Pacific Oil & Gas Pty Limited

RANDALL NO.1

EP10, NORTHERN TERRITORY

WELL COMPLETION REPORT

ONSHORE

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1. SUMMARY AND INTRODUCTION

Randall No.1 was the first of four petroleum exploration wells drilled by Pacific Oil & Gas Pty Limited in the Company's 1991 Georgina Basin drilling program. **Randall No.1** was designed to test a hydrocarbon soil gas anomaly found during the 1990 soil gas survey. Objectives were to test the porosity of, and hydrocarbon potential of, the basal shoal of the Chabalowe Formation and the Arthur Creek Formation. It was anticipated that the well would penetrate the following: Dulcie Sandstone, Tomahawk beds, Arrinthrunga Formation, Arthur Creek Formation, and late proterozoic redbed sediments. Control on the stratigraphy was supplied by regional geology and by interpretation projected from the results of the nearby Bundy River Seismic Program (1988).

Rockdril Rig 20 was rigged up and drilling operations at **Randall No.1** commenced at 1200 hours on 16 April 1991. Water was supplied by a pre-existing property bore. A 12.25" hole was air hammered down to 24m and 9 5/8" casing was installed and cemented to surface.

8.5" hole was air hammered to 122m and 7" casing was run in and cemented at a depth of 117m. The casing was cemented to surface and the BOPs installed and tested. 6m of new formation was drilled and a leak-off test was carried out. Leak off was detected at 220psi, and pressure stabilised at 100 psi, indicative of a shoe strength of 13.2 ppgMWE.

6.25" hole was hammered to 464m, where problems were encountered with the hammer. A 5 7/8" bit was then made up and hammer to 467m. A suite of wireline logs were run from 467m to the 7" casing shoe. 5" casing was then set at 464m and cemented to surface. The 5" casing shoe was drilled out and 13m of new formation penetrated, and a formation integrity test was carried out. No leak off was detected 1200psi, indicating a shoe strength of >23.5 ppgMWE.

The remainder of the hole was wireline cored (CHD101). Problems with seating of the core tube caused some core to be lost at 910.65m, which was recovered by reaming over the dropped core and into formation. No other serious drilling or formation problems occurred. TD of 1020.4m was reached on 8 May 1991.

Three open hole drill stem tests were carried out. DST No.1 was carried out over the interval 838.6-851.9m and was unsuccessful as the tool failed to open. DST No.2 over the same interval recovered 6.10bbl of water after a combined flow period of 95 minutes. Pressure analysis indicates an initial reservoir pressure of 1135 psia, with a permeability-thickness of 79 md-ft. DST No.3 was carried out over the interval 872.0-934.25m and had a combined flow period of 74 minutes. 13.7 bbls of water was recovered and pressure analysis indicates an initial reservoir pressure of 1163 psia, with a permeability-thickness of 1378 md-ft.

The hole was logged at TD by BPB Australia Limited and a velocity survey was carried out by Velocity Data. The hole was plugged and abandoned at 0600 hours on the 10 May 1991. Cement plugs were set across the tested zone, the 5" casing, and at the surface.

The well was spudded in unconsolidated Quarternary sand which extended to a depth of 27.5m. The Dulcie Sandstone, 27.5-48m, a yellowish fine grained micaceous sandstone, overlies the Tomahawk Beds, 48-176m, a shallow marine sequence of interbedded sandstone and shale, and sandstone and siltstone. The upper portion of the Arrinthrunga Formation, a dolomite grainstone, extends from 176m down to 345m, where it overlies the Eurowie Member of the Arrinthrunga Formation.

The Eurowie Sandstone Member (345-403m) comprises 58m of dolomite interbedded with quartz sandstone and siltstone. Underlying the Eurowie is the lower portion of the Arrinthrunga Formation, a shallow marine deposit with dolomitic mudstone and siltstone, dolomite, and minor stromatolites at the base, ooid or peloid grainstones in the middle 45m, and recrystallised calcareous dolomite in the upper 64m. It grades down into the upper unit of the Chabalowe Formation (576-758.4m), a supratidal sequence of mixed clastic and dolomitic sandstone, siltstones, and mudstones in the upper section, and finely laminated and/or fining upwards microcycles of dolomitic siltstone, sandstone and mudstone, with common stromatolites. Anhydrite is occasional to common in this sequence, and signs of subaerial exposure are common.

The Hagen Member of the Chabalowe Formation (758.4-918.6m) is comprised of three facies groups. The top is a sabkha deposit, characterised by abundant anhydrite and consisting of dolomitic mudstone, fine grainstone, and stromatolites with associated chert. The middle is a lagoon facies which lacks anhydrite: dolomitic mudstone, sandstone, and fine grainstones are interbedded with stromatolites. DST Nos 1 & 2 were run over an interval of oil bleeding from stromatolites with marginal porosity. The base, a shallow marine shoal, is a porous dolomite grainstone. DST No.3 was run over this interval of better than average visual porosity.

The shallow marine Arthur Creek Formation (918.6-984.4m) consists of stylolitised dolomitic grainstone and recrystallised dolomites. Vugs and fractures are filled with anhydrite. Some pinhole porosity exists. The Andagera Formation (984.4-1014.2m) is a coarse sandstone, feldspathic in the central section but otherwise quartzose. It is silica-cemented and originated as an alluvial-fan deposit. Basement was intersected at 1014.2m: a dark pink granitic gneiss with high angle foliation.

Randall No.1 identified substantial porosity and permeability in the Hagen Member, and the presence of migrated hydrocarbons throughout the Chabalowe Formation. There was a clear chemical distinction between reservoir and surface waters. In the Hagen Member, high energy conditions in the environment of deposition were sufficient for reservoir development. However, oil bleed distribution and dull background fluorescence suggests that the oil that was present has been flushed out.

The presence of the Andagera Formation with some porosity and oil shows is new in this area.

2. WELL HISTORY

2.1 GENERAL DATA

Well name:	**Randall No.1**
CRAE Number:	RD/DD91GB17
Well Type:	Wildcat
Interest Holders:	Pacific Oil & Gas Pty Ltd - 100%
Permit:	EP10, Northern Territory
Operator:	Pacific Oil & Gas Pty Limited 826 Whitehorse Road Box Hill, Victoria, 3128
Water Supply:	Pastoral waterbore, 6 l/s approx. For details see Appendix II
Map References:	Huckitta (SF53-11) 1:250 000 sheet Macdonald Downs (5953) 1:100 000 sheet
Surveyed Location: (AGD 6)	Latitude: 22° 01' 40.06" S Longitude: 135° 12' 17.03" E
AMG Co-ordinates: (Zone 53	521 128m East 7 564 074m North
Surveyed Elevation:	Ground Level: 421.0m Drill Floor: 425.2m
Total Depth:	Driller: 1020.4m Logger: 1018.5m
Primary Objectives:	Chabalowe Formation Arthur Creek Formation
Status:	Plugged and Abandoned as dry hole.
Well Cost:	$500 957.00

2.2 DRILLING DATA

Dates and Duration

Rig 20 spudded:	16 April 1991
TD reached:	8 May 1991
Rig Released:	10 May 1991, at 0600 hrs
Drilling Time to TD:	23 days

Contractors:	Rockdril Contractors P/L 1 Jijaws Street Sumner Park, QLD, 4074
Drilling Rigs:	Rockdril Rig 20
Rig Details:	Longyear HD600 Coremaster (modified for petroleum exploration) Complete specifications for Rockdril Rig 20 can be found in Appendix IV, "Rig Specifications".

2.3 DRILLING SUMMARY

A complete drilling record for **Randall No.1** including Drilling Parameters Plot (PetNTcw3493) and Mud Parameters Plot (PetNTcw3494) is given in Appendix V. The Actual Time-Depth Curve and Hole Diagram (PetNTcw3492) appears at the end of this section. The following summary of events is taken from the IADC drilling reports and the wellsite geologist's morning reports.

2.3.1 12.25" Hole Section

Rockdril Rig No. 20 arrived on location at **Randall No.1** at 02.30 13th April 1991. After rigging up, the well was spudded at 12.00 on the 16th of April, 1991. A 12.25" hole was air rotary drilled to 24m. Circulation was lost at TD and a high viscosity mud was pumped down the hole. POOH and run in 2 joints of 9 5/8" K55 261b/ft BTC casing, and cement to surface.

2.3.2 8.5" Hole Section

An 8.5" flat face air hammer was made up and RIH. Cement was hammered for one hour and then formation was hammered to a depth of 121.95m. At 1500 hours 17/4/91 the conductor seat failed. POOH and lay down the hammer assembly. 7" casing was run in, but the hole was bridged at 32m. POOH, pump 6bbls of 14.7ppg + 1.5% soda ash cement to the conductor annulus and hole. RIH with bit no. 3 (HTC rotary reaming bit), conductor seat was still washed out. Rig drill for mud drilling, ream out bridge, wash to bottom and circulate and clean hole. No mud returns were obtained, so one sack of mica per 30 bbls mud were added, and full returns were regained. Pull back 7 stands, ream to 36m and circulate to clean hole, POOH and lay down reaming bit.

Nine joints of 7" K55 231b/ft BTC casing were run in and landed at 116.94m. Mix cement, 11 bbls of 15.6ppg Class 'A' slurry, with 10% excess, pump and displace, and bump plug with 800 psi. Cement returns to surface were obtained. Casing was slacked off after eight hours, the well head installed, and BOPs were nippled up. The accumulator failed during function tests and was replaced. Function tests then proceeded satisfactorily.

The 6¼" bit was made up and RIH. The choke manifold and HCR, choke and kill lines, kelly cock and floor manifold were tested to 1000psi and 5min per valve. The annular BOP and pipe rams were tested to 1000psi against casing for 15min each.

2.3.3 6" Hole Section

The float, cement, shoe and new formation as drilled to 128m with bit no. 4. A leak-off test was performed, and a leak off was noted at 220psi which bled back to 100psi. Air hammer 6¼" hole to 433.95m. A small water influx was noted at 360m, yielding approximately 1000gph. At 433.95m, the air hammer blocked, POOH, unblock and service hammer, RIH, hammer to 463.95. A deviation survey was carried out, then hammer would not restart. POOH, clean hammer and change dhammer choke. RIH, but attempt to restart hammer failed. POOH, make up 6¼" tricone bit but it would not enter the casing crossover. Make up 5 7/8" bit (no.5), RIH, clean out hole, and rotary air drill to 467.38m. Displace hole to mud and circulate, POOH. Rig up BPB from 0200 24/4/91 and run logs (resistivity, density, gamma, neutron, and sonic). Rig down BPB at 12.45 24/4/91.

RIH and circulate hole clean, POOH and lay down 3½" drill string. Forty-five joints of 5" casing (Range II 13lb/ft FL4S K55) was run in with the shoe set at 464.4m. Mix 21 bbls of 15.6 lb/gal Class 'A' slurry, and pump and displace with 2bbls of water as a spacer. Bump plug at 600psi (full rise), no returns to surface. Waited on cement for 7.5 hours. The cup tester leaked during BOP testing and could not be used so BOPs were tested to 1500psi against the casing. Duration of testing was reduced from 15 minutes to 5 minutes to avoid casing damage. No pressure loss was detected.

2.3.4 4.35" CHD101 Hole Section

Pick up CHD101 and bit no.6 (4 3/4" tricone) and RIH. Test pipe rams and choke manifold against cup tester, pressure bled off, remove cup tester and test against CSG to 1800psi for 5 minutes, test HCR choke and kill lines to 1500psi for 5 minutes each. Tag cement at 463.12m, drill out cement, shoe and formation to 467.5m. POOH, break out bit no.6, make up core barrel with bit no.7 (Longyear Series 6) and RIH. Displace mud, ream to bottom, and cut core to 474.75m. Formation Integrity Test was carried out, no leak off at 1200 psi, equivalent to a hydraulic gradient of 1.22 psi/square foot, 23.5 lb/gal equivalent mud weight. Coring continued to 761m. At 1015 hours 27/4/91 (533.75m), BOP drill was performed, and the well was shut down and crew in position in 1 minute 30 seconds. At 761m (0830 hrs, 1/5/91) POOH, BOP function test, break out old bit, fit bit no.8 (Longyear Series 6) and RIH. Bit hung up in casing shoe, ream through and ream to bottom. Core was cut to 910.65, where some core was lost. The tube was rerun but did not seat, POOH but the core was not in the core barrel. RIH and ream over dropped core; core to 911.65m. Continue coring CHD101 to 934.25, then POOH for DST no.1.

DST no.1 was carried out on 5/5/91 over the interval 838.6-851.9m. The object was to test a series of thin oil shows in the Chabalowe Formation dolomite which exhibited marginal reservoir characteristics. DST no.1 failed due to mechanical problems. DST no.2 was run over the same interval on the same day. Recovery was measured as 0.38bbl rathole mud, and 6.10bbl water. No hydrocarbons were noted. DST no.3 was carried out on 6/5/91 over the interval 872-934.25m. The object was to test a thick interval of Chabalowe Formation dolomite which displayed better than average visual porosity and permeability but which contained no hydrocarbon shows. Recovery was 1.8bbl rathole mud and 13.7bbl water. The water recovered from both DSTs had a sulphurous odour and contained fine black particles.

The core barrel was made up, mud circulated and coring continued until TD in granitic gneiss at 1020.4m. Wireline logging commenced at 1300 hours 8/5/91 and ceased at 1000 hours 9/5/91. Cement plugs were placed from 890-830m and from 494-434m. Plug no.2 was tagged at 421m with 3000 lbs after waiting on cement for six hours. Rig down, lift BOP stack and set cement plug no.3 from 50m depth to surface. The rig was released at 0600 hours on 10/5/91.

2.3.5 Time Distribution

A total of 22.75 days was spent from the commencement of operations to Rig Release. This was distributed as follows:

Operations	Days
Drilling, retube, bit trips	12.67
Evaluation, log, & DST	3.10
BOPs, casing, plugs	3.34
Hole problems	2.54
Rig Repair	1.10

Evaluation time was high due to running three DSTs as well as wireline logs. Rig repair time was relatively low.

2.3.6 Water Supply

Water supply for rig and camp purposes was pumped from a water bore (Registered Number 14170) located approximately 2km from the wellsite at Grid Reference 305-252, Map Number SF53-11. The bore was drilled in 1984 and is reported in NT Water Resources Report No. 14170 (drilling and analysis reports in Appendix II). At spud, the water table was at a depth of 14.5m.

2.3.7 Deviation Surveys

Deviation surveys were run using a Totco downhole survey tool. Surveys were taken approximately every 100m after the start of coring. The results are summarised below and also appear on the Pacific Oil & Gas Composite Log and the Exlog mudlog (Enclosures I and II respectively) and the Actual Time-Depth Curve (PetNTcw3492). The hole was essentially vertical; no deviation was greater than 3/4 degree.

Depth	Deviation
463.95m	1/4 degree
563.15m	0 degree
658.05m	0 degree
752.05m	3/4 degree
850m	1/4 degree
1010.4m	1/2 degree

2.3.8 Completion Summary

Randall No. 1 was plugged and abandoned as a dry hole on 10 May 1991. Three abandonment plugs were set: 890-830m, over the porous intervals tested in DSTs 1, 2, and 3; 494-434m at the 5" casing shoe, and at surface. No casing was retrieved. Plug and casing depths are shown in the hole schematic in the Actual Time-Depth Curve and Hole Diagram (PetNTcw3492).

Plug No. 1	890-830mDF	3.6 bbls	0% excess
Plug No. 2	494-434mDF	3.75 bbls	0% excess
Plug No. 3	50-0mDF	2 blls	0% excess

2.4 FORMATION EVALUATION

2.4.1 Mudlogging

Mudlogging services were provided by Exploration Logging Pty Ltd. 24 hour monitoring of ROP, gas, gas chromatography, H_2S, pump rate, depth and pit level were provided.

Samples were caught, washed and described at 3m intervals from surface to 5" casing shoe (464.4m). All cuttings samples were examined under ultraviolet (UV) light for the presence of hydrocarbons. Cuttings descriptions may be found in Appendix VII.

Calcimetry was performed on chip samples at 3m intervals from 21-186m, and at roughly 6m intervals (range: 3-9m) to 465m. From 465-1015m calcimetry was performed every 5m. Results are in Appendix XI, and are displayed graphically on the Actual Section (PetNTcw3501).

ROP, mud gas and lithology are summarised graphically on the 1:500 scale mudlog (Enclosure II). Splits of the cuttings have been retained for:

(a) Pacific Oil & Gas Pty Limited
(b) Northern Territory Department of Mines & Energy

2.4.2 Testing

DST No.1 was carried out on 5/5/91 over the interval 838.6-851.9m. The object was to test a series of thin oil shows in the lagoon facies of the Hagen Member (Chabalowe Formation). These dolomites exhibited marginal reservoir characteristics. DST No.1 failed due to insufficient weight being placed on the tool, which failed to open. DST no.2 was run over the same interval on the same day. Combined flow periods amounted to 95 minutes. Recovery was measured as 0.38bbl rathole mud, and 6.10bbl water. Rw of recovery was 1.1 Ohm-m at 24°C; this was slightly less saline than the mud filtrate (Rmf at TD was 0.82 Ohm-m at 20°C). No hydrocarbons were noted.

DST No.3 was carried out on 6/5/91 over the interval 872-934.25m. The object was to test a thick interval of Chabalowe Formation dolomite, the basal shoal of the Hagen Member. This interval displayed excellent visual porosity and permeability and very dull fluorescence. Combined flow periods amounted to 74 minutes. Recovery was 1.8bbl rathole mud and 13.7bbl water. Rw of recovery was 0.59 Ohm-m at 25°C. This is considerably more saline than water at the surface (Rw = 8.130 Ohm-m, App II) or water at Hagens Bore (Rw = 7.299 Ohm-m App VIc) where the Chabalowe Formation crops out. This indicates a separation between surface and formation waters, both uphole and updip.

The water recovered from both DSTs had a sulphurous odour and contained fine black particles. Full details including water analysis are included in Appendix VI.

2.4.3 Coring

The well was continuously cored at CHD101 size from 467.38m to 1020.4m TD. Details of core recovery are provided in Appendix V.

Total meterage cored was 552.9m recovered 552.23m (99.9%). All core was examine under UV light for hydrocarbon fluorescence. Detailed lithological descriptions are given in Appendix VII. Results of core analysis are given in Appendix VIII. All core is stored at the Pacific Oil & Gas office in Alice Springs and will be despatched to the Northern Territory Department of Mines and Energy core store on completion of studies.

2.4.4 Electric Logging

Electric logging services were provided by BPB Pty Ltd using truck V333. A set of petrophysical data was acquired from **Randall No. 1**, comprising Neutron Porosity, Dual Resistivity, Caliper, Density, Gamma and Sonic. Logs are included as Enclosure III. An intermediate suite was run from 464.4m to 117m and a final suit from TD to 464.4m.

2.4.5 Geothermal Gradient

An approximate geothermal gradient of 3.04°C per 100m (30.4°C per km) has been calculated using the maximum observed bottom hole temperatures recorded during the two logging suites and DST Nos 1 and 2 (Plan PetNTcw3394).

2.4.6 Velocity Data

A velocity survey was run at total depth (1020.4m) on 9 May 1991, by Velocity Data Services using the BPB wireline. AN-60 explosive was used as an energy source. Shots were detonated in shallow (6m) air drilled holes approximately 75m from the well. Data quality was considered to be excellent, and superior to that derived from shots located in the sump. Full wave train arrivals were recorded at 7msec (one way time), intervals up the bore hole to allow for VSP processing. VSP processing was not carried out as the well was unsuccessful. The results are attached as Enclosure IV.

2.4.7 Synthetic Seismogram

A synthetic seismogram has been generated by ENCOM Technology (Vic) Pty Ltd based on the density data derived from the Density and Sonic logs and the well seismic survey. The synthetic seismogram and data listings are included in Enclosure V.

2.4.8 Magnetic Susceptibility

Magnetic Susceptibility readings of all core recovered from **Randall No. 1** were taken and averaged at 1m intervals. This data has been incorporated into a Magnetic Susceptibility Plot which is included in the Actual Section (PetNTcw3501). The raw data is appended in Appendix X. A maximum magnetic susceptibility of 71.76 SI x 10^{-5} was recorded in crystalline basement.

2.4.9 Elemental Analysis

Chip samples were taken every 3m to 465m (no samples over the interval 60-120m due to lost circulation). Bulk samples of ground rock were obtained over the cored section of **Randall No. 1** at 5m intervals using a "Goldfields" core grinder. A total of 257 samples of around 100g weight were sent to Australian Laboratory Services Pty Ltd in Brisbane for analysis of 19 different elements. Analytical methods used were: Fire Assay for Au, Pt and Pd; ICP for CU, Pb, Zn, Ag, Fe, As, Co, Ti, P, S, V, Mn, Sb, Ni, K, Ba. Results are appended in Appendix IX.

2.4.10 Other Analyses

Samples of core have been analysed for porosity/permeability and the results are contained in Appendix VIII.

3. GEOLOGY

3.1 REGIONAL SETTING AND STRUCTURE

The Georgina Basin is a large Palaeozoic intracratonic sedimentary basin trending north-west from latitude 25°S in western Queensland into the east central portion of the Northern Territory to about 18°S (PetNTcw588), (Smith 1972). The basin is about 1000km long, 500km wide and has an area of approximately 325 000km². It comprises a sequence of sedimentary rocks of Late Proterozoic to Devonian age (Draper et al, 1978), which were deposited on a major segment of an extensive epicontinental shelf which covered most of eastern Australia.

Basement under the basin is an irregular surface of granitic ridge and depression topography, subdued by Upper Proterozoic to Lower Cambrian sequences. Vendian to Lower Cambrian rocks forming the base of the sequence in the southern portion of the basin are siliciclastics with minor carbonate rocks of terrestrial and marine original (Draper et al, 1978). The Middle to Upper Cambrian shelf sediments comprise carbonates in the north and east, and mixed carbonate and terrigenous rocks in the west (Radke, 1981). Lower to Middle Ordovician sediments are progressively restricted in extent (southern margin to Toko syncline), become more siliciclastic with decreasing age, and are of shallow marine origin. Devonian sandstones of freshwater (alluvial fan, braided stream and lacustrine) and aeolian origin are restricted to the southern part of the basin (Smith, 1967). A regional correlation of stratigraphic units is shown in Plan PetNTcw3023.

The margins of the Georgina Basin are often identified as an unconformity, commonly faulted, separating Lower Proterozoic Carpentarian, and Adelaidean rocks from Vendian (late Adelaidean) and older sediments (Draper et al, 1978). The Georgina Basin is bounded by the Proterozoic Mt Isa Block to the east; by the Arunta Block to the south; by the Proterozoic Davenport Province, Tennant Creek and Arunta Blocks in the Palaeozoic Wiso Basin to the west; and by the Proterozoic McArthur and south Nicholson Basins to the north (Freeman et al, 1990).

Mesozoic rocks conceal any connection between the Georgina Basin and Daly River Basin to the northwest, while the southeastern margin is concealed beneath the Mesozoic Eromanga Basin (Draper et al, 1978), (see PetNTcw588).

The basin has been asymetrically deformed by minor to moderate folding and faulting, especially in the east and south, with local intense faulting and thrusting on the margins (Freeman et al, 1990), although large areas appear not to have been disturbed tectonically and the sediments are mainly flat-lying and unmetamorphosed (Smith, 1972).

Structural deformation took place during an Upper Devonian or early Carboniferous orogeny. Along the southern margin there are numerous parallel faults, downthrown to the east, which trend north-west for up to 80km; and some anticlines, domes, and monoclines are known. The most prominent folds are the Dulcie and Toko Synclines. Both are asymmetric folds with steep dips on their southwestern flanks; in the Toko Syncline, these steep dips are clearly related to faults, but there is no evidence of faulting along the south-western flank of the Dulcie Syncline (Smith, 1967). PetNTcw3471 shows the position of **Randall No.** 1 stratigraphic well in relation to the main structural features in the Georgina Basin.

3.2 OBJECTIVES

Randall No. 1 was drilled on a surface hydrocarbon anomaly identified during a soil geochemistry survey undertaken in 1990 (CRAE Report No. 304422). The primary objectives were to test for the presence of hydrocarbons in, and reservoir quality of shoal carbonates within the basal Chabalowe Formation and the Arthur Creek Formation.

3.3 STRATIGRAPHIC TABLE

FORMATION	DEPTH (m)	SUBUNIT THICKNESS (m)	UNIT THICKNESS (m)
Qa	Surface		27.5
Dulcie Sandstone	27.5		20.5
Tomahawk Beds	48		128
Arrinthrunga Fm (upper)	176	169	400
Eurowie Sst Mem	345	58	
Arrinthrunga Fm (lower)	403	173	
Chabalowe Fm	576	182.4	342.6
Hagen Mem	758.4	160.2	
Arthur Creek Fm	918.6		65.8
Andagera Fm	984.4		29.8
Basement	1014.2		
TD	1020.4		

3.4 STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENT

Basement Precambrian 1014.2 mDF dlr
1015.5 mDF lgr

Randall No. 1 was terminated at a depth of 1020.4m after encountering a dark pink coarsely crystalline granite with a distinct high-angle foliation, weathered and chloritised in the top 2m and fresh thereafter.

Andagera Formation | Early Cambrian | 984.4 mDF dlr
985.0 lgr

The Andagera Formation here consists of 29.8m of very light grey to light brown sandstone with dense silica cement. Clasts (quartz, quartzite, and in the central zone feldspar) are moderately to poorly sorted, subrounded and range from fine-grained to conglomeratic but are predominantly coarse- grained. Bedding shows an indistinct coarsening upwards with irregular contacts. Wispy clay laminae and occasional thin interbeds of bioturbated dolomite occur. Bituminous stylolites occur occasionally within the dolomite. The Andagera Formation originated as an alluvial fan/coarse valley-fill system with coarse clastic input from the Davenport Ranges area (Stidolph et al, 1988).

Arthur Creek Formation | Middle Cambrian | 918.6mDF dlr
920 lgr

The basal Arthur Creek Formation is a dolomite grainstone, fine grained and recrystallised into massive dolomite in the bottom 2.65m. The next 0.95m consists of coarse dolomitic grainstone, with faint, thin, parallel bedding, vuggy porosity, and some oil shows. Above this basal section, layers of massive white dolomite are overlain by thick black laminae containing coarse sand and pyrite blebs for 3.6m. This interval finishes with a very distinct bedding contact.

The remaining 58.6m of the Arthur Creek Formation consists of dolomite grainstones: coarse clean sometimes recrystallised grainstones grading up into or occasionally interbedded with fine grained muddy grainstones. Stylolites are common to abundant with stylonodular to stylobrecciated sections towards the top. Vugs at stylolite intersections (near the top) and fractures near the bottom are filled with anhydrite. Bioturbation, fossil fragments, and phosphate pellets occur. Small vugs and pinhole porosity at 980.8-980.9m occasionally showed oil bleeds but larger pores were barren. The Arthur Creek Formation in this area is shallow marine and corresponds to the aerobic facies of Freeman, 1986.

Chabalowe Formation: Hagen Member | Middle Cambrian
758.4 mDF dlr
758.4 lgr

The Hagen Member is made up of 160.2m of dolomites, dolomite mudstones, and stromatolites, and can be divided into three sections: a basal shallow marine shoal, a lagoon, and a sabkha at the top (c.f. Stidolph et al., 1986, where the Hagen Member is divided into shoal and sabkha only).

The basal shoal is a white/pale grey calcite-cemented coarse dolomite grainstone. There is abundant large vuggy porosity and intercrystalline porosity, with some tight intervals. The shoal is 32m thick with a total of 18m of porous interval. A very dull yellow fluorescence was noted in the porous interval. This was associated with the calcite cement and was considered to be mineral fluorescence. On examination, a very weak crush cut fluorescence was detected indicating hydrocarbons. The fluorescence probably indicates that this reservoir has been filled with oil in the past.

The lagoon facies (838.8-886m) consists of stromatolites interbedded with: dolomite mudstone, or sandstone, or dolomite mudstone and fine grainstone; and interbedded fine grainstone and mudstone. The stromatolites are large and well-developed, sometimes silicified or brecciated, occasionally recrystallised, with some fenestral or interlayer porosity. Some oil bleeds are present. The dolomite mudstone is light to dark grey and bioturbated The sandstone is fine to very fine grained, finely laminated, mildly bioturbated, and cemented by dolomite. The grainstone is fine to medium grained, recrystallised in places, bioturbated in places, with fully cemented porosity in the bottom 18.7m. No anhydrite is present in the lagoon facies.

The sabkha facies (758.4-838.8m) is characterised by the frequent occurrences of anhydrite: as large, often coarsely crystalline nodules, as a replacement of dolomite, as patchy cement, and as pore filling. Lithologies are dominated by dolomite mudstone or fine grainstone, sometimes recrystallised or massive. The lower sabkha facies consists of 9m of recrystallised fine grainstone, topped by 2.8m of brecciated flat dolomite clasts in a dolomite mudstone matrix. Dolomitic siltstone, rippled at the base, grades up to finely crystalline dolomite and stromatolitic dolostone in the next 7.2m. From 819.8-770.2m, a series of coarsening (shallowing) upwards bedding cycles comprises dolomite mudstones grading up to massive dolomite, grainstone, or stromatolites. These cycles are interbedded with crossbedded sandstone, cemented with silica, dolomite, and anhydrite, from 797.2-813m. Chert nodules are frequently associated with the stromatolites in this section. Thinly laminated dolomite mudstone and fine grainstone over an intraformational lag breccia (6.8m thick) and microcrystalline, compacted, wavy-bedded dolomite top off the sabkha facies, and forms the top of the Hagen Member.

Chabalowe Formation: Upper unit Middle Cambrian

576 mDF dlr
574.2 lgr

The upper unit of the Chabalowe Formation originated as a supratidal area at the margin of a shallow basin. This is the equivalent of the lagoonal upper unit of Stidolph et al (1986) but contains elements of lagoon, sabkha, tidal and supratidal settings. Anhydrite is occasionally present in this unit, as cement, nodules, or filling of fenestral porosity, but it is considerably less common than in the Hagen Member (sabkha). Clastic sedimentation plays a greater role in the upper unit than it does in the Hagen Member.

The lower 39.4m of the upper unit is very similar to, and may be a facies equivalent of, some sections of the Arrinthrunga Formation. At the base, 12.4m of dolomitic siltstone is finely laminated, grading up through ripple bedding to disrupted bedding and rip up clasts near the top. Common zones of small anhydrite nodules occur. The overlying 27m consists of fining upwards microcycles of ripple to occasionally planar laminated dolomitic lime mudstone. Thin shoaling intervals and eroded, red stained exposure surfaces occur.

The middle section of the upper unit (618.8-719m) is characterised by fining-upwards microcycles. Dolomitic siltstone is interlaminated with fine grainstone and sandstone in fining-upwards cycles for the bottom 18.8m (to 700.2m). Eroded bedding surfaces, iron staining and dessication cracks show common subaerial exposure; and fine dolomitisation, chalky microporosity and rip up clasts are also common. Overlying this thinly-bedded interval is a 53.4m interval of thicker bedding. Sandstone is interbedded with dolomitic siltstone and minor dolomite on a 1-5m scale at the base but thins up to <1m above the base of this interval. The sandstone is fine to coarse grained, ripple laminated, and cemented by silica, dolomite, and anhydrite. Occasional zones or bands of intergranular porosity occur. The dolomitic siltstone is wavy ripple laminated and occurs in 1-4cm fining upwards microcycles. From 646.8-618.8m, laminated dolomitic lime mudstone is interbedded with minor sandstone and algal dolostone. Bedding in this interval also fines upwards. Occasional exposure surfaces occur (reddish-brown intervals with dessication cracks). The sandstones have minor porosity and the dolomites have intercrystalline microporosity.

The remaining 42.2m of the Chabalowe Formation consists of thin intervals (3-10m) of mixed lithologies originating in shallow water and/or supratidal facies. Sandstones, siltstones, and mudstones, both clastic and mixed clastic/dolomitic, occur as discreet intervals and as interbeds. The sandstones are poorly sorted with abundant intraformational lithics, low porosity, and silica, dolomite, and anhydrite cement. Siltstone and mudstone are thinly laminated and often ripple bedded. Some show fining-up microcycles; some coarsen up to sandstone. Stromatolites occur throughout this interval, occasionally associated with minor fabric-destructive chalky dolomitisation. Rip up clasts, dessication cracks, iron staining and water escape structures also occur.

Arrinthrunga Formation (below Eurowie): Mid to Late Cambrian
403 mDF dlr
401 lgr

The Chabalowe Formation grades up into the Arrinthrunga Formation, which has at its base 63.6m of shallow marine deposits: dolomitic lime mudstone, interbedded siltstone and dolomite, dolomitic siltstone and minor stromatolites. Thinly bedded with frequent ripple laminations, the rocks also show dessication features, load casts, water escape structures, slumps, bioturbation, and fining-upwards microcycles. A shoal deposit occurs at 554.8m, where 2.6m of ripple-bedded limestone coarsens upwards into fine grainstone, thrombolite, and an eroded top.

The next 44.9m (467.5-512.4m) is characterised by the presence of ooid or peloid grainstones, in 4-10m intervals between intervals of intraclast grainstone and carbonate mudstone, or interbedded with algal dolostones or dolomite mudstone and grainstone. The ooid/peloid grainstones are cemented by calcite which is dolomitised in places; stylolites are common. Coarsening upwards cycles occur within the ooid-peloid units, and two intervals of fine grainstone and carbonate mudstone coarsen upwards into intervals of ooid grainstone. Load casts, water escape structures, mud cracks, imbricate flat-pebble conglomerates, and bioturbation all occur. Occasional solution cavities or vugs are filled with anhydrite. The ooid-rich section of the Arrinthrunga Formation is overlaid by 64.4m of finely recrystallised calcareous dolomite, mostly white but occasionally grey and silty/clayey.

Arrinthrunga Formation: Eurowie Sandstone Member
Mid to Late Cambrian

345 mDF dlr
337.5 lgr

Interbedded dolomites, siltstones, and sandstones of the Eurowie Member overlie the lower Arrinthrunga. The dolomite is finely recrystallised, and occasionally silty, sandy, or carbonaceous. The siltstone is dolomitic and is gradational with silty dolomite in places. The sandstone is quartzose, usually fine grained, and cemented with silica and dolomite. Laminations may be seen in the siltstones but otherwise there is little structure in the interval.

Arrinthrunga Formation (above Eurowie): Mid to Late Cambrian

176 mDF dlr
172 lgr

The upper section of the Arrinthrunga Formation in **Randall No. 1** consists of 169m of recrystallised fine dolomite grainstone, with slight traces of clastics in the top 31m. From 270-345m, light coloured lithologies were coarser grained and more coarsely crystalline, indicating a possible origin of alternating fine grainstone and mudstone.

Tomahawk Beds Late Cambrian to Early Ordovician

48 mDF dlr
47 lgr

This shallow-marine sequence is represented by interbedded sandstone and shale (54m thick) grading up into interbedded sandstone and siltstone (74m thick). The sandstone is fine grained, moderately well sorted, quartzose with minor lithics, and cemented by silica. The siltstone interbeds contain a trace of glauconite, are fissile and grade down to shale interbeds.

Dulcie Sandstone	Early to Middle Devonian	27.5 mDF dlr 25 lgr

The Dulcie Sandstone in this well consists of yellowish fine grained sandstone, well-sorted, friable, micaceous, with common quartz overgrowths. Occasional fragments of dark grey fissile shale occur.

Quaternary Sediments	Surface

The surface sediment in this area is unconsolidated aeolian sand, overlying soft yellowish brown silty claystone.

3.5 HYDROCARBON INDICATIONS AND RESERVOIR QUALITY

Oil shows and gas peaks were noted in the Chabalowe Formation (Hagen Member), the Arthur Creek Formation, and the Andagera Formation. Drill gas data and DST data are appended (Appendices XII and VI). Twenty core samples were analysed for some or all of the following: porosity, permeability, residual fluids, and grain density (Appendix VIII).

Shows in the Hagen Member of the Chabalowe Formation were generally numerous and occupied the full core diameter, but were thin. Oil was the continuous phase. Many of the zones of shows were extremely tight; oil was seen to be bleeding out over several days. See Table 1 (below) for a list of oil shows in the Hagen Member.

An interval of significant porosities and oil shows in the dolomites of the Hagen Member (between 759-840m) was tested in DST No. 2. The tested zone had some tight bleed occurrences similar to those described above, but there was some evidence of better intercrystalline and vuggy porosity towards the bottom. However, oil in the sections of better porosity was of substantially decreased quality. In this interval, 40cm (759-759.4m) of light oil (bright greenish-yellow/white fluorescence) was bleeding from fine fractures and stylolites in coarse grainstone and algal dolostone.

DST No. 3 was run over the basal shoal of the Hagen Member. In this interval, some very dull and weak green-yellow hydrocarbon fluorescence was present and showed a very faint cut in solvent. A total of 18m over this interval showed abundant fine to occasionally large vuggy porosity and intergranular porosity. Core analysis of this interval showed permeability of up to a maximum of 3.6 Darcies, compared to <0.01-13 millidarcies in the tight rocks with better oil bleeds described in paragraph 2 of this section. Porosity ranged between 8-14%. This is the cleanest reservoir yet found in the Georgina Basin.

Smaller shows and bleeds occurred in the Arthur Creek Formation from 953.2-986.2m. Traces of oil bleeding from pinhole porosity showed yellow fluorescence with fast cut, but was not continuous throughout the core (953.2, 953.8, 960.8, and 961.4m). Between 980.8-982m, and most commonly in the top 10cm, oil was bleeding from fine vuggy porosity in vuggy grainstone. Shows only occurred in the smaller isolated pores; larger, open pores in the same interval were barren.

Discontinuous fluorescence in sandstone of the Andagera Formation (986.1-986.2m) was confined to a thin zone where some porosity was developed in coarser-grained layers of cross bedding

Oil bleeds and live oil traces were associated with small but recognisable gas peaks. Gas species present were generally C1-C4, with C5 present in places There were no significant gas peaks without oil shows, but a rise in gas background was recorded in the Arthur Creek Formation.

Table 1: Oil Occurrences 759-851m, Hagen Member

OIL OCCURRENCES 759 - 851m

DEPTH (m)	OIL TYPE & POROSITY	LITHOLOGY
759-759.4	bleed, greenish yellow/white bright fluorescence, from intercrystalline, porosity, fractures, stylolites	coarse grainstone, thrombolytic algal dolostone
770.2-777	dark bitumen stain in intercrystalline micro-porosity	along original bedding of recrystallised dolomite
772-773	light bleed from fracture and interlayer porosity	concentric chert nodules and stromatolites
772.4, 772.8	bleed, very tight	algal/nodular material
775.3	small bleed from inter-crystalline porosity	
776	bleed from shrinkage around silica nodule	

.../cont.

.../cont.

DEPTH (m)	OIL TYPE & POROSITY	LITHOLOGY
777-793	small bleeds from fine intercrystalline shrinkage and interlamination porosity	
782.8	bleed from interlaminar porosity	dolomite (above), anhydrite replacing dolomite (below)
788.4-789	bleed	silica nodule
792.4	bleed	algal/nodular material
793-793.7	light bleeding	algal/chert bands
795.7-796	oil show	chert bands
805	trace oil	chert nodule
807.1-807.6, 812	bleed	porous intervals in coarse parts of crossbed sandstones
813.5	patchy oil/bitumen in fine intercrystalline porosity	
820.6	trace oil	stromatolite
839.1-839.5		distorted silicified stromatolite
840.2-840.9	strong show from interlayer fenestral porosity	stromatolite
844	bleeding oil in fenestral porosity as above	large stromatolite
845.5	small weak bleeds from fenestral porosity around large solution cavity	
850.2	weak bleed, as for 845.5m	

3.6 CONTRIBUTIONS TO EXPLORATION

The basal shoal of the Hagen Member was present as predicted from regional geology. The shoal reservoir contains substantial porosity and permeability, and the presence of migrated hydrocarbons. The formation water in the reservoir, though not the original phreatic water, differs substantially in chemistry from surface waters, indicating at least some form of separation or seal.

The well location proved to be basinwards of the target Arthur Creek Formation pinchout, where the basal shoal is expected to coalesce with the Hagen Member basal shoal, pinching out the remainder of the Arthur Creek Formation against a basement high. Nonetheless, high energy conditions sufficient for reservoir development were present in the basal shoal of the Hagen Member.

On the basis of this well, free soil hydrocarbons in this area are reflecting a strong background of residual hydrocarbons rather than an oil in place.

The distribution of oil shows within the core would suggest that substantial amounts of oil have either migrated through, or been reservoired in this area. The bulk of this oil has since been displaced elsewhere, leaving sporadic residual shows of live oil, bitumen and fluorescence.

Randall No. 1 disclosed the presence of the Andagera Formation in the area, and demonstrated some porosity and oil shows within it.

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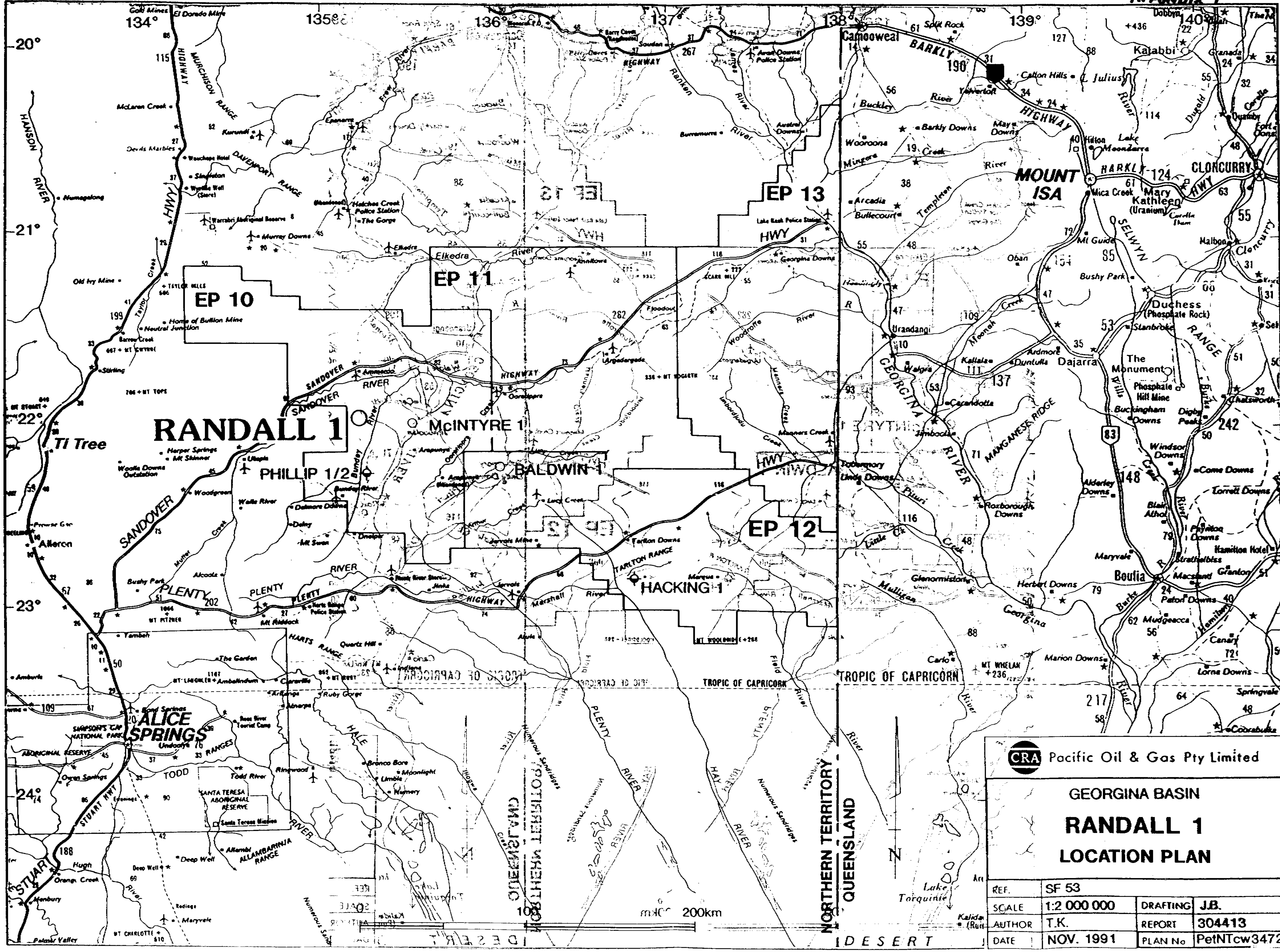
KEYWORDS AND LOCALITY

Petroleum, Hydrocarbons, Carbonate, Stromatolites, Ooids, conglomerate, Sandstone, Black shale, Evaporite, Facies Marine Shallow, Sabkha, Lagoon, Alluvial Fan, Quaternary, Palaeozoic, Devonian, Ordovician, Drill diamond, Drill rotary, Sampling, Drilling mud, Reservoir, Porosity, Permeability.

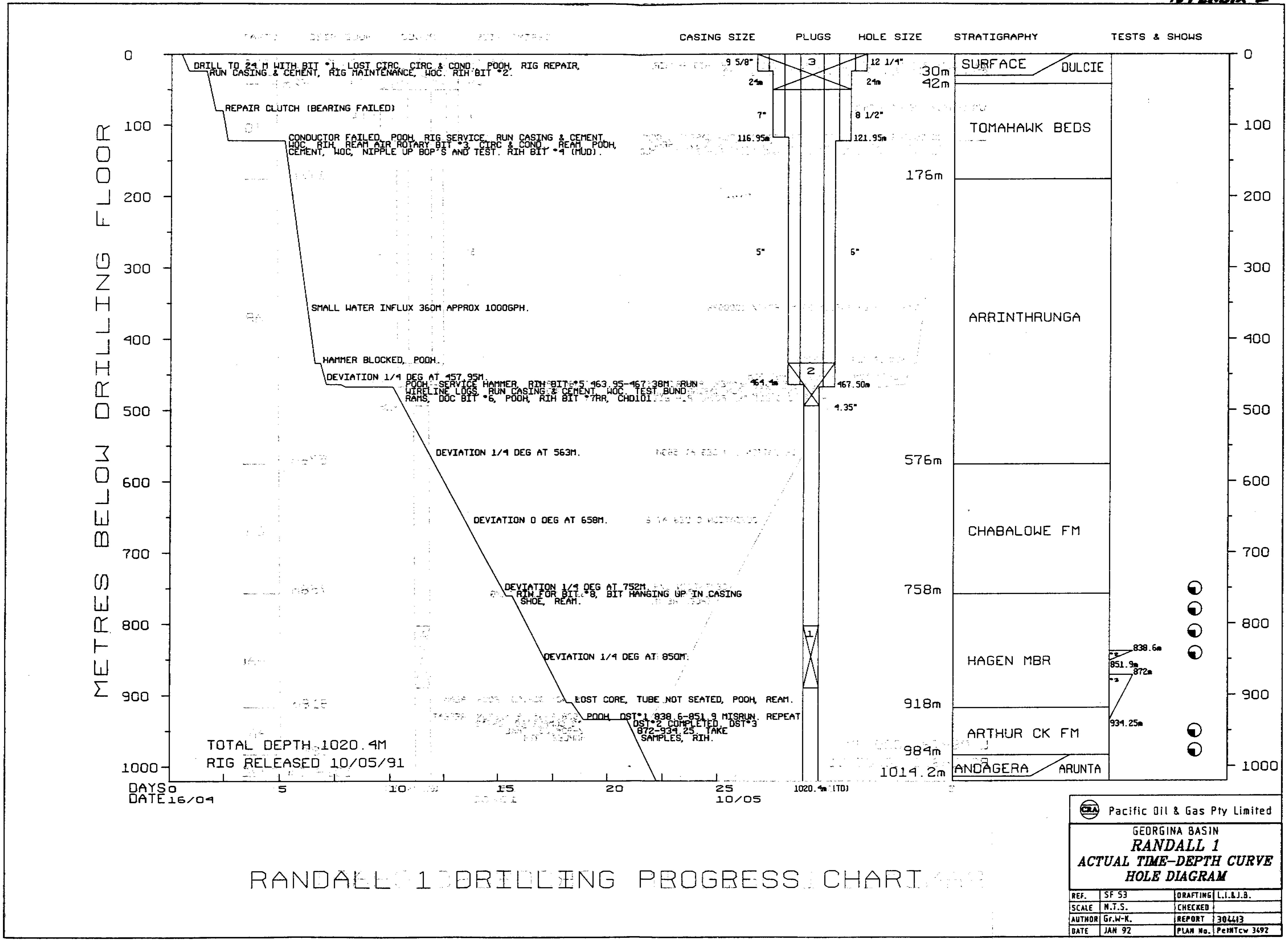
Randall No. 1, EP10, Derry Downs, HUCKITTA SF53-11, MACDONALD DOWNS 5953, Georgina Basin, Northern Territory.

APPENDIX 1



CRA Pacific Oil & Gas Pty Limited
GEORGINA BASIN
RANDALL 1
LOCATION PLAN
REF. SF 53
SCALE 1:2 000 000
DRAFTING J.B.
AUTHOR T.K.
REPORT 304413
DATE NOV. 1991
PLAN No PetNTcw3472
RANDALL 1
McINTYRE 1
BALDWIN 1
PHILLIP 1/2
HACKING 1
EP 10
EP 11
EP 12
EP 13
MOUNT ISA
CLONCURRY
ALICE SPRINGS
Ti Tree
Camooweal
Boulia
Dajarra
Urandangi
NORTHERN TERRITORY
QUEENSLAND
TROPIC OF CAPRICORN
SANDOVER HIGHWAY
PLENTY HIGHWAY
BARKLY HIGHWAY
GEORGINA RIVER
200km

APPENDIX 2



RANDALL 1 DRILLING PROGRESS CHART

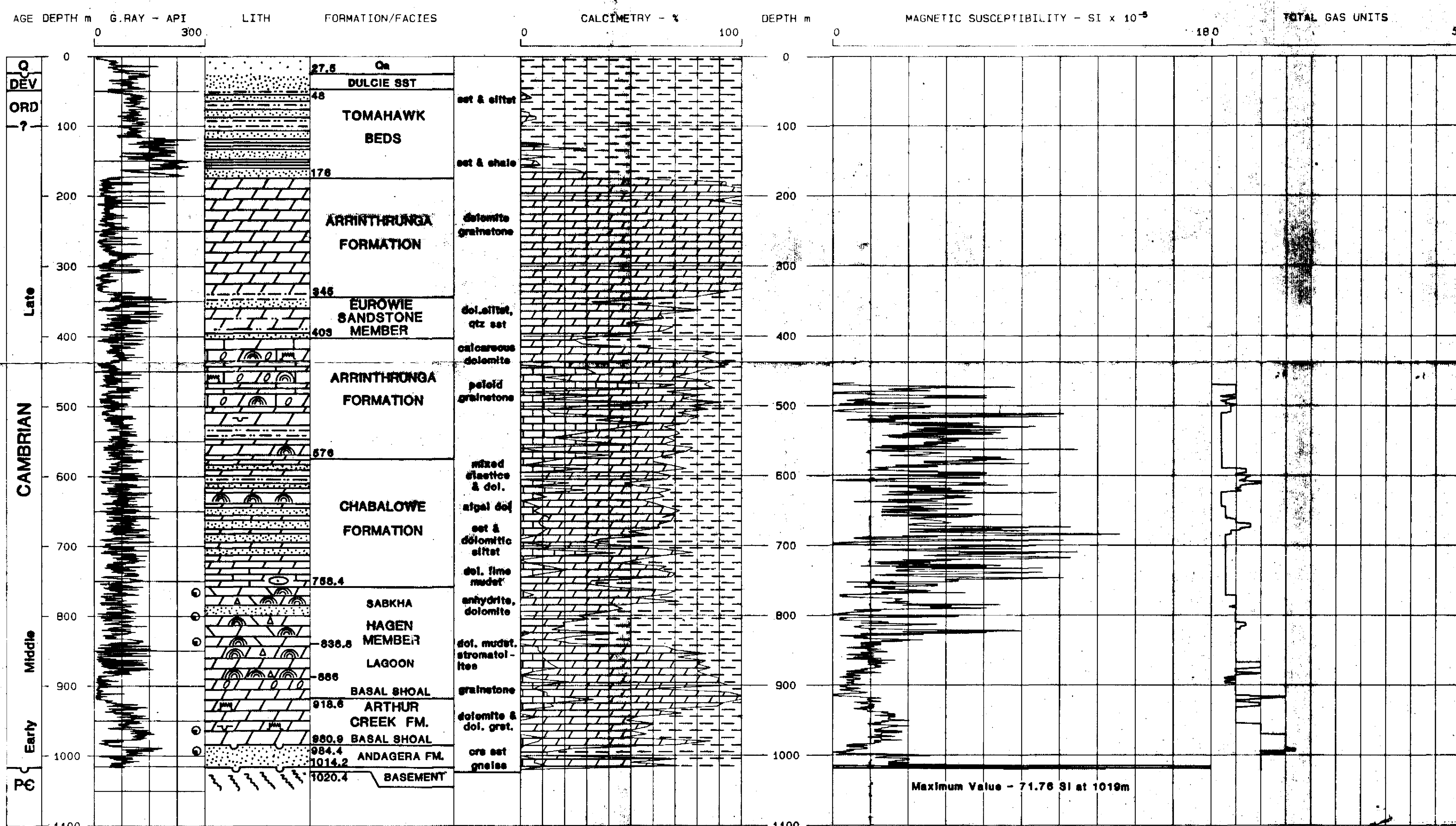
PACIFIC OIL AND GAS

Date: 14 Jan 1992

ACTUAL SECTION - 1: 5000

Drawing no.

RANDALL #1



LITHOLOGY

- Shale
- Siltstone
- Sandstone
- Anhydrite
- Dolomite : or dolomitic mudstone, siltstone or grainstone
- Unconformity
- Stromatolites
- Stylolites
- Bioturbation
- Peloids/ooids
- Chert
- Oil Show

CALCIMETRY

- Limestone
- Dolomite
- Siltstone

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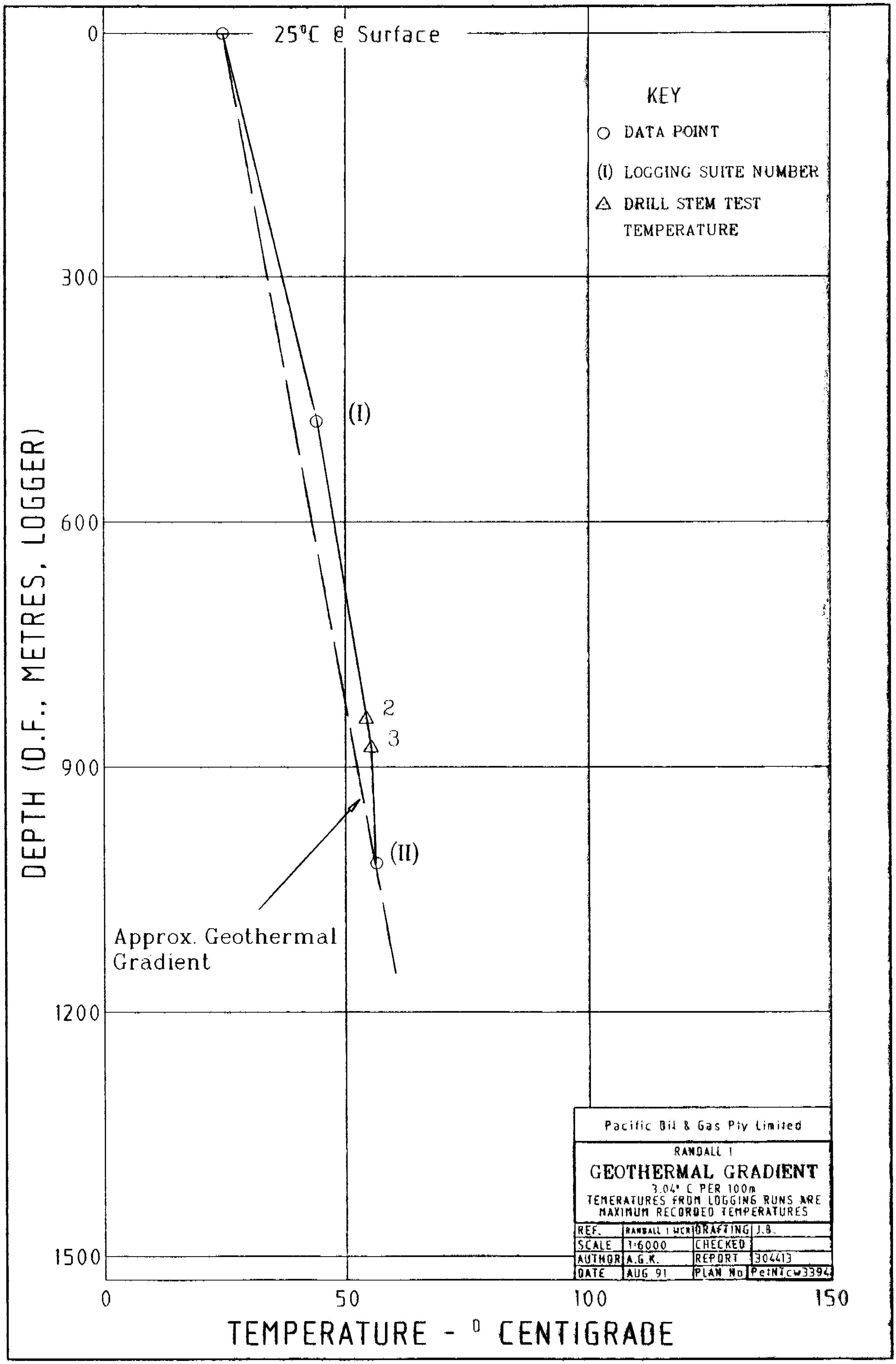
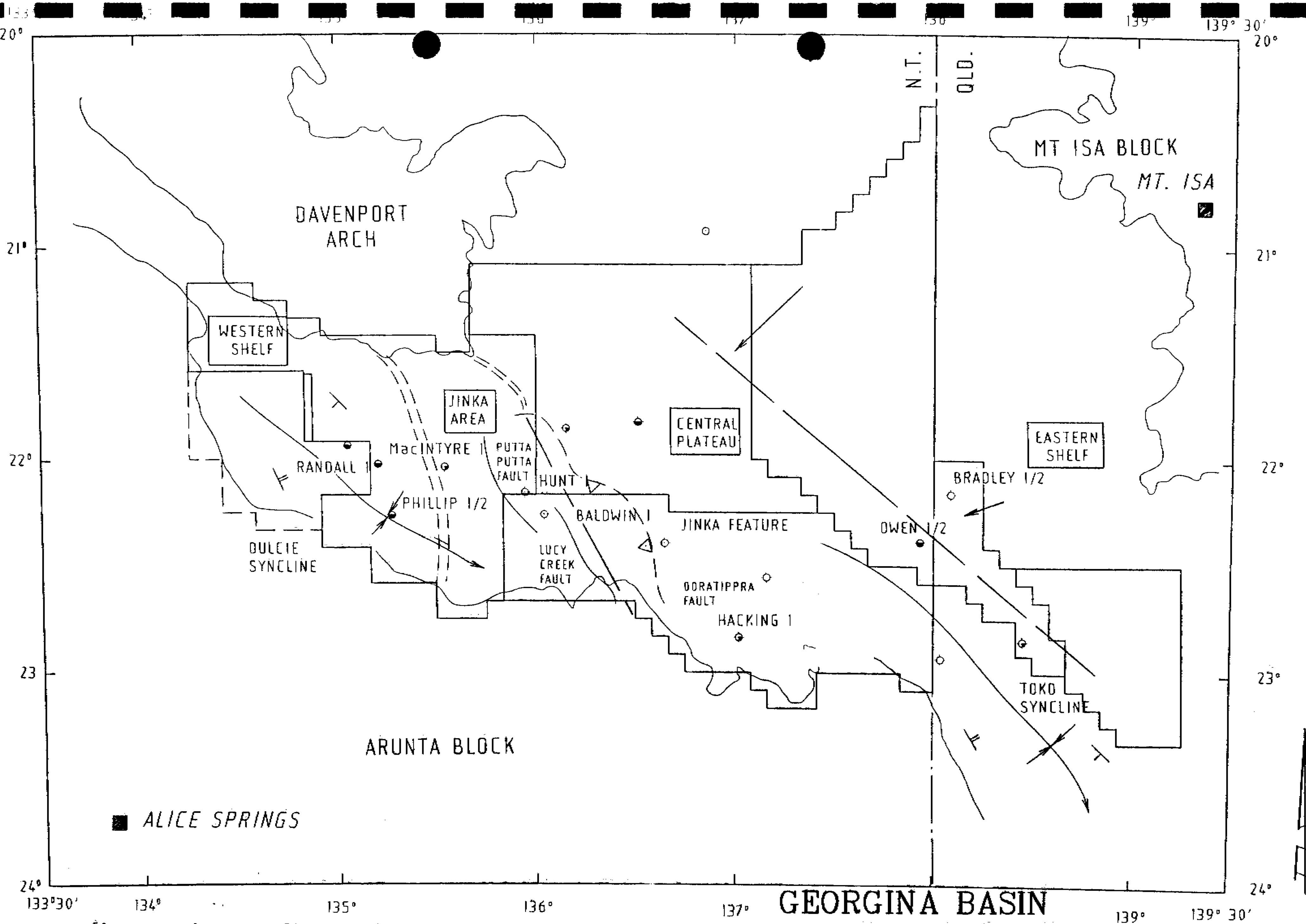
RANDALL 1
ACTUAL SECTION

REF.			
SCALE	1:5000	DRAFTING	Hammond Carto.
AUTHOR	G. Wakelin-King	REPORT	304413
DATE	January, 1992	PLAN No.	[illegible]

APPENDIX 2

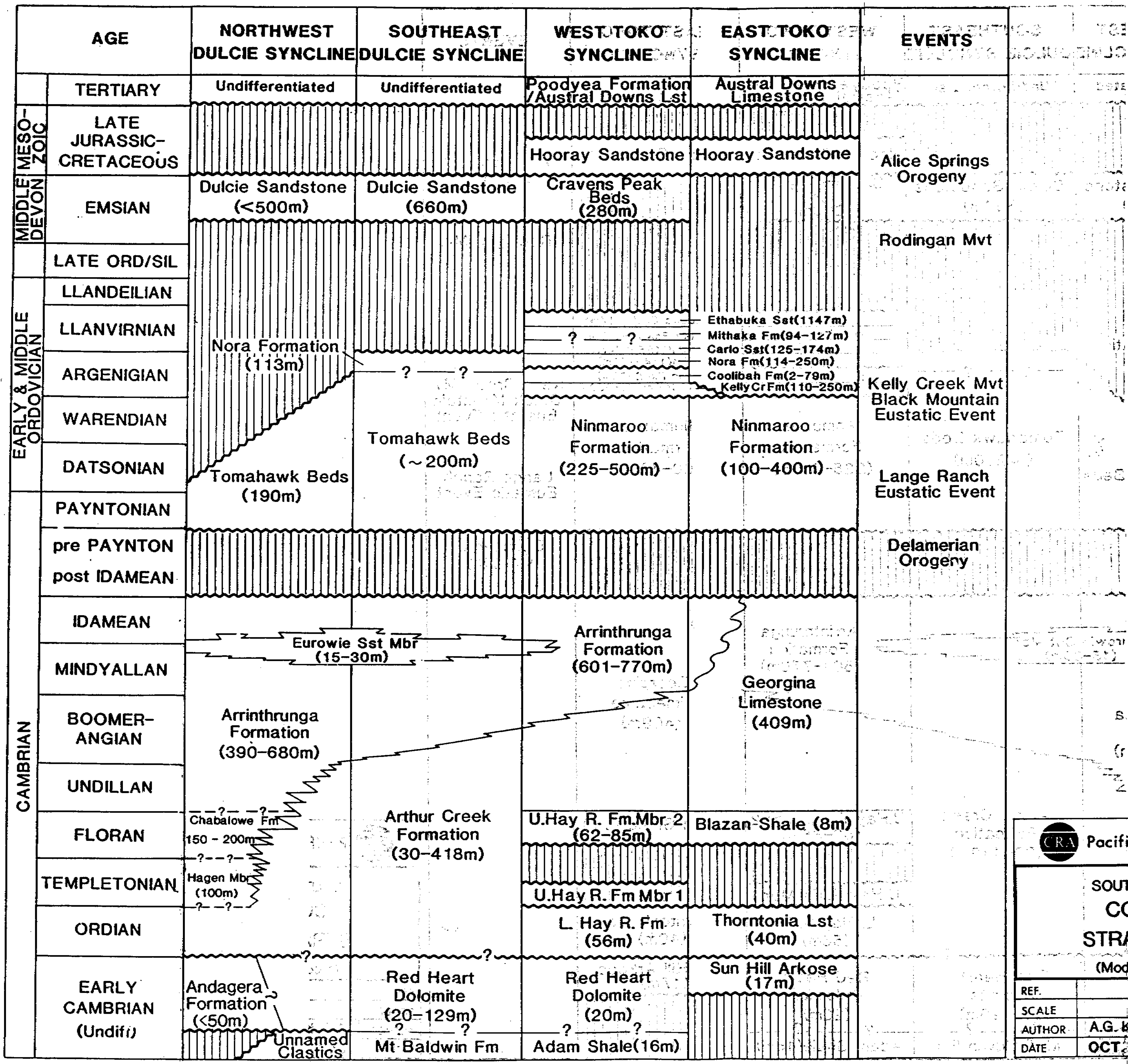


25°C @ Surface
KEY
DATA POINT
(I) LOGGING SUITE NUMBER
DRILL STEM TEST TEMPERATURE
(I)
2
3
(II)
Approx. Geothermal Gradient
0
300
600
900
1200
1500
DEPTH (D.F., METRES, LOGGER)
0
50
100
150
TEMPERATURE - ° CENTIGRADE
Pacific Oil & Gas Pty Limited
RANDALL 1
GEOTHERMAL GRADIENT
3.04° C PER 100m
TEMERATURES FROM LOGGING RUNS ARE MAXIMUM RECORDED TEMPERATURES
REF. RANDALL 1 WCR
DRAFTING J.B.
SCALE 1:6000
CHECKED
AUTHOR A.G.K.
REPORT 304413
DATE AUG 91
PLAN No PetNTcw3394



GEORGINA BASIN STRUCTURAL ELEMENTS INCLUDING WELLS

PetNTcw3471



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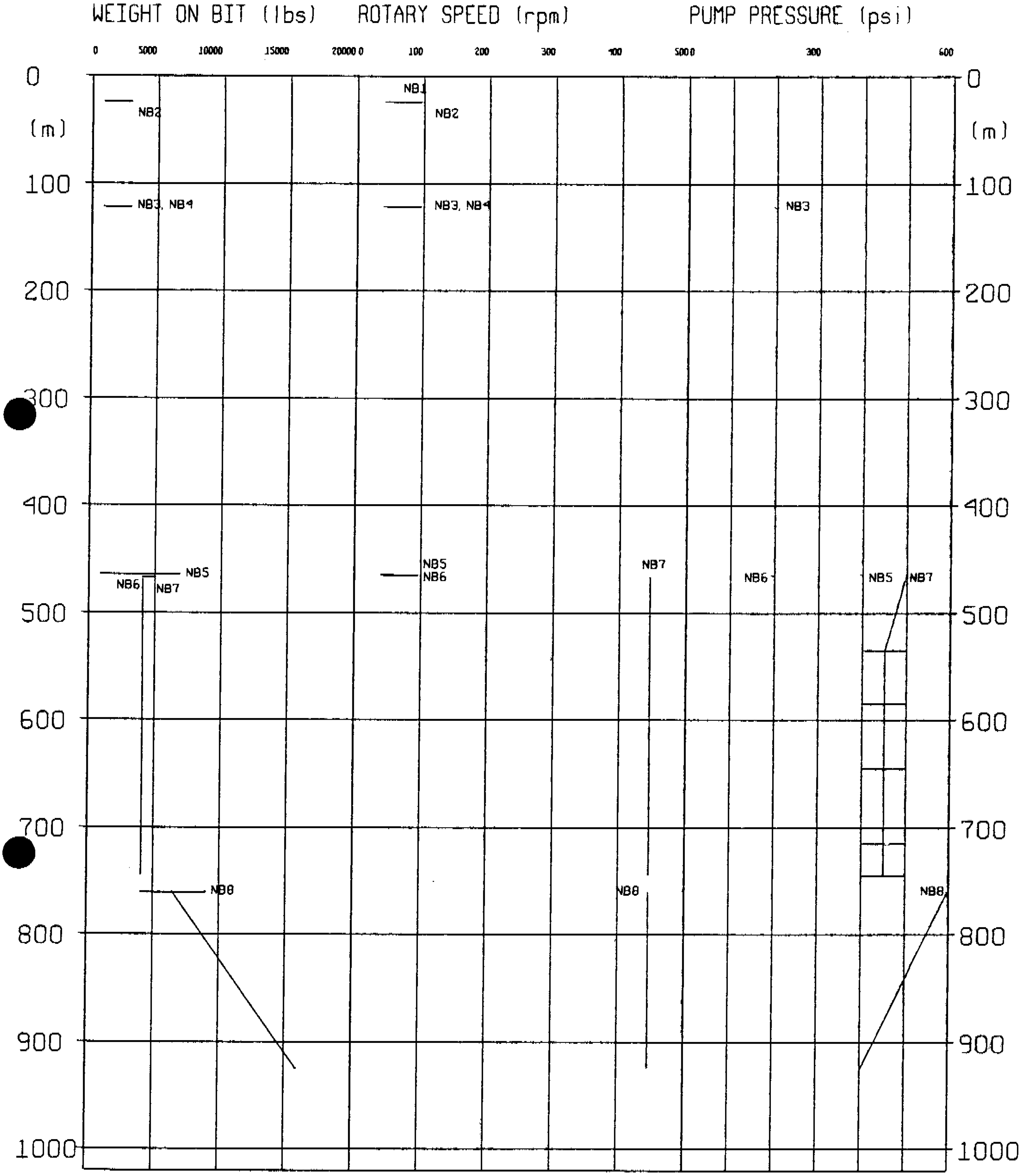
SOUTHERN GEORGINA BASIN
CORRELATION OF STRATIGRAPHIC UNITS
(Modified from Morris, 1988)

REF.			
SCALE		DRAFTING	
AUTHOR	A.G. KRESS	REPORT	304413
DATE	OCT. 1991	PLAN No	PetNTcw3430

APPENDIX 3

RANDALL 1 DRILLING PARAMETERS PLOT



HORIZONTAL LINES INDICATE PARAMETER RANGES

CRA Pacific Oil & Gas Pty Limited

GEORGINA BASIN

RANDALL 1

DRILLING PARAMETERS PLOT

REF.	SF 53	DRAFTING	L.J.&J.B.
SCALE	N.T.S.	CHECKED	
AUTHOR	Gr.W-K.	REPORT	304413
DATE	JAN 92	PLAN No.	PetNTcw 3493

RANDALL 1 MUD PARAMETERS PLOT

Pacific Oil & Gas Pty Limited

GEORGINA BASIN

RANDALL 1

MUD PARAMETERS PLOT

REF.	SF 53	DRAFTING	L.I.&J.B.
SCALE	N.T.S.	CHECKED	
AUTHOR	Gr.W-K.	REPORT	304413
DATE	JAN 92	PLAN No.	PeINTcw 3494

APPENDIX 5