WATERHOUSE - 2
WELL COMPLETION REPORT

WATERHOUSE NO. 2

WELL COMPLETION REPORT

AMADEUS BASIN

OP 175

by

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Pancontinental Petroleum Limited

PPL Report No. 130

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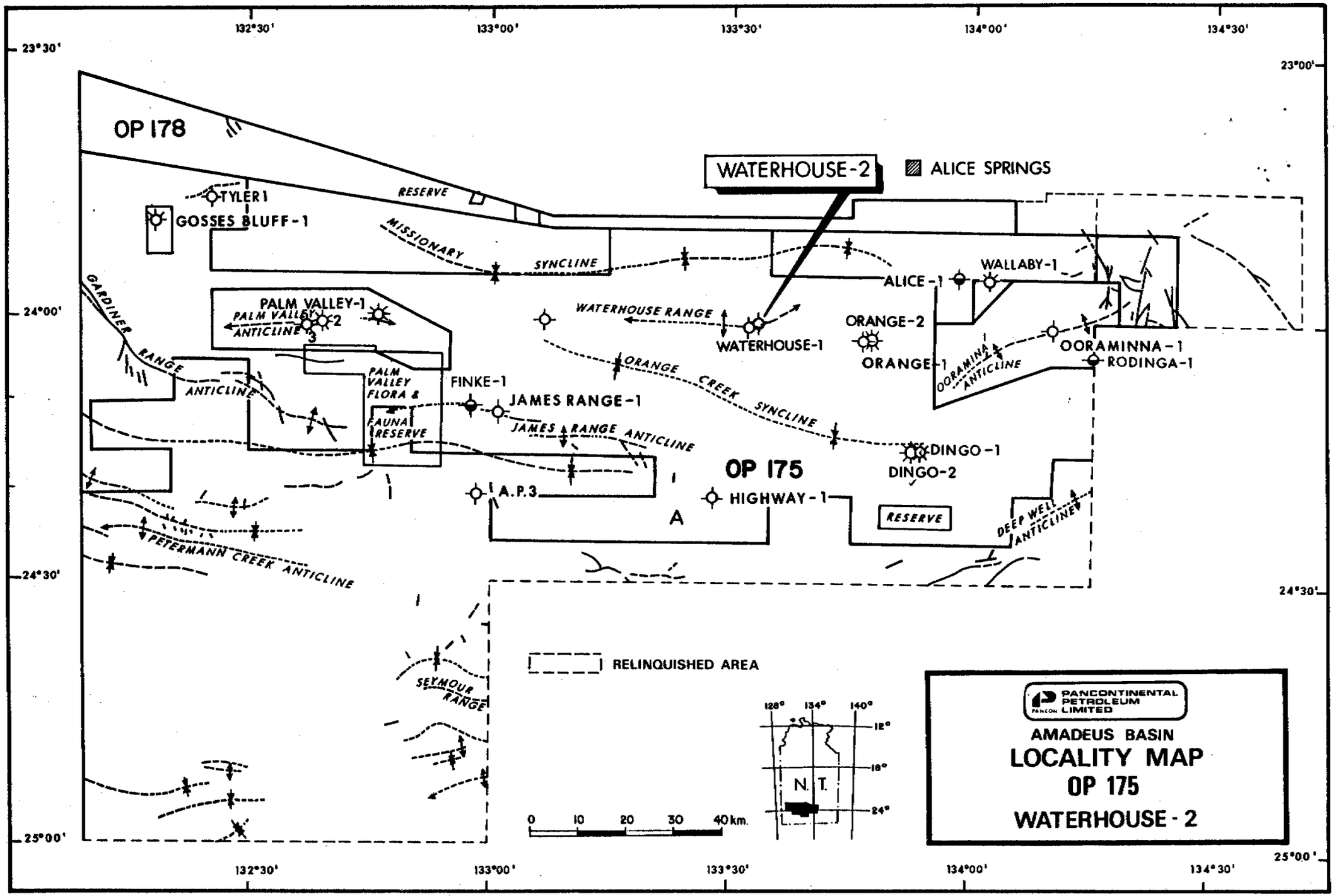
1. INTRODUCTION

The Waterhouse No. 2 exploration well was spudded in at 0930 hours on January 4th, 1985, approximately 48 kilometres south west of Alice Springs, and 260 metres east of Waterhouse No. 1 (Figure 1). The well was drilled in Oil Permit No. 175 of the Northern Territory using PDSA Rig 4. The joint venture exploration consortium for OP 175 as at 1st January 1985 was as follows:-

Magellan Petroleum (N.T.) Pty Limited (Permit Holder)	30.8705%
International Oil Proprietary	14.1704%
Pancontinental Petroleum Limited (Operator)	10.0000%
Amadeus Oil N.L.	9.8891%
International Energy Development Corporation of Australia Pty. Limited	9.8891%
Orca Petroleum N.L.	5.9484%
Farmout Drillers N.L.	4.9556%
Canso Resources Limited	4.6306%
Apollo International Minerals N.L.	3.3908%
Oilmin N.L.	3.2113%
C.D. Resources Pty. Limited	1.5822%
Transoil N.L.	1.3763%
Canada Southern Petroleum Limited	0.0705%
Petromin N.L.	0.0152%

Waterhouse No. 2 was drilled to assess the gas potential of the basal Arumbera Sandstone, not reached at the nearby Waterhouse No. 1 well (Centralian Oil Pty Ltd., 1965). The stratigraphic succession was predicted to be similar to that at the recently drilled Orange No. 2 well (Marsden et al., 1985b) below the total depth of Waterhouse No. 1.


132°30'
133°00'
133°30'
134°00'
134°30'
23°30'
23°00'
24°00'
24°30'
25°00'
OP 178
WATERHOUSE-2
ALICE SPRINGS
TYLER 1
GOSSES BLUFF-1
RESERVE
MISSIONARY SYNCLINE
ALICE-1
WALLABY-1
PALM VALLEY-1
PALM VALLEY ANTICLINE
2
3
GARDINER RANGE ANTICLINE
WATERHOUSE RANGE
WATERHOUSE-1
ORANGE-2
ORANGE-1
OORAMINA ANTICLINE
OORAMINNA-1
RODINGA-1
ORANGE CREEK SYNCLINE
PALM VALLEY FLORA & FAUNA RESERVE
FINKE-1
JAMES RANGE-1
JAMES RANGE ANTICLINE
DINGO-1
DINGO-2
OP 175
A.P.3
HIGHWAY-1
A
RESERVE
DEEP WELL ANTICLINE
PETERMANN CREEK ANTICLINE
SEYMOUR RANGE
RELINQUISHED AREA
0 10 20 30 40 km.
128° 134° 140°
12°
18°
24°
N.T.
PANCONTINENTAL PETROLEUM LIMITED
AMADEUS BASIN
LOCALITY MAP
OP 175
WATERHOUSE - 2

2. SUMMARY

2.1 Drilling

Waterhouse No. 2 was spudded in at 0930 hours on January 4th, 1985, after the 13-3/8" conductor pipe was set and cemented at 14 metres. A 12-1/4" hole was drilled to 180.9 metres, where a wiper trip was conducted prior to setting the 9-5/8" casing.

14 joints of 9-5/8" casing were run and cemented at 169.5 metres. The B.O.P's were nipped up and the hydril was pressure tested to 1500 psi. The pipe rams, blind rams, choke manifold and all valves were pressure tested to 3000 psi prior to performing a formation leak off test to an equivalent mud weight of 9.8 ppg. The 8-1/2" hole was drilled 443 metres where significant deviation was noted. The bottom hole assembly was changed, and the weight on bit was decreased in an attempt to decrease the deviation.

The well was then drilled ahead to 974 metres where a sample was circulated from a drill break. No gas was detected and the 8-1/2" hole was drilled to 1200.7 metres (drillers depth) with the deviation varying from 4 degrees to 13 degrees at total depth.

The hole was circulated clean and a wiper trip was conducted prior to strapping out of the hole. Gearhart Australia Ltd run a suite of logs after which the bottom hole assembly and drill collars were laid down. 4 cement plugs were set and drill pipe was laid down. The mud tanks were cleaned and the rig was released at 1600 hours on the 23rd January, 1985.

2.2 Geology

Waterhouse No. 2 was drilled to assess the gas potential of the lower Arumbera Sandstone reservoir which contain gas at the nearby Dingo Gas Field.

The Waterhouse No. 2 well was spudded near the mapped eastern closure of the Waterhouse anticline. (Marsden et al, 1985a). The well penetrated 674 metres of Cambrian limestone, dolomite, siltstone and shale uncomformably overlying 354.0 metres of Early Cambrian to Late Proterozoic sandstone, siltstone and shale, followed by 174.8 metres of Late Proterozoic shale, siltstone and dolomite.

The well encountered excellent reservoirs within the basal Arumbera Sandstone, but the upper Arumbera 1 siltstone seal present at both Dingo and Orange was non sealing. Log analysis from this reservoir interval indicates that the formation water is relatively fresh (c.f. Dingo and Orange) which may be attributed to the lack of seal at the top of the A1.

Waterhouse No. 2 was plugged and abandoned at 1202.8 metres (loggers depth) after failing to encounter significant hydrocarbons.

3. WELL HISTORY

3.1 General Data

Well Name and Number:	Waterhouse No. 2
Name and Address of Operator:	Pancontinental Petroleum Limited 50 Margaret Street Sydney NSW 2000
Permit Holder:	Magellan Petroleum (N.T.) Pty Limited 420 George Street Brisbane QLD 4000
Permit:	OP 175
Basin:	Amadeus, Northern Territory
Location:	Latitude 24 deg. 00'34" S Longitude 133 deg. 32'20" E
Water Supply:	Water bore RN 11803 nearby to Waterhouse No. 2 oil well
Elevation:	G.L. 630 metres a.s.l. K.B. 637 metres a.s.l.
Total Depth:	Driller 1200.7 metres K.B. Logger 1202.8 metres K.B.
Well Spudded:	0930 hrs, 4th January, 1985
Total Depth Reached:	0230 hrs, 21st January, 1985
Rig Release:	1600 hrs, 23rd January, 1985

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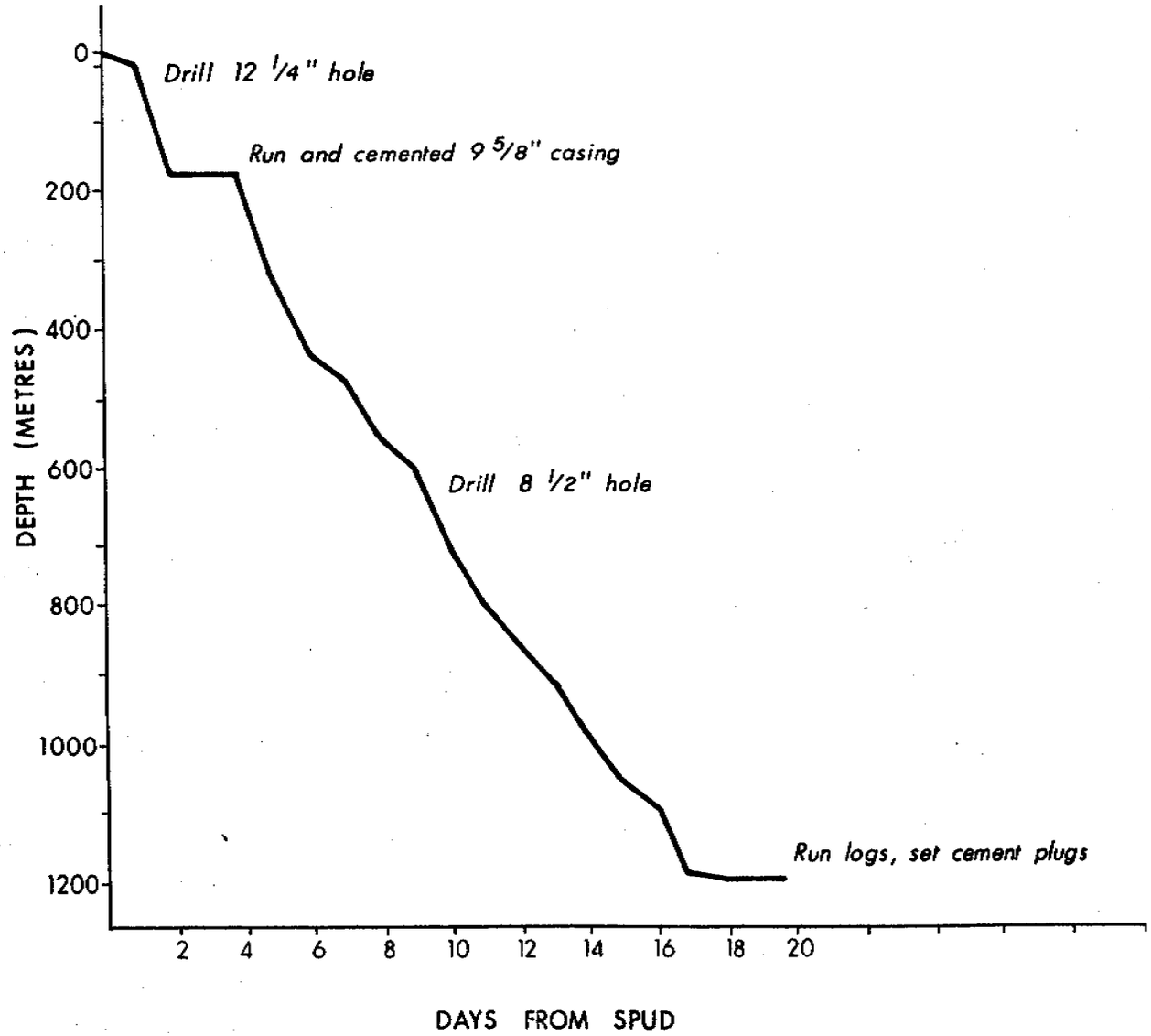
PANCON

WATERHOUSE 2
TIME DEPTH CURVE



AUTHOR: G.R.M.	DATE: FEB. '85
DRAWN: V.B.	FIG. N°: 2

Total Drilling Time:	16 days, 17 hours
Spud to Rig Release:	19 days, 6-1/2 hours (Figure 2)
Well Status:	Plugged and Abandoned

3.2 Drilling Plant

Drilling Contractor:	Petroleum Drilling Services (Australia) Pty Ltd 35th Floor, BHP House 140 William Street Melbourne Vic 3000
Drilling Rig:	PDSA Rig 4
Make:	Houston 5000
Power:	6 x 12V-71 Detroit Diesel Engines 4 x GE SGT 558 DC Generator units 2 x Combination AC-DC Generator units with 2 x GE SGT 558 DC Generators and 2 x Allis Chalmers 300 KW, AC Generators
Mast Make:	Pyramid 136' x 24'
Mast Capacity:	600,000 Ibs
Pumps:	2 x Skytop Brewster B-750 Duplex 1 : 8" x 6" Mission, 2 : 6" x 5" Mission

Rotary Table:	Gardner Denver 27-1/2" with split Master Bushing
Drill Pipe:	3245 metres 4-1/2", 16.6 lb/ft Grade E drill pipe. 12 joints 4-1/2", 42 lb/ft drill pipe (Heavy weight)
Drill Collars:	8 x 9" Drill Collars 15 x 8" Drill Collars 30 x 6-1/2" Drill Collars
Well Control Equipment:	Annular Preventor - Hydril MSP 2000, 21-1/4" rated to 2000 psi. Annular Preventor - Shaffer Spherical, 13-5/8" rated to 5000 psi. Rams - 2 Shaffer LWS 13-5/8" rated at 5000 psi - single ram. - 1 Shaffer SL SGL 13-5/8" rated at 5000 psi - single ram.

3.3 Drilling Data

3.3.1 Well Configuration

HOLE SIZE	DEPTH	CASING AND CEMENTING DETAILS
12-1/4"	180.9m	Ran 14 joints of 47 ppf. N-80, 9-5/8" casing to 169.5 metres. Cemented with 150 sacks Class "A" cement with 2.1% gel, 0.4 gallon/sack D-80 at 13.2 ppg, and 100 sacks Class "A" cement neat at 15.6 ppg. Cement returns to surface.
8-1/2"	2100.7m	No casing set in 8-1/2" hole.

3.3.2 Abandonment Programme

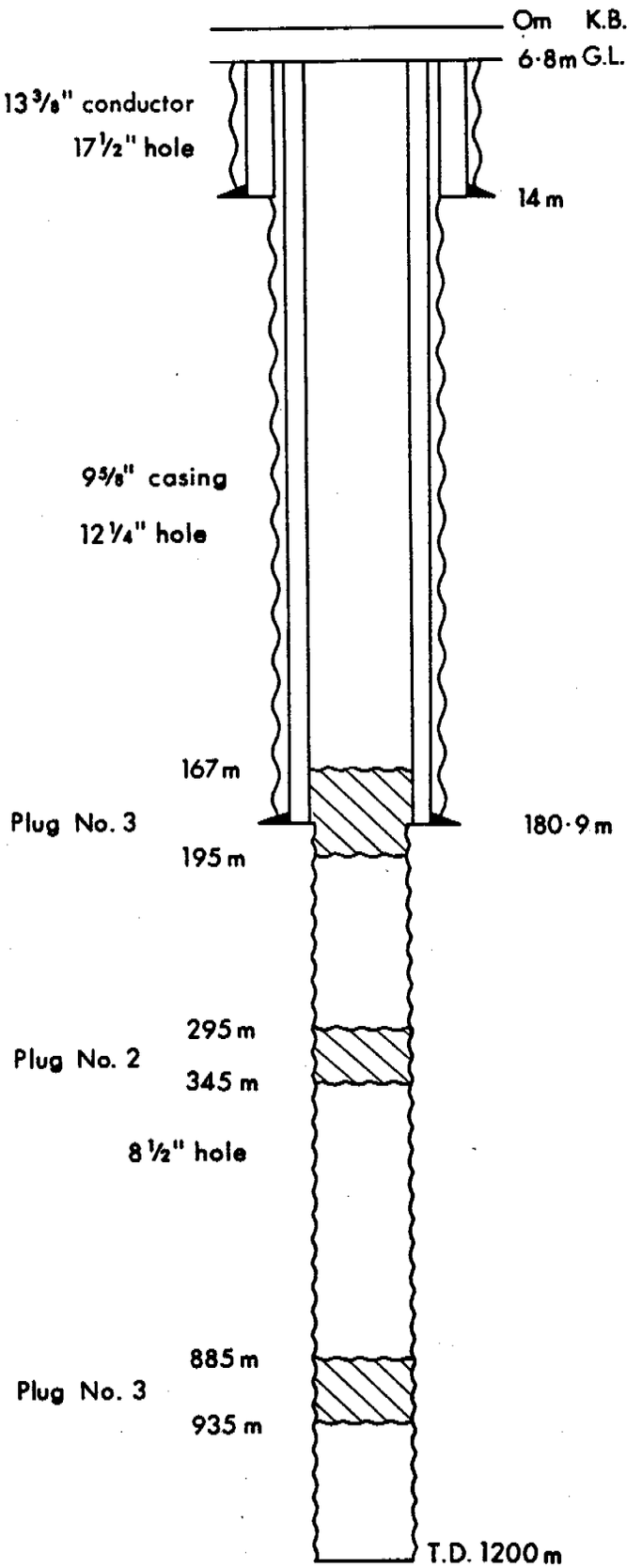
The following plugs were run in accordance with the Northern Territory Department of Mines and Energy (Figure 3).

Plug No 1 - 935-885 metres: cemented with 68 sacks of Class "A" cement.

Plug No 2 - 345-295 metres: cemented with 68 sacks of Class "A" cement. Tagged top of cement at 295 metres with 500 pounds after 4 hours.

Plug No 3 - 195-167 metres: cemented with 40 sacks Class "A" cement. Top plug tagged at 167 metres.

WATERHOUSE 2
WELL SCHEMATIC



AUTHOR: G.R.M.	DATE: FEB. '85
DRAWN: V.B.	FIG. N°: 3

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3.3.3 Drilling Fluid

Drilling Fluid materials and engineering services were supplied by Geofluids. Appendix D contains the complete drilling fluids report.

3.3.4 Deviation Surveys

51 Deviation surveys were taken at Waterhouse No. 2 as follows:

Depth (m)	Deviation (deg)	Depth (m)	Deviation (deg)	Depth (m)	Deviation (deg)
31	3/4	534	7	831	6
84	3/4	544	7	841	6
125	1/2	553	6-3/4	851	6
180.9	3/4	563	6	879	6-3/4
305	2	572	6	891	6-1/2
350	2	582	5-3/4	899	6-1/2
388	3	592	5-1/4	909	6-1/2
399	3-1/2	601	5	938	6-1/2
422	3-1/2	631	4-1/4	996	6-1/4
443	4	659	4-1/4	1024	6-1/4
455	4-1/4	687	4-1/2	1053	7
472	5-1/4	712	5	1082	7-3/4
486	6-1/4	745	5	1101	8
496	7	774	5	1120	7
505	7	784	5-1/4	1149	9
515	7	812	5-3/4	1158	10-1/4
524	7-1/4	821	5-3/4	1200	13

3.3.5 Formation Sampling

Drill cuttings were collected every five metres from the 9-5/8" casing shoe to total depth. Sample distribution was as follows:-

1 - Northern Territory Department of Mines and Energy
1 - Bureau of Mineral Resources
1 - Magellan Petroleum Australia Limited
3 - Pancontinental Petroleum Limited

Sample description are included as Appendix A.

3.3.6 Conventional Coring

No conventional cores were cut at Waterhouse No. 2.

3.3.7 Sidewall Coring

No sidewall cores were cut at Waterhouse No. 2.

3.3.8 Wireline Logging

The following logs were run at Waterhouse No. 2 by Gearhart Australia Limited.

DLL-MSFL-GR	1202.5 - 169.3 metres
CNS-CDL	1202.5 - 169.3 metres
BCS-GR	1199.0 - 169.0 metres
(GR to surface)	
FAD	1202.8 - 169.2 metres

3.3.9 Drill Stem Testing

No drill stem tests were conducted in the Waterhouse No. 2 well.

3.3.10 Velocity Survey

A velocity survey was not conducted at Waterhouse No. 2.

3.3.11 Temperature Survey

The following temperatures were measured during the final logging programme:

LOG	TEMPERATURE	TIME SINCE CIRCULATING
DLL-MSFL-GR	49 deg. C	5 hours, 18 mins
CNS-CDL	49 deg. C	8 hours, 25 mins
BCS-GR	49 deg. C	12 hours, 19 mins
FAD	51 deg. C	15 hours, 10 mins

The extrapolated bottom hole temperature at Waterhouse No. 2 is therefore 53 deg. C, which coincides with a geothermal gradient of 2.17 deg. C/100 metres (assuming surface temperature = 27 deg. C).

4. REGIONAL GEOLOGY

The Amadeus Basin is an 800 kilometre long, east-west oriented intracratonic depression lying in the southern part of the Northern Territory and extending partly into Western Australia. Commencing with Late Proterozoic clastics, which rest on an older Precambrian basement of metamorphic and igneous rocks, the basin has had a long and diversified history of sedimentation (Figure 4). Following Late Proterozoic sedimentation, rocks of Cambrian, Ordovician, possibly Silurian, Devonian and Permian age were deposited. Depositional and climatic conditions varied greatly in space and time throughout this long history. The Late Proterozoic, Cambrian and Ordovician were largely times of marine sedimentation resulting in the accumulation of great thicknesses of sandstone, shale, limestone and dolomite, with periods of evaporite (salt) deposition in the Late Proterozoic and Cambrian. Two periods of glaciation also occurred in the Late Proterozoic. The Siluro-Devonian sandstones, which were deposited during a period of aridity, are partly fluviatile and aeolian. Mountain building movements along the northern rim of the basin provided material for a thick wedge of fluviatile sediments in the Late Devonian. Minor fluviatile and lacustrine deposition in the Permian and again in the Tertiary concluded the sedimentary history of the Amadeus Basin.

Sedimentation was modified by tectonic movements which occurred intermittently from Late Proterozoic to Late Devonian. Tectonic movements in the Proterozoic established the shape of the basin, and formed the structural framework within which the subsequent movement took place (Figure 4).

Two major cycles of sedimentation associated with tectonism are evident. The older cycle began in the Late Proterozoic with mature orthoquartzite and carbonate rocks and finished with relatively immature fluvatile sandstone in the Early Cambrian (Petermann Range Orogeny). The second cycle commenced later in the Cambrian with marine sedimentation predominating and ended in the Late Devonian with the Alice Springs Orogeny. Smaller

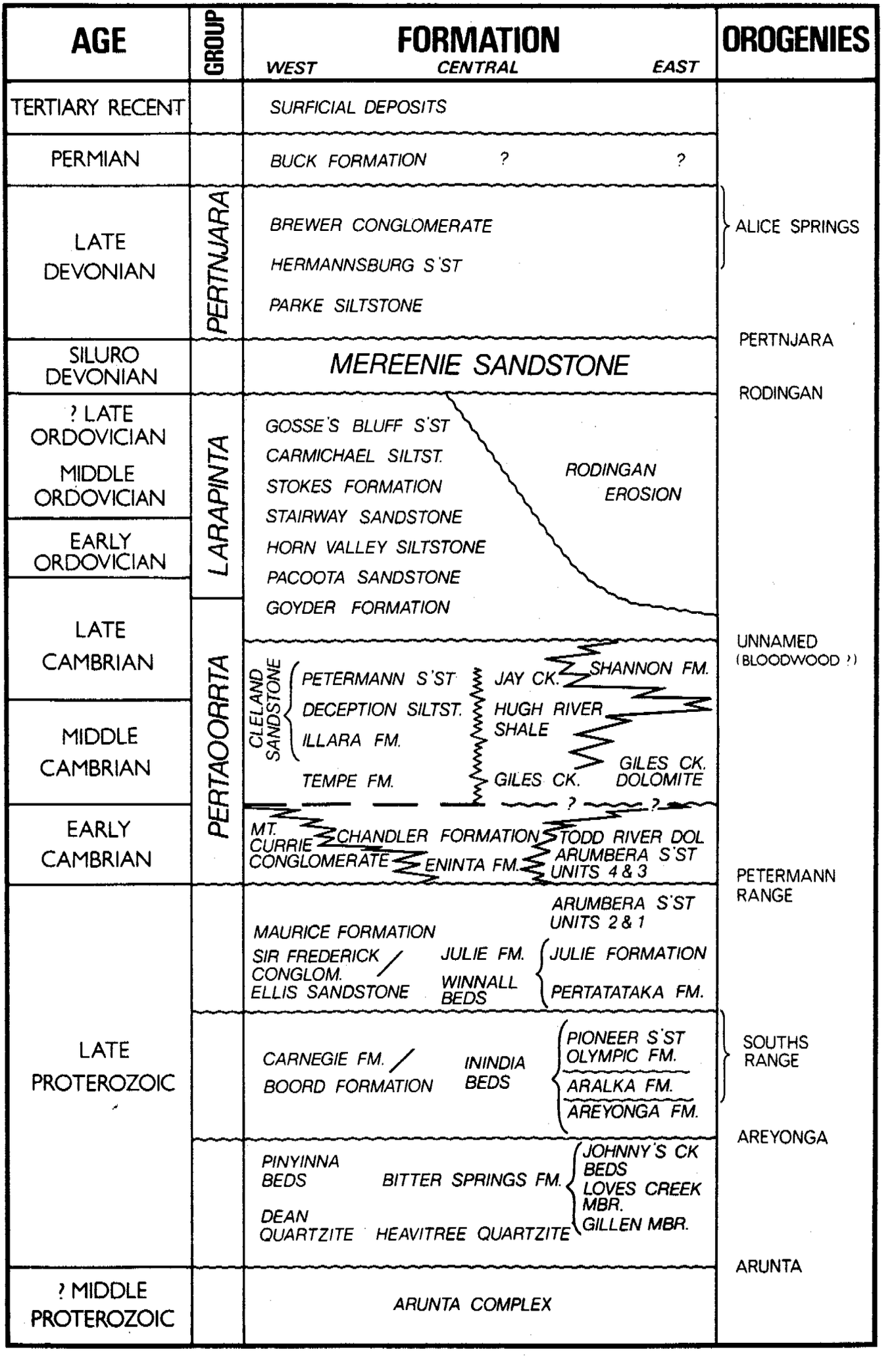
AGE
GROUP
FORMATION
WEST
CENTRAL
EAST
OROGENIES
TERTIARY RECENT
SURFICIAL DEPOSITS
PERMIAN
BUCK FORMATION
?
?
LATE DEVONIAN
PERTNJARA
BREWER CONGLOMERATE
HERMANNSBURG S'ST
PARKE SILTSTONE
ALICE SPRINGS
PERTNJARA
SILURO DEVONIAN
MEREENIE SANDSTONE
RODINGAN
? LATE ORDOVICIAN
MIDDLE ORDOVICIAN
EARLY ORDOVICIAN
LARAPINTA
GOSSE'S BLUFF S'ST
CARMICHAEL SILTST.
STOKES FORMATION
STAIRWAY SANDSTONE
HORN VALLEY SILTSTONE
PACOOTA SANDSTONE
GOYDER FORMATION
RODINGAN EROSION
LATE CAMBRIAN
MIDDLE CAMBRIAN
EARLY CAMBRIAN
PERTAOORRTA
CLELAND SANDSTONE
PETERMANN S'ST
DECEPTION SILTST.
ILLARA FM.
TEMPE FM.
JAY CK.
SHANNON FM.
HUGH RIVER SHALE
GILES CK.
GILES CK. DOLOMITE
?
?
MT. CURRIE CONGLOMERATE
CHANDLER FORMATION
ENINTA FM.
TODD RIVER DOL
ARUMBERA S'ST UNITS 4 & 3
UNNAMED (BLOODWOOD ?)
PETERMANN RANGE
LATE PROTEROZOIC
ARUMBERA S'ST UNITS 2 & 1
MAURICE FORMATION
SIR FREDERICK CONGLOM.
ELLIS SANDSTONE
JULIE FM.
WINNALL BEDS
JULIE FORMATION
PERTATATAKA FM.
CARNEGIE FM.
BOORD FORMATION
ININDIA BEDS
PIONEER S'ST
OLYMPIC FM.
ARALKA FM.
AREYONGA FM.
SOUTHS RANGE
AREYONGA
PINYINNA BEDS
DEAN QUARTZITE
BITTER SPRINGS FM.
HEAVITREE QUARTZITE
JOHNNY'S CK BEDS
LOVES CREEK MBR.
GILLEN MBR.
ARUNTA
? MIDDLE PROTEROZOIC
ARUNTA COMPLEX

FIG. 4

local cycles associated with the movements have been named on Figure 4.

Folding and faulting in the southwestern area initiated in the Proterozoic, sometimes associated with salt tectonics, produced east-west striking anticlines, often faulted along the flanks and showing thinning of Late Proterozoic sediments over the crest. These structures were modified, and new ones created, by the Alice Springs Orogeny in Late Devonian time - the final major tectonism in the Amadeus Basin. An important precursor to the Alice Springs Orogeny was the Late Orodovician Rodingan Movement. The low angle uncomformity that indicates this movement is best developed in the north and northeast, where the earlier deposited Ordovician sediments were progressively eroded eastwards. The total sediment thickness and the stratigraphy of sediments preserved over any structure depend on the amount of Rodingan erosion to which the structure has been subjected. Thus more western structures, such as Palm Valley and Mereenie are more likely to have a more complete sedimentary section preserved over them than eastern structures, such as the Dingo structure.

Structures may be further complicated by the occurrence of salt diapirs, emanating from the Bitter Springs Formation or Chandler Formation, flowing into the cores of structures. The Goyder Pass, Dingo and Orange structures have all had salt diapirism associated with their growth. The salt cored structures are known to have grown intermittently from Late Proterozoic to Devonian time, as shown by local thinning of units.

At least two generations of thrust faulting are present in the Amadeus Basin, with thrusting from both north and southwest. Thrusting events probably took place during the Petermann Range Orogeny in the southwest and during the Alice Springs Orogeny. These thrusting movements further complicate the geology and have led to thickened section, overthrust anticlines and possibly the development of fracture porosity.

5. STRATIGRAPHY

The geological section at Waterhouse No. 2 was anticipated to be similar to that drilled at Waterhouse No. 1 and Orange No. 2. (Marsden et al, 1985a). The predicted versus actual section is shown as Enclosure 3.

The Arumbera Sandstone section penetrated by the Waterhouse No. 2 well is compared with the sections at Orange No. 2, Wallaby No. 2 and the Ooraminna measured section in combination with the tophole section at Ooraminna No. 1 in Enclosure 4. Table 1 shows the depth of the various formations penetrated by the Waterhouse No. 2 well, and the thickness of each of the formations.

Table 1: Stratigraphy at Waterhouse No. 2

	Depth (KB) (m)	Thickness (m)
Jay Creek Limestone	7	326
Upper Giles Creek Dolomite	333	145
Middle Giles Creek Dolomite	478	110
Lower Giles Creek Dolomite	588	31
Chandler Formation	619	50.5
Todd River Dolomite	669.5	4.5
Arumbera 4 Sandstone	674	10
Arumbera 3 Sandstone	684	127
Arumbera 2c Sandstone	811	14
Arumbera 2b Sandstone	825	26
Arumbera 2a Sandstone	851	59
Arumbera 1 Sandstone	910	118
Julie Formation	1028	16.5
Pertatataka Formation	1044.5	158.3 +
T.D.	1202.8	

5.1 Jay Creek Limestone : 7-333 metres (326m thick) Age - Late to Middle Cambrian

The Waterhouse No. 2 well spudded into weathered siltstone, shale and dolomite of the Jay Creek Limestone. Within the unweathered zone beneath the 9-5/8" casing shoe, the Jay Creek Limestone consists of shale, dolomite, siltstone and sandstone.

The shale is red brown, purple brown, mauve, arenaceous in part, occasionally gradational to siltstone, with minor pyritic disseminations. The dolomite is cream to white, occasionally tan, rarely light grey green, crypto to microcrystalline, hard, variably argillaceous, slightly calcareous with vugs up to 1mm and rare intergranular porosity.

The siltstone is red brown, occasionally medium green to grey green, slightly calcareous/dolomitic commonly micaceous, and gradational to shale. The sandstone is clear to pale orange, predominantly medium grained, well sorted, ferruginous, with predominantly siliceous cement and rare pitted grain surfaces. Porosity is fair to poor, with the best development indicated in the zone 300-303 metres (refer to BHC Sonic log).

5.2 Upper Giles Creek Dolomite : 333-478 metres (145m thick) Age - Middle Cambrian

The top of the Upper Giles Creek Dolomite at Waterhouse No. 2 is picked by wireline log correlation with Orange No. 2 and the nearby Dingo Gas Field wells. The unit consists of interbedded dolomite siltstone and shale.

The dolomite is white, buff, light grey green and occasionally red brown to brown, hard, argillaceous and predominantly microcrystalline. Rare sand grains are present after acid digestion, but the dominant clastic

material is mica and fine carbonaceous argillaceous material. The siltstone is red brown to mauve, occasionally arenaceous, mildly dolomitic, and commonly gradational to silty dolomite. The shale is red brown to green grey, commonly mottled, blocky to subfissile, micaceous and occasionally pyritic.

5.3 Middle Giles Creek Dolomite 478-588 metres (110m thick) Age - Middle Cambrian

The Middle Giles Creek Dolomite at Waterhouse No. 2 consists of siltstone and dolomite, with the proportion of dolomite increasing with depth. The top of the unit is picked at the base of massive siltstone between 452 and 478 metres.

The siltstone is red brown, grey green, frequently mottled, argillaceous, moderately dolomitic, firm to blocky and grades to dolomitic siltstone with depth. The dolomite is white to grey brown, tan, also grey green, frequently silty, cryptocrystalline with minor vuggy porosity. Occasional sand grains are also present towards the base of the unit, as well as minor calcareous cement in the basal portion between 575 and 588 metres.

5.4 Lower Giles Creek Dolomite 588-619 metres (31m thick) Age - Middle Cambrian

At Waterhouse No. 2, the Lower Giles Creek Dolomite consists of shale with minor dolomite towards the base. The top of the unit is picked by wireline log correlations immediately beneath the massive calcareous dolomite at the base of the Middle Giles Creek Dolomite.

The shale is red brown to brown, occasionally mottled grey green to green, dolomitic, occasionally silty, firm to hard, subfissile to fissile, and gradational to siltstone in part. The dolomite is white, occasionally light green,

hard, cryptocrystalline to microcrystalline and silty in part.

A change in dip direction is apparent on the dipmeter at 619 metres, which coincides with the base of the Giles Creek Dolomite. This feature is interpreted to be a decollement surface at the Chandler formation level (Appendix G).

5.5 Chandler Formation 619-669.5 metres (50.5m thick) Age - Early Cambrian

At Waterhouse No. 2 the Chandler Formation consists of claystone with minor limestone. The top of the unit is picked by wireline log correlation and the gross change in dip orientation coincidental with the base of the Giles Creek Dolomite.

The claystone is orange, occasionally white and also pale green, silty throughout, calcareous, moderately soft, with minor sand grains within the clay matrix. The limestone is white, orange, light green and moderately silty. The limestone gave off a strong petroliferous odour when dissolved in concentrated hydrochloric acid. No porosity was developed in the limestone.

5.6 Todd River Dolomite 669.5-674 metres (4.5m thick) Age - Early Cambrian

At Waterhouse NO. 2, the Todd River Dolomite consists of 4.5 metres of dolomite only.

The dolomite is grey to white, frequently mottled, cryptocrystalline to microcrystalline, sucrosic, with rare vuggy porosity. The dolomite is silty in part, but overall the unit is pure anhedral dolomite.

5.7 Arumbera 4 Sandstone 674-684 metres (10m thick) Age - Early Cambrian

The top of the Arumbera Sandstone at Waterhouse No. 2 coincides with the top of the A4 unit. The A4 subunit is picked by regional log correlations immediately beneath the Todd River Dolomite. At Waterhouse No. 2 the A4 unit consists of sandstone and shale.

The sandstone is orange to red brown, fine to extremely fine grained, moderately sorted with a cement of silica and ferruginous material. The overall pore space is occluded by the cementing material and also due to the silty matrix. The shale is red brown to orange brown, calcareous in part, rarely arenaceous, micromicaceous and moderately soft.

The gamma ray log indicates that the A4 unit contains a single coarsening upwards cycle. The thickness of the unit is marginally thinner than expected, and the possibility of minor erosion at the top of the Arumbera Sandstone, prior to the deposition of the Todd River Dolomite, must not be dismissed.

5.8 Arumbera 3 Sandstone : 684-811 metres (127m thick) Age - Early Cambrian

At Waterhouse No. 2, the top of the Arumbera 3 Sandstone is picked by wireline log correlations. The unit consists predominantly of siltstone, but minor sandstone and dolomite is also present.

The siltstone is red brown to chocolate brown, ferruginous, extremely micaceous, very rarely mottled light green, with minor calcareous cement. The sandstone is orange, orange red, light green, silty throughout, extremely fine to medium grained, moderately to poorly sorted, with frequent siliceous cement. Porosity in the sandstones is poor to very rarely fair. A thin dolomitic band is noted on logs

at 704 metres, and this band is easily correlated at 2560 metres at Orange No. 2.

5.9 Arumbera 2c Sandstone : 811-825 metres (14m thick) Age - Late Proterozoic

At Waterhouse No. 2, the Arumbera 2c Sandstone is picked as the two upwards coarsening cycles at the base of the A3 unit. In outcrop the A2c contains "poorly sorted conglomerate and conglomeratic sandstone with a medium to coarse grained groundmass"(Conrad, 1981, p 51). At Waterhouse No. 2 the lithology contains vein quartz and chert, but due to the bit action, it is not certain if conglomerate is present.

At Waterhouse No. 2, the best evidence for the existence of the A2c unit is the sighting of minor chert fragments and an increased angularity in the sandstone samples described.

5.10 Arumbera 2b Sandstone : 825-851 metres (26m thick) Age - Late Proterozoic

At Waterhouse No. 2, the Arumbera 2b is picked immediately beneath the two coarsening upwards cycles representing the "conglomerates" of the A2c. The A2b consists of interbedded sandstone and siltstone.

The sandstone is red brown, occasionally white to light green, fine to predominantly medium grained, with siliceous and ferruginous cements and a silty matrix. The sandstones are premdominantly poorly sorted, with rare pyritic disseminations and poor porosity. The siltstone is red brown, mauve brown, occasionally sandy, frequently micaceous, rarely calcareous, pyritic and gradational to sandstone in part.

5.11 **Arumbera 2a Sandstone : 851-910 metres (59m thick)**
Age - Late Proterozoic

The Arumbera 2a Sandstone is picked as the massive sandstone unit with low gamma ray signature. At Waterhouse No. 2 the unit consists of sandstone, with subordinate siltstone.

The sandstone is clear to white, rarely stained slightly orange, fine to medium grained, sub angular to subrounded and moderately to well sorted. The dominant cementing agent is silica and rare clay matrices are reported. Porosity throughout is fair, with a maximum computed value of 16% at 882 metres. The siltstone is red brown to orange brown, hard, blocky, micaceous and variable arenaceous.

5.12 **Arumbera 1 Sandstone : 910-1028 metres (118 thick)**
Age - Late Proterozoic

The Arumbera 1 Sandstone is generally picked at the gamma ray and sonic change immediately beneath the massive sandstone of the A2a. At Waterhouse No. 2, the A1 consists of sandstone with interbedded siltstone.

The sandstone is pale orange, also clear to pale brown, red brown, very fine to medium grained, predominantly fine grained, sub-rounded to sub angular, moderately sorted, with siliceous and rarely calcareous cement. The sandstone is silty in part, with a high proportion of unconsolidated grains indicating fair porosity. The siltstone is red brown to medium brown, rarely mottled grey green, micaceous, moderately hard to brittle and gradational to sandstone in part.

The A1 may be generally split into an upper silty unit and a lower sandy unit, especially at Dingo No. 1 & 2, and Orange No. 2. At Waterhouse No. 2, the upper siltstone unit contains a higher proportion of sandstone and the lack

of seal is believed to be the reason for the failure of the Waterhouse No. 2 well.

Overall porosity in the basal portion of the Al is good, with computed values up to 18.6% in places. This increase in porosity at Waterhouse No. 2 compared to Orange No. 2 may be due to the burial loading on the Waterhouse Anticline, or to the fresh water washing of the reservoir. The fresh water may have dissolved some of the more soluble minerals and thus enhance the reservoir properties in the basal Al sands.

5.13 **Julie Formation : 1028 - 1044.5 metres (16.5m thick)**
Age: Late Proterozoic

The top of the Julie Formation is picked immediately beneath the tight sandstone as seen on the sonic log between 1013 and 1028 metres. At Waterhouse No. 2, the Julie Formation consists of siltstone, shale and dolomite.

The siltstone is red brown, grey brown, pale green, occasionally grey green, mottled throughout, firm to hard and extremely micaceous. The shale is medium to dark grey, fissile to occasionally brittle, slightly to non calcareous and highly argillaceous.

The dolomite is white to cream, occasionally dark grey to black, moderately carbonaceous and occasional fine to medium grained sand particles. The dolomite is very hard to occasionally brittle, with very poor porosity.

5.14 **Pertatataka Formation : 1044.5-1202.8 (T.D.)**
(158.3+m thick)
Age: Late Proterozoic

The top of the Pertatataka Formation is picked at the incoming of the dark grey to black shales coincidental with an increase in the gamma ray count. At Waterhouse No. 2,

the Pertatataka Formation consists of shale, with minor traces of crystalline dolomite.

The shale is medium to dark grey, green and blue grey, hard to brittle, subfissile to fissile, micromicaceous in part and predominantly non calcareous. The dolomite is white to cream, microcrystalline, very hard with minor fine grained sand grains. No porosity is apparent in the dolomites.

6. STRUCTURAL GEOLOGY

Waterhouse No. 2 well was drilled 260 metres east of Waterhouse No. 1 on the mapped crest of the Waterhouse Anticline. The feature is a large breached anticline oriented east west and extending for some 40 kilometres.

The Waterhouse Anticline shows uplift in excess of 2000 metres with respect the nearby synclines of the Missionary Plain. No faulting is recognized on the surface, but interpretation of seismic lines to the west shows evidence of thrusting within the Proterozoic Bitter Springs Formation. Further evidence of thrusting is noted by analysis of the dipmeter at Waterhouse No. 2 (Appendix G). Thrust faults are recognised at 538 metres and 619 metres and other compressional features are noted. A major thrust fault is also expected at the top of the Bitter Springs Formation, although this unit was not penetrated.

Analysis of the dipmeter also indicated that the crestal position of the reservoir sandstone within the Arumbera 1 Sandstone is slightly north of the location at which Waterhouse No. 2 was drilled.

7. HYDROCARBON POTENTIAL

7.1 Reservoir Potential and Hydrocarbon Indications

Porosity throughout the Cambrian sequence is generally poor, but some is present between 300 and 304 metres (refer BHC Sonic log).

Poor porosity is described in cuttings throughout the Giles Creek Dolomite with no hydrocarbon indications. A strong sonic log break is apparent at 521 metres, below which porosity in the dolomites becomes extremely poor.

No reservoir potential is indicated within the Chandler Formation at Waterhouse No. 2

Porosity within the Arumbera 4 Sandstone and Arumbera 3 Sandstone was described as poor and no hydrocarbons were liberated. Within the Arumbera 2 Sandstone, some porosity is developed, especially in the A2a, where up to 16% is interpreted from the sonic log.

Quantitive log analysis from the Arumbera 1 Sandstone indicates good porosity development ranging upwards to 18.6%. Despite these excellent porosities log analysis indicated a fresh water wet reservoir.

Minimal porosity was noted from cuttings throughout the Julie Formation and Pertatataka Formation. Log analysis supports these reports.

7.2 Source Potential

Five bulk samples were collected from within the Pertatataka Formation at Waterhouse No. 2 and subjected to Total Organic Carbon (TOC) determinations. An average TOC of 0.13% was recorded from these samples indicative of a very poor source rock. No Rock-Eval Pyrolysis was

attempted on these samples due to the low level of organic material.

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