SANTOS – BEACH

COMPILED FOR

SANTOS LIMITED

ABN 800 075 50923

NARINGAL 1

WELL COMPLETION REPORT

Prepared by:
A. HUDDLESTON
July 2002

NARINGAL 1 WCR

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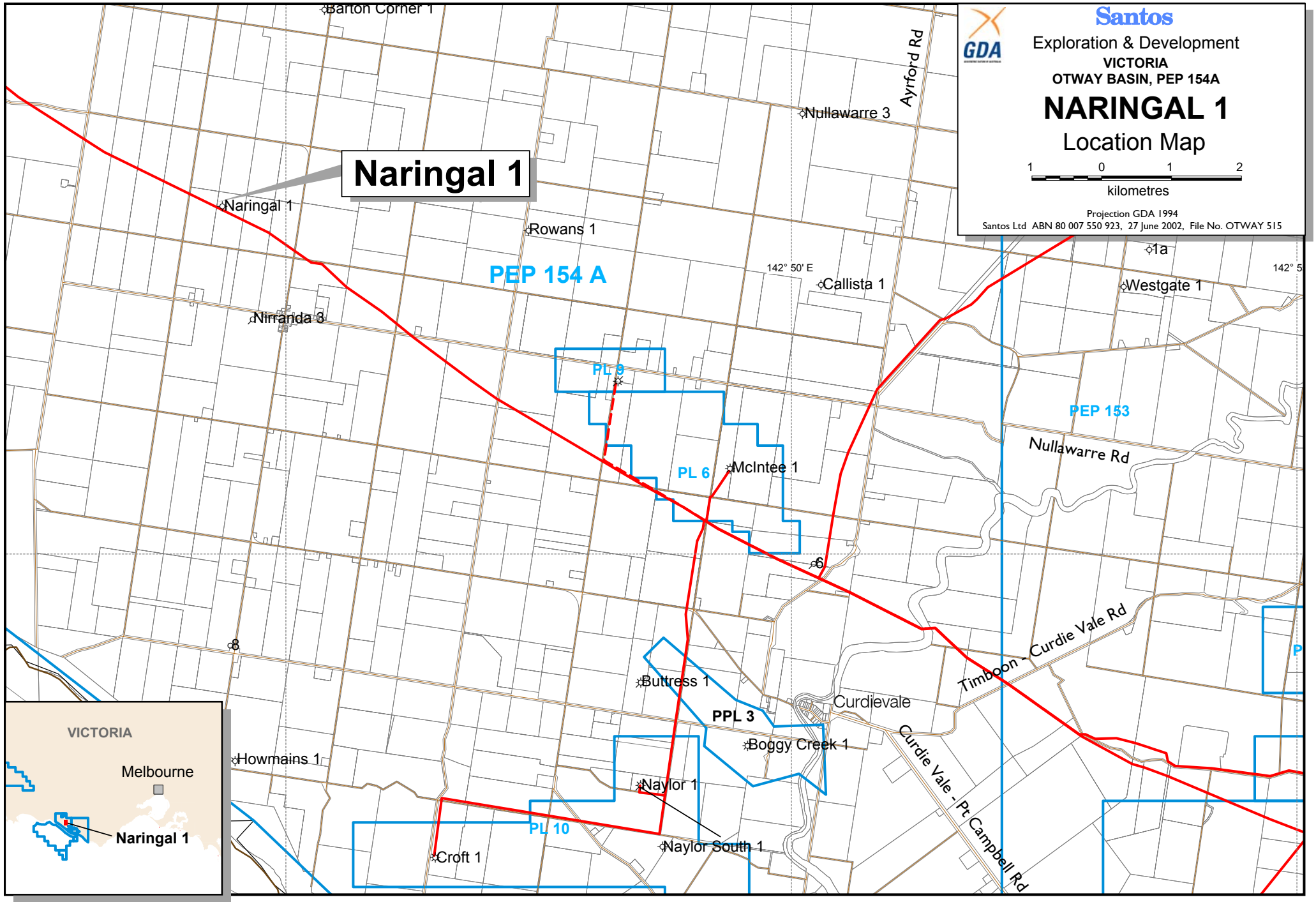
LOCATION MAP


Santos
Exploration & Development
VICTORIA
OTWAY BASIN, PEP 154A
NARINGAL 1
Location Map
1 0 1 2
kilometres
Projection GDA 1994
Santos Ltd ABN 80 007 550 923, 27 June 2002, File No. OTWAY 515
GDA
Naringal 1
Barton Corner 1
Nullawarre 3
Ayrford Rd
Naringal 1
Rowans 1
PEP 154 A
142° 50' E
Callista 1
1a
Westgate 1
142° 5
Nirranda 3
PL 9
PEP 153
Nullawarre Rd
PL 6
McIntee 1
6
8
Timboon - Curdie Vale Rd
Buttress 1
Curdievale
PPL 3
Boggy Creek 1
Curdie Vale - Pt Campbell Rd
Howmains 1
Naylor 1
PL 10
Naylor South 1
Croft 1
VICTORIA
Melbourne
Naringal 1

WELL DATA CARD

WELL: NARINGAL 1	**WELL CATEGORY:** EXPLORATION **WELL INTENT:** GAS	**SPUD:** 1600, 24-01-2002 **TD REACHED:** 0430, 30-01-2002	
		RIG RELEASED: 0700, 02/02/2002 **CMPLT**:	
LAT:	**LONG**: (AGD84)	**RIG**: OD&E 30	
LAT: 38 27' 18.32" S	**LONG**: 142 44' 22.34" E (GDA94)	**STATUS**: PLUGGED AND ABANDONED	
SEISMIC STATION: INLINE 2202 CDP 10532		**REMARKS**: FOUR PLUGS SET	
ELEVATION GND: 50.17 m	**RT:** 54.87 m	· 30m – Surface	
BLOCK/LICENCE: PEP 154		· 404m – 320m	
TD 1710 m (Logr Ext)	1710 m (Drlr)	· 1135m – 1035m	
PBTD m (Logr)	m (Drlr)	· 1618m – 1528m	
TYPE STRUCTURE: FAULT TRAP		**HOLE SIZE** / **CASING SIZE** / **SHOE DEPTH** / **TYPE**	
TYPE COMPLETION: PLUGGED AND ABANDONED		250.825mm (9 7/8") / 193.675mm (7 5/8") / 378m (D&L) / 26 lb/ft L80, BT&C	
ZONE(S):		171.45mm (6 ¾")	

AGE	FORMATION OR ZONE TOPS	DEPTH (m)		THICKNESS	HIGH (H)
		LOGGERS	TVD SS	TVD (m)	LOW (L)
MIDDLE-LATE MIOCENE	PORT CAMPBELL LIMESTONE			280	NP
EARLY-MIDDLE MIOCENE	GELLIBRAND MARL	280	225	372	NP
EARLY OLIGOCENE-EARLY MIOCENE	CLIFTON FORMATION	652	597	14	21 L
LATE EOCENE-EARLY OLIGOCENE	NARRAWATURK MARL	666	611	53	NP
MIDDLE EOCENE-EARLY OLIGOCENE	MEPUNGA FORMATION	719	664	79	31 L
EOCENE	DILWYN FORMATION	798	743	217	34 L
EARLY EOCENE-LATE PALAEOCENE	PEMBER MUDSTONE	1015	960	44	76 L
LATE PALAEOCENE	PEBBLE POINT FORMATION	1059	1004	34	85 L
MASTRICHTIAN-CAMPANIAN	PAARATTE FORMATION	1093	1038	272	99 L
SANTONIAN	SKULL CREEK MUDSTONE	1365	1310	125	59 L
LATE EOCENE-EARLY OLIGOCENE	NULLAWARRE GREENSAND	1490	1435	37	NP
SANTONIAN-CONIACIAN	BELFAST MUDSTONE	1527	1473	38	146 L
TURONIAN	FLAXMANS FORMATION	1565	1510	13	10 H
TURONIAN	WAARRE FORMATION, UNIT C	1578	1523	12	18 H
TURONIAN	WAARRE FORMATION, UNIT B	1590	1535	7	NP
TURONIAN	WAARRE FORMATION, UNIT A	1597	1542	14	NP
LATE ALBIAN	EUMERALLA FORMATION	1611	1556	85 +	29 H
LATE ALBIAN	TOTAL DEPTH (EXTRAP.)	1710	1655		5 L

PRELIMINARY LOG INTERPRETATION (Interval Averages)					
INTERVAL (m)	Ø %	SW %	INTERVAL (m)	Ø %	SW %
NO PAY					

PERFORATIONS (4 shots/m)	
FORMATION	INTERVAL
No perforations	

CORES				
FORM	NO.	INTERVAL	CUT	REC
		No cores cut		

LOG	SUITE/ RUN	INTERVAL (M)	BHT/TIME/ REMARKS
GR	1/1	1675 - SURF	Maximum Temperature 71°C/07:05 hrs since last circulation.
SDT		1685 - 360	Waveform processing to 1485m
MSFL		1695 - 360	
DLL		1694 - 360	
CAL		1695 - 360	Noisy data over sands
LDL		1680 - 1480	
CNL		1677 - 1480	

LOG	SUITE/ RUN	INTERVAL (M)	BHT/TIME/ REMARKS
GR-SWC	1/2	1545.7-1660.7	NO BHT RECORDED. 24 SAMPLES. 4 MISFIRES, 1 LOST,19 BOUGHT
VELOCITY	1/3	1545.7-1660.7	NO BHT RECORDED. 20 LEVEL CHECK POINT SURVEY

FORMATION TESTS										
NO.	**INTERVAL (m)**	**FORMATION**	**FLOW (mins)**	**SHUT IN (mins)**	**BOTTOM GAUGE IP/FP (psia)**	**SIP**	**MAX SURF PRESS (psia)**	**FLUID TO SURF (mins)**	**TC/ BC**	**REMARKS**
										No formation tests

SUMMARY:

Naringal 1 is located in South Western Victoria in the onshore portion of the Otway Basin. It is located in the PEP 154 licence (90% Santos (operator) and 10% Beach Petroleum N.L), and sited at CDP 10532, inline 2202, on the Curdievale 3D Seismic Survey. It lies approximately 21 km north west of the town of Peterborough, 9 km WNW of the McIntee gas field and 10 km NW of the Naylor gas field. The Naringal 1 prospect is situated towards the western limit of the productive Waarre Sandstone play fairway of the Port Campbell Embayment.

Naringal 1 was a gas exploration well, targeting the Waarre Sandstone. The Naringal prospect is a tilted fault block closure defined by the Heytesbury-Naringal 3D seismic dataset.

One suite of wireline logging was carried out by Reeves Logging after reaching total depth, and consisted of the following: Run 1: GR-STD-MSFL-DLL-CAL-LDL-CNL; Run 2: GR-SWC; Run 3: VELOCITY SURVEY.

Log analysis of Naringal 1 has identified the following:

- No pay in the Waarre Sandstones

Naringal 1 reached a total depth of 1710m (Drlr), 1710m (Logr Ext), and has been plugged and abandoned.

AUTHOR: A. Huddleston	**DATE**: July 2002

WELL HISTORY

1. GENERAL DATA

Well Name:	Naringal 1
Well Classification:	Gas Exploration
Interest Holders:	Santos Ltd (90%) Beach Petroleum (10%)
Participating Interests:	Santos Ltd (90%) Beach Petroleum (10%)
Operator	Santos
Block/Licence	PEP 154, Onshore Otway Basin, Victoria
Surface Location	Latitude: 38° 27' 18.32" South Longitude: 142° 44' 22.34" East
Surveyed Elevation	Ground Level: 50.17m Rotary Table: 54.87m
Seismic Survey	CURDIEVALE 3D
Seismic Location	CDP 10532, LINE 2202
Total Depth	Driller: 1710.0m Logger Ext: 1710.0m
Completion	Four plugs were set. Plug 1 set from 1618m to 1528m; Plug 2 set from 1135m to 1035m; Plug 3 set from 404m to 320m; Plug 4 set from 30m to surface.
Status	Plugged & Abandoned

2. DRILLING DATA

Date Drilling Commenced	1600 hours, 23rd January 2002
Date Drilling Completed	0430 hours, 30th January 2002
Date Rig Released	0700 hours, 2nd February 2002
Contractor	Oil Drilling & Exploration Pty Ltd (OD&E)
Rig	OD&E 30
Rig Specifications	Refer to Appendix XIV

3. DRILLING SUMMARY

(a) Drilling Summary:

Naringal 1 was spudded at 1600 hours on the 23rd January 2002. A 250.825mm (9 7/8") surface hole was drilled to 382m (Drlr). A 193.675mm (7 5/8") surface casing was run and cemented from surface to 378m (Drlr). A Leak-Off Test was conducted to 1.95 S.G. EMW (16.3 ppg EMW) at 385m (Drlr). A 171.45mm (6 ¾") main hole was then drilled to a Total Depth of 1710m (Drlr) which was reached at 0430 hours, on the 30th January 2002. Naringal 1 was plugged and abandoned post logging with 4 plugs set. Plug#1 was set from 1618m to 1528m, Plug#2 set from 1135m to 1035m, Plug#3 set from 404m to 320m and Plug#4 set from 30m to surface. The rig was released at 0700 hours on 2nd February 2002. A more comprehensive drilling summary can be found in Appendix XIII, in the Drilling - Final Well Report.

Tables I and II summarise the casing, cementing and mud systems used in this well. A more comprehensive summary is appended to this report Appendix XIII: (Drilling - Final Well Report).

TABLE I: CASING, HOLE, AND CEMENT DETAILS

BIT SIZE	DEPTH	CSG SIZE	CSG DEPTH	JNTS	CSG TYPE	CEMENT
250.825mm (9.875")	382m	193.675mm (7 5/8")	378m (D&L)	32	26.4 lb/ft L-80	Lead: 60 bbls of Slurry (119 sacks Class G cement) @ 11.0 ppg + 4% bwoc of D020 + 1.5% bwoc of S001 + 0.01 gal/sax of D047. Tail: 22 bbls of slurry (104 sacks Class G) @ 15.6 ppg + 0.5 gal/sx of D145A + 0.01 gal/sx of D144 + 0.5 gal/sx of S001.
171.45mm (6.75")	1710 (D) 1710 (L)					

TABLE II: SUMMARY OF MUD SYSTEMS

MUD TYPE	INTERVAL (m)
Spud Mud (Gel/Water)	Surface – 382m
KCL/PHPA	382m – 1660m
KCL/Polymer	1660m – 1710m

(b) Lost Time:

Lost time at Narringal 1 – Please refer to Appendix XIII (Drilling - Final Well Report: Time Breakdown Data).

(c) Water Supply:

Local sources of water were used for Naringal 1. The make up water had the following properties:

Cl: 800 mg/l
Hardness(Ca++): -100 mg/l
PH: 7.3
Pf/Mf: 0.0/0.4

(d) Mudlogging:

Mudlogging services were provided by Geoservices Ltd. Samples were collected, washed, and described at 10m intervals from the surface to 1000m, 3m intervals from 1000m to 1710m (TD). All samples were checked for oil shows using ultraviolet fluorescence. Gas levels were monitored from the surface casing shoe to TD using a total gas detector and other parameters monitored include rate of penetration, weight on hook and mud pit levels.

(e) Testing:

No DST's were conducted on Naringal 1.

(f) Coring:

No cores were cut on Naringal 1.

(g) Electric Logging:

Reeves completed one suite with three wireline logging runs. A sonic and resistivity run (GR-STD-MSFL-DLL-CAL-LDL-CNL), side wall core run (GR-SWC) and a velocity survey run.

One suite of wireline logs was run in Naringal 1, as detailed below:

TABLE III: ELECTRIC LOG SUMMARY

LOG	SUITE/ RUN	INTERVAL (m)	BHT/TIME/ REMARKS	LOG	SUITE/ RUN	INTERVAL (m)	BHT/TIME/ REMARKS
GR	1/1	1675-surface	71°C/35:00hrs	GR - SWC	1/2		
SDT	1/1	1685 - 360	71°C/35:00hrs (waveform processing to 1485m)				24 Samples, 4 misfires, 1 lost, 19 bought. BHT not recorded
MSFL	1/1	1695 - 360	71°C/35:00hrs	VELOCITY	1/3		
DLL	1/1	1694 - 360	71°C/35:00hrs				20 point check point survey. BHT not recorded
CAL	1/1	1695 - 360	71°C/35:00hrs (noisy data over sands)				
LDL	1/1	1680 - 1480	71°C/35:00hrs				
CNL	1/1	1677 – 1480	71°C/35:00hrs				

*Logger Contractor - REEVES

(h) Geothermal Gradient:

An estimated static bottom hole temperature of 71.0°C at 1710m, and a geothermal gradient of 2.94°C/100m was calculated from down hole temperatures recorded during logging run 1.

(i) Hole Deviation

Directional surveys indicate a maximum deviation from vertical of 1.75° inclination 50.46°T at 1694m.

(j) Velocity Survey:

Velocity survey was run on Naringal 1.

(k) Completion Summary:

Naringal 1 was plugged and abandoned on the 2/2/02.

GEOLOGY

1. PRE-DRILLING SUMMARY (after Well Proposal)

Naringal 1 is proposed as an Otway Basin near field gas exploration well in the PEP 154 licence. The proposed location lies approximately 21 km north west of the town of Peterborough, 9 km WNW of the McIntee gas field and 10 km NW of the Naylor gas field. The Naringal 1 prospect is situated towards the western limit of the productive Waarre Sandstone play fairway of the Port Campbell Embayment.

The PEP 154 licence is held 90% Santos (Operator) and 10% Beach Petroleum NL. The Naringal prospect is a tilted fault block closure defined by the Heytesbury-Naringal 3D seismic dataset and the proposed location will crestally test the structure. The stratigraphic column for the Otway Basin is shown in Appendix IX. The primary objective in the well is the Waarre Sandstone, with a prognosed mean average pay of 14m across the structure. **The critical risk on the prospect is seal related to the nature of updip cross fault seal.** The prospect does not exhibit a significant full stack amplitude anomaly at the Waarre Sandstone but has some increase in amplitude with offset over the prospect. The lack of amplitude/AVO at the well location is interpreted either to be a function of the thinner Waarre section at this location or raypath interference from the bounding fault, rather than lack of hydrocarbon charge.

Naringal 1 is an attractive project with a mean prognosed success case of 7.64 BCF sales gas (15.0 BCF OGIP) and a Pc (probability of commercial success) of 25% resulting in expected mean reserves of 1.89 BCF sales gas. If successful the well will be connected via a pipeline routed along the existing GPU easement, which will allow rapid connection and production.

The project has an NPV_{15} (after tax) of $6.60 million and an EMV_{15} of $1.10 million.

A successful hydrocarbon discovery at Naringal 1 will lead to the drilling of Glenbrae-1 (~1 km north) with a mean success volume of 6.2 BCF and a general upgrading in the prospectivity of the western sector of the Port Campbell Embayment.

2. DRILLING RATIONALE (after Well Proposal)

GEOLOGICAL RISK ASSESSMENT

2.1 Play Analysis

The Naringal 1 prospect is mapped as a tilted fault block closure with the primary reservoir of the Waarre Sandstone. Vertical seal is provided by the Belfast Mudstone with cross fault seal interpreted as being provided by the Belfast/Skull Creek Mudstone section. There is a possibility that the Waarre is juxtaposed against the Nullawarre Greensand along the updip fault, however shale smear may be present thereby provided seal. The prospect is charged from mature source beds located within the underlaying Eumeralla and/or Crayfish Group, with migration either directly into the reservoir or via fault conduits. The play has proven successful in the nearby McIntee, Lavers, Naylor and Croft fields. The prospect does not exhibit a significant full stack amplitude anomaly at the Waarre Sandstone but has some increase in amplitude with offset over the prospect. The lack of amplitude/AVO at the well location is interpreted either to be a function of the thinner Waarre section at this location in the western part of the Port Campbell Embayment, or interference from the bounding fault, as evidenced at the Wallaby Creek Field.

2.2 Trap and Mapping (Pcl = 75%)

Interpretation and mapping of the Naringal prospect was based on the Heytesbury-Naringal 3D survey that was recorded in February – March 2001. The data quality is good in the Naringal area.

The Naringal 1 prospect is mapped as a northwest/southeast aligned tilted fault block. Three way dip closure is to the southwest with updip fault closure along the northeast flank of the structure (Figures 3 and 4 – not shown). Dip and strike seismic lines are shown in Figures 5 & 6 (not shown). The Glenbrae-1 prospect to the north of the Naringal (1 km) is a similar structure occurring on the updip side of the next tilted fault block to the north. Regionally the Naringal 1 structure is located on a southwest/northeast trending palaeo ridge, similar in strike to the McIntee/Naylor ridge, and the Mylor/Fenton Creek ridge. Vertical closure at the Waarre is in the order of 60m and Naringal 1 represents a structure similar to the existing discoveries in the Port Campbell Embayment.

No significant full stack amplitude anomaly occurs at the Waarre at the Naringal prospect. This is interpreted either to be a function of the thinning of the Waarre Sandstone package (37m predicted mean gross interval) and variation in sand distribution within this thinner section (variation in unit "C", "B" and "A"), as evidenced from the Naringal-3 water well result or from loss of amplitude from raypath distortion from the bounding fault. From a preliminary review of the post stack near and far offsets there is an increase in amplitude with offset, less than observed at McIntee-1, but comparable to that seen at the Wallaby Creek Field. Wallaby Creek-1 was drilled off structure (but within a higher far-near amplitude zone) and encountered ~9m pay, whereas the structurally higher Wallaby Creek-2 was drilled close to the bounding fault. This well intersected ~20m pay from a 48.6m gross interval (but in a region of little amplitude expression) interpreted to be caused by interference from the fault. This can be used as an analogue for the Naringal-1 prospect.

Proposed location for the Naringal-1 is at Inline 2202 CDP 10532 which is crestal on the structure.

There is a reasonably high level of confidence that the structure is robust and accordingly closure risk is 85%.

2.3 Reservoir (Prs = 70%)

At the Naringal-1 prospect area the Waarre Sandstone is considered to be well developed, and of the order of 50m, as observed in nearest wells Rowans-1 (4 km to east), Lavers-1 (6 km to ESE) and Naringal-3 a water well 1.5 km to SSW (Figures 7, 8 & 9 – not shown). At Naringal 1, 37m of Waarre is predicted. Typically the Waarre "C" and "A" sand prone units are predicted, with the unit "C" being the best in sand quality and quantity. Nearby wells indicate that net sand development in the order of 70% of the total Waarre section can be anticipated with average porosities in the range of 16-25%. Permeabilities in the region area are good to excellent (Boggy Creek-1 core permeabilities average 4.5 Darcies).

A 70% risk has been placed on reservoir based on the nearby wells in that there is a risk in sand thickness developed within the various subunits of the Waarre Sandstone.

2.4 Seal (Psl = 60%)

Seal is the major risk on the Naringal 1 prospect, specifically cross fault seal as the structure is reliant on updip cross fault seal via the Belfast/Skull Creek Mudstone package. Top seal is considered to be adequate with about 200m of Belfast Mudstone predicted at the location.

Cross fault seal is reliant on the Belfast/Skull Creek Mudstone section and while this package is present there is a possibility that along the updip fault the Waarre may be juxtaposed in part against the Nullawarre Greensand. In such a case the trap would leak, however the presence of shale smear would negate this problem. Based on this the risk on seal is recognised as critical and accordingly determined at 60%.

2.5 Charge (Pch = 70%)

The concepts on charge are discussed in the Port Campbell Embayment Geological Assessment. The Naringal 1 location meets the requirements for charge.

Charge is risked at 70% to recognise that the location may be reliant on longer migration pathways as the location is in a regionally shallower part of the Port Campbell Embayment.

3. RESULTS OF DRILLING

(a) Stratigraphy

The following table lists the formations intersected in Naringal 1, together with sub-sea elevations (Logr) and thicknesses.

TABLE IV: STRATIGRAPHY IN THE NARINGAL 1 WELL

AGE	FORMATIONS	DEPTH (m)	THICK. (m)	ELEV. (m)
	HEYTESBURY GRP			
MIDDLE-LATE MIOCENE	PORT CAMPBELL LIMESTONE	Surface	280	55
EARLY-MIDDLE MIOCENE	GELLIBRAND MARL	280	372	-225
EARLY OLIGOCENE-EARLY MIOCENE	CLIFTON FM NIRRANDA GRP	652	14	-597
LATE EOCENE-EARLY OLIGOCENE	NARRAWATURK MARL	666	53	-611
MIDDLE EOCENE-EARLY OLIGOCENE	MEPUNGA FORMATION	719	79	-664
EOCENE	DILWYN FORMATION	798	217	-743
EARLY EOCENE–LATE PALAEOCENE	PEMBER MUDSTONE	1015	44	-960
LATE PALEOCENE	PEBBLE PT FM SHERBROOK GRP	1059	34	-1004
MAASTRICHTIAN-CAMPANIAN	PAARATTE FORMATION	1093	272	-1038
SANTONIAN	SKULL CREEK MUDSTONE	1365	125	-1310
LATE EOCENE-EARLY OLIGOCENE	NULLAWARRE GREENSAND	1490	37	-1435
SANTONIAN-CONIACIAN	BELFAST MUDSTONE	1527	38	-1472
TURONIAN	FLAXMANS FORMATION	1565	13	-1510
TURONIAN	WAARRE FM, UNIT C	1578	12	-1523
TURONIAN	WAARRE FM, UNIT B	1590	7	-1535
TURONIAN	WAARRE FM, UNIT A	1597	14	-1542
LATE ALBIAN	EUMERALLA FORMATION	1611	85 +	-1556
	TOTAL DEPTH (EXTRAP.)	**1710**		**-1655**

Samples were collected, washed, and described at 10m intervals from the surface to 1000m, 3m intervals from 1000m to total depth at 1710m (Drlr), 1710m (Logr Ext).

A brief summary of the formations penetrated in Naringal 1, their ages and interpreted environments of deposition follows:- (For more detailed lithological descriptions refer to Appendix I). For specific relationships between the units, refer to the stratigraphic column in Appendix IX)

Total depth for Naringal 1 was reached at 1710m (Drlr), 1710m (Logr Ext), in the Early Cretaceous **Eumeralla Formation,** of the **Otway Group**. The well intersected 85m of the Eumeralla, the top coming in at 1611m (maximum recorded thickness in the Otway Basin is 2743m, in the Fergusons Hill-1 well). The formation consists of interbedded sandstone and siltstone. The sandstones are white, clear and pale grey. The quartz grains are fine to medium, with rare coarse. They are subangular to subrounded, moderately well sorted, contain common weak to moderate siliceous cement, and have a common to abundant argillaceous matrix. Characteristically, the Eumeralla contains a high percentage of volcanic rock fragments (38-53%--Abele *et al*, 1995). In Naringal 1, there is trace pyrite and trace quartz overgrowths present, and the sandstone varies from loose grains to minor moderately hard aggregates, but only exhibits poor porosity. No oil fluorescence was observed. The siltstone comprises approximately 20-30% of the section drilled and is light grey and off white. The siltstone is argillaceous, firm to soft and is subblocky to blocky.

The Eumeralla was deposited in a low-energy fluviatile environment, probably in a major braided stream system where there was an abundant supply of sand-sized volcanic detritus. The landscape also included occasional high energy streams, lakes and channel tracts. The source of the volcanic material is unknown, but due to results from age dating, it appears that volcanism was contemporaneous with sedimentation (Foster and Hodgson, 1995). In the eastern portion of the Otway Basin the Eumeralla has been dated to be Aptian to Albian.

The Late Cretaceous **Sherbrook Group** unconformably overlies the Early Cretaceous Eumeralla in the Otway Basin. The **Waarre Formation** makes up the oldest formation of the group and is dated to be Turonian in age (Partridge, 1997). The formation was divided up into 4 units by Buffin (1989), however the youngest, "Unit D", is generally called the Flaxmans Formation, after Flaxmans-1, by Bain (1961). The sandstone is off-white, pale brown, clear to translucent, grey, fine to coarse grained and poorly sorted. The grains are subangular to subrounded, and occasionally rounded. The sandstone has moderate siliceous cement, with occasional quartz overgrowths and common argillaceous matrix. The sandstone contains trace glauconite and pyrite, with predominantly loose grains with occasional hard aggregates. The sandstone has poor to fair visual and inferred porosity and no fluorescence. The siltstone is light grey, greyish brown and dark grey. It is arenaceous with rare argillaceous, common glauconite and is soft to hard. The siltstone is subblocky to blocky and occasionally fissile.

The sandstone packages are from 3 to 15m thick and are generally blocky in shape, although the Waarre B sand package exhibits a fining upward signature. The basal Waarre is interpreted to be shallow marine to marginal marine. After the transgression in the lower part of the Waarre, the formation became more regressive, depositing the best reservoir sands in the lower coastal and delta areas.

The Waarre Formation was transgressed by another flooding event (conformably overlain) by the **Flaxmans Formation.** In the Naringal 1 well it was intersected at 1565m (-1510m SS), and is 13m thick. It consists of a coarsening upward package of approximately 70% sandstone and 30% siltstone. The siltstone is dark brownish grey, medium grey, brown, arenaceous with common glauconite and trace micromicaceous and lithics. The siltstone is firm and subblocky. The sandstone is predominantly pale brown with common pale green grains aswell as trace off white to translucent grains. The grains are very fine to fine, occasionally medium, moderately well sorted, angular to subangular, weak to moderately strong siliceous cement with minor argillaceous matrix. The sandstone contains abundant glauconite, rare micromicaceous, trace lithics, friable to firm aggregates and trace to rare loose grains. This formation has poor visual and inferred porosity with no fluorescence. The Flaxmans is dated as being Coniacian in age, and is defined as the initial sediments of the major marine transgression to the overlying Belfast Mudstone. Both the Flaxmans and Belfast are considered part of the regional seal and side seal for the Waarre Formation.

The **Belfast Mudstone** conformably overlies the Flaxmans Formation. It was penetrated at 1527m (-1472m SS), and is 38m thick. The siltstone is dark greenish grey, medium grey, arenaceous and contains abundant glauconite and trace micromicaceous. Trace lithics are noted in this formation, and is firm and subblocky. The sandstone is pale green, clear to translucent, greenish grey and occasionally pale yellow. This sandstone is fine to coarse grained, predominantly medium, poorly sorted, subangular to subrounded, occasionally angular, weak siliceous cement and contains trace argillaceous matrix. The formation contains abundant glauconite, trace lithics and trace carbonaceous inclusions. The grains are predominantly loose with poor visual and inferred porosity and no fluorescence. The Belfast has been dated as Turonian to Campanian (Abele *et al*., 1995), but Partridge (1997) considered it to be only Coniacian to Santonian. It was deposited below storm wave base in low-energy marine conditions, in a pro-delta environment.

The **Nullawarre Greensand** conformably overlies the Belfast with a top intersected at 1490m (-1435m SS), and is 37m thick. It is predominantly made up of a pale green to pale green grey, fine to medium grains with occasional course. The sandstone is poorly sorted, with subangular to subrounded grains, with weak siliceous cement, common quartz overgrowths, trace argillaceous matrix and common glauconite. This sandstone contains trace quantities of pyrite and lithics and is comprised of predominantly loose grains with occasional firm aggregates. It has poor visual and inferred porosity. No shows were registered.

The Nullawarre is regarded as being Late Santonian in age and is marine deposit formed above storm wave base. It may be a sheet sand which accumulated on the upper part of the shelf (Abele *et al*, 1995).

The **Skull Creek Mudstone,** (often considered part of the Paaratte Formation), conformably overlies the Nullawarre Sandstone. The top of the mudstone was encountered at 1365m (-1310m SS), and is 125m thick. It comprises a pale grey, light brownish grey siltstone. The siltstone is argillaceous, with rare arenaceous. The siltstone contains trace quantities of micromicaceous flakes, trace disseminated pyrite and trace glauconite. The siltstone is soft to dispersive, amorphous and subblocky. The sandstone is clear to translucent, occasionally pale grey to off white, very fine to medium with occasional coarse grains. Sorting is poor to moderate, the grains are subangular to subrounded and the sandstone has weak siliceous cement. The sandstone contains trace glauconite, trace lithics, trace pyrite and trace carbonaceous specks. The grains are predominantly loose with occasional friable to firm aggregates. The sandstone has poor inferred porosity with no fluorescence. A pro-delta environment of deposition is interpreted for the Skull Creek and an age of Santonian has been attributed to it.

The top of the youngest formation of the Sherbrook Group, the **Paaratte Formation,** was intersected at 1093m (-1038m SS). The formation is 272m thick and is made up sandstone with interbedded siltstone. The sandstone is clear, translucent, milky to off white and pale brown/grey. The quartz grains are very fine to predominantly medium, with occasional coarse, and are moderately sorted. The grains are subangular to subrounded, angular in part with trace moderate siliceous cement. Rare to trace pale grey argillaceous matrix occurs in this formation as well as occasional pyrite nodules. The sandstone is dominantly loose and exhibits poor to fair porosity. No fluorescence was noted.

The minor interbedded siltstone is medium to dark grey brown, commonly arenaceous with traces of argillaceous material. Occassional carbonaceous specks and laminations are also seen in this siltstone. The siltstone is very soft to firm in part, and very dispersive and sub-blocky to amorphous.

The Paaratte Formation was deposited in a deltaic environment, in this case, presumably delta plain, and has been dated to be Santonian to Maastrichtian in age in the Otway Basin.

Unconformably overlying the Paaratte Formation is the oldest unit in the **Wangerrip Group**, the **Pebble Point Formation**. At Naringal 1, the Pebble Point is 34m thick, from 1059m (-1004m SS) to 1093m, and consists of interbedded sandstone and claystone. The claystone is light to medium brown grey, dark grey/brown, and is calcareous and argillaceous. The claystone contains trace micromicaceous, trace lithics and is soft to dispersive, amorphous and occasionally sub-blocky. The sandstone seen in the Pebble Point Formation is brown, clear to translucent, fine to medium, occasionally coarse, poorly sorted, subrounded to occasionally subangular. It contains loose grains and has poor inferred porosity with no fluorescence.

The environment of deposition for the Pebble Point is interpreted to be shallow water, near-shore, restricted marine with periodic influxes of coarse detrital material. Various megafossils and microfossils have been identified in the formation that indicate a Palaeocene age (Abele *et al*, 1995).

Conformably overlying the Pebble Point is the **Pember Mudstone**, between 1015m (-960m SS) and 1059m, thus is 44m thick. This claystone is light to medium brown, medium grey and contains trace micromicaceous flakes and common carbonaceous specks. The claystone has trace lithics, is soft to dispersive, amorphous and occasionally calcareous.

The Pember Mudstone was deposited in a marine environment where there was restricted circulation and low energy conditions, probably below or close to storm wave base. It has been given an age of Late Paleocene to Early Eocene (Abele *et al*, 1995) as a result of enclosed palynomorphs.

The **Dilwyn Formation** conformably overlies the Pember Mudstone at this location, and was encountered between 798m (-743m SS) and 1015m (-960m SS). It is 217m thick. The section consists predominantly of sandstone with minor interbedded claystone. The sandstone is a light to medium brown, orange brown, translucent, fine to medium with occasional coarse grains. It is moderately sorted with grains that are subrounded to rounded. Moderate calcareous cement is present, as is a trace amount of brown argillaceous matrix. Trace quantities of pyrite nodules are also seen. The sand grains are loose with poor to fair inferred porosity with no fluorescence. The claystone is light to medium brown, calcareous with trace fossil fragments. It is soft to firm and amorphous.

Both macrofossils and microfossils from the Dilwyn have been dated to be Early Eocene. The environment of deposition is interpreted to be shallow marine, with the cleaner sandy portions representing shore-face deposits of a coastal barrier system and the interbedded section possibly back beach lagoonal sediments, with some breaching occurring. Another interpretation is that the Dilwyn could have formed in a lower delta plain area with the sands, distributary channels and mouth bars, and the clays, the inter-distributary bay fills (Abele *et al*., 1995).

The Dilwyn Formation is the youngest unit of the **Wangerrip Group**, and is disconformably overlain by the **Mepunga Formation**, the oldest formation of the **Nirranda Group**. In the Naringal 1 well, the Mepunga was intersected at 719m (-664m SS) and is 79m thick. The sandstone is opaque to translucent, trace clear, medium to fine grained with trace coarse and is moderately sorted. The grains are subangular to subrounded. The sandstone has weak calcareous cement with minor argillaceous matrix. Trace glauconite nodules are present. The sandstone is predominantly loose grained with occasional friable aggregates. The sandstone has good inferred porosity, and no fluorescence is seen. The claystone is grey to dark grey, arenaceous, very soft to soft and microcrystalline.

According to dating of forams, molluscs and palynomorphs discovered within the Mepunga, an age of Late Eocene has been given. The sandstones have been interpreted as being deposited in beach and near-shore locations as barrier islands, whereas the claystone is regarded as estuarine and some as deep lagoonal in origin (Abele *et al,* 1995).

The **Narrawaturk Marl** overlies the Mepunga Formation with a conformable contact. The marl was encountered at 666m (-611m SS), and is 53m thick. The formation comprises a sandstone that is light brown to brown orange with trace clear grains, predominantly fine to medium grained with poor to moderate sorting. The sandstone has subrounded grains with weak calcareous cement and common redish brown argillaceous matrix. Iron oxide fossil replacement is present, as is trace fossil fragments. The sandstone contains friable to moderately hard aggregates and has trace loose grains. The sandstone has poor visual and inferred porosity with no fluorescence. The limestone present in this formation is light orange to light brown, lutitic, arenaceous in part, soft to firm and crystalline to microcrystalline. The marl in this formation is grey to dark grey, common calcareous, argillaceous, commonly micritic, contains trace glauconite and fossil fragments. The marl is soft to dispersive and is amorphous to subblocky.

The Narrawaturk represents the youngest formation of the Nirranda Group, and overlying it with a regional disconformity is the **Clifton Formation**, the oldest unit of the **Heytesbury Group.** The Clifton is a 14m thick formation of calcarenite, found from 652m (-597m SS) to 666m in the Naringal 1 well. The Sandstone is orange to reddish brown and very iron oxide rich. It is very fine to medium, coarse in part, poorly sorted and subangular to subrounded grains, with weak calcareous cement and common orange to reddish brown argillaceous matrix, grading to LIMESTONE in part. It is friable to loose in part, with poor porosity and no fluorescence.

Fossils found within the calcarenite have been dated to be Late Oligocene, and it is thought to represent a shallow marine unit, a carbonate sand, deposited above fair weather base under fairly energetic conditions (Abele *et al*, 1995).

The Clifton Formation grades vertically, and in places laterally into the **Gellibrand Marl**. Here, the marl is 372m thick, from 280m (-225m SS) to 652m. It is a pale to medium grey Marl, which is moderately to strongly calcareous, with trace to common fossil fragments including bryozoa, forams, shell fragments, echinoid spines and sponge spicules. It is very soft to dispersive and amorphous in part.

The Early to Middle Miocene Gellibrand Marl was deposited in low-energy, continental shelf environment, with a minimum water depth of 60m, due to the presence of glauconite (Abele *et al*, 1995).

The Naringal 1 well was spudded into the **Port Campbell Limestone**, the topmost formation of the Heytesbury Group, (overlying the Gellibrand with a transitional contact), appearing from spud to 280m in depth. The calcarenite is white, off white to pale greyish brown, microcrystalline, predominantly loose. The formation has common shell fragments and is soft to dispersive and amorphous to subblocky.

The Port Campbell Limestone is Middle to Late Miocene in age and was deposited in a moderate-energy, continental shelf environment, above fair weather wave base.

For further details concerning the formations encountered in Naringal 1, refer to **Appendix I** of this report.

(b) Stratigraphic Prognosis (after Well Proposal)

The geological section penetrated was within tolerance to prognosis. Formation tops ranged from 146m low to 59m high. The primary objective, the Waarre Formation, was 18m high. Actual versus predicted formation tops and thicknesses for Naringal 1 are tabled below (all depths quoted are Logger's Depths):

TABLE V: ACTUAL VERSUS PREDICTED DEPTHS AND THICKNESSES NARINGAL 1

FORMATION	PROG SS DEPTH	ACTUAL SS DEPTH	DEPTH DIFF	PROG THICK	ACTUAL THICK	THICK DIFF
Port Campbell Lst		-55m			280m	
Gellibrand Marl		-225m			372m	
Clifton Fm	-576m	-597m	21mL		14m	
Narrawaturk Marl		-611m			53m	
Mepunga Fm	-633m	-664m	31mL	76m	79m	+3m
Dilwyn Fm	-709m	-743m	34mL	175m	217m	+42m
Pember Mdst	-884m	-960m	76mL	35m	44m	+9m
Pebble Point Fm	-919m	-1004m	85mL	20m	34m	
Paaratte Fm	-939m	-1038m	99mL	312m	272m	-40m
Skull Creek Mdst	-1251m	-1310m	59mH		125m	
Nullawaarre Grnsnd		-1435m			37m	
Belfast Mdst	-1326m	-1472m	146mL	194m	38m	-156m
Flaxmans Fm	-1520m	-1510m	10mH	21m	13m	-8m
Waarre Fm, UNIT C	-1541m	-1523m	18mH		12m	
Waarre Fm, UNIT B		-1535m			7m	
Waarre Fm, UNIT A		-1542m			14m	
Eumeralla Fm	-1585m	-1556m	29mH	65m	85m	
TD	-1650m	-1655m	5mL			

(c) Hydrocarbon Summary

Total gas was recorded from the surface to total depth (1710m RT) using a FID total gas detector run by Geoservices Ltd. One unit of gas is equal to 200 ppm methane equivalent. Chromatographic analysis was determined using a FID chromatograph and these values are quoted as percentages (C1-C4). Ditch cuttings were washed, described and checked for fluorescence using ultraviolet light.

Surface to the top of the Paaratte Formation (spud to 1093m)

No gas was recorded through the Port Campbell Limestone, Gellibrand Marl, Clifton Formation, Narrawaturk Marl, Mepunga Formation, Dilwyn Formation, Pember Mudstone or the Pebble Point Formation. No hydrocarbon fluorescence in the drill cuttings was recorded within these formations.

Paaratte Formation (1093m to 1365m)

No gas was recorded through the majority of this formation. Traces (less than 1%) of 100% C1 were detected at the very bottom of the formation. No hydrocarbon fluorescence in the drill cuttings was recorded within this formation.

Skull Creek Mudstone (1365m to 1490m)

There were only trace amounts of 100% C1 gas detected in this formation. No hydrocarbon fluorescence was recorded within this formation.

Nullawaarre Greensand (1490m to 1527m)

There was no more than trace amounts of 100% C1 detected in this formation. No hydrocarbon fluorescence was recorded in the Nullawaarre Greensand.

Belfast Mudstone (1527m to 1565m)

The top half of this formation showed the presence of only trace amounts of 100% C1, however at deeper depths, gas levels rose partially to 10 units of gas (still less than 1%). A chromatograph gas ratio of C1=98%, C2=2% was seen. No hydrocarbon fluorescence was recorded within this formation.

Flaxmans Formation (1565m to 1578m)

During the Flaxmans Formation the background gas level was 4 units, which had a gas chromatograph ratio of C1=99%, C2=1%. No hydrocarbon fluorescence was recorded within this formation.

Waarre Formation (1578m to 1611m)

Waarre "Unit C" (1578m to 1590m)

The primary objective of the Naringal 1 well was the Waarre Sandstone. This unit yielded very poor gas values in the top sand, with no gas shows. Gas levels increased only slightly to a maximum of 25 units of gas in Unit C. The gas chromatograph ratio was of C1=97%, C2=3%. No hydrocarbon fluorescence was recorded within this formation.

Log analysis data identified no pay in Waarre "Unit C".

Waarre "Unit B" (1590m to 1597m)
Very poor gas shows were also recorded in Unit B of the Waarre Formation. Over the 7m thickness of Unit B, gas readings were steady and ranged between 8 and 10 units, with no stand out gas peaks indicated. Gas ratios within Unit B were C1=98%, C2=2%. No oil fluorescence was observed within this formation.

Log analysis data identified no pay in Waarre "Unit B".

Waarre "Unit A" (1597m to 1611m)
There was no gas peak which stood out against background gas levels in the Waarre "Unit A". Gas levels were once again very poor, showing only 8 to 11 units, with a gas ratio of C1=98%, C2=2%. No oil fluorescence was observed in this unit.

Log analysis data identified no pay in Waarre "Unit A".

Eumeralla Formation (1611m to 1710m T.D.)

In the Eumeralla Formation, total gas levels started at 7 units at the top of the formation, and reached a maximum gas reading of 19 units at a depth of 1639m. This gas peak encountered stood out against the background gas of this formation which was 6 units. The gas peak seen in this formation had a gas ratio of C1=99%, C2=1%, whilst the remaining formation showed a gas chromatograph reading of 100% C. No oil fluorescence was observed in this unit.

4. SUMMARY

Naringal 1 has been drilled as an Otway Basin gas exploration well located in the PEP 154 licence, approximately 21 km north west of the town of Peterborough, 9 km WNW of the McIntee gas field and 10 km NW of the Naylor gas field. The Naringal 1 prospect is situated towards the western limit of the productive Waarre Sandstone play fairway of the Port Campbell Embayment.

The primary objective of Naringal 1 was the Late Cretaceous Waarre Sandstone which was mapped as a tilted-fault block closure.

Drilling of Naringal 1 was terminated 85m into the Eumeralla Formation. The majority of the formation tops came within 10m-60m to prognosis. The Flaxmans Formation, Waarre Formation and the Eumeralla Formation all came in high to prognosed (10m, 18m and 29m respectively). The remaining formation tops all came in low to prognosed, ranging from 21m low for the Clifton Formation to 146m low for the Belfast Mudstone.

Wireline logging at total depth of 1710m consisted of the following: Run 1: GR-STD-MSFL-DLL-CAL-LDL-CNL; Run 2: GR-SWC; Run 3: VELOCITY SURVEY. No cores or DST's were carried out on Naringal 1.

Log analysis data indicate the following:

- **No pay in the Waarre Sandstones**.

The Naringal 1 well was plugged and abandoned on 2nd February, 2002.

Four plugs were set at Naringal 1. Plug 1 was set from 1618m to 1528m; Plug 2 set from 1135m to 1035m; Plug 3 set from 404m to 320m and Plug 4 set from 30m to surface.

5. REFERENCES

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APPENDIX I: LITHOLOGICAL DESCRIPTIONS

APPENDIX I (a): CUTTINGS

LITHOLOGICAL DESCRIPTIONS

Ditch cuttings were collected, washed, described, and checked for fluorescence at 10m intervals from the surface to 1000m, 3m intervals from 1000m to total depth at 1710m (driller).

HEYTESBURY GROUP

Port Campbell Limestone (Middle to Late Miocene)

280m thick
SPUD-280m

Spud-280m LIMESTONE: white, off white to buff, microcrystalline, predominantly loose, occasional friable to firm, common shell fragments, common fossil fragments.

MARL: pale to medium grey, medium greyish brown, very calcareous, trace fossil fragments, soft, amorphous to subblocky.

Gellibrand Marl (Early to Middle Miocene)

372m thick
280m-652m

280-382m MARL: pale to medium grey, medium greyish brown, very calcareous, trace fossil fragments, soft, amorphous to subblocky.

382-652m MARL: medium grey to light grey, moderately calcareous, common shell fragments, trace fossil fragments, soft to dispersive in part, amorphous to trace subblocky.

Clifton Formation (Late Oligocene - Early Miocene)

14m thick
652-666m

652-666m MARL: medium grey to light grey, light red, moderately calcareous, common shell fragments, trace fossil fragments, common iron staining, soft to dispersive in part, amorphous to trace subblocky.

LIMESTONE: light orange to light brown, orange red in part, lutitic, arenaceous in part, soft to firm in part, crystalline to micro-crystalline.

Narrawaturk Marl (Late Eocene - Early Oligocene)

53m thick
666-719m

666-719m MARL: medium grey to light grey, light red, moderately calcareous, common shell fragments, trace fossil fragments, common iron staining, soft to dispersive in part, amorphous to trace subblocky.

NIRRANDA GROUP
Mepunga Formation (Middle to Early Oligocene)
79m thick
719m-798m

719-798m MARL: medium grey to light grey, light red, moderately calcareous, common shell fragments, trace fossil fragments, common iron staining, soft to dispersive in part, amorphous to trace subblocky.

SANDSTONE: opaque to translucent, trace clear, medium to fine, trace coarse, moderately sorted, subangular to subrounded, weak calcareous cement, minor argillaceous matrix, trace glauconite nodules, loose, friable in part, good inferred porosity, no fluorescence.

WANGERRIP GROUP
Dilwyn Formation (Eocene)
217m thick
798-1015m

798-830m: SANDSTONE: pale brown, orange brown, minor clear to translucent, medium to coarse grained, occasionally fine, poorly sorted, subrounded to rounded, occasionally well rounded, weak calcareous cement, trace argillaceous matrix, trace pyrite, predominantly loose, good inferred and visual porosity, no fluorescence.

CLAYSTONE: grey to dark grey, arenaceous, very soft to soft, silty, trace sandstone.

830-915m: SANDSTONE: pale brown, orange brown, minor clear to translucent, medium to coarse , occasionally fine, poorly sorted, subrounded to rounded, occasionally well rounded, weak calcareous cement, trace argillaceous matrix, trace pyrite, predominantly loose, good inferred and visual porosity, no fluorescence.

CLAYSTONE: medium to light brown, occasionally grey brown, arenaceous, very soft to soft, minor firm, silty, trace very fine sandstone.

915-1015m: SANDSTONE: pale brown, orange brown, minor clear to translucent, medium to coarse grained, occasionally fine, poorly sorted, subrounded to rounded, occasionally well rounded, weak calcareous cement, trace argillaceous matrix, trace pyrite, predominantly loose, good inferred and visual porosity, no fluorescence.

CLAYSTONE: medium brown, light to medium grey brown, light brown, occasionally medium light grey, arenaceous, trace micromicaceous, trace pyrite, soft to dispersive, trace firm, amorphous to subblocky.

Pember Mudstone (Early Paleocene to Early Eocene)
44m thick
1015-1059m

1015-1059m CLAYSTONE: light to medium brown, medium grey, trace micromicaceous, common carbonaceous specks, trace lithics, soft to dispersive, amorphous, occasionally calcareous.

Pebble Point Formation (Late Palaeocene)
34m thick
1059-1093m

1059-1093m CLAYSTONE: light to medium brown, medium grey, trace micromicaceous, common carbonaceous specks, trace lithics, soft to dispersive, amorphous, occasionally calcareous.

SANDSTONE: clear to translucent, pale brownish grey, fine to medium, occasionally coarse, poorly sorted, subrounded occasionally subangular, loose, poor inferred porosity, no fluorescence.

SHERBROOK GROUP
Paaratte Formation (Mastrichtian to Campanian)
272m thick
1093-1365m

1093-1142m SANDSTONE: clear to translucent, occasionally pale grey brown, very fine to fine, occasionally medium, rare coarse, poorly sorted, subrounded to rounded, minor subangular, predominantly loose, occasional quartz overgrowths, poor inferred porosity, no fluorescence.

CLAYSTONE: light to medium grey, pale brown grey, arenaceous in part, trace micromicaceous, trace lithics, very soft to soft, occasionally dispersive, amorphous, occasionally subblocky.

1142-1172m SANDSTONE: clear to translucent, occasionally pale brown grey, medium to coarse, poorly sorted, subangular to subrounded, weak siliceous cement, common quartz overgrowths, trace lithics, loose, poor inferred porosity, no fluorescence.

SILTSTONE: pale grey, pale brown, medium grey brown, arenaceous, argillaceous in part grading to claystone, trace micromicaceous, trace lithics, soft, subblocky.

1172-1257m SANDSTONE: clear to translucent, minor opaque to frosted, trace pale grey, coarse to very coarse, poorly sorted, subangular to subrounded, weak calcareous cement, common arenaceous matrix, trace quartz overgrowths, common pyrite nodules, common disseminated pyrite with trace fossil replacement, poor to fair visual and inferred porosity, no fluorescence.

SILTSTONE: grey to light grey, arenaceous, trace disseminated pyrite, rare pyrite nodules, trace glauconite, trace fossils fragments, predominantly soft, dispersive in part, subblocky.

1257-1315m SANDSTONE: clear to translucent, off white to opaque in part, medium to coarse, rare very coarse, rare fine, poorly to moderately sorted, subangular, weak siliceous cement, trace arenaceous matrix, rare pyrite nodules, predominantly loose grains, friable in part, fair visual and inferred porosity, no fluorescence.

SILTSTONE: medium dark grey, trace to rare carbonaceous specks, trace disseminated pyrite, rare pyrite nodules, trace fossil fragments, soft to very soft, subblocky to commonly amorphous.

1315-1365m SANDSTONE: clear to translucent, medium to coarse, fine and very coarse in part, poorly sorted, weak siliceous cement, trace arenaceous matrix, rare pyrite nodules, trace quartz overgrowths, predominantly loose grains, fair to good visual and inferred porosity, no fluorescence.

SILTSTONE: dark grey, rare pale grey to pale brown, arenaceous, micromicaceous, disseminated pyrite, rare pyrite nodules, firm to soft, sub blocky to amorphous in part.

<u>Skull Creek Mudstone</u> (Santonian to Campanian)
125m thick
1365-1490m

1365-1490m SILTSTONE: pale grey, light brown grey, rare off white, argillaceous, rare arenaceous, trace micromicaceous, trace glauconite, trace disseminated pyrite, soft to dispersive, amorphous, occasionally subblocky.

SANDSTONE: clear to translucent, occasionally pale grey, occasionally off white, very fine to medium, occasionally coarse, poorly to moderately well sorted, subangular to subrounded, weak siliceous cement, trace glauconite, trace lithics, trace pyrite, trace carbonaceous specks, predominantly loose, occasionally friable to firm aggregates, poor inferred porosity, no fluorescence

<u>Nullawaarre Greensand</u> (Late Eocene-Early Oligocene)
37m thick
1490-1527m

1490-1527m SANDSTONE: pale green, pale grey green, clear to translucent, fine to medium grained, occasionally coarse, poorly sorted, subangular to subrounded, weak siliceous cement, common quarts overgrowths, trace argillaceous matrix, abundant glauconite, trace lithics, trace pyrite, predominantly loose, occasionally firm aggregates, poor inferred and visual porosity, no fluorescence.

<u>Belfast Mudstone</u> (Santonian to Coniacian)
38m thick
1527-1565m

1527-1565m SILTSTONE: dark green grey, medium grey, arenaceous, abundant glauconite, trace micromicaceous, trace lithics, firm, subblocky.

SANDSTONE: pale green, clear to translucent, green grey, occasionally pale yellow, fine to coarse grained, predominantly medium, poorly sorted, subangular to subrounded, occasionally angular, weak siliceous cement, trace argillaceous matrix, abundant glauconite, trace lithics, trace carbonaceous inclusions, predominantly loose, poor inferred and visual porosity, no fluorescence.

Flaxmans Formation (Turonian)
13m thick
1565-1578m

1565-1578m SANDSTONE: predominantly pale brown, common pale green, trace translucent to off white, very fine to fine, medium in part, angular to subangular, weak to moderate siliceous cement, minor argillaceous matrix, abundant glauconite, rare micromicaceous, trace lithics, friable to firm aggregates, trace to rare loose, poor inferred and visual porosity, no fluorescence.

SILTSTONE: dark brown grey, medium grey, brown, arenaceous, common glauconite, trace micromicaceous, trace lithics, firm, subblocky.

Waarre Formation (Turonian)
33m thick
1578-1611m

1578-1611m SANDSTONE: pale brown, off white, clear to translucent, yellow, grey, fine to coarse, poorly sorted, subangular to subrounded, occasional subrounded, moderate siliceous cement, occasional quartz overgrowths, common argillaceous matrix, trace glauconite, trace pyrite, predominantly loose grains, occasional hard aggregates, poor to fair visual and inferred porosity, no fluorescence.

SILTSTONE: light grey, grey brown, dark grey, arenaceous, rare argillaceous, common glauconite, soft to hard, subblocky to blocky, occasionally fissile.

Eumeralla Formation (Albian)
85+m
1611-1710m(D) TD

1611-1710m SANDSTONE: white, clear, pale grey, yellow brown in part, fine to medium, rare coarse, moderately well sorted, subangular to subrounded, abundant argillaceous matrix, weak to moderate siliceous cement, rare glauconite (possible contamination), trace pyrite, trace quartz overgrowths, predominantly loose, minor firm aggregates, poor visual and inferred porosity, no fluorescence.

SILTSTONE: light grey, off white, argillaceous, soft to firm, subblocky to blocky.

APPENDIX I (b): SIDE WALL CORES

Core Gun Shot Report

Reeves

Tool Assembly
CGR- 13
CBA- 15

Client: Santos
Well: Naringal 1

Date: 31-Jan-02
Unit: V1030

Engineer: J. Kokonas
Witness: A. Hill

Core No.	Core Depth	Depth Offset	Shot Depth	Sonic Transit Time	Bullet Type	Cutter Ring	Powder Load	Pull	Sold	Remarks
1	1660.7	3.1	1657.6	79	Bobcat	Yes	550		Yes	Good Recovery
2	1647.7	3.0	1644.7	83	Bobcat	Yes	550	100	Yes	Good Recovery
3	1625.7	3.0	1622.7	84	Bobcat	No	550		Yes	Good Recovery
4	1615.7	2.9	1612.8	86	Bobcat	No	550		Yes	Good Recovery
5	1611.7	2.8	1608.9	80	Bobcat	Yes	550		Yes	Good Recovery
6	1609.7	2.8	1606.9	77	Bobcat	Yes	550	200	Yes	Good Recovery
7	1607.7	2.7	1605.0	83	Bobcat	No	550		Yes	Good Recovery
8	1605.7	2.6	1603.1	83	Bobcat	Yes	550		Yes	Good Recovery
9	1602.7	2.6	1600.1	84	Bobcat	Yes	550		No	Misfire
10	1600.7	2.5	1598.2	81	Bobcat	Yes	550	100	Yes	Good Recovery
11	1598.7	2.4	1596.3	81	Bobcat	No	550		Yes	Good Recovery
12	1595.7	2.4	1593.3	84	Bobcat	Yes	550		No	Lost
13	1594.2	2.3	1591.9	91	Bobcat	Yes	450	100	Yes	Good Recovery
14	1592.7	2.3	1590.4	83	Bobcat	No	550		Yes	Good Recovery
15	1590.7	2.2	1588.5	88	Bobcat	Yes	450		Yes	Good Recovery
16	1585.7	2.1	1583.6	89	Bobcat	Yes	450	100	Yes	Good Recovery
17	1582.7	2.1	1580.6	84	Bobcat	No	550		Yes	Good Recovery
18	1581.2	2.0	1579.2	90	Bobcat	Yes	450	50	Yes	Good Recovery
19	1576.7	1.9	1574.8	80	Bobcat	No	550	50	Yes	Good Recovery
20	1574.7	1.9	1572.8	86	Bobcat	No	550		Yes	Good Recovery
21	1571.2	1.8	1569.4	82	Bobcat	No	550		No	Misfire
22	1559.7	1.7	1558.0	89	Bobcat	Yes	550		Yes	Good Recovery
23	1554.7	1.7	1553.0	97	Bobcat	Yes	550		No	Misfire
24	1545.7	1.6	1544.1	92	Bobcat	Yes	550		No	Misfire

APPENDIX II: HYDROCARBON SHOW REPORTS

There were no hydrocarbon shows on Naringal 1

APPENDIX III: WIRELINE LOGGING REPORTS

APPENDIX III (a): LOGGING ORDER FORM

Santos
A.B.N. 80007 550 923

LOGGING ORDER FORM

COMPANY:	Santos		
WELL:	NARINGAL 1	**FIELD:**	OTWAY
RIG:	OD&E 30	**STATE:**	VICTORIA
LOCATION:	OTWAY, VICTORIA	**BLOCK:**	PEP 154
LATITUDE:	38 27' 18.32" S (GDA 94)	**LONGITUDE:**	142 44' 22.34" E (GDA 94)
ELEVATION:	**GL:** 50.17	**RT:** 54.87	**DF:** 4.70
9 7/8" HOLE:	382m	**7 5/8" CSG:** 378 (D)	**WT:** 26.4 lb/ft, L-80, BTC
6 3/4" HOLE:	1710	**CSG:**	**WT:**
TD (Drilr.)	1710	**TD (Logr.):**	1696.00
MUD SYSTEM:	4.2% KCl / Polymer	**CIRC. STOPPED:**	07:15 AM 30/January/2002
WT: 9.4	**VISC:** 39 **PV/YP:** 11/14 **PH:** 9.5	**FLUID LOSS:** 6.2	**CHL:** 26,000
GEOLOGIST:	A. HILL		**K+:** 22,700

INFORMATION GIVEN ABOVE IS TO BE USED ON LOG HEADING SHEETS.

HOLE CONDITIONS: (TIGHT SPOTS, DEVIATION, COALS, BARITE IN MUD, ETC..)

Maximum Hole Deviation:1.75deg @ 1694m
Maximum Dog Leg Severity: 1.99deg @ 1694m
KCl: 4.2 %, BARITE 0.50%

No expected over-pressure or depletion in Waarre Sandstone, possible over pressure in Eumeralla Fmn.
Expected fm press: 2250 psi
TIGHT HOLE:
Expected BHT: 200 Deg F Static (93.3 DegC)

DRILL STEM TESTS/CORED INTERVALS:

NO FORMATION TESTS

COMMENTS

LOGS:

PROGRAM CONFIRMED WITH OPERATIONS GEOLOGIST AT **07:30HRS** **HOURS ON** **30/01/2002**

PROGRAM VARIES FROM PRE-SPUD NOTES: **YES:** **X** **NO:**

LOG	INTERVAL (m)	REMARKS/REPEAT SECTION
RUN # 1		
GR	TD to Surface	
SDT	TD to Surface	Full Waveform to 1500m
MSFL-DLL-CAL	TD to surface casing	MFSL to 100m above Pember Member, approx 850m
LDL-CNL	TD to 1490m	
RUN # 2		
SWC		
20 Samples	Points to be chosen from Run 1	Contingent on town
RUN # 3		
GR		
20 MDT Points	Points to be chosen from Run 1	Contingent on town
RUN # 4		
VELOCITY SURVEY		
Transmitted Ascii data to include: dt24, dth, dtr, dtt, so11, so12, so13, so14 sonic curves.		

REMARKS:

(ALL OPERATIONS ARE TO CONFORM TO CURRENT SANTOS OPERATING PROCEDURES)

1 TENSION CURVE - TO BE DISPLAYED ON LOG FROM T.D. TO CASING SHOE.

2 ALL CALIBRATIONS IN CASING MUST BE VERSUS DEPTH. (IF HOLE CONDITIONS PERMIT).

3 SONIC WAVEFORMS TO BE RECORDED FROM TD TO 30m ABOVE CONIACIAN (WAARRE FORMATION.

4 ALL ZONES OF SONIC CYCLE SKIPPING OR POOR QUALITY DATA TO BE REPEATED AND NOTED IN REMARKS SECTION. (EXCEPT ABOVE NARRAWATURK MARL. IF HOLE CONDITION IS POOR).

5 REPEAT SECTION NOT TO BE RUN IN 6" HOLES, COMPARE DOWN LOG FOR REPEAT ANALYSIS.

6 REPEAT SECTION TO BE LOGGED PRIOR TO MAIN LOG OVER INTERVAL OF INTEREST. (IF HOLE CONDITIONS ALLOW). CONFIRM REPEAT SECTION INTERVAL WITH OPERATIONS GEOLOGIST.

7 ALL THERMOMETER READINGS TO BE RECORDED ON LOG

8 ALL SCALES AND PRESENTATIONS TO CONFIRM TO STANDARDS UNLESS OTHERWISE ADVISED.

9 THE FIELD/EDIT TAPE MUST BE A MERGED COPY OF ALL LOGS RUN. SEPARATE TAPES ARE ONLY ACCEPTABLE AS AN INTERIM MEASURE.

10 ANY CHANGE FROM STANDARD PROCEDURES/SCALES TO BE NOTED IN REMARKS SECTION.

11 RM, RMF, RMC AND BHT MUST BE ANNOTATED ON FAXED LOGS. FAXED LOGS SHOULD ALSO INDICATE IF ON DEPTH OR NOT.

12 LOG DATA IS TO BE TRANSMITTED AS SOON AS POSSIBLE AFTER ACQUISITION. IF ANY DELAYS ARE LIKELY OR IF DATA TRANSMISSION WILL ADVERSELY EFFECT THE OPERATION THEN THE OPERATIONS GEOLOGIST MUST BE IMMEDIATELY INFORMED.

13 THE OPERATIONS GEOLOGIST MUST BE INFORMED IMMEDIATELY OF ANY TOOL OR HOLE PROBLEMS, LOST TIME OR ANY OTHER EVENT WHICH MAY AFFECT THE LOGGING OPERATIONS.

APPENDIX III (B): ELECTRIC LOG TIME SUMMARY

30-Jan	RIG UP / DOWN	TOOL CHECK	RIH / POOH	LOGGING	DATA TX	LOST TIME LOGGER	I. O.	WIPER TRIP	LOST TIME OTHERS	OTHERS	COMMENTS / REMARKS
0:00											
:30											
1:00											
:30											
2:00											
:30											
3:00											
:30											
4:00											
:30											04:30, WELL TD, CIRCULATE BOTTOMS UP
5:00											
								0:15			WIPER TRIP
:30								0:15			
								0:15			
6:00								0:15			
								0:15			
:30								0:15			
								0:15			
7:00								0:15			
			0:15								07:15, STOP CIRCULATION, POOH FOR LOGGING
:30			0:15								
			0:15								
8:00			0:15								
			0:15								
:30			0:15								
			0:15								
9:00			0:15								
			0:15								
:30			0:15								
			0:15								
10:00			0:15								
			0:15								
:30			0:15								
			0:15								
11:00			0:15								
			0:15								
:30	0:15										11:30, START RIGGING UP SHEAVES.
	0:15										

WSG (SIGN)	ENGINEER (SIGN)

TOTALS

0:30	0:30	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

TOOLS RUN:	GR-SDT-MFSL-DLL-CAL-LDL-CNL
TOOLS RUN:	GR-SWC
TOOLS RUN:	GR-VELOCITY

LOGGING UNIT:	1030	WELL NAME:	NARINGAL 1	PAGE:	2

30-Jan	RIG UP / DOWN	TOOL CHECK	RIH / POOH	LOGGING	DATA TX	LOST TIME LOGGER	I. O.	WIPER TRIP	LOST TIME OTHERS	OTHERS	COMMENTS / REMARKS
12:00	0:15										
	0:15										12:25, RIH WITH RUN 1 (GR-MSFL-DLL-CAL-LDL-CNL)
:30			0:15								12:35, CALIBRATE @ SHOE, 2m OUT, REZERO @ SURFACE
		0:15									12:50, 2m OFF DEPTH, POOH, REZERO @ SURFACE
13:00						0:15					13:05, BACK TO SHOE, CALIBRATE CORRECT.
			0:15								
:30			0:15								
			0:15								
14:00			0:15								
				0:15							14:20, AT BOTTOM, LOGGERS TD - 1695m
:30				0:15							START SEMBLANCE PROCESSING
				0:15							
15:00				0:15							BACK TO BOTTOM FOR MAIN UPLOG
				0:15							
:30				0:15							
				0:15							
16:00				0:15							16:00, STOP UPLOG FOR PDF FILE MAKING
				0:15							
:30				0:15							
				0:15							
17:00				0:15							17:10, TOOLS AT SURFACE, START RIG DOWN RUN 1.
	0:15										
:30	0:15										
	0:15										
18:00	0:15										18:00, TOOLS ON CATWALK
	0:15										18:30, RUN 1 RIGGED DOWN, RIG UP RUN 2 (GR-SWC)
:30	0:15										RIG UP SWC GUN, 24 SAMPLES PLANNED
	0:15										
19:00	0:15										
	0:15										
:30	0:15										
	0:15										
20:00	0:15										
	0:15										
:30	0:15										
	0:15										
21:00			0:15								21:00, CONDUCT SAFETY MEETING, START RIH RUN 2
			0:15								
:30			0:15								
			0:15								21:45, GR CORRELATION, AND AGAIN, AND AGAIN…….
22:00			0:15								
			0:15								
:30				0:15							22:30, SHOOT FIRST POINT,
				0:15							
23:00						0:15					21:55, GR SUB FAILED, LOST TOOL COMUNICATION, POOH
						0:15					5 GOOD SHOTS.
:30						0:15					
						0:15					

WSG (SIGN)	ENGINEER (SIGN)

TOTALS

6:30	1:45	0:15	1:15	3:00	0:00	0:15	0:00	0:00	0:00	0:00	TOOLS RUN: GR-SDT-MFSL-DLL-CAL-LDL-CNL
5:30	2:30	0:00	1:30	0:30	0:00	1:00	0:00	0:00	0:00	0:00	TOOLS RUN: GR-SWC
0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	TOOLS RUN: GR-VELOCITY

31-Jan	RIG UP / DOWN	TOOL CHECK	RIH / POOH	LOGGING	DATA TX	LOST TIME LOGGER	I. O.	WIPER TRIP	LOST TIME OTHERS	OTHERS	COMMENTS / REMARKS
0:00						0:15					
				0:15							BACK IN TO SHOOT SWC
:30				0:15							
				0:15							
1:00				0:15							
				0:15							
:30				0:15							
				0:15							
2:00				0:15							
			0:15								02:30, TOOL TO SURFACE, START RIG DOWN…
:30	0:15										
	0:15										02:50, RIG DOWN SHEAVES, START WIPER TRIP..
3:00								0:15			WIPER TRIP PRIOR TO VELOCITY SURVEY
								0:15			
:30								0:15			
								0:15			
4:00								0:15			
								0:15			
:30								0:15			
								0:15			
5:00								0:15			
								0:15			
:30								0:15			
								0:15			
6:00								0:15			
								0:15			
:30								0:15			
								0:15			
7:00								0:15			
								0:15			
:30								0:15			
								0:15			
8:00								0:15			
								0:15			
:30								0:15			
								0:15			
9:00								0:15			
								0:15			
:30								0:15			
								0:15			
10:00								0:15			
								0:15			
:30	0:15										10:30, START RIG UP FOR VELOCITY SURVEY… WAIT ON
	0:15										EXPERTEST TO RIG CHARGES..
11:00	0:15										
	0:15										
:30	0:15										
	0:15										

WSG (SIGN)	ENGINEER (SIGN)

TOTALS

0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
3:00	0:30	0:00	0:15	2:00	0:00	0:15	0:00	0:00	0:00	0:00
1:30	1:30	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

TOOLS RUN:	GR-SDT-MFSL-DLL-CAL-LDL-CNL
TOOLS RUN:	GR-SWC
TOOLS RUN:	GR-VELOCITY

LOGGING UNIT:	1030	WELL NAME:	GR-SDT-MFSL-DLL-CAL	PAGE:	2

31-Jan	RIG UP / DOWN	TOOL CHECK	RIH / POOH	LOGGING	DATA TX	LOST TIME LOGGER	I. O.	WIPER TRIP	LOST TIME OTHERS	OTHERS	COMMENTS / REMARKS
12:00	0:15										
	0:15										
:30			0:15								12:30, RIH WITH VELOCITY GEAR... NO GR ????
				0:15							12:45, POWER DOWN TO RIG, START RIG UP CHARGES
13:00				0:15							FIRST TESTS @ 56m, BACKGROUND NOISE CHECK..
				0:15							
:30				0:15							13:35, TESTS AT CASING SHOE.....
				0:15							
14:00				0:15							14:00, RIH TO TESTS ON DOWN RUN.
				0:15							
:30				0:15							
				0:15							
15:00				0:15							15:00, AT BOTTOM, START UP - TESTING POINTS
				0:15							
:30				0:15							
				0:15							
16:00				0:15							
				0:15							
:30				0:15							
				0:15							
17:00				0:15							
				0:15							
:30				0:15							
				0:15							
18:00				0:15							18:00, LAST SHOT DONE, POOH, START RIG DOWN
	0:15										18:20, INITIAL TEST REPORT FINISHED
:30	0:15										
	0:15										
19:00											WELL TO SANTOS
:30											
20:00											
:30											
21:00											
:30											
22:00											
:30											
23:00											
:30											

WSG (SIGN)	ENGINEER (SIGN)

TOTALS

0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
7:00	1:15	0:00	0:15	5:30	0:00	0:00	0:00	0:00	0:00	0:00

TOOLS RUN:	GR-SDT-MFSL-DLL-CAL-LDL-CNL
TOOLS RUN:	GR-SWC
TOOLS RUN:	GR-VELOCITY

GRAND TOTALS

7:00	2:15	0:15	1:15	3:00	0:00	0:15	0:00	0:00	0:00	0:00	TOOLS RUN: GR-SDT-MFSL-DLL-CAL-LDL-CNL
8:30	3:00	0:00	1:45	2:30	0:00	1:15	0:00	0:00	0:00	0:00	TOOLS RUN: GR-SWC
8:30	2:45	0:00	0:15	5:30	0:00	0:00	0:00	0:00	0:00	0:00	TOOLS RUN: GR-VELOCITY

OVERALL JOB TOTAL

24:00	8:00	0:15	3:15	11:00	0:00	1:30	0:00	0:00	0:00	0:00

SERVICE QUALITY SUMMARY

CLIENT WSG					ENGINEER					
1	2	3	4	5	1	2	3	4	5	
						✓				SAFETY
					✓					PROMPTNESS
							✓			TOOL & SURFACE SYSTEM PERFORMANCE
					✓					ATTITUDE & CO-OPERATION
					✓					WELLSITE PRODUCTS / LOG QUALITY
						✓				COMMUNICATIONS / TX PERFORMANCE
										OTHER (PLEASE SPECIFY)

1 Excellent, 2 - 3 Normal, 4 - 5 Very Poor

APPENDIX III (C): FIELD ELECTRIC LOG REPORT

SANTOS LIMITED

FIELD ELECTRIC LOG REPORT

WELL:	**NARINGAL 1**	**GEOLOGIST:**	**A. HILL**
LOGGING ENGINEER:	**J. KOKONAS, G McMANUS**		**SUITE 1, RUN 1 & 2**
RUN No.:	**1, 2**	**DATE LOGGED:**	**30-Jan-02**
DRILLERS DEPTH:	**1710.00**	**LOGGERS DEPTH:**	**1696.00**
ARRIVED ON SITE:	**PM (29 JAN)**	**CIRCULATION STOPPED:**	**07:15 30/Jan/02**
ACTUAL LOGGING TIME:	**24:00**	**LOST TIME LOGGERS:**	**1:30**
TOTAL TIME:	**24:00**	**LOST TIME OTHERS:**	**0:00**

TYPE OF LOG	**GR-SDT-MFSL-DLL-CAL-LDL-CNL**	**GR-SWC**
TIME CIRC. STOPPED:	**07:15 30/Jan/02**	**07:15 30/Jan/02**
TIME TOOL RIG UP:	**11:30 30/Jan/02**	**18:30 30/Jan/02**
TIME TOOL RIH:	**12:25 30/Jan/02**	**21:00 30/Jan/02**
TIME TOOL RIG DOWN:	**18:30 30/Jan/02**	**03:00 31/Jan/02**
TOTAL TIME:	**7:00**	**8:30**

TYPE OF LOG	**GR-VELOCITY**	
TIME CIRC. STOPPED:	**07:15 30/Jan/02**	
TIME TOOL RIG UP:	**10:30 31/Jan/02**	
TIME TOOL RIH:	**12:30 31/Jan/02**	
TIME TOOL RIG DOWN:	**19:00 31/Jan/02**	
TOTAL TIME:	**8:30**	

TYPE OF LOG	**FROM (m)**	**TO (m)**	**REPEAT SECTION**	**TIME SINCE LAST CIRCULATION**	**BHT**
RUN # 1					
GR	1675	SURFACE		7:10	71°C
STD	1685	360			
STD (WAVEFORM)	1685	1485			
MSFL	1695	360			
DLL	1694	360			
CAL	1695 (MSFL), 1679 (LDL)	360			
LDL	1680	1480			
CNL	1677	1480			
RUN # 2					
GR-SWC	24 PRESET POINTS	4 MISFIRES, 1 LOST, 19 BOUGHT		BHT not recorded	
RUN # 3					
VELOCITY SURVEY	20 CHECK SHOTS			BHT not recorded	

SUITE/ RUN	**BHT**	**DEPTH**	**TIME**	**SUITE/ RUN**	**BHT**	**DEPTH**	**TIME**	**SUITE/ RUN**	**BHT**	**DEPTH**	**TIME**	**SUITE/ RUN**	**BHT**	**DEPTH**	**TIME**
1 / 1	71	1690	7.2	**1 / 2**				**1 / 3**				**1 / 4**			

MUD SYSTEM:	**TYPE**	**WT.**	**VISC.**	**WL**	**PH**	**Cl^-**	**PV/YP**	**RMF**	**RM**	**RMC**
	4.2% KCl / Polymer	9.4	39	6.2	9.5	26,000	11/14	0.216 ohmm @ 16.5 C	0.233 ohmm @ 18.8 C	0.388 ohmm @ 20.9 C

HOLE CONDITIONS:

Maximum Hole Deviation:1.75deg @ 1694m

Maximum Dog Leg Severity: 1.99deg @ 1694m

KCl: 4.2 %, BARITE 0.50%

LOG ORDER FORM	✓	MUD SAMPLE RESISTIVITY	✓	TOOL No. / CODE CHECK	
OFFSET WELL DATA		CABLE DATA CARD	✓	LOG SEQUENCE CONFIRM	✓

LOG TYPE	SDT	GR	CAL	DLL	MSFL	SP	ZDL	CNL		GR	SWC	REMARKS
CASING CHECK			✓									
SCALE CHECK	✓	✓	✓	✓	✓	✓	✓	✓				
DEPTH Casing Total		✓	✓		✓							
CALIBRATIONS OK	✓	✓	✓	✓	✓	✓	✓	✓				
REPEATABILTY												
LOGGING SPEED	✓	✓	✓	✓	✓	✓	✓	✓				
OFFSET WELL REPEATABILITY												
NOISY MISSING DATA	🗁		🗁									
CURVES / LOGS DEPTH MATCHED												
Rm MEASURMENTS				✓	✓							
RS / RD CHECK				✓								
?PERF / ZCOR CHECK												
LOG HEADER / TAIL	✓	✓	✓	✓	✓	✓	✓	✓				
PRINT FILM QUALITY	✓	✓	✓	✓	✓	✓	✓	✓				

Notes:

1 - SDT DATA A LITTLE NOISY DUE TO ROAD NOISE?

2 - CAL DATA STRANGE…. HAS VERY RUGOSE WALL?

APPENDIX IV: LOG ANALYSIS

NARINGAL 1 - LOG ANALYSIS

Naringal 1 wireline logs were analysed over the Waarre Sandstone to total depth (1561m-1678m) interval. No gas pay was identified. Naringal 1 was plugged and abandoned.

A 9 7/8" surface hole was drilled to 382 metres and 7 5/8" casing set at 378 metres. A 6 3/4" hole was then drilled with KCl/PHPA mud to 1710 metres (D). Wireline logging was carried out by Reeves (as described below).

Unless otherwise specified, all depths mentioned below are loggers depths referenced to the drill floor.

Logs Acquired

Run 1	GR	1675-Surface
	CSS (Long Spaced Compensated Sonic Sonde)	1685-360m
	(Waveform Sonic)	1685-1487m
	DLS (Dual Laterolog Sonde)	1694-360m
	MLL (Microlog)	1697-360m
	PDS (Compensated Density Sonde)	1680-1480m
	CNS (Compensated Neutron Sonde)	1678-1480m

Mud Parameters

Mud Type	KCl/polymer
Mud Density	9.35ppg
KCl	4.2%
Rm	0.233 ohmm @ 18.8^{o}C
Rmf	0.216 ohmm @ 16.5^{o}C
Rmc	0.388 ohmm @ 20.9^{o}C
MRT	71.0^{o}C from Run 1 at 1697m

Remarks

- The laterolog and sonic was run with 1 inch stand-offs.
- Neutron run with eccentraliser

Log Processing

- Regional salinity data was used to derive the R_w used for this analysis.
- A BHT of 76^{o}C was used for the analysis (Gradient of 30^{o}C/km).

Interpretation Procedures and Parameters

An interpretation over the Waarre Sandstone intervals was conducted using density (DPHI)-neutron (NPRL) porosity. A gamma-ray derived volume of shale was calculated with water saturations computed using a pseudo-Archie Equation (Parameters used for the interpretation are detailed in Table 1).

- The GR from Run 1 was corrected for environmental effects such as mud-weight, KCl and borehole size using measurements made from the MLL caliper.

- Borehole corrections for the Dual Laterolog SLL and DLL curves using 1" stand-offs were applied (Table 1). These are ratios illustrated in the Reeves charts Lat-1 and Lat-2 respectively.

- The borehole corrected deep resistivity curve (DLL_BC) was further corrected for shoulder effects (DLLc).

- The invasion corrected R_T was derived using the following tornado chart emulation relationship:

  $R_T = (1.59*DLL_C - 0.59*SLL\_BC)$
  where:
  DLL_C = Deep resistivity response borehole and shoulder bed corrected.
  SLL_BC = Shallow resistivity response borehole corrected.

- Density porosity was calculated over the Waarre Sandstones as shown below. The 2.67 value was taken as the average grain density from core analysis in offset wells.

  DPHI = (2.67 - DEN) / (1.67)
  where:
  DEN= Bulk Density in g/cc.

- A Hunt-Raymer sonic porosity curve was calculated:

  SPHI = (DTC2 – 55.5/DTC1)*0.625

  where:
  DTC2 = 3-4ft Compensated Sonic (μs/ft).

- PHIE was primarily produced from the minimum value of DPHI and NPRL with some editing to SPHI and porosity interpreted from the MLL.

A shale corrected porosity (PHIE to be used in the pseudo-Archie equation) was calculated as follows:

if Vsh < VshSt…….. PHIE = DPHI

elseif VshSt < Vsh < VshCO… PHIE = a proportional percentile correction from DPHI to (DPHI – (Vsh * PHIsh))

elseif Vsh > VshCO …… PHIE = DPHI - (Vsh * PHIsh)

where:
VshSt = The start of the sliding scale Vsh correction.
VshCO = Shale volume cut-off.
Vsh = Shale volume.
DPHI = Combination of density/neutron and sonic porosity.
PHIsh = Apparent shale porosity.

- Limited SCAL data from Mylor indicate that the cementation exponent “m” for the Waarre sandstones has a range between 1.67 and 1.84 and varies with porosity. Given this range, it was appropriate to use a variable cementation exponent “m” for the use in calculating S_w. The derivation of “m” was porosity based and results in “m” decreasing as porosity increases. The variable “m” relationship is given as;

  *MEXP = (-0.2413 * Log10 PHIE) +2.4657*

- Limited SCAL data from Mylor indicate that the saturation exponent "n" for the Waarre sandstones has a range between 1.52 and 1.78 and varies with porosity and shaleness. A pseudo saturation exponent "n" has been used in the Archie equation. This is to take into account the impact of micro-porosity inherent in shaly sandstones. It is postulated that shale intergranular micro-porosity increases the surface area (conductivity) of the rock, and therefore "n" needs to be adjusted to compensate for the extra conductivity in shaly sandstones.

  Clean sand "n" =1.85 Shaly sand "n" = 1.50

  Shaly sand is defined where the shale volume is greater than a cut-off of 40%. Saturation exponent is gradational between the two end-points above.

- Water saturations were calculated using a pseudo-Archie equation.

$$SW = \sqrt[n]{\frac{aRw}{\phi^m Rt}}$$

where: R_w = Resistivity of formation water at formation temperature.
RT = True resistivity, i.e. resistivity of the non-invaded reservoir (i.e. LLD corrected for borehole, invasion and resistive shoulder beds).
PHIT = Input as shale corrected PHIE (derived above).
a = Porosity coefficient (default = 1).
m = Cementation factor or exponent from the variable "m" relationship.
n = Saturation exponent from the "n" relationship derived above.

Conclusions

1. Naringal 1 log analysis identified no pay in the Waarre Sandstones.

2. Naringal 1 was plugged and abandoned.

Attached is the well evaluation summary (WES) plot for Naringal 1 (02.010)
/data/wes_ot/naringal1_02.010_waarre.wes

TABLE 1
Log Analysis Parameters

PARAMETERS	WAARRE C SANDSTONE	WAARRE A SANDSTONE
R_w (ohmm) @ 25°C	0.3	0.3
a	1	1
m	Variable	Variable
n	Variable	Variable
Borehole cor RD	0.96	0.96
Borehole cor RS	0.95	0.95
RD Shoulder Corr.	0.8	0.8
GR matrix (API)	30	30
GR shale (API)	120	120
VSHST	0.0	0.0
VSHCO	0.4	0.4
PHISH	0.12	0.12

APPENDIX V: PRESSURE SURVEY

No pressure surveys were taken for Naringal 1

APPENDIX VI: DRILL STEM TEST DATA

No drill stem tests were conducted for Naringal 1

APPENDIX VII: HYDROCARBON ANALYSIS

No Hydrocarbon Analysis was done for Naringal 1

APPENDIX VIII: WATER ANALYSIS

No Water Analysis was conducted on Naringal 1

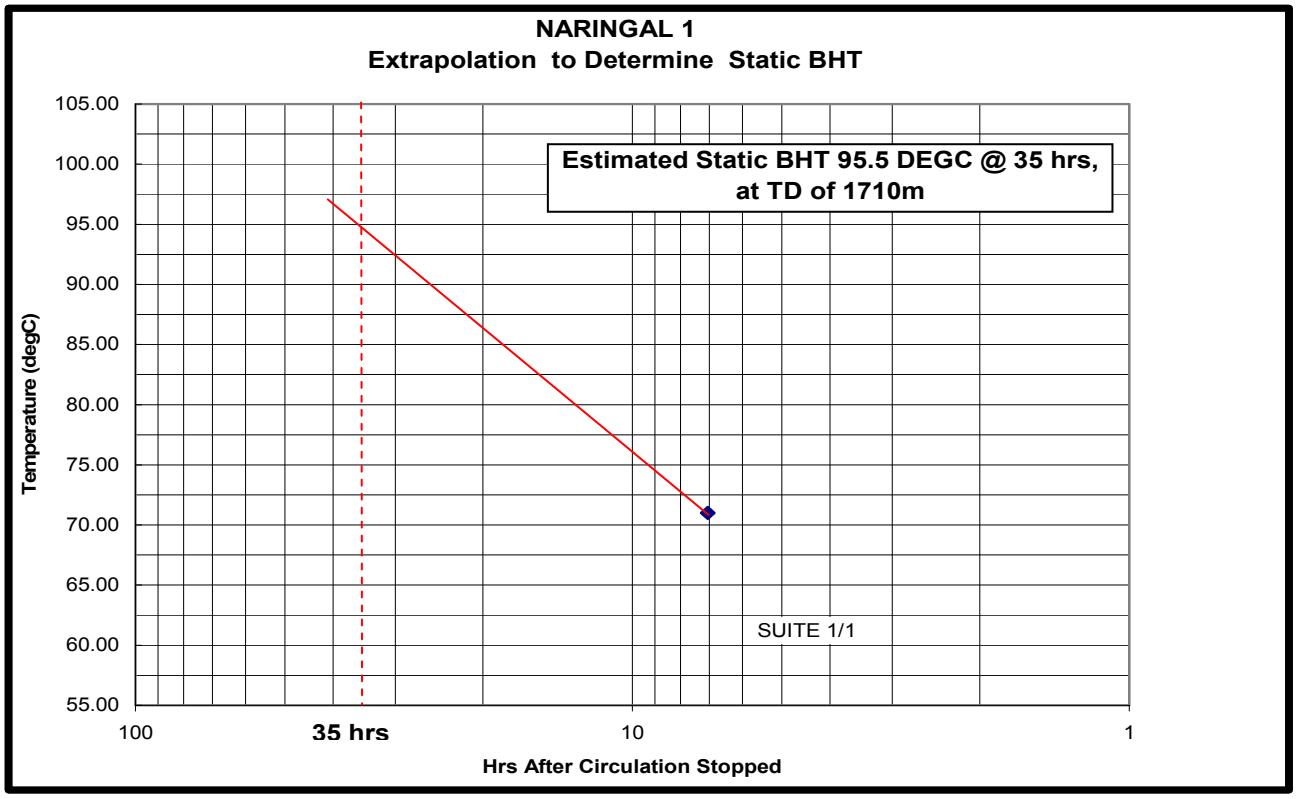
APPENDIX IX: PALYNOLOGICAL ANALYSIS

This analysis will be forwarded as soon as it is available.

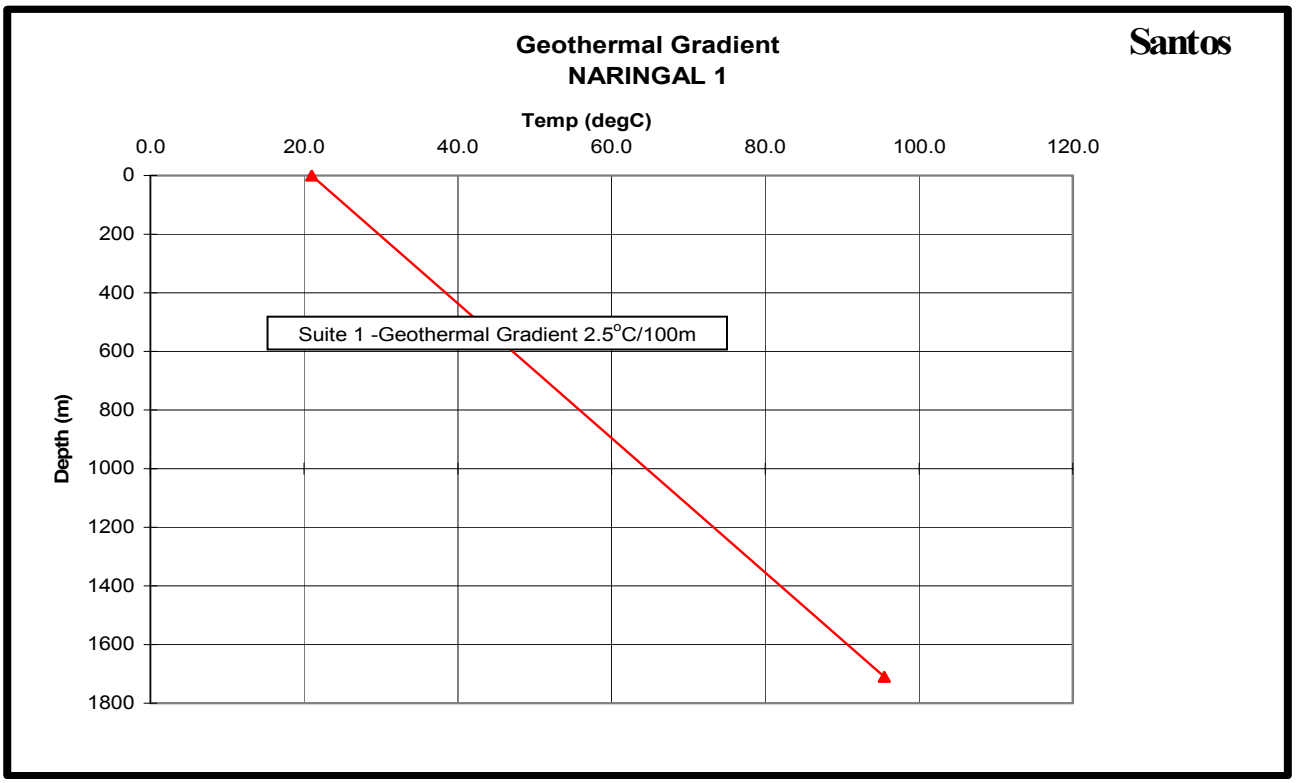
APPENDIX X: GEOTHERMAL GRADIENT

Calculated using Rule of Thumb method as only one logging temperature recorded.

	Max Recorded Temp (degC)	Depth Recorded (m)	Time Since Circulation. (hrs)	Total Depth (m)	Estimated BHT (degC)
Run 1	71	1710	7.05	1710	71.00
Run 2					
Run 3					

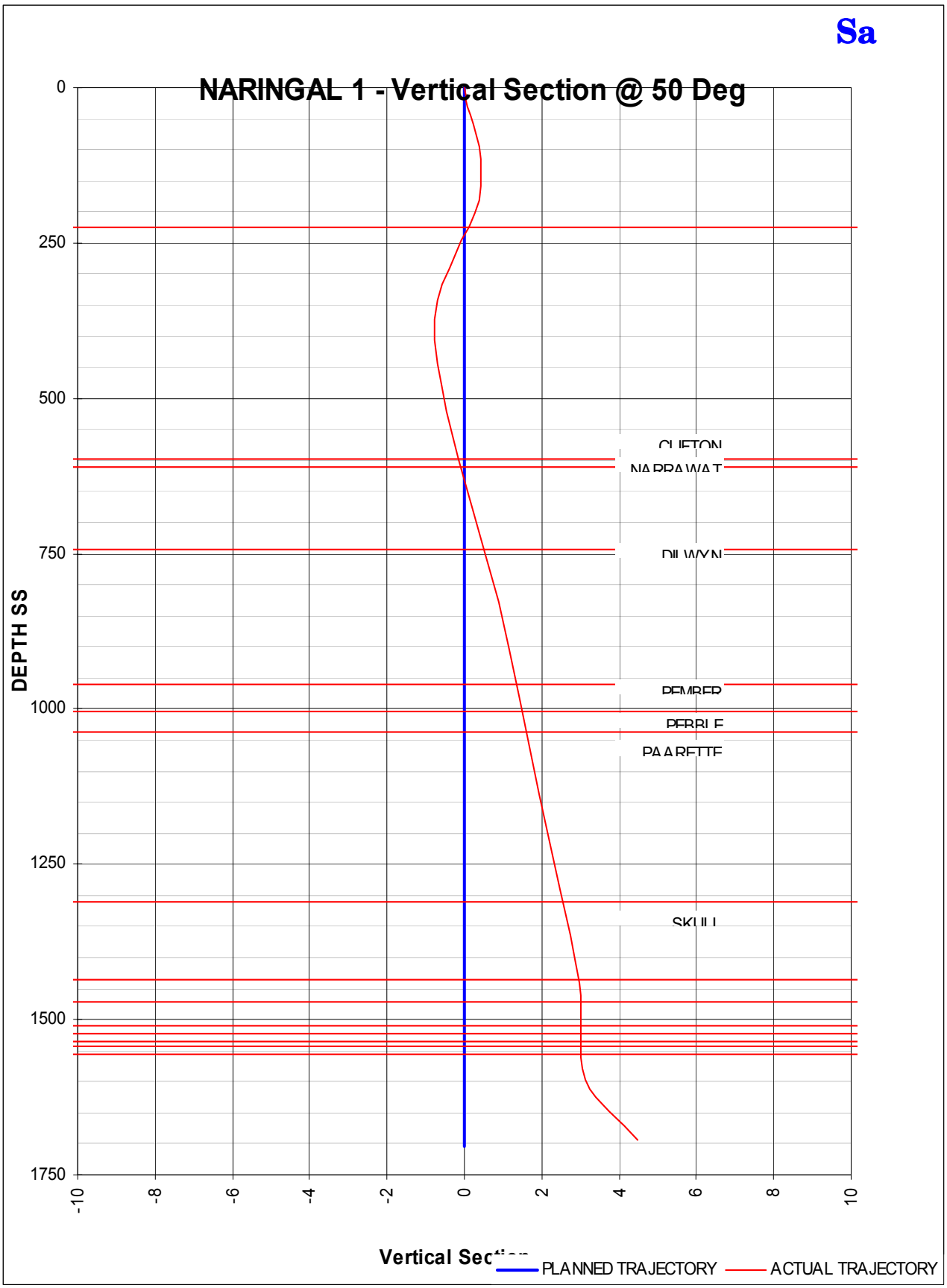


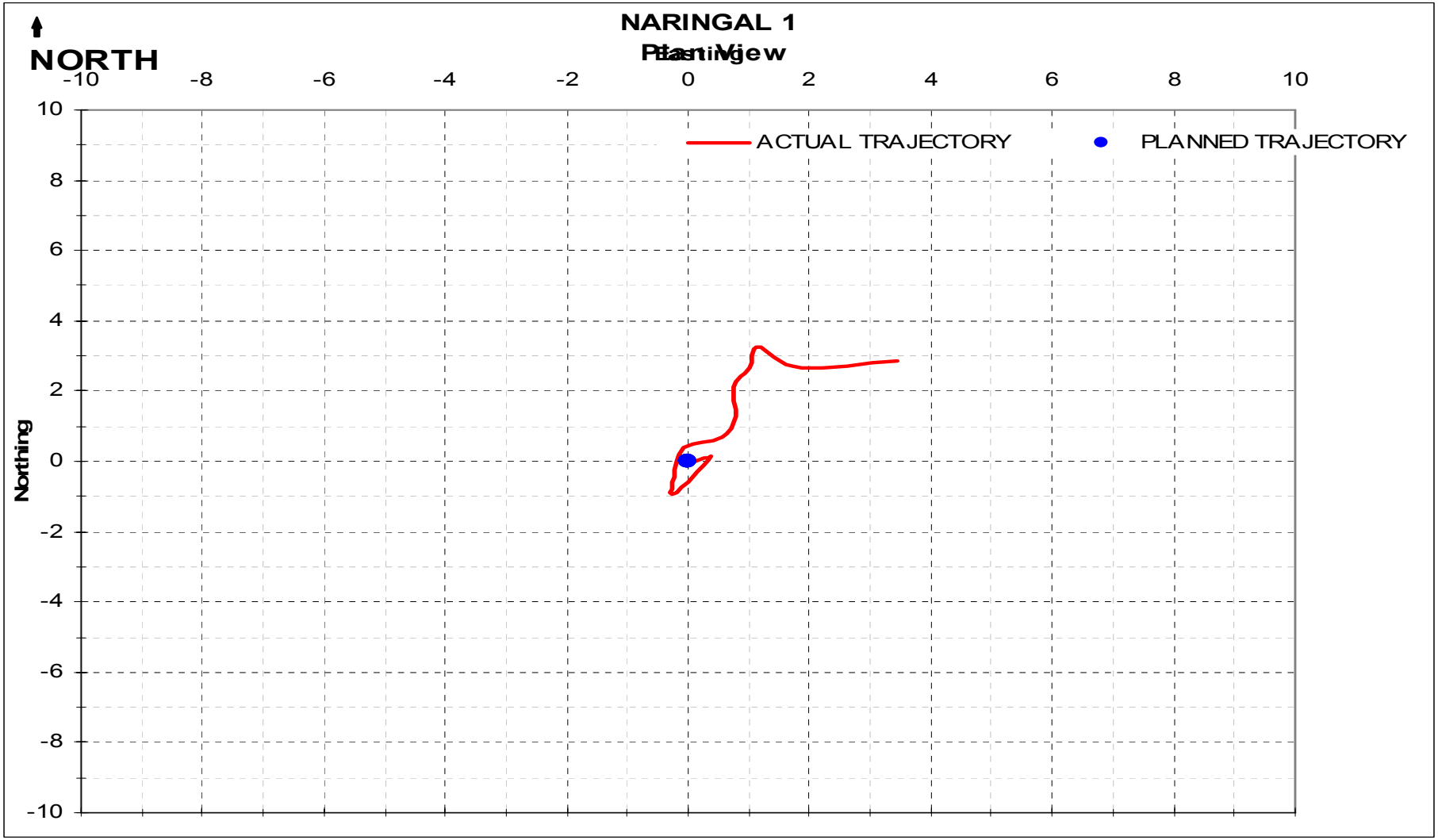
STATIC BHT @ 35 hrs	95.5	°C	@	1710	m
SURFACE TEMP.	21	°C	@	0	m
Geothermal Gradient for Suite 1		2.50	°C/100 m		



APPENDIX XI: DEVIATION DATA

NARINGAL 1					Actual Trajectory Data				Angle for section plot:			50
DEPTH	INCLIN	Azimuth	TVD	TVD	Northing	Easting	Dog Leg	Vert	Vert	TVD for	Displ	Direction
MD (FT)	DEG	DEG (T)	FT	S/S ft	north	east	°/100'	Sect	Plane	Plan Traj		True
0.00	0.00	000	0.00	-54.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31.00	0.38	085	31.00	-23.87	0.01	0.10	1.22	0.08	-0.08	31.00	0.10	85.00
95.00	0.25	018	95.00	40.13	0.16	0.36	0.57	0.38	-0.38	95.00	0.39	65.82
181.00	0.25	196	181.00	126.13	0.16	0.36	0.58	0.38	-0.38	181.00	0.40	66.45
268.00	0.63	212	268.00	213.13	-0.43	0.06	0.45	-0.23	0.23	268.00	0.43	172.38
374.00	0.00	011	373.99	319.12	-0.92	-0.25	0.59	-0.79	0.79	373.99	0.96	195.22
520.00	0.38	004	519.99	465.12	-0.44	-0.22	0.26	-0.45	0.45	519.99	0.49	206.26
674.00	0.25	020	673.99	619.12	0.38	-0.07	0.10	0.20	-0.20	673.99	0.39	350.10
828.00	0.38	091	827.99	773.12	0.69	0.56	0.25	0.87	-0.87	827.99	0.89	38.95
983.00	0.50	335	982.99	928.12	1.29	0.79	0.48	1.43	1.43	982.99	1.52	31.27
1136.00	0.25	050	1135.98	1081.11	2.11	0.76	0.33	1.94	-1.94	1135.98	2.25	19.77
1290.00	0.25	356	1289.98	1235.11	2.67	0.99	0.15	2.47	2.47	1289.98	2.84	20.45
1440.00	0.25	036	1439.98	1385.11	3.26	1.16	0.11	2.98	-2.98	1439.98	3.46	19.66
1598.00	0.75	150	1597.98	1543.11	2.64	1.88	0.56	3.14	-3.14	1597.98	3.24	35.50
1694.00	1.75	059	1693.96	1639.09	2.85	3.45	1.99	4.48	-4.48	1693.96	4.48	50.46


Sa
NARINGAL 1 - Vertical Section @ 50 Deg
DEPTH SS
0
250
500
750
1000
1250
1500
1750
-10
-8
-6
-4
-2
0
2
4
6
8
10
Vertical Sec
PLANNED TRAJECTORY
ACTUAL TRAJECTORY


NARINGAL 1
Plan View
NORTH
-10
-8
-6
-4
-2
0
2
4
6
8
10
ACTUAL TRAJECTORY
PLANNED TRAJECTORY
Northing

APPENDIX XII: WELL LOCATION SURVEY

61355612935

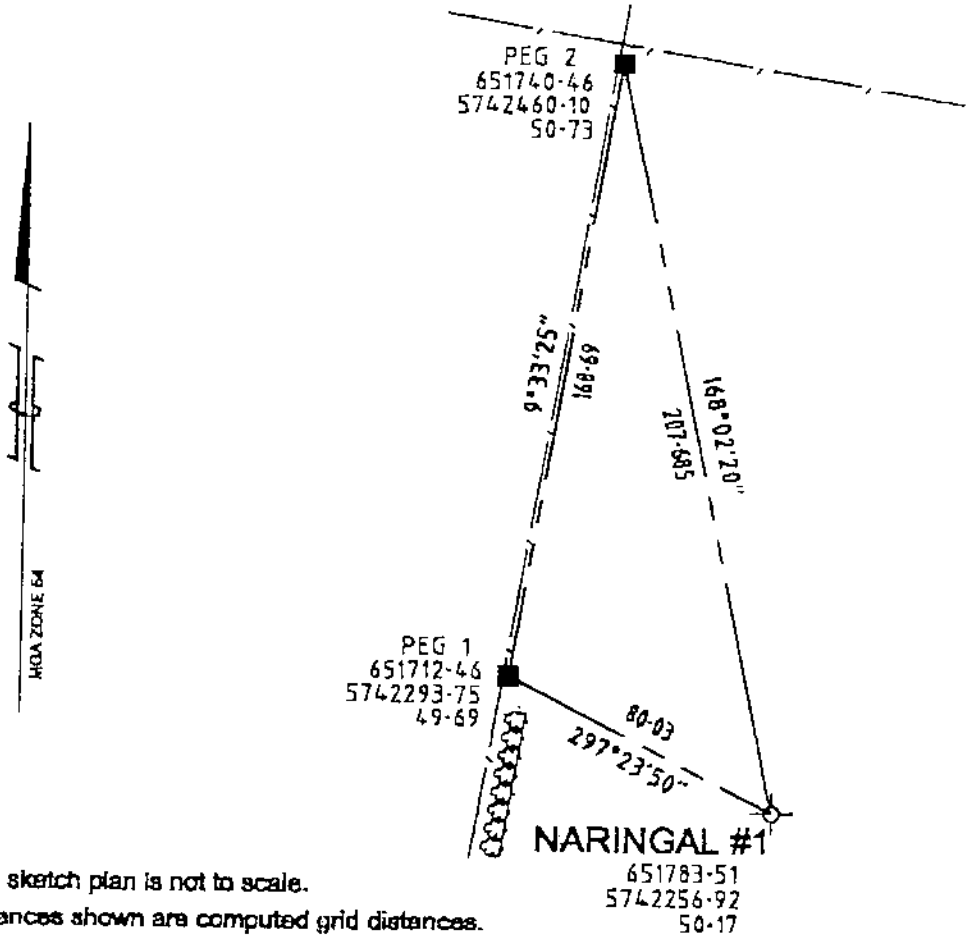
VICTORIA

GAS WELL LOCATION

REFERENCE MARKS SKETCH PLAN

EXPLORATION LICENCE PEP 154

Well Name	NARINGAL #1		
Map			
Spheroid	GDA94	MGA 94	ZONE 54
Latitude	S 38°27'18·32"	Measurement units	(metres)
Longitude	E 142°44'22·34"	Easting	651 783·51
Convergence	1°04'55"	Northing	S 742 256·92
Scale Factor	0·99987584	Elevation	50·17 AHD



NOTES : This sketch plan is not to scale.
Distances shown are computed grid distances.
Bearings shown are computed grid bearings.

DATUM : GDA94 vide Peg 1 and Peg 2.
Datum coordinates determined by Fyfe Surveyors 22 / 10 / 2001.
Height datum is to AHD vide pegs as above.

Estimated Horizontal error is less than +/- 0.05 metre.

Estimated Vertical error is less than +/- 0.05 metre.

Date of Survey : 21 / 01 / 2002

Paul Crowe Surveyor
ABN 59521601183
"Ambleside" 192 Koroit Street
Warrnambool 3280
Ph. (03) 5561 1500

REF 1063

Date 21 / 01 / 2002

Trevor McDowell

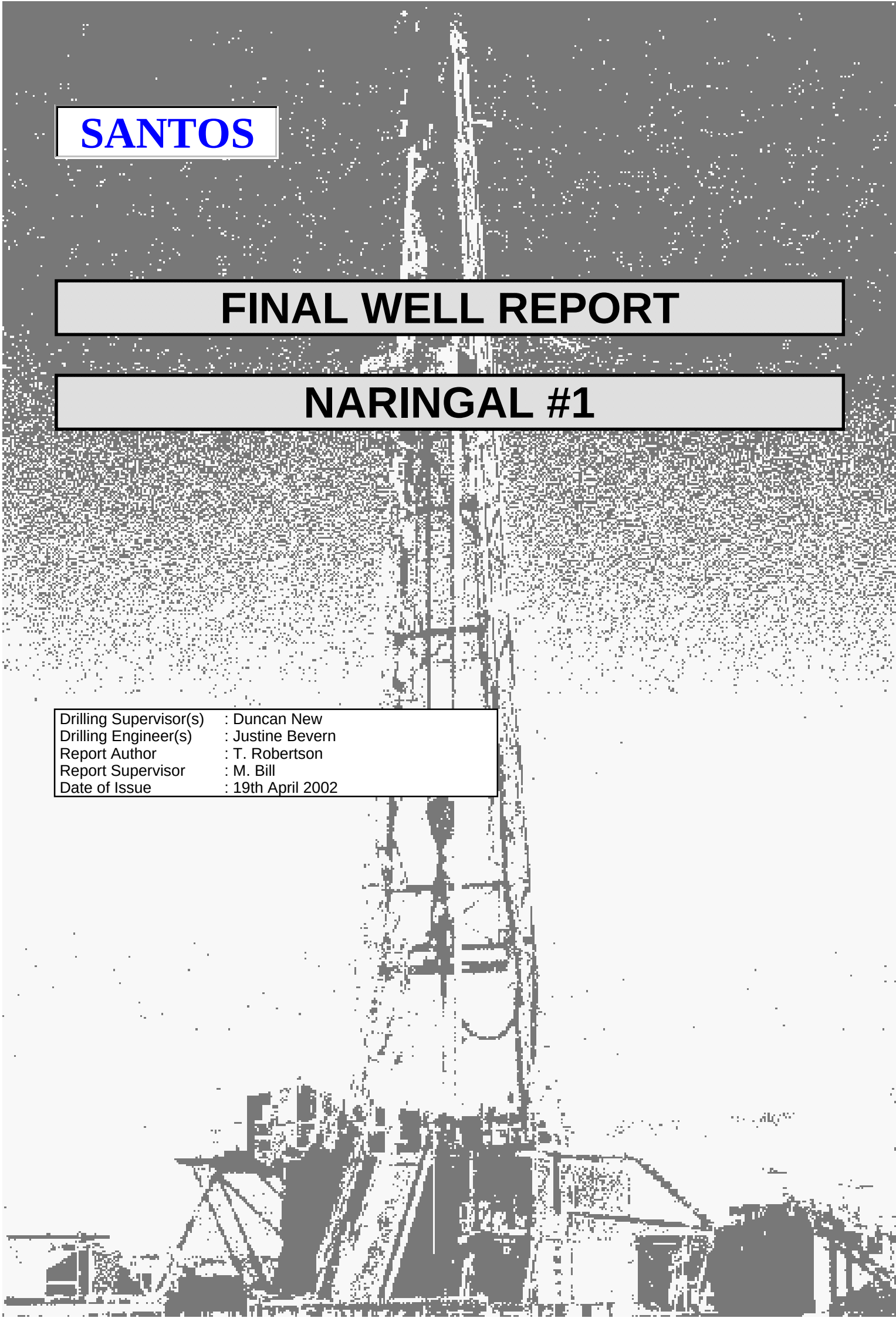
TREVOR McDOWELL
LICENSED SURVEYOR

APPENDIX XIII: DRILLING - FINAL WELL REPORT

SANTOS

FINAL WELL REPORT

NARINGAL #1



Drilling Supervisor(s)	: Duncan New
Drilling Engineer(s)	: Justine Bevern
Report Author	: T. Robertson
Report Supervisor	: M. Bill
Date of Issue	: 19th April 2002

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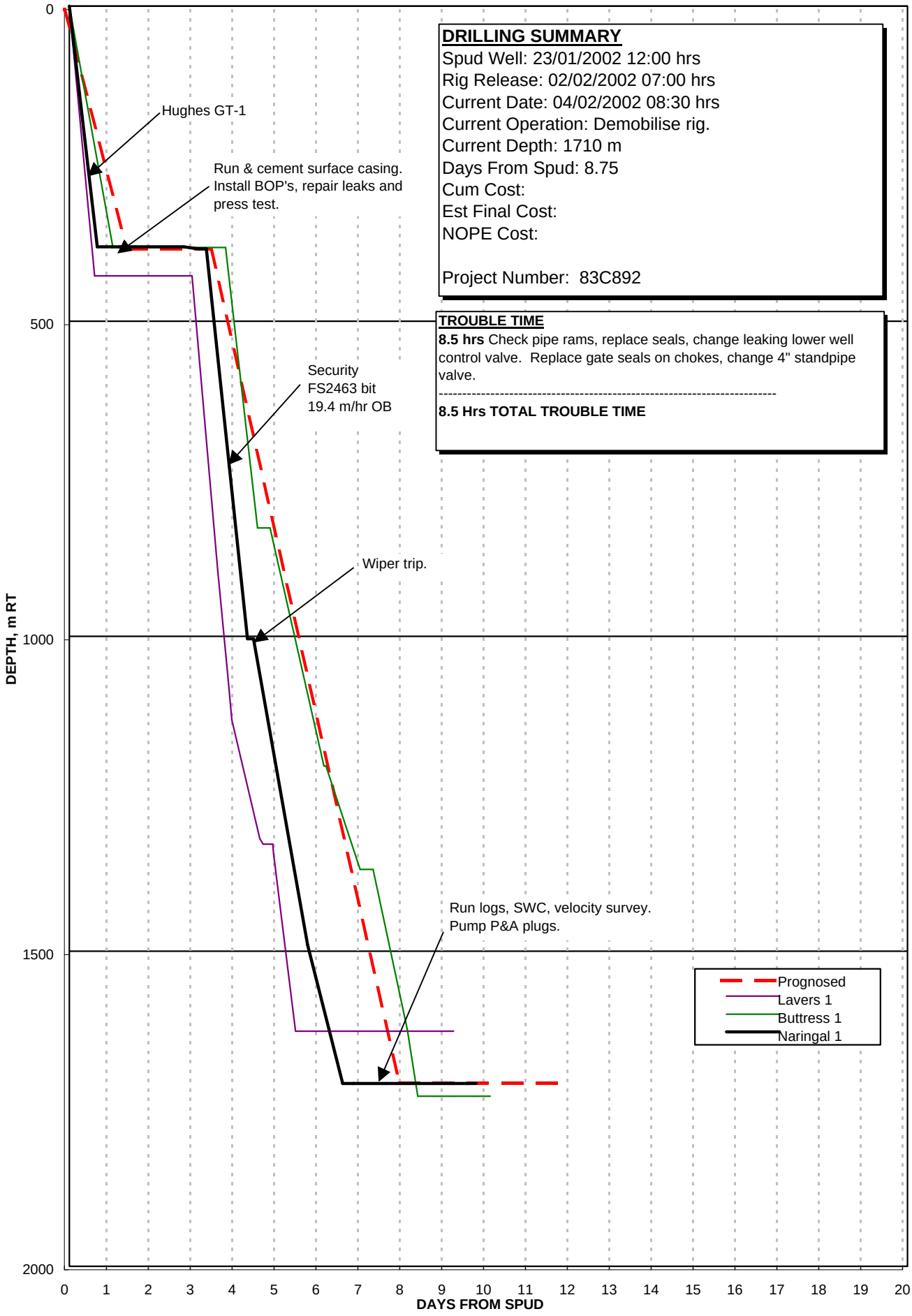
Casing and Cementing Report/s.....
Wellhead Installation Report/Plug and Abandonment Report.....

Section 1 – Well Summary

Time vs Depth Curve

NARINGAL 1
TIME v DEPTH CURVE



Section 2 – Well History

Well History Report

NARINGAL #1

Drilling Co.: OD&E **Rig:** OD&E #30

RT above GL: 53 m	Lat : 38 deg 27 min 18.32 sec	Spud Date: 23/01/2002	Release Date: 02/02/2002
GL above MSL : 49 m	Long : 142 deg 44 min 22.33 sec	Spud Time: 16:00:00	Release Time: 07:00:00

Well History

#	DATE	DEPTH	WELL HISTORY (24 Hr Summary)
1	19/01/2002	0	Start rigging down at Butress #1.
2	20/01/2002	0	Rig down and lower mast. prepare to move rig. Move matting and spot and new location.
3	21/01/2002	0	Move rig to Naringal #1 and rig up.
4	22/01/2002	0	Wait on daylight. Rig up.
5	23/01/2002	181	Finish rigging up. Spud in and drill to 195m.
6	24/01/2002	382	Drill to 382m Circulate hole clean. Wiper trip to bit. Circulate hole clean. POOH and lay out DC's. Rig up and run 32 joints of 7 5/8" casing. Cement casing.
7	25/01/2002	382	Finish cementing casing. WOC. Install bradenhead. Nipple up and test BOP's.
8	26/01/2002	436	Pressure test BOP's. Change out pipe ram rubbers. Replace gate and seat on two choke valves. M/U BHA and RIH. Drill shoe track and run LOT. Replace/repair and test upper kelly cock and 4" valve on standpipe. Drill ahead.
9	27/01/2002	1,004	Drill ahead with surveys to 1004m Circulate. Run survey. POOH to 231m for wiper trip.
10	28/01/2002	1,376	Drill ahead with surveys to 1374m.
11	29/01/2002	1,672	Drill to 1619m. CBU. Wiper trip to 828m. Drill to 1629m Shut in and monitor pressures. Drill ahead to 1672m.
12	30/01/2002	1,710	Drill to 1710m. CBU. 5 stand wiper trip. CBU. POOH. Run wireline logs. Run 1 super combo. Run 2 CST's.
13	31/01/2002	1,710	Run wireline logs run 2. Wiper trip to TD. Run log #3: Velocity survey.
14	01/02/2002	1,710	Set cement plug 3 across shoe. Lay down pipe. RIH and tag plug. Lay down BHA. Nipple down BOP's.
15	02/02/2002	1,710	Set surface plug. Clean tanks lay out kelly and release rig.

Section 3 – Drilling Data

Bit Record

FIT/LOT Report

NARINGAL #1

Drilling Co.: OD&E

Rig : OD&E #30

RT above GL : 53 mtrs
GL above MSL : 49 mtrs

Lat : 38 deg 27 min 18.32 sec
Long : 142 deg 44 min 22.33 sec

Spud Date: 23/01/2002
Spud Time: 16:00:00

Release Date: 02/02/2002
Release Time: 07:00:00

BIT RECORD

DATE	BIT#	SIZE "	IADC	SER	MFR	TYPE	JETS	D.IN mtrs	D.OUT mtrs	MTRG	HRS o/b	SPP psi	FLW gpm	WOB k-lbs	RPM	MW ppg	TFA sq.in	VEL mps	HHP /sq"	ROP m/hr	I	O1	D	L	B	G	O2	R
24/01/2002	1	9.88	117	A33JB	HUGHES	GT-1	3x20	0	382	382	7.9	953	560	5.0	110	8.9	0.921	59	0.00	48.4	2	2	WT	A	0	I	RR	TD
30/01/2002	2	6.75		5009516	DBS	FS2463	4x12	382	1,710	1,328	52.7	1495	334	5.1	101	9.1	0.442	69	0.00	25.2	8	3	RO	N	X	I	BT	TD
31/01/2002	3RR	6.75	517	MH 4631	SMITH	XR32TDG	3x32	1,710	1,710	0	0.0	1800	311	0.0	0	9.5	2.357	13	0.00		5	5	WT	A	E	I	ER	TD

Santos

Santos Ltd
A.C.N. 007 550 923

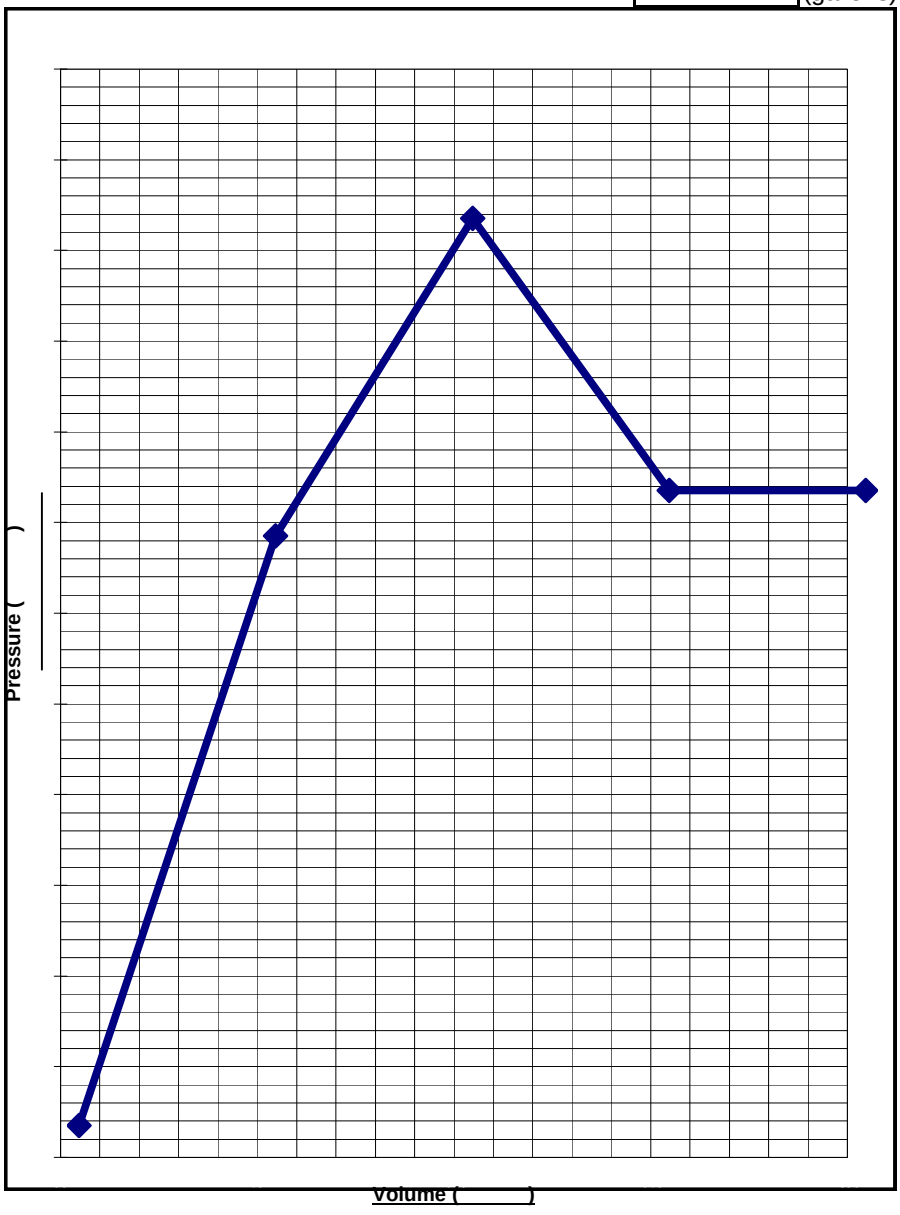
LEAK OFF TEST / FORMATION INTEGRITY TEST

WELL:	Naringal #1	RIG:	30	DATE:	26/01/2002

CASING SIZE: 7 5/8 (inch) SANTOS SUPERVISOR: Duncan New

A. MUD DENSITY IN USE:		8.5	(ppg)
B. HOLE DEPTH:		1262.8	(ft)
C. SHOE DEPTH:		1239.84	(ft)
D. F.F.P. PRESSURE (GRAPH):		500	(psi)
E. EQUIVALENT DENSITY:			
PRESSURE. (D) (psi) / SHOE DEPTH (C) (ft) x 0.052	+ MUD DENSITY IN USE (A) (ppg)	**16.3**	**(ppg) (EMW)**
F. STABILIZED PRESSURE RECORDED:		350	(psi)
G. VOLUME PUMPED:		20	(gallons)
H. VOLUME REGAINED:		7	(gallons)

Volume ( )	Pressure ( )
0	0
5	325
10	500
15	350
20	350



Section 4 – Casing and Cementing

Casing and Cementing Report/s

Wellhead Installation Report/Plug and Abandonment Report

Santos

Santos Ltd

A.C.N. 007 550 923

CASING AND CEMENTING REPORT

Well Name: **Naringal #1**

FORM **DQMS F-220**

Casing type: [X] Surface casing [ ] Intermediate Casing [ ] **Production Casing** [ ] Completion tubing

Originated by: D. New Date: 24-Jan-02 **Checked by:** **Date:**

Hole Size:	9 7/8"	**T.D.:**	382	**Rig:**	ODE Rig 30	**Date:**	**Cemented by:**	Dowel

PRE-FLUSH bbls. @

Additives:

SPACER 40 bbls@ 8.4 ppg

Mains water

CEMENT

LEAD SLURRY:	119	sacks class	"G"
Slurry Yield:	2.84	cu.ft./sack	
Mixwater Req't:	17.43	gal./sack	
Actual Slurry Pumped:	60.0	bbls @	11.0 ppg
	337 cu ft		

TAIL SLURRY:	104	sacks class	"G"
Slurry Yield:	1.19	cu.ft./sack	
Mixwater Req't:	5.24	gal./sack	
Actual Slurry Pumped:	22.0	bbls @	15.6 ppg
	123 cu ft		

ADDITIVES

	%	Amount
D020 Bentonite	4	446 lbs
S001 Accelerator	1.5	167 lbs
D047 Antifoam	0.01 ga/sx	1 gal
D145A Dispersant	0.05 gal/sx	5.2 gal
D144 Antifoam	0.01 gal/sx	1.0 gal
S001 Accelerator	0.5 gal/sx	51.9 gal

DISPLACEMENT Fluid: Mud 9.1 ppg

Theoretical Displ.:	55.8	bbl.		Bumped plug with	1000 psi
Actual Displ.	54.3	bbl @	4 BPM	Pressure Tested to:	2000 psi
Displaced via	Rig pumps			Bleed back:	0.5 bbl

ACTIVITY		Time
Start Running csg.	**23/01**	17:30
Casing on Bottom		21:00
Start Circulation		21:25
Start Pressure Test		23:00
Pump Preflush (Dowel)		23:25
Start Mixing		23:35
Finish Mixing	**24-Jan**	00:10
Start Displacing		00:12
Bump		00:25
Press. test		00:35

Returns to Surface: 120 bbls mud and spacer 10 bbls Cement

Reciprocated/Rotated Casing: No - chained down

Top Up Job run: Yes / No Yes 25 sx class G

Plug Set make/type: Weatherford non rotating top and bottom plugs.

Centraliser type/depth: Weatherford at, 371, 359, 339.3, 316.7, 293.5 and 16.7m

Remarks: **5.45m in on landing joint set BOP's a bit low recommend only 5.35m on next well**

Full returns throught job.

Leadslurry good at 11.5 ppg. Tail slurry density varible. First 10 bbls less than 13 ppg, pumped an extra 10 bbls to ensure good cement round shoe (total volume pumped was 32 bbls but only 22 was good tail cement).

Bumped plug 1.5 bbls early.

No. JOINTS	**SIZE OD**	**WT lb/ft**	**GRADE**	**THREAD**	**M**	**FROM**	**TO**
Stick up					-0.95	-0.95	0.00
Rotary table to top of bradenhead					5.04	0.00	5.04
Bradenhead. WG-CH 5k 9" x 7 5/8" Clamp on type.					0.41	5.04	5.45
30	7 5/8"	26.4	L80	BTC	345.83	5.45	351.28
Pup joint	7 5/8"	26.4	L80	BTC	2.94	351.28	354.22
Float collar	7 5/8"	26.4	L80	BTC	0.41	354.22	354.63
2	7 5/8"	26.4	L80	BTC	23.27	354.63	377.90
Float shoe	7 5/8"	26.4	L80	BTC	0.45	377.90	378.35
				Landing joint 6.4m. Landed out			
				at 5.45m in. (5.35m in would have			
				been better).			

Theoretical Bouyed wt of casing(klb):	28	Bradenhead Height above GL 0.34m below ground level	
Actual wt of casing (last joint run-block wt, klb)	26	Pup jts Left	1.00
Hanging wt (after cementing and pressure bleed off)	28	Total Jts on Loc	36
Casing wt just prior to setting slips	28	Total No. Run	32
		No. Left	4

Santos	ABANDONMENT REPORT	FORM DMS F-133

WELL: Naringal #1

DATE: 31/1/02

Supervisor: D. New

Well Details

Hole Section	Hole Size	Depth	Casing Size	Depth
Surface	9 7/8"	382	7 5/8"	378
Intermediate				
Production				

Formation Tops (ft RT)

Formation	Depth	Formation	Depth	Formation	Depth
Clifton	658	Pebble Point	1067	Flaxmans	-
Mepunga	729	Paarate	1093	Waare	1578
Dilwyn	780	Skull Creek	1367	Eumeralla	1625
Pember	1019	Belfast	1520	TD	1710

Plug Details

Plug No.	Reason	Top Depth	Top Depth	Length m	Cement Type	Sacks	Weight	Additives	Tagged Depth	Tagged Weight
1	Waaree Isolation	1618	1528	90	G	73	15.6	D081, D145A	-	
2	Parrate	1135	1035	100	G	73	15.6	D081, D145A	-	
3	Shoe isolation	404	320	84	G	78	15.6	D145A, S001	320	15 klb
4	Surface	30	0	30	G	24	15.6	D145A, S001	-	
5										
6										

Identification Plate Installed (Yes/No)?	Yes

Braden Head Removed (Yes/No)?	Yes

Additional Comments:
Tagged shoe plug at 320m with 15 klb and pressure tested to 1100 psi for 10 min.

APPENDIX XIV: RIG SPECIFICATIONS

Rig Inventory for RIG # 30

DRAWWORKS	:	Ideco Hydrair H-725-D double drum with V-80 Parmac hydromatic brake, Martin Decker satellite automatic drilling control. Max. single line pull - 50,000 lbs. Main drum grooved for 1-1/8" drilling line.
SUBSTRUCTURE	:	One piece substructure 14' high x 13'6" wide x 50' long with 12' BOP clearance. Setback area loading: 250,000 lbs Casing area loading: 275,000 lbs
ENGINES	:	Four (4) Caterpillar Model 3412 PCTA diesel engines.
BRAKE	:	V-80 Parmac hydromatic brake,
MAST	:	Dreco Model #: M12713-510 Floor Mounted Cantilever Mast designed in accordance with API Specification 4E Drilling & Well Servicing Structures. Hook load Gross Nominal Capacity - 510,000 lbs with:- 10 lines strung - 365,000 lbs 8 lines strung - 340,000 lbs Clear working height of 127'. Base width of 13'6". Adjustable racking board with capacity for i) 108 stands of 4.½" drill pipe, ii) 10 stands of 6.½" drill collars, iii) 3 stands of 8" drill collars Designed to withstand an API windload of 84 mph with pipe racked and 100 mph with no pipe racked.
CATHEADS	:	One (1) Foster Model 37 make-up spinning cathead mounted on drillers side. One (1) Foster Model 24 break-out cathead mounted off drillers side.
TRAVELLING BLOCK/HOOK	:	One (1) 667 Crosby McKissick 250 ton combination block hook Web Wilson. 250 ton Hydra hook Unit 5 - 36" sheaves.
WINCHES	:	One (1) Ingersol Rand HU-40 with 5/8" wireline. Capacity 2,000 lb. One (1) ANSI B30.7 with 3/8´wire capacity 4000lbs @ 70 fpm
SWIVEL	:	One (1) Oilwell PC-300 ton swivel
RIG LIGHTING	:	Explosive proof fluorescent. As per approved State Specifications.
KELLY DRIVE	:	One (1) 27 HDP Varco kelly drive bushing.
MUD PUMPS	:	Two (2) Gardner Denver mud pumps Model PZH-8 each driven by 750 HP EMD D-79 motors. 8" stroke with liner size 6" through to 5". 6" liner maximum pressure 2387 psi 5.1/2" liner maximum pressure 2841 psi 5" liner maximum pressure 3437 psi 6" liner maximum volume 412 gpm 5.1/2" liner maximum volume 345 gpm 5" liner maximum volume 280 gpm

MIXING PUMP	:	Two (2) Mission Magnum 5" x 6" x 14" centrifugal pump complete with 50 HP, 600 Volt, 60 Hz, 3 phase explosion proof electric motors.
MUD AGITATORS	:	Five (5) Geolograph/Pioneer 40TD - 15" 'Pitbull' mud agitators with 15 HP, 60 Volt, 60 HZ, 3 phase electric motors.
LINEAR MOTION SHALE SHAKERS	:	Two (2) DFE SCR-01 Linear motion shale shakers.
DEGASSER	:	48" Dia Poor Boy Degasser
DESILTER	:	One (1)DFE - Harrisburg style 12 cone desilter 12 x 5" cones. Approximate output of 960 gpm. Driven by Mission Magnum 5" x 6" x 11" centrifugal pump complete with 50 hp 600 volt 60 Hz 3 phase explosion proof motor.
GENERATORS	:	Four (4) Brown Boveri 600 volt, 600 Kw, 750 kva , 3 phase, 60 HZ AC generators. Powered by four (4) Cat 3412 PCTA diesel engines.
BOP's & ACCUMULATOR	:	One (1) Wagner Model 20-160 3 BND 160 gallon accumulator consisting of: Sixteen (16) 11 gallon bladder type bottles One (1) 20 HP electric driven triplex pump 600 volts, 60 HZ, 3 phase motor and controls. One (1) Wagner Model A 60 auxiliary air pump 4.5 gals/minute.
BOP's & ACCUMULATOR (Cont'd)	:	One (1) Wagner Model UM2SCB5S mounted hydraulic control panel with five (5) 1" stainless steel fitted selector valves and two (2) stripping controls and pressure reducing valves. Three (3) 4" hydraulic readout gauges:- one for annular pressure- one for accumulator pressure one for manifold pressure. One (1) Stewart & Stevenson 5 station remote drillers control with air cable umbilical with three pressure gauges, increase and decrease control for annular pressure. One (1) Shaffer 13.5/8" x 3,000 psi spherical annular BOP, One (1) Shaffer 13.5/8" x 5,000 psi LWS studded, double gate autolock B.O.P.
KELLY COCK (UPPER)	:	Two (2) Upper Kelly Cock 7.3/4"OD with 6.5/8" API connections (1 x M&M, 1 x Hydril).
KELLY COCK (LOWER)	:	Three (3) M&M Lower Kelly Cocks 6.½" OD with 4" IF connections
DRILL PIPE SAFETY VALVE	:	One (1) Hydril 6.½" stabbing valve (4" IF). One (1) Gray inside BOP with 4.3/4" OD and 2.1/4" ID with 3.1/2" IF connections c/w releasing tool and thread protectors.
AIR COMPRESSORS AND RECEIVERS	:	Two (2) LeRoi Dresser Model 660A air compressor packages c/w 10 HP motors rated at 600 Volts, 60 HZ, 3 phase. Receivers each 120 gallon capacity and fitted with relief valves.
POWER TONGS	:	One (1) Farr 13.5/8" - 5.½" hydraulic casing tongs c/w hydraulic power pack and hoses and torque gauge assembly. One (1) Foster hydraulic kelly spinner with 6.5/8" LH connection.
TORQUE WRENCH	:	Yutani c/w drive sockets 1 1/8" through to 2 3/8"

SPOOLS	:	One (1) set double studded adaptor flanges to mate 13.5/8" 5,000 psi. API BOP flange to following wellhead flange 13.5/8" x 3,000 series, 11" x 3,000 series, 11" x 5,000 series 7.1/16" x 3,000 series, 7.1/16" x 5,000 series 4 1/16" 5000 x 3 1/16" 5000 3 1/16" 5000 x 2 1/16" 5000
SPOOLS (Cont'd)	:	1 double studded adaptor flange 4 1/16"5K x 3 1/16"5K 1 double studded adaptor flange 3 1/16" 5K x 2 1/16" 5K 1 only 14" - BOP mud cross (drilling spool) 13.5/8" 5,000 x 13.5/8" 5,000 BX160. with 2 x 3 1/16" 5K outlets. 1 only BOP spacer spool 13 5/8" 3,000 x 13 5/8" 3,000 1 only BOP spacer .spool 11" 3,000 x 13.5/8" 5,000 .
ROTARY TABLE	:	One (1) Oilwell A 20.½" rotary table torque tube driven from drawworks complete with Varco MASTER bushings and Insert Bowls.
MUD TANKS	:	SHAKER Active No 1. 277 BBL Desilter 73 BBL Sand Trap 50 BBL Trip Tank 29 BBL Total 429 BBL SUCTION Active No 2 174 BBL Pre-Mix 146 BBL Pill Tank 63 BBL Total 383 BBL
TRIP TANK	:	Trip Tank 29 BBL One (1) Mission Magnum 2" x 3" centrifugal pump complete with 20 HP, 600 Volts, 60 HZ, 3 phase explosion proof motors
KILL LINE VALVE	:	2 x 3 1/8" Cameron FL 5K gate valves
CHOKE LINE VALVES	:	1 x 4 1/16 Cameron FC 5K hydraulic operated gate valve 1 x 4 1/16 5K manual gate valve
CHOKE MANIFOLD	:	One (1) McEvoy choke and kill manifold 3" 5,000 psi with hydraulic Swaco "super" choke.
DRILL PIPE	:	240 joints (2270 m) - 3.½" 13.30lb/ft drill pipe Grade 'G' 105 with 3 1/2" IF conn
PUP JOINTS	:	One (1) - 10'(3.65 m)3.½" OD Grade 'G' with 3.½" IF conn
HEVI-WATE DRILL PIPE	:	6 joints of 3.½" H.W.D.P. with 3.½" IF conn
DRILL COLLARS	:	12 x 6.½" OD drill collars (113 m) with 4" IF conn 24 x 4 ¾" O.D. drill collars (227 m) with 3.½"IF conn 1 x 4.3/4" OD Pony Drill Collar
KELLIES	:	Two (2) Square Kelly drive 4.¼" x 40' complete with Scabbard and 55 ft x 3 ½" kelly hose

FISHING TOOLS	:	One (1) only 8.1/8" Bowen series 150 FS overshot One (1) 5.3/4" SH Bowen 150 Overshot c/w grapples and packoffs to fish contractors downhole equipment. One (1) only Reverse circulating junk basket 4" IF box One (1) only 6.½" OD Griffith Fishing Jars One (1) only 4 ¾" O.D. Bowen Type "Z" Fishing Jar One (1) only Bumper Sub 6.½" OD 4" IF pin & box. One (1) 5" R.C.J.B. One (1) 5" Junk Sub with 4.3/4" OD x 1.1/2" ID.
WIRELINE SURVEY UNIT	:	Gearmatic hydraulic drive Model 5 c/w .092" line
SUBSTITUTES	:	Two (2)Bit Sub - 7.5/8" reg x 6.5/8" reg double box. Two (2) Bit Subs - 6.5/8" reg double box. Two (2) Bit Sub - 6.5/8" reg box. x 4½" IF box Two (2) Bit Subs - 4.½" reg x 4" IF double box. Two (2) 4.3/4" bit subs (36" long) with 3.1/2" IF box x 3.1/2" reg box bored for float. One (1) Float Sub 6.5/8" reg box (FC) x 6.5/8" reg pin Two (2) XO Sub - 4" IF box x 4.½" IF pin. Two (2) XO Sub - 4½" IF box x 4." IF pin. One (1) XO Sub - 4.½" reg x 4" IF double pin. Two (2) XO Sub - 6.5/8" reg pin x 4" IF box. One (1) Junk Sub - 6.5/8" reg pin x 6.5/8" reg box One (1) Junk Sub - 4.½" reg box x 4.½" reg pin. One (1) XO Sub - 4.½" IF box x 4" IF box. Two (2) Kelly Saver Subs c/w rubber 4" IF pin & box. Two (2) Kelly Saver Subs 4" IF pin & box One (1) Kelly Saver Subs 4½" IF pin & box. Two (2)4 IF box x 3.1/2" IF pin Saver Subs. One (1) Circulating Subs - 4" IF x 2" 1502 hammer union. One (1) Circulating Subs - 4" IF x 2" 602 hammer union. Eleven (11) Lifting Subs - 18□ Taper 4.½" pick up neck and 4" IF pin. Eight (8) Lift Subs with 3.1/2" OD D.P. neck and 3.1/2" IF pin connections.
HANDLING TOOLS	:	2 only 4.½" BJ 250 ton 18 degree taper D/P elevators. 1 only 3.½" BJ 200 ton 18 degree taper D/P elevators. 1 only 3.1/2" BJ type MGG 18° centre latch Elevators. 1 only 4.½" Varco SDXL D/P slips. 1 only 4.½" Varco SDML D/P slips 2 only 8" - 6.½" DCS-R drill collar slips. 1 only 3.1/2" Varco SDML Slips 1 only 4.3/4" Varco DCS-S Drill Collar Slips
CASING RUNNING TOOLS	:	1 only 13.3/8" Webb Wilson 150 ton side door elevator. 1 only 13.3/8" single joint P.U. elevators. 1 only 9.5/8" Webb Wilson 150 ton side door elevators. 1 only 9.5/8 single joint P.U. elevator. 1 only 7" BJ 150 ton side door elevators. 1 only 7" single joint P.U. elevators. 1 only 5.½" BJ 200 ton S11 1 only 2.7/8" BJ 100 ton tubing elevator. 1 only 2.3/8" BJ 100 ton tubing elevator. (all P.U. elevators c/w slings & swivel) 1 only 13.3/8" Varco CMS-XL casing slips 1 only 9.5/8" Varco CMS-XL casing slips. 1 only 7" Varco CMS-XL casing slips. 1 only 3.1/2" Varco SDML tubing slips.

CASING / TUBING DRIFTS	:	9 5/8, 7", 5 ½",3 ½"
THREAD PROTECTORS	:	9 5/8, 7".
KELLY SPINNER	:	One (1) Foster hydraulic kelly spinner with 6.5/8" LH connection.
PIPE SPINNER	:	One (1) International 850H hydraulic pipe spinner
WELDING EQUIPMENT	:	1 - Miller 400 amp welding machine. 1 - oxy acetylene set.
DOGHOUSE	:	1 Doghouse 5m x 2.4m x 2.3m
GENERATOR HOUSE	:	Ross Hill SCR
UTILITY HOUSE	:	1 Utility and Mechanics House
CATWALKS	:	2 catwalks total 18.6m long x 1.6m wide x1.08m high
PIPE RACKS	:	8 - 9m tumble racks.
DAY FUEL TANK	:	1 only 19,000 ltrs
WATER/FUEL TANK	:	WATER 1 only 320 bbls. 1 only brake cooling tank 80 bbl FUEL 1 only 27,500 litres
OIL STORAGE	:	drums
DRILLING RATE RECORDER	:	1 only 6 pen Pioneer Geolograph drill sentry recorder to record: weight (D) penetration (feet) pump pressure (0-6,000 psi) electric rotary torque rotary speed (rpm) pump spm (with selector switch)
DEVIATION RECORDER	:	1 set Totco 'Double Shot' deviation instrument 0□-8□.
INSTRUMENTS & INDICATORS	:	1 only Martin Decker Sealtite. 1 only Martin Decker Deadline type. 1 only drillers console including the following equipment. Martin Decker Weight Indicator type'D' Electric rotary torque gauge. MD Totco Mud Watch Instrumentation c/w display and alarms. Rotary rpm gauge
MUD TESTING	:	1 set Baroid mud testing laboratory (standard kit
RATHOLE DRILLER	:	One (1) fabricated rotary table chain driven.
MUD SAVER	:	Okeh unit
CELLAR PUMP	:	Cellar jet from No 1 pump
WATER PUMP	:	Three (3) Mission Magnum 2" x 3" centrifugal pumps c/w 20 HP, 600 Volts, 60 HZ, 3 phase explosion proof motors
FIRE EXTINGUISHERS	:	Dry Chemical Rig 22 Camp 20 CO2 Rig 3 Camp 0 Foam Rig 1 Camp 1

PIPE BINS	:	5 units
CUP TESTER	:	Two (2) Grey Cup Tester c/w test cups for 9.5/8" & 13.3/8".
DRILLING LINE	:	5,000' 1.1/8" - E.I.P.S

TRANSPORT EQUIPMENT AND MOTOR VEHICLES

One (1) International 530 Forklift
One (1) Tray Top Utility
One (1) Crew Bus

CAMP EQUIPMENT

Four (4) x 8-Man Bunkhouses (12 man emergency)
One (1) x Recreation/Canteen unit
One (1) x Ablution/Laundry/Freezer unit
One (1) x Kitchen/Cooler/Diner unit
One (1) x Toolpushers unit
One (1) x Meeting / Smoko unit
One (1) x Combined Water/Fuel Tank unit
Two (2) x CAT 3304PC generator sets each 106 kVa, 86 KW, 50 HZ.

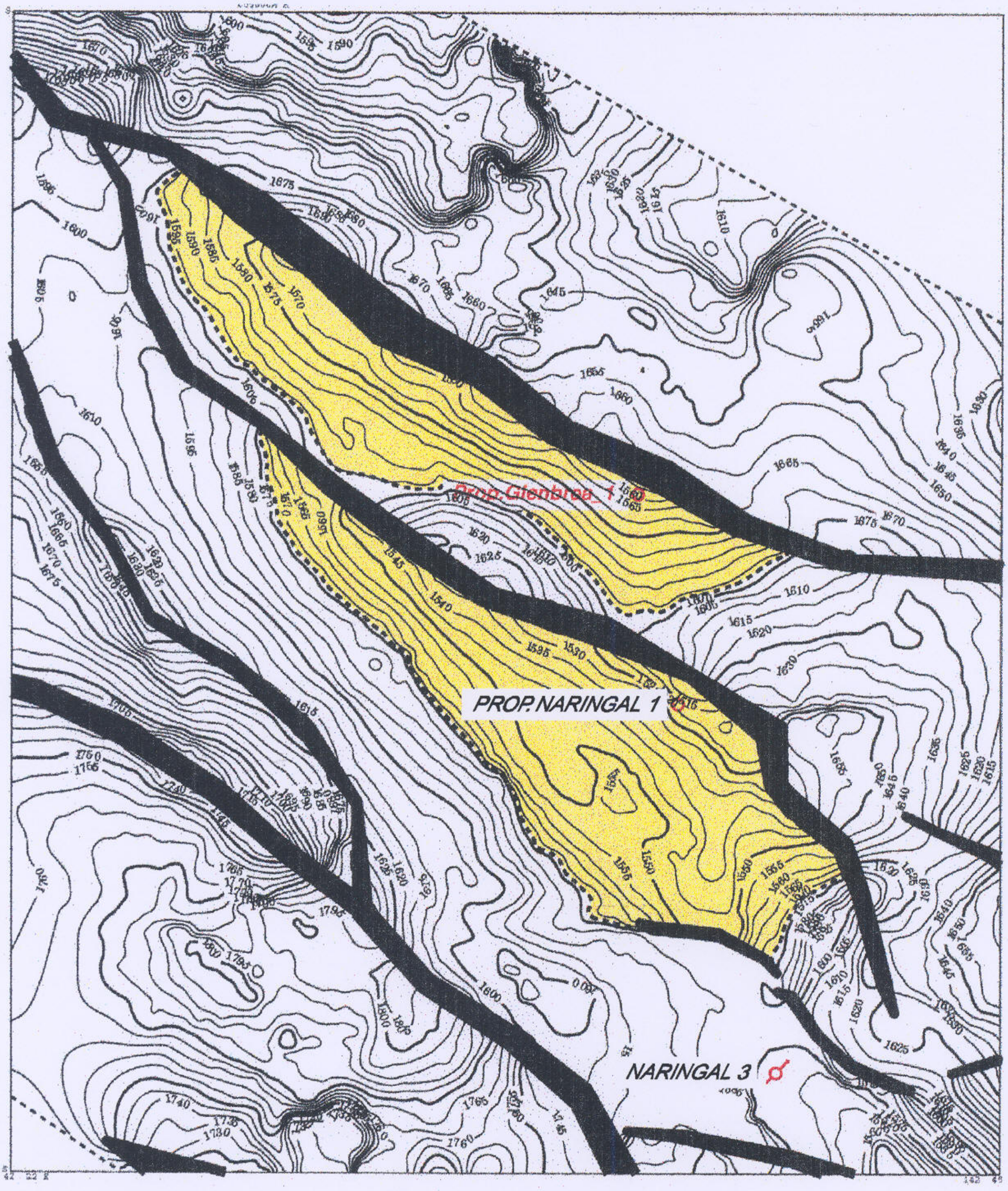
NOTE: At Contractor's discretion any of the foregoing items may be replaced by equipment of equivalent or greater capacity.

ENCLOSURE I : 1:200M COMPOSITE LOG

ENCLOSURE II : 1:500M MUDLOG

ENCLOSURE III : STRUCTURE MAPS (PRE-DRILLING)

NARINGAL GLENBREA



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KILOMETRES

UNIVERSAL TRANSVERSE MERCATOR PROJECTION
G.R.S. 1980 SPHEROID
CENTRAL MERIDIAN 141 00 00 E
Mapsheet datum: "GDA94"

GDA

Santos

DEPTH

Near Top Waarre Sand

Nov. 2001

M.Majedi

Date :	Author :	ENCL
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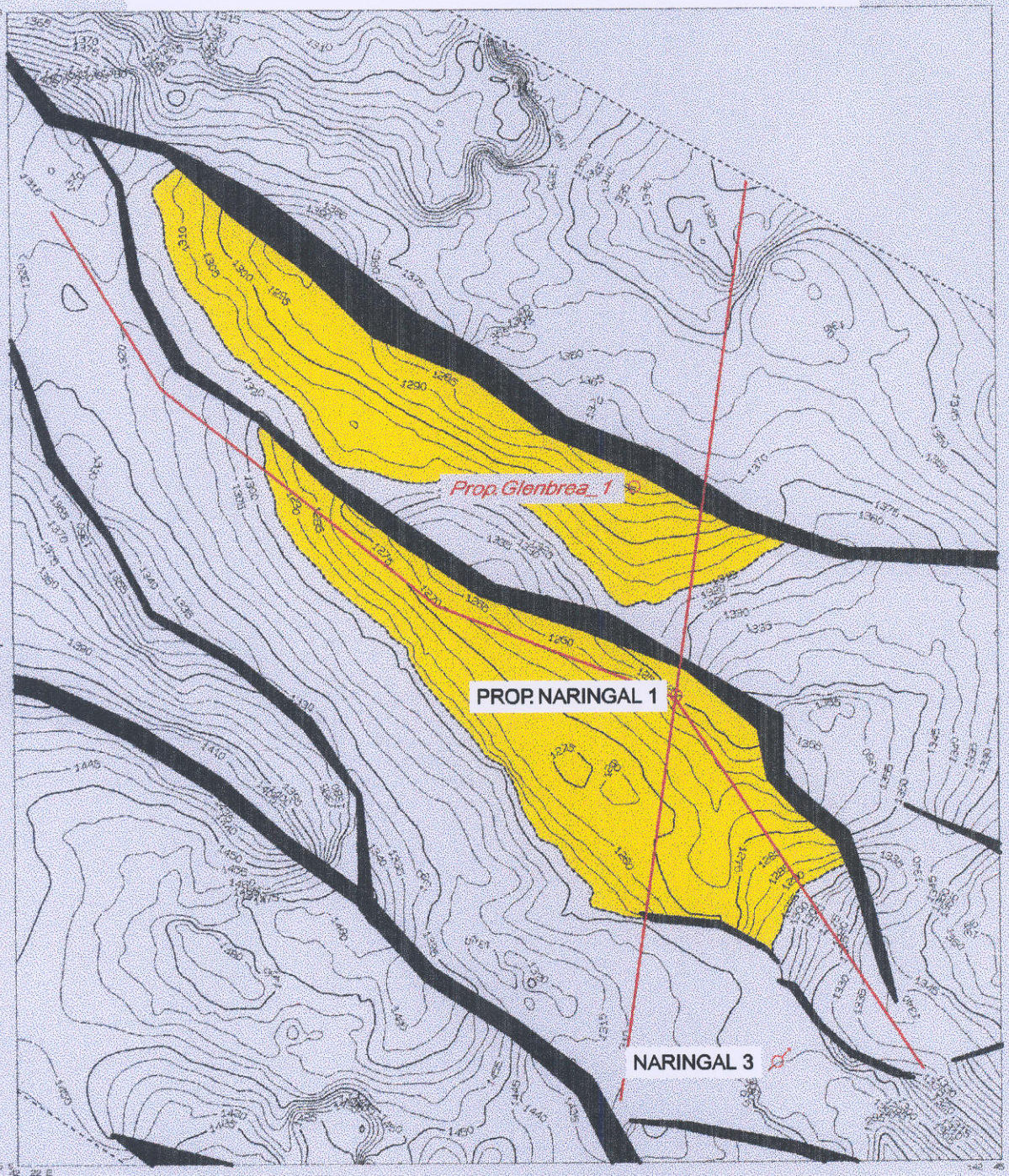
NARINGAL GLENBREA



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KILOMETRES

UNIVERSAL TRANSVERSE MERCATOR PROJECTION
G.R.S. 1980 SPHEROID
CENTRAL MERIDIAN 141 00 00 E
MAPSHEET DATUM "GDA94"

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Santos

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Near Top Wanrre Sand

Nov. 2001

M.Majedi

ENCLOSURE IV : WELL EVALUATION SUMMARY PLOT