POWER AND WATER AUTHORITY

BORE COMPLETION REPORT
BORE 29687 AND BORE 29688
RORRUWUY OUTSTATION

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Water Resources Division
Darwin
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Report 32/1996 D
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<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMG</td>
<td>Australian Map Grid</td>
</tr>
<tr>
<td>°C</td>
<td>degree Celsius</td>
</tr>
<tr>
<td>ID</td>
<td>internal diameter</td>
</tr>
<tr>
<td>km</td>
<td>kilometres</td>
</tr>
<tr>
<td>L/s</td>
<td>litres per second</td>
</tr>
<tr>
<td>L/c/d</td>
<td>litres per capita per day</td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
</tr>
<tr>
<td>mm</td>
<td>millimetre</td>
</tr>
<tr>
<td>m³/d</td>
<td>cubic metres per day</td>
</tr>
<tr>
<td>mg/L</td>
<td>milligrams per litre</td>
</tr>
<tr>
<td>pH</td>
<td>acidity</td>
</tr>
<tr>
<td>SWL</td>
<td>standing water level</td>
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1. INTRODUCTION

The objective of this work was to drill and construct two production bores providing an adequate water supply for the community. The work was carried out by Water Resources Division of Power and Water Authority, Darwin on behalf of the Aboriginal and Torres Strait Islander Commission, Nhulunbuy. Previous exploratory work was carried out in August and September 1983 and was limited to the vicinity of the outstation. During this project six bore were drilled and two production bores (bore 22303 and 22304) were constructed.

A desktop study was conducted and aboriginal sacred site clearance gained, followed by field reconnaissance during which prospective sites were pegged and access checked. Drilling and bore construction were undertaken in November 1995 and test pumping followed in December 1995.

The Rorruwuy is an outstation of Laynhapuy Homelands Association. It is located approximately 60 km west of Nhulunbuy accessed via a dirt road through out the year. It is covered by topographic map of Arnhem 1: 100 000 map sheet 6273 (AMG Grid Reference 640 500 - 8 650700).

The geomorphology of Arnhem Land was divided into eight categories (Lynch. B.T., et al., 1996) based on association between geology and landforms. The project area lies within two major geomorphology units of Arnhem Land;

- Coastal dunefields and sandplains
- Lateritic and sandy lowlands

The "Coastal dunefields and sandplains" are distributed along the southern coast line. A dune field and sandplains located south of Rorruwuy outstation are approximately 4.5 km long and up to 500 m wide. The maximum relief elevation is less than 10 m above sea level.

The "Lateritic and sandy lowlands" extending to the north cover 90% of the Rorruwuy outstations area and are represented by gently undulating plains with plateaux, rises and scarps (Lynch.B.T., al., 1996). The landscape is associated with deep weathering profiles or laterite. The formation of the lateritic and sandy lowlands has been explained by the development of a level erosion surface on the Cretaceous sediments.

The climate of the region is monsoonal with hot, humid summers and mild dry winters. Average annual rainfall is approximately 1600 mm and average annual evaporation greater than 2400 mm.
The regional geology is covered by the 1 : 100 000 map of Rorruwuy Sheet 6273 completed by Northern Territory Geological Survey (Fig. 1) and the 1 : 250 000 Geological Series Map Arnhem Bay/Gove, NT Sheet SD/53 - 3/4 and associated explanatory notes (Dunnet, D., 1965).

Rorruwuy is located on the northwest part of the McArthur Basin. It is underlain by Mesoproterozoic sediments covered by Cretaceous sediments of the Carpentaria Basin. The Carpentaria Basin consists of Early Jurassic to Early Cretaceous continental and marine sediments deposited in a large epeiric seaway which covered much of the northern Australian landmass.

The Mesoproterozoic Roper Group Mantungula Formation, which is outcropping north of the outstation, is mainly represented by sandstone, fine grained, thin to very thin bedded, micaceous interbedded with mudstone grey-green to black.

The Cretaceous rocks in northeastern Arnhem Land represent alluvial/coastal-plain and inner-shelf depositional environments (Krassay, A. A., 1994). These rocks were previously named as the Mullaman Beds, but two new stratigraphic names Walker River Formation and Yirkala Formation are proposed by A.A.Krassay and used in this report. The Walker River Formation is composed of moderately to well sorted, typically cross-bedded, fossiliferous, fine- to coarse-grained quartz sandstone interbedded with laminated clayey siltstone and chert granules and pebble conglomerate. The Yirkala Formation is composed of poorly sorted, fine to very coarse-grained, large-scale crossbedded matrix-poor quartz sandstone with dispersed chert pebbles and rare plant fossils.

The Cainozoic sediments, in the vicinity of Rorruwuy, are represented as a sand, silt, clay commonly shelly and ferricrete.

2.1 AQUIFER OCCURRENCE

The Mesoproterozoic Roper Group sediments are considered to be a low yielding aquifer controlled by secondary porosity. Previous drilling in the area shows that a supply of up to 0.5 L/s can be obtained in selected places for example Bore 27719 and 27781 for Muthamula outstation.

The aquifers developed in the Cretaceous are the high yielding groundwater sources in the Gulf Region. The groundwater potential is related to the intergranular porosity of the rock. More than 80% of successful bores obtain water from the sandstone between 35 and 65 m depth. Water supplies from this formation vary from 3.0 L/s (Bore 30070 at Spring Camp Outstation) to 8.0 L/s (Bore 30046 at Garrathiya Outstation). Production bores for the Rorruwuy Outstation encountered shallow aquifers between 15.0 m and 31.0 m with supply up to 5.0 L/s (airlift).
Cainozoic sediments are moderate aquifers, supply is controlled by primary porosity and extent and thickness of sediments. Aquifers of capacity 0.05 to 5.0 L/s can be located.

2.2 SURFACE WATER

There are no known surface water sources in a 2 km radius from the Rorruwuy outstation.
The quality of groundwater (Table 1) from bore 29687 and bore 29688 is suitable for human consumption being within acceptable limits according to guidelines for potable water published by the Australian Water Resources Council/National Health and Medical Research Council (AWRC/NHMRC), 1987. Water from bore 29677 and bore 29688 is corrosive (Fig.3) with pH 5.0 - 5.2, alkalinity 3.0 - 7.0 mg/L and total dissolved solids concentration 31 - 45 mg/L. This water will cause corrosion to conventional copper or brass plumbing fittings. Consideration should be given to the use of corrosion resistant materials (including PVC pipes) in the storage, head works and reticulation system.
<table>
<thead>
<tr>
<th>BORE REGISTERED NUMBER</th>
<th>DATE OF SAMPLING</th>
<th>pH</th>
<th>ELECTRICAL CONDUCTIVITY (US at 25 deg C) Field/Lab</th>
<th>TOTAL DISSOLVED SOLIDS (mg/l by evaporation at 180 deg C)</th>
<th>SODIUM, Na</th>
<th>POTASSIUM, K</th>
<th>CALCIUM, Ca</th>
<th>MAGNESIUM, Mg</th>
<th>IRON (TOTAL), Fe</th>
<th>TOTAL HARDNESS (as CaCO3)</th>
<th>SILICA, SiO2</th>
<th>CHLORIDE, Cl</th>
<th>SULPHATE, SO4</th>
<th>NITRATE, NO3</th>
<th>BICARBONATE, HCO3</th>
<th>CARBONATE, CO3</th>
<th>FLUORIDE, F</th>
<th>NaCl (calc from chloride)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22303</td>
<td>22/04/92</td>
<td>5.8</td>
<td>85</td>
<td>50</td>
<td>11</td>
<td>4</td>
<td>1</td>
<td>0.1</td>
<td>7</td>
<td>2</td>
<td>11</td>
<td>23</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0.1</td>
<td>38</td>
</tr>
<tr>
<td>22304</td>
<td>30/09/93</td>
<td>6.2</td>
<td>90</td>
<td>65</td>
<td>11</td>
<td>1</td>
<td>4</td>
<td>0.1</td>
<td>10</td>
<td>8</td>
<td>11</td>
<td>20</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>0.1</td>
<td>33</td>
</tr>
<tr>
<td>29687</td>
<td>7/12/94</td>
<td>5.0</td>
<td>74</td>
<td>45</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>5.3</td>
<td>5</td>
<td>7</td>
<td>12</td>
<td>14</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>29688</td>
<td>9/12/94</td>
<td>5.2</td>
<td>53</td>
<td>31</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>14</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0.1</td>
<td>23</td>
</tr>
</tbody>
</table>

Analyses in milligrams per litre (unless otherwise stated)

** - Maximum recommended levies for potable water. (AWRC/NHMRC, 1987)

Levels exceed non-health related limits.

**TABLE 1 - WATER QUALITY DATA**
Fig. 2

RELATIONSHIP BETWEEN pH VALUE AND ALKALINITY
4. WATER DEMAND

The present and future water demand for Rorruwuy outstation could be met with a supply from bore 29687 and bore 29688. Based on a population of 50, and an assumed demand of 250 L/c/d (Draft "Guidelines for levels of service to rural communities and outstations" PAWA, 1995), the calculated consumption would be 12.5 m³/d compared to a potential supply from bore 29687 and bore 29688 of 86.4 m³/d and 86.4 m³/d respectively.
5. RESULTS

During this project two bores were drilled:

- Bore 29687 located at AMG co-ordinates 641000 - 8 650800
- Bore 29688 located at AMG co-ordinates 641000 - 8 650800

and constructed as production bores.

Bore 29687 was drilled to a total depth of 33.3 m and encountered 5.0 L/s (cumulative airlift) of potable water from 15.0 to 31.0 m. The bore was constructed with PVC class 12 casing and stainless steel screens with 0.5 mm apertures from 27.0 m to 31.0 m. For the construction detail see attached Composite Log of Bore 29687.

An eleven hours constant discharge test and recovery test were performed on the bore to establish the maximum rate and pump setting. The test report (see attached Test Report Bore 29687) indicated that a pumping rate of 1.0 L/s and a pump setting of 12.0 m below ground level should be adopted.

Bore 29688 was drilled to a total depth of 27.2 m and encountered 4.0 L/s (airlift) of potable water from 19.0 to 23.0 m. The bore was constructed with PVC class 12 casing and stainless steel screens with 0.5 mm apertures from 19.0 m to 23.0 m. For the construction detail see attached Composite Log of Bore 29688.

A twenty two hours rate test and recovery test were performed on the bore to establish the maximum rate and pump setting. The test report (see attached Test Report Bore 30072) indicated that a pumping rate of 1.0 L/s and a pump setting of 12.0 m below ground level should be adopted.

The quality of groundwater in the area is suitable for human consumption. However, the water from bore 29687 and bore 29688 will cause corrosion to conventional plumbing materials. Consideration should be given to the use of PVC pipes in the supply and reticulation system.
It is recommended that:

- pump setting for Bore 29687 - Depth should be 12.0 m below ground level for a pumping rate of 1.0 L/s; for the solar pump with pumping rate 2.0 L/s pump setting should also be 12.0 m below ground level;

- pump setting for Bore 29688 - Depth should be 12.0 m below ground level for a pumping rate of 1.0 L/s; for the solar pump with pumping rate 2.0 L/s pump setting should also be 12.0 m below ground level;

- consideration should be given to the use of corrosion resistant fittings in the water supply and reticulation;

- absorption trenches and septic tanks should not be constructed within 100 m of the bore.
REFERENCES


4. Lynch, B.T. & Wilson, P.L., "Land Systems of Arnhem Land" Department of Lands, Planning and Environment, Darwin, NT.
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>BORE CONSTRUCTION</th>
<th>GRAPHIC LOG</th>
<th>STRATA DESCRIPTION</th>
<th>AQUIFERS (WATER STRUCK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.58m</td>
<td>BACKFILL - CEMENT</td>
<td>142mm ID PVC CASING CLASS 12</td>
<td>Soil: red brown</td>
<td>SWL 4.42m 6-12-94</td>
</tr>
<tr>
<td>1.1m</td>
<td>203mm ID STEEL CASING</td>
<td>120mm ID STAINLESS STEEL SUMP</td>
<td>Clay: red, grey and brown</td>
<td></td>
</tr>
<tr>
<td>1.4m</td>
<td>154mm ID STAINLESS STEEL SCREENS WITH 0.5mm APERTURE</td>
<td>Laterite and Clay</td>
<td>-0.2 L/s</td>
<td></td>
</tr>
<tr>
<td>1.7m</td>
<td>Quartz Sand</td>
<td>Clay: white, purple and some Laterite</td>
<td>0.7 L/s</td>
<td></td>
</tr>
<tr>
<td>2.0m</td>
<td></td>
<td>Laterite</td>
<td>-5.0 L/s</td>
<td></td>
</tr>
<tr>
<td>2.3m</td>
<td></td>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6m</td>
<td></td>
<td>Clay: brown, grey and Sand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMPOSITE LOG OF BORE 29687**
Bore Location: RORRUWUY.  
Map: Arnhem 1:100,000  
Sheet: 6173.  

Client: ATSIC.  
Purpose: Outstation Supply.

RECOMMENDATION:  
Pumping Rate: 1 L/s.  
Pump Setting: 12 m.

For alternative pumping rates or settings contact: Water Resources,  
General recommendations are on the reverse side.  
In all correspondence please quote bore 29687.

BORE DATA:

Finished depth: 33 m.  Completion Date: 21.11.94.  Test Date: 7.12.94.  
Standing Water Level: 4.42 m on 6.12.94.  Test Rates: 8 L/s.  
Construction Details:  Test Duration: 11 hrs.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 6.0 m</td>
<td>203 mm ID steel casing.</td>
</tr>
<tr>
<td>0 - 27.0 m</td>
<td>142 mm ID class 12 PVC casing.</td>
</tr>
<tr>
<td>27.0 - 31.0 m</td>
<td>152 mm ID stainless steel screens, 0.5 mm apertures.</td>
</tr>
<tr>
<td>31.0 - 33.0 m</td>
<td>160 mm ID stainless steel sump.</td>
</tr>
</tbody>
</table>

Notes:  
1. Top of casing as constructed was 0.58 m above ground.  
2. All depths are measured from natural ground level.  
3. Test rates are not necessarily indicative of a sustainable yield for production pumping.

WARNING:  
MINIMUM INTERNAL BORE DIAMETER IS 142 mm.  
MINIMUM INTERNAL BORE DIAMETER TO RECOMMENDED PUMP SETTING IS 142 mm.

COMMENTS:  
1. The above recommendations are based on a constant rate test at 8 L/s for 11 hours and assume hydrological conditions remain constant.  
2. Provision to monitor water levels and obtain water samples while pumping should be incorporated when equipping this bore.
3. Water quality analysis indicates a corrosive nature due to low pH and TDS which will affect pumping equipment and recirculation fittings of a ferrous composition.
4. High iron levels can be reduced by aeration of discharge.
5. For solar pumps recommended pumping rate can be increased up to 2 L/s.
6. This bore can sustain higher pumping rates. Further advice should be obtained from Water Resources Division if higher yields are required.

WATER ANALYSIS:  
Prepared by: R Setchell  
20.12.94  
Checked by: B Thatcher  
6.01.95
RECOMMENDATIONS FOR FINISHING, OPERATING AND PROTECTING GROUNDWATER BORES.

Attention to the following points will ensure a long and safe life for the bore supply and help prevent pollution of the groundwater resource.

1. Construct a concrete apron around the bore head to prevent surface flow, seepage and waste from entering the bore.

2. Seal the space between the casing and pump equipment to prevent entry of vermin, dirt and pollutants.

3. Prevent spillage of fuel and oil on the ground around the bore. Store fertilizer and other chemicals at least 50 m away.

4. Keep stock away from the bore head. Discourage domestic activity at the bore.

5. If the bore is no longer required the casing is to be securely capped.

IN ADDITION, please ensure that the BORE IDENTIFICATION TAG is retained securely at all times. The registered bore number is Water Resources Division's only reference to the scientific and engineering data on this bore and hence important to WRD's further advice to bore owners.

BORE LOCATION MAP.
STEP DRAWDOWN TEST
6.12.94

DRAWDOWN IN METRES

TIME IN MINUTES

Q = 2 L/s
Q = 4 L/s
Q = 5 L/s
Q = 6 L/s

RORRUWUY
RN 29687
Note: Full Recovery In Less Than 1 Minute

Q = 8 L/s

CONSTANT DISCHARGE TEST
7.12.94

RORRUWUY
RN 29687
DEPT (m)  | BORE CONSTRUCTION | GRAPHIC LOG | STRATA DESCRIPTION | AQUIFERS
---|---|---|---|---
0.57m | | | Soil: red and brown | SWL 4.48m 6-12-94
5.00m | CEMENT | | Clay: red and grey | |
10.00m | 142mm ID PVC CASING CLASS 12 | 203mm ID STEEL CASING | Clay: red, grey and some Laterite | |
20.00m | 152mm ID STAINLESS STEEL SCREENS WITH 0.5mm APERTURE | | Sand | 4.0 L/s
25.00m | 160mm ID STAINLESS STEEL SUMP | | Clay: brown and grey | |
30.00m | | | | |

COMPOSITE LOG OF BORE 29688
POWER
AND
WATER
AUTHORITY

WATER RESOURCES DIVISION

TEST REPORT — BORE RN. 29688

Bore Location: RORRUWUY.
Map: Arnhem 1:100,000 Sheet: 6173.

Client: ATSIC.
Purpose: Outstation Supply.

*******************************************************************************

RECOMMENDATION: Pumping Rate: 1 L/s. Pump Setting: 12 m.
For alternative pumping rates or settings contact:-
General recommendations are on the reverse side.
In all correspondence please quote bore 29688.
Water Resources, Palm Court, Darwin NT.
*******************************************************************************

BORE DATA:

Finished depth: 27.2 m. Completion Date: 22.11.94. Test Date: 9.12.94.
Standing Water Level: 4.48 m on 8.12.94. Test Rates: 1.5L/s to 6L/s
Construction Details:

<table>
<thead>
<tr>
<th>Interval</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 6.0 m</td>
<td>203 mm ID steel casing.</td>
</tr>
<tr>
<td>0 - 19.0 m</td>
<td>142 mm ID class 12 PVC casing.</td>
</tr>
<tr>
<td>19.0 - 23.0 m</td>
<td>152 mm ID stainless steel screens, 0.5 mm apertures.</td>
</tr>
<tr>
<td>23.0 - 27.2 m</td>
<td>160 mm ID stainless steel sump.</td>
</tr>
</tbody>
</table>

Notes:
1. Top of casing as constructed was 0.57 m above ground.
2. All depths are measured from natural ground level.
3. Test rates are not necessarily indicative of a sustainable yield for production pumping.

WARNING: MINIMUM INTERNAL BORE DIAMETER IS 142 mm.
MINIMUM INTERNAL BORE DIAMETER TO RECOMMENDED PUMP SETTING IS 142 mm.
*******************************************************************************

COMMENTS:

1. The above recommendations are based on a multi rate test to 6 L/s for 400 minutes which was then extended at 4 L/s for a further 10 hours and assume hydrological conditions remain constant.
2. Provision to monitor water levels and obtain water samples while pumping should be incorporated when equipping this bore.
3. Water quality analysis indicates a corrosive nature due to low pH and TDS which will affect pumping equipment and reticulation fittings of a ferrous composition.
4. High iron levels can be reduced by aeration of discharge.
5. For solar pumps recommended pumping rate can be increased up to 2 L/s.
6. This bore can sustain higher pumping rates.Further advice may be obtained from Water Resources Division.
7. This bore is a standby for bore RN 29687 and they should not be pumped in conjunction.
*******************************************************************************

WATER ANALYSIS: 94/95/0820

Prepared by: R Setchell 20.12.94
Checked by: B Thatcher 6.01.95
Attention to the following points will ensure a long and safe life for the bore supply and help prevent pollution of the groundwater resource.

1. Construct a concrete apron around the bore head to prevent surface flow, seepage and waste from entering the bore.

2. Seal the space between the casing and pump equipment to prevent entry of vermin, dirt and pollutants.

3. Prevent spillage of fuel and oil on the ground around the bore. Store fertilizer and other chemicals at least 50 m. away.

4. Keep stock away from the bore head. Discourage domestic activity at the bore.

5. If the bore is no longer required the casing is to be securely capped.

IN ADDITION, please ensure that the BORE IDENTIFICATION TAG is retained securely at all times. The registered bore number is Water Resources Division's only reference to the scientific and engineering data on this bore and hence important to WRD's further advice to bore owners.
STEP DRAWDOWN TEST
8.12.94

DRAWDOWN IN METRES

TIME IN MINUTES

Q = 1.5 L/s

Q = 3.0 L/s

Q = 4.5 L/s

Q = 6.0 L/s

RORRUWUY
RN 29688