIONS | | Gun | | Charges | | | |
|---|---|---|---|---|---|---|---|
| **Formation** | **Interval (m KB)** | **Size** | **Typ** | **SPF** | **Typ** | **Ph** | **gm** |
| Waarre Formation | 1509.0 - 1515.0 | 4.5" | TCP 34JL | 12 | HM | 45 | 21.3 |

| | |
|---|---|
| **Surface Casing** | 9-5/8", 36ppf, K55, BTC @ 401.1 mKB |
| **Production Casing** | 7", 26 ppf K55 BTC @ 1606.5 mKB |
| **Cementing Details** | 500 sacks class G + 1% Halad 322 |
| **Remarks** | |
| | |

| | | | |
|---|---|---|---|
| **String Weight Calculated** | 55,000 | **Actual** | 50,000 |

| | | | | |
|---|---|---|---|---|
| Wellsite Supervisor | Barry Beetson | | | Not to Scale |
| Date of Installation | 12/04/99 | | | Proposed |
| Drafted by | RAN | Date: | 15/04/99 | Re-Completion |
| Checked by | RAN | Date: | 15/04/99 | Completion X |

Figure 5

## 5.0 COMPLETION

The completion of North Paaratte-4 was carried out between 11th April 1999 and 13th April 1999. Wellsite supervision was provided by Barry Beetson.

After the well had been cased and cemented, the well was immediately completed using the drilling rig (Century Rig 2).

The well was perforated with approximately 1000 psi underbalance using 4-1/2" TCP guns suspended on 4-1/2" EUE tubing. A packer was not used in this completion and a bit and scraper trip was consequently not carried out.

A 4-1/16" 3,000 psi wellhead was installed on the well.

Immediately post perforation and clean up flow, a PX plug and prong was set in the tailpipe to allow the tubing to be bled to zero - as a safety precaution for rigging down and moving out the drilling rig.

## 6.0 REFERENCES

Oil Company of Australia Limited; Drilling Program : PPL-1 : North Paaratte-4, Unpublished report prepared for Boral Energy Petroleum Limited, February 1999.

Fawcett W.R.; Proposal to Drill North Paaratte 4, PPL 1, Otway Basin Victoria, Unpublished report prepared for Boral Energy Resources Limited, February 1999.

## APPENDIX 1

## CUTTINGS DESCRIPTIONS

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 20 (1.7) | 100 | CALCARENITE, white to yellow-orange, fossil fragments, (bryozoan, shell) with subordinate clear to white medium to coarse, sub-rounded to rounded, moderate sorted, loose quartz grains, rare black medium to coarse, spherical ironstone nodules, fair to good porosity. | |
| 30 (1.7) | 100 | CALCARENITE, a.a. – very fossiliferous and grades to limestone / coquina. | 0.0 (0:0:0:0:0) |
| 40 (2.4) | 100 | CALCARENITE, white to light grey, very fine to fine quartz grains, minor fossil fragments, calcite cement, friable, fair porosity. | 0.0 (0:0:0:0:0) |
| 50 (1.5) | 100 | CALCARENITE, a.a. | 0.0 (0:0:0:0:0) |
| 60 (0.9) | 100 | CALCARENITE, white to pale grey, very fine to fine quartz grains, sub-rounded, moderate to well sorted, argillaceous / calcareous matrix / cement, minor shell fragments, poor to fair porosity. | 0.0 (0:0:0:0:0) |
| 70 (1.5) | 100 | CALCARENITE, a.a. | 0.0 (0:0:0:0:0) |
| 80 (1.5) | 30<br>70 | CALCARENITE, a.a.<br>MARL, light to moderate grey to grey-brown, soft, silty, argillaceous. | 0.0 (0:0:0:0:0) |
| 90 (0.9) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 100 (0.7) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 110 (0.6) | 100 | MARL, light to moderate grey, soft, silty, argillaceous, pinkish white fossil fragments. | 0.0 (0:0:0:0:0) |
| 120 (0.7) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 130 (0.7) | 100 | MARL, a.a. – soft, silty, dispersive, fossiliferous. | 0.0 (0:0:0:0:0) |
| 140 (0.7) | 100 | MARL, a.a. – occasionally bluish grey. | 0.0 (0:0:0:0:0) |
| 150 (0.7) | 100 | MARL, light to moderate grey to bluish grey, soft, dispersive, very argillaceous, silty in part, fossiliferous. | 0.0 (0:0:0:0:0) |
| 160 (0.9) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 170 (0.9) | 100 | MARL, a.a. – fossiliferous. | 0.0 (0:0:0:0:0) |
| 180 (0.9) | 100 | MARL, a.a. – very argillaceous, very dispersive and very fossiliferous. | 0.0 (0:0:0:0:0) |
| 190 (1.4) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 200 (0.8) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 210 (0.7) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 220 (0.8) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 230 (0.8) | 100 | MARL, a.a. – very fossiliferous and dispersive. | 0.0 (0:0:0:0:0) |
| 240 (0.8) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 250 (1.0) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 260 (0.9) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 270 (1.2) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 280 (1.0) | 100 | MARL, moderate to dark grey to blue-grey, soft dispersive, very argillaceous, abundant white to pink fossil fragments. | 0.0 (0:0:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 290 (0.9) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 300 (0.9) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 310 (1.2) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 320 (1.6) | 100 | MARL, a.a. | 0.0 (0:0:0:0:0) |
| 330 (1.4) | 100 | MARL, a.a. – trace glauconitic pellets. | 0.0 (0:0:0:0:0) |
| 340 (2.4) | 40 | SANDSTONE, clear to translucent yellow-brown, dark, lustreous brown-black, very fine to medium, occasionally coarse, sub-rounded to well rounded quartz and ironstone grains, moderate sorted, loose, good porosity. | 0.0 (0:0:0:0:0) |
| | 60 | MARL, a.a. – very fossiliferous and grades to coquina. | |
| 350 (2.2) | 60 | SANDSTONE, clear to translucent-white, very fine to fine, sub-rounded, moderate to well sorted, loose quartz grains, abundant very fine to medium dark green to black glauconitic pellets, minor pyrite nodules, good inferred porosity. | 0.0 (0:0:0:0:0) |
| | 40 | MARL, a.a. | |
| 360 (1.4) | 30 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| | 70 | MARL, moderate brown, soft, dispersive, silty and argillaceous, pinkish white fossil fragments. | |
| 370 (1.7) | 100 | MARL, a.a. – moderate to dark brown and grey-brown, abundant (10%) pyrite, fossiliferous. | 0.0 (0:0:0:0:0) |
| 380 (1.6) | 100 | MARL, a.a. – (10%) pyrite. | 0.0 (0:0:0:0:0) |
| 390 (1.6) | 100 | MARL, moderate to dark brown, soft, silty, very argillaceous, abundant pyrite, very fossiliferous. | 0.0 (0:0:0:0:0) |
| 400 (1.1) | 100 | SILTSTONE, moderate to dark brown, soft to firm, argillaceous, grades to very fine sandstone, non-fissile, calcareous, very glauconitic (10%), very fossiliferous (10%), abundant pyrite. | 0.0 (0:0:0:0:0) |
| 410 (1.6) | 50 | SANDSTONE, dark green, fine to coarse, sub-rounded to well rounded, moderate sorted, loose glauconitic pellets. | 0.0 (0:0:0:0:0) |
| | 50 | SILTSTONE, a.a. | |
| 420 (2.3) | | CEMENT | 0.0 (0:0:0:0:0) |
| 430 (1.6) | 100 | SANDSTONE, clear to translucent yellow-brown, fine to very coarse, sub-rounded to well rounded, poor to moderate sorted, loose, polished iron stained quartz grains, glauconitic, good porosity. | 0.0 (0:0:0:0:0) |
| 440 (1.2) | 80 | SANDSTONE, a.a. – dispersive silty argillaceous matrix, minor glauconite, loose, good porosity. | 0.0 (0:0:0:0:0) |
| | 20 | SILTSTONE, light to moderate grey, occasional moderate to dark brown, very argillaceous, soft, dispersive. | |
| 450 (1.0) | 100 | SANDSTONE, a.a. – mostly very fine to medium, glauconitic, minor dispersive argillaceous matrix, predominantly loose, good porosity. | 0.0 (0:0:0:0:0) |
| | Tr | SILTSTONE, a.a. | |
| 460 (0.8) | 100 | SANDSTONE, a.a. – fine to coarse, sub-rounded to well rounded, poor to moderate sorted, minor glauconite, rare pyrite, silty dispersive clay matrix, loose, good porosity. | 0.0 (0:0:0:0:0) |
| 470 (0.6) | 70 | SANDSTONE, light yellow-brown, very fine to medium, sub-angular to well rounded, poorly sorted, trace glauconite, loose, dispersive silty clay matrix, fair inferred porosity. | 0.0 (0:0:0:0:0) |
| | 30 | SILTSTONE, moderate grey-brown, soft, argillaceous, dispersive. | |
| 480 (0.7) | 90 | SANDSTONE, clear to light yellow-brown, very fine to medium, sub-angular to well rounded, poorly sorted, trace pyrite and glauconite, loose, trace silty dispersive clay matrix, good inferred porosity. | 0.0 (0:0:0:0:0) |
| | 10 | SILTSTONE, a.a. – grey, soft, dispersive. | |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 490 (0.6) | 100 | SANDSTONE, clear to light brown, fine to medium, sub-rounded to well rounded, poor to moderate sorted, common pyrite, glauconite and ironstone pellets, loose, no visible matrix or cement, very good porosity. | 0.0 (0:0:0:0:0) |
| 500 (0.5) | 100<br>Tr | SANDSTONE, clear to yellow, fine to medium, sub-angular to sub-rounded, moderate sorted, trace pyrite and glauconite, loose, no matrix or cement, very good porosity.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 510 (0.9) | 100 | SANDSTONE, clear to translucent brown, fine to coarse, sub-angular to rounded, moderate sorted, loose quartz grains, trace pyrite and mica flakes, trace silty dispersive clay matrix, good porosity. | 0.0 (0:0:0:0:0) |
| 520 (0.9) | 100 | SANDSTONE, clear to translucent white, fine to very coarse, sub-angular to rounded, moderate sorted, loose quartz grains, trace pyrite, very good porosity. | 0.0 (0:0:0:0:0) |
| 530 (1.0) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 540 (0.9) | 100<br>Tr | SANDSTONE, a.a. – trace glauconite and pyrite.<br>SILTSTONE, dark grey-brown, soft, dispersive, very argillaceous and grades to claystone. | 0.0 (0:0:0:0:0) |
| 550 (1.2) | 100<br>Tr | SANDSTONE, a.a. – moderately pyritic, sub-angular to rounded.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 560 (0.7) | 100<br>Tr | SANDSTONE, a.a. – fine to very coarse, sub-angular to well rounded, poor to moderate sorted, trace dispersive clay matrix, trace glauconite and pyrite, loose, good porosity.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 570 (0.8) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 580 (0.9) | 100 | SANDSTONE, clear to translucent white, fine to very coarse, sub-angular to rounded, moderate sorted, loose quartz grains, rare pyrite and glauconite, trace dispersive clay matrix, good porosity. | 0.0 (0:0:0:0:0) |
| 590 (1.2) | 90<br>10 | SANDSTONE, clear to light brown, fine to medium, sub-angular to rounded, poor to moderate sorted, abundant pyrite, minor ironstone pellets, trace glauconite, silty dispersive clay matrix, good inferred porosity.<br>SILTSTONE, moderate brown, very soft, argillaceous, dispersive. | 0.0 (0:0:0:0:0) |
| 600 (1.2) | 90<br>10 | SANDSTONE, a.a. – angular to sub-rounded, common pyrite, silty dispersive clay matrix, good inferred porosity.<br>SILTSTONE, moderate to dark brown, very soft, dispersive. | 0.0 (0:0:0:0:0) |
| 610 (0.7) | 100 | SANDSTONE, a.a. – trace glauconite and pyrite. | 0.0 (0:0:0:0:0) |
| 620 (1.9) | 70<br>30 | SANDSTONE, a.a. – fine to very coarse, sub-angular to rounded, loose quartz grains, trace glauconite and pyrite, dispersive silty clay matrix, good porosity.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 630 (1.2) | 100 | SANDSTONE, a.a. – medium to very coarse, rare pyrite and chert grains, loose, good porosity. | 0.0 (0:0:0:0:0) |
| 640 (1.2) | 80<br>20 | SANDSTONE, clear to translucent, medium to coarse, angular to sub-rounded, poor to moderate sorted, trace glauconite, silty dispersive clay matrix, fair to good inferred porosity.<br>SILTSTONE, moderate brown, very soft, dispersive. | 0.0 (0:0:0:0:0) |
| 650 (1.3) | 100<br>Tr | SANDSTONE, a.a. – clear to translucent, medium to coarse, angular to sub-rounded, moderate to well sorted, trace pyrite and glauconite, some silty dispersive clay matrix, good to very good inferred porosity.<br>SILTSTONE, a.a. – very soft, dispersive. | 0.0 (0:0:0:0:0) |
| 660 (1.0) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 670 (0.7) | 100<br>Tr | SANDSTONE, a.a. – trace pyrite, mica flakes and glauconite, loose, trace silty dispersive clay matrix.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 680 (0.6) | 90<br>10 | SANDSTONE, clear to translucent, fine to coarse, angular to rounded, poor to moderate sorted, trace pyrite and glauconite, silty dispersive clay matrix, loose, fair to good inferred porosity.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 690 (1.7) | 60<br>40 | SANDSTONE, clear to translucent yellow, very fine to fine, moderate sorted, sub-angular to rounded, trace pyrite and glauconite, abundant clay matrix, dispersive, poor inferred porosity.<br>CLAYSTONE, light grey-brown, very soft, argillaceous, dispersive. | 0.0 (0:0:0:0:0) |
| 700 (1.8) | 70<br>30 | SANDSTONE, clear to translucent, very fine to fine, angular to sub-rounded, well sorted, trace glauconite and pyrite, common dispersive clay matrix, pip.<br>CLAYSTONE, grey, very soft, argillaceous, dispersive. | 0.0 (0:0:0:0:0) |
| 710 (1.0) | 20<br>80 | SANDSTONE, a.a. – very fine, well sorted, abundant clay matrix.<br>CLAYSTONE, a.a. – light grey, moderate to dark grey. | 0.0 (0:0:0:0:0) |
| 720 (1.0) | 10<br>90 | SANDSTONE, a.a. – very fine to fine, moderate to well sorted.<br>CLAYSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 730 (1.2) | 10<br>90 | SANDSTONE, a.a. – very fine, moderate to well sorted, trace pyrite and glauconite, abundant clay matrix, pip.<br>CLAYSTONE, a.a. – grey to light brown, very soft, argillaceous, dispersive. | 0.0 (0:0:0:0:0) |
| 740 (1.4) | 10<br>90 | SANDSTONE, a.a. – trace mica and glauconite.<br>CLAYSTONE, a.a. – grey to light brown. | 0.0 (0:0:0:0:0) |
| 750 (1.0) | 10<br>90 | SANDSTONE, a.a. – abundant glauconite, very poor porosity.<br>CLAYSTONE, a.a. – grey, very soft, dispersive. | 0.0 (0:0:0:0:0) |
| 760 (0.9) | 80<br>20 | SANDSTONE, clear to translucent, medium to coarse, angular to sub-rounded, moderate sorted, common glauconite, dispersive clay matrix, fair inferred porosity.<br>CLAYSTONE, a.a. – grey, soft, dispersive. | 0.0 (0:0:0:0:0) |
| 770 (0.6) | 40<br>60 | SANDSTONE, clear to translucent, fine to coarse, sub-angular to sub-rounded, poor to moderate sorted, trace pyrite and glauconite, clay matrix, fair inferred porosity.<br>CLAYSTONE, grey to light brown, soft, sticky. | 0.0 (0:0:0:0:0) |
| 780 (0.6) | 100<br>Tr | SANDSTONE, a.a. – clear to translucent, medium to coarse, angular to sub-rounded, moderate to well sorted, trace glauconite and trace dispersive clay matrix, good inferred porosity.<br>CLAYSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 790 (0.6) | 100 | SANDSTONE, a.a. – clear to light yellow, trace pyrite and glauconite, trace clay matrix. | 0.0 (0:0:0:0:0) |
| 800 (0.8) | 70<br>30 | SANDSTONE, clear to translucent light yellow, fine to coarse, sub-angular to rounded, moderate sorted loose quartz grains, dispersive brown clay matrix, common silty ironstone nodules, rare glauconite, good porosity.<br>CLAYSTONE, moderate to dark brown to grey-brown, soft to occasionally firm, silty, dispersive. | 0.0 (0:0:0:0:0) |
| 810 (0.9) | 50<br>50 | SANDSTONE, clear to light translucent yellow, fine to coarse, angular to sub-angular, poor to moderate sorted, trace glauconite, loose quartz grains, soft dispersive clay matrix, fair porosity.<br>CLAYSTONE, grey to light brown, soft, dispersive. | 0.0 (0:0:0:0:0) |
| 820 (0.8) | 70<br>30 | SANDSTONE, a.a. – angular to sub-rounded, trace pyrite and glauconite, clay matrix.<br>CLAYSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 830 (0.7) | 100 | SANDSTONE, clear to translucent, fine to coarse, angular to sub-rounded, moderate sorted, trace glauconite, loose, unconsolidated quartz grains, very good porosity. | 0.0 (0:0:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 840 (0.7) | 100 | SANDSTONE, clear to translucent white, medium to very coarse, sub-angular to rounded, moderate sorted, loose quartz grains, very good porosity. | 0.0 (0:0:0:0:0) |
| 850 (0.7) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 860 (0.5) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 870 (0.6) | 100<br>Tr | SANDSTONE, a.a. – fine to very coarse, trace translucent yellow and grey quartzite grains, loose, good porosity.<br>SILTSTONE, moderate to dark grey to blue-grey, moderate to dark brown to black, soft to firm, argillaceous, occasionally carbonaceous and lignitic. | 0.0 (0:0:0:0:0) |
| 880 (0.6) | 100<br>Tr | SANDSTONE, a.a. – fine to coarse, occasionally very coarse, rare pyrite.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 890 (0.5) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 900 (0.6) | 100 | SANDSTONE, a.a. – fine to very coarse, predominantly medium to coarse, sub-angular to sub-rounded, moderate sorted loose quartz grains, minor pyrite, good porosity. | 0.0 (0:0:0:0:0) |
| 910 (0.6) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 920 (0.7) | 100 | SANDSTONE, a.a. – sub-angular, good porosity. | 0.9 (100:0:0:0:0) |
| 930 (1.0) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, light to moderate brown, light grey, soft to firm, argillaceous, occasionally lignitic. | 1.1 (100:0:0:0:0) |
| 940 (0.7) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 1.3 (100:0:0:0:0) |
| 950 (0.7) | 100 | SANDSTONE, a.a. – clear to translucent, medium to very coarse, sub-angular to sub-rounded, moderate sorted, loose quartz grains, rare grey quartzite grains, good porosity. | 0.5 (100:0:0:0:0) |
| 960 (0.9) | 100 | SANDSTONE, a.a. | 0.0 (100:0:0:0:0) |
| 970 (0.8) | 100 | SANDSTONE, a.a. – clear to translucent, medium to very coarse, sub-angular to sub-rounded, moderate sorted, loose quartz grains, good inferred porosity. | 0.0 (100:0:0:0:0) |
| 980 (0.9) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 990 (1.2) | 100 | SANDSTONE, clear to translucent, medium to coarse, angular to sub-rounded, well sorted, trace glauconite and pyrite, loose, good inferred porosity. | 0.0 (0:0:0:0:0) |
| 1000 (1.2) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1010 (1.0) | 100 | SANDSTONE, clear to translucent, fine to medium, angular to sub-rounded, moderate to well sorted, trace pyrite and glauconite, trace silty dispersive clay matrix, loose, good inferred porosity. | 0.0 (0:0:0:0:0) |
| 1020 (0.9) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1030 (0.7) | 100 | SANDSTONE, clear to translucent white, fine to coarse, angular to sub-rounded, poorly sorted, trace pyrite and carbonaceous material, trace silty clay matrix and calcite cement, fair inferred porosity. | 0.0 (0:0:0:0:0) |
| 1040 (0.8) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1050 (1.1) | 100 | SANDSTONE, clear to translucent, fine, angular to sub-rounded, well sorted,, abundant pyrite and glauconite, trace silty dispersive clay matrix, good inferred porosity. | 0.0 (0:0:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 1060 (1.2) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1070 (1.2) | 100 | SANDSTONE, clear to translucent, fine to medium, well rounded, moderate to well sorted, trace pyrite, glauconite and carbonaceous material, trace silty dispersive clay matrix, loose, good porosity. | 0.0 (0:0:0:0:0) |
| 1080 (1.0) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1090 (1.6) | 100 | SANDSTONE, clear to translucent, fine to medium, angular to rounded, occasionally well rounded quartz grains, well sorted, trace pyrite and glauconite, trace dispersive silty matrix, loose, good inferred porosity. | 0.0 (0:0:0:0:0) |
| 1100 (0.8) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1110 (1.1) | 100 | SANDSTONE, clear to translucent, occasionally light yellow-orange, fine to medium angular to rounded, poor to moderate sorted, common pyrite, trace glauconite, loose, good porosity. | 0.0 (0:0:0:0:0) |
| 1120 (1.4) | 100 | SANDSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1130 (1.0) | 90<br>10 | SANDSTONE, clear to translucent, fine to medium, sub-angular to sub-rounded, poor to moderate sorted, trace glauconite and carbonaceous material, soft dispersive clay matrix, loose, good porosity.<br>SILTSTONE, light grey, light brown, soft, dispersive, argillaceous. | 0.0 (0:0:0:0:0) |
| 1140 (1.1) | 90<br>10 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1150 (1.0) | 90<br>10 | SANDSTONE, clear to translucent white, fine to medium, sub-angular to sub-rounded, poorly sorted, abundant carbonaceous material, trace pyrite and glauconite, silty dispersive clay matrix, loose, good inferred porosity.<br>SILTSTONE, moderate to dark grey, very soft, dispersive. | 0.0 (0:0:0:0:0) |
| 1160 (1.0) | 90<br>10 | SANDSTONE, a.a. – clear to translucent, fine to medium, trace carbonaceous material, pyrite and glauconite, silty dispersive clay matrix, good porosity.<br>SILTSTONE, a.a. – light grey, light brown, very soft, argillaceous, dispersive. | 0.0 (0:0:0:0:0) |
| 1170 (1.6) | 80<br>20 | SANDSTONE, clear to translucent, fine to medium, sub-angular to sub-rounded, moderate to well sorted, common carbonaceous material, trace pyrite, silty dispersive clay matrix, poor inferred porosity.<br>SILTSTONE, moderate grey, very soft, dispersive, argillaceous, trace carbonaceous material. | 0.0 (0:0:0:0:0) |
| 1180 (4.9) | 80<br>10<br>10 | SANDSTONE, clear to translucent, some light yellow grains, fine to coarse, angular to sub-rounded, poorly sorted, trace glauconite and pyrite, trace silty dispersive clay matrix, loose, poor to fair porosity.<br>SILTSTONE, light grey, light brown, very soft, argillaceous, dispersive.<br>COAL, dull black, blocky, lignitic. | 0.0 (0:0:0:0:0) |
| 1190 (2.1) | 80<br>20 | SANDSTONE, a.a. – abundant carbonaceous material.<br>SILTSTONE, light grey-brown, very soft, dispersive, slightly carbonaceous. | 0.0 (0:0:0:0:0) |
| 1200 (2.0) | 60<br>40 | SANDSTONE, clear to translucent, occasionally light yellow, fine to medium, sub-angular to sub-rounded, moderate sorted, abundant pyrite, trace glauconite and carbonaceous material, light grey-brown dispersive silty clay matrix, loose, poor to fair porosity.<br>SILTSTONE, a.a. | 0.0 (0:0:0:0:0) |
| 1210 (3.5) | 30<br>70 | SANDSTONE, a.a. – abundant pyrite.<br>SILTSTONE, light to moderate grey to grey-brown, soft, dispersive, very argillaceous and grades to claystone in part, trace dark brown to black, very carbonaceous / lignitic. | 0.0 (0:0:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 1220<br>(3.1) | 20<br>80 | SANDSTONE, a.a. – minor pyrite and glauconite.<br>SILTSTONE, a.a. | 0.0<br>(0:0:0:0:0) |
| 1230<br>(2.0) | 100<br><br>Tr | SANDSTONE, clear to white, very fine to coarse, sub-angular to rounded, poorly sorted, minor pyrite and glauconite, dispersive clay matrix, calcite cement with some very fine grained aggregates, predominantly loose, good porosity.<br>SILTSTONE, a.a. | 0.0<br>(0:0:0:0:0) |
| 1240<br>(6.4) | 40<br><br>60 | SANDSTONE, clear to white, light yellow, very fine to coarse, sub-angular to rounded, poorly sorted, trace pyrite and glauconite, abundant silty dispersive clay matrix, poor inferred porosity.<br>SILTSTONE, moderate grey, light brown, very soft, dispersive, argillaceous, slightly carbonaceous. | 0.0<br>(0:0:0:0:0) |
| 1250<br>(5.8) | 80<br><br>20 | SANDSTONE, a.a. – occasional very fine grained calcite cemented aggregates.<br>SILTSTONE, a.a. – moderate to dark grey, very soft, dispersive. | 0.0<br>(100:0:0:0:0) |
| 1260<br>(2.8) | 70<br><br>30 | SANDSTONE, white, light yellow-brown, fine to coarse, angular to sub-rounded, poor to moderate sorted, trace pyrite and carbonaceous material, occasional very fine calcite cemented aggregates, dark grey dispersive clay matrix, predominantly loose, fair porosity.<br>SILTSTONE, moderate to dark grey, very soft to soft, carbonaceous. | 0.7<br>(100:0:0:0:0) |
| 1270<br>(4.1) | 50<br><br>50 | SANDSTONE, translucent to light yellow, fine to medium, angular to rounded, moderate sorted, trace glauconite and carbonaceous material, trace pyrite, dispersive clay matrix, poor inferred porosity.<br>SILTSTONE, moderate to dark grey, soft to very soft, argillaceous, carbonaceous. | 1.1<br>(100:0:0:0:0) |
| 1280<br>(6.0) | 10<br><br>90 | SANDSTONE, clear to white, fine to medium, angular to sub-rounded, moderate sorted, rare pyrite, abundant silty clay matrix, loose, poor inferred porosity.<br>SILTSTONE, moderate to dark grey, soft to very soft, dispersive. | 1.4<br>(100:0:0:0:0) |
| 1290<br>(4.3) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 1.3<br>(100:0:0:0:0) |
| 1300<br>(4.8) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 1.4<br>(100:0:0:0:0) |
| 1310<br>(4.1) | 100<br><br>Tr | SANDSTONE, clear to very light green, very fine to medium, sub-rounded, well sorted, common glauconite, trace light green silty dispersive clay matrix, loose, good inferred porosity.<br>SILTSTONE, white, light to medium green, very soft, dispersive. | 2.1<br>(100:0:0:0:0) |
| 1320<br>(0.7) | 100 | SANDSTONE, clear to light yellow, very fine to coarse, angular to sub-rounded, moderate to well sorted, rare pyrite, abundant glauconite, loose, good inferred porosity. | 2.1<br>(100:0:0:0:0) |
| 1330<br>(1.5) | 100 | SANDSTONE, clear to light yellow, very fine to coarse, sub-angular to sub-rounded, moderate to well sorted, abundant glauconite, trace silty clay matrix, good inferred porosity. | 1.7<br>(100:0:0:0:0) |
| 1340<br>(2.6) | 90<br><br>10 | SANDSTONE, clear translucent light yellow-orange, very fine to medium, sub-angular to rounded, moderate to well sorted, abundant glauconite, minor carbonaceous material, moderate greenish grey, dispersive clay matrix, good porosity.<br>SILTSTONE, moderate grey-brown, very soft, glauconitic, dispersive. | 2.2<br>(100:0:0:0:0) |
| 1350<br>(0.8) | 80<br><br>20 | SANDSTONE, a.a. – angular to sub-rounded, well sorted, abundant glauconite, greenish grey dispersive clay matrix, fair to good porosity.<br>SILTSTONE, a.a. – carbonaceous. | 2.8<br>(100:0:0:0:0) |
| 1360<br>(1.0) | 80<br>20 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 2.5<br>(100:0:0:0:0) |
| 1370<br>(1.2) | 100 | SANDSTONE, clear to light yellow, very fine to coarse, sub-angular to rounded, well sorted, abundant glauconite, rare pyrite and carbonaceous material, trace greenish grey silty dispersive clay matrix, loose, good inferred porosity. | 3.9<br>(100:0:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 1380 (1.0) | 100 | SANDSTONE, a.a. | 1.1 (100:0:0:0:0) |
| 1390 (1.4) | 100 | SANDSTONE, a.a. | 2.4 (100:0:0:0:0) |
| 1400 (3.3) | 60<br>40 | SANDSTONE, clear to light yellow, very fine to coarse, sub-angular to rounded, common glauconite and rare carbonaceous material, abundant grey-green soft dispersive clay matrix, poor inferred porosity.<br>SILTSTONE, a.a. – grey-green, very soft, dispersive, common glauconite, argillaceous, trace carbonaceous material. | 1.1 (100:0:0:0:0) |
| 1410 (5.1) | 60<br>40 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 0.6 (100:0:0:0:0) |
| 1420 (5.0) | 60<br>40 | SANDSTONE, clear to light yellow-orange, very fine to very coarse, angular to rounded, moderate to well sorted, abundant glauconite, rare pyrite, abundant grey-green soft, dispersive clay matrix, loose, poor inferred porosity.<br>SILTSTONE, a.a. | 2.0 (100:0:0:0:0) |
| 1430 (4.3) | 30<br>70 | SANDSTONE, translucent to white, pale yellow, very fine to medium, sub-angular to rounded, moderate to well sorted, abundant glauconite, rare pyrite, abundant moderate grey-green silty clay matrix, poor inferred porosity.<br>SILTSTONE, moderate grey-green, very soft, argillaceous, dispersive, abundant carbonaceous material. | 1.9 (99:1:0:0:0) |
| 1440 (3.6) | 40<br>60 | SANDSTONE, clear to translucent yellow, very fine to medium, sub-angular to well rounded, abundant glauconite, trace coal / carbonaceous material, trace pyrite, abundant grey-green dispersive clay matrix, poor inferred porosity.<br>SILTSTONE, a.a. – moderate grey-green, soft, dispersive, very argillaceous and grades to claystone, trace carbonaceous material. | 2.0 (96:4:0:0:0) |
| 1443 (4.1) | 20<br>80 | SANDSTONE, a.a.<br>SILTSTONE, light grey to moderate grey-green, soft, dispersive, very argillaceous and grades to claystone, trace carbonaceous material. | 1.3 (96:4:0:0:0) |
| 1446 (4.8) | 50<br>50 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 2.7 (96:4:0:0:0) |
| 1449 (3.9) | 20<br>80 | SANDSTONE, a.a.<br>SILTSTONE, a.a. – moderate grey to grey-green, soft, dispersive, very argillaceous and grades to claystone, glauconitic. | 2.3 (96:4:0:0:0) |
| 1452 (3.3) | 10<br>90 | SANDSTONE, a.a. – clear, loose, fine to coarse, sub-rounded quartz grains and abundant fine to medium sub-rounded dark green glauconite pellets.<br>SILTSTONE, a.a. | 1.0 (96:4:0:0:0) |
| 1455 (2.9) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 1.7 (96:4:0:0:0) |
| 1458 (5.5) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 2.0 (96:4:0:0:0) |
| 1461 (2.2) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 1.0 (95:5:0:0:0) |
| 1464 (2.3) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 6.3 (95:5:0:0:0) |
| 1467 (2.3) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 2.3 (96:4:0:0:0) |
| 1470 (2.6) | 10<br>90 | SANDSTONE, clear to translucent, very fine to medium, sub-rounded to well rounded, well sorted, abundant glauconite, some carbonaceous material, rare pyrite, abundant grey-green dispersive clay matrix, loose, poor inferred porosity.<br>SILTSTONE, a.a. | 2.0 (96:4:0:0:0) |
| 1473 (3.6) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 2.3 (95:5:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 1476 (4.6) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 3.3 (96:4:0:0:0) |
| 1479 (2.4) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 2.0 (94:6:0:0:0) |
| 1482 (2.3) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 4.3 (91:9:0:0:0) |
| 1485 (2.1) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 5.3 (93:7:0:0:0) |
| 1488 (2.5) | 20<br>80 | SANDSTONE, clear to translucent, very fine to fine, angular to sub-rounded, moderate to well sorted, abundant glauconitic, common pyrite, trace carbonaceous material, abundant moderate to dark grey clay matrix, predominantly loose, poor inferred porosity.<br>SILTSTONE, a.a. | 3.3 (96:4:0:0:0) |
| 1491 (3.5) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 4.3 (96:4:0:0:0) |
| 1494 (3.6) | Tr<br>100 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 6.7 (95:5:0:0:0) |
| 1497 (4.0) | Tr<br>100 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 6.3 (95:5:0:0:0) |
| 1500 (4.5) | Tr<br>100 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 4.3 (97:3:0:0:0) |
| 1503 (4.2) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 6.3 (97:3:0:0:0) |
| 1506 (4.0) | 40<br>60 | SANDSTONE, clear, fine to coarse, sub-angular, moderate sorted, loose quartz grains, trace pyrite and pyritic cement, good porosity.<br>SILTSTONE, a.a. | 19.7 (98:2:0:0:0) |
| 1509 (3.1) | 50<br>50 | SANDSTONE, clear, light yellow, fine to medium, sub-angular to rounded, moderate sorted, trace pyrite and glauconite, silty clay matrix, good porosity.<br>SILTSTONE, moderate to dark grey, soft, dispersive, very argillaceous and grades to claystone, trace carbonaceous material. | 78.3 (98:2:0:0:0) |
| 1512 (1.4) | 100<br>Tr | SANDSTONE, clear, very fine to coarse, angular to sub-rounded, moderate sorted, common pyrite and glauconite, trace silty clay matrix, predominantly loose, good porosity.<br>SILTSTONE, light brown to olive brown, dispersive, argillaceous. | 176.7 (96:4:0:0:0) |
| 1515 (1.4) | 100<br>Tr | SANDSTONE, white to translucent, very fine to coarse, angular to sub-rounded, poor to moderate sorted, common pyrite and glauconite pellets, trace silty clay matrix, good porosity.<br>SILTSTONE, a.a. | 126.3 (98:2:0:0:0) |
| 1518 (1.2) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 57.3 (94:6:0:0:0) |
| 1521 (1.5) | 90<br>10 | SANDSTONE, clear to white, fine to coarse, sub-angular to sub-rounded, poor to moderate sorted, predominantly loose quartz grains, abundant pyrite, trace grey, silty, argillaceous matrix, good porosity.<br>SILTSTONE, light to moderate grey to grey-brown, occasionally dark brown, soft to occasionally firm, dispersive, very argillaceous and grades to claystone. | 97.7 (98:2:0:0:0) |
| 1524 (1.2) | 30<br>70 | SANDSTONE, a.a.<br>SILTSTONE, a.a. – dispersive and grades to claystone. | 66.7 (98:2:0:0:0) |
| 1527 (1.5) | 30<br>70 | SANDSTONE, a.a.<br>SILTSTONE, light to moderate grey, occasionally grey-brown, soft, dispersive, very argillaceous and grades to claystone. | 21.0 (97:3:0:0:0) |
| 1530 (3.1) | 20<br>80 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 19.7 (97:3:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 1533 (4.0) | 30<br><br><br><br>70 | SANDSTONE, a.a. – also minor white to pale green, very fine to fine, sub-angular to sub-rounded, moderate sorted, lithic, feldspathic, greenish white clay matrix, silty slightly calcareous, friable to moderately hard, poor porosity.<br>SILTSTONE, a.a. | 27.0 (97:3:0:0:0) |
| 1536 (4.0) | 30<br><br><br><br>70 | SANDSTONE, clear, fine to coarse, loose, sub-angular to sub-rounded, moderate sorted, quartz grains, trace pyrite; also greenish white to pale green, silty to very fine, with abundant greenish white clay matrix.<br>SILTSTONE, pale grey to brownish grey, soft, silty, dispersive. | 26.7 (96:4:0:0:0) |
| 1539 (3.5) | 30<br><br>70 | SANDSTONE, a.a. – clear, loose, very fine to medium; also very fine, greenish white, silty, argillaceous.<br>SILTSTONE, light brown to grey-brown, very argillaceous, grades to claystone. | 19.0 (95:5:0:0:0) |
| 1542 (3.2) | 10<br>90 | SANDSTONE, a.a. – common pyrite and rounded glauconite pellets.<br>SILTSTONE, light grey to light greenish grey, soft, dispersive, very argillaceous and grades to claystone. | 19.7 (96:4:0:0:0) |
| 1545 (3.9) | 100 | SILTSTONE, a.a. – light grey to light greenish grey, light grey to grey-brown, soft, argillaceous. | 15.7 (95:5:0:0:0) |
| 1548 (4.4) | Tr<br>100 | SANDSTONE, a.a.<br>SILTSTONE, light to moderate grey to grey-brown, soft, dispersive, very argillaceous and grades to claystone. | 19.0 (94:6:0:0:0) |
| 1551 (1.7) | 30<br><br><br><br>70 | SANDSTONE, clear to white, rare greenish white, very fine to medium, occasionally coarse, sub-angular to sub-rounded, moderate sorted loose quartz grains, trace pyrite, minor glauconite, moderate dispersive clay matrix, occasionally calcareous, fair inferred porosity.<br>SILTSTONE, a.a. | 70.7 (96:4:0:0:0) |
| 1554 (2.1) | 80<br><br><br>20 | SANDSTONE, a.a. – very fine to medium, occasionally coarse to very coarse, sub-angular to sub-rounded, loose quartz grains, trace pyrite and glauconite, dispersive clay matrix, fair inferred porosity.<br>SILTSTONE, a.a. | 16.7 (93:7:0:0:0) |
| 1557 (2.7) | Tr<br>100 | SANDSTONE, a.a.<br>SILTSTONE, light to moderate grey to grey-brown, occasional grey-green, soft, dispersive, very argillaceous and grades to claystone. | 4.7 (98:2:0:0:0) |
| 1560 (5.0) | 10<br><br><br>90 | SANDSTONE, clear to translucent, very fine to medium, sub-angular to sub-rounded, moderate to well sorted, common pyrite and glauconite, loose, dispersive clay matrix, fair inferred porosity.<br>SILTSTONE, a.a. | 4.0 (97:3:0:0:0) |
| 1563 (5.6) | 10<br>90 | SANDSTONE, a.a.<br>SILTSTONE, a.a. – light grey to greenish grey, light grey-brown, soft, dispersive, very argillaceous and grades to claystone, occasional carbonaceous material. | 5.3 (97:3:0:0:0) |
| 1566 (5.5) | 100 | SILTSTONE, a.a. | 5.7 (96:4:0:0:0) |
| 1569 (3.9) | 100 | SILTSTONE, moderate grey to grey-brown, soft, dispersive, very argillaceous and grades to claystone. | 4.7 (96:4:0:0:0) |
| 1572 (4.6) | 100 | SILTSTONE, a.a. | 3.7 (96:4:0:0:0) |
| 1575 (4.5) | 100 | SILTSTONE, a.a. | 2.3 (95:5:0:0:0) |
| 1578 (3.8) | 40<br><br><br>60 | SANDSTONE, clear to translucent white, very fine to medium, occasionally coarse, sub-rounded, poorly sorted, loose quartz grains, trace yellow and green lithic / quartzite grains, poor inferred porosity.<br>SILTSTONE, a.a. – occasionally dark grey. | 2.3 (96:4:0:0:0) |
| 1581 (4.0) | 60<br>40 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 4.3 (98:2:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 1584 (3.0) | 70<br><br><br><br>30 | SANDSTONE, a.a. – clear to white, greenish white, common greenish white to greenish grey lithic / quartzite grains, abundant dispersive white to greenish white clay matrix, trace pyrite, friable to loose, poor porosity.<br>SILTSTONE, a.a. | 3.7 (97:3:0:0:0) |
| 1587 (3.9) | 80<br>20 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 5.7 (96:4:0:0:0) |
| 1590 (1.2) | 80<br><br><br><br>20 | SANDSTONE, white to greenish white, very fine to medium, sub-rounded, moderate sorted quartz grains, common moderate to dark green lithic / quartzite grains, trace glauconite, abundant white to greenish white clay matrix, slightly calcareous, friable, poor porosity.<br>SILTSTONE, a.a. | 8.7 (96:4:0:0:0) |
| 1593 (3.6) | 90<br>10 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 4.0 (96:4:0:0:0) |
| 1596 (3.3) | 80<br>20 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 25.3 (95:5:0:0:0) |
| 1599 (1.8) | 70<br>30 | SANDSTONE, a.a.<br>SILTSTONE, light to moderate grey to greenish grey, soft, dispersive, very argillaceous and grades to claystone. | 22.7 (96:4:0:0:0) |
| 1602 (2.1) | 100 | SANDSTONE, white to dark grey, fine to medium, occasionally coarse, sub-rounded, moderate sorted quartz and abundant light to dark green lithic / quartzite grains, predominantly loose, white dispersive clay matrix, poor porosity. | 6.3 (97:3:0:0:0) |
| 1605 (5.5) | 100 | SANDSTONE, a.a. | 6.3 (97:3:0:0:0) |
| 1608 (3.1) | 70<br><br><br><br>30 | SANDSTONE, clear to translucent white, light green, very fine to medium, sub-rounded, moderate to well sorted, rare pyrite, abundant light to dark green lithics, abundant dispersive clay matrix, poor porosity.<br>SILTSTONE, light to moderate grey to greenish grey, soft, dispersive, very argillaceous and grades to claystone. | 5.3 (97:3:0:0:0) |
| 1611 (3.3) | 70<br>30 | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 9.0 (96:4:0:0:0) |
| 1614 (2.3) | 100<br><br><br><br>Tr | SANDSTONE, clear to translucent, white to light green, loose quartz grains, very fine to medium, sub-angular to rounded, moderate to well sorted, abundant light to dark green lithics, light grey to light greenish grey dispersive clay matrix, good inferred porosity.<br>SILTSTONE, light grey to greenish grey, light brown to grey-brown, soft, dispersive, very argillaceous and grades to claystone. | 32.3 (94:5:1:0:0) |
| 1617 (2.0) | 100<br>Tr | SANDSTONE, a.a.<br>SILTSTONE, a.a. | 13.3 (95:5:0:0:0) |
| 1620 (1.8) | 100 | SANDSTONE, white to green, very fine to medium, sub-rounded, moderate to well sorted, loose quartz and grey-green to dark green (minor pinkish red) lithic / quartzite grains, trace white to greenish white dispersive clay matrix, fair inferred porosity. | 30.7 (96:4:0:0:0) |
| 1623 (1.6) | 100 | SANDSTONE, a.a. | 14.0 (97:3:0:0:0) |
| 1626 (3.6) | 100 | SANDSTONE, a.a. | 12.0 (97:3:0:0:0) |
| 1629 (1.9) | 100 | SANDSTONE, a.a. | 13.3 (97:3:0:0:0) |
| 1632 (1.2) | 100 | SANDSTONE, a.a. – clear to translucent white, light green, fine to medium, sub-angular to sub-rounded, well sorted, abundant dark green lithics, trace silty dispersive light brown to light green clay matrix, loose, fair to good inferred porosity. | 12.0 (97:3:0:0:0) |
| 1635 (1.4) | 100 | SANDSTONE, a.a. | 8.7 (97:3:0:0:0) |

| DEPTH (ROP) | | NORTH PAARATTE-4 LITHOLOGICAL DESCRIPTIONS | GAS (%) |
|---|---|---|---|
| 1638 (1.0) | 100 | SANDSTONE, a.a. | 8.0 (96:4:0:0:0) |
| 1641 (1.2) | 100 | SANDSTONE, a.a. | 6.7 (97:3:0:0:0) |
| 1644 (1.3) | 100 | SANDSTONE, a.a. | 10.0 (96:4:0:0:0) |
| 1647 (1.6) | 100 | SANDSTONE, a.a. | 10.0 (97:3:0:0:0) |
| 1650 (1.8) | 100 | SANDSTONE, a.a. | 11.7 (96:4:0:0:0) |
| | | TD = 1651m. @ 02.30 hours 09/04/1999 | |

## APPENDIX 2

## WIRELINE LOG ANALYSIS

907476 057

BORAL ENERGY
RESOURCES LIMITED

# PETROPHYSICS REPORT

# NORTH PAARATTE 4
# &
# NORTH PAARATTE 5

# PPL 1

# OTWAY BASIN

# VICTORIA

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*November 1999*

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

## APPENDICES



## ENCLOSURES

## SUMMARY

The petrophysical evaluation of the North Paaratte 4 &5 was conducted by Boral Energy Resources Ltd as part of a PPL1 reserves determination study. The evaluation used the methodologies of Dr Mark Deakin who was closely involved in the study and provided endorsement of the final results.

Volume of shale was calculated using the Clavier equation. Density Porosity and Shale Corrected Neutron Porosity were calculated and combined to produce Density-Neutron Porosity. Density-Neutron Porosity was calibrated to overburden corrected core porosity. Sonic Porosity and Vsh Porosity provided Badhole Porosity. Water Saturation was calculated using the Archie Equation. Core Permeability was crossplotted against Porosity, Water Saturation and Vsh. Permeability was predicted from a weighted average of these individual permeability relationships, with the weighting dependent upon the strength of each correlation.

Pay was determined within identified gas zones using a permeability cutoff of 0.3mD. A backup Vsh cutoff of 50% was added to ensure reservoir quality.

A summary of pay and pay statistics for the North Paaratte 4 and 5 wells is shown below;


| BORAL ENERGY - NORTH PAARATTE 4 & 5 PETROPHYSICS | | | | | | | |
|---|---|---|---|---|---|---|---|
| WELL | INTERVAL | PAY | Ave Vsh | Ave Sw | Ave Por | AveK | HC THK |
| NORTH PAARATTE 4 | C3-B | 18.09 | 0.10 | 0.45 | 0.22 | 324.21 | 2.21 |
| NORTH PAARATTE 5 | C1-TWE | 24.33 | 0.06 | 0.16 | 0.24 | 444.12 | 4.95 |

## 1.0 INTRODUCTION

This report documents the petrophysical evaluation of North Paaratte 4 and North Paaratte 5. The evaluation was part of a wider PPL1 reserves determination study for the North Paaratte, Wallaby Creek and Grumby gasfields.

The study applied the methodologies of Mark Deakin using Terrastation petrophysical software. Dr Deakin provided input on a Daily basis during the course of the study.

The North Paaratte, Wallaby Creek and Grumby gas fields were the focus of the study. However, the dataset was expanded to incorporate a number of other wells and fields within the vicinity of PPL1 for calibration purposes. Table 1 lists all wells which formed the dataset for the study.

**Table 1 – Well Dataset**

| FIELD | WELLS | WELLS | WELLS | WELLS |
|---|---|---|---|---|
| North Paaratte<br>Wallaby Creek<br>Grumby<br>Mylor<br>Skull Creek | North Paaratte 1<br>Wallaby Creek 1<br>Grumby 1<br>Mylor 1<br>Skull Creek West 1<br>Braeside 1 | North Paaratte 2<br>Wallaby Creek 2 | North Paaratte 4 | North Paaratte 5 |

## 2.0 EXPLORATION HISTORY OF PPL1 and THE PORT CAMBPBELL EMBAYMENT

The first hydrocarbon discovery in the Port Campbell embayment was made in 1959 when Frome-Broken Hill drilled the Port Campbell 1 exploration well. The well flowed gas from the Late Cretaceous Waarre Formation at an initial rate of 1.5 MMCFD. However, the rate declined rapidly and the discovery was deemed non-commercial.

The first commercial hydrocarbon discovery was made in 1979 when the North Paaratte 1 well was drilled by Beach Petroleum NL. The well was located on the southern flank of an elongate, east-west trending faulted anticline and intersected gas in the Waarre Formation. Subsequent testing flowed gas at rates of 9.5 MMCFD and confirmed a new field discovery. North Paaratte 2 was drilled in 1981 approximately 1.6km to the east and intersected a similar high deliverability reservoir in the Waarre Formation. North Paaratte 3 was located on separate structure to the east and failed to encounter a gas column.

Following the North Paaratte gas discovery, the Wallaby Creek and Grumby gas fields were discovered by Beach in 1981. Subsequent exploration led to the discovery of the Iona gas field in 1988 (Beach Petroleum NL) and the Boggy Creek $CO_2$ field in 1991 (GFE Resources).

In 1994, Bridge Petroleum and GFE discovered the Mylor 1 gas field immediately north of the North Paaratte gasfield. In the same year, GFE drilled the Langley-1 well which flowed $CO_2$ rich gas from the Waarre Formation. After acquiring the assets of GFE Resources, Basin Oil discovered the Skull Creek field in 1996. However, subsequent drilling at Skull Creek West 1 and Skull Creek North-1 proved the field to be much smaller than anticipated. In 1997, Santos and Basin drilled the Fenton Creek-1 well and flowed gas and condensate from the Waarre Formation.

After acquiring Basin's interest in PPL1, Boral Energy drilled the North Paaratte 4 and 5 wells updip of North Paaratte 1 and 2 in 1999. Both wells confirmed the continuity of the gas accumulation in the Waarre Formation at North Paaratte.

## 3.0 LOG DATASET

North Paaratte 4 and 5 was logged by Schlumberger using Platform Express (PEX). Table 2 provides details of the logging program in each well.

| TABLE 2 - PPL 1 WIRELINE LOGGING PROGRAMS | | | | | | |
|---|---|---|---|---|---|---|
| WELL | COMMENT | LOGS RECORDED | SUITE | RUN | LOGGED INTERVAL | |
| | | | | | TOP | BOTTOM |
| NTH PAARATTE 4 | Schlumberger | PEX(HALS)-BHC-RHOZ-TNPHI | 1 | 1 | 25 | 1648.7 |
| NTH PAARATTE 5 | Schlumberger | PEX(HALS)-BHC-RHOZ-TNPHI | 1 | 1 | 400 | 1591.71 |

## 4.0 TVD

North Paaratte 4 and 5 were drilled from a single drill pad and deviated 450m to the northwest and northeast respectively. Sperry Sun was contracted to provide directional drilling equipment and control during the drilling of these wells. Borehole dip and azimuth data provided by Sperry Sun was input into Terrastation and TVD calculated using a Minimum Radius of Curvature method.

**Figure 1 - North Paaratte 4, Well Path & TVD Calculation**

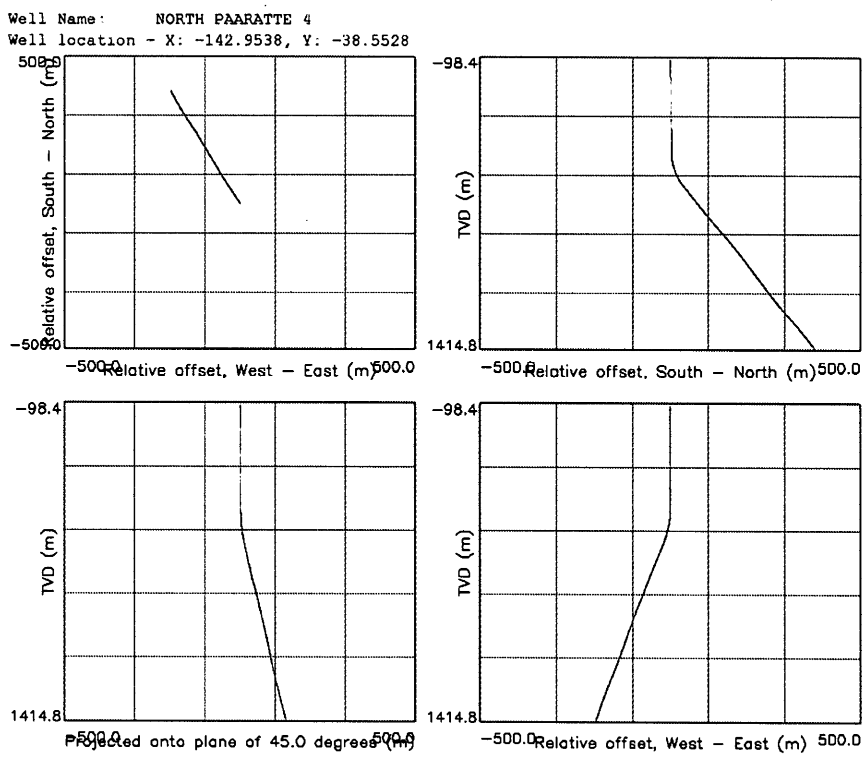
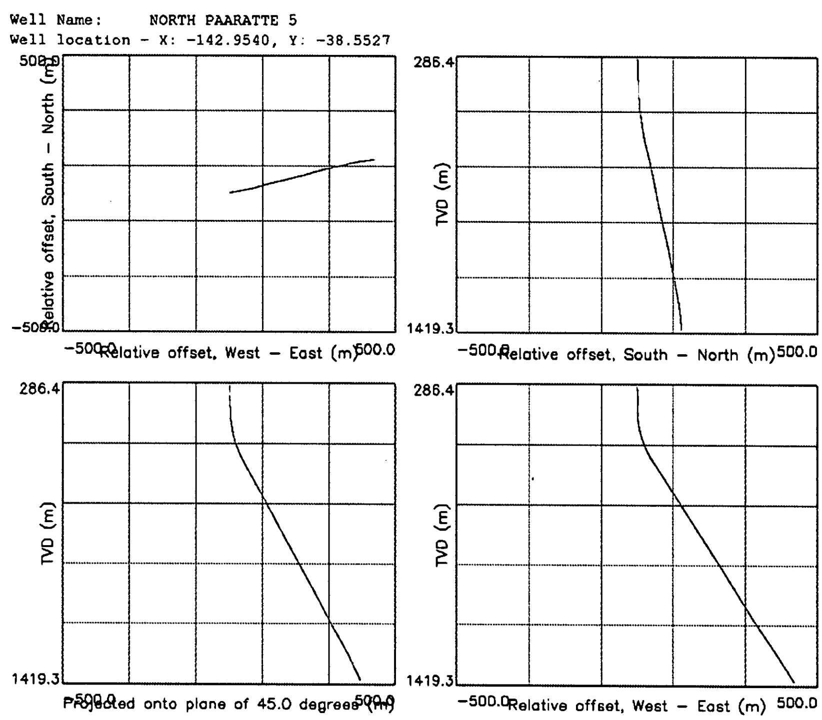



**Figure 2 - North Paaratte 5, Well Path & TVD Calculation**



## 5.0 DEPTH MATCHING

Schlumberger's Platform Express (PEX) was used to acquire wireline log data in North Paaratte 4 and North Paaratte 5. The PEX allows all conventional wireline instruments to be run during one pass, thus eliminating depth error.

# 6.0 ENVIRONMENTAL CORRECTIONS

## 6.1 Resistivity Logs

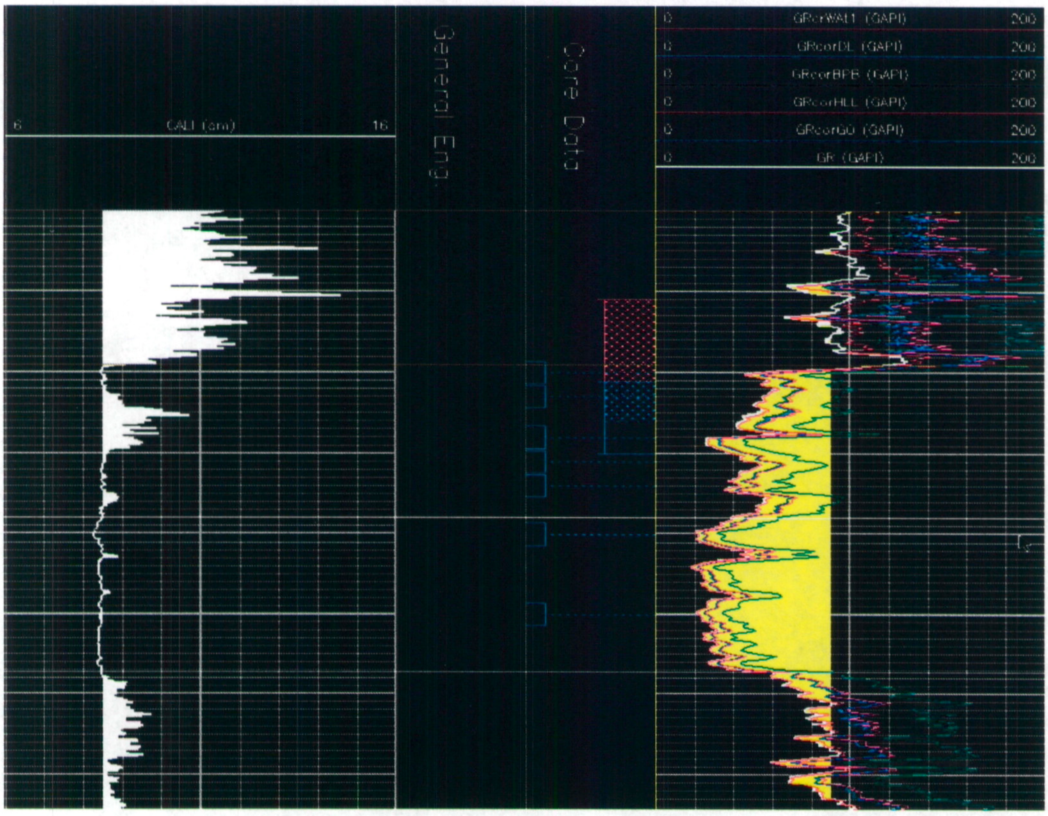
The Laterolog Resistivity Tools were environmentally corrected using standard correction algorithms taken from the Schlumberger chartbook. The MSFL was corrected using chart Rxo-3 whilst the LLS and LLD were corrected using chart Rcor-2.

In order to determine True Formation Resistivity (Rt), Invaded Zone Resistivity (Rxo) and Invasion Diameter (DI), Tornado Chart Rint-9a was applied. However, it was observed that the MSFL log performed erratically in Mylor 1, Grumby 1, Wallaby Creek 1&2, and North Paaratte 2, often recording resistivities greater than the deeper reading tools and occasionally showing "spiky" nature. For this reason it was decided to discard the Tornado chart calculated value of Rt and use Environmentally corrected LLD during subsequent Water Saturation calculations (Chapter 10).

## 6.2 Gamma Ray Logs

Environmental Correction of the GR curve could not be done using the Schlumberger correction algorithm within Terrastation. Several GR environmental correction algorithms were tested on North Paaratte 2. Figure 3 shows the relative magnitude of corrections provided by the different Service Company algorithms. The BPB Correction (dark green) provides a small correction in the sands and is not as severe as all other corrections in the shales. The BPB correction was considered the most believable and was used to correct the GR in all wells, including North Paaratte 4 and 5.

**Figure 3 – GR Correction, Nth Paaratte 2**



## 7.0 NORMALISATION

Logging tools were crossplotted over the Waarre Formation interval to investigate the presence of anomalous logs. Three crossplots were made, RHOB vs DT, GR vs TNPHI and RHOB vs LLD (Figure 4a, 4b, 4c). The Neutron log in North Paaratte 1 appears to be reading low relative to other wells. The evaluation proceeded without Normalisation but the TNPHI of North Paaratte 1 was monitored closely at each stage.

**Figure 4a – Normalisation Crossplot RHOB vs DT**

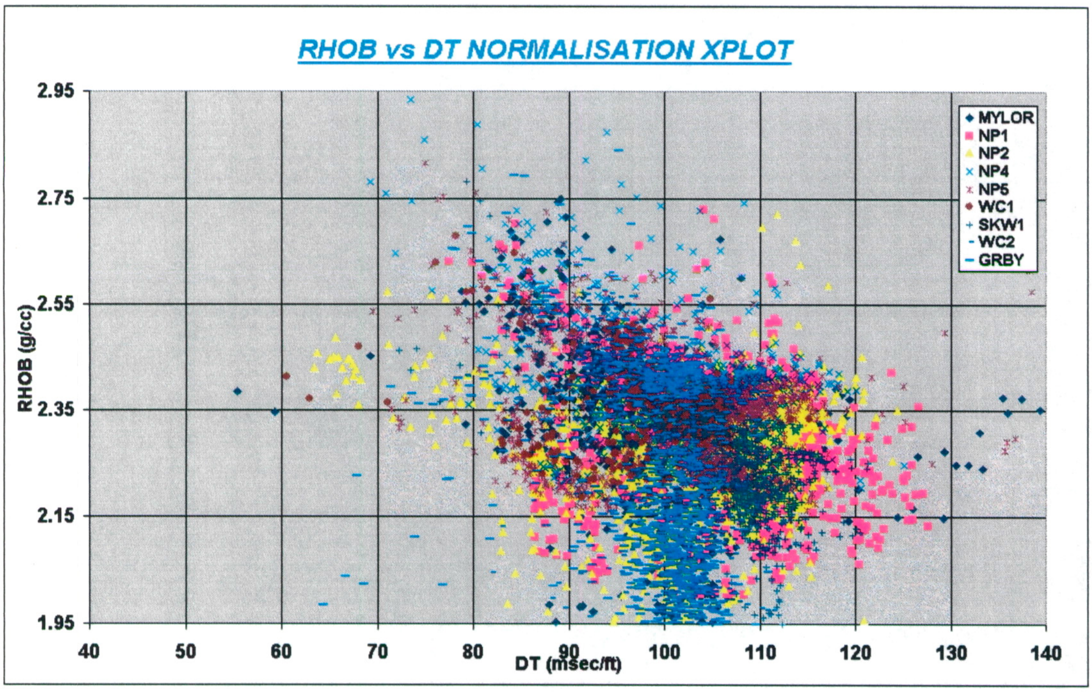
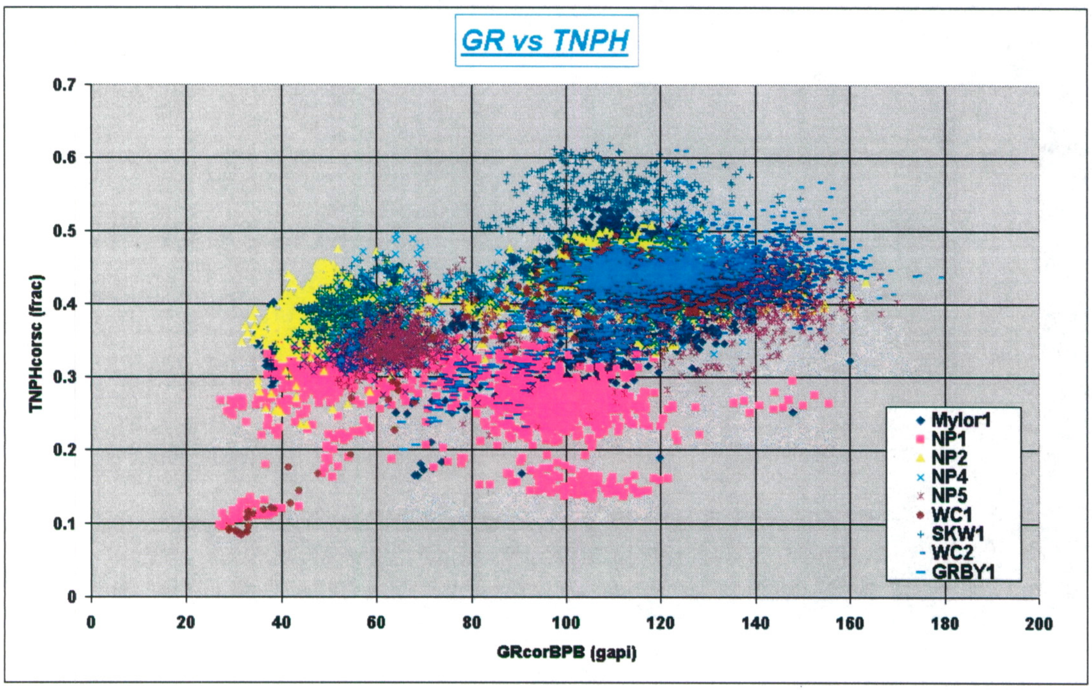
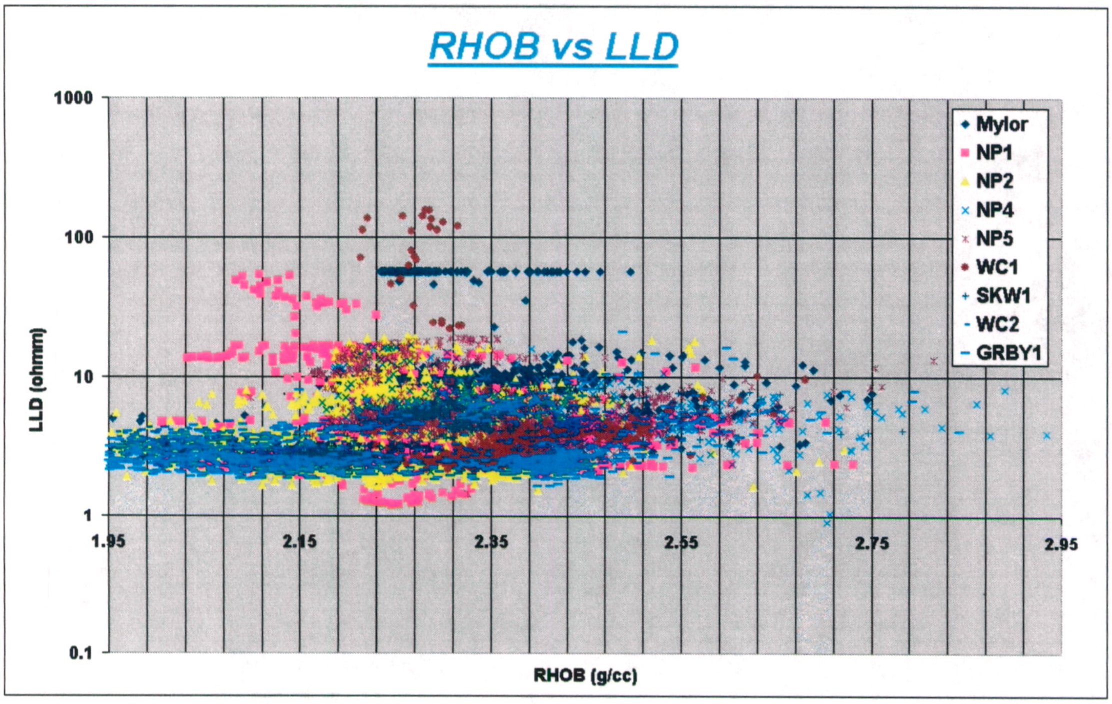



**Figure 4b – Normalisation Crossplot GR vs TNPH**



<u>**Figure 4c – Normalisation Crossplot, RHOB vs LLD**</u>



# 8.0 VOLUME OF SHALE

## 8.1 Gamma Ray Cut-Offs

Volume of Shale (Vsh) was determined using the Gamma Ray log. GR clean and GR shale cutoffs were determined for each well by picking the 5% and 95% values from histograms of environmentally corrected Gamma Ray (Figures 5a & 5b). Each individual well histogram was plotted over the same stratigraphic interval, namely the Waarre Formation (Units A to D). Table 4 shows the cutoffs which were determined for North Paaratte 4 and 5;

**Table 3 – GR Cutoffs for Vsh**

| WELL | GR clean GAPI | GR shale GAPI |
|---|---|---|
| North Paaratte 4 | 45 | 150 |
| North Paaratte 5 | 45 | 150 |

**Figure 5a – North Paaratte 4 GR Histogram**

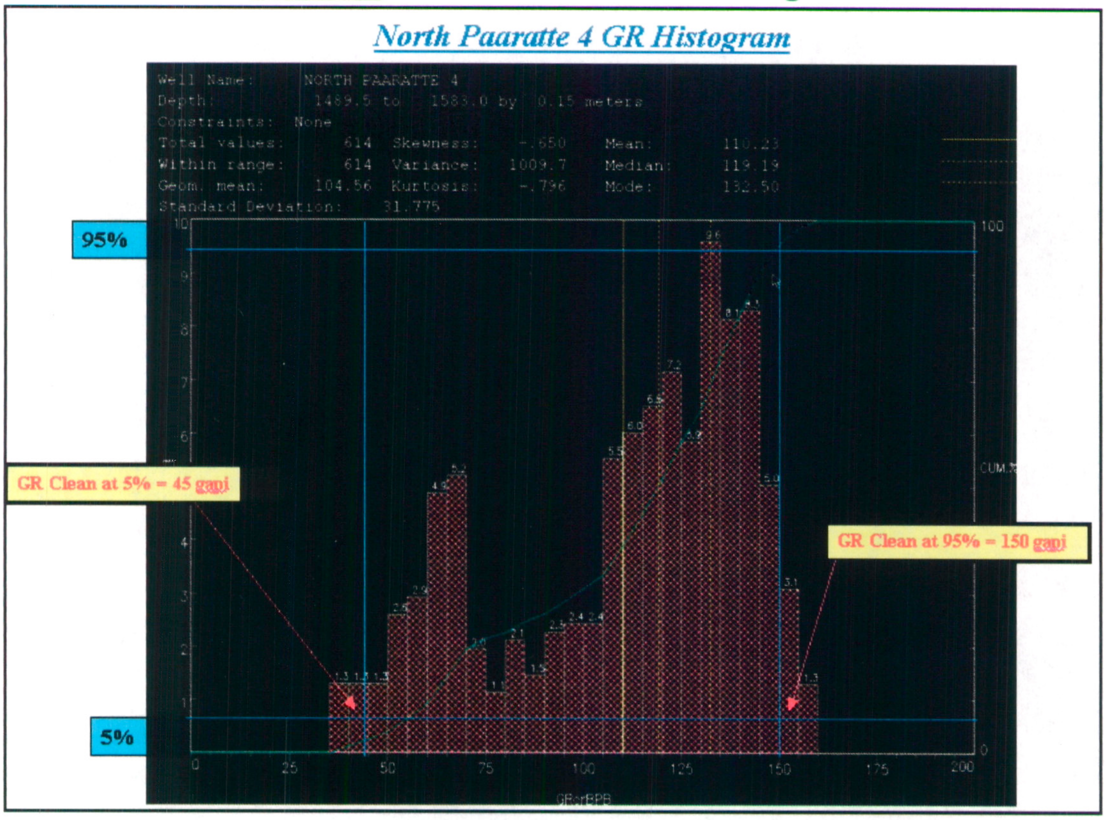
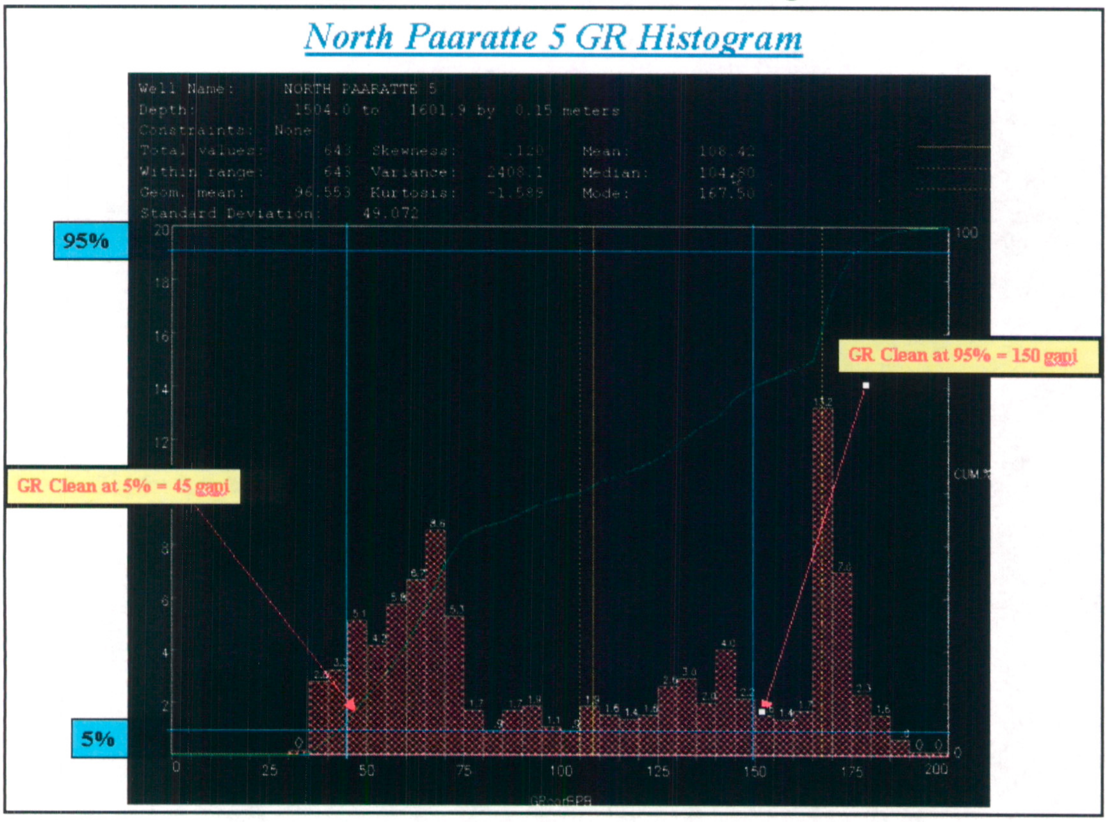


**Figure 5b - North Paaratte 5 GR Histogram**




### 8.2 Vsh Calculation

Six methods of Vsh Calculation were tested, three linear and three non-linear calculations.

#### 8.2.1 Linear Vsh

Three Linear Vsh Functions were evaluated, the standard Linear function, the Clavier function and the Steiber function. These Functions are listed below;

**LINEAR**

$$Vsh_{LINEAR} = \frac{(GR_{LOG} - GR_{CLEAN})}{(GR_{SHALE} - GR_{CLEAN})}$$ **Equation 1**

**CLAVIER**

$$Vsh_{CLAVIER} = 1.7 - \left[3.38 - \{[Vsh_{LINEAR}] + 0.7\}^2\right]^{0.5}$$ **Equation 2**

**STEIBER**

$$Vsh_{STEIBER} = \left\{\frac{0.5 * [Vsh_{LINEAR}]}{1.5 - [Vsh_{LINEAR}]}\right\}$$ **Equation 3**

Where;

| | | | |
|---|---|---|---|
| | $GR_{LOG}$ | = | Environmentally Corrected Gamma Ray Log Value |
| | $GR_{CLEAN}$ | = | Gamma Ray Clean Sand Value |
| | $GR_{SHALE}$ | = | Gamma Ray Shale Value |

### 8.2.2 Non-Linear Vsh

Linear Vsh is often viewed as pessimistic. A non-linear Vsh is more optimistic and provides for improved evaluation (Dewan 1983). If thin section data is available, non-linear Vsh can be tested by cross-plotting linear Vsh against Vcltx. A quadratic function applied to the data will give a customised non-linear Vsh function. Whilst thin section data was available for this evaluation, time constraints did not permit implementation of a customised non-linear Vsh function. However, Deakin (1999) suggests the use of the following non-linear function;

$$Vsh_{NONLINEAR} = 0.6 * Vsh_{LINEAR} + 0.4 * Vsh_{LINEAR}^2$$ **Equation 4**

This non-linear function was applied to the Linear, Steiber, and Clavier linear Vsh functions.

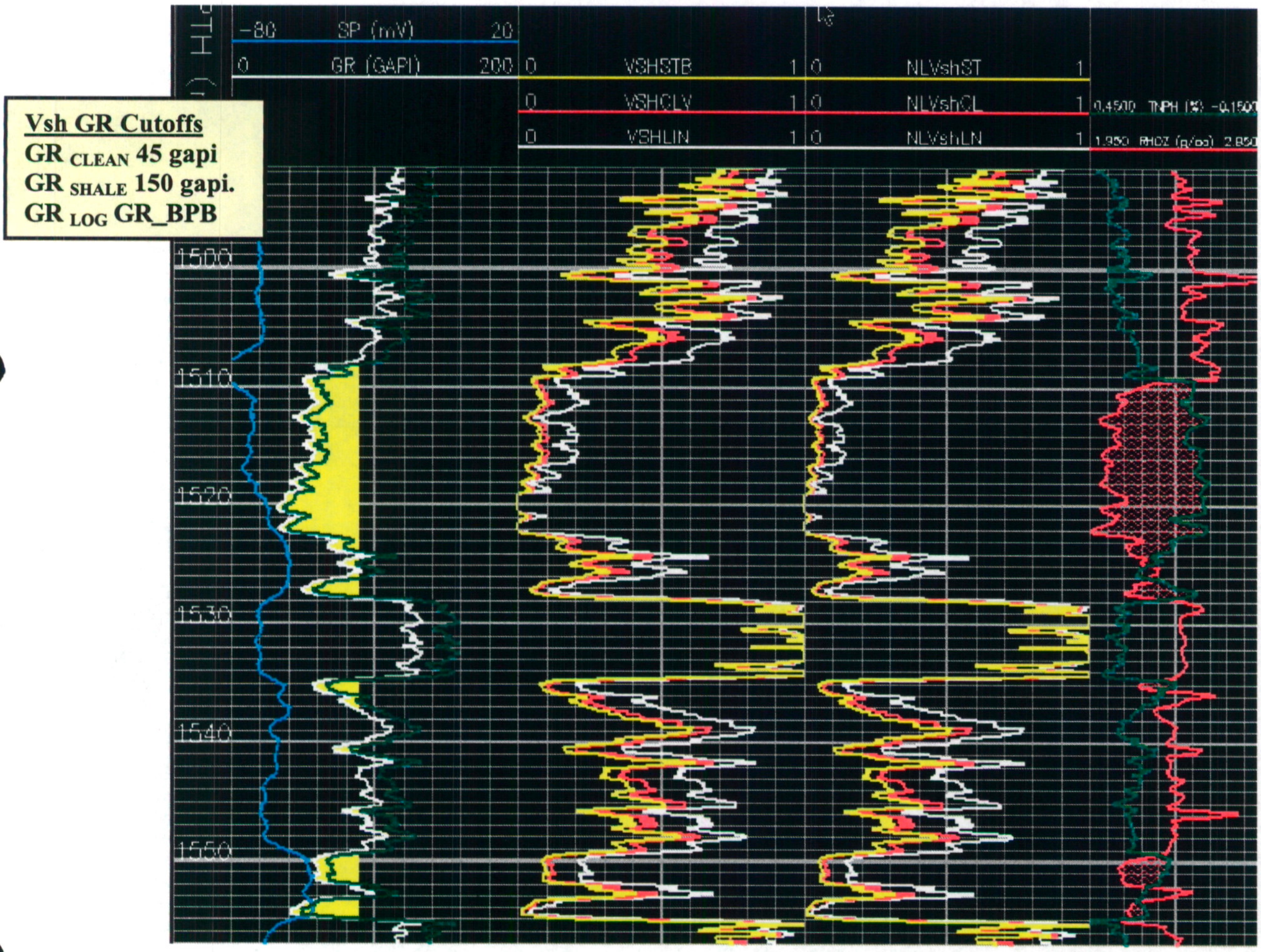
### 8.2.3 Final Vsh

The six Vsh techniques were applied to each well. Figure 6a shows the results of this process on the North Paaratte 4 well.

The results of the linear Vsh calculations were analysed and comparisons made against core and mudlog descriptions and core photographs. Following this analysis, it was decided to use a conservative linear Vsh function. The Clavier (red) Vsh Function was chosen to represent Volume of Shale for this evaluation.

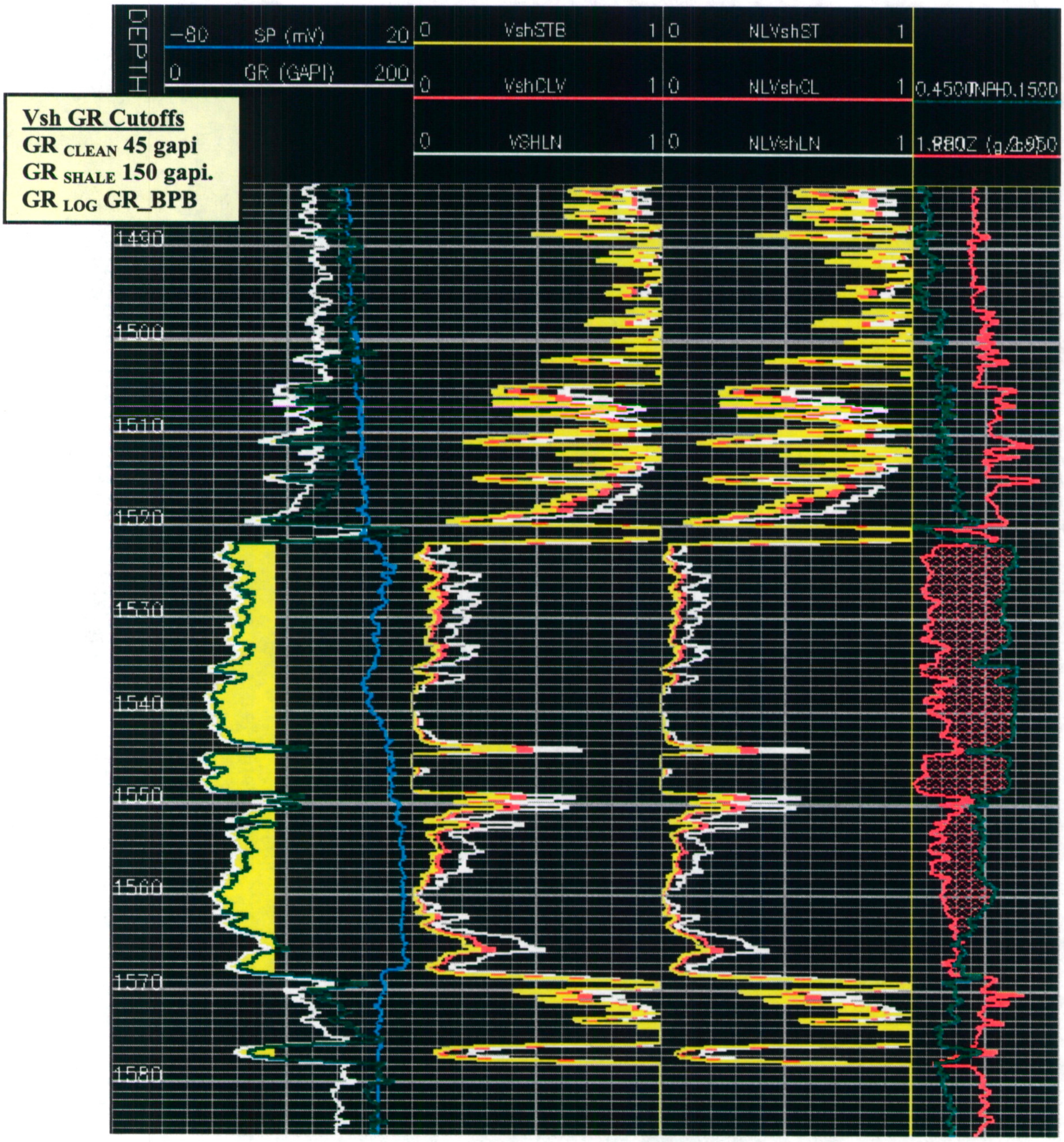
**Figure 6a - North Paaratte 4**

**Linear and Non-Linear Vsh Functions**



# Figure 6b - North Paaratte 5

**Linear and Non-Linear Vsh Functions**



# 9.0 POROSITY

## 9.1 Overburden Porosity Factor

Core Porosity, adjusted for overburden uniaxial stress, is most representative of reservoir conditions. Core compaction data is acquired under triaxial loading which requires less stress than uniaxially applied stress to achieve the same porosity reduction. 62% of the laboratory hydrostatic stress is assumed to be equivalent to reservoir uniaxial stress.

The reservoirs Net Overburden Stress (NOS) which acts uniaxially is approximated by;

$$NOS = \left( ft\_{TVDSS} * 1.00 \frac{psi}{ft} \right) - RFT_{FM\_PRESSURE(PSI)}$$ **Equation 5**

| Where; | | | |
|---|---|---|---|
| | NOS | = | Net Overburden Stress |
| | $RFT_{FM\_PRESSURE}$ | = | Formation Pressure recorded by the RFT Tool |
| | ft_TVDSS | = | Vertical Subsea Depth of Reservoir in Feet. |
| | 1.00 psi/ft | = | Formation Overburden is assumed at 1.00 psi/ft |

$$EQHS = 0.61 * NOS$$ **Equation 6**

Where; EQHS = Equivalent Hydrostatic Stress

| TABLE 4 - O/B POROSITY | Depth mSS | | | | Net Ovb Stress | Fm Pressure | EQV Lab Stress | Por Factor | Int Por Factor |
|---|---|---|---|---|---|---|---|---|---|
| | top | base | ave | ftSS | PSI | PSI | PSI | frac | frac |
| Wallaby Creek 1 | 1472 | 1484 | 1478 | 4849.067 | 4849.06674 | 2164 | 1637.890711 | | 0.928 |
| Wallaby Creek 2 | 1426 | 1461 | 1443.5 | 4735.878 | 4735.878105 | 2152 | **1576.165644** | **0.9702** | **0.935** |
| North Paaratte 2 | 1350 | 1364 | 1357 | 4452.086 | 4452.08631 | 1973 | 1512.242649 | | 0.942 |
| Grumby 1 | 1575 | 1595 | 1585 | 5200.116 | 5200.11555 | 2291 | 1774.560486 | | 0.913 |
| Skull Creek West 1 | 1187 | 1195 | 1191 | 3907.469 | 3907.46853 | 1758 | **1311.175803** | **0.9642** | **0.964** |
| Mylor 1 | 1566 | 1599 | 1582.5 | 5191.913 | 5191.913475 | 2344 | 1737.22722 | | 0.917 |
| Braeside 1 | 1358.3 | 1391.7 | 1375 | 4511.141 | 4511.14125 | 2018.793129 | **1520.332354** | **0.941** | **0.941** |

[1]

Core overburden porosity was measured at Wallaby Creek 2, Braeside 1, and Skull Creek West 1. However, porosity at EQHS needed to be interpolated because laboratory overburden porosity was measured at pressures in excess of 2000psi.

In order to calculate the Overburden Porosity Factor, Ambient Porosity was crossplotted against interpolated EQHS Porosity (Figures 7, 8, 9).

[1] No Formation Pressures were available for Braeside 1. Formation pressure at Braeside was interpolated from a Formation Pressure vs Depth Plot.

**Figure 7 – Skull Creek West 1.** Overburden Porosity at EQHS vs Ambient Porosity.

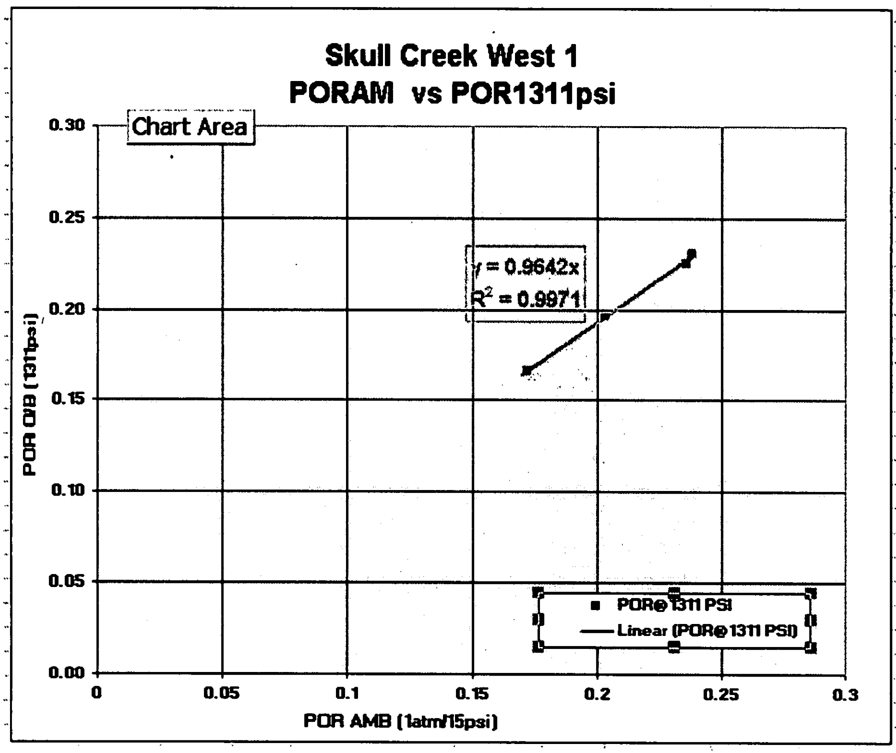



**Figure 8 – Braeside 1.** Overburden Porosity at EQHS vs Ambient Porosity.

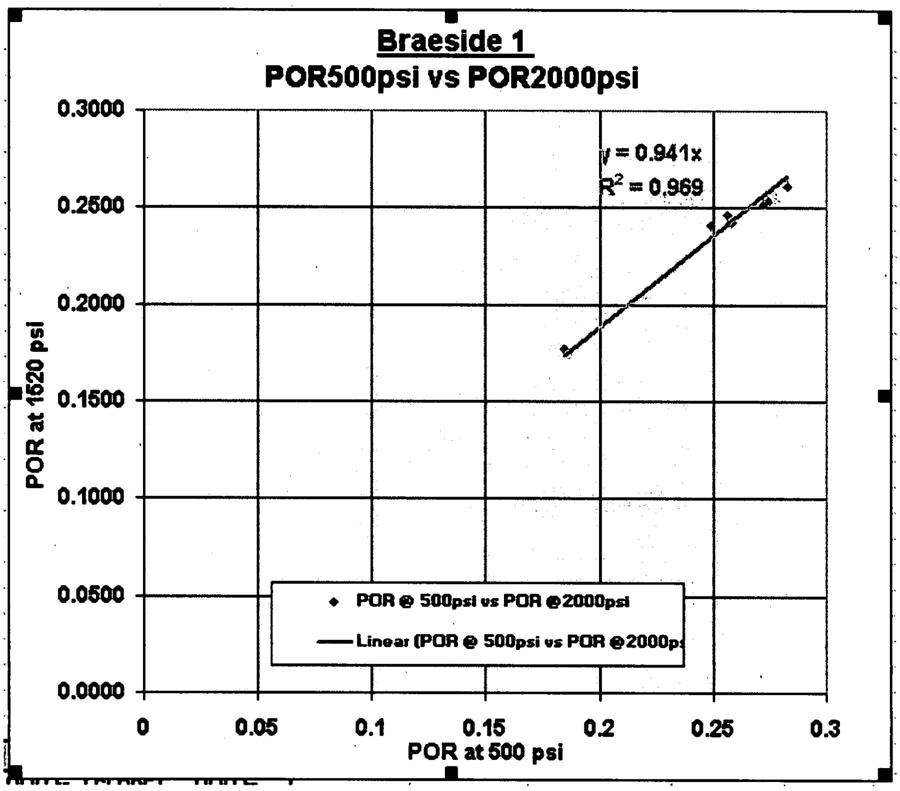
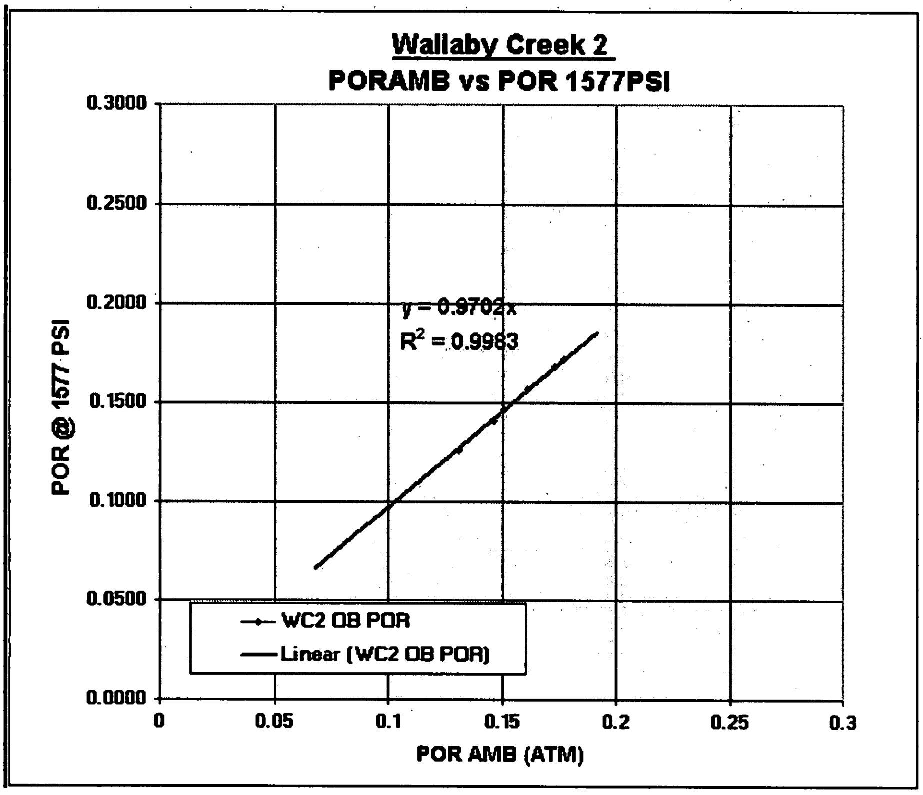
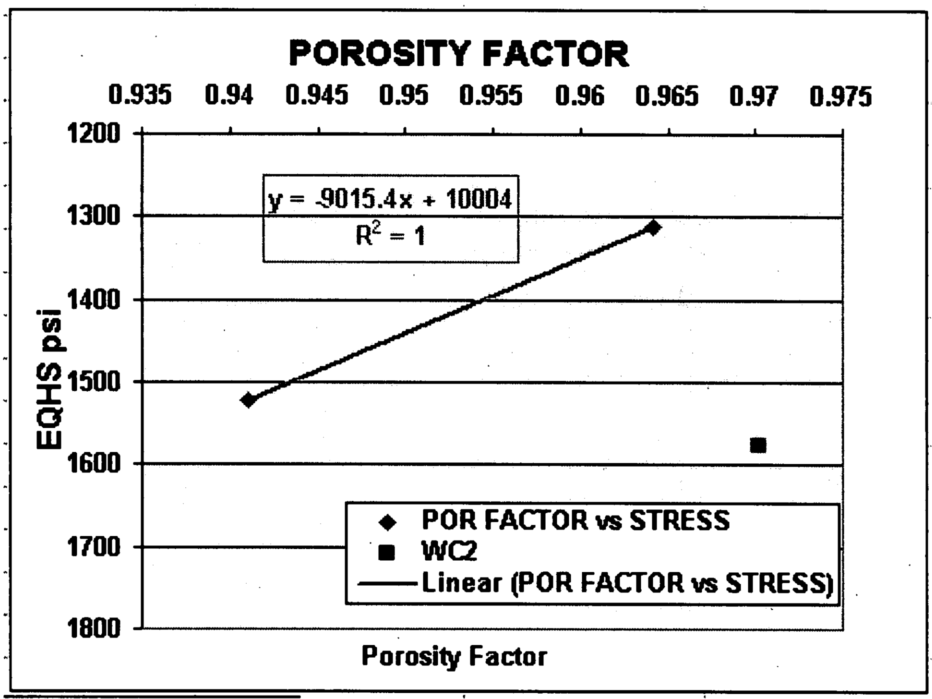


**Figure 9 – Wallaby Creek 2**
Overburden Porosity at EQHS vs Ambient Porosity.




For those cored wells without overburden porosity measurements, a Porosity Factor was interpolated by plotting Porosity Factor against EQHS. A trend was defined by Braeside 1 and Skull Creek West 1. However, Wallaby Creek 2 was excluded because it did not fit a realistic trend (Figure 10).

**Figure 10 – Interpolated Porosity Factor**

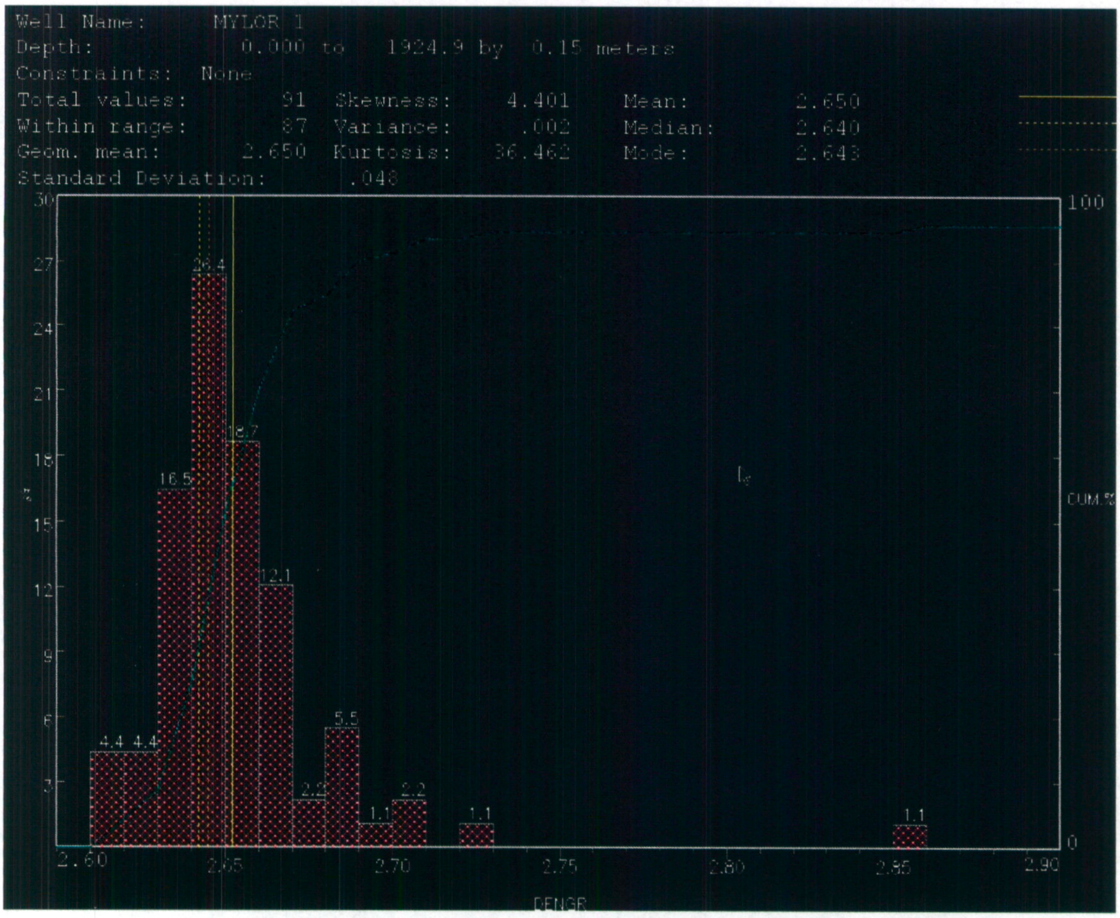


## 9.2 DENSITY POROSITY

### 9.2.1 Mean Grain Density

Mean grain densities (RHOg) were determined from histograms of core grain densities. Figure 11 shows a grain density histogram from the core of Mylor 1. The mean grain density was determined to be 2.65gm/cm$^3$.

**Figure 11 – Mylor 1 Grain Density Histogram**



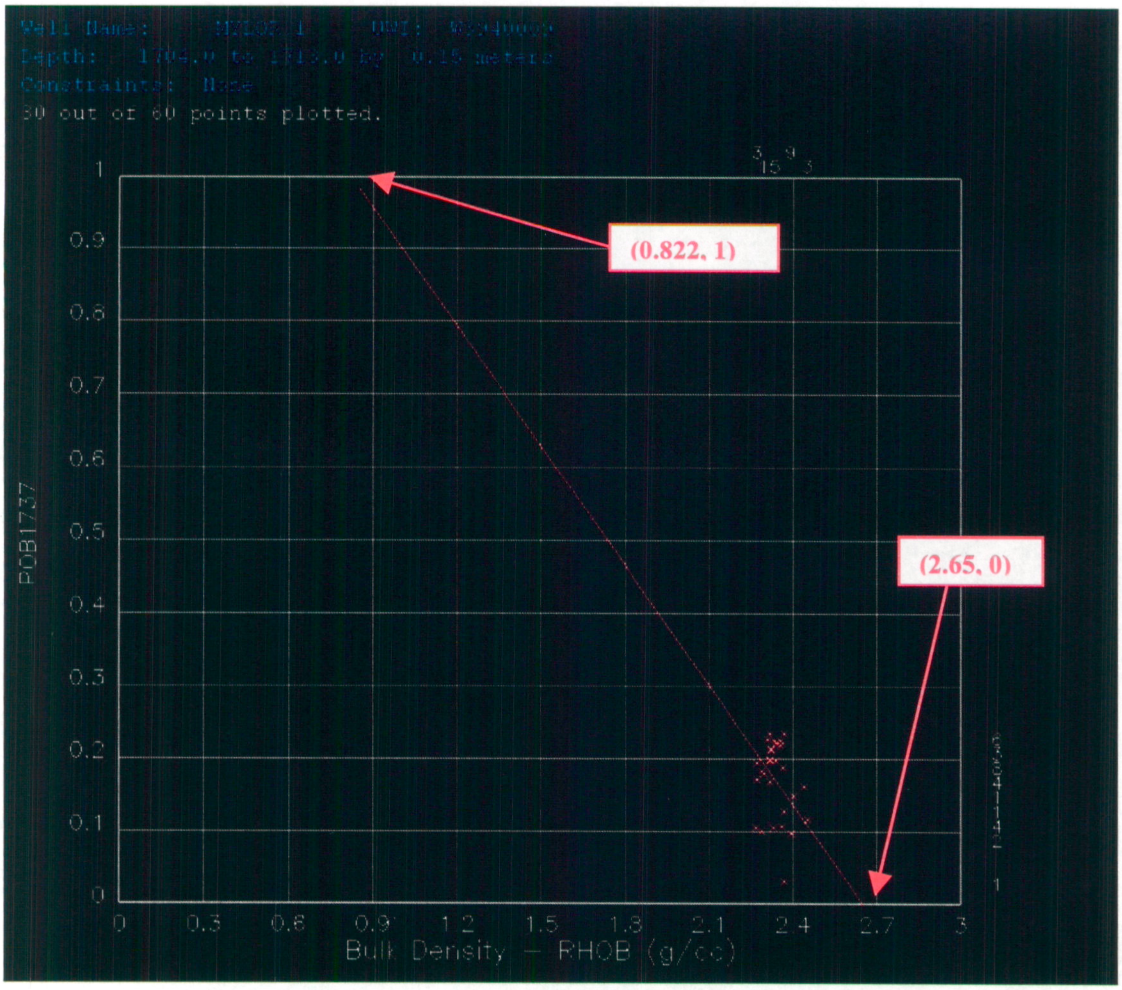

| TABLE 5 - MEAN GRAIN DENSITY | |
|---|---|
| | MEAN GRAIN DENSITY |
| NTH PAARATTE 2 | 2.68 |
| MYLOR 1 | 2.65 |
| SKULL CREEK WEST 1 | 2.67 |
| BRAESIDE 1 | 2.68 |
| WALLABY CREEK 2 | 2.70 |
| AVERAGE | 2.67 |

Table 6 lists mean grain densities derived from core grain density histograms. All of the above wells except Wallaby Creek 2 contain core within the Waarre "C" Sand. Wallaby Creek 2 cored the lower "A" Sand and top Eumeralla Formation. The average grain density for the Waarre "C" Sand excluded grain densities from Wallaby Creek 2. A grain density of 2.67 gm/cm3 was used in subsequent Density Porosity calculations.

### 9.2.2 Fluid Density

Fluid Density (RHOf) was determined by a fixed point regression of bulk density (RHOB) versus overburden core porosity (POB) for water and hydrocarbon zones. Figure 12 shows the Water Zone RHOf crossplot for Mylor 1;

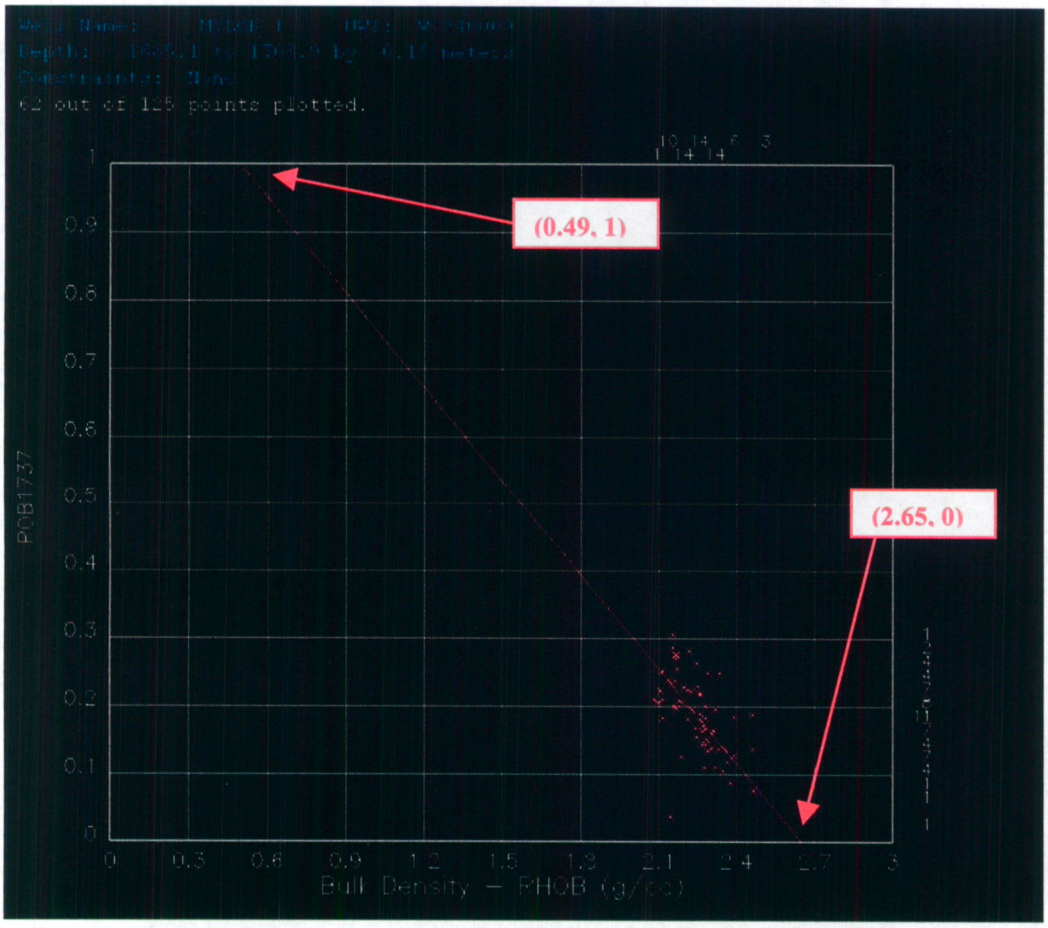
**Figure 12 – Mylor 1 RHOf Crossplot (Water Zone)**




Overburden Porosity at EQHS Pressure of 1737psi was crossplotted against RHOB (Bulk Density). At zero porosity, RHOB is equal to a RHOg of 2.65g/cc (determined previously from RHOg Histogram). This point provides a fixed point for the regression (2.65,0). If the regression line is extrapolated to a porosity of 1, this point represents the fluid density of the zone. In this case, the fluid density of the water zone is 0.822 g/cm$^3$.

A similar process was repeated for the gas zone at Mylor 1;

**Figure 13 – Mylor 1 RHOf Crossplot (Gas Zone)**




If this case, the Fluid Density of the gas zone was found to be 0.49 gm/cm$^3$.

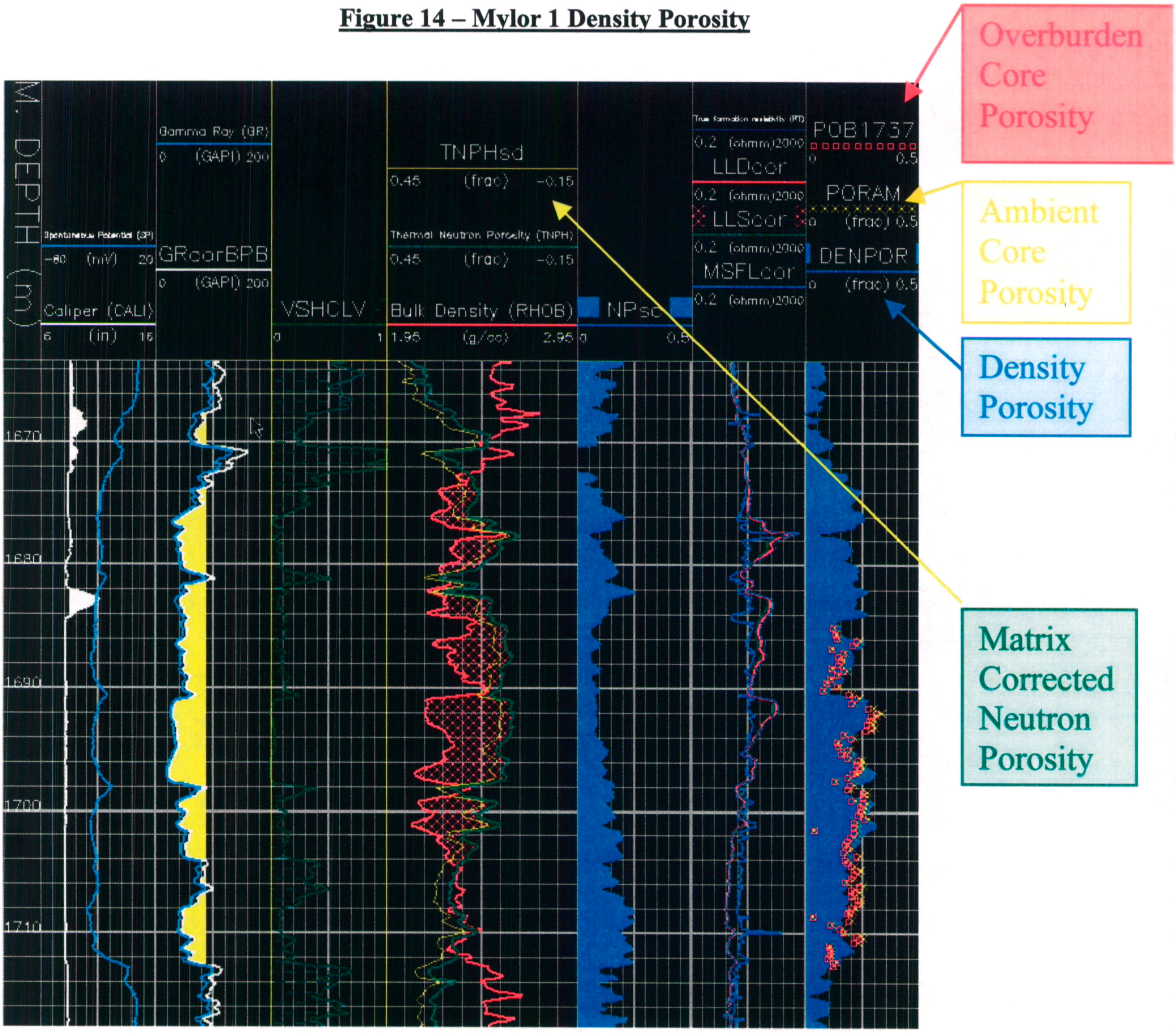
Table 7 provides a Summary of all Fluid Density plots;

| TABLE 6 - RHOf SUMMARY TABLE | | |
|---|---|---|
| | RHOf water | RHOf gas |
| NTH PAARATTE 2 | na | 0.198 |
| MYLOR 1 | 0.822 | 0.49 |
| SKULL CREEK WEST 1 | 0.872 | na |
| BRAESIDE 1 | 1.132 | na |
| AVERAGE | 0.942 | |

Table 7 shows a range in calculated Fluid Density. Given this variability, it was decided to use a constant RHOf of 1.0gm/cm$^3$ in Density Porosity calculations.

Figure 14 shows the results of the Density Porosity calculation. Mylor 1 is shown for comparison with overburden porosity core data.

**Figure 14 – Mylor 1 Density Porosity**



## 9.3 SHALE CORRECTED NEUTRON POROSITY

### 9.3.1 Matrix Correction

TNPHI was corrected to sandstone units using the Schlumberger Por13a algorithm within Terrastation. The results of this correction can be seen above in Figure 14.

### 9.3.2 Shale Correction

The objective of the neutron shale correction is to provide a neutron porosity curve which tracks density porosity over varying degrees of shaliness. Density Porosity in shales is assumed to be a reasonable approximation to actual shale total porosity.

Density Porosity of shale and Neutron Porosity of shale was determined by crossplotting Density Porosity vs Vsh (Figure 15a,15b) and Neutron Porosity vs Vsh (Figure 16a, 16b).

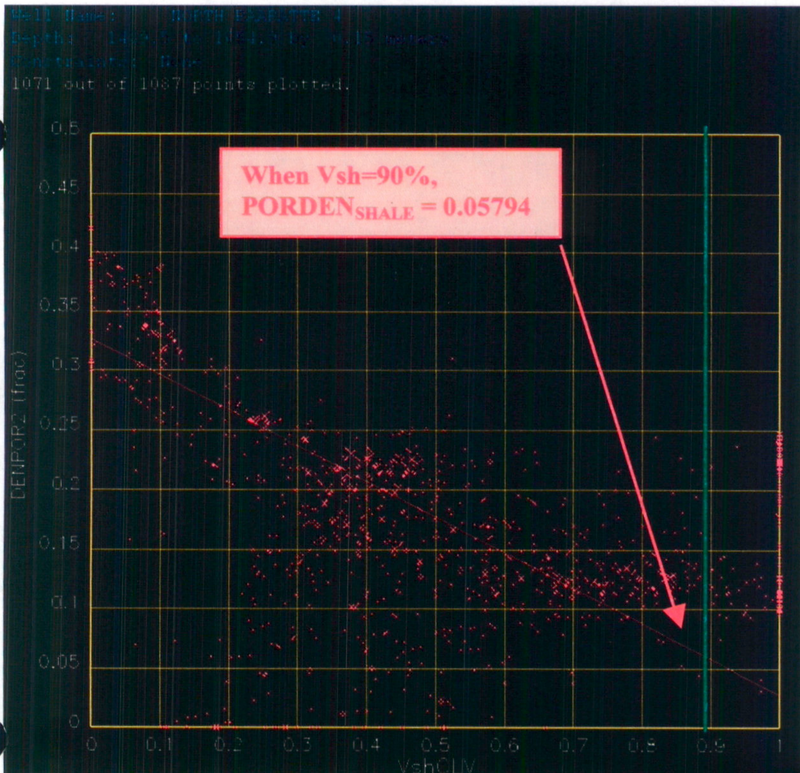



**Figure 15a**
**North Paaratte 4 – Shale Density Porosity**

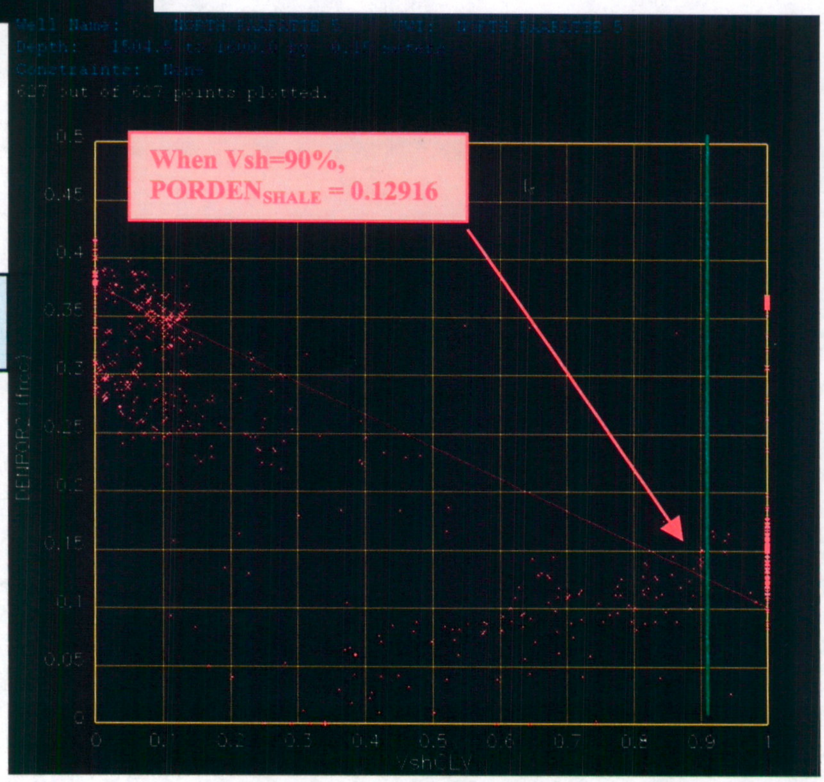



**Figure 15b**
**North Paaratte 5 – Shale Density Porosity**

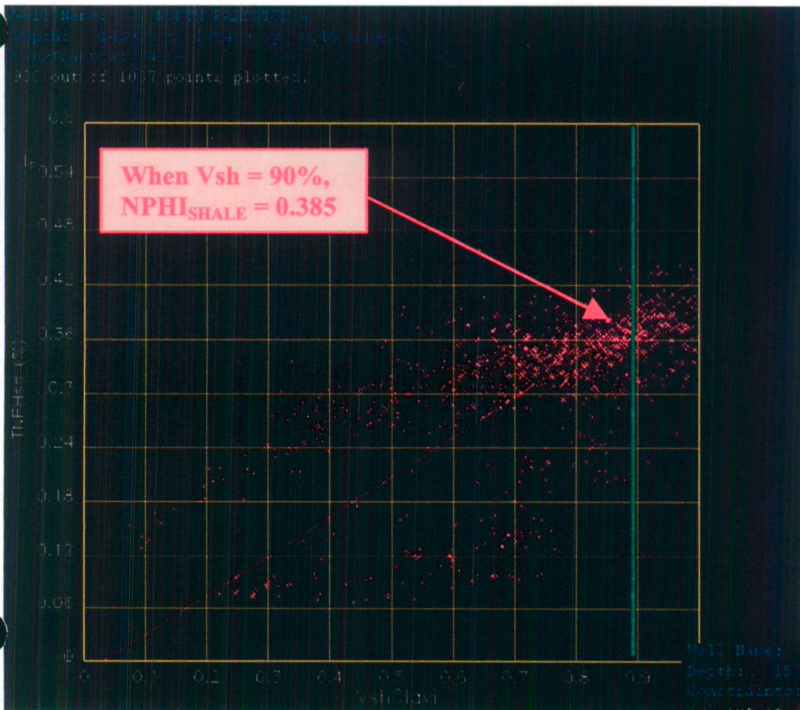



**Figure 16a - North Paaratte 4**
**Shale Neutron Porosity (Matrix Corrected)**

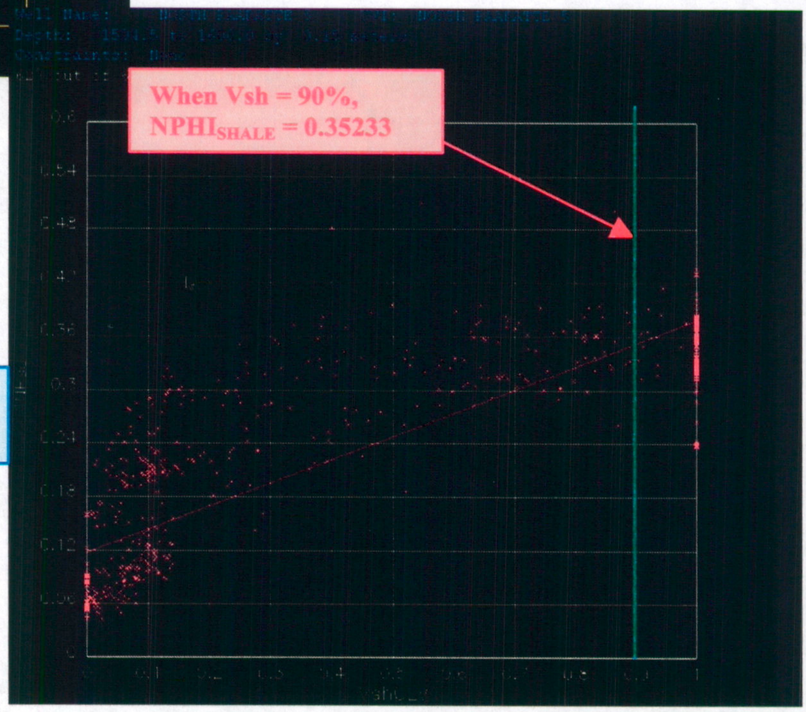



**Figure 16b - North Paaratte 5**
**Shale Neutron Porosity (Matrix Corrected)**

The difference between the higher neutron porosity and density porosity in shales provides the correction for neutron porosity to track density porosity as shale increases. Therefore in the case of North Paaratte 4, the equation for shale corrected Neutron Porosity is;

$$NPSC = NPHI - Vsh(NPHI_{SHALE} - DENPOR_{SHALE})$$
$$NPSC_{NP4} = NPHI - Vsh(0.385 - 0.05794)$$

**Equation 7**

**Where;**

| | | |
|---|---|---|
| NPSC | - | Neutron Porosity Shale Corrected |
| NPHI | - | Neutron Porosity (Matrix Corrected) |
| Vsh | - | Volume of Shale (Clavier) |
| $NPHI_{SHALE}$ | - | Neutron Porosity at 90% Shale |
| $DENPOR_{SHALE}$ | - | Density Porosity at 90% Shale |

## 9.4 NEUTRON POROSITY CORE CALIBRATION

The final adjustment to Neutron Porosity was to calibrate it with core. However, many of the wells (including North Paaratte 4 & 5) did not contain core or did not contain enough core porosity data points to produce a meaningful correlation. Therefore, instead of calibrating NPSC with core, it was calibrated with Density Porosity. The crossplots (Figure 17a, 17b) show a fixed point regression of shale corrected neutron porosity with density porosity at North Paaratte 4 and 5.

The fixed point is NPSC = NPMX (Neutron response to zero porosity clay free matrix) when Density Porosity is equal to zero. In order to find NPMX, the petrological analysis of core in Mylor 1 and Skull Creek West 1 was examined. For each sample analysed by the petrographer, the percentage of each component identified was multiplied by its Neutron response as quoted in the Schlumberger chartbook. These component responses were summed and averaged to get a final NPMX. Table 9 shows this procedure;

**TABLE 7 - MYLOR 1 NPMX from PETROLOGY**

| Sample DEPTH | COMPONENT FRACTION | Fqz fr | Ffld fr | Flth fr | Fmica fr | Fglc fr | Facc fr | Mcly fr | Mmud fr | Mopq fr | Mqz fr | Mpyr fr | Mkao fr | Mcrb fr | SUM COM-PONENTS | SUM NEUTRON RESPONSE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CNL pu | -0.04 | -0.03 | -0.02 | 0.12 | 0.13 | | 0.36 | | 0.40 | -0.04 | -0.03 | 0.36 | -0.01 | | |
| 1681.5 | COMPONENT (fr) | 0.78 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.02 | 0.00 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | | -0.03 |
| 1686.2 | COMPONENT (fr) | 0.81 | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.06 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0 | | -0.01 |
| 1688.6 | COMPONENT (fr) | 0.81 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.06 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0 | | -0.01 |
| 1690.4 | COMPONENT (fr) | 0.81 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.06 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0 | | -0.01 |
| 1692.2 | COMPONENT (fr) | 0.91 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 1 | |
| | NEUT RESPONSE | -0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | | -0.04 |
| 1696.1 | COMPONENT (fr) | 0.83 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.06 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0 | | 0.00 |
| 1698.2 | COMPONENT (fr) | 0.70 | 0.06 | 0.02 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.02 | 0.01 | 0.06 | 0.06 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0 | | 0.02 |
| 1700.3 | COMPONENT (fr) | 0.82 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.01 | 0.00 | 0.02 | 0.04 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0 | | -0.01 |
| 1701.2 | COMPONENT (fr) | 0.82 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.06 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0 | | -0.01 |
| 1702.4 | COMPONENT (fr) | 0.73 | 0.07 | 0.11 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.01 | 0.03 | 0 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0 | | -0.01 |
| 1705.4 | COMPONENT (fr) | 0.76 | 0.06 | 0.07 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.01 | 0.01 | 0.01 | 0.04 | 0.00117 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | -1E-05 | | 0.00 |
| 1708.4 | COMPONENT (fr) | 0.75 | 0.13 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.12563 | 1 | |
| | NEUT RESPONSE | -0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | -0.0013 | | -0.01 |
| AVERAGE | | | | | | | | | | | | | | | | -0.01 |

AVERAGE NPMX
⇒FIXED POINT is (-0.01,0)

**Figure 17a – North Paaratte 4**

**Neutron Porosity (Shale Corrected) Density Porosity Calibration**

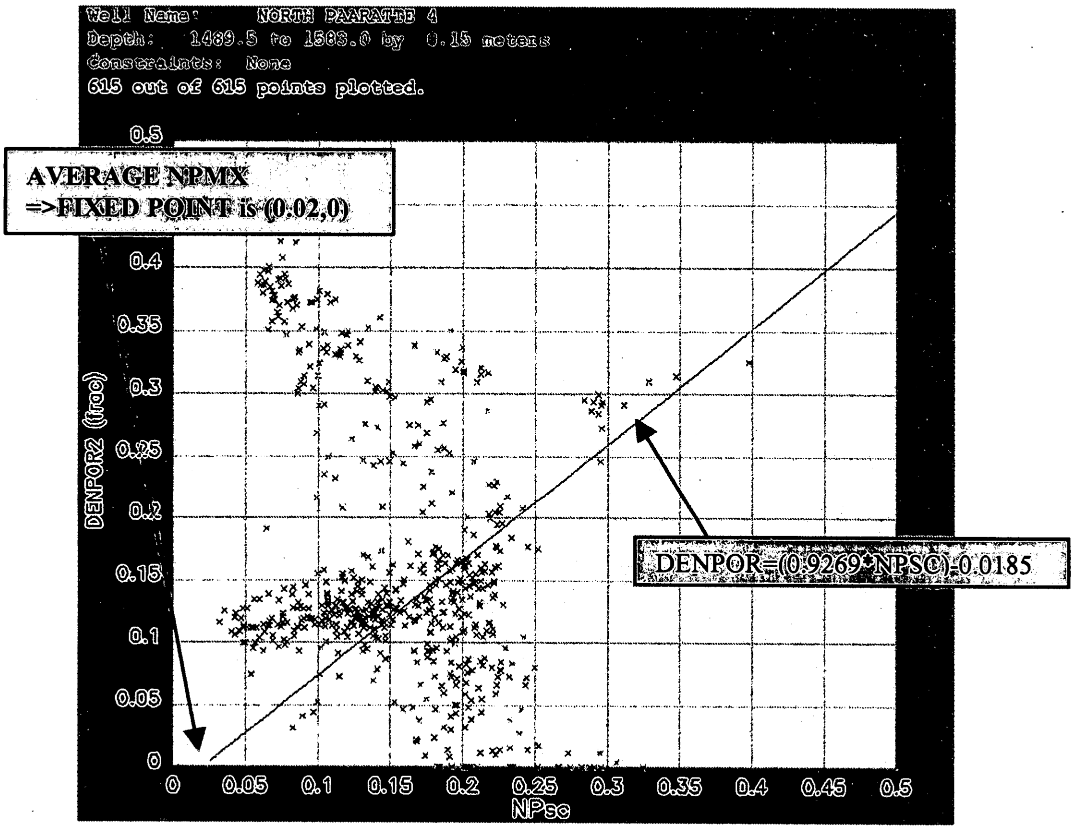
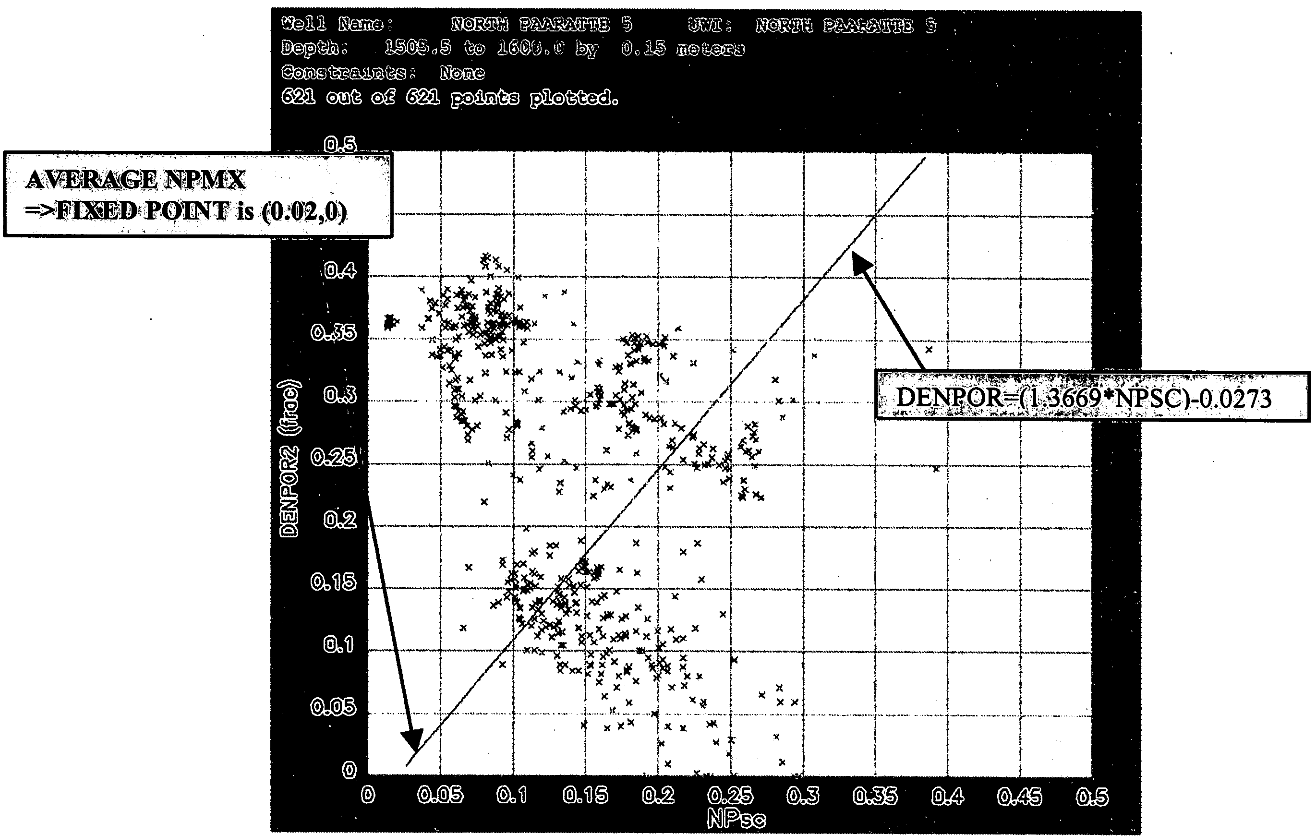



**Figure 17b – North Paarate 5**

**Neutron Porosity (Shale Corrected) Density Porosity Calibration**



## 9.5 NEUTRON POROSITY SUMMARY

The above procedure provides a matrix and shale corrected neutron porosity which mimics density porosity but which deviates in the opposite sense when either fluids or matrix properties impair density porosity (Figures 19a, 19b, 19c).

## 9.6 DENSITY-NEUTRON POROSITY - SHALE CORRECTED

The density tool responds primarily to matrix and requires constant matrix densities to indicate pore fluids. The neutron tool responds primarily to fluids. Fortunately, most minerals and fluids which cause density porosity to under calculate, cause shale corrected neutron porosity to over calculate. Density-Neutron porosity reduces grain density error to less than half because dense minerals tend to have positive hydrogen indices, partially cancelling the error.

Gas zones can be most effectively evaluated by utilising the opposing effect which gas has on the density and neutron tools ("gas effect"). To calculate Density-Neutron porosity the following equation was used;

$$\Phi DN = \sqrt{\frac{\Phi D^2 + \Phi N^2}{2}}$$ **Equation 8**

**Where;**

| | | |
|---|---|---|
| ΦDN | = | Density-Neutron Porosity |
| ΦD | = | Density Porosity |
| ΦN | = | Shale Corrected, Core Calibrated Neutron Porosity |

## 9.7 DENSITY-NEUTRON POROSITY - CORE CALIBRATED

To calibrate Density-Neutron porosity to overburden core porosity, two multiwell crossplots of Overburden Porosity vs Density-Neutron Porosity were made (Figures 18a and 18b). The first plotted these two parameters over the identified gas zones only whilst the second was restricted to the water zones.

The inset tables show the regression derived Density-Neutron Porosity core calibration equations. To core calibrate Density-Neutron Porosity at North Paaratte 4 & 5, the composite multiwell equation was used.

**Figure 18a – Multiwell Crossplot, Density-Neutron Porosity vs Core Overburden Porosity (Gas Zone)**

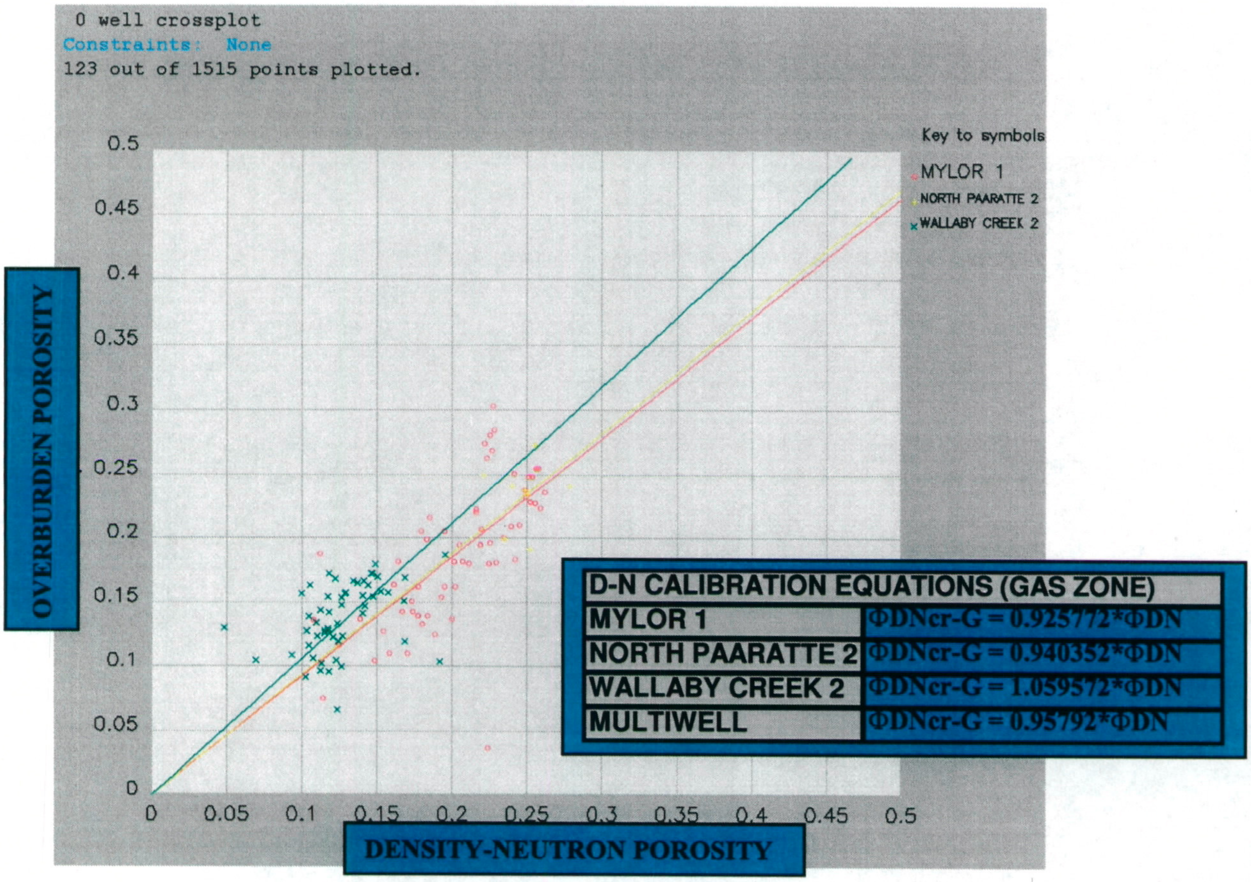



**Figure 18b – Multiwell Crossplot, Density-Neutron Porosity vs Core Overburden Porosity (Water Zone)**

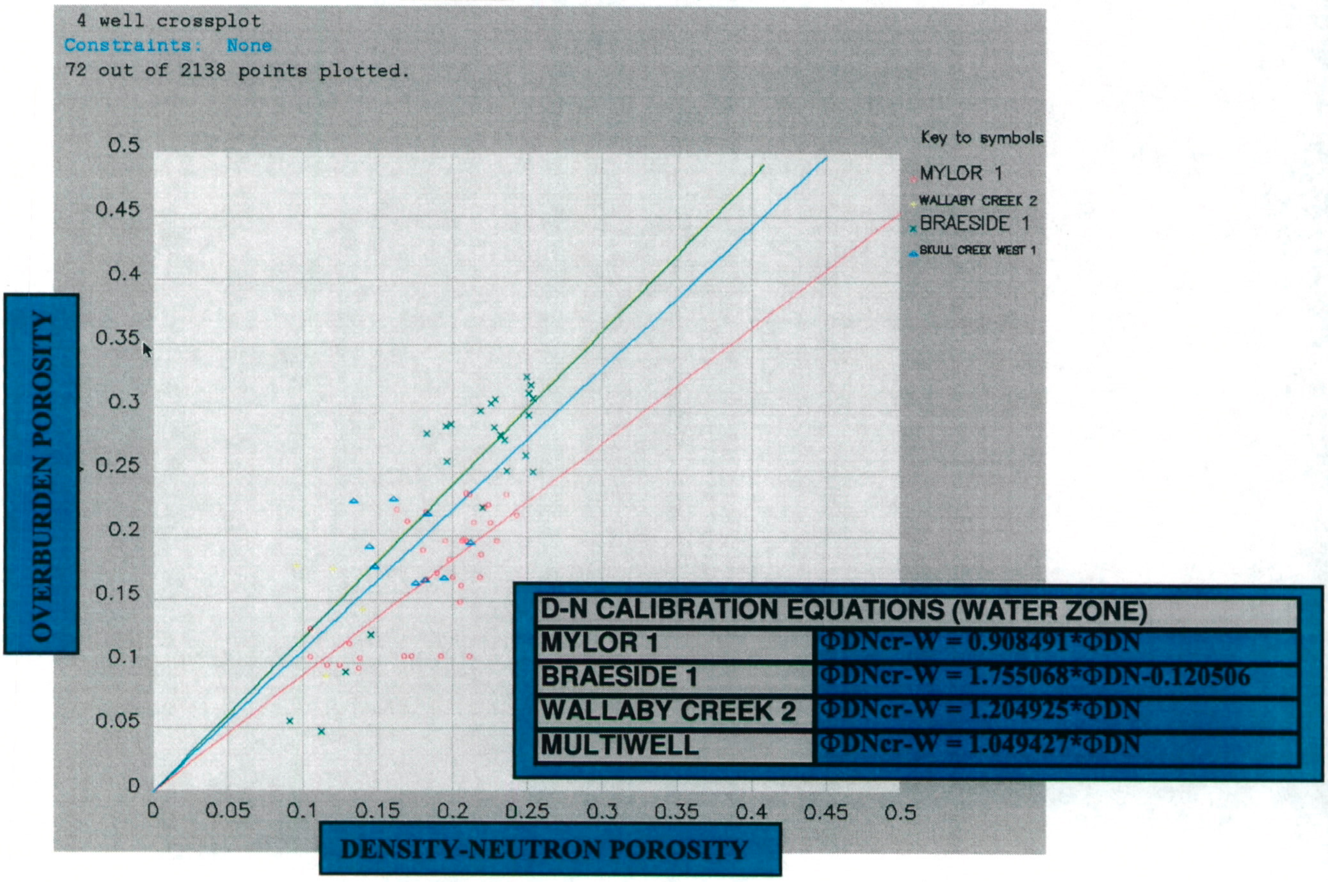


Figure 19a provides a summary of all Porosity models generated thus far. Core Calibrated Density Neutron-Porosity appears in Red in Track 7. Above the GWC, the gas zone equation was used whilst below the GWC the water zone equation was used. Figures 19b & 19c show core calibrated Density-Neutron Porosity for North Paaratte 4 and 5.

## Figure 19a - Mylor1 – Density-Neutron Core Calibration

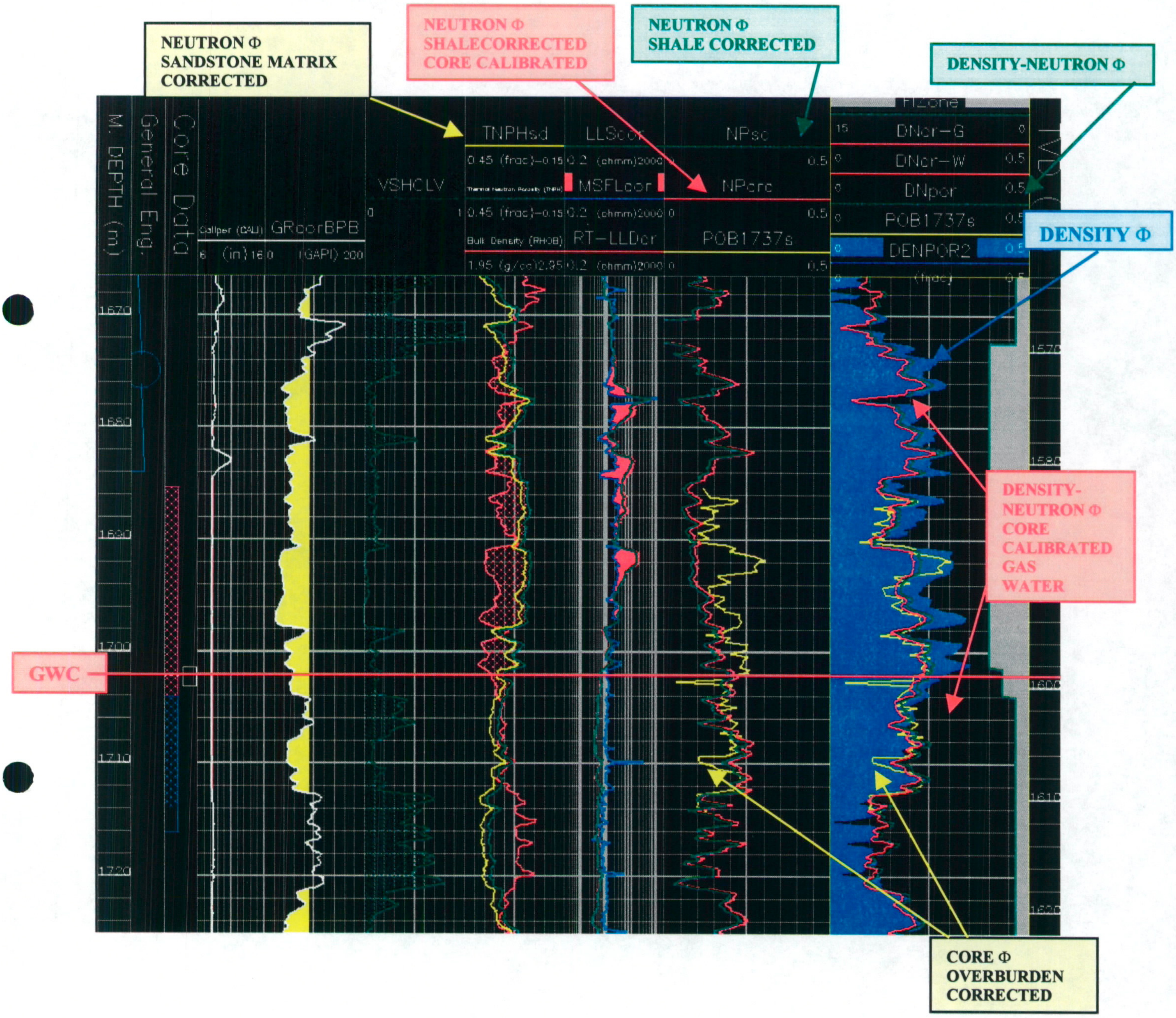


**Figure 19b - North Paaratte 4**
**Density-Neutron Core Calibrated Porosity**

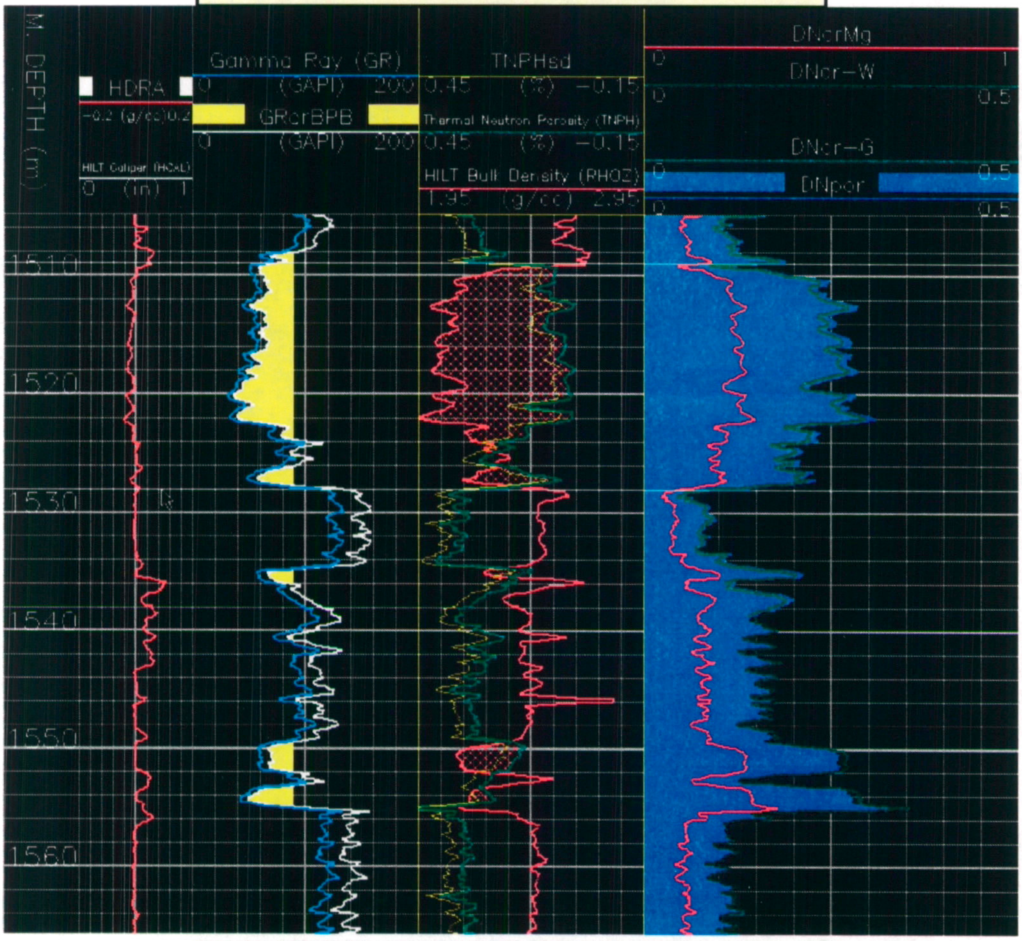
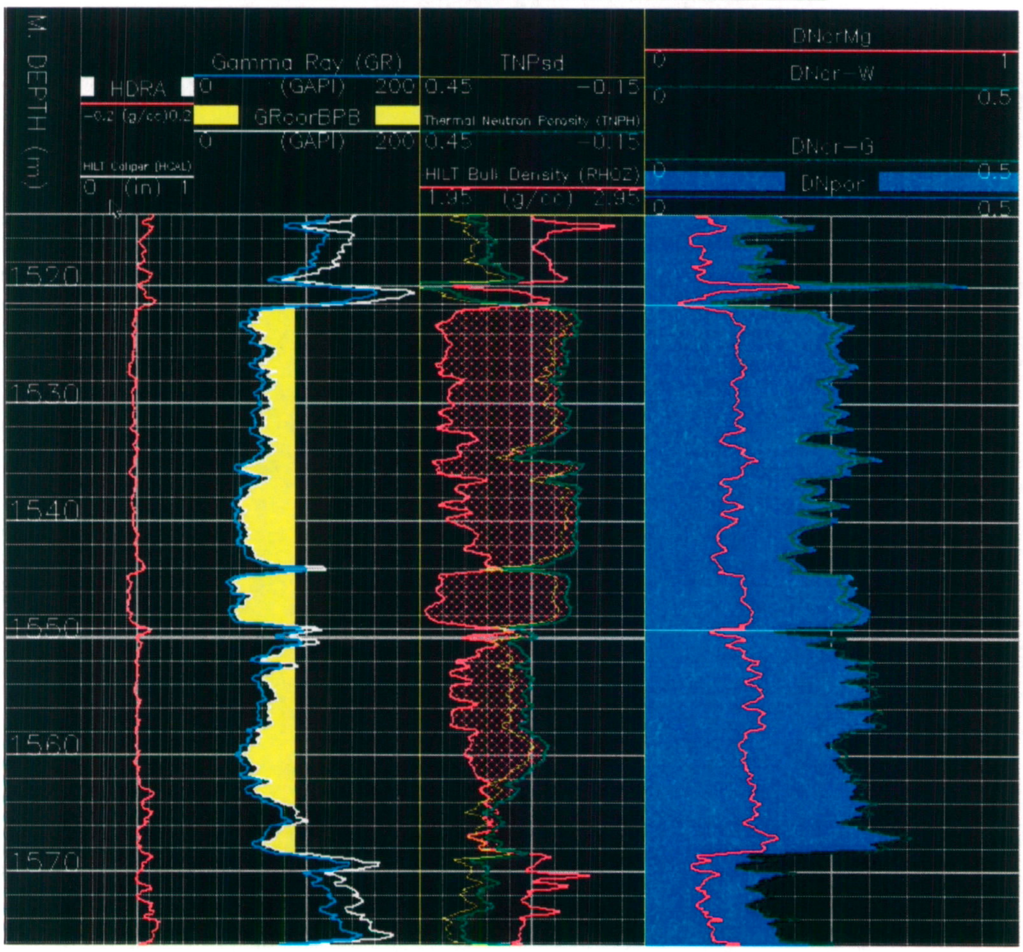



**Figure 19c - North Paaratte 4**
**Density-Neutron Core Calibrated Porosity**



## 9.8 SONIC (Δt) POROSITY

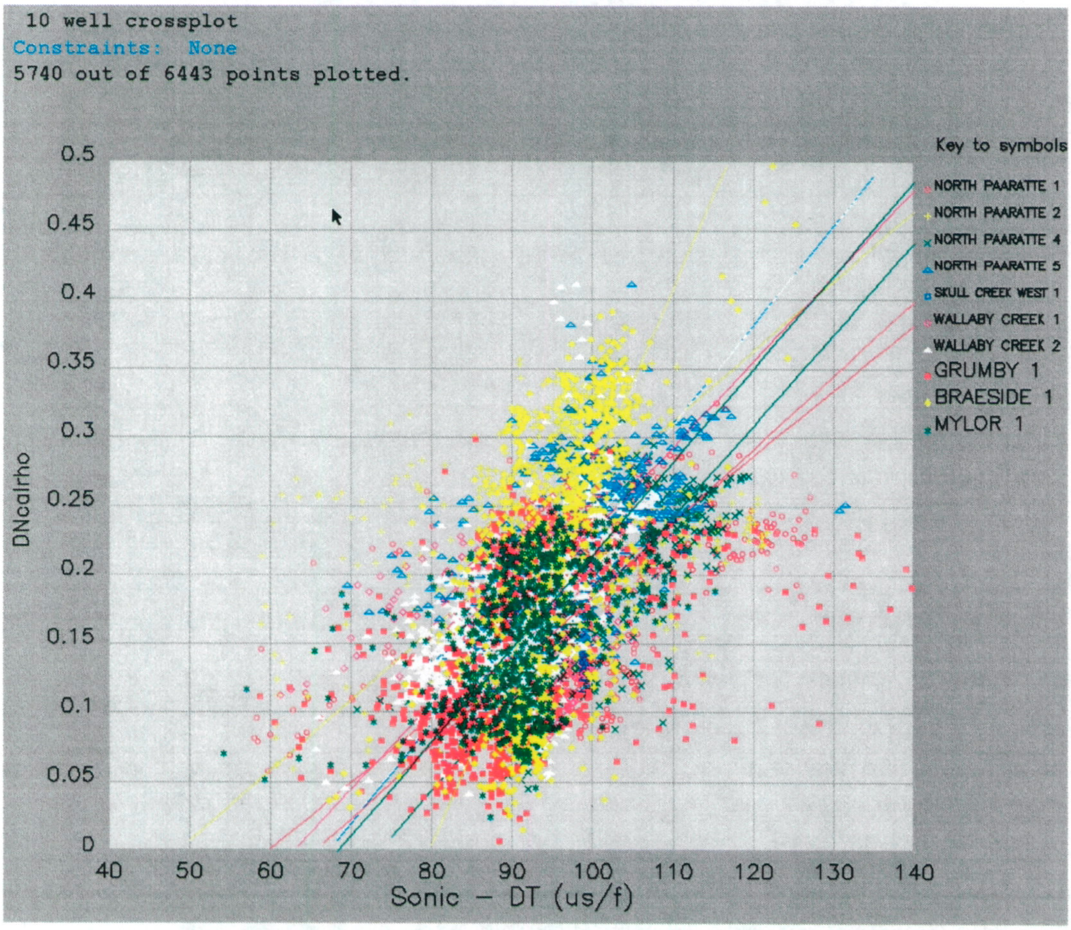
The sonic tool is less sensitive to hole size and rugosity than the density or neutron tools. However, sonic porosity lacks the useful opposing effect to density porosity with variations in matrix and fluid which makes neutron porosity so useful.

With this in mind, sonic porosity was calculated to substitute for core calibrated density-neutron porosity where bad hole was identified.

A multiwell crossplot of Sonic versus Density-Neutron (core calibrated) Porosity was made over the Waarre Formation interval (Figure 20). All badhole zones over the interval were excluded from the crossplot using the following constraints;

| | | |
|---|---|---|
| **1.** | CALIPER | > 10.5 inches |
| **2a.** | DRHO | < -0.1 |
| **2b.** | DRHO | > 0.1 |

**Figure 20 – Sonic vs Density-Neutron Porosity (Core Calibrated)**

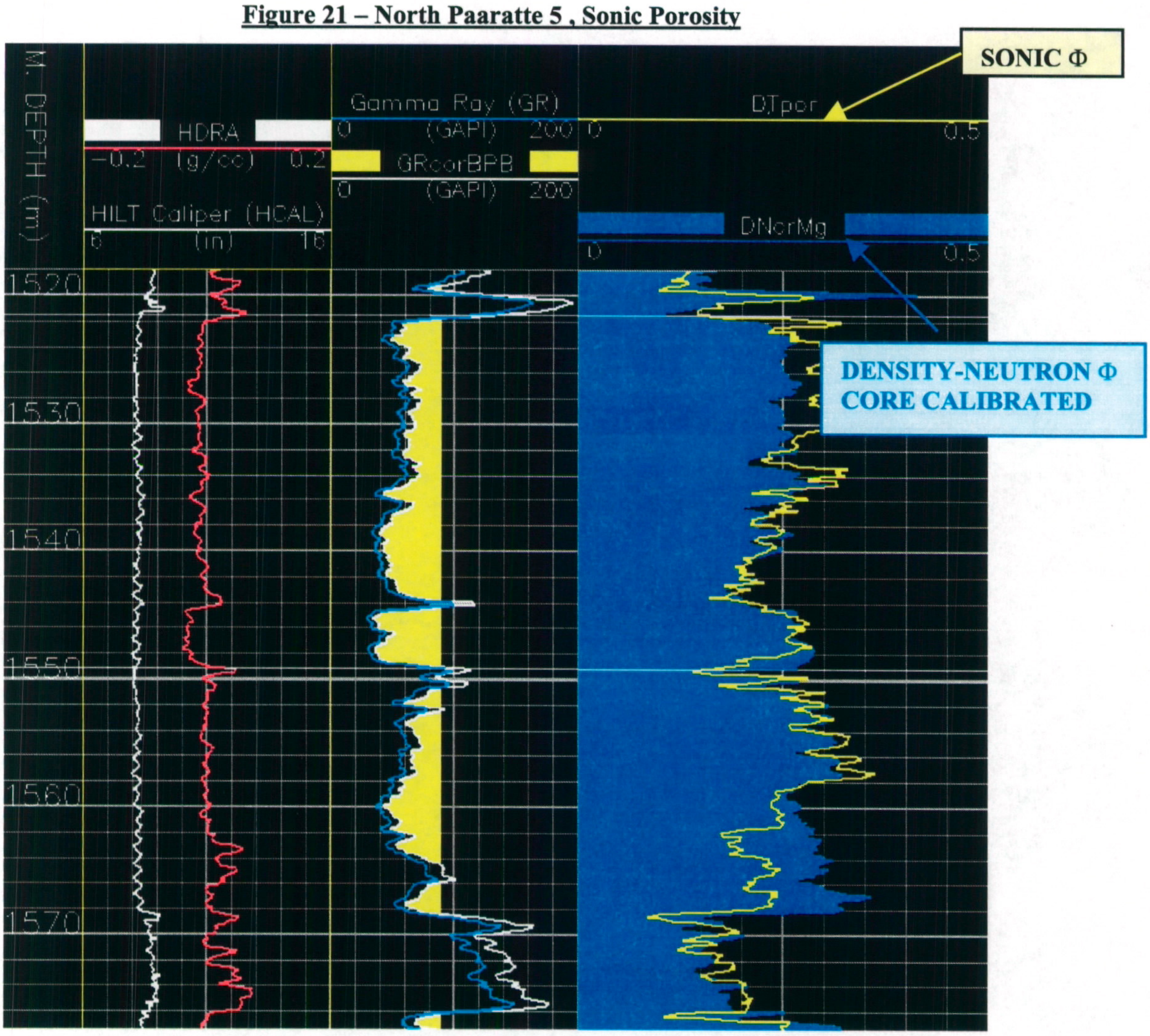



For each well, a RMA (Reduced Major Axis) regression was plotted and an equation calibrating the Sonic Log obtained (Table 11).

| TABLE 8 - DN to SONIC POROSITY CALIBRATION | | |
|---|---|---|
| DT Calibrated=SLOPE*DT+INTERCEPT | | |
| WELL | SLOPE no exclusion | I'CEPT no exclusion |
| Nth Paaratte 4 | 0.00662 | -0.485642 |
| Nth Paaratte 5 | 0.007217 | -0.485544 |
| Mylor 1 | 0.00677 | -0.462474 |

Figure 21 shows the resulting Sonic Porosity curve at North Paaratte 5. Sonic Porosity is plotted with Density-Neutron Core Calibrated Porosity for comparison.

**Figure 21 – North Paaratte 5 , Sonic Porosity**




## 9.9 V-SHALE POROSITY

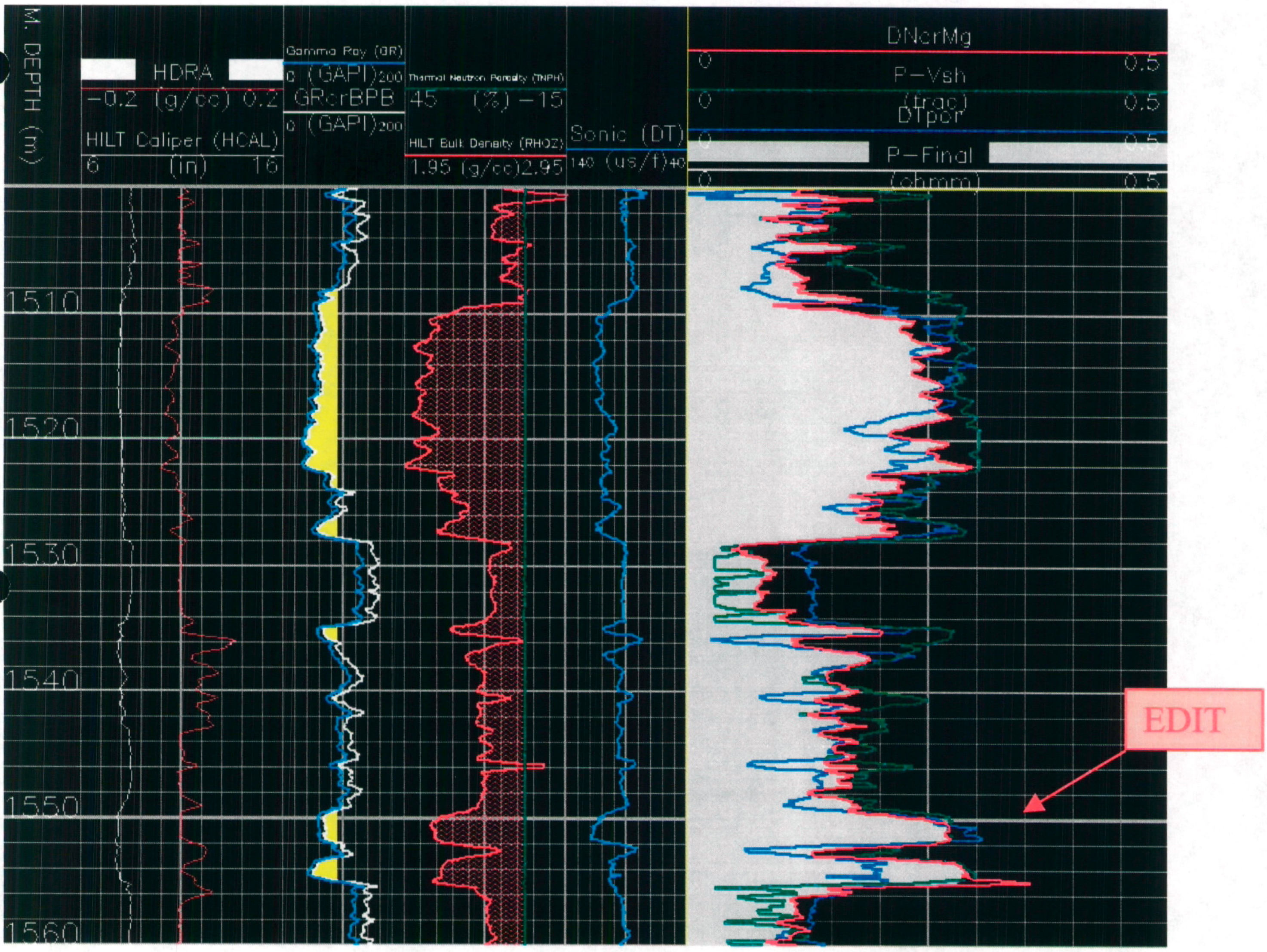
Cycle skipping in the presence of gas or poor hole condition causes sonic derived porosity to become invalid. A Gamma Ray sourced V-Shale Porosity is less effected by hole condition. V-Shale Porosity was calculated for North Paaratte 4 & 5 but was not required in these two wells.

## 9.10 FINAL POROSITY

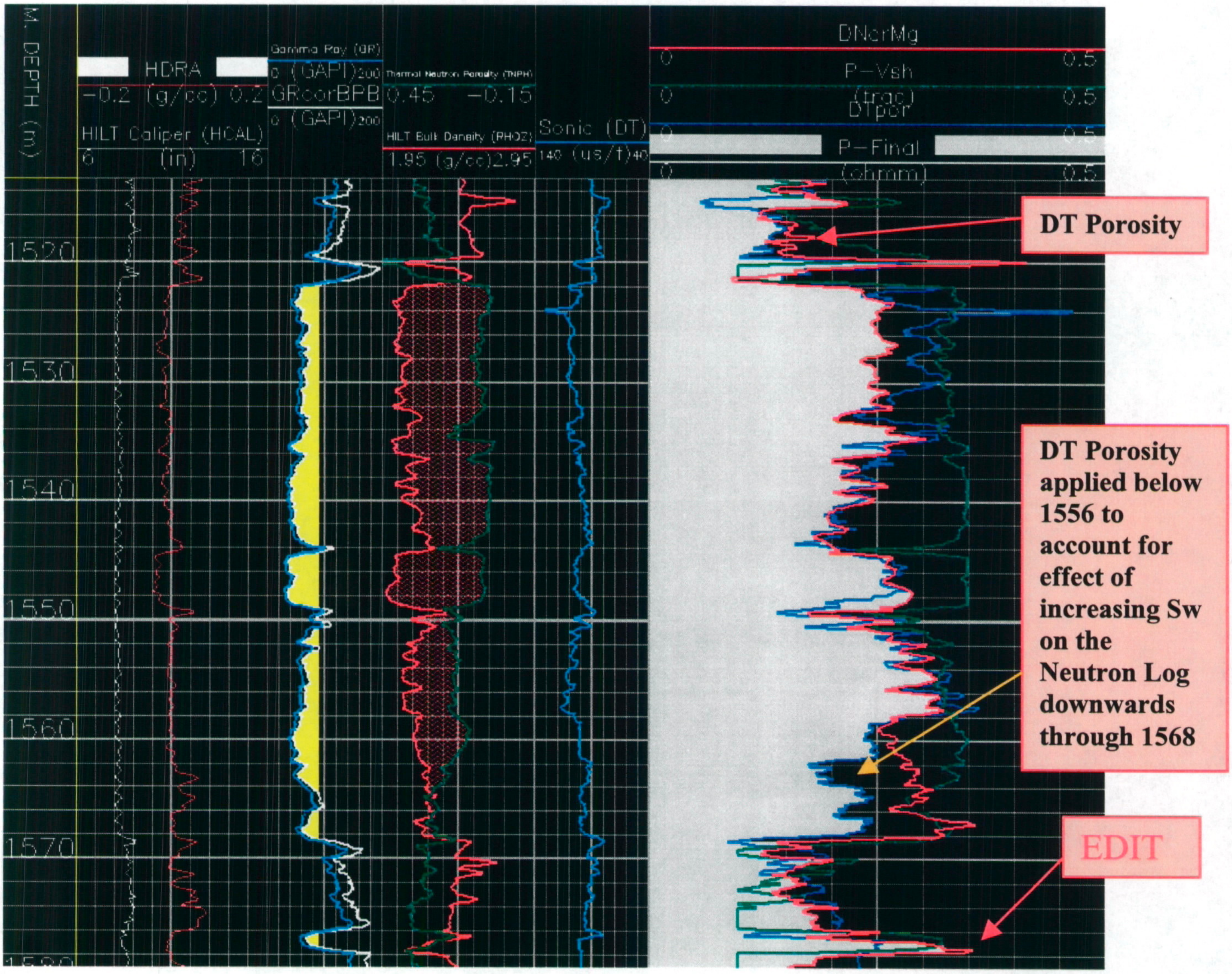
In general, excellent hole was achieved in North Paaratte 4 and 5 and the badhole cutoffs were never reached. However, in North Paaratte 5, Sonic Porosity was applied below 1556m KB to correct for the effect of increasing water saturation on the Neutron Log.

Figures 22a and 22b show Density-Neutron Porosity, Sonic Porosity and Composite Final Porosity (P-Final) for North Paaratte 4 and North Paaratte 5. Key zones where substitute porosities were used are illustrated.

**FIGURE 22a**
**NORTH PARRATTE 4 – FINAL COMPOSITE POROSITY**



## FIGURE 22b
## NORTH PARRATTE 5 – FINAL COMPOSITE POROSITY



# 10.0 WATER SATURATION (Sw)

## 10.1 ARCHIE APPARENT WATER RESISTIVITY (Rwa)

Apparent water resistivity (Rwa) is calculated from the Archie equation with Water Saturation (Sw) set at unity;

$$Sw^2 = \frac{a \times Rw}{\Phi^m \times Rt}$$

**Equation 10** (Archie)

Therefore, when Sw=1 (ie. 100% Water Saturated Formation), the Equation becomes;

$$1^2 = \frac{a \times Rwa}{\Phi^m \times Rt}$$

$$Rwa = \frac{\Phi^m \times Rt}{a}$$

**Equation 11** (Rwa)

**Where;**

| | | | | | |
|---|---|---|---|---|---|
| **Sw** | = | Water Saturation (frac) | **Rw** | = | Water Resistivity |
| **a** | = | Tortuosity Factor | **Rwa** | = | Apparent Water Resistivity |
| **Φ** | = | Porosity (pu) | **m** | = | Cementation Exponent |
| **Rt** | = | True Formation Resistivity | | | |

### 10.1.1 Pickett Plots

Pickett Plots were used to determine Rwa. However, before Rt could be plotted against Porosity, a number of steps needed to be taken;

1. Rwa assumes 100% water saturated reservoir. A Pickett plot of 100% water saturated sands only is much safer than a minimum Rwa from Pickett plots. In order to plot only wet sands, total gas, cuttings, sidewall and conventional core shows were examined and tabulated to ensure intervals were in fact fully saturated (Table 13).

**TABLE 9 - GAS SHOWS IN PPL1 - Sw 100 Zones**

| WELL | INTERVAL m MDKB | HOLE COND | POR:RLLD TREND | WFT | SHOWS | CHROMATOGRAPH C1/C2 | CHROMATOGRAPH TG | INFER'D Sw | COMMENT |
|---|---|---|---|---|---|---|---|---|---|
| NORTH PAARATTE 4 | 1549.3-1551.9<br>1553-1555 | gd<br>gd | wtr<br>wtr | | | | | | |
| NORTH PAARATTE 5 | 1550.5-1562.6<br>1565.8-1568.3 | gd<br>gd | resid gas<br>wtr | | gas<br>ns | C1/C2/tr<br>C1 | 200u<br>20u | 0.5 | |
| | Wet Sands (included in Pickett Plot) | | | | | | | | |
| | Possible gas sands (excluded from plot) | | | | | | | | |

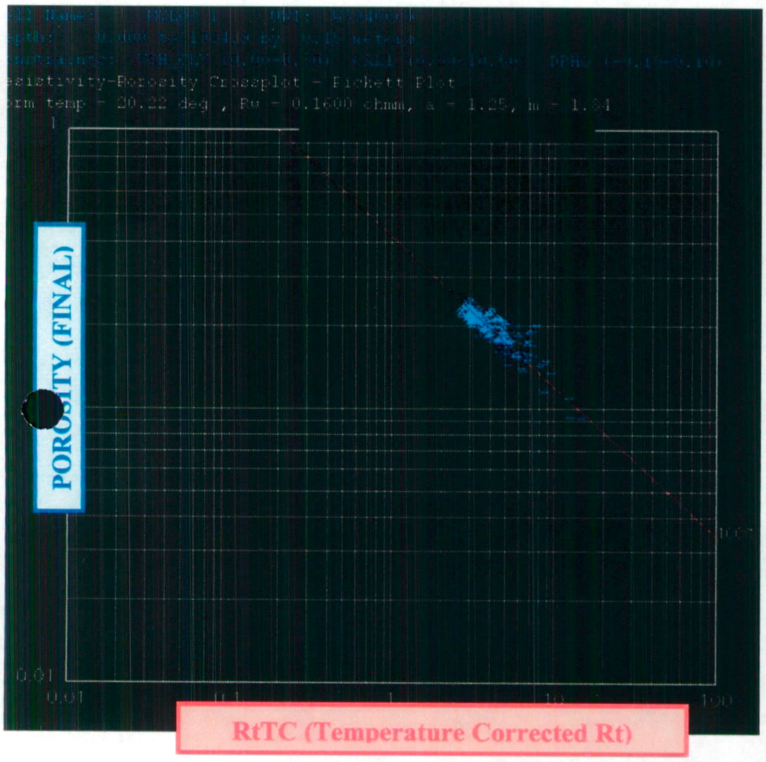
2. The wells within the dataset intersected the Waarre "C" Sand at a variety of depths. Consequently, the Waarre"C" reservoir temperature at each well varied. To eliminate temperature error in the Resistivity tool, Rt was corrected to an average Waarre Formation reservoir temperature of **35.6°C**. Table 14 shows how this average temperature was calculated.

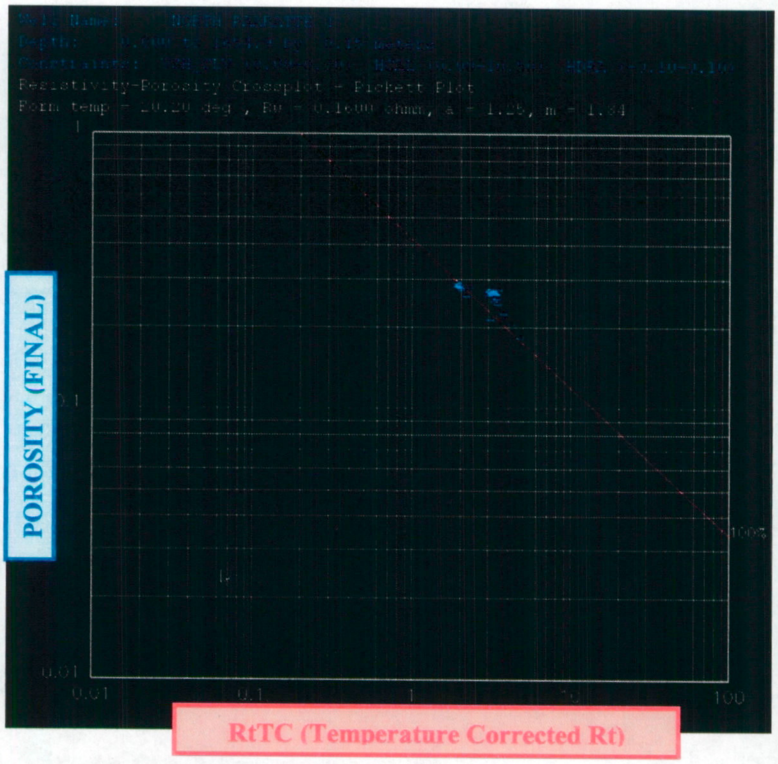
**TABLE 10 - Waarre Reservoir Temperature**

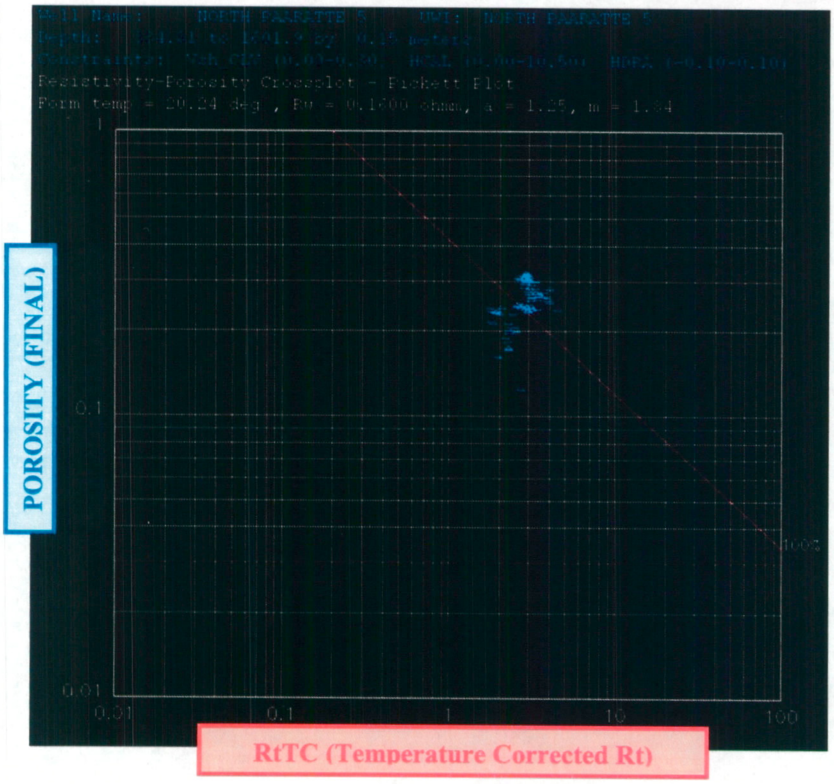
| Well | TD TVDGL | BHT | Tgrad degC/m | DEPTH WAARRE "A" TVD m GL | T@Res degC |
|---|---|---|---|---|---|
| North Paaratte 4 | 1550.1 | 56.7 | 0.0237 | 1419.5 | 33.6 |
| North Paaratte 5 | 1496.3 | 55.6 | 0.0238 | 1422.9 | 33.9 |
| Mylor 1 | 1916.2 | 64.5 | 0.0232 | 1667.2 | 38.7 |

Following these two steps, temperature corrected resistivity (RtTC) was plotted against porosity for water saturated sands only. Figures 23a,b,& c shows the resulting Pickett plots for Mylor1, North Paaratte 4 & 5;

**Figure 23 a,b.c – Mylor 1, NP-4 & 5 Pickett Plots**



The regression line which achieved the best fit for the Mylor1, North Paaratte 4 and North Paaratte 5 Pickett plots had a, Rw and m parameters of;

| | | |
|---|---|---|
| a | = | 1.25 |
| Rw | = | 0.16Ωm @ 35.6 °C (or 0.2Ωm at 25 °C) |
| m | = | 1.84 |

## 10.2 FORMATION WATER RESISTIVITY

Independent confirmation of Rw was achieved by examining formation water recoveries from PPL1. The Rw required is from water in the hydrocarbon zone but pore water in this zone is immovable and cannot be flowed to the surface. Water from the aquifer may have been flushed following hydrocarbon emplacement with salinities unrelated to immovable water in the hydrocarbon zone. The transition zone is less likely to have been effected by aquifer flushing and provides the water sample of choice.

It is extremely important to understand the source of each water sample, its acquisition method and therefore whether it is likely to be representative of the hydrocarbon zone. Generally, well tests are the best sources of Rw because of the large volumes of produced water which dilute contaminants. However, well tests may suffer from aquifer contamination and behind casing flows. Alternatively, wireline samples, whilst not sampling large volumes, can produce representative samples. Figure 24 and Table 15 lists all water samples obtained and their acquisition details.

**Figure 24 – Waarre Formation Water Analysis**

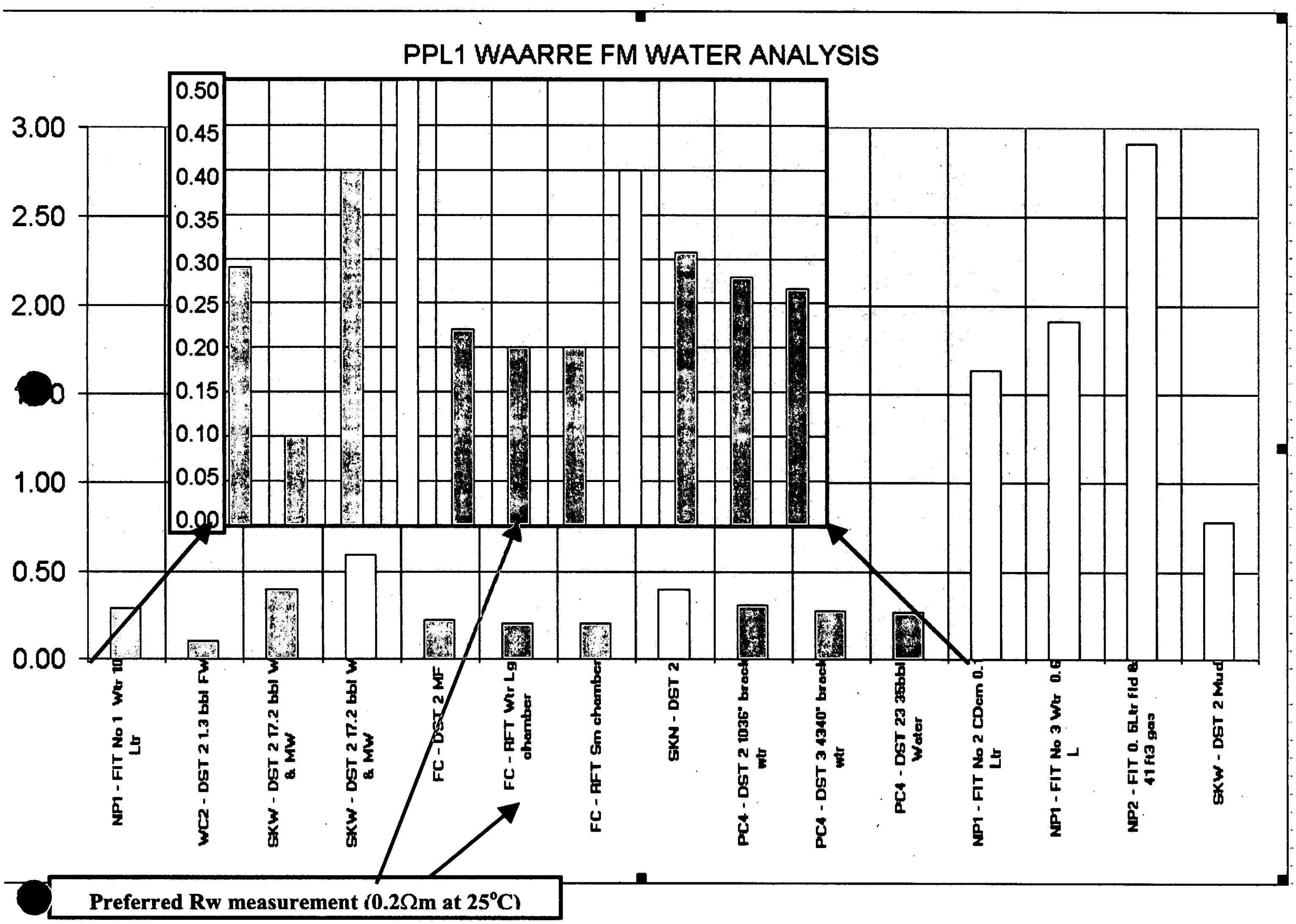


Figure 24 shows that there is little reliable water analysis from which to determine Rw. Water samples from DST appear contaminated where significant volumes were produced. An RFT at Fenton Creek 1 (SANTOS, PEP 108) recovered a water sample from a large chamber with a Rw of 0.2 at 25°C. This is consistent with values of Rw derived from Pickett plots (Chapter 10.1).

## Table 11 – Waarre Formation Water Analysis

**PPL1 WAARRE FM WATER ANALYSIS**

| Well | Comment | FM | KB | TD | TD mSS | DEPTH m MDKB | BHT |
|---|---|---|---|---|---|---|---|
| North Paaratte 1 | NP1 - FIT No 1 Wtr 10 Ltr | WAARRE A | 96 | 1535.887 | 1439.887 | 1494 | 52.2 |
| Wallaby Creek 2 | WC2 - DST 2 1.3 bbl FW | WAARRE "A" | 54.7 | 1697 | 1642.3 | 1510 | 62 |
| Skull Creek West 1 | SKW - DST 2 17.2 bbl W & MW | WAARRE | 100.3 | 2002 | 1901.7 | 1311 | 67 |
| Skull Creek West 1 | SKW - DST 2 17.2 bbl W & MW | WAARRE | 100.3 | 2002 | 1901.7 | 1311 | 67 |
| Fenton Creek 1 | FC - DST 2 MF | WAARRE | 86.9 | 1840 | 1753.1 | 1574 | 66 |
| Fenton Creek 1 | FC - RFT Wtr Lg chamber | WAARRE | 86.9 | 1840 | 1753.1 | 1662 | 66 |
| Fenton Creek 1 | FC - RFT Sm chamber | WAARRE | 86.9 | 1840 | 1753.1 | 1665 | 66 |
| Skull Creek North 1 | SKN - DST 2 | WAARRE | 82.2 | 1810 | 1727.8 | 1280 | 61 |
| Port Campbell 4 | PC4 - DST 2 1036' brack wtr | WAARRE | 134.1 | 2597 | 2462.9 | 1512 | 79 |
| Port Campbell 4 | PC4 - DST 3 4340' brack wtr | WAARRE | 134.1 | 2597 | 2462.9 | 1525 | 79 |
| Port Campbell 4 | PC4 - DST 23 35bbl Water | WAARRE | 134.1 | 2597 | 2462.9 | 1604 | 79 |
| North Paaratte 1 | NP1 - FIT No 2 CDcm 0.1 Ltr | WAARRE C | 96 | 1535.887 | 1439.887 | 1460 | 52.2 |
| North Paaratte 1 | NP1 - FIT No 3 Wtr 0.6 L | WAARRE C | 96 | 1535.887 | 1439.887 | 1456 | 52.2 |
| North Paaratte 2 | NP2 - FIT 0. 5Ltr fld & 41 ft3 gas | WAARRE | 120.2 | 1603 | 1482.8 | 1481 | 57 |
| Skull Creek West 1 | SKW - DST 2 Mud | WAARRE | 100.3 | 2002 | 1901.7 | 1311 | 67 |

| Rw @ degC OhmM | deg C | Tgrad degC/m | T@ Res degC | Rw@ 25degC | Rw @ Tres | Rw=0.2 Rw atTres | Source | Report | Comment |
|---|---|---|---|---|---|---|---|---|---|
| 0.34 | 18.3 | 0.021 | 31.322 | 0.29 | 0.256 | 0.176 | DME Vic | | Water Sample from FIT No 1 (4902 ft) 10 Litres |
| 0.1 | 25 | 0.0247 | 37.372 | 0.10 | 0.079 | 0.158 | DST 2 | AMDEL | |
| 0.4 | 25 | 0.0235 | 30.778 | 0.40 | 0.356 | 0.178 | DST 2 sample 3 | AMDEL | Water Sample |
| 0.59 | 25 | 0.0235 | 30.778 | 0.59 | 0.525 | 0.178 | DST 2 sample 2 | AMDEL | Water Sample |
| 0.22 | 25 | 0.025 | 39.35 | 0.22 | 0.168 | 0.153 | DST 2, Sample 9 | AMDEL | Mud Filtrate |
| 0.2 | 25 | 0.025 | 41.55 | 0.20 | 0.148 | 0.148 | RFT Sample 1 | AMDEL | Water Sample, 1662m, Lg Sample |
| 0.2 | 25 | 0.025 | 41.625 | 0.20 | 0.147 | 0.147 | RFT Sample 2 | AMDEL | Small sample chamber |
| 0.4 | 25 | 0.0227 | 28.994 | 0.40 | 0.368 | 0.184 | DST 2 | | |
| 0.381 | 16 | 0.0227 | 34.35 | 0.31 | 0.256 | 0.167 | DST2 | WCR | 1036' brackish water (+90' mud and water) |
| 0.346 | 16 | 0.0227 | 34.646 | 0.28 | 0.231 | 0.166 | DST 3 | WCR | 90' rhm, 180' mcw, 4340' brackish water |
| 0.324 | 16.7 | 0.0227 | 36.441 | 0.27 | 0.214 | 0.161 | DST 23 | WCR | 35BBL Water swabbed |
| 1.7 | 23.3 | 0.021 | 30.609 | 1.64 | 1.462 | 0.178 | DME Vic | | Sample from FIT No 2 100mL Condensate cut mud |
| 2.2 | 18.9 | 0.021 | 30.525 | 1.91 | 1.708 | 0.179 | DME Vic | | Water Sample from FIT No 3 (4778ft) 0.6 L |
| 2.98 | 23.9 | 0.0231 | 34.184 | 2.91 | 2.430 | 0.167 | | | FIT at 1481m, 500mL of fluid and 41 cuft gas |
| 0.78 | 25 | 0.0235 | 30.778 | 0.78 | 0.694 | 0.178 | DST 2 sample 4 | AMDEL | Mud Sample |

## 10.3 SATURATION EXPONENT "n"

Electrical resistivities of partially saturated plugs were measured during Special Core Analysis performed on 7 plugs from Braeside 1 and North Paaratte 2. Resistivity Index values were calculated and the results tabulated below.

**TABLE 12 - SCAL SATURATION EXPONENT "n"**

| | SAMPLE | K | POR | FF | Sw | RI |
|---|---|---|---|---|---|---|
| NORTH PAARATTE 2 | 2H | 1170 | 0.232 | 11.5 | 1 | 1 |
| | | | | | 0.693 | 1.97 |
| | | | | | 0.512 | 3.4 |
| | | | | | 0.395 | 5.42 |
| | | | | | 0.309 | 8.5 |
| NORTH PAARATTE 2 | 5H | 587 | 0.251 | 9.9 | 1 | 1 |
| | | | | | 0.673 | 1.98 |
| | | | | | 0.561 | 2.75 |
| | | | | | 0.483 | 3.55 |
| | | | | | 0.446 | 3.94 |
| BRAESIDE 1 | 1 | 529 | 0.258 | 10.3 | 1 | 1 |
| | | | | | 0.875 | 1.25 |
| | | | | | 0.614 | 2.41 |
| | | | | | 0.475 | 3.71 |
| | | | | | 0.411 | 4.38 |
| | | | | | 0.352 | 6.62 |
| | | | | | 0.276 | 10.8 |
| BRAESIDE 1 | 8 | 2770 | 0.283 | 8.3 | 1 | 1 |
| | | | | | 0.941 | 1.12 |
| | | | | | 0.405 | 5.29 |
| | | | | | 0.248 | 12.1 |
| | | | | | 0.224 | 14.8 |
| | | | | | 0.189 | 23.8 |
| | | | | | 0.153 | 31.6 |
| BRAESIDE 1 | 11 | 5860 | 0.274 | 9.5 | 1 | 1 |
| | | | | | 0.868 | 1.3 |
| | | | | | 0.271 | 10.5 |
| | | | | | 0.192 | 17.1 |
| | | | | | 0.182 | 18.4 |
| | | | | | 0.169 | 21.7 |
| | | | | | 0.143 | 26.8 |
| BRAESIDE 1 | 20 | 270 | 0.249 | 11.1 | 1 | 1 |
| | | | | | 0.902 | 1.21 |
| | | | | | 0.615 | 2.34 |
| | | | | | 0.502 | 3.65 |
| | | | | | 0.438 | 4.76 |
| | | | | | 0.367 | 6.26 |
| | | | | | 0.219 | 16.9 |
| BRAESIDE 1 | 23 | 4420 | 27.2 | 9.2 | 1 | 1 |
| | | | | | 0.821 | 1.43 |
| | | | | | 0.325 | 6.83 |
| | | | | | 0.26 | 9.61 |
| | | | | | 0.224 | 13.1 |
| | | | | | 0.186 | 22.5 |
| | | | | | 0.153 | 28.8 |

Resistivity Index is defined as the ratio of Rt and Ro;

$$RI = \frac{Rt}{Ro}$$ Equation 12

and is related to Sw by the equation;

$$RI = \frac{Rt}{Ro} = Sw^{-n}$$ Equation 13

Taking the LOG of both sides gives;

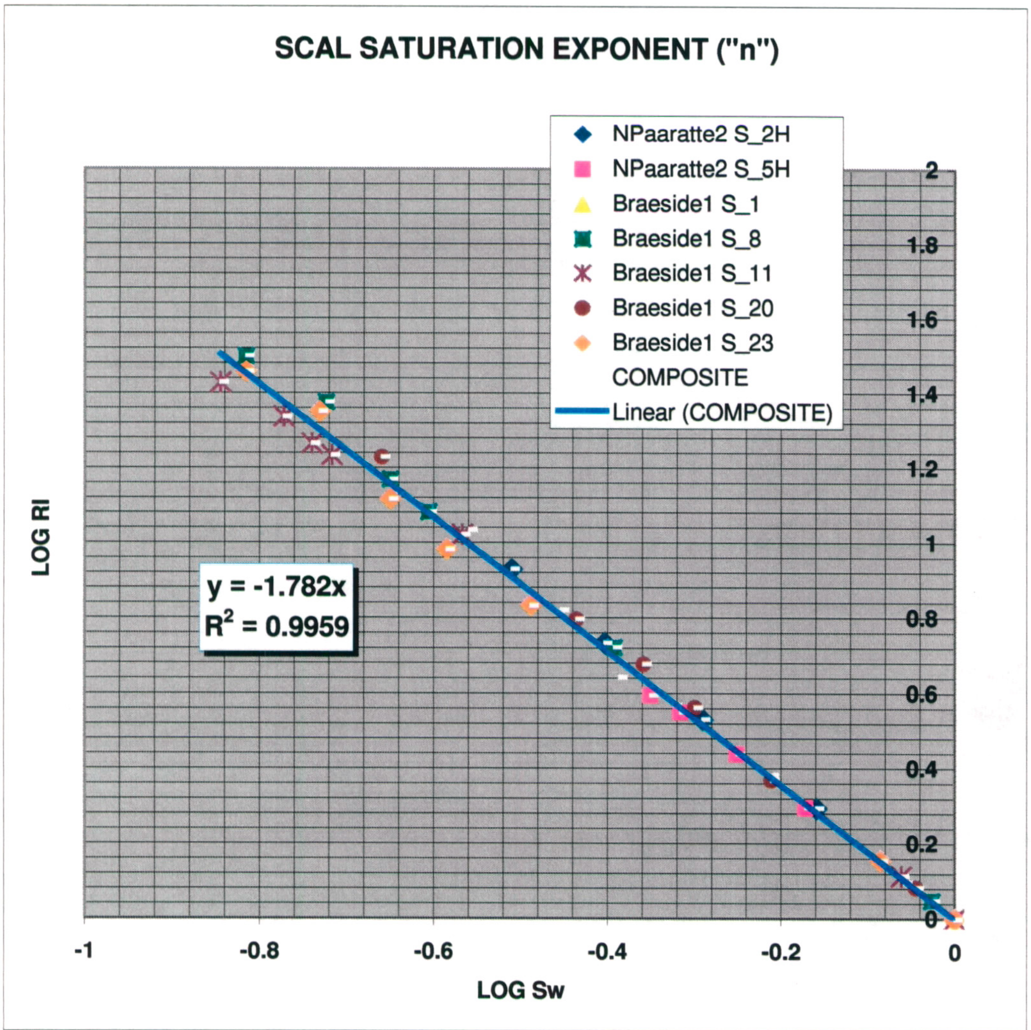
$$LOG(RI) = LOG(Sw^{-n})$$
$$LOG(RI) = -n * LOG(Sw)$$

Equation 14

Therefore, by plotting the log of Resistivity Index against the log of Sw, the slope of the regression line is the value of "n" (Figure 25).

The regression line in Figure 25 has a slope or "n" value of 1.782. The regression has a 99% correlation, suggesting that "n" does not vary systematically with overburden. Therefore it is inappropriate to vary "n" from the ambient SCAL measurements.

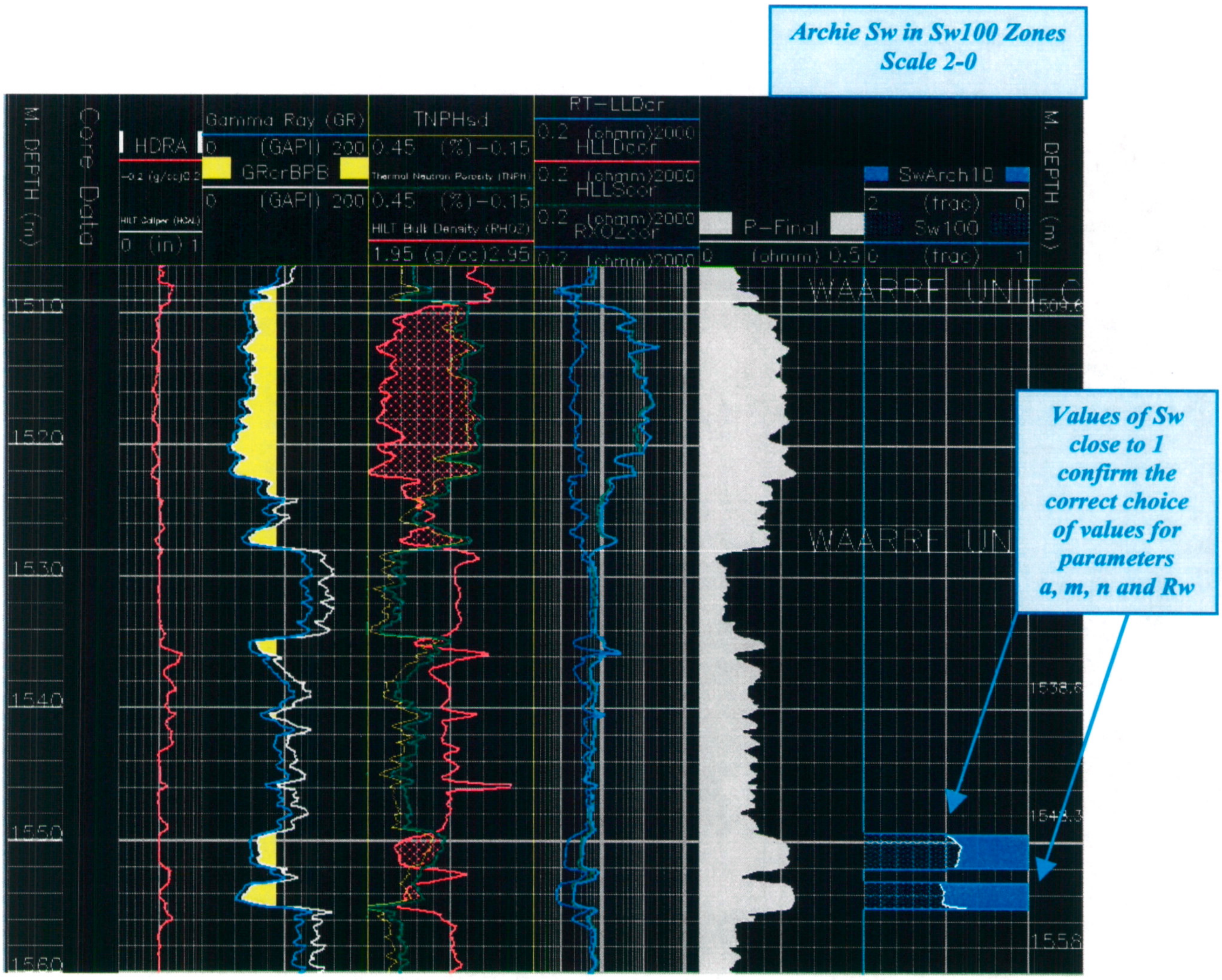
**Figure 25 – Saturation Exponent**



## 10.4 Sw100 PLOTS

In order to confirm the derived resistivity equation parameters of a, Rw, m and n, Archie Water Saturation was calculated in the previously defined 100% water saturated zones (Sw100). A result of Sw equal to 1 in these zones would confirm that these parameters were correct. Figure 26 shows Archie Water Saturation in the Sw100 zones of North Paaratte 4;

**Figure 26 – Archie Water Saturation in Sw100 Zones at North Paaratte 4**




Sw100 plots for North Paaratte 5 and Mylor 1 confirmed the suitability of the a, m, n, and Rw values;

**Table 13 – Sw Equation Parameters.**

| Sw Equation Parameter | Value |
|---|---|
| a | 1.25 |
| m | 1.84 |
| n | 1.782 |
| Rw | 0.2 @ 25degC |

Following confirmation of these values, Archie water saturation was run over the entire Waarre Formation interval for North Paaratte 4 and North Paaratte 5. Calculated Water Saturation for North Paaratte 4 and 5 is shown in track 6 of Figure 27a and 27b. Track 7 shows Water Saturation and Gas Saturation as a fraction of overall porosity (Bulk Volume Water and Bulk Volume Gas);

Figure 27a - Archie Water Saturation, North Paaratte 4

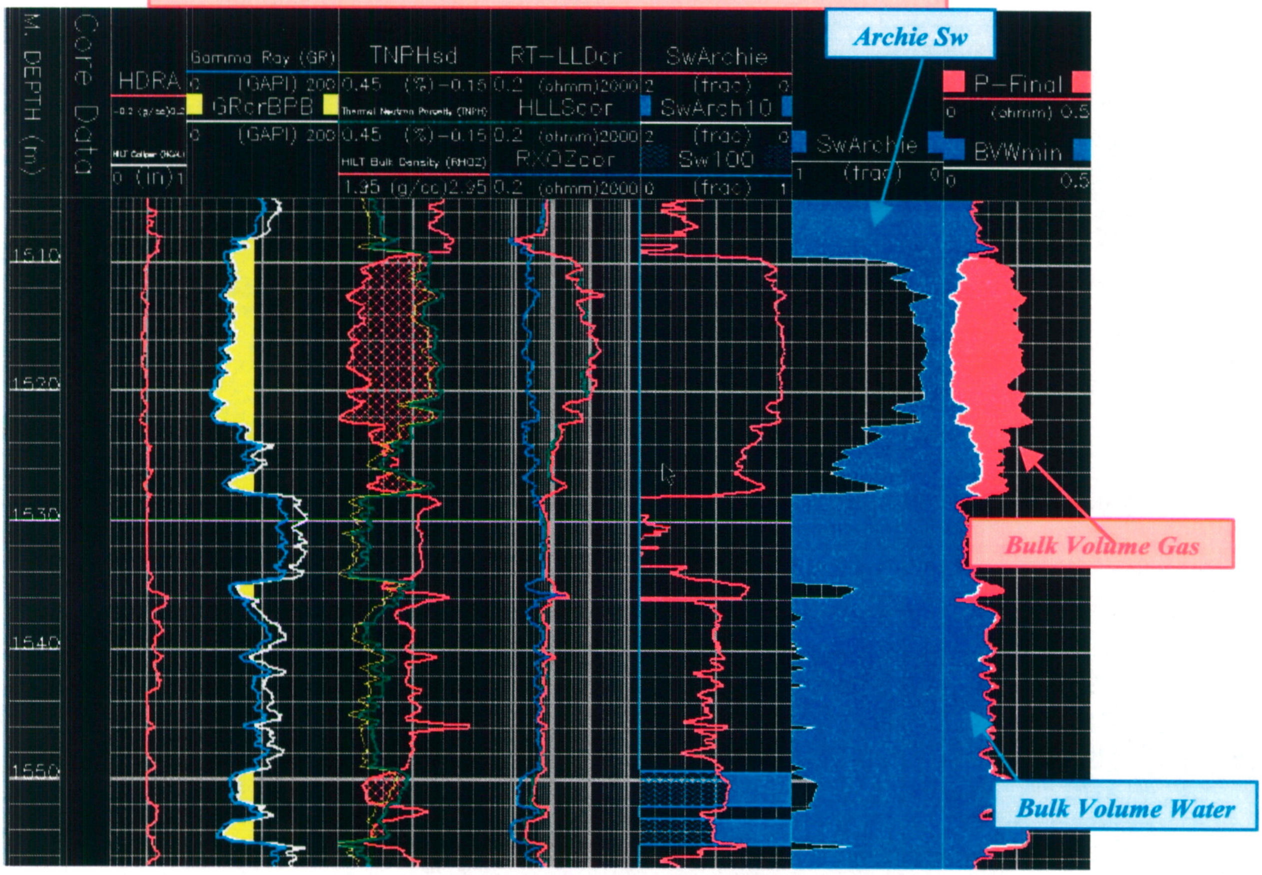
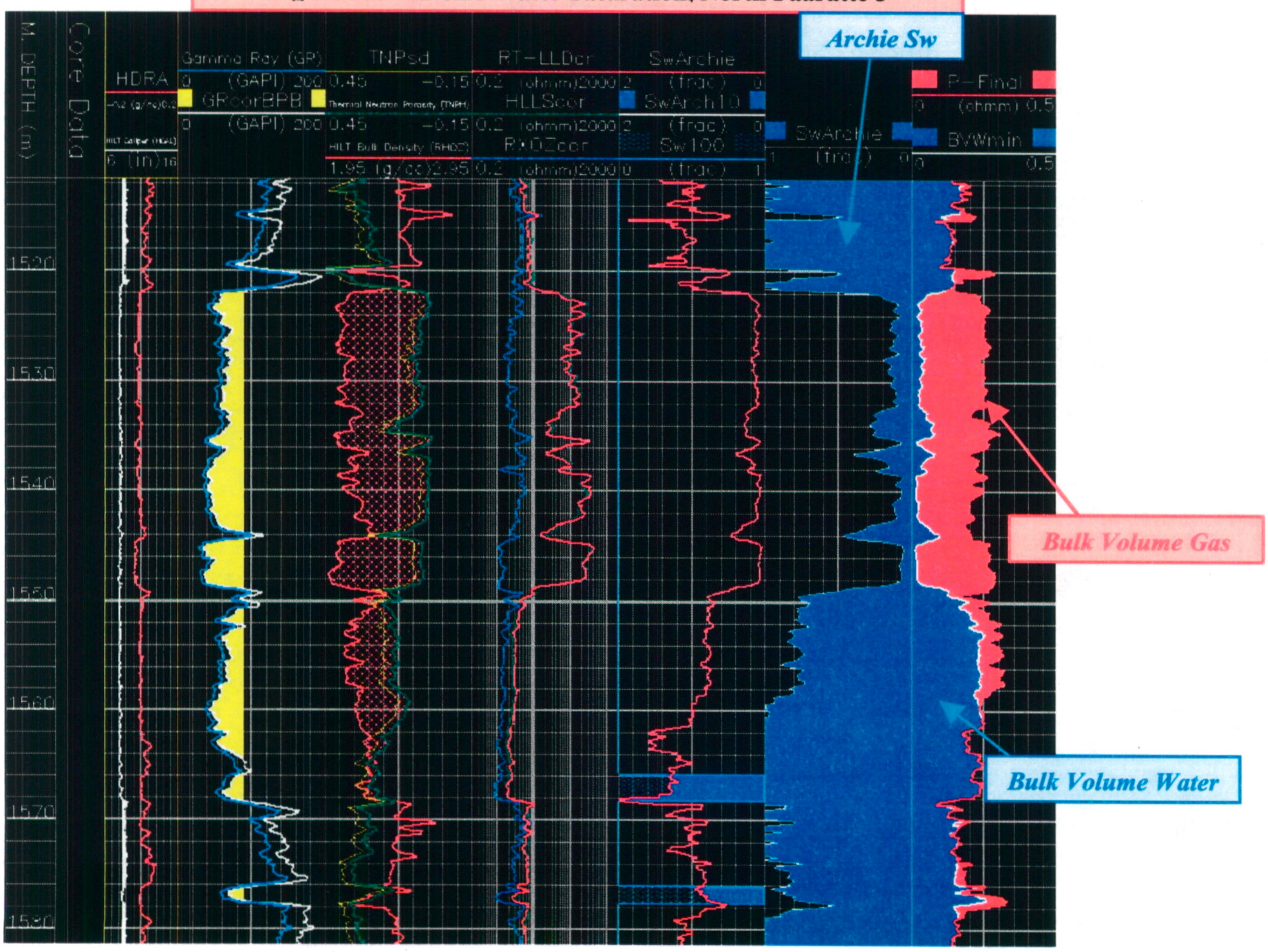



Figure 27b - Archie Water Saturation, North Paaratte 5



## 10.5 FLUID ZONE CLASIFICATION

Fluid zone classification determines whether or not calculated hydrocarbons will be included in Net Pay and Volumetric calculations. During the classification process, horizontal slices of formation containing different fluids are identified. Fluid Zone categories were;

- Gas Zone
- Oil Zone
- Transition Zone
- Residual Oil Zone and water encroachment Zone
- Water Zone

Initially, the fluid zone classification was done without reference to RFT pressure data. Instead, fluid zones were defined by reference to;

- Resistivity response
- Neutron-Density separation
- Calculated Sw and Bulk Hydrocarbon Volume.
- Lithlog/Mudlog Cut, Fluorescence, Stain, Chromatograph
- Produced fluids from DST and RFT

Current, Original and Palaeo Gas-Water contacts, or Original Gas Down To and Original Water Up To, were deduced from the above information and tabulated (Table 18). At this stage no reference was made to RFT derived contacts.

### Table 14 – Nth Paaratte & Mylor 1 Fluid Zone Table

| KB | 95.4528 | | 121.5 | | 98.4 | | 98.4 | | 103.2 | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLUID ZONE | NORTH PAARATTE 1 | | NORTH PAARATTE 2 | | NORTH PAARATTE 4 | | NORTH PAARATTE 5 | | MYLOR 1 | |
| | Pre-Prodn | TVDSS | Pre-Prodn | TVDSS | Post-Prodn | TVDSS | Post-Prodn | TVDSS | Pre-Prodn | TVDSS |
| Top Reservoir | 1449 | 1353.5 | 1469.5 | 1348 | 1509.3 | 1327.5 | 1521.6 | 1329.56 | 1672.4 | 1569.2 |
| Current GWC | 1454.8 | 1359.3 | 1483? | 1361.5 | | | 1548.6 | 1354.01 | 1702 | 1598.8 |
| Original GWC | x | | 1489 | 1367.5 | | | 1558.6 | 1363.09 | 1702 | 1598.8 |
| Palaeo GWC | 1470.4 | 1374.9 | | | | | | | | |
| Original GDTo | | | | | 1527.8 | 1344.4 | | | | |
| Original WUTo | | | | | 1549.3 | 1363.8 | 1565.8 | 1365.86 | 1706.7 | 1603.5 |
| RFT GWC | 1460.653 | 1365.2 | 1486.7 | 1365.2 | 1552.2 | 1365.2 | 1562.405 | 1365.2 | 1701.4 | 1598.2 |
| Original OWC | | | | | | | | | 1704 | 1600.8 |
| COMMENT | FIT @ 1460 rec 1.4m3 gas and cond cut mud | 1354.5 | RFT @1481 rec1.13m3 gas & 500ml wtr/mud | 1359.5 | No Tests | | No Tests | | RFT entirely consistent with data | |
| | DST to 1454.5 7 mmcfd | 1358.8 | DST Fail | | | | | | OIL Core contained oil from 1701.4-1704 RFT at 1702.3 rec 1.3m3 gas,150ml oil | |
| SUMMARY | Overall, data is consistent with an OGWC at 1365.2mSS. The RFT data in NP2 supports at contact at 1365.2mSS. Whilst NP1 logs may suggest a highr contact at 1359.3mSS, an FIT which recovered gas at 1364.5mSS suggets otherwise. | | | | | | | | GWC 1702.74 MDKB | 1599.54 |
| | | | | | | | | | | |
| Fluid Zone 3 | 1449.0192 | 1353.6 | 1469.5117 | 1348 | 1509.2172 | 1327.5 | 1521.714 | 1329.8 | | |
| | 1461.8208 | 1366.4 | 1487.94 | 1366.4 | 1528.1148 | 1344.6 | 1548.384 | 1353.8 | | |
| Fluid Zone 1.5 | | | | | 1528.2672 | 1344.7 | 1548.6888 | 1354 | | |
| | | | | | 1552.194 | 1366.5 | 1562.4048 | 1366.5 | | |

For the North Paaratte gasfields, all contacts were plotted on multiwell cross-sections. Discrepancies and anomalies in fluid contacts were identified and field consistent fluid contacts were agreed upon.

In North Paaratte field, it was found that the original Gas-Water contact identified by this methodology was entirely consistent with the Gas-Water contact suggested by the RFT pressure data. A Water

Encroachment Zone was identified in North Paaratte 5 which was found to be consistent with Gas Down To (GDTo) and Water Up To (WUTo) levels in North Paaratte 4[2].

Table 19 summarises final agreed contacts;

| TABLE 15 - SUMMARY OF FLUID CONTACTS | | |
|---|---|---|
| FIELD | Original GWC | Current GWC |
| | m TVDSS | m TVDSS |
| NORTH PAARATTE | 1365.2 | 1354.01 |

Fluid Zones were input into a Terrastation curve called FlZone which is shown in Track 6 of Figure 32 & 33.

A numerical value was ascribed to each zone according to the following classification;

**Table 16 – Fluid Zone Classification**

| VALUE | ZONE |
|---|---|
| 1 | WATER ZONE |
| 1.5 | WATER ENCROACHMENT ZONE |
| 2 | OIL ZONE |
| 3 | GAS ZONE |

[2] North Paaratte 1 and 2 were drilled prior to production whilst North Paaratte 4 and 5 are post production wells.

# 11.0 PERMEABILITY

## 11.1 Poro-Permeability (K-Φ)

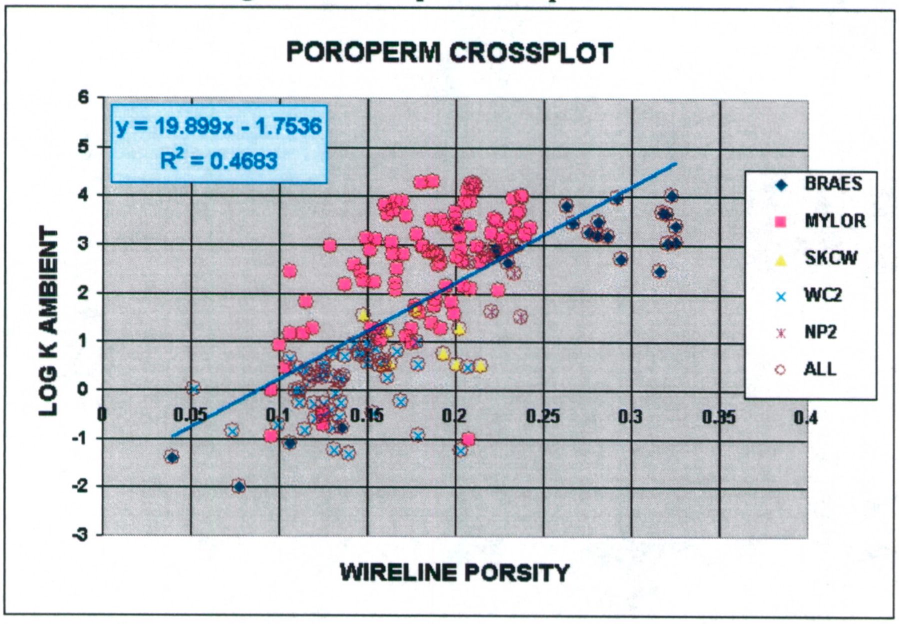
The traditional permeability predictor is porosity. The advantages of porosity are;

- Relatively well defined by log evaluation
- Can be used over all fluid zones
- Simple, traditional, universally accepted

The disadvantage is that it often does not correlate with permeability as well as saturation, and it places unnecessary dependence on RHOB, resulting in an "under-determined" evaluation (Deakin, 1999).

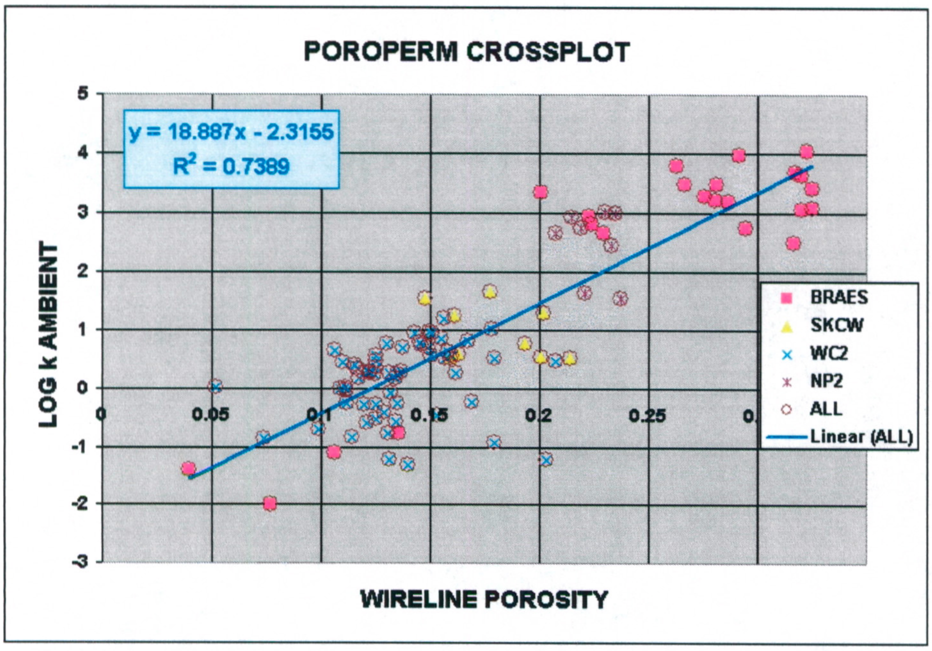
The Porosity-Permeability relationship was defined in this study by crossplotting the wireline porosity against Ambient Core Permeability for the wells North Paaratte 2, Wallaby Creek 2, Skull Creek West 1, Mylor 1 and Braeside 1;

**Figure 28a– Poroperm Crossplot**




The Poroperm crossplot (Figure 28a) shows a moderate correlation factor of 47%, chiefly due to data from Mylor 1. It was thought that a better correlation could be achieved if Mylor was excluded (Figure 28b).

**Figure 28b– Poroperm Crossplot (excluding Mylor 1)**




A much stronger correlation (74%) was achieved by excluding Mylor 1. The formation of diagenetic clays would alter the porosity-permeability relationship. It may be that the Waarre Formation at Mylor 1 has undergone a different style of diagenesis compared with wells to the south.

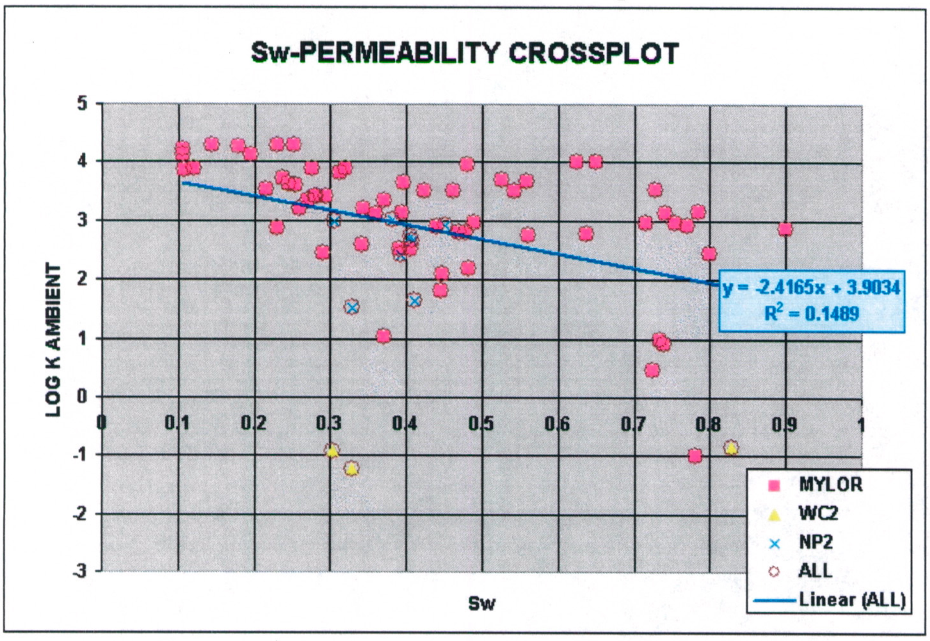
:

## 11.2 Water Saturation Permeability (K-Sw)

Both permeability and water saturation are influenced by pore throat size and pore surface area. This creates a stronger relationship between *Swi* (Irreducible Water Saturation) and *K* (Permeability) than between Φ (Porosity) and *K*. The Sw-K relationship is also more stable across changing pore geometry than the
*k*-Φ. The basic concept of predicting permeability with Sw has been in existence for 50 years (Wyllie and Rose 1950). Given that Sw is determined with reasonable accuracy during evaluation, it is the ideal candidate for hydrocarbon zone permeability prediction if contacts are known with reasonable certainty (Deakin, 1999)

Unfortunately, the Sw-K Crossplot for this study did not show the close relationship which has been described above. A correlation coefficient of 15% resulted, 22% if the Wallaby Creek 2 core points were excluded.

**Figure 29– Sw-Permeability Crossplot**



### 11.3 Vsh-Permeability (K-Vsh)

Shale volume (Vsh) is the least useful of the permeability predictors. However, in fields with poor porosity data, Vsh will provide benefit. The advantages of Vsh prediction are;

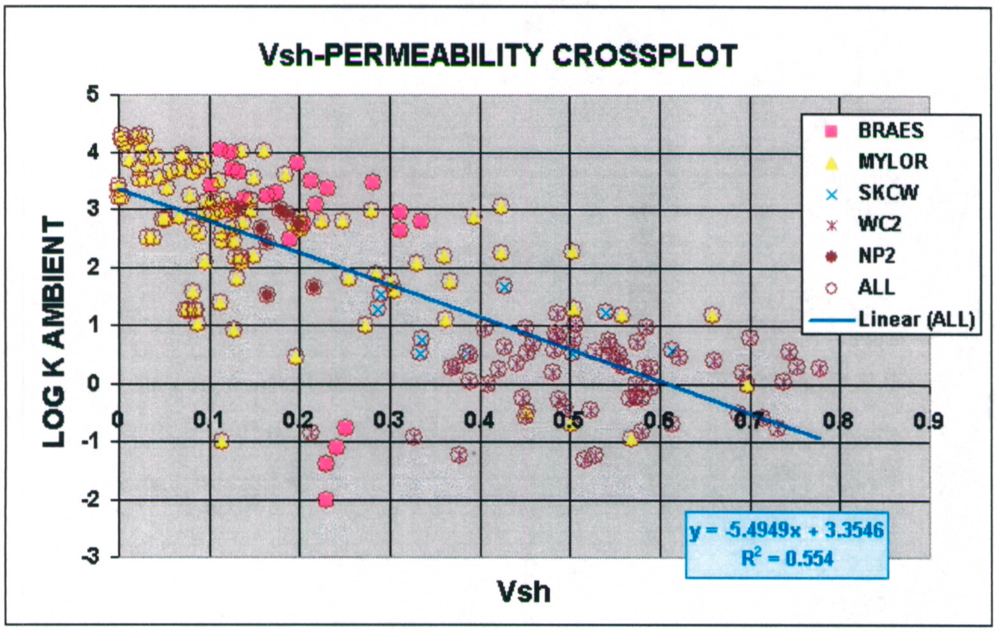
- Provides independent input as insurance against tool error
- Remains more valid over badhole than K-Φ and K-Sw
- Corresponds to "gut" feelings as to what *is* and *is not* good reservoir.

Disadvantages are;

- Reliable, but poor correlation coefficient with core K.
- Vsh may not correlate with dispersed clays which are influential to Core K .
- Vsh is usually inaccurate

(Deakin, 1999)

**Figure 30– Vsh-Permeability Crossplot**




Surprisingly, the Vsh-Permeability Crossplot achieved a respectable correlation factor of 55%, easily surpassing the Sw-K relationship.

### 11.4 FINAL PERMEABILITY

Final Permeability was predicted from a weighted average of individual predictions found to influence permeability i.e. Porosity, Vsh and Sw. The weighting was determined by the correlation coefficients of the linear regressions in each case;

**Table 17 – Permeability Equation Correlation Coefficients**

| | CORRELATION COEFFICIENT | K EQUATION |
|---|---|---|
| PORO-K | 73.89% | $k = 10^{18.887(\phi) - 2.3155}$ |
| Sw-K | 14.90% | $k = 10^{-2.4165(Sw) + 3.9034}$ |
| Vsh-K | 55.40% | $k = 10^{-5.4949(Vsh) + 3.3546}$ |

The Final Permeability equation contained the greatest weighting on the Porosity-Permeability relationship and the Vsh-Permeability relationship. The Sw-Permeability relationship received a very minor weighting.

$$K = [0.6 \times fn(\Phi)] + [0.3 \times fn(Vsh)] + [0.1 \times fn(Sw)]$$ **Equation 15**

## 11.5 OVERBURDEN PERMEABILITY CORRECTION

Overburden Permeability analysis was performed on core from Skull Creek West 1 and Wallaby Creek 2. At Skull Creek West 1, air permeability was calculated for four core plugs which were placed under an overburden pressure of 2550psi. At Wallaby Creek 2, overburden pressure of 2500psi was applied to six core plugs.

Equivalent Hydrostatic Stress (EQHS) for the Waarre Formation at Skull Creek West 1 and Wallaby Creek 2 was 1311psi and 1577psi respectively. A linear interpolation was applied to correct SCAL overburden permeabilities to EQHS. A crossplot of Ambient Permeabilty versus Overburden Permeability was used to define a composite overburden permeability correction factor. This factor was applied to Ambient Permeability calculations for wells within the study area.

**Figure 31 – Ambient Permeability vs Overburden Permeability**

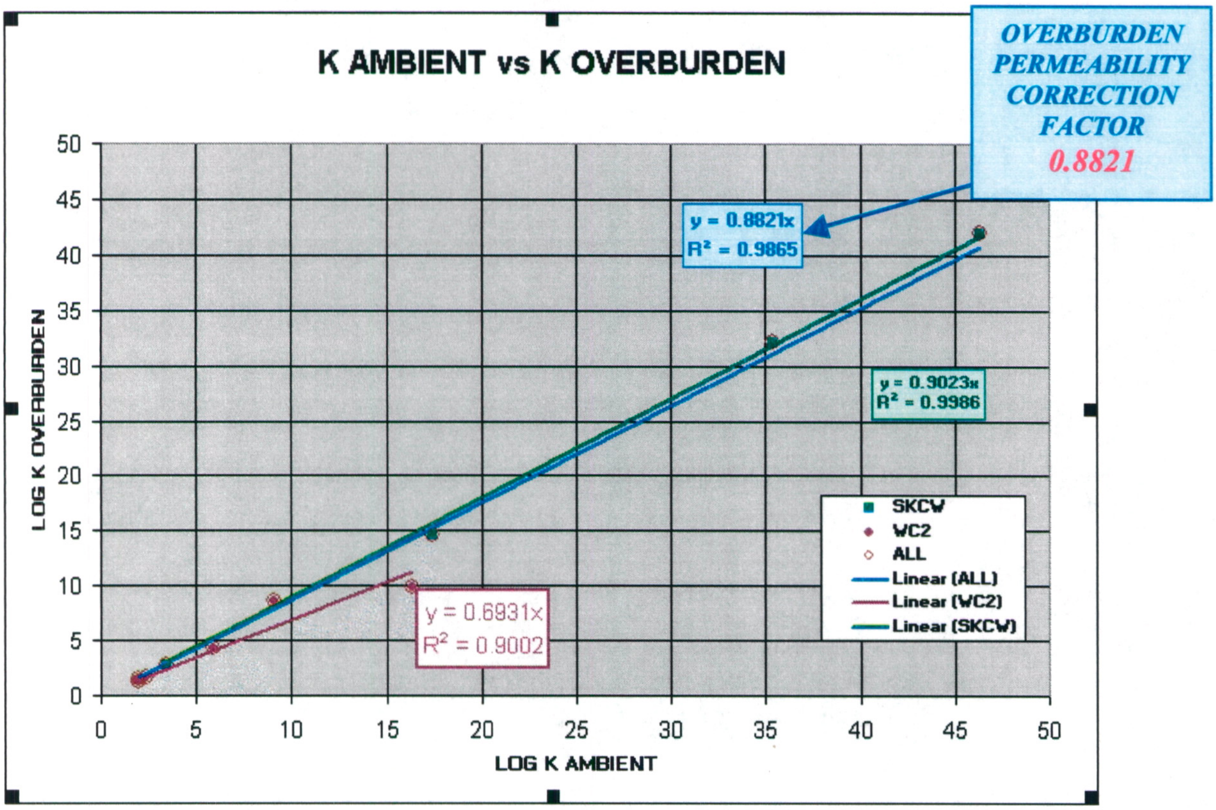


FIGURE 32 - NORTH PAARATTE 4, PERMEABILITY

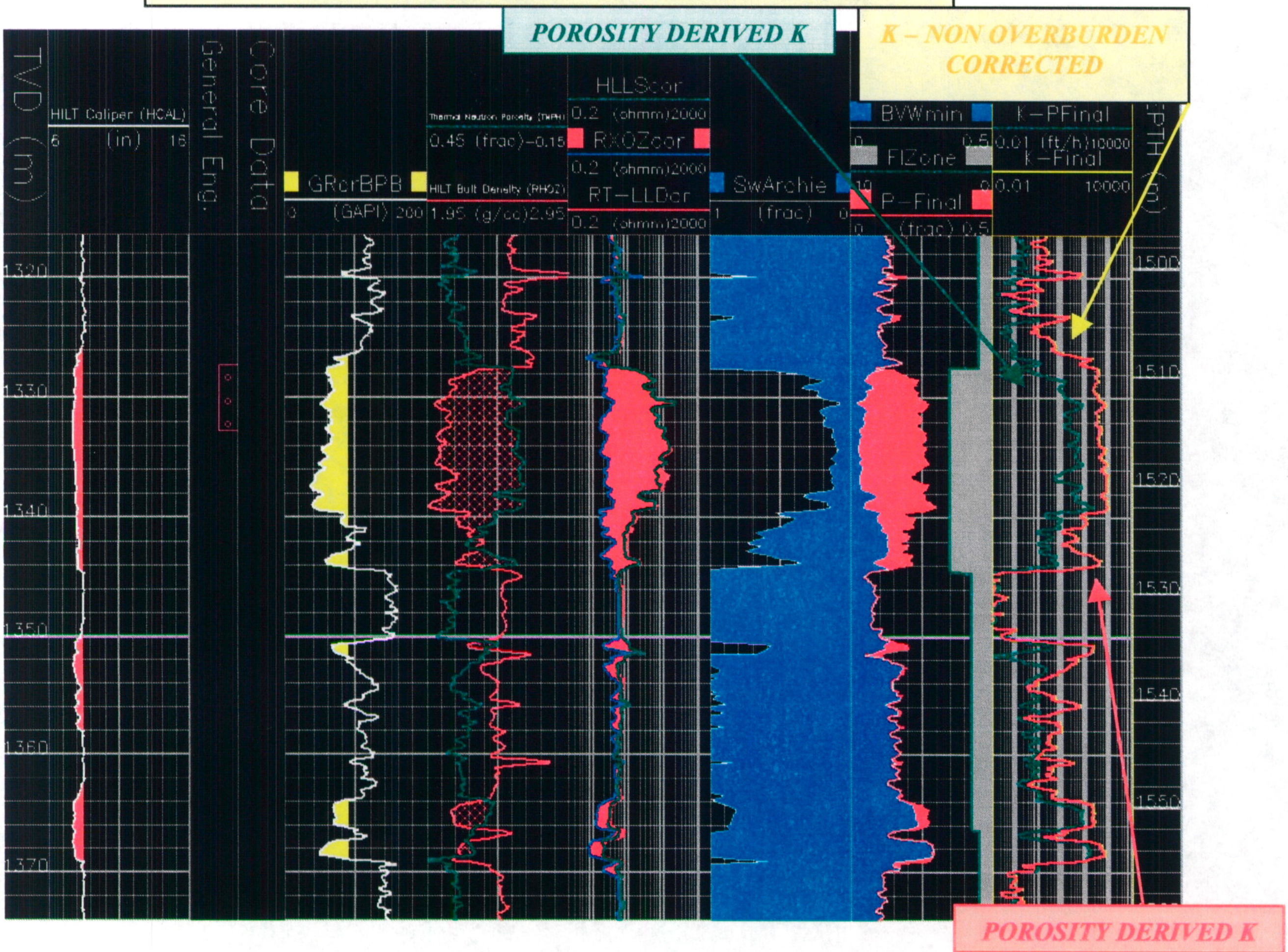
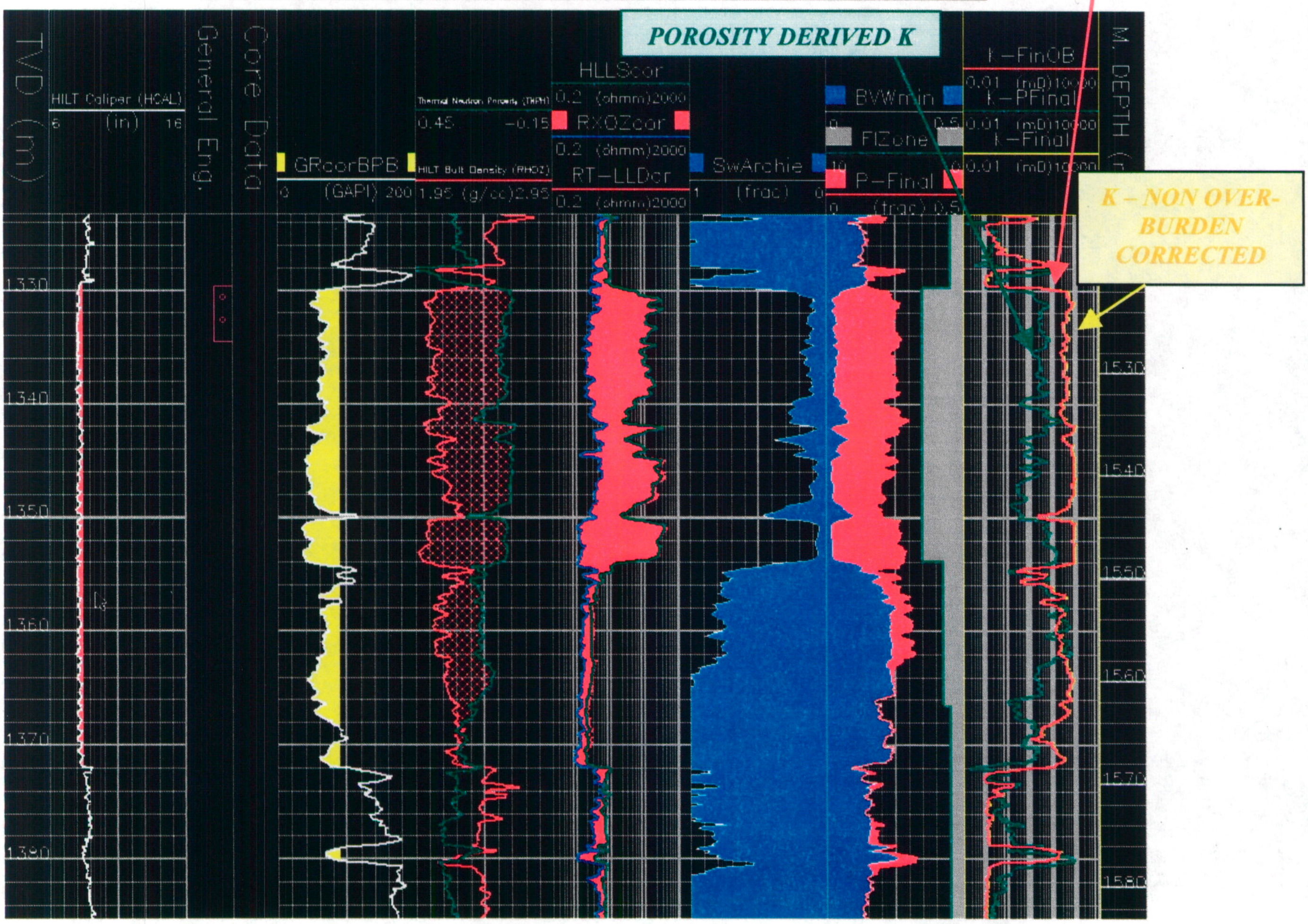



FIGURE 33 - NORTH PAARATTE 5, PERMEABILITY



# 12.0 NET PAY

## 12.1 NET PAY CUTOFFS

The objective of a net pay cutoff is to delineate intervals containing fluids which make no contribution to production during the life of a field. Fluids which move or experience a change in pressure during production will make a finite, if small, contribution to production. This includes fluids which move at sub-commercial rates (Deakin, 1999).

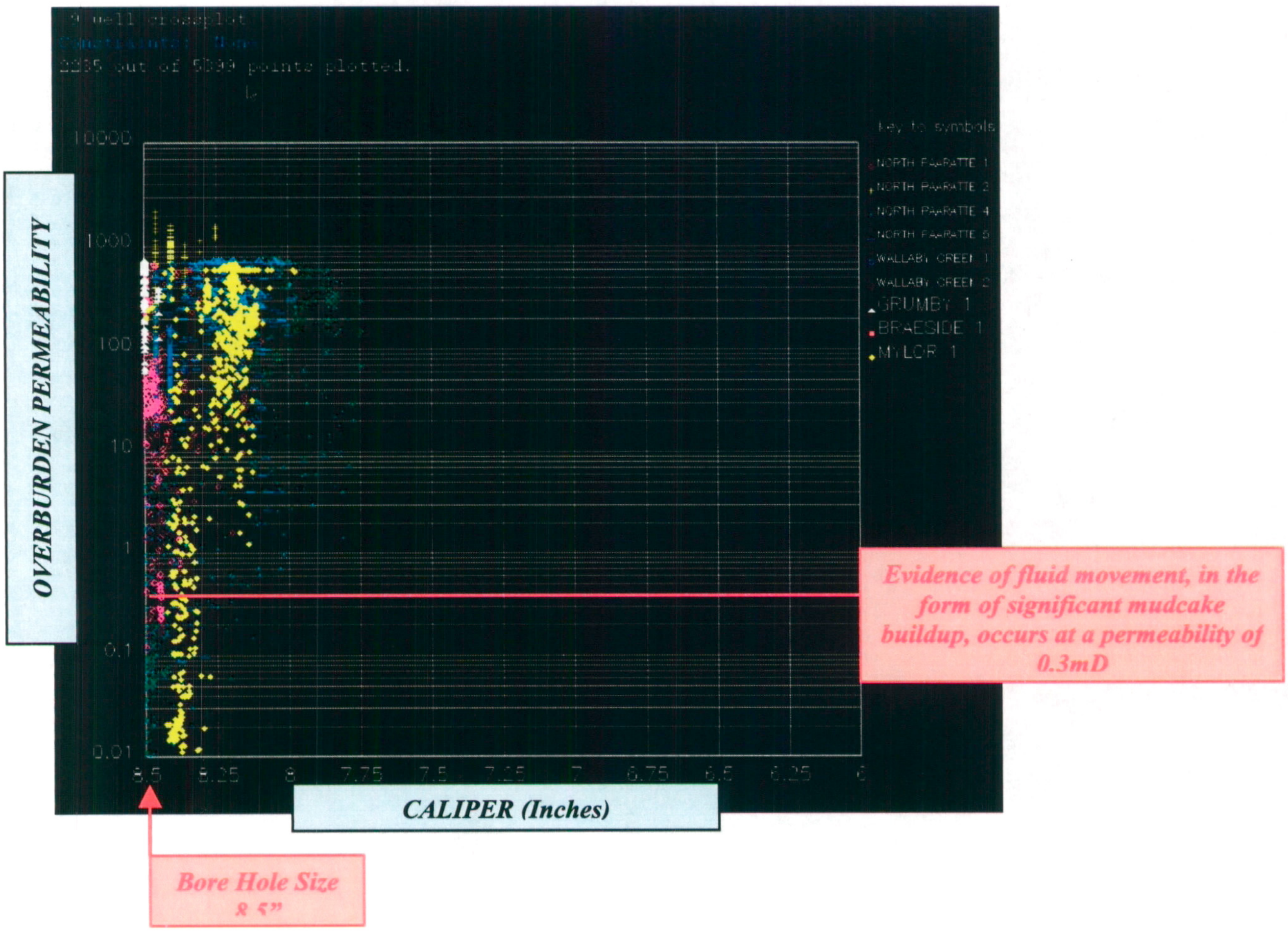
Permeability is the preferred criteria for net determination because it is a measure of a rock's ability to pass fluids. Shale volume and porosity are inadequate measures of a rock's ability to pass fluids. A rock will or will not pass fluids for a given shale content or porosity, depending on shale distribution and pore geometry. Conversely, permeability is the result of such influences and measures directly the rock's ability to pass fluids. The relationship between net indicators and permeability is stronger than with porosity and shale volume (Deakin, 1999).

### 12.1.1 Evidence of Fluid Movement - Mudcake

Mudcake provides direct evidence of net intervals because filtration (fluid movement) is implied. If the borehole has remained in gauge, a correctly calibrated caliper log will detect mudcake build-up. Shading the log from caliper to bitsize reveals intervals where mudcake has built-up.

In order to relate mudcake build-up and fluid movement/net pay to permeability, a crossplot of mudcake vs permeability was made.

**Figure 34 – Crossplot of Mudcake vs Permeability**
**(Waarre Formation Interval)**



Evidence of fluid movement, and hence net pay, is indicated by mudcake build-up at a permeability of 0.3mD. Therefore, the permeability cut-off for net pay is 0.3mD.

### 12.1.2 Evidence of Fluid Movement – Invasion

A resistivity invasion profile will show one of three things;

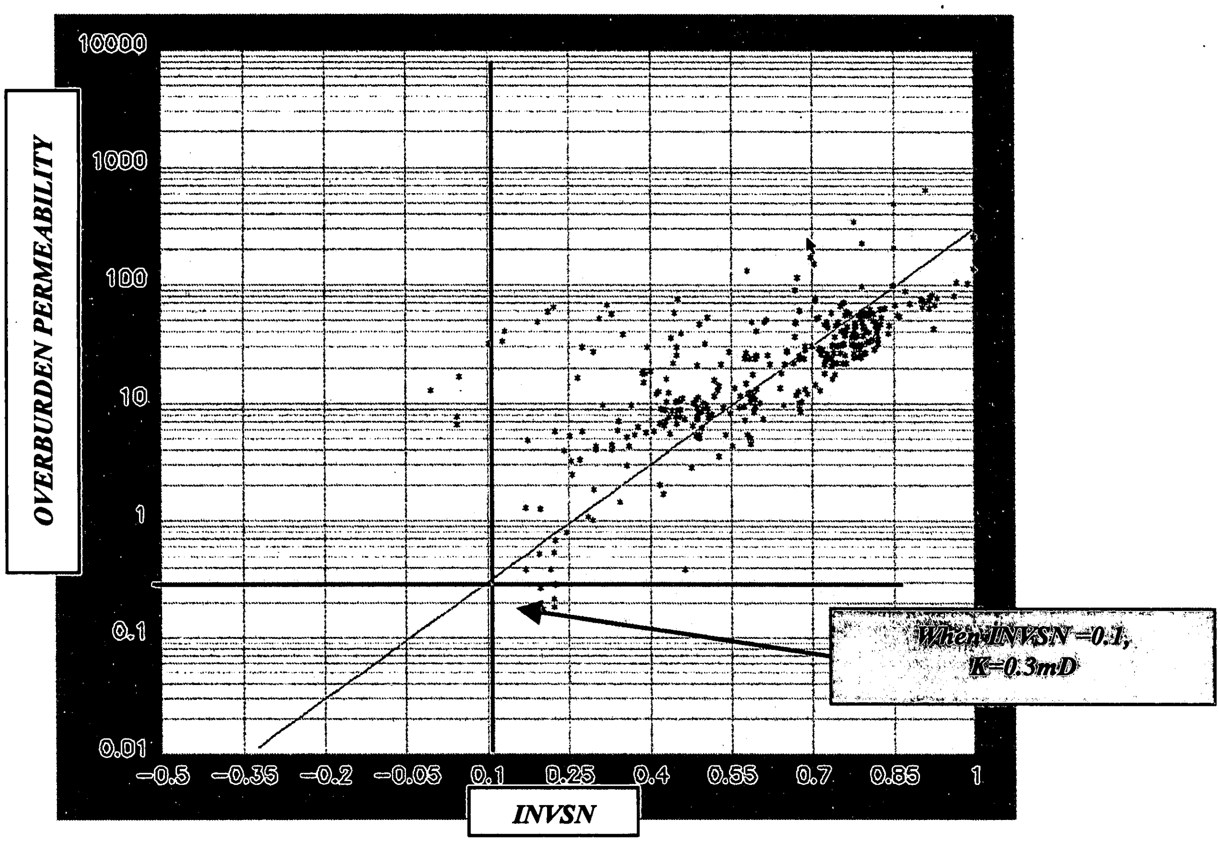
- Impermeable massive shales
- Porous hydrocarbon zones
- Porous water zones.

Impermeable shales show approximately overlying Rshallow, Rmedium and Rdeep. The lack of invasion results in little change in resistivity from the borehole wall to further into the formation. Good reservoir quality, hydrocarbon saturated units will show clear invasion profiles with Rdeep>> Rshallow. Such units are clearly net pay.

In this study, confidence in the permeability net pay cutoff of 0.3mD was enhanced by crossplotting a parameter named INVSN with permeability (Figure 35).

Where, $$INVSN = LOG(Rt) - LOG(Rxo) > 0.1$$ **Equation 16**

**Figure 35 – Permeability vs INVSN, Wallaby Creek 2**
**(Gas zones only)**



## 12.2 FINAL CUTOFFS

Final Net Pay was run within Fluid Zone 3 (Chapter 10.5) using a permeability cut-off of 0.3 mD. A backup Vsh cut-off of 50% was added to ensure reservoir quality. Table 22 is a summary of the Net Pay cutoffs;

**Table 18 – Net-Pay Cutoffs**

| FINAL NET PAY CUT-OFFS | |
|---|---|
| Fluid Zone | 3 |
| Permeability | 0.3mD |
| Vsh | 0.5 |

## 12.3 NET PAY

Table 23 lists net pay and average net pay statistics for the wells North Paaratte 4 and 5. Figures appearing in black are pays and averages for stratigraphic subdivisions, whereas those in red are well totals. Enclosures 1 and 2 provide a guide to stratigraphic subdivisions and correlations. A complete pay-depth listing for each well can be found in Appendix 1.

Pay flags are shown for each well in Enclosures 1 and 2. .

**Table 19 – Net Pay & Pay Statistics**

**NORTH PAARATTE 4**

| LAYERS | TOP | BOTTOM | Vshale | Sw | Porosity | Perm(mD) | PAY THK |
|---|---|---|---|---|---|---|---|
| TOP C3- TOP B | -1326.36 | -1344.55 | 0.104 | 0.453 | 0.223 | 324.211 | 18.095 |
| TTL TOP C3-TOP B | -1326.36 | -1344.55 | 0.104 | 0.453 | 0.223 | 324.211 | 18.095 |
| TOP B1 -BASE B1 | -1350.34 | -1351.92 | 0.171 | 0.932 | 0.145 | 99.093 | 1.522 |
| BASE B1-TOP A (TWE) | -1351.92 | 1354.8 | 0.337 | 0.995 | 0.170 | 13.883 | 1.660 |
| TTL TOP C3-TOP A (TWE) | 1326.36 | 1354.8 | 0.127 | 0.529 | 0.213 | 283.950 | 21.277 |
| TOPA-BASE A1 | 1354.8 | 1359.66 | 0.381 | 1.038 | 0.159 | 8.845 | 4.294 |
| TOP A2-BASE A2 | 1360.39 | 1362.42 | 0.407 | 1.091 | 0.160 | 5.921 | 1.941 |
| BASE A2-TOP A3 | 1362.42 | 1363.73 | 0.418 | 0.976 | 0.172 | 3.670 | 0.832 |
| TOP A3-GWC | 1363.73 | 1365.2 | 0.144 | 0.887 | 0.236 | 135.116 | 1.388 |
| TTL TOP C3-GWC | 1326.36 | 1365.2 | 0.191 | 0.668 | 0.202 | 211.435 | 29.733 |
| GWC-EUM | 1365.2 | 1369.56 | 0.168 | 0.974 | 0.245 | 202.493 | 3.888 |

**NORTH PAARATTE 5**

| | TOP | BOTTOM | Vshale | Sw | Porosity | Perm(mD) | PAY THK |
|---|---|---|---|---|---|---|---|
| TOP C1-BASE C1 | 1329.72 | 1339.78 | 0.087 | 0.141 | 0.245 | 322.224 | 10.030 |
| BASE C1-TOP C2 | 1339.78 | 1341.12 | 0.116 | 0.256 | 0.239 | 192.140 | 1.375 |
| TOP C2-TWE | 1341.12 | 1354.01 | 0.037 | 0.156 | 0.237 | 565.592 | 12.928 |
| TOP C1-TWE | 1329.72 | 1354.01 | 0.062 | 0.155 | 0.241 | 444.121 | 24.333 |
| TWE-BASE C2 | 1354.01 | 1354.39 | 0.138 | 0.447 | 0.263 | 186.050 | 0.413 |
| BASE C2-TOP C3 | 1354.39 | 1355.93 | 0.332 | 0.727 | 0.224 | 15.178 | 1.514 |
| TOP C3-GWC | 1355.93 | 1365.2 | 0.092 | 0.829 | 0.279 | 233.623 | 9.236 |
| TTL TOP C1-GWC | 1329.72 | 1365.2 | 0.082 | 0.358 | 0.250 | 368.167 | 35.496 |
| GWC-TOP B | 1365.2 | 1372.19 | 0.140 | 1.348 | 0.209 | 163.841 | 6.904 |
| TOP B - MFSb | 1372.19 | 1378.55 | 0.475 | 0.838 | 0.201 | 1.580 | 0.138 |
| TOP B1-BASE B1 | 1378.8 | 1380.48 | 0.177 | 0.829 | 0.262 | 86.841 | 1.384 |

## 12.4 SENSITIVITY STUDY

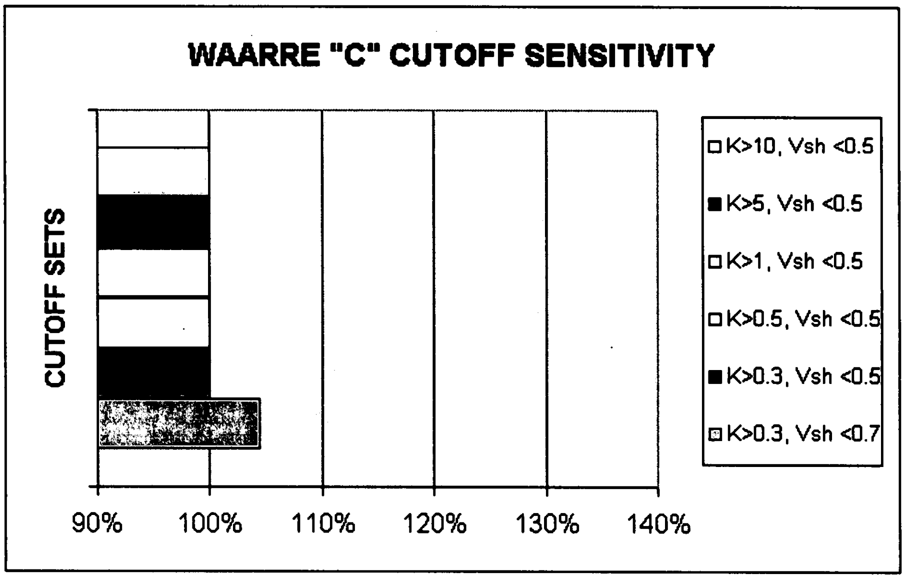
A sensitivity study was performed upon the "A" and "C" sands of Wallaby Creek 2.

### 12.4.1 Cutoff Sensitivity

The Net Pay cutoffs of Permeability and Vsh were varied to determine the Net Pay sensitivity to these cutoffs. Firstly Vsh was increased from the base case of <0.5 to a generous <0.7. Little effect was seen in the "C" sand (Figure 36).

Increases in the permeability cutoff from 0.3mD to 10mD had no effect in the "C" Sand (Figure 36).

**Figure 36 – Cutoff Sensitivity Histograms**

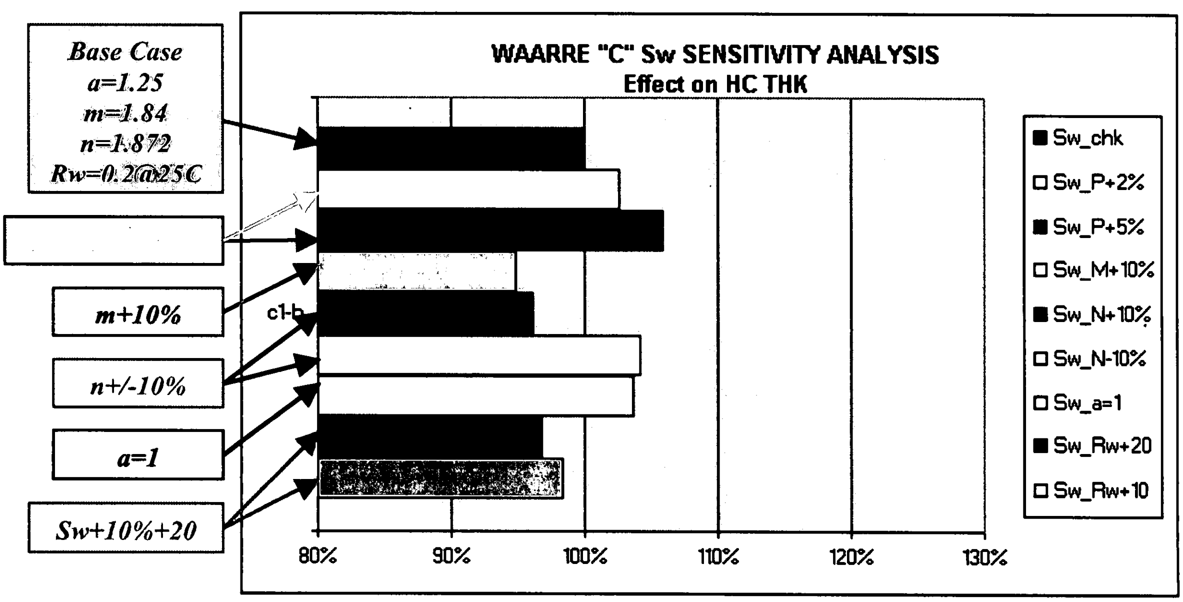



### 12.4.2 Water Saturation Equation - Input Parameter Sensitivity

Porosity, m, n, a and Rw inputs to the Archie Equation were varied to understand their effect on Hydrocarbon Thickness. A Histogram for the "C" sands is plotted below in Figure 37.

The critical factor seems to be the Cementation Exponent "m". When increased by 10%, hydrocarbon thickness decreased by 5% in the "C" sand. Fortunately, a high level of confidence is placed in the Pickett Plot derived value of "m" (1.84).

**Figure 37 – Hydrocarbon Thickness Sensitivity to Archie Equation Input Parameters**



PE605486

This is an enclosure indicator page.
The enclosure PE605486 is enclosed within the container PE907476 at this location in this document.

The enclosure PE605486 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE605486 |
| CONTAINER_BARCODE = | PE907476 |
| NAME = | North Paaratte-4 Composite Plot |
| BASIN = | OTWAY |
| ONSHORE? = | Y |
| DATA_TYPE = | WELL |
| DATA_SUB_TYPE = | WELL_LOG |
| DESCRIPTION = | North Paaratte-4 Petrophysical Composite Plot Enclosure 1 of Appendix 2 |
| REMARKS = | Copy 1 |
| DATE_WRITTEN = | |
| DATE_PROCESSED = | |
| DATE_RECEIVED = | 27-JAN-2000 |
| RECEIVED_FROM = | Boral Energy Ltd |
| WELL_NAME = | North Paaratte-4 |
| CONTRACTOR = | |
| AUTHOR = | |
| ORIGINATOR = | Boral Energy Ltd |
| TOP_DEPTH = | |
| BOTTOM_DEPTH = | |
| ROW_CREATED_BY = | DN07_SW |

(Inserted by DNRE - Vic Govt Mines Dept)

PE605487

This is an enclosure indicator page.
The enclosure PE605487 is enclosed within the container PE907476 at this location in this document.

The enclosure PE605487 has the following characteristics:

| | |
|---|---|
| ITEM_BARCODE = | PE605487 |
| CONTAINER_BARCODE = | PE907476 |
| NAME = | North Paaratte-5 Composite Plot |
| BASIN = | OTWAY |
| ONSHORE? = | Y |
| DATA_TYPE = | WELL |
| DATA_SUB_TYPE = | WELL_LOG |
| DESCRIPTION = | North Paaratte-5 Petrophysical Composite Plot Enclosure 2 of Appendix 2 |
| REMARKS = | Copy 1 |
| DATE_WRITTEN = | |
| DATE_PROCESSED = | |
| DATE_RECEIVED = | 27-JAN-2000 |
| RECEIVED_FROM = | Boral Energy Ltd |
| WELL_NAME = | North Paaratte-5 |
| CONTRACTOR = | |
| AUTHOR = | |
| ORIGINATOR = | Boral Energy Ltd |
| TOP_DEPTH = | |
| BOTTOM_DEPTH = | |
| ROW_CREATED_BY = | DN07_SW |

(Inserted by DNRE - Vic Govt Mines Dept)

# APPENDIX 3

# BIT RECORD

# OIL COMPANY OF AUSTRALIA LIMITED
## BIT RECORD



NB: USE YOU "TAB" KEY TO MOVE FROM CELL TO CELL
*Fill in these cells "DATA Cells"*
*These cells will calculate results from "DATA" cells.*

Well : **North Paaratte 4** Basin / Area : **Otway** Permit : **PPL 1** Field : Nth Paaratte
Location : Latitude : 38 ° 33 ' 9.92 ' SOUTH State : **VIC** G.L. 92.90 metres Spud Date: 3-Apr-99
Longitude : 142 ° 57 ' 13.70 ' NORTH K.B. 98.40 metres T.D. Date: 8-Apr-99
Contractor : Century Drilling Rig Number: 2 Well Site Supervisor/s: **Barry Beetson** Rig Released Date: 10-Apr-99

### PUMPS

| No. | Type | Stroke (mm) | Liner (mm) | Output (gpm) |
|---|---|---|---|---|
| 1 | National 8P8O | 216.00 | 153.00 | 420.00 |
| 2 | National 8P8O | 216.00 | 153.00 | 420.00 |

### MUD TYPES

| INTERVAL | | | | | TYPE |
|---|---|---|---|---|---|
| SURFACE HOLE: | 0.00 | to | 406.00 | metres | PrehydratedGel/2%KCL |
| MAIN HOLE: | 406.00 | to | 1620.00 | metres | PHPA/polymer |

Please use IADC Dull Bit Grading Nomeculature provided on the following sheet.

| Bit No. | Run No. | Size (mm) | Make | Type | IADC Code | Serial No. | Nozzles | Motor Yes / No | Depth Out | Shock-Sub Serial No. | Metres | Hours | ROP (m/hr) | Accum Hours | Bit Grading I | O | D | L | B | G | O | R | WOB Mn | WOB Mx | RPM Mn | RPM Mx | Press (psi) | Pump (gpm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RR1 | 1 | 311 | Varel | L114 | 114 | 142725 | 3 x16 | NO | 406.00 | NO | 406.00 | 14.00 | 29.00 | 14.00 | 3 | 3 | WT | A | E | 1 | NO | TD | 5 | 15 | 120 | 140 | 1400 | 600 |
| 2 | 1 | 216 | Hughes | MX03 | 417 | E84DC | 14,14,16 | Yes | 1233.00 | NO | 827.00 | 28.00 | 29.54 | 42.00 | 3 | 6 | LT | A | E | 3 | ER | PR | 5 | 15 | 140 | 150 | 1050 | 540 |
| 3 | 1 | 216 | Hughes | GTP03 | 417 | T49CH | 14,16,16 | Yes | 1651.00 | NO | 418.00 | 29.00 | 14.41 | 71.00 | 6 | 6 | LT | A | E | 2 | ER | TD | 20 | 30 | 127 | 192 | 2000 | 475 |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

*Comments :* Erosion apparent in bit 3. Bit 2 was run a little longer than it should. Gouging due to balling up in clays evident. Some very tenacious sections of clay

907476 118

# IADC DULL BIT GRADING

| CUTTING STRUCTURE | | | | BEARING / SEALS | GAGE | OTHER DULL CHAR. | REASON PULLED |
|---|---|---|---|---|---|---|---|
| INNER | OUTER | DULL CHAR. | LOCATION | | | | |
| ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ |

## ① INNER CUTTING STRUCTURE (All inner rows)

## ② OUTER CUTTING STRUCTURE (Gage row only)

In columns 1 and 2 a linear scale from 0 to 8 is used to describe the condition of the cutting structure according to the following:

| STEEL TOOTH BITS | INSERT BITS | FIXED CUTTER BITS |
|---|---|---|
| A measure of lost tooth height due to abrasion and / or damage | A measure of total cutting structure reduction due to lost, worn and / or broken inserts | A measure of lost, worn and / or broken cutting structure |
| 0 - NO LOSS OF TOOTH HEIGHT | 0 - NO LOST, WORN AND/OR BROKEN INSERTS | 0 - NO LOST, WORN AND/OR BROKEN CUTTING STRUCTURE |
| 8 - TOTAL LOSS OF TOOTH HEIGHT | 8 - ALL INSERTS LOST, WORN AND/OR BROKEN | 8 - ALL OF CUTTING STRUCTURE LOST, WORN AND/OR BROKEN |

## ③ DULL CHARACTERISTICS (Use only cutting structure related codes.)

| | | | | | |
|---|---|---|---|---|---|
| BC * | BROKEN CONE | FC | FLAT CRESTED WEAR | RG | ROUNDED GAGE |
| BF | BOND FAILURE | HC | HEAT CHECKING | RO | RING OUT |
| BT | BROKEN TEETH / CUTTERS | JD | JUNK DAMAGE | SD | SHIRT-TAIL DAMAGE |
| BU | BALLED UP BIT | LC * | LOST CONE | SS | SELF-SHARPENING WEAR |
| CC * | CRACKED CONE | LN | LOST NOZZLE | TR | TRACKING |
| CD * | CONE DRAGGED | LT | LOST TEETH / CUTTERS | WO | WASHED OUT BIT |
| CI | CONE INTERFERENCE | OC | OFF-CENTRE WEAR | WT | WORN TEETH / CUTTERS |
| CR | CORED | PB | PINCHED BIT | NO | NO DULL CHARACTERISTICS |
| CT | CHIPPED TEETH / CUTTERS | PN | PLUGGED NOZZLE / FLOW PASSAGE | | |
| ER | EROSION | | | | * Show Cone # or #'s under location ④ |

## ④ LOCATION

| ROLLER CONE | | |
|---|---|---|
| N | NOSE ROW | CONE # |
| M | MIDDLE ROW | 1 |
| G | GAGE ROW | 2 |
| A | ALL ROWS | 3 |

| FIXED CUTTER | | | |
|---|---|---|---|
| C | CONE | S | SHOULDER |
| N | NOSE | G | GAGE |
| T | TAPER | A | ALL AREAS |

## ⑤ BEARINGS /SEALS

| NON-SEALED BEARINGS | |
|---|---|
| A linear scale estimating bearing life used. | |
| 0 | No life used |
| 8 | All life used (No bearing life left.) |

| SEALED BEARINGS | | | |
|---|---|---|---|
| E | SEALS EFFECTIVE | X | FIXED CUTTER (BEARINGLESS) |
| F | SEALS FAILED | | |
| N | NOT ABLE TO GRADE | | |

## ⑥ GAGE (Measure in sixteenths of an inch)

| 0 | 1 | 2 | 4 |
|---|---|---|---|
| - IN GAGE | 1/16" OUT OF GAGE | 1/8" OUT OF GAGE | 1/4" OUT OF GAGE |

## ⑦ OTHER DULL CHARACTERIST (Refer to column ③ codes)

## ⑧ REASON PULLED OR RUN TERMINATED

| | | | | | |
|---|---|---|---|---|---|
| BHA | CHANGE BOTTOM HOLE ASSEMBLY | LIH | LEFT IN HOLE | HR | HOURS ON BIT |
| | | RIG | RIG REPAIR | PP | PUMP PRESSURE |
| DMF | DOWNHOLE MOTOR FAILURE | CM | CONDITION MUD | PR | PENETRATION RATE |
| DTF | DOWNHOLE TOOL FAILURE | CP | CORE POINT | TD | TOTAL DEPTH / CASING DEPTH |
| DSF | DRILL STRING FAILURE | DP | DRILL PLUG | TQ | TORQUE |
| DST | DRILL STEM TEST | FM | FORMATION CHANGE | TW | TWIST OFF |
| LOG | RUN LOGS | HP | HOLE PROBLEMS | WC | WEATHER CONDITIONS |

**APPENDIX 4**

**DRILLING FLUID SUMMARY**
**by**
**MI PTY. LTD.**

907476 121

# Drilling Fluids Recap

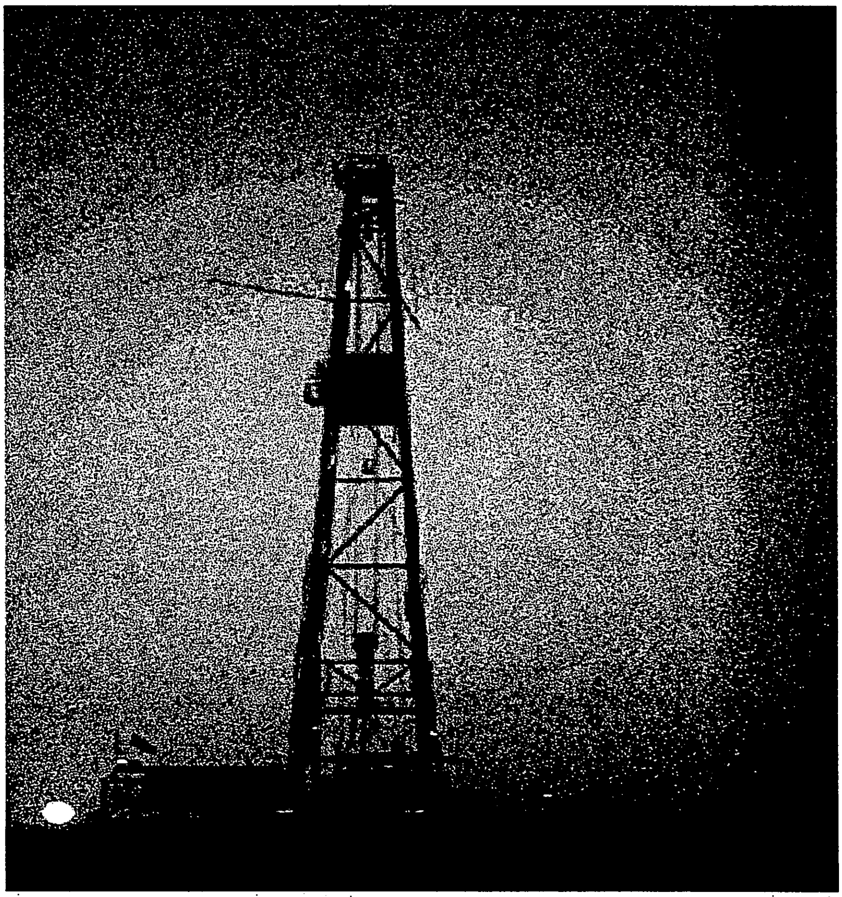
## Boral Energy

North Paaratte 4

Victoria

Otway Basin

Development



# M-I L.L.C.

# MUDTRAX

## DRILLING FLUIDS DATA MANAGEMENT SYSTEM

Operator : Boral Energy
Well Name : North Paaratte 4
Field/Area : Victoria
Description : Development
Location : Otway Basin
Warehouse : Adelaide
Contractor : Century Drilling

Spud Date : 3/04/99
TD Date : 10/04/99
Loc Code : 7001
Dist Engr : Tim Monteath
Sales Engr : Jim Kelleher
Sales Engr :
M-I Well No. : NP4

Comments :

| Type | Size in | Depth m | TVD m | Hole in | MaxMW lb/gal | Mud 1 | Mud 2 | Drilling Problem | Days | Cost $ |
|---|---|---|---|---|---|---|---|---|---|---|
| Casing | 9.625 | 401 | 401 | 12.25 | 8.90 | Spud Mud | | None | 2 | 827.40 |
| Casing | 7 | 1640 | 1640 | 8.5 | | KCL/Polymer | | None | 6 | 18393.78 |

Total Depth : 1651 m  TVD : 1651 m  Water Depth : m  Drilling Days : 8  Total Mud Cost : $ 19221.18

# BORAL ENERGY

# NORTH PAARATTE 4

# DISCUSSION BY INTERVAL

*BORAL ENERGY*
*NORTH PAARATTE 4*

DRILLING FLUIDS
*Performance Through Engineering*

North Paaratte 4 was a gas development well for Boral Energy Petroleum Pty Ltd drilled by Century Rig 2. The well is located in the Otway Basin in Victoria. After spudding on the 3rd April 1999, the well reached TD of 1651 meters on the 9th April 1999.

The primary objective was the Waarre Formation Unit "C" sand which is the sole reservoir in the field.

**STRATIGRAPHY:**

| Formation | Rock Type | Period | Formation Tops (m MD KB) |
|---|---|---|---|
| Port Campbell Limestone | Limestone | Miocene | 5.5 |
| Gellibrand Marl | Marl | Oligocene | 81 |
| Clifton Formation | Sandstone | Early Oligocene | 315 |
| Narrawaturk Marl | Marl | Late Eocene | 355 |
| Mepunga Formation | Sandy Marl | Late Eocene | 385 |
| Dilwyn Formation | Sandstone | Middle Eocene | 426 |
| Pember Mudstone | Mudstone | Early Eocene | 680 |
| Pebble Point Formation | Sandstone | Late Palaeocene | 745 |
| Paaratte Formation | Sand | Late Cretaceous | 825 |
| Skull Creek Member | Silt | Late Cretaceous | 1165 |
| Nullawarre Greensand | Sand | Late Cretaceous | 1307 |
| Belfast Formation | Silt | Late Cretaceous | 1393 |
| Waarre Formation (Unit C sand) | Sand | Late Cretaceous | 1509 |
| Eumeralla Formation | Silty Clay | Late Cretaceous | 1581 |
| **Total Depth** | | | **1651** |

*BORAL ENERGY*
*NORTH PAARATTE 4*

DRILLING FLUIDS
*Performance Through Engineering*

| INTERVAL I | 0 – 406 METERS | 12.25" HOLE | 9.625" CASING SET @ 401 METERS |
|---|---|---|---|

**MUD TYPE** : **Spud Mud**

**HOLE PROBLEMS** : **None**

**MUD PROPERTIES** : Mud Weight : 8.6 ppg (1.03 SG)
Funnel Viscosity : 41 seconds

**OPERATIONS:**

North Paaratte 4 was spudded in at 23:00 hrs on the 3rd April 1999 with a 12.25" Varel I114 bit. There were no problems while drilling down to the interval TD of 406m through mainly clays. After circulating the hole clean, a wiper trip was made back to the 12.25" stabilizers. Good hole was encountered all the way with no fill on bottom.

Operations went smoothly while running the 9 5/8" casing to the required depth of 401 meters and cementing although with the 100% excess cement pumped meant that with the hole near to in-gauge, 100 bbls of cement was pumped into the sump.

**MUD:**

Initially mixed up just 150 bbls of prehydrated gel at 29 ppb Trugel. This mud was used to drill out the mouse hole and rat hole. While drilling the 12.25" hole, sump water at 8000 mg/L Chlorides was added to the system to give a flocculating affect to the mud for increased carrying capacity. Even with this amount of Chlorides in the system the hole was still making mud and required no further additions of PHG or any other chemicals.

**SOLIDS CONTROL:**

Flat 84 mesh screens on the 2 DFE shakers had no trouble handling the 594 gal/min flow rate although the cuttings were very sticky requiring constant hosing down of the shaker screens. Once a full circulating system was established, the 2X10" desander was operated plus the 10x6" desilter with both putting out large volumes of limestone sand.

**OBSERVATIONS AND RECOMMENDATIONS:**

This section of the well was drilled cheaply and trouble free and no changes are recommended to the mud program on any future wells in the area. The KCl in the sump water at 1.5% by weight had a beneficial affect on the hole as no mud rings were formed. On the previous well, Paaratte 5, mud rings caused problems with "packing off" and hours of rig time were lost on cleaning out the flowline and extra circulation to clean out the hole.

*BORAL ENERGY*
*NORTH PAARATTE 4*

DRILLING FLUIDS
*Performance Through Engineering*

| INTERVAL II | 406 – 1651 METERS | 8.5" HOLE | 7" CASING SET @ 1640 METERS |
|---|---|---|---|

**MUD TYPE** : **KCl/PHPA**

**HOLE PROBLEMS** : **Tight Hole on wiper trip.**

**MUD PROPERTIES** :

| | | |
|---|---|---|
| Mud Weight | : | 8.6-9.6 ppg (1.03-1.15 SG) |
| Funnel Viscosity | : | 43-56 secs |
| Plastic Viscosity | : | 13-21 cps |
| Yield Point | : | 21-35 lb/100 sq ft |
| Initial Gel Strengths | : | 4-6 lb/100 sq ft |
| 10 min Gels | : | 6-14 lb/100 sq ft |
| 6 rpm reading | : | 5-7 dial units |
| Fluid Loss | : | 5.8-6.5 cc |
| KCL% by wt | : | 4-4.5% |
| PHPA Content | : | 1.4-1.8 ppb |
| Sulphites | : | 100-120 ppm |
| Reactive Clays (MBT) | : | 0-12.5 ppb |

**OPERATIONS:**

An 8.5" HTC MX03 was run in the hole with MWD and mud motor. After drilling out the floats etc with water, 3m of new hole was drilled to 409m and the hole displaced to 8.6ppg KCL/PHPA mud. A leak off test was run to 14.6 ppg before drilling ahead

The deviation was gradually built up to about 25 degrees and this angle was maintained to TD with limited amounts of sliding.

At 1233m, slow drilling forced a bit change with good hole all the way on the trip and no fill. The new HTC GT P03 bit drilled to TD at 1651m. After circulating the hole clean, a 30 stand wiper trip was made with tight intervals having to be worked from 1525 to 1487m in the sands of the Waare Formation and into the silt of the Belfast Formation plus another interval from 1487 to 1412m in the Belfast Formation had to be worked. On running back in, the hole was good and no fill was encountered. The hole was also slick on pulling out to run logs.

**MUD:**

An initial 600 bbls of KCL/PHPA mud was made up at 8.65 ppg with 5.0% by weight KCL. The percentage of PHPA was kept low at 0.5 ppb at this stage to save any hassles with unsheared PHPA skidding over the shaker screens. Soda Ash was used to lower the hardness in the water. C-121 Viscosifier was added at 0.5 ppb to lower the fluid loss and increase the Yield Point. Duovis at 0.5 ppb was used to get the low end rheologies up to the recommended levels.

The initial brew of 600 bbls was made up with sump water with 1.5% by weight KCL but the water in the sump became too alkaline at almost 12 pH after drilling out the cement so the following two premixes at 150 bbls each were made with mainly fresh water. Once the pH in the sump water had fallen to a reasonable level, the subsequent premixes were made up with sump water although the Chlorides in the sump had fallen to just 3000 ppm by this stage.

*BORAL ENERGY*
*NORTH PAARATTE 4*

MI DRILLING FLUIDS
*Performance Through Engineering*

| INTERVAL II | 406 – 1651 METERS | 8.5" HOLE | 7" CASING SET @ 1640 METERS |
|---|---|---|---|

All the premixes contained 2.0 ppb PHPA and variable amounts of C-121, Duovis, and KCL depending on hole conditions and active system requirements. Towards the end of the well, Yield Point and the low end rheology readings tended to rise without Polymer additions so the last couple of premixes just contained KCL, PHPA and C-122 which was used for fluid loss reduction without affecting Yield Point.

Also towards the end of the well, the weight tended to rise a little above recommended due to non-reactive clays entering the system. On circulating bottoms up after the wiper trip at TD, a prodigous amount of mushy cuttings came over the shakers for about half an hour raising the mud weight by 2 points and increasing the funnel viscosity by 7 seconds. About 30 bbls of water was added at this stage to keep the mud pumpable.

**SOLIDS CONTROL:**

For the initial circulations until the PHPA in the mud had sheared, two 84 mesh screens were used on each DFE shaker with the third screen equivalent to a 20 mesh screen by ripping off the fine mesh from two old shaker screens just leaving the backing. This allowed normal circulation at 505 gals per minute without the need to bypass the shaker screens or slow the pumps or pull back into the shoe to shear the mud.

Once the mud had sheared gradually downsized the screens to 110 mesh.

The 2x10" desander and the 10x6" desilter were run at all times while circulating. Both the desander and desilter performed well while drilling sands and silts with almost a dry solid discharge.

**OBSERVATIONS AND RECOMMENDATIONS:**

This mud system performed well to give almost trouble free in-gauge hole at under the budgeted cost and no changes are recommended to the mud system.

# DAILY DISCUSSION REPORT

| | Operator : Boral Energy Petr P<br>Well Name : North Paaratte 4<br>Contractor : Century Drilling | Field/Area : Victoria<br>Description : Development<br>Location : Otway Basin | **Daily Discussion**<br>M-I Well : **NP4** |
|---|---|---|---|

| 3/04/99 | TD = 22 m | Day 1 |
|---|---|---|

Century Rig #2 was used to spud in North Paaratte 4 at 23:00 hours
Made up 150 bbls of Prehydrated Gel using fresh water with Trugel and added to 150 bbls of sump water to give 300 bbl active system.

Spud in North Paaratte 4.

| 4/04/99 | TD = 406 m | Day 2 |
|---|---|---|

Drill 12.25" from 22 to 406m. Circulate hole clean. Run wiper trip back to the 12.25" stabilizers. Run back in with good hole all the way and no fill. Circulate and pull out to run casing. Start running 9 5/8" casing.
Brought all the pits into the active system by adding sump water. Chlorides in the 8.45 ppg sump water were 8000 ppm equivalent to about 1.5% by weight KCL.
Unlike the previous hole, no mud rings came up to surface.
Cuttings still very sticky requiring constant hosing down of the shaker screens.

Drill 12.25" to 406m. Wiper trip. POOH. Run casing.

| 5/04/99 | TD = 406 m | Day 3 |
|---|---|---|

Ran 9 5/8" casing to the programmed depth of 401m and cemented without problems.
Work on BOP and pressure test.
Made up 600 bbls of KCL/PHPA using sump water with 5000 ppm chlorides and weight of 8.45 ppg. Shearing through gun lines.
Do not have fluid loss control as yet as there is no solids in the system.

Ran 9 5/8" Casing and cemented. Work on BOP. Made up new mud.

| 6/04/99 | TD = 922 m | Day 4 |
|---|---|---|

Run in with MWD and mud motor. Drill out float and shoe plus 3m of new formation down to 409m using drill water. Displace to KCL/PHPA mud at 8.65 ppg. Run FIT to 14.6 ppg. Directional drill 8.5" from 409 to 922m.
Survey at 902m was 26.3 degrees deviation.
Made up 280 bbls of premixes at 2.0 lb/bbl PHPA and 4.0% KCL.
Clay cuttings of reasonable quality but some dispersing straight into the system causing mud weight increase.

RIH w/MWD & Mud Motor. Drill out cement etc. and new formation to 409m.
Run FIT. Drill 8.5" to 922m.

| 7/04/99 | TD = 1263 m | Day 5 |
|---|---|---|

Directional drilll 8.5" from 922 to 1233m. Circ bottoms up and pull out for bit change. Ran back in with MWD and Mud Motor. Wash and ream from 1128 to 1149m. RIH to 1233m and directional drill 8.5" hole to 1263m. Survey at 1224m 23 degrees.
Made up just the one 150 bbl premix using sump water and 2.0 lb/bbl PHPA and 4% KCL.
Still gaining mud weight from dispersive clays.

Directional drill 8.5" to 1233m. Trip for new bit. Drill to 1263m.

| 8/04/99 | TD = 1603 m | Day 6 |
|---|---|---|

Drill directional 8.5" hole from 1263 to 1603m.
Tight on connections comes free after minimal reaming.
Added to active 3x120 bbl premixes plus 60 bbls sump water with 8% KCL added. Still using sump water for premixes. Chlorides in sump water now down to 3000 mg/L but weight up to 8.5 ppg. Clays very dispersive just maintaining mud weight at 9.4 ppg.
Gel used for cement job.

Directional drill 8.5" hole to 1603m.

| 9/04/99 | TD = 1651 m | Day 7 |
|---|---|---|

Continue to drill 8.5" hole from 1603 to TD at 1651m. Circulate hole clean and run 30 stand wiper trip. Work tight hole from 1525 to 1487 and 1412 to 1355m. No fill on running back to bottom and hole slick on pullling out. Run logs. Hole in-gauge. Run back in hole with bit.
On circulating bottoms up after tight wiper trip, large quantities of very mushy cuttings came to surface. Added 30 bbls of water but weight still

| Operator : Boral Energy Petr P | Field/Area : Victoria | Daily Discussion |
|---|---|---|
| Well Name : North Paaratte 4 | Description : Development | |
| Contractor : Century Drilling | Location : Otway Basin | M-I Well : NP4 |

came up 2 points to 9.6 ppg. Viscosity increased by 8 seconds.

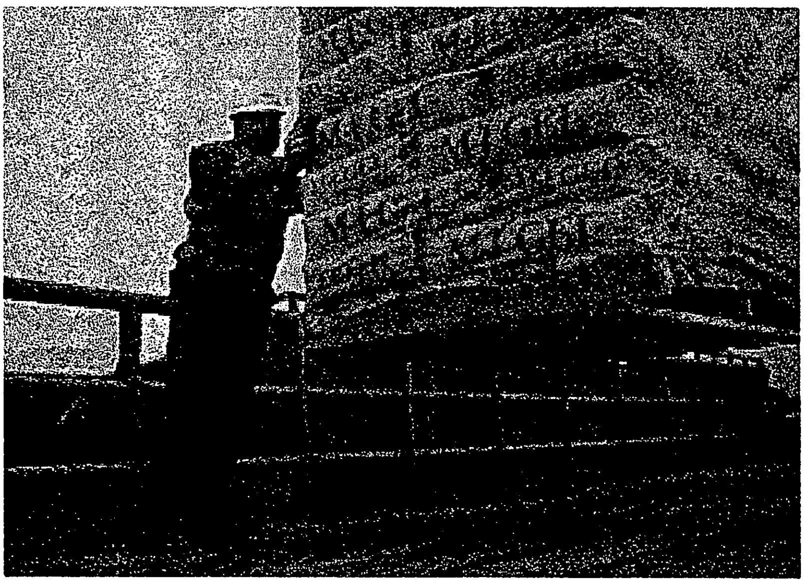
Drill to TD at 1651m. Circ. Wiper trip tight. POOH to run logs. Hole Good. Run Logs. RIH with bit.

| 10/04/99 | TD = 1651 m | Day 8 |
|---|---|---|

Wiper trip to bottom. Circulate. Pull out to run casing.
Added 30 bbls of water while circulating.

Run 7" Casing

# PRODUCT USAGE BY INTERVAL



# PRODUCT SUMMARY

**Operator :** Boral Energy Petr PL
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin

## SUMMARY OF PRODUCT USAGE FOR INTERVAL 3/04/99 - 4/04/99, )0 - 406 m

PRODUCTS USED FOR 12.25" SECTION

| WATER-BASED MUD | SIZE | AMOUNT | UNIT COST ($) | PROD COST ($) |
|---|---|---|---|---|
| 1 - M-I BAR | 25 KG BG | 30 | 5.53 | 165.90 |
| 2 - Trugel | 25 KG BG | 80 | 7.90 | 632.00 |
| 3 - CAUSTIC SODA | 25 KG DM | 1 | 29.50 | 29.50 |

WATER-BASED MUD TOTAL COST: 827.4

TOTAL MUD COST FOR INTERVAL: 827.40

# MudTrax

Operator : Boral Energy Petr PL
Well Name : North Paaratte 4
Field/Area : Victoria
Description : Development
Location : Otway Basin

## Cost Analysis

BREAKDOWN OF COST BY PRODUCT GROUP 3/04/99 - 4/04/99, 0 - 406 m

| Water-Based Mud Products | $ | % |
|---|---|---|
| 1-Alkalinity Control | 29.50 | 3.6 |
| 2-Bentonite | 632.00 | 76.4 |
| 3-Weight Material | 165.90 | 20.1 |
| Water-Based Mud Total Cost: $ | 827.40 | 100.0 |

### Water-Based Mud

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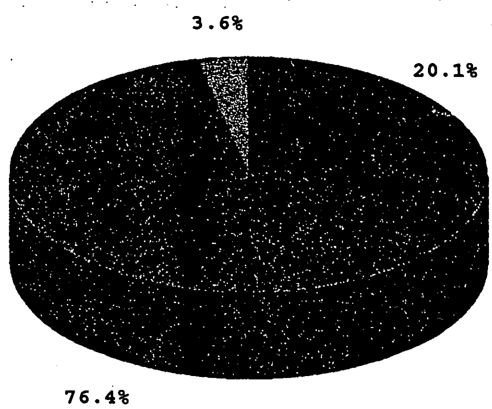

# PRODUCT SUMMARY



| | | | |
|---|---|---|---|
| **Operator :** | Boral Energy Petr PL | **Field/Area :** | Victoria |
| **Well Name :** | North Paaratte 4 | **Description :** | Development |
| **Contractor :** | Century Drilling | **Location :** | Otway Basin |

**SUMMARY OF PRODUCT USAGE FOR INTERVAL** **5/04/99 - 10/04/99, 406 - 1651 m**

PRODUCTS USED FOR 8.5" SECTION

| WATER-BASED MUD | SIZE | AMOUNT | UNIT COST ($) | PROD COST ($) |
|---|---|---|---|---|
| 1 - M-I GEL API | 25 KG BG | 12 | 11.30 | 135.60 |
| 2 - GLUTE 25 (25 LTR CN) | 25 LT DM | 2 | 111.09 | 222.18 |
| 3 - M-I BAR | 25 KG BG | 160 | 5.53 | 884.80 |
| 4 - C-122 Fluid Loss | 25 KG BG | 6 | 140.10 | 840.60 |
| 5 - C-121 Viscosfier | 25 KG BG | 9 | 140.10 | 1260.90 |
| 6 - CAUSTIC SODA | 25 KG DM | 3 | 29.50 | 88.50 |
| 7 - POTASSIUM CHLORIDE | 25 KG BG | 470 | 12.79 | 6011.30 |
| 8 - SODA ASH | 25 KG BG | 10 | 14.43 | 144.30 |
| 9 - SODIUM SULPHITE | 25 KG BG | 6 | 28.80 | 172.80 |
| 10 - POLY PLUS | 25 KG BG | 47 | 101.70 | 4779.90 |
| 11 - DUOVIS | 25 KG BG | 10 | 385.29 | 3852.90 |

WATER-BASED MUD TOTAL COST: 18393.78

TOTAL MUD COST FOR INTERVAL: 18393.78

| MudTrax | Operator : Boral Energy Petr PL<br>Well Name : North Paaratte 4<br>Field/Area : Victoria<br>Description : Development<br>Location : Otway Basin | Cost Analysis |
|---|---|---|

**BREAKDOWN OF COST BY PRODUCT GROUP 5/04/99 - 10/04/99, 406 - 1651 m**

| Water-Based Mud Products | $ | % |
|---|---|---|
| 1-Alkalinity Control | 232.80 | 1.3 |
| 2-Bentonite | 135.60 | 0.7 |
| 3-Corrosion Control | 172.80 | 0.9 |
| 4-Encapsulators | 4779.90 | 26.0 |
| 5-Fluid Loss Reducers | 840.60 | 4.6 |
| 6-Misc. | 222.18 | 1.2 |
| 7-Salt | 6011.30 | 32.7 |
| 8-Viscosifiers | 5113.80 | 27.8 |
| 9-Weight Material | 884.80 | 4.8 |
| Water-Based Mud Total Cost: $ | 18393.78 | 100.0 |

## Water-Based Mud

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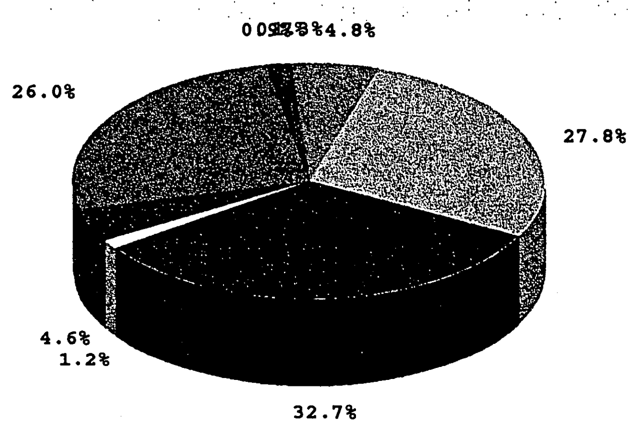

# VOLUME SUMMARY

***BORAL ENERGY***
***NORTH PAARATTE 4***

**DRILLING FLUIDS**
*Performance Through Engineering*

**12.25" Hole**

| | Mud Volume Status | | | | | Mud Volume Built | | | | | | | Mud Volume Lost | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date 1999 | Depth | Hole | Surf Active | Res | Total Vol | Water | Mud Built | Brine | Bar | Mud Recvd | Daily Total | Cum Built | Solids Equip | Surf | Dump | Back loaded | Hole | Casing Plugs | Daily Total | Cummul Lost |
| 3-Apr | 22 | 7 | 290 | | 297 | | 300 | | | | 300 | 300 | 3 | | | | | | 3 | 3 |
| 4-Apr | 406 | 171 | 440 | | 611 | | 400 | | | | 401 | 701 | 87 | | | | 0 | 0 | 87 | 90 |
| 5-Apr | 406 | DW | 0 | | 0 | | 0 | | | | | 701 | | | 611 | | | | 611 | 701 |

**8.5" Hole**

| | Mud Volume Status | | | | | Mud Volume Built | | | | | | | Mud Volume Lost | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date 1999 | Depth | Hole | Surf Active | Res | Total Vol | Water | Mud Built | Brine | Bar | Mud Recvd | Daily Total | Cum Built | Solids Equip | Surf | Dump | Back loaded | Hole | Casing Plugs | Daily Total | Cummul Lost |
| 5-Apr | 406 | DW | 600 | | 600 | | 600 | | | | 600 | 600 | | | | | | | 0 | 0 |
| 6-Apr | 922 | 183 | 420 | | 603 | | 280 | | | | 280 | 880 | 163 | 114 | | | | | 277 | 277 |
| 7-Apr | 1263 | 255 | 310 | | 565 | | 155 | | | | 155 | 1035 | 193 | | | | | | 193 | 470 |
| 8-Apr | 1603 | 328 | 320 | | 648 | | 463 | | | | 463 | 1498 | 320 | | 60 | | | | 380 | 850 |
| 9-Apr | 1651 | 338 | 280 | | 618 | | 33 | | | | 33 | 1531 | 63 | | | | | | 63 | 913 |
| 10-Apr | 1651 | 338 | 280 | | 618 | | 30 | | | | 33 | 1564 | 33 | | | | | | 33 | 946 |

# TOTAL MATERIAL CONSUMPTION

# PRODUCT SUMMARY



**Operator :** Boral Energy Petr PL
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin

**SUMMARY OF PRODUCT USAGE FOR INTERVAL** **3/04/99 - 10/04/99,** 0 – 1651 m

PRODUCTS USED FOR WHOLE WELL

| WATER-BASED MUD | SIZE | AMOUNT | UNIT COST ($) | PROD COST ($) |
|---|---|---|---|---|
| 1 - M-I GEL API | 25 KG BG | 12 | 11.30 | 135.60 |
| 2 - GLUTE 25 (25 LTR CN) | 25 LT DM | 2 | 111.09 | 222.18 |
| 3 - M-I BAR | 25 KG BG | 190 | 5.53 | 1050.70 |
| 4 - Trugel | 25 KG BG | 80 | 7.90 | 632.00 |
| 5 - C-122 Fluid Loss | 25 KG BG | 6 | 140.10 | 840.60 |
| 6 - C-121 Viscosfier | 25 KG BG | 9 | 140.10 | 1260.90 |
| 7 - CAUSTIC SODA | 25 KG DM | 4 | 29.50 | 118.00 |
| 8 - POTASSIUM CHLORIDE | 25 KG BG | 470 | 12.79 | 6011.30 |
| 9 - SODA ASH | 25 KG BG | 10 | 14.43 | 144.30 |
| 10 - SODIUM SULPHITE | 25 KG BG | 6 | 28.80 | 172.80 |
| 11 - POLY PLUS | 25 KG BG | 47 | 101.70 | 4779.90 |
| 12 - DUOVIS | 25 KG BG | 10 | 385.29 | 3852.90 |

WATER-BASED MUD TOTAL COST: 19221.18

TOTAL MUD COST FOR INTERVAL: 19221.18

# MudTrax

Operator : Boral Energy Petr PL
Well Name : North Paaratte 4
Field/Area : Victoria
Description : Development
Location : Otway Basin

# Cost Analysis

BREAKDOWN OF COST BY PRODUCT GROUP 3/04/99 - 10/04/99, 0 - 1651 m

| Water-Based Mud Products | $ | % |
|---|---|---|
| 1-Alkalinity Control | 262.30 | 1.4 |
| 2-Bentonite | 767.60 | 4.0 |
| 3-Corrosion Control | 172.80 | 0.9 |
| 4-Encapsulators | 4779.90 | 24.9 |
| 5-Fluid Loss Reducers | 840.60 | 4.4 |
| 6-Misc. | 222.18 | 1.2 |
| 7-Salt | 6011.30 | 31.3 |
| 8-Viscosifiers | 5113.80 | 26.6 |
| 9-Weight Material | 1050.70 | 5.5 |
| Water-Based Mud Total Cost: $ | 19221.18 | 100.0 |

## Water-Based Mud

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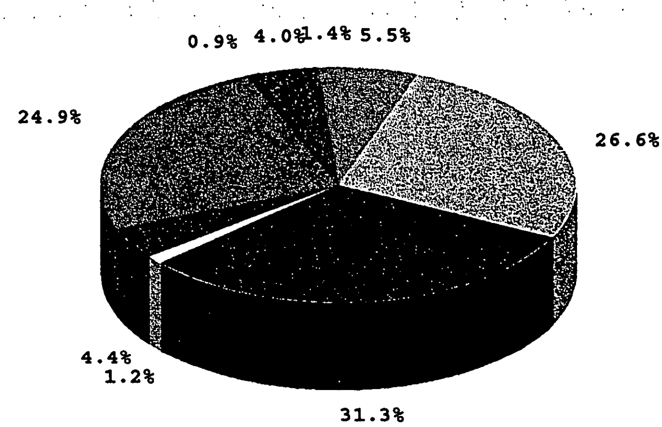


# HYDRAULICS RECAP

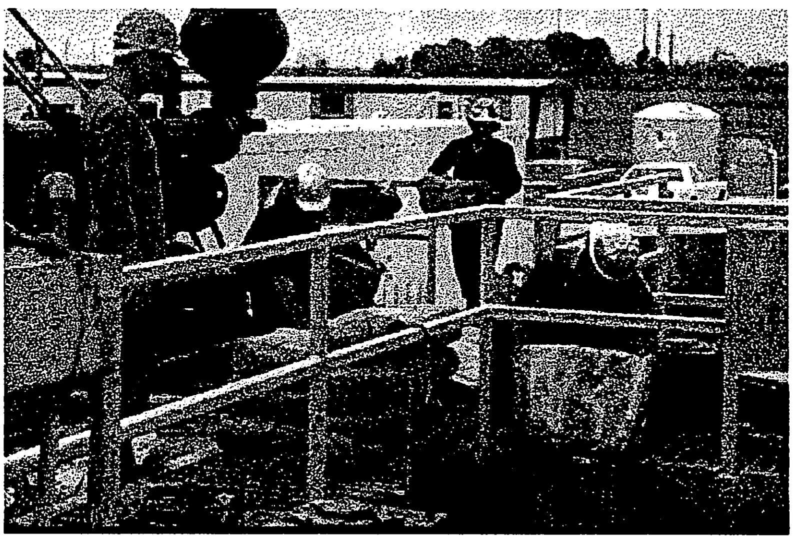
# HYDRAULICS SUMMARY 907476 143

Operator : Boral Energy Petr PL
Well Name : North Paaratte 4
Contractor : Century Drilling

Field/Area : Victoria
Description : Development
Location : Otway Basin

| Date | | 3/04/99 | 4/04/99 | 5/04/99 | 6/04/99 | 7/04/99 | 8/04/99 | 9/04/99 | 10/04/99 |
|---|---|---|---|---|---|---|---|---|---|
| Depth | m | 22 | 406 | 406 | 922 | 1263 | 1603 | 1651 | 1651 |
| Days Since Spud | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *RHEOLOGICAL PROPERTIES | | | | | | | | | |
| Mud Wt | lb/gal | 8.5 | 8.9 | 8.6 | 9.1 | 9.4 | 9.4 | 9.6 | 9.6 |
| Plastic Visc | cP | 8 | 12 | 14 | 13 | 15 | 16 | 21 | |
| Yield Point | lb/100 ft² | 26 | 19 | 26 | 21 | 27 | 35 | 39 | |
| 3-rpm Rdg | Fann deg | 6 | 6 | 4 | 5 | 5 | 5 | 7 | |
| np Value | Value | .3049 | .4721 | .433 | .4671 | .4406 | .3937 | .433 | .433 |
| Kp Value | lb•s^n/100ft² | 5.4196 | 1.7417 | 2.8681 | 1.97 | 2.8718 | 4.6723 | 4.3021 | 4.3021 |
| na Value | Value | .3133 | .1977 | .459 | .3807 | .4093 | .459 | .3953 | .3953 |
| Ka Value | lb•s^n/100ft² | 3.8403 | 4.6375 | 2.0187 | 2.867 | 2.7366 | 2.5234 | 3.9192 | 3.9192 |
| *FLOW DATA | | | | | | | | | |
| Flow Rate | gal/min | 563 | 593 | 0 | 504 | 474 | 474 | 474 | 0 |
| Pump Pressure | psi | 900 | 1400 | 0 | 2000 | 2000 | 2000 | 2000 | 0 |
| Pump | hhp | 296 | 484 | * | 588 | 553 | 553 | 553 | * |
| *PRESSURE LOSSES | | | | | | | | | |
| Drill String | psi | 15 | 363 | * | 439 | 513 | 601 | 695 | * |
| Bit | psi | 715 | 831 | * | 862 | 660 | 660 | 674 | * |
| Annulus | psi | 1 | 9 | * | 78 | 110 | 158 | 187 | * |
| Total System | psi | 731 | 1202 | * | 1378 | 1283 | 1419 | 1555 | * |
| *BIT HYDRAULICS | | | | | | | | | |
| Nozzles | 1/32" | 3x16 | 3x16 | 2x14 | 2x14 | 14 | 14 | 14 | 14 |
| Nozzles | 1/32" | | | 16 | 16 | 2x16 | 2x16 | 2x16 | 2x16 |
| Bit Pressure | % | 79 | 59 | * | 43 | 33 | 33 | 34 | * |
| Bit | hhp | 235 | 287 | * | 253 | 182 | 182 | 186 | * |
| Bit HSI | (index) | 2 | 2 | * | 4 | 3 | 3 | 3 | * |
| Jet Velocity | ft/sec | 93 | 98 | * | 99 | 85 | 85 | 85 | * |
| Impact Force | lb | 759 | 882 | * | 772 | 646 | 646 | 659 | * |
| DRILL COLLARS ANNULUS | | | | | | | | | |
| Velocity | m/min | 49 | 41 | * | 126 | 118 | 118 | 118 | * |
| Critical Vel | m/min | 100 | 77 | * | 116 | 122 | 139 | 144 | * |
| Reynolds Number | | 762 | 869 | * | 2828 | 2345 | 1906 | 1813 | * |
| Crit Re (Lam - Tran) | | 3052 | 2823 | * | 2830 | 2866 | 2931 | 2877 | * |
| *DRILL PIPE ANNULUS | | | | | | | | | |
| Velocity | m/min | 49 | 34 | * | 72 | 68 | 68 | 68 | * |
| Critical Vel | m/min | 100 | 75 | * | 99 | 102 | 113 | 121 | * |
| Reynolds Number | | 762 | 660 | * | 1511 | 1298 | 1123 | 987 | * |
| Crit Re (Lam - Tran) | | 3052 | 2823 | * | 2830 | 2866 | 2931 | 2877 | * |
| *HOLE CLEANING | | | | | | | | | |
| Slip Velocity | m/min | 6 | 7 | * | 6 | 6 | 6 | 5 | * |
| Rising Velocity | m/min | 43 | 27 | * | 66 | 62 | 62 | 63 | * |
| Lifting Capacity | % | 1 | 1 | * | 1 | 1 | 1 | 1 | * |
| Cutting Conc | % | 0.0 | 2.08 | * | 1.12 | 0.87 | 0.52 | 0.7 | * |
| Penetration Rate | m/hr | 0 | 29.5 | 0 | 32 | 23.5 | 14 | 19 | 0 |
| CASING SHOE PRESSURES | | | | | | | | | |
| ECD | lb/gal | 8.84 | 9.01 | * | 9.53 | 9.87 | 9.95 | 10.24 | * |
| ECD+Cuttings | lb/gal | 8.84 | 9.26 | * | 9.66 | 9.97 | 10.01 | 10.32 | * |
| TOTAL DEPTH PRESSURES | | | | | | | | | |
| ECD | lb/gal | 8.84 | 9.03 | * | 9.61 | 9.93 | 10.01 | 10.3 | * |
| ECD+Cuttings | lb/gal | 8.84 | 9.27 | * | 9.74 | 10.03 | 10.07 | 10.38 | * |

# DAILY RECAP



# DRILLING FLUIDS SUMMARY

907476 145

**Operator :** Boral Energy Petr PL | **Field/Area :** Victoria

**Well Name :** North Paaratte 4 | **Description :** Development

**Contractor :** Century Drilling | **Location :** Otway Basin

| Date - Day | | 3/04/99 - 1 | 4/04/99 - 1 | 5/04/99 - 1 | 6/04/99 - 1 | 7/04/99 - 1 | 8/04/99 - 1 |
|---|---|---|---|---|---|---|---|
| Depth/TVD | m | 22/10 | 406/406 | 406/406 | 922/903 | 1263/1250 | 1603/1511 |
| Activity | | Drill 12.25" | Run Casing | Work on BOP | Drill 8.5" | Drill 8.5" | Drill 8.5" |
| Mud Type | | Spud Mud | Spud Mud | KCL/PHPA | KCL/PHPA | KCL/PHPA | KCL/PHPA |
| Hole Size | in | 12.25 | 12.25 | 8.5 | 8.5 | 8.5 | 8.5 |
| Circ Volume | bbl | 304 | 782 | 673 | 786 | 820 | 976 |
| Flow Rate | gal/min | 563 | 593 | 0 | 504 | 474 | 474 |
| Circ Pressure | psi | 900 | 1400 | 0 | 2000 | 2000 | 2000 |
| Avg ROP | m/hr | 0 | 29.5 | 0 | 32 | 23.5 | 14 |
| Sample From | | Pit | Pit | Pit | FL | FL | FL |
| Flow Line Temp | °F | | | | | | |
| Mud Weight | lb/gal | 8.5 @ °F | 8.9@ °F | 8.6@ °F | 9.1@ °F | 9.4@ °F | 9.4@ °F |
| Funnel Viscosity | s/qt | 43 | 41 | 47 | 43 | 47 | 48 |
| PV | cP | 8 | 12 | 14 | 13 | 15 | 16 |
| YP | lb/100 ft² | 26 | 19 | 26 | 21 | 27 | 35 |
| R600/R300/R200 | | 42/34/23 | 43/31/17 | 54/40/27 | 47/34/27 | 57/42/31 | 67/51/38 |
| R100/R6/R3 | | 18/8/6 | 12/8/6 | 20/5/4 | 19/6/5 | 21/7/5 | 25/7/5 |
| 10s/10m/30m Gel | lb/100 ft² | 4/14/ | 6/15/ | 4/6/ | 5/8/ | 5/12/ | 5/14/ |
| API Fluid Loss | cc/30 min | NC | NC | NC | 6.5 | 6.2 | 5.8 |
| HTHP Fluid Loss | cc/30 min | | | | | | |
| Cake API/HT | 1/32" | / | / | / | 1/ | 1/ | 1/ |
| Solids | % Vol | | 5 | 6 | 7 | 8 | 8 |
| Oil/Water | % Vol | / | 0/95 | 0/94 | 0/93 | 0/92 | /92 |
| Sand | % Vol | | 0.25 | 0 | 0.25 | 0.25 | 0.25 |
| MBT | lb/bbl | | 15 | 0 | 5 | 10 | 12.5 |
| pH | | 9.5 | 9.5 | 9.5 | 9.0 | 9 | 9.0 |
| Alkal Mud (Pm) | | | 0.15 | 0.15 | 0.15 | 0.1 | 0.1 |
| Pf/Mf | | / | 0.15/0.5 | 0.15/0.6 | 0.1/0.45 | 0.1/0.5 | 0.1/0.6 |
| Chlorides | mg/l | | 6000 | 25000 | 23000 | 24000 | 26000 |
| Hardness Ca | | | 40 | 240 | 200 | 240 | 120 |
| KCL | % wt | | | | 4.0 | 4 | 4.5 |
| PHPA | lb/bbl | | | | 1.5 | 1.7 | 1.8 |
| Sulphite | mg/L | | | | 120 | 120 | 120 |
| | | | | | | | |
| | | | | | | | |
| Daily Mud Cost | $ | 661.50 | 165.90 | 6528.02 | 3395.27 | 1856.32 | 5311.75 |
| Cuml Mud Cost | $ | 661.50 | 827.40 | 7355.42 | 10750.69 | 12607.01 | 17918.76 |
| Sales Engineer | | Jim Kelleher | Jim Kelleher | Jim Kelleher | Jim Kelleher | Jim Kelleher | Jim Kelleher |
| Products Used | | Caus / 1 | Bar / 30 | Pacr / 6 | Pacr / 2 | Pacr / 1 | PacUL / 6 |
| | | Tgel / 80 | | XCD / 6 | XCD / 2 | XCD / 1 | Caus / 3 |
| | | | | Pol+ / 12 | Pol+ / 12 | Bar / 30 | XCD / 1 |
| | | | | KCL / 164 | KCL / 80 | Pol+ / 6 | Gel / 12 |
| | | | | Soda / 4 | Soda / 3 | KCL / 40 | Pol+ / 17 |
| | | | | | SodSul / 2 | Soda / 1 | KCL / 160 |
| | | | | | | SodSul / 1 | Soda / 2 |
| | | | | | | | SodSul / 2 |

## REMARKS

3/04/99: Spud in North Paaratte 4.

4/04/99: Drill 12.25" to 406m. Wiper trip. POOH. Run casing.

5/04/99: Ran 9 5/8" Casing and cemented. Work on BOP. Made up new mud.

6/04/99: RIH w/MWD & Mud Motor. Drill out cement etc. and new formation to 409m. Run FIT. Drill 8.5" to 922m.

7/04/99: Directional drill 8.5" to 1233m. Trip for new bit. Drill to 1263m.

8/04/99: Directional drill 8.5" hole to 1603m.

# DRILLING FLUIDS SUMMARY

907476 146

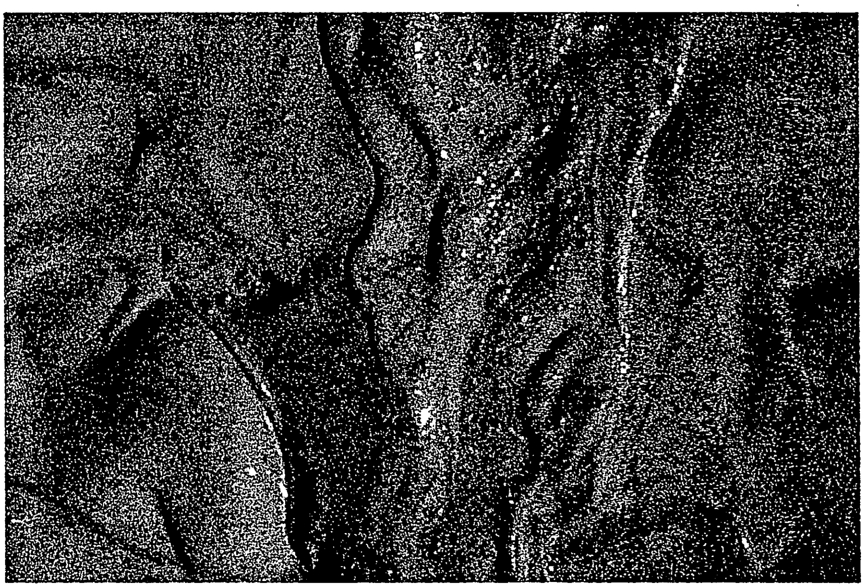
**Operator :** Boral Energy Petr PL
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin

| Date - Day | | 9/04/99 - 1 | 10/04/99 - 1 | | | | |
|---|---|---|---|---|---|---|---|
| Depth/TVD | m | 1651/1555 | 1651/1555 | | | | |
| Activity | | Trip | Run Casing | | | | |
| Mud Type | | KCL/PHPA | KCL/PHPA | | | | |
| Hole Size | in | 8.5 | 8.5 | | | | |
| Circ Volume | bbl | 956 | 956 | | | | |
| Flow Rate | gal/min | 474 | 0 | | | | |
| Circ Pressure | psi | 2000 | 0 | | | | |
| Avg ROP | m/hr | 19 | 0 | | | | |
| Sample From | | Pit | Pit | | | | |
| Flow Line Temp | °F | | | | | | |
| Mud Weight | lb/gal | 9.6@ °F | 9.6 @ °F | | | | |
| Funnel Viscosity | s/qt | 56 | 56 | | | | |
| PV | cP | 21 | | | | | |
| YP | lb/100 ft² | 39 | | | | | |
| R600/R300/R200 | | 81/60/44 | / / | | | | |
| R100/R6/R3 | | 28/9/7 | / / | | | | |
| 10s/10m/30m Gel | lb/100 ft² | 6/18/ | // | | | | |
| API Fluid Loss | cc/30 min | 5.8 | | | | | |
| HTHP Fluid Loss | cc/30 min | | | | | | |
| Cake API/HT | 1/32" | 1/ | / | | | | |
| Solids | % Vol | 9 | | | | | |
| Oil/Water | % Vol | /91 | / | | | | |
| Sand | % Vol | 0.25 | | | | | |
| MBT | lb/bbl | 15 | | | | | |
| pH | | 9.0 | | | | | |
| Alkal Mud (Pm) | | 0.15 | | | | | |
| Pf/Mf | | 0.1/0.6 | / | | | | |
| Chlorides | mg/l | 25000 | | | | | |
| Hardness Ca | | 200 | | | | | |
| KCL | % wt | 4.5 | | | | | |
| PHPA | lb/bbl | 1.8 | | | | | |
| Sulphite | mg/L | 120 | | | | | |
| | | | | | | | |
| Daily Mud Cost | $ | 693.38 | 609.04 | | | | |
| Cuml Mud Cost | $ | 18612.14 | 19221.18 | | | | |
| Sales Engineer | | Jim Kelleher | Jim Kelleher | | | | |
| Products Used | | Glute / 2 | Bar / 50 | | | | |
| | | Bar / 80 | KCL / 26 | | | | |
| | | SodSul / 1 | | | | | |

**REMARKS**

9/04/99: Drill to TD at 1651m. Circ. Wiper trip tight. POOH to run logs. Hole Good. Run Logs. RIH with bit.
10/04/99: Run 7" Casing

# DAILY MUD & INVENTORY REPORTS



# WATER-BASED MUD REPORT No. 1

| | | | |
|---|---|---|---|
| Date | 3/04/99 | Depth/TVD | 22 m / 10 m |
| Spud Date | 3/04/99 | Mud Type | Spud Mud |
| Water Depth | | Activity | Drill 12.25" |

| | | | |
|---|---|---|---|
| Operator : | Boral Energy | Field/Area : | Victoria |
| Report For : | Barry Beetson | Description : | Development |
| Well Name : | North Paaratte 4 | Location : | Otway Basin |
| Contractor : | Century Drilling | M-I Well No. : | NP4 |
| Report For : | | | |

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 12.25 in Varel L114 | | Surface | Hole |
| Nozzles 3x16 / 1/32" | | | 6.7 |
| Drill Pipe Size | Length | Intermediate | Active Pits |
| 8 in | 22 m | | 290.3 |
| Drill Pipe Size | Length | Intermediate | Total Circulating Vol |
| in | m | | 297 |
| Drill Collar Size | Length | Production or Liner | In Storage |
| 8 in | 22 m | | |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATIONAL 8P-80 | NATIONAL 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | 2.965 gal/stk | 2.965 gal/stk |
| ump stk/min | 95@95% | 95@95% |
| Flow Rate | 563 | gal/min |
| Bottoms Up | .5 min | 86 stk |
| Total Circ Time | 22.2 min | 4210 stk |
| Circulating Pressure | 900 psi | |

## MUD PROPERTIES

| | | | |
|---|---|---|---|
| Sample From | | Pit@24:00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 22/10 | |
| Mud Weight | lb/gal | 8.5 | |
| Funnel Viscosity | s/qt | 43 | |
| Rheology Temp | °F | | |
| R600/R300 | | 42/34 | |
| R200/R100 | | 23/18 | |
| R6/R3 | | 8/6 | |
| PV | cP | 8 | |
| YP | lb/100 ft² | 26 | |
| 10s/10m/30m Gel | lb/100 ft² | 4/14/ | |
| API Fluid Loss | cc/30 min | NC | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | | |
| Solids | % Vol | | |
| Oil/Water | % Vol | | |
| Sand | % Vol | | |
| MBT | lb/bbl | | |
| pH | | 9.5 | |
| Alkal Mud (Pm) | | | |
| Pf/Mf | | | |
| Chlorides | mg/l | | |
| Hardness Ca | | | |
| | | | |
| KCL | % wt | | |
| PHPA | lb/bbl | | |
| Sulphite | mg/L | | |

## PRODUCTS USED LAST 24 HRS

| Products | Size | Amt |
|---|---|---|
| CAUSTIC SODA | 25 KG DM | 1 |
| Trugel | 25 KG BG | 80 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 0 |
| Desilter | 10 x 6" | 0 |

## MUD PROPERTY SPECIFICATIONS

| | |
|---|---|
| Weight | alap |
| Viscosity | 35+ |
| Filtrate | NC |

## REMARKS AND TREATMENT

Made up 150 bbls of Prehydrated Gel using fresh water with Trugel and added to 150 bbls of sump water to give 300 bbl active system.

## REMARKS

Century Rig #2 was used to spud in North Paaratte 4 at 23:00 hours

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) | SOLIDS ANALYSIS (%/lb/bbl) | | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|---|---|---|---|
| Rig Up/Service | 23 | Oil Added | | NaCl | / | np/na Values | 0.305/0.313 |
| Drilling | 1 | Water Added | 300 | KCl | / | kp/ka (lb•s^n/100ft²) | 5.420/3.840 |
| Tripping | | Mud Received | 0 | Low Gravity | / | Bit Loss (psi / %) | 715 / 79.5 |
| B.O.P. NU | | Mud Disposed | 0 | Bentonite | / | Bit HHP (hhp / HSI) | 235 / 2 |
| B.O.P. Testing | | Shakers Loss | 7.9 | Drill Solids | / | Bit Jet Vel (m/sec) | 93 |
| Cementing | | Evaporation Loss | 0 | Weight Material | / | Annular Vel DP (m/min) | 48.87 |
| Condition Hole | | Centrifuge Loss | 0 | Chemical Conc | - / | Annular Vel DC (m/min) | 48.87 |
| Condition Mud | | Formation Loss | 0 | Inert/React | | Crit Vel DP (m/min) | 100 |
| Coring | | Left in Hole | 0 | Average SG | | Crit Vel DC (m/min) | 100 |
| Dev. Survey | | Other | 0 | Carb/BiCarb (m mole/L) | / | ECD @ 22 (lb/gal) | 8.84 |

| M-I ENGR / PHONE | | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|---|
| Jim Kelleher | 089 3254822 | 01415 110697 | | $ 661.50 | $ 661.50 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 1
**Date :** 3/04/99

## COST SUMMARY

| | |
|---|---|
| **Net Daily Cost :** | 661.50 |
| **Sales Tax :** | 0.00 |
| **Total Daily Cost :** | 661.50 |
| **Cumulative Cost :** | 661.50 |

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 0 | 69 | 0 | 0 | 69 | 0 | |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 0 | 36 | 0 | 0 | 36 | 0 | |
| C-209 ID Free | 55 GA DM | 606.43 | 0 | 4 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 0 | 29 | 0 | 1 | 28 | 1 | 29.50 |
| DEFOAMER IDF | 25 LT CN | 54.21 | 0 | 5 | 0 | 0 | 5 | 0 | |
| [illegible]OVIS | 25 KG BG | 385.29 | 0 | 46 | 0 | 0 | 46 | 0 | |
| [illegible]LUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 0 | 7 | 0 | 0 | 7 | 0 | |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 0 | 4 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 0 | 48 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 0 | 52 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 0 | 310 | 0 | 0 | 310 | 0 | |
| M-I GEL API | 25 KG BG | 11.30 | 0 | 45 | 0 | 0 | 45 | 0 | |
| MICA MEDIUM | 25 KG BG | 12.10 | 0 | 32 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 0 | 48 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 0 | 71 | 0 | 0 | 71 | 0 | |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 0 | 590 | 0 | 0 | 590 | 0 | |
| SAPP | 25 KG BG | | 0 | 18 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 0 | 34 | 0 | 0 | 34 | 0 | |
| SODIUM BICARBONATE | 25 KG BG | | 0 | 48 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 0 | 32 | 0 | 0 | 32 | 0 | |
| Trugel | 25 KG BG | 7.90 | 0 | 530 | 0 | 80 | 450 | 80 | 632.00 |

# WATER-BASED MUD REPORT No. 2

| Date | 4/04/99 | Depth/TVD | 406 m / 406 m |
|---|---|---|---|
| Spud Date | 3/04/99 | Mud Type | Spud Mud |
| Water Depth | | Activity | Run Casing |

**Operator :** Boral Energy
**Report For :** Barry Beetson
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Report For :** Wayne Costhwaite
**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin
**M-I Well No. :** NP4

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 12.25 in Varel L114 | | Surface | Hole 171 |
| Nozzles 3x16 / 1/32" | | | |
| Drill Pipe Size 4.5 in | Length 72 m | Intermediate | Active Pits 440.1 |
| Drill Pipe Size 5 in | Length 245 m | Intermediate | Total Circulating Vol 611 |
| Drill Collar Size 6.5 in | Length 89 m | Production or Liner | In Storage |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATION 8P-80 | NATION 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | 2.965 gal/stk | 2.965 gal/stk |
| ump stk/min | 100@95% | 100@95% |
| Flow Rate | 593 gal/min | |
| Bottoms Up | 11.2 min | 2238 stk |
| Total Circ Time | 43.3 min | 8655 stk |
| Circulating Pressure | 1400 psi | |

| MUD PROPERTIES | | | |
|---|---|---|---|
| Sample From | | Pit@24:00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 406/406 | |
| Mud Weight | lb/gal | 8.9 | |
| Funnel Viscosity | s/qt | 41 | |
| Rheology Temp | °F | | |
| R600/R300 | | 43/31 | |
| R200/R100 | | 17/12 | |
| R6/R3 | | 8/6 | |
| PV | cP | 12 | |
| YP | lb/100 ft² | 19 | |
| 10s/10m/30m Gel | lb/100 ft² | 6/15/ | |
| API Fluid Loss | cc/30 min | NC | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | | |
| Solids | % Vol | 5 | |
| Oil/Water | % Vol | 0/95 | |
| Sand | % Vol | 0.25 | |
| MBT | lb/bbl | 15 | |
| pH | | 9.5 | |
| Alkal Mud (Pm) | | 0.15 | |
| Pf/Mf | | 0.15/0.5 | |
| Chlorides | mg/l | 6000 | |
| Hardness Ca | | 40 | |
| | | | |
| KCL | % wt | | |
| PHPA | lb/bbl | | |
| Sulphite | mg/L | | |

| PRODUCTS USED LAST 24 HRS | | |
|---|---|---|
| Products | Size | Amt |
| M-I BAR | 25 KG BG | 30 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 4 |
| Desilter | 10 x 6" | 14 |

| MUD PROPERTY SPECIFICATIONS | |
|---|---|
| Weight | alap |
| Viscosity | 35+ |
| Filtrate | NC |

## REMARKS AND TREATMENT

Brought all the pits into the active system by adding sump water. Chlorides in the 8.45 ppg sump water were 8000 ppm equivalent to about 1.5% by weight KCL.
Unlike the previous hole, no mud rings came up to surface.
Cuttings still very sticky requiring constant hosing down of the shaker screens.

## REMARKS

Drill 12.25" from 22 to 406m. Circulate hole clean. Run wiper trip back to the 12.25" stabilizers. Run back in with good hole all the way and no fill. Circulate and pull out to run casing. Start running 9 5/8" casing.

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) | SOLIDS ANALYSIS | (%/lb/bbl) | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|---|---|---|---|
| Rig Up/Service | | Oil Added | 0 | NaCl | .1/ 1.3 | np/na Values | 0.472/0.198 |
| Drilling | 13 | Water Added | 400 | KCl | .3/ 2.6 | kp/ka (lb•s^n/100ft²) | 1.742/4.637 |
| Tripping | 7 | Mud Received | 0 | Low Gravity | 3.8/ 34.7 | Bit Loss (psi / %) | 831 / 59.3 |
| B.O.P. NU | | Mud Disposed | 0 | Bentonite | 1.4/ 12.7 | Bit HHP (hhp / HSI) | 287 / 2.4 |
| B.O.P. Testing | | Shakers Loss | 50 | Drill Solids | 2.3/ 21. | Bit Jet Vel (m/sec) | 98 |
| Run Casing | 1 | Evaporation Loss | 0 | Weight Material | NA/ NA | Annular Vel DP (m/min) | 34.13 |
| Condition Hole | | Centrifuge Loss | 0 | Chemical Conc | - / 1. | Annular Vel DC (m/min) | 41.09 |
| Circulating | 1 | Formation Loss | 0 | Inert/React | 1.244 | Crit Vel DP (m/min) | 75 |
| Coring | | Left in Hole | 0 | Average SG | 2.6 | Crit Vel DC (m/min) | 77 |
| Dev. Survey | 2 | Other | 37.1 | Carb/BiCarb (m mole/L) | 3./ 4.7 | ECD @ 406 (lb/gal) | 9.03 |

| M-I ENGR / PHONE | | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|---|
| Jim Kelleher | 089 3254822 | 01415 110697 | | $ 165.90 | $ 827.40 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 2
**Date :** 4/04/99

## COST SUMMARY

**Net Daily Cost :** 165.90
**Sales Tax :** 0.00
**Total Daily Cost :** 165.90
**Cumulative Cost :** 827.40

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 69 | 0 | 0 | 0 | 69 | 0 | |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 36 | 0 | 0 | 0 | 36 | 0 | |
| C-209 ID Free | 55 GA DM | 606.43 | 4 | 0 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 28 | 0 | 0 | 0 | 28 | 1 | |
| DEFOAMER IDF | 25 LT CN | 54.21 | 5 | 0 | 0 | 0 | 5 | 0 | |
| UOVIS | 25 KG BG | 385.29 | 46 | 0 | 0 | 0 | 46 | 0 | |
| LUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 7 | 0 | 0 | 0 | 7 | 0 | |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 4 | 0 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 48 | 0 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 52 | 0 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 310 | 0 | 0 | 30 | 280 | 30 | 165.90 |
| M-I GEL API | 25 KG BG | 11.30 | 45 | 0 | 0 | 0 | 45 | 0 | |
| MICA MEDIUM | 25 KG BG | 12.10 | 32 | 0 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 48 | 0 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 71 | 0 | 0 | 0 | 71 | 0 | |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 590 | 0 | 0 | 0 | 590 | 0 | |
| SAPP | 25 KG BG | | 18 | 0 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 34 | 0 | 0 | 0 | 34 | 0 | |
| SODIUM BICARBONATE | 25 KG BG | | 48 | 0 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 32 | 0 | 0 | 0 | 32 | 0 | |
| Trugel | 25 KG BG | 7.90 | 450 | 0 | 0 | 0 | 450 | 80 | |

# WATER-BASED MUD REPORT No. 3

| | | | |
|---|---|---|---|
| Date | 5/04/99 | Depth/TVD | 406 m / 406 m |
| Spud Date | 3/04/99 | Mud Type | KCL/PHPA |
| Water Depth | | Activity | Work on BOP |

**Operator :** Boral Energy
**Report For :** Barry Beetson
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Report For :** Wayne Costhwaite

**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin
**M-I Well No. :** NP4

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 8.5 in Tri-cone | | Surface | Hole |
| Nozzles 2x14 /16 / 1/32" | | | 73.4 |
| Drill Pipe Size | Length | Intermediate | Active Pits |
| 4.5 in | 92 m | | 526.6 |
| Drill Pipe Size | Length | Intermediate | Total Circulating Vol |
| 5 in | 272 m | | 600 |
| Drill Collar Size | Length | Production or Liner | In Storage |
| 6.5 in | 42 m | | |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATION 8P-80 | NATION 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | gal/stk | gal/stk |
| ump stk/min | | |
| Flow Rate | gal/min | |
| Bottoms Up | | |
| Total Circ Time | | |
| Circulating Pressure | | |

## MUD PROPERTIES

| | | | |
|---|---|---|---|
| Sample From | | Pit@24;00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 406/406 | |
| Mud Weight | lb/gal | 8.6 | |
| Funnel Viscosity | s/qt | 47 | |
| Rheology Temp | °F | | |
| R600/R300 | | 54/40 | |
| R200/R100 | | 27/20 | |
| R6/R3 | | 5/4 | |
| PV | cP | 14 | |
| YP | lb/100 ft² | 26 | |
| 10s/10m/30m Gel | lb/100 ft² | 4/6/ | |
| API Fluid Loss | cc/30 min | NC | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | | |
| Solids | % Vol | 6 | |
| Oil/Water | % Vol | 0/94 | |
| Sand | % Vol | 0 | |
| MBT | lb/bbl | 0 | |
| pH | | 9.5 | |
| Alkal Mud (Pm) | | 0.15 | |
| Pf/Mf | | 0.15/0.6 | |
| Chlorides | mg/l | 25000 | |
| Hardness Ca | | 240 | |
| | | | |
| KCL | % wt | | |
| PHPA | lb/bbl | | |
| Sulphite | mg/L | | |

## PRODUCTS USED LAST 24 HRS

| Products | Size | Amt |
|---|---|---|
| C-121 Viscosfier | 25 KG BG | 6 |
| DUOVIS | 25 KG BG | 6 |
| POLY PLUS | 25 KG BG | 12 |
| POTASSIUM CHLORIDE | 25 KG BG | 164 |
| SODA ASH | 25 KG BG | 4 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 0 |
| Desilter | 10 x 6" | 0 |

## MUD PROPERTY SPECIFICATIONS

| | |
|---|---|
| Weight | alap |
| Viscosity | 35+ |
| Filtrate | |

## REMARKS AND TREATMENT

Made up 600 bbls of KCL/PHPA using sump water with 5000 ppm chloride and weight of 8.45 ppg. Shearing through gun lines.
Do not have fluid loss control as yet as there is no solids in the system.

## REMARKS

Ran 9 5/8" casing to the programmed depth of 401m and cemented without problems. Work on BOP and pressure test.

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) | SOLIDS ANALYSIS (%/lb/bbl) | | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|---|---|---|---|
| Rig Up/Service | 20.5 | Oil Added | | NaCl | .3/ 3.1 | np/na Values | 0.433/0.459 |
| Drilling | | Water Added | 417.4 | KCl | 1.5/ 14.3 | kp/ka (lb•s^n/100ft²) | 2.868/2.019 |
| Tripping | | Mud Received | 0 | Low Gravity | .4/ 3.8 | Bit Loss (psi / %) | / 1 |
| B.O.P. NU | | Mud Disposed | 440 | Bentonite | ./. | Bit HHP (hhp / HSI) | / 1 |
| B.O.P. Testing | | Shakers Loss | 0 | Drill Solids | .4/ 3.2 | Bit Jet Vel (m/sec) | |
| Run Casing | 3 | Evaporation Loss | 0 | Weight Material | NA/ NA | Annular Vel DP (m/min) | |
| Condition Hole | | Centrifuge Loss | 0 | Chemical Conc | - / 1. | Annular Vel DC (m/min) | |
| Circulating | 0.5 | Formation Loss | 0 | Inert/React | - | Crit Vel DP (m/min) | 103 |
| Coring | | Left in Hole | 0 | Average SG | 2.6 | Crit Vel DC (m/min) | 127 |
| Dev. Survey | | Other | 0 | Carb/BiCarb (m mole/L) | 3./ 4.7 | ECD @ 406 (lb/gal) | 8.6 |

| M-I ENGR / PHONE | | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|---|
| Jim Kelleher | 089 3254822 | 01415 110697 | | $ 6,528.02 | $ 7,355.42 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 3
**Date :** 5/04/99

## COST SUMMARY

**Net Daily Cost :** 6528.02
**Sales Tax :** 0.00
**Total Daily Cost :** 6528.02
**Cumulative Cost :** 7355.42

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 69 | 0 | 0 | 6 | 63 | 6 | 840.60 |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 36 | 0 | 0 | 0 | 36 | 0 | |
| C-209 ID Free | 55 GA DM | 606.43 | 4 | 0 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 28 | 0 | 0 | 0 | 28 | 1 | |
| DEFOAMER IDF | 25 LT CN | 54.21 | 5 | 0 | 0 | 0 | 5 | 0 | |
| DUOVIS | 25 KG BG | 385.29 | 46 | 0 | 0 | 6 | 40 | 6 | 2311.74 |
| GLUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 7 | 0 | 0 | 0 | 7 | 0 | |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 4 | 0 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 48 | 0 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 52 | 0 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 280 | 0 | 0 | 0 | 280 | 30 | |
| M-I GEL API | 25 KG BG | 11.30 | 45 | 0 | 0 | 0 | 45 | 0 | |
| MICA MEDIUM | 25 KG BG | 12.10 | 32 | 0 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 48 | 0 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 71 | 0 | 0 | 12 | 59 | 12 | 1220.40 |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 590 | 0 | 0 | 164 | 426 | 164 | 2097.56 |
| SAPP | 25 KG BG | | 18 | 0 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 34 | 0 | 0 | 4 | 30 | 4 | 57.72 |
| SODIUM BICARBONATE | 25 KG BG | | 48 | 0 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 32 | 0 | 0 | 0 | 32 | 0 | |
| Trugel | 25 KG BG | 7.90 | 450 | 0 | 0 | 0 | 450 | 80 | |

# WATER-BASED MUD REPORT No. 4

| Date | 6/04/99 | Depth/TVD | 922 m / 903 m |
|---|---|---|---|
| Spud Date | 3/04/99 | Mud Type | KCL/PHPA |
| Water Depth | | Activity | Drill 8.5" |

**Operator :** Boral Energy
**Report For :** Barry Beetson
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Report For :** Mark Richardson

**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin
**M-I Well No. :** NP4

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 8.5 in HTC MX03 | | Surface | Hole 183 |
| Nozzles 2x14 /16 / 1/32" | | | |
| Drill Pipe Size 4.5 in | Length 608 m | Intermediate | Active Pits 420 |
| Drill Pipe Size 5 in | Length 272 m | Intermediate | Total Circulating Vol 603 |
| Drill Collar Size 6.5 in | Length 42 m | Production or Liner | In Storage |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATION 8P-80 | NATION 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | 2.965 gal/stk | 2.965 gal/stk |
| ump stk/min | 85@95% | 85@95% |
| Flow Rate | 504 | gal/min |
| Bottoms Up | 12.1 min | 2065 stk |
| Total Circ Time | 50.3 min | 8543 stk |
| Circulating Pressure | 2000 psi | |

## MUD PROPERTIES

| Property | Unit | | |
|---|---|---|---|
| Sample From | | FL@24:00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 922/903 | |
| Mud Weight | lb/gal | 9.1 | |
| Funnel Viscosity | s/qt | 43 | |
| Rheology Temp | °F | | |
| R600/R300 | | 47/34 | |
| R200/R100 | | 27/19 | |
| R6/R3 | | 6/5 | |
| PV | cP | 13 | |
| YP | lb/100 ft² | 21 | |
| 10s/10m/30m Gel | lb/100 ft² | 5/8/ | |
| API Fluid Loss | cc/30 min | 6.5 | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | 1/ | |
| Solids | % Vol | 7 | |
| Oil/Water | % Vol | 0/93 | |
| Sand | % Vol | 0.25 | |
| MBT | lb/bbl | 5 | |
| pH | | 9.0 | |
| Alkal Mud (Pm) | | 0.15 | |
| Pf/Mf | | 0.1/0.45 | |
| Chlorides | mg/l | 23000 | |
| Hardness Ca | | 200 | |
| | | | |
| KCL | % wt | 4.0 | |
| PHPA | lb/bbl | 1.5 | |
| Sulphite | mg/L | 120 | |

## PRODUCTS USED LAST 24 HRS

| Products | Size | Amt |
|---|---|---|
| C-121 Viscosfier | 25 KG BG | 2 |
| DUOVIS | 25 KG BG | 2 |
| POLY PLUS | 25 KG BG | 12 |
| POTASSIUM CHLORIDE | 25 KG BG | 80 |
| SODA ASH | 25 KG BG | 3 |
| SODIUM SULPHITE | 25 KG BG | 2 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 15 |
| Desilter | 10 x 6" | 14 |

## MUD PROPERTY SPECIFICATIONS

| | |
|---|---|
| Weight | alap |
| Viscosity | 40+ |
| Filtrate | 7 |

## REMARKS AND TREATMENT

Made up 280 bbls of premixes at 2.0 lb/bbl PHPA and 4.0% KCL.
Clay cuttings of reasonable quality but some dispersing straight into the system causing mud weight increase.

## REMARKS

Run in with MWD and mud motor. Drill out float and shoe plus 3m of new formation down to 409m using drill water. Displace to KCL/PHPA mud at 8.65 ppg. Run FIT to 14.6 ppg. Directional drill 8.5" from 409 to 922m.
Survey at 902m was 26.3 degrees deviation.

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) | SOLIDS ANALYSIS | (%/lb/bbl) | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|---|---|---|---|
| Rig Up/Service | 3.5 | Oil Added | | NaCl | .2/ 1.9 | np/na Values | 0.467/0.381 |
| Drilling | 16 | Water Added | 280 | KCl | 1.5/ 13.8 | kp/ka (lb•s^n/100ft²) | 1.970/2.867 |
| Tripping | 4.5 | Mud Received | 0 | Low Gravity | 4./ 36.4 | Bit Loss (psi / %) | 862 / 1 |
| B.O.P. NU | | Mud Disposed | 30 | Bentonite | .1/ 1.3 | Bit HHP (hhp / HSI) | 253 / 1 |
| B.O.P. Testing | | Shakers Loss | 133.1 | Drill Solids | 3.6/ 33.1 | Bit Jet Vel (m/sec) | 99 |
| Run Casing | | Evaporation Loss | 0 | Weight Material | NA/ NA | Annular Vel DP (m/min) | 72.41 |
| Condition Hole | | Centrifuge Loss | 0 | Chemical Conc | - / 2. | Annular Vel DC (m/min) | 125.5 |
| Circulating | | Formation Loss | 0 | Inert/React | 5.888 | Crit Vel DP (m/min) | 99 |
| Coring | | Left in Hole | 0 | Average SG | 2.6 | Crit Vel DC (m/min) | 116 |
| Dev. Survey | | Other | 0 | Carb/BiCarb (m mole/L) | 2./ 10. | ECD @ 922 (lb/gal) | 9.61 |

| M-I ENGR / PHONE | | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|---|
| Jim Kelleher | 089 3254822 | 01415 110697 | | $ 3,395.27 | $ 10,750.69 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 4
**Date :** 6/04/99

## COST SUMMARY

**Net Daily Cost :** 3395.27
**Sales Tax :** 0.00
**Total Daily Cost :** 3395.27
**Cumulative Cost :** 10750.69

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 63 | 0 | 0 | 2 | 61 | 8 | 280.20 |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 36 | 0 | 0 | 0 | 36 | 0 | |
| C-209 ID Free | 55 GA DM | 606.43 | 4 | 0 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 28 | 0 | 0 | 0 | 28 | 1 | |
| DEFOAMER IDF | 25 LT CN | 54.21 | 5 | 0 | 0 | 0 | 5 | 0 | |
| [illegible]OVIS | 25 KG BG | 385.29 | 40 | 0 | 0 | 2 | 38 | 8 | 770.58 |
| [illegible]LUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 7 | 0 | 0 | 0 | 7 | 0 | |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 4 | 0 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 48 | 0 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 52 | 0 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 280 | 0 | 0 | 0 | 280 | 30 | |
| M-I GEL API | 25 KG BG | 11.30 | 45 | 0 | 0 | 0 | 45 | 0 | |
| MICA MEDIUM | 25 KG BG | 12.10 | 32 | 0 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 48 | 0 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 59 | 0 | 0 | 12 | 47 | 24 | 1220.40 |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 426 | 0 | 0 | 80 | 346 | 244 | 1023.20 |
| SAPP | 25 KG BG | | 18 | 0 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 30 | 0 | 0 | 3 | 27 | 7 | 43.29 |
| SODIUM BICARBONATE | 25 KG BG | | 48 | 0 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 32 | 0 | 0 | 2 | 30 | 2 | 57.60 |
| Trugel | 25 KG BG | 7.90 | 450 | 0 | 0 | 0 | 450 | 80 | |

# WATER-BASED MUD REPORT No. 5

| | | | |
|---|---|---|---|
| Date | 7/04/99 | Depth/TVD | 1263 m / 1250 m |
| Spud Date | 3/04/99 | Mud Type | KCL/PHPA |
| Water Depth | | Activity | Drill 8.5" |

**Operator :** Boral Energy
**Report For :** Barry Beetson
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Report For :** Mark Richardson
**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin
**M-I Well No. :** NP4

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 8.5 in HTC GT P03 | | Surface | Hole |
| Nozzles 14 /2x16 / 1/32" | | | 255.4 |
| Drill Pipe Size 4.5 in | Length 949 m | Intermediate | Active Pits 309.6 |
| Drill Pipe Size 5 in | Length 272 m | Intermediate | Total Circulating Vol 565 |
| Drill Collar Size 6.5 in | Length 42 m | Production or Liner | In Storage |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATION 8P-80 | NATION 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | 2.965 gal/stk | 2.965 gal/stk |
| ump stk/min | 80@95% | 80@95% |
| Flow Rate | 474 gal/min | |
| Bottoms Up | 17.9 min | 2867 stk |
| Total Circ Time | 50.1 min | 8010 stk |
| Circulating Pressure | 2000 psi | |

| MUD PROPERTIES | | | |
|---|---|---|---|
| Sample From | | FL@24:00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 1263/1250 | |
| Mud Weight | lb/gal | 9.4 | |
| Funnel Viscosity | s/qt | 47 | |
| Rheology Temp | °F | | |
| R600/R300 | | 57/42 | |
| R200/R100 | | 31/21 | |
| R6/R3 | | 7/5 | |
| PV | cP | 15 | |
| YP | lb/100 ft² | 27 | |
| 10s/10m/30m Gel | lb/100 ft² | 5/12/ | |
| API Fluid Loss | cc/30 min | 6.2 | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | 1/ | |
| Solids | % Vol | 8 | |
| Oil/Water | % Vol | 0/92 | |
| Sand | % Vol | 0.25 | |
| MBT | lb/bbl | 10 | |
| pH | | 9 | |
| Alkal Mud (Pm) | | 0.1 | |
| Pf/Mf | | 0.1/0.5 | |
| Chlorides | mg/l | 24000 | |
| Hardness Ca | | 240 | |
| KCL | % wt | 4 | |
| PHPA | lb/bbl | 1.7 | |
| Sulphite | mg/L | 120 | |

| PRODUCTS USED LAST 24 HRS | Size | Amt |
|---|---|---|
| C-121 Viscosfier | 25 KG BG | 1 |
| DUOVIS | 25 KG BG | 1 |
| M-I BAR | 25 KG BG | 30 |
| POLY PLUS | 25 KG BG | 6 |
| POTASSIUM CHLORIDE | 25 KG BG | 40 |
| SODA ASH | 25 KG BG | 1 |
| SODIUM SULPHITE | 25 KG BG | 1 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 15 |
| Desilter | 10 x 6" | 15 |

| MUD PROPERTY SPECIFICATIONS | |
|---|---|
| Weight | alap |
| Viscosity | 40+ |
| Filtrate | 7 |

## REMARKS AND TREATMENT

Made up just the one 150 bbl premix using sump water and 2.0 lb/bbl PHPA and 4% KCL.
Still gaining mud weight from dispersive clays.

## REMARKS

Directional drilll 8.5" from 922 to 1233m. Circ bottoms up and pull out for bit change. Ran back in with MWD and Mud Motor. Wash and ream from 1128 to 1149m. RIH to 1233m and directional drill 8.5" hole to 1263m. Survey at 1224m 23 degrees.

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) |
|---|---|---|---|
| Rig Up/Service | 1.5 | Oil Added | |
| Drilling | 14.5 | Water Added | 150 |
| Tripping | 7 | Mud Received | 0 |
| B.O.P. NU | | Mud Disposed | 0 |
| Wash and Ream | 0.5 | Shakers Loss | 110 |
| Run Casing | | Evaporation Loss | 0 |
| Condition Hole | | Centrifuge Loss | 0 |
| Circulating | 0.5 | Formation Loss | 0 |
| Coring | | Left in Hole | 0 |
| Dev. Survey | | Other | 82.2 |

| SOLIDS ANALYSIS (%/lb/bbl) | | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|
| NaCl | .2/ 2.4 | np/na Values | 0.441/0.409 |
| KCl | 1.4/ 13.4 | kp/ka (lb•s^n/100ft²) | 2.872/2.737 |
| Low Gravity | 6.2/ 56.7 | Bit Loss (psi / %) | 660 / 1 |
| Bentonite | .5/ 4.4 | Bit HHP (hhp / HSI) | 182 / 1 |
| Drill Solids | 5.5/ 50.3 | Bit Jet Vel (m/sec) | 85 |
| Weight Material | NA/ NA | Annular Vel DP (m/min) | 68.1 |
| Chemical Conc | - / 2. | Annular Vel DC (m/min) | 118.03 |
| Inert/React | 4.4695 | Crit Vel DP (m/min) | 102 |
| Average SG | 2.6 | Crit Vel DC (m/min) | 122 |
| Carb/BiCarb (m mole/L) | 2./ 10. | ECD @ 1263 (lb/gal) | 9.93 |

| M-I ENGR / PHONE | | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|---|
| Jim Kelleher | 089 3254822 | 01415 110697 | | $ 1,856.32 | $ 12,607.01 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 5
**Date :** 7/04/99

## COST SUMMARY

| | |
|---|---|
| **Net Daily Cost :** | 1856.32 |
| **Sales Tax :** | 0.00 |
| **Total Daily Cost :** | 1856.32 |
| **Cumulative Cost :** | 12607.01 |

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 61 | 0 | 0 | 1 | 60 | 9 | 140.10 |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 36 | 0 | 0 | 0 | 36 | 0 | |
| C-209 ID Free | 55 GA DM | 606.43 | 4 | 0 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 28 | 0 | 0 | 0 | 28 | 1 | |
| DEFOAMER IDF | 25 LT CN | 54.21 | 5 | 0 | 0 | 0 | 5 | 0 | |
| DUOVIS | 25 KG BG | 385.29 | 38 | 0 | 0 | 1 | 37 | 9 | 385.29 |
| GLUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 7 | 0 | 0 | 0 | 7 | 0 | |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 4 | 0 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 48 | 0 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 52 | 0 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 280 | 0 | 0 | 30 | 250 | 60 | 165.90 |
| M-I GEL API | 25 KG BG | 11.30 | 45 | 0 | 0 | 0 | 45 | 0 | |
| MICA MEDIUM | 25 KG BG | 12.10 | 32 | 0 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 48 | 0 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 47 | 0 | 0 | 6 | 41 | 30 | 610.20 |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 346 | 0 | 0 | 40 | 306 | 284 | 511.60 |
| SAPP | 25 KG BG | | 18 | 0 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 27 | 0 | 0 | 1 | 26 | 8 | 14.43 |
| SODIUM BICARBONATE | 25 KG BG | | 48 | 0 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 30 | 0 | 0 | 1 | 29 | 3 | 28.80 |
| Trugel | 25 KG BG | 7.90 | 450 | 0 | 0 | 0 | 450 | 80 | |

# WATER-BASED MUD REPORT No. 6

| | | | |
|---|---|---|---|
| Date | 8/04/99 | Depth/TVD | 1603 m / 1511 m |
| Spud Date | 3/04/99 | Mud Type | KCL/PHPA |
| Water Depth | | Activity | Drill 8.5" |

| | | | |
|---|---|---|---|
| Operator : | Boral Energy | Field/Area : | Victoria |
| Report For : | Barry Beetson | Description : | Development |
| Well Name : | North Paaratte 4 | Location : | Otway Basin |
| Contractor : | Century Drilling | M-I Well No. : | NP4 |
| Report For : | Mark Richardson | | |

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 8.5 in HTC GT P03 | | Surface | Hole 327.7 |
| Nozzles 14 /2x16 / 1/32" | | | |
| Drill Pipe Size 4.5 in | Length 1289 m | Intermediate | Active Pits 320.3 |
| Drill Pipe Size 5 in | Length 272 m | Intermediate | Total Circulating Vol 648 |
| Drill Collar Size 6.5 in | Length 42 m | Production or Liner | In Storage |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATION 8P-80 | NATION 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | 2.965 gal/stk | 2.965 gal/stk |
| ump stk/min | 80@95% | 80@95% |
| Flow Rate | 474 | gal/min |
| Bottoms Up | 22.9 min | 3666 stk |
| Total Circ Time | 57.4 min | 9187 stk |
| Circulating Pressure | 2000 psi | |

## MUD PROPERTIES

| | | | |
|---|---|---|---|
| Sample From | | FL@24:00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 1603/1511 | |
| Mud Weight | lb/gal | 9.4 | |
| Funnel Viscosity | s/qt | 48 | |
| Rheology Temp | °F | 120 | |
| R600/R300 | | 67/51 | |
| R200/R100 | | 38/25 | |
| R6/R3 | | 7/5 | |
| PV | cP | 16 | |
| YP | lb/100 ft² | 35 | |
| 10s/10m/30m Gel | lb/100 ft² | 5/14/ | |
| API Fluid Loss | cc/30 min | 5.8 | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | 1/ | |
| Solids | % Vol | 8 | |
| Oil/Water | % Vol | /92 | |
| Sand | % Vol | 0.25 | |
| MBT | lb/bbl | 12.5 | |
| pH | | 9.0 | |
| Alkal Mud (Pm) | | 0.1 | |
| Pf/Mf | | 0.1/0.6 | |
| Chlorides | mg/l | 26000 | |
| Hardness Ca | | 120 | |
| | | | |
| KCL | % wt | 4.5 | |
| PHPA | lb/bbl | 1.8 | |
| Sulphite | mg/L | 120 | |

## PRODUCTS USED LAST 24 HRS

| Products | Size | Amt |
|---|---|---|
| C-122 Fluid Loss | 25 KG BG | 6 |
| CAUSTIC SODA | 25 KG DM | 3 |
| DUOVIS | 25 KG BG | 1 |
| M-I GEL API | 25 KG BG | 12 |
| POLY PLUS | 25 KG BG | 17 |
| POTASSIUM CHLORIDE | 25 KG BG | 160 |
| SODA ASH | 25 KG BG | 2 |
| SODIUM SULPHITE | 25 KG BG | 2 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 24 |
| Desilter | 10 x 6" | 24 |

## MUD PROPERTY SPECIFICATIONS

| | |
|---|---|
| Weight | alap |
| Viscosity | 40+ |
| Filtrate | 7 |

## REMARKS AND TREATMENT

Added to active 3x120 bbl premixes plus 60 bbls sump water with 8% KCL added. Still using sump water for premixes. Chlorides in sump water now down to 3000 mg/L but weight up to 8.5 ppg. Clays very dispersive just maintaining mud weight at 9.4 ppg.
Gel used for cement job.

## REMARKS

Drill directional 8.5" hole from 1263 to 1603m.
Tight on connections comes free after minimal reaming.

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) |
|---|---|---|---|
| Rig Up/Service | | Oil Added | |
| Drilling | 24 | Water Added | 440 |
| Tripping | | Mud Received | 0 |
| B.O.P. NU | | Mud Disposed | 60 |
| Wash and Ream | | Shakers Loss | 140 |
| Run Casing | | Evaporation Loss | 0 |
| Condition Hole | | Centrifuge Loss | 0 |
| Circulating | | Formation Loss | 0 |
| Coring | | Left in Hole | 0 |
| Dev. Survey | | Other | 181.5 |

| SOLIDS ANALYSIS (%/lb/bbl) | | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|
| NaCl | .2/ 2.2 | np/na Values | 0.394/0.459 |
| KCl | 1.6/ 15.1 | kp/ka (lb•s^n/100ft²) | 4.672/2.523 |
| Low Gravity | 6.1/ 55.3 | Bit Loss (psi / %) | 660 / 1 |
| Bentonite | .8/ 7.4 | Bit HHP (hhp / HSI) | 182 / 1 |
| Drill Solids | 5./ 45.9 | Bit Jet Vel (m/sec) | 85 |
| Weight Material | NA/ NA | Annular Vel DP (m/min) | 68.1 |
| Chemical Conc | - / 2. | Annular Vel DC (m/min) | 118.03 |
| Inert/React | 3.2614 | Crit Vel DP (m/min) | 113 |
| Average SG | 2.6 | Crit Vel DC (m/min) | 139 |
| Carb/BiCarb (m mole/L) | 2./ 10. | ECD @ 1603 (lb/gal) | 10.01 |

| M-I ENGR / PHONE | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|
| Jim Kelleher 089 3254822 | 01415 110697 | | $ 5,311.75 | $ 17,918.76 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 6
**Date :** 8/04/99

## COST SUMMARY

**Net Daily Cost :** 5311.75
**Sales Tax :** 0.00
**Total Daily Cost :** 5311.75
**Cumulative Cost :** 17918.76

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 60 | 0 | 0 | 0 | 60 | 9 | |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 36 | 0 | 0 | 6 | 30 | 6 | 840.60 |
| C-209 ID Free | 55 GA DM | 606.43 | 4 | 0 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 28 | 0 | 0 | 3 | 25 | 4 | 88.50 |
| DEFOAMER IDF | 25 LT CN | 54.21 | 5 | 0 | 0 | 0 | 5 | 0 | |
| DUOVIS | 25 KG BG | 385.29 | 37 | 0 | 0 | 1 | 36 | 10 | 385.29 |
| GLUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 7 | 0 | 0 | 0 | 7 | 0 | |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 4 | 0 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 48 | 0 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 52 | 0 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 250 | 0 | 0 | 0 | 250 | 60 | |
| M-I GEL API | 25 KG BG | 11.30 | 45 | 0 | 0 | 12 | 33 | 12 | 135.60 |
| MICA MEDIUM | 25 KG BG | 12.10 | 32 | 0 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 48 | 0 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 41 | 0 | 0 | 17 | 24 | 47 | 1728.90 |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 306 | 0 | 0 | 160 | 146 | 444 | 2046.40 |
| SAPP | 25 KG BG | | 18 | 0 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 26 | 0 | 0 | 2 | 24 | 10 | 28.86 |
| SODIUM BICARBONATE | 25 KG BG | | 48 | 0 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 29 | 0 | 0 | 2 | 27 | 5 | 57.60 |
| Trugel | 25 KG BG | 7.90 | 450 | 0 | 0 | 0 | 450 | 80 | |

# WATER-BASED MUD REPORT No. 7

| | | | |
|---|---|---|---|
| Date | 9/04/99 | Depth/TVD | 1651 m / 1555 m |
| Spud Date | 3/04/99 | Mud Type | KCL/PHPA |
| Water Depth | | Activity | Trip |

**Operator :** Boral Energy
**Report For :** Barry Beetson
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Report For :** Mark Richardson

**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin
**M-I Well No. :** NP4

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 8.5 in HTC GT P03 | | Surface | Hole 337.8 |
| Nozzles 14 /2x16 / 1/32" | | | |
| Drill Pipe Size 4.5 in | Length 1337 m | Intermediate | Active Pits 280.2 |
| Drill Pipe Size 5 in | Length 272 m | Intermediate | Total Circulating Vol 618 |
| Drill Collar Size 6.5 in | Length 42 m | Production or Liner | In Storage |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATION 8P-80 | NATION 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | 2.965 gal/stk | 2.965 gal/stk |
| ump stk/min | 80@95% | 80@95% |
| Flow Rate | 474 | gal/min |
| Bottoms Up | 23.6 min | 3779 stk |
| Total Circ Time | 54.8 min | 8762 stk |
| Circulating Pressure | 2000 psi | |

| MUD PROPERTIES | | | |
|---|---|---|---|
| Sample From | | Pit@24:00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 1651/1555 | |
| Mud Weight | lb/gal | 9.6 | |
| Funnel Viscosity | s/qt | 56 | |
| Rheology Temp | °F | | |
| R600/R300 | | 81/60 | |
| R200/R100 | | 44/28 | |
| R6/R3 | | 9/7 | |
| PV | cP | 21 | |
| YP | lb/100 ft² | 39 | |
| 10s/10m/30m Gel | lb/100 ft² | 6/18/ | |
| API Fluid Loss | cc/30 min | 5.8 | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | 1/ | |
| Solids | % Vol | 9 | |
| Oil/Water | % Vol | /91 | |
| Sand | % Vol | 0.25 | |
| MBT | lb/bbl | 15 | |
| pH | | 9.0 | |
| Alkal Mud (Pm) | | 0.15 | |
| Pf/Mf | | 0.1/0.6 | |
| Chlorides | mg/l | 25000 | |
| Hardness Ca | | 200 | |
| | | | |
| KCL | % wt | 4.5 | |
| PHPA | lb/bbl | 1.8 | |
| Sulphite | mg/L | 120 | |

| PRODUCTS USED LAST 24 HRS | | |
|---|---|---|
| Products | Size | Amt |
| GLUTE 25 (25 LTR CN) | 25 LT DM | 2 |
| M-I BAR | 25 KG BG | 80 |
| SODIUM SULPHITE | 25 KG BG | 1 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 4 |
| Desilter | 10 x 6" | 4 |

| MUD PROPERTY SPECIFICATIONS | |
|---|---|
| Weight | alap |
| Viscosity | 40+ |
| Filtrate | 7 |

## REMARKS AND TREATMENT

On circulating bottoms up after tight wiper trip, large quantities of very mushy cuttings came to surface. Added 30 bbls of water but weight still cam up 2 points to 9.6 ppg. Viscosity increased by 8 seconds.

## REMARKS

Continue to drill 8.5" hole from 1603 to TD at 1651m. Circulate hole clean and run 30 stand wiper trip. Work tight hole from 1525 to 1487 and 1412 to 1355m. No fill o running back to bottom and hole slick on pullling out. Run logs. Hole in-gauge. Run back in hole with bit.

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) | SOLIDS ANALYSIS | (%/lb/bbl) | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|---|---|---|---|
| Rig Up/Service | 2.5 | Oil Added | | NaCl | .1/ 1.6 | np/na Values | 0.433/0.395 |
| Drilling | 2.5 | Water Added | 30 | KCl | 1.6/ 14.9 | kp/ka (lb•s^n/100ft²) | 4.302/3.919 |
| Tripping | 13.5 | Mud Received | 0 | Low Gravity | 7.7/ 69.8 | Bit Loss (psi / %) | 674 / 1 |
| Electric Logs | 3.5 | Mud Disposed | 0 | Bentonite | .9/ 8.4 | Bit HHP (hhp / HSI) | 186 / 1 |
| Wash and Ream | | Shakers Loss | 40 | Drill Solids | 6.5/ 59.4 | Bit Jet Vel (m/sec) | 85 |
| Run Casing | | Evaporation Loss | 0 | Weight Material | NA/ NA | Annular Vel DP (m/min) | 68.1 |
| Condition Hole | | Centrifuge Loss | 0 | Chemical Conc | - / 2. | Annular Vel DC (m/min) | 118.03 |
| Circulating | 2 | Formation Loss | 0 | Inert/React | 3.5211 | Crit Vel DP (m/min) | 121 |
| Coring | | Left in Hole | 0 | Average SG | 2.6 | Crit Vel DC (m/min) | 144 |
| Dev. Survey | | Other | 23.4 | Carb/BiCarb (m mole/L) | 2./ 10. | ECD @ 1651 (lb/gal) | 10.3 |

| M-I ENGR / PHONE | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|
| Jim Kelleher 089 3254822 | 01415 110697 | | $ 693.38 | $ 18,612.14 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 7
**Date :** 9/04/99

## COST SUMMARY

**Net Daily Cost :** 693.38
**Sales Tax :** 0.00
**Total Daily Cost :** 693.38
**Cumulative Cost :** 18612.14

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 60 | 0 | 0 | 0 | 60 | 9 | |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 30 | 0 | 0 | 0 | 30 | 6 | |
| C-209 ID Free | 55 GA DM | 606.43 | 4 | 0 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 25 | 0 | 0 | 0 | 25 | 4 | |
| DEFOAMER IDF | 25 LT CN | 54.21 | 5 | 0 | 0 | 0 | 5 | 0 | |
| DUOVIS | 25 KG BG | 385.29 | 36 | 0 | 0 | 0 | 36 | 10 | |
| GLUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 7 | 0 | 0 | 2 | 5 | 2 | 222.18 |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 4 | 0 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 48 | 0 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 52 | 0 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 250 | 0 | 0 | 80 | 170 | 140 | 442.40 |
| M-I GEL API | 25 KG BG | 11.30 | 33 | 0 | 0 | 0 | 33 | 12 | |
| MICA MEDIUM | 25 KG BG | 12.10 | 32 | 0 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 48 | 0 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 24 | 0 | 0 | 0 | 24 | 47 | |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 146 | 0 | 0 | 0 | 146 | 444 | |
| SAPP | 25 KG BG | | 18 | 0 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 24 | 0 | 0 | 0 | 24 | 10 | |
| SODIUM BICARBONATE | 25 KG BG | | 48 | 0 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 27 | 0 | 0 | 1 | 26 | 6 | 28.80 |
| Trugel | 25 KG BG | 7.90 | 450 | 0 | 0 | 0 | 450 | 80 | |

# WATER-BASED MUD REPORT No. 8

| Date | 10/04/99 | Depth/TVD | 1651 m / 1555 m |
|---|---|---|---|
| Spud Date | 3/04/99 | Mud Type | KCL/PHPA |
| Water Depth | | Activity | Run Casing |

**Operator :** Boral Energy
**Report For :** Barry Beetson
**Well Name :** North Paaratte 4
**Contractor :** Century Drilling
**Report For :** Mark Richardson
**Field/Area :** Victoria
**Description :** Development
**Location :** Otway Basin
**M-I Well No. :** NP4

| DRILLING ASSEMBLY | | CASING | MUD VOLUME (bbl) |
|---|---|---|---|
| Bit Size 8.5 in HTC GT P03 | | Surface | Hole 337.8 |
| Nozzles 14 /2x16 / 1/32" | | | |
| Drill Pipe Size 4.5 in | Length 1337 m | Intermediate | Active Pits 280.2 |
| Drill Pipe Size 5 in | Length 272 m | Intermediate | Total Circulating Vol 618 |
| Drill Collar Size 6.5 in | Length 42 m | Production or Liner | In Storage |

| CIRCULATION DATA | | |
|---|---|---|
| Pump Make | NATION 8P-80 | NATION 8P-80 |
| Pump Size | 6 X 8.5in | 6 X 8.5in |
| Pump Cap | gal/stk | gal/stk |
| ump stk/min | | |
| Flow Rate | gal/min | |
| Bottoms Up | | |
| Total Circ Time | | |
| Circulating Pressure | | |

## MUD PROPERTIES

| | | | |
|---|---|---|---|
| Sample From | | Pit@12:00 | |
| Flow Line Temp | °F | | |
| Depth/TVD | m | 1651/1555 | |
| Mud Weight | lb/gal | 9.6 | |
| Funnel Viscosity | s/qt | 56 | |
| Rheology Temp | °F | | |
| R600/R300 | | | |
| R200/R100 | | | |
| R6/R3 | | | |
| PV | cP | | |
| YP | lb/100 ft² | | |
| 10s/10m/30m Gel | lb/100 ft² | | |
| API Fluid Loss | cc/30 min | | |
| HTHP FL Temp | cc/30 min | | |
| Cake API/HT | 1/32" | | |
| Solids | % Vol | | |
| Oil/Water | % Vol | | |
| Sand | % Vol | | |
| MBT | lb/bbl | | |
| pH | | | |
| Alkal Mud (Pm) | | | |
| Pf/Mf | | | |
| Chlorides | mg/l | | |
| Hardness Ca | | | |
| KCL | % wt | | |
| PHPA | lb/bbl | | |
| Sulphite | mg/L | | |

## PRODUCTS USED LAST 24 HRS

| Products | Size | Amt |
|---|---|---|
| M-I BAR | 25 KG BG | 50 |
| POTASSIUM CHLORIDE | 25 KG BG | 26 |

| SOLIDS EQUIP | Size | Hr |
|---|---|---|
| Desander | 2 x 10" | 1 |
| Desilter | 10 x 6" | 1 |

## MUD PROPERTY SPECIFICATIONS

| | |
|---|---|
| Weight | alap |
| Viscosity | 40+ |
| Filtrate | 7 |

## REMARKS AND TREATMENT

Added 30 bbls of water while circulating.

## REMARKS

Wiper trip to bottom. Circulate. Pull out to run casing.

| TIME DISTR | Last 24 Hrs | MUD VOL ACCTG | (bbl) | SOLIDS ANALYSIS | (%/lb/bbl) | MUD RHEOLOGY & HYDRAULICS | |
|---|---|---|---|---|---|---|---|
| Rig Up/Service | | Oil Added | | NaCl | -.9/ -11.3 | np/na Values | 0.433/0.395 |
| Drilling | | Water Added | 30 | KCl | 1.6/ 14.8 | kp/ka (lb•s^n/100ft²) | 4.302/3.919 |
| Tripping | | Mud Received | 0 | Low Gravity | 9.3/ 84.9 | Bit Loss (psi / %) | / 1 |
| Electric Logs | | Mud Disposed | 0 | Bentonite | ./. | Bit HHP (hhp / HSI) | / 1 |
| Wash and Ream | | Shakers Loss | 33.5 | Drill Solids | 10.3/ 93.3 | Bit Jet Vel (m/sec) | |
| Run Casing | | Evaporation Loss | 0 | Weight Material | NA/ NA | Annular Vel DP (m/min) | 68.1 |
| Condition Hole | | Centrifuge Loss | 0 | Chemical Conc | - / 2. | Annular Vel DC (m/min) | 118.03 |
| Circulating | | Formation Loss | 0 | Inert/React | - | Crit Vel DP (m/min) | 121 |
| Coring | | Left in Hole | 0 | Average SG | 2.6 | Crit Vel DC (m/min) | 144 |
| Dev. Survey | | Other | 0 | Carb/BiCarb (m mole/L) | ./ -.1 | ECD @ 1651 (lb/gal) | 10.3 |

| M-I ENGR / PHONE | RIG PHONE | WAREHOUSE PHONE | DAILY COST | CUMULATIVE COST |
|---|---|---|---|---|
| Jim Kelleher 089 3254822 | 01415 110697 | | $ 609.04 | $ 19,221.18 |

# WELLSITE MUD INVENTORY

## DAILY MUD INVENTORY REPORT

**Operator :** Boral Energy
**Well Name :** North Paaratte 4
**Location :** Otway Basin

**M-I Well No. :** NP4
**Report No. :** 8
**Date :** 10/04/99

## COST SUMMARY

| | |
|---|---|
| **Net Daily Cost :** | 609.04 |
| **Sales Tax :** | 0.00 |
| **Total Daily Cost :** | 609.04 |
| **Cumulative Cost :** | 19221.18 |

## MUD INVENTORY

| Product Name | Unit | Unit Price | Begin Invent | Recvd Today | Return Today | Used Today | Final Invent | Total Used | Daily Cost |
|---|---|---|---|---|---|---|---|---|---|
| C-121 Viscosfier | 25 KG BG | 140.10 | 60 | 0 | 0 | 0 | 60 | 9 | |
| C-122 Fluid Loss | 25 KG BG | 140.10 | 30 | 0 | 0 | 0 | 30 | 6 | |
| C-209 ID Free | 55 GA DM | 606.43 | 4 | 0 | 0 | 0 | 4 | 0 | |
| CAUSTIC SODA | 25 KG DM | 29.50 | 25 | 0 | 0 | 0 | 25 | 4 | |
| DEFOAMER IDF | 25 LT CN | 54.21 | 5 | 0 | 0 | 0 | 5 | 0 | |
| DUOVIS | 25 KG BG | 385.29 | 36 | 0 | 0 | 0 | 36 | 10 | |
| GLUTE 25 (25 LTR CN) | 25 LT DM | 111.09 | 5 | 0 | 0 | 0 | 5 | 2 | |
| HYDROCHLORIC ACID 33% | 25 LT DM | 28.55 | 4 | 0 | 0 | 0 | 4 | 0 | |
| KWIK SEAL MEDIUM | 40 LB BG | 35.37 | 48 | 0 | 0 | 0 | 48 | 0 | |
| LIME | 25 KG BG | 10.36 | 52 | 0 | 0 | 0 | 52 | 0 | |
| M-I BAR | 25 KG BG | 5.53 | 170 | 0 | 0 | 50 | 120 | 190 | 276.50 |
| M-I GEL API | 25 KG BG | 11.30 | 33 | 0 | 0 | 0 | 33 | 12 | |
| MICA MEDIUM | 25 KG BG | 12.10 | 32 | 0 | 0 | 0 | 32 | 0 | |
| MIX II FINE | 25 LB BG | 42.02 | 48 | 0 | 0 | 0 | 48 | 0 | |
| POLY PLUS | 25 KG BG | 101.70 | 24 | 0 | 0 | 0 | 24 | 47 | |
| POTASSIUM CHLORIDE | 25 KG BG | 12.79 | 146 | 0 | 0 | 26 | 120 | 470 | 332.54 |
| SAPP | 25 KG BG | | 18 | 0 | 0 | 0 | 18 | 0 | |
| SODA ASH | 25 KG BG | 14.43 | 24 | 0 | 0 | 0 | 24 | 10 | |
| SODIUM BICARBONATE | 25 KG BG | | 48 | 0 | 0 | 0 | 48 | 0 | |
| SODIUM SULPHITE | 25 KG BG | 28.80 | 26 | 0 | 0 | 0 | 26 | 6 | |
| Trugel | 25 KG BG | 7.90 | 450 | 0 | 0 | 0 | 450 | 80 | |

## APPENDIX 5

## WELL LOCATION SURVEY

Alan Simpson
B. App. Sci. (Survey), L.S., M.I.S.

Trevor McDowell
B. App. Sci. (Survey), L.S., M.I.S.

# ALAN H. SIMPSON 907476 165

## LAND SURVEYOR - WARRNAMBOOL

A.C.N. 062 912 510

LICENSED SURVEYORS PLANNING CONSULTANTS DEVELOPMENT MANAGERS

P.O. Box 421,
Warrnambool 3280
(125a Kepler Street,)

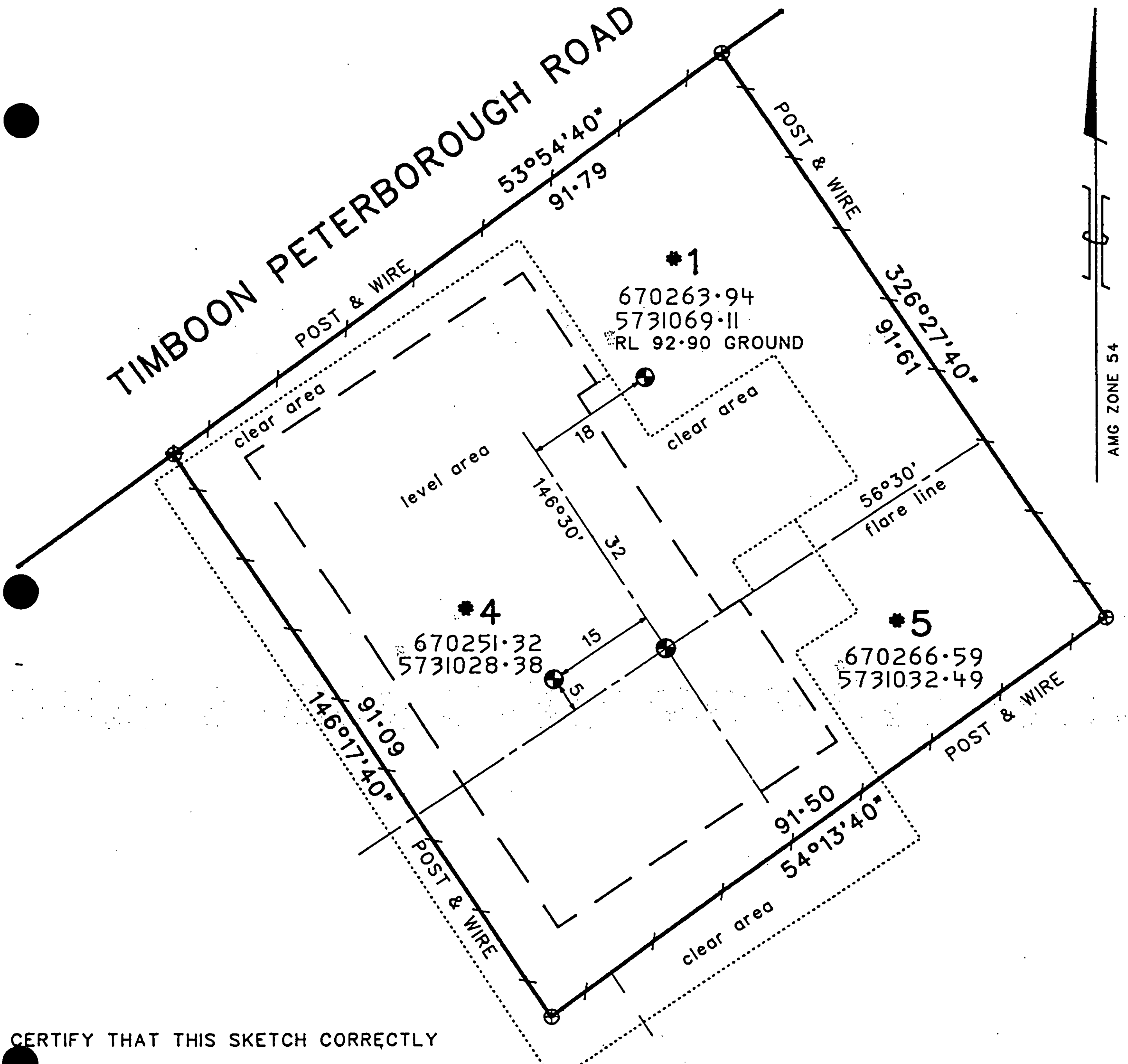
Ph: (03) 5561 1846
Fax: (03) 5562 1775

# NORTH PAARATTE

SCALE 1:800

DATUM OF BEARINGS IS TO AMG ZONE 54

| | EASTING | NORTHING | LATITUDE | LONGITUDE |
|---|---|---|---|---|
| NORTH PAARATTE •1 | 670263·94 | 5731069·11 | -38°33'08·59" | 142°57'14·18" |
| NORTH PAARATTE •4 | 670251·32 | 5731028·38 | -38°33'09·92" | 142°57'13·70" |
| NORTH PAARATTE •5 | 670266·59 | 5731032·49 | -38°33'09·78" | 142°57'14·32" |




I CERTIFY THAT THIS SKETCH CORRECTLY REPRESENTS THE SITE CONDITIONS ON 18/2/1999.

Trevor McDowell

TREVOR McDOWELL L.S.

APPENDIX 6

MWD SURVEY DATA

By

SPERRY-SUN

sperry-sun
DRILLING SERVICES

# MWD End of Well Report
for

## BORAL ENERGY PTY LTD

Rig : CENTURY RIG #2
Well : NORTH PAARATTE 4
Field : OTWAY BASIN
Country : AUSTRALIA

Job No. : AU-DW-90025 Date : 09-APR-99

# Contents

# Section 1. : GENERAL INFORMATION

# General Information

| | | |
|---|---|---|
| Company | : | BORAL ENERGY PTY LTD |
| Rig | : | CENTURY RIG #2 |
| Well | : | NORTH PAARATTE 4 |
| Field | : | OTWAY BASIN |
| Country | : | AUSTRALIA |
| | : | |
| Sperry-Sun job number | : | AU-DW-90025 |
| Job start date | : | 05-APR-99 |
| Job end date | : | 09-APR-99 |
| North reference | : | GRID |
| Declination | : | 12.1 |
| Dip angle | : | -69.8 |
| Total magnetic field | : | 60.98 |
| Date of magnetic data | : | 23-MAR-99 |
| Wellhead coordinates N | : | |
| Wellhead coordinates E | : | |
| Vert. section direction | : | 332.2 |
| MWD Engineers | : | PAUL DAUD |
| | : | |
| | : | |
| | : | |
| Company Representatives | : | B.BEETSON |
| | : | |
| Company Geologists | : | |

**Engineering units used :**

| | | | | | |
|---|---|---|---|---|---|
| Depth / length | : | metres | Viscosity | : | sec/litre |
| OD / ID | : | inches | PV | : | cp |
| Temperature | : | deg. C | YP | : | Pa |
| Flow Rate | : | galls/min | Chlorides | : | mg/l |
| Pressure | : | psi | Fluid loss | : | ml (cc.) |
| Weight on bit | : | metric Tonnes | Casing weight | : | lbs/ft |
| Mud Weight | : | ppg | | | |

# Section 2. : OPERATIONAL OVERVIEW

# Operational Overview

Sperry-Sun Drilling Services were contracted by Boral Energy Resources Pty Ltd to provide directional only services while drilling the 8 1/2" hole section of North Paaratte 4 by Century rig #2.

The section successfully reached TD at 1651 mRT in two bit runs. No MWD problems were experienced during the drilling of this well.

# Section 3. : SUMMARY OF MWD RUNS

# Summary of MWD runs

sperry-sun DRILLING SERVICES

| MWD Run | Bit No. | Hole Size | MWD Sensors | Start Depth | End Depth | Drill/Wipe Distance | Run Start Time | Run Start Date | Run End Time | Run End Date | BRT Hours | Oper. Hours | Circ. Hours | Max. Temp. | Service Interrupt | Trip for MWD | Failure Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 8.50 | DIR | 406.0 | 1233.0 | 827.0 | 22:00 | 05-APR-99 | 16:00 | 07-APR-99 | 42.00 | 42.00 | 24.00 | 49.0 | | | |
| 2 | 3 | 8.50 | DIR | 1233.0 | 1651.0 | 418.0 | 16:45 | 07-APR-99 | 14:45 | 09-APR-99 | 46.00 | 46.00 | 28.10 | 54.0 | | | |
| | | | | TOTALS ⇒ | | 1245.0 | | | | | 88.00 | 88.00 | 52.10 | | 0 | 0 | |

# Section 4. : BITRUN SUMMARY

# Bitrun Summary

sperry-sun DRILLING SERVICES

## MWD Run Time Data

| | |
|---|---|
| MWD Run | 1 |
| Rig Bit | 2 |
| Hole Size | 8.50 in |
| Run Start | 22:00 05-APR-99 |
| Run End | 16:00 07-APR-99 |
| BRT hrs | 42.00 |
| Circ.hrs | 24.00 |
| Oper.hrs | 42.00 |

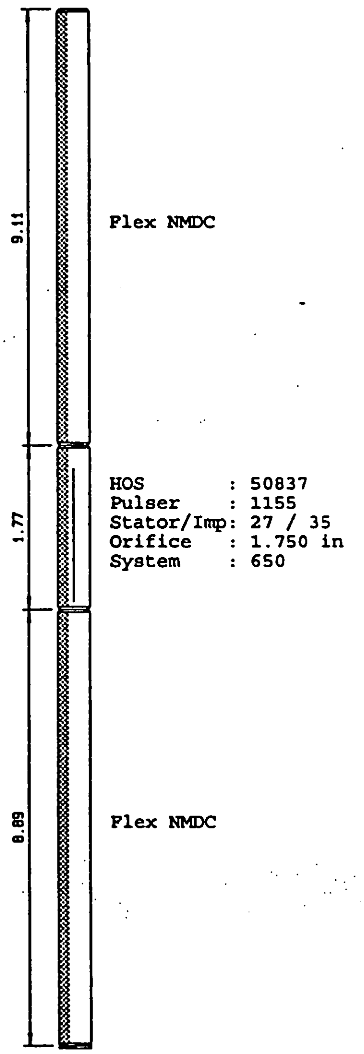
## Drilling Data

| | |
|---|---|
| Start Depth | 406.0 m |
| End Depth | 1233.0 m |
| Footage | 827.0 m |
| Flow Rate | 500.00 gpm |
| R.P.M. | 65 |
| W.O.B. | 20 T |
| R.O.P. | 29.3 m/hr |
| S.P.P | 1600 psi |

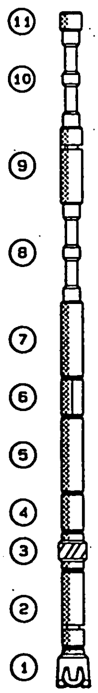
## Mud Data

| | |
|---|---|
| Mud type | KCL/PHPA |
| Weight/Visc | 9.10 / 43.0 |
| Chlorides | 23000 |
| PV / YP | 13 / 21 |
| Solids/Sand | 7.0 / 0.25 |
| Max. Temp. | 49.0 deg C |

## MWD Schematic




## BHA Schematic



| Component | Length | O.D. | I.D. |
|---|---|---|---|
| 11. X/O | 0.48 | 6.500 | 2.813 |
| 10. 10 x HWDP | 91.00 | 5.000 | 3.000 |
| 9. JAR | 9.40 | 6.500 | 2.500 |
| 8. 20 x HWDP | 182.00 | 5.000 | 3.000 |
| 7. Flex NMDC | 9.11 | 6.500 | 2.813 |
| 6. HOS | 1.77 | 6.750 | 2.813 |
| 5. Flex NMDC | 8.89 | 6.500 | 2.813 |
| 4. Float sub | 0.84 | 6.500 | 2.813 |
| 3. String stab | 1.97 | 6.750 | 2.813 |
| 2. Sperrydrill 1.5 deg | 9.04 | 6.750 | 4.498 |
| 1. Tricone | 0.25 | 8.500 | |

## Comments

Drill 8 1/2" hole from 406.0m to 1233m
POOH to change bit.

## MWD Performance

| | |
|---|---|
| Sys Sz/Type | 650 /D/GWD |
| Survey/TF % | 96 / 99 |
| Gam RT/Rec% | 0 / 0 |
| Min. Inc. | 0.2 /477 |
| Max. Inc. | 26.3 /902 |
| Min/Max Az. | 179.5/335.2 |
| Pulser RPM | 2500 |

# Bitrun Summary

sperry-sun DRILLING SERVICES

## MWD Run Time Data

MWD Run : 2
Rig Bit : 3
Hole Size: 8.50 in
Run Start: 16:45 07-APR-99
Run End : 14:45 09-APR-99
BRT hrs : 46.00
Circ.hrs : 28.10
Oper.hrs : 46.00

## Drilling Data

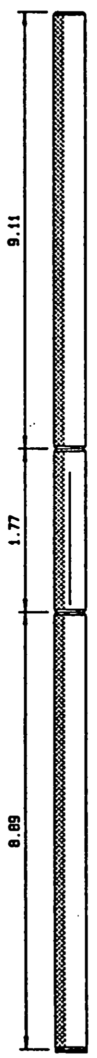
Start Depth: 1233.0 m
End Depth : 1651.0 m
Footage : 418.0 m
Flow Rate : 500.00 gpm
R.P.M. : 65
W.O.B. : 20 T
R.O.P. : 14.1 m/hr
S.P.P : 1900 psi

## Mud Data

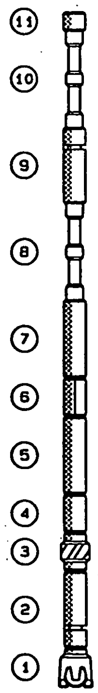
Mud type : KCL/PHPA
Weight/Visc: 9.40 / 48.0
Chlorides : 26000
PV / YP : 16 / 35
Solids/Sand: 8.0 / 0.25

Max. Temp. : 54.0 deg C

## MWD Schematic




## BHA Schematic




| Component | Length | O.D. | I.D. |
|---|---|---|---|
| 11. X/O | 0.48 | 6.500 | 2.813 |
| 10. 10 x HWDP | 91.00 | 5.000 | 3.000 |
| 9. JAR | 9.40 | 6.500 | 2.500 |
| 8. 20 x HWDP | 182.00 | 5.000 | 3.000 |
| 7. Flex NMDC | 9.11 | 6.500 | 2.813 |
| 6. HOS | 1.77 | 6.750 | 2.813 |
| 5. Flex NMDC | 8.89 | 6.500 | 2.813 |
| 4. Float sub | 0.84 | 6.500 | 2.813 |
| 3. String stab | 1.97 | 6.750 | 2.813 |
| 2. Sperrydrill 1.15 deg | 9.04 | 6.750 | 4.498 |
| 1. Hughes Christenen | 0.25 | 8.500 | |

## Comments

Drill 8 1/2" hole from 1233m to 1651m
POOH to run wireline logs.

## MWD Performance

Sys Sz/Type: 650 /D/GWD
Survey/TF %: 90 / 95
Gam RT/Rec%: 0 / 0
Min. Inc. : 23.0 /1592
Max. Inc. : 25.7 /1366
Min/Max Az.: 331.3/337.3
Pulser RPM : 2400

# Section 5. : SURVEYS

SPERRY-SUN DRILLING SERVICES

BORAL ENERGY PTY LTD
NORTH PAARATTE 4

05-APRIL-99
AU-DW-90025

| MEASURED DEPTH | ANGLE DEG | DIRECTION DEG | VERTICAL DEPTH | LATITUDE METRES | DEPARTURE METRES | VERTICAL SECTION | DOG LEG |
|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 58.00 | 0.00 | 0.00 | 58.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 104.00 | 0.25 | 0.00 | 104.00 | 0.10 N | 0.00 | 0.09 | 0.16 |
| 213.00 | 0.75 | 0.00 | 213.00 | 1.05 N | 0.00 | 0.93 | 0.14 |
| 217.00 | 0.25 | 0.00 | 217.00 | 1.09 N | 0.00 | 0.96 | 3.75 |
| 394.00 | 0.75 | 0.00 | 393.99 | 2.63 N | 0.00 | 2.33 | 0.08 |
| 410.48 | 0.40 | 302.10 | 410.47 | 2.77 N | 0.05 W | 2.47 | 1.16 |
| 467.23 | 0.30 | 270.70 | 467.22 | 2.88 N | 0.37 W | 2.72 | 0.11 |
| 486.20 | 0.40 | 317.80 | 486.19 | 2.93 N | 0.46 W | 2.80 | 0.47 |
| 495.62 | 1.40 | 331.30 | 495.60 | 3.05 N | 0.54 W | 2.95 | 3.23 |
| 505.15 | 2.50 | 335.20 | 505.13 | 3.34 N | 0.68 W | 3.27 | 3.49 |
| 514.62 | 3.90 | 332.40 | 514.58 | 3.82 N | 0.92 W | 3.80 | 4.46 |
| 524.14 | 4.80 | 334.30 | 524.08 | 4.46 N | 1.24 W | 4.52 | 2.87 |
| 533.69 | 6.20 | 332.40 | 533.58 | 5.28 N | 1.65 W | 5.44 | 4.43 |
| 543.15 | 7.10 | 328.80 | 542.98 | 6.23 N | 2.19 W | 6.53 | 3.14 |
| 552.59 | 8.20 | 330.90 | 552.33 | 7.32 N | 2.82 W | 7.79 | 3.61 |
| 562.07 | 9.80 | 329.10 | 561.70 | 8.60 N | 3.56 W | 9.27 | 5.14 |
| 571.56 | 11.10 | 329.10 | 571.03 | 10.08 N | 4.45 W | 10.99 | 4.11 |
| 580.88 | 12.30 | 327.50 | 580.16 | 11.69 N | 5.44 W | 12.87 | 4.00 |
| 599.82 | 14.90 | 328.00 | 598.56 | 15.45 N | 7.82 W | 17.31 | 4.12 |
| 609.22 | 16.30 | 328.00 | 607.62 | 17.60 N | 9.16 W | 19.84 | 4.47 |
| 618.71 | 17.70 | 329.40 | 616.69 | 19.97 N | 10.60 W | 22.60 | 4.61 |
| 628.14 | 18.50 | 331.70 | 625.66 | 22.52 N | 12.03 W | 25.53 | 3.41 |
| 646.99 | 21.60 | 333.30 | 643.36 | 28.25 N | 15.01 W | 31.99 | 5.01 |
| 656.36 | 22.90 | 331.20 | 652.03 | 31.39 N | 16.67 W | 35.54 | 4.88 |
| 665.83 | 24.40 | 331.50 | 660.71 | 34.73 N | 18.49 W | 39.34 | 4.77 |
| 675.28 | 25.10 | 331.60 | 669.29 | 38.20 N | 20.37 W | 43.29 | 2.23 |
| 703.73 | 25.10 | 330.40 | 695.05 | 48.76 N | 26.22 W | 55.36 | 0.54 |
| 732.12 | 25.00 | 330.70 | 720.77 | 59.23 N | 32.13 W | 67.38 | 0.17 |
| 760.41 | 25.80 | 331.80 | 746.33 | 69.86 N | 37.97 W | 79.51 | 0.98 |
| 788.97 | 26.00 | 332.10 | 772.02 | 80.87 N | 43.83 W | 91.98 | 0.25 |
| 817.47 | 25.10 | 331.10 | 797.73 | 91.69 N | 49.68 W | 104.27 | 1.05 |
| 845.70 | 25.80 | 333.90 | 823.22 | 102.45 N | 55.27 W | 116.40 | 1.48 |
| 874.06 | 26.30 | 334.70 | 848.70 | 113.67 N | 60.67 W | 128.85 | 0.65 |
| 902.39 | 26.30 | 335.40 | 874.10 | 125.05 N | 65.97 W | 141.38 | 0.33 |
| 930.78 | 26.00 | 332.40 | 899.59 | 136.28 N | 71.47 W | 153.89 | 1.43 |
| 959.26 | 26.00 | 333.00 | 925.18 | 147.38 N | 77.20 W | 166.37 | 0.28 |
| 987.63 | 25.50 | 330.80 | 950.74 | 158.25 N | 83.00 W | 178.69 | 1.14 |
| 1016.05 | 25.20 | 332.10 | 976.42 | 168.94 N | 88.81 W | 190.86 | 0.67 |
| 1044.33 | 24.10 | 333.10 | 1002.12 | 179.41 N | 94.24 W | 202.65 | 1.25 |

Page 2

SPERRY-SUN DRILLING SERVICES

BORAL ENERGY PTY LTD
NORTH PAARATTE 4

05-APRIL-99
AU-DW-90025

| MEASURED DEPTH | ANGLE DEG | DIRECTION DEG | VERTICAL DEPTH | LATITUDE METRES | DEPARTURE METRES | VERTICAL SECTION | DOG LEG |
|---|---|---|---|---|---|---|---|
| 1072.71 | 23.70 | 333.80 | 1028.07 | 189.69 N | 99.38 W | 214.15 | 0.52 |
| 1101.02 | 23.90 | 332.60 | 1053.97 | 199.89 N | 104.53 W | 225.57 | 0.56 |
| 1129.38 | 23.30 | 331.90 | 1079.96 | 209.94 N | 109.82 W | 236.93 | 0.70 |
| 1157.94 | 23.40 | 333.80 | 1106.18 | 220.01 N | 114.99 W | 248.24 | 0.80 |
| 1186.26 | 22.80 | 333.90 | 1132.23 | 229.98 N | 119.88 W | 259.35 | 0.64 |
| 1224.23 | 23.10 | 332.20 | 1167.19 | 243.18 N | 126.59 W | 274.15 | 0.57 |
| 1252.50 | 23.60 | 331.30 | 1193.15 | 253.05 N | 131.90 W | 285.36 | 0.65 |
| 1280.95 | 23.80 | 331.30 | 1219.20 | 263.08 N | 137.39 W | 296.79 | 0.21 |
| 1309.47 | 24.00 | 332.70 | 1245.28 | 273.28 N | 142.81 W | 308.34 | 0.63 |
| 1337.81 | 25.00 | 331.70 | 1271.06 | 283.67 N | 148.29 W | 320.10 | 1.15 |
| 1366.22 | 25.70 | 332.40 | 1296.74 | 294.42 N | 153.99 W | 332.26 | 0.80 |
| 1394.50 | 25.70 | 331.50 | 1322.22 | 305.24 N | 159.76 W | 344.52 | 0.41 |
| 1422.85 | 25.00 | 333.10 | 1347.84 | 315.99 N | 165.41 W | 356.66 | 1.04 |
| 1451.34 | 25.60 | 333.50 | 1373.60 | 326.86 N | 170.88 W | 368.83 | 0.66 |
| 1479.71 | 25.60 | 333.60 | 1399.18 | 337.84 N | 176.34 W | 381.09 | 0.05 |
| 1498.65 | 25.20 | 334.10 | 1416.29 | 345.13 N | 179.92 W | 389.21 | 0.72 |
| 1536.42 | 24.80 | 335.00 | 1450.52 | 359.54 N | 186.78 W | 405.16 | 0.44 |
| 1564.68 | 24.00 | 336.40 | 1476.26 | 370.18 N | 191.58 W | 416.81 | 1.05 |
| 1592.93 | 23.00 | 337.30 | 1502.17 | 380.54 N | 196.01 W | 428.04 | 1.13 |
| 1630.80 | 23.20 | 336.80 | 1537.00 | 394.22 N | 201.81 W | 442.84 | 0.22 |
| 1651.00 | 23.20 | 336.80 | 1555.57 | 401.53 N | 204.94 W | 450.78 | 0.00 |

THE DOGLEG SEVERITY IS IN DEGREES PER 30.00 METRES
THE VERTICAL SECTION WAS COMPUTED ALONG 332.25° (GRID)

BASED UPON MINIMUM CURVATURE TYPE CALCULATIONS. THE BOTTOM HOLE DISPLACEMENT IS 450.81 METRES, IN THE DIRECTION OF 332.96° (GRID)

ALL DIRECTIONS REFERENCED TO GRID NORTH.
ALL DEPTHS RELATIVE TO RKB.
VERTICAL SECTION REFERENCED TO WELLHEAD.
LAT 5731028.38 N
DEP 670251.32 E
SURVEY @ 1651m EXTRAPOLATED TO TD.

PE605490

This is an enclosure indicator page.
The enclosure PE605490 is enclosed within the container PE907476 at this location in this document.

The enclosure PE605490 has the following characteristics:

```
     ITEM_BARCODE = PE605490
CONTAINER_BARCODE = PE907476
             NAME = North Paaratte-4 Composite Log
            BASIN = OTWAY
        ONSHORE? = Y
        DATA_TYPE = WELL
    DATA_SUB_TYPE = MONTAGE_LOG
      DESCRIPTION = North Paaratte-4 Composite Well Log
                    Scale 1:500 Enclosure 1
          REMARKS = Copy 1
     DATE_WRITTEN = 30-APR-1999
   DATE_PROCESSED =
    DATE_RECEIVED = 27-JAN-2000
    RECEIVED_FROM = Boral Energy Ltd
        WELL_NAME = North Paaratte-4
       CONTRACTOR =
           AUTHOR =
       ORIGINATOR = Boral Energy Ltd
        TOP_DEPTH = 0
     BOTTOM_DEPTH = 1651
   ROW_CREATED_BY = DN07_SW
```

(Inserted by DNRE - Vic Govt Mines Dept)

PE605492

This is an enclosure indicator page.
The enclosure PE605492 is enclosed within the container PE907476 at this location in this document.

The enclosure PE605492 has the following characteristics:

ITEM_BARCODE = PE605492
CONTAINER_BARCODE = PE907476
NAME = North Paaratte-4 Composite Log
BASIN = OTWAY
ONSHORE? = Y
DATA_TYPE = WELL
DATA_SUB_TYPE = MONTAGE_LOG
DESCRIPTION = North Paaratte-4 Composite Well Log Scale 1:200 Enclosure 2
REMARKS = Copy 1
DATE_WRITTEN = 30-APR-1999
DATE_PROCESSED =
DATE_RECEIVED = 27-JAN-2000
RECEIVED_FROM = Boral Energy Ltd
WELL_NAME = North Paaratte-4
CONTRACTOR =
AUTHOR =
ORIGINATOR = Boral Energy Ltd
TOP_DEPTH = 1300
BOTTOM_DEPTH = 1651
ROW_CREATED_BY = DN07_SW

(Inserted by DNRE - Vic Govt Mines Dept)

PE605494

This is an enclosure indicator page.
The enclosure PE605494 is enclosed within the container PE907476 at this location in this document.

The enclosure PE605494 has the following characteristics:

ITEM_BARCODE = PE605494
CONTAINER_BARCODE = PE907476
NAME = North Paaratte-4 Mud Log
BASIN = OTWAY
ONSHORE? = Y
DATA_TYPE = WELL
DATA_SUB_TYPE = MUD_LOG
DESCRIPTION = North Paaratte-4 Formation Evaluation Mud Log Scale 1:200 Enclosure 3
REMARKS = Copy 1
DATE_WRITTEN =
DATE_PROCESSED =
DATE_RECEIVED = 27-JAN-2000
RECEIVED_FROM = Boral Energy Ltd
WELL_NAME = North Paaratte-4
CONTRACTOR =
AUTHOR =
ORIGINATOR = Boral Energy Ltd
TOP_DEPTH = 0
BOTTOM_DEPTH = 1651
ROW_CREATED_BY = DN07_SW

(Inserted by DNRE - Vic Govt Mines Dept)