POWER AND WATER AUTHORITY
WATER DIRECTORATE

BORE COMPLETION REPORT
RN 14520 AND 14522

JOINT DEFENCE SPACE
RESEARCH FACILITY
PINE GAP
DECEMBER 1985

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Hydrogeology Section
Water Resources
ALICE SPRINGS

Job No RWT290
File No 55.15 R3
TABLE OF CONTENTS

1. INTRODUCTION
2. WATER DEMAND
3. HYDROGEOLOGY
4. DRILLING AND TEST PUMPING RESULTS
5. WATER QUALITY
6. RECOMMENDATIONS
7. REFERENCES

ATTACHMENTS

1. TEST REPORTS - BORES RN 14520 AND 14522
2. DRAWDOWN/YIELD RELATIONSHIP
3. COMPOSITE BORELOGS RN 14094, 14096, 14097, 14520 AND 14522
4. RESULTS OF CHEMICAL ANALYSIS
5. PLAN - LOCATION OF DRILLING SITES

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LIST OF ABBREVIATIONS

L/s Litres/second
L/c/d Litres/capita/day
mm Millimetre
m Metre
m³/d Cubic metres/day
3.

1. INTRODUCTION

In September 1983 Mr W J Williams the Australian Defence Representative at the Joint Defence Space Research Facility (JDSRF) asked the Water Division of the NT Department of Transport and Works – later to become the NT Water Directorate – to undertake a review of the water supply situation at Pine Gap. This review was completed and the report, issued in February 1984 recommended that

(1) Existing pumps not be lowered any deeper than their present setting.

(2) Drilling of new production holes should be programmed as soon as possible.

(3) Drilling of pilot holes to identify deeper aquifers and to delineate possible problems should precede construction of production bores.

(4) Observation bore RN 5730 should be cleaned out promptly so that recording of water levels can resume in this section of the borefield.

(5) All observation bores should be cased with perforated 50 mm diameter galvanised water pipe to their full depth to enable readings to be taken should hole collapse occur.

All recommendations were accepted and Water Division was commissioned by Order No FX2398-081-84 of 13 July 1984 to perform tasks 2 - 5. Following discussions between JDSRF and Water Division representatives the scope of the project was confirmed to include

(A) Drilling and casing of three investigation holes.

(B) Drilling, casing and testing of two production bores with minimum internal diameter of 10" (254mm) and a yield of 22.5 L/s (300 GPM) against a head of 183m (600 ft).

(C) Cleaning and casing of observation bores.

Field work commenced on 1/8/1984 with cleaning and casing of the observation bores and the drilling of investigation bore RN 14094 using Water Division's crew and rig. The third investigation hole was completed on 14/9/84. Because the construction of the large diameter production bores was outside the scope of the NT Period Drilling Contract it was necessary to prepare a
4. Specification and call tenders for this work. Tender Board Contract No 20112/84 was awarded to Gorey and Cole Drillers of Alice Springs on 20 June 1985. Large diameter drilling bits were then manufactured and drilling was performed between 5 October and 3 November 1985.

Test pumping of the production bores, by Water division, was completed between 14 and 28 November 1985.

2. WATER DEMAND

Annual water demand at the Facility has been within the range 150 - 170 ML since 1970 with no major changes anticipated over the next few years. Although existing bores are able to meet this requirement there is no spare capacity for fire fighting purposes so additional higher capacity bores were required. As the borehole pumps were required to deliver direct to the Facility, about 1.5 km away, they needed to be of 80 - 100 HP (590 - 746 Kw). Electric submersible pumps of this power have a diameter of 200 mm and it was this factor which necessitated casing with a minimum internal diameter of 254 mm.

On a continuous pumping basis 170 ML/year equates to 5.4 L/s. The combined output of the two production bores is 70 L/s so the demand is satisfied by an adequate margin.

3. HYDROGEOLOGY

The Facility’s well field is located on Mereenie sandstone. This is a well known formation, which outcrops along the base of the Macdonnell Range from Roe Creek to a point about 1.5 km west of the Pine Gap. The formation has a true thickness of about 350 m and dips south at 45°. Most of the formation consists of fine angular quartz grains but occasional quartzite cobbles up to 100 mm diameter are encountered during drilling. Although the rock is normally strong some weaker bands are present and these tend to scour causing loss of drilling fluids.

The Ping Gap aquifer is hydraulically connected to the Roe Creek aquifer which supplies Alice Springs.
5.

Monitoring of water levels at Roe Creek shows that there has been a steady drop of about 2m/year for the last few years. Measurements in observation bore RN 5798 at Pine Gap between December 1980 and December 1985 show a total drop of 6 m. To allow for this steady drawdown it was recommended by Stephens (1984) that all future boreholes should be drilled to a minimum of 200 m so that pumps could be set at 150 m. This would be sufficient for the next 20 years at least. The present drilling was in accordance with these recommendations.

4. DRILLING AND TEST PUMPING RESULTS

Drilling of the three investigation holes (RN14094, 14096 & 14097) took place with relatively little trouble considering the depth of the holes. Bore RN 14094 penetrated weak zones at 118 m and 190 m and partial collapse at 170 m. Air was used as flushing medium to 230 m. Further penetration using mud was attempted but as this was unsuccessful the hole was terminated at that depth. Bores RN 14096 and RN 14097 were taken to find depths of 221 m and 203 m using air only.

These three bores were tested using the air lift method and all had yields in excess of 20 L/s. The bores were fitted with plain casing to 174 m and if fitted with pumps placed at 160 m could provide useful supplementary supplies for several years.

Production bore RN 14520 and 14522 were drilled using mud. Bore RN 14521 was attempted about 6 m east of RN 14906 and at a depth of 75 m the specially manufactured bit disintegrated. Fragments could not be recovered so the hole was abandoned and backfilled. RN 14522 was drilled 6 m to the east as a replacement.

Performance testing using a shaft driven turbine pump involved a four stage step test and a constant rate test with recovery measurements. From these tests the drawdown/yield curves for one day, one week and one year were prepared. Recommend pump settings and extraction rates are shown on the two test reports which are based on continuous pumping. In practice the pumps will only be operated alternately for about 20 hrs per week. This will result in total drawdown considerably less than those shown on the curves.
5. WATER QUALITY

Water samples were taken for chemical analysis from the production bores on completion of drilling and test pumping. Results of analysis are attached and show that all samples comply with Northern Territory drinking water standards as recommended by the Northern Territory Department of Health. Standards prepared by the World Health Organization were taken into consideration during the preparation of the NT recommendations.

6. RECOMMENDATIONS

It is recommended that

(a) The two production bores be equipped in accordance with details set out on the Test Reports for bores RN 14520 and 14522.

(b) The three investigation bores RN 14094, 14096 and 14097, fitted with 174 m of blank casing of 152 mm internal diameter, should be used for standby or monitoring purposes.

(c) To avoid possible contamination of the aquifer all bores not fitted with pumps should be sealed with locked caps.

7. REFERENCES


TEST REPORT — BORE RN. 14520

Bore location: PINE GAP
Client/owner: J.D.S.R.F.
Client’s reference:
Purpose of supply: Water Supply for facility

Map: SF 53.14
Grid reference: 373 200mE 7 365 200mN

RECOMMENDATIONS
Pumping rate: 30 L/s. Pump setting: 160 m below ground level
General recommendations are given on the reverse side.
The aquifer and bore cannot sustain higher pumping rates with deeper pump settings or for short periods in favourable seasons. Further advice can be obtained from:
(In all correspondence refer to the bore’s RN number).

BORE DATA
Finished depth: 210 m. Completion date: Test date: 14.11.85
Standing water level: 130.3 m on 14.11.85 Test rates: 19.82 L/s
Construction details:

<table>
<thead>
<tr>
<th>Interval (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2</td>
<td>Red Topsoil</td>
</tr>
<tr>
<td>2 - 210</td>
<td>Grey Fractured Sandstone</td>
</tr>
</tbody>
</table>

Test duration: hrs

Notes: 1. Top of casing as constructed was 0.35m above ground
2. All depths are measured from natural ground level
3. Test rates are not indicative of safe long term pumping rates.

WARNING: MINIMUM INTERNAL BORE DIAMETER IS 250 mm

COMMENTS

1. Provision should be made to obtain water samples at the well head
2. An air line should be placed in the bore to permit easy measurement of standing water level.

WATER QUALITY

See water laboratory report (Analysis No. 85/86/1316)

WRD4020
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. Maintain pumping equipment in good order to prevent pollution. 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. The first tap on the pipeline should not be less than 5 m from the bore head.
5. Pumping the bore at higher than recommended rates may fork the bore leading to instability or pump maintenance problems. Seek the professional advice of an hydrogeologist or groundwater engineer.
6. If the bore is no longer required, the casing is to be removed or securely capped and the bore backfilled with clayey material. A cement plug may be required in some instances.

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.
TEST REPORT — BORE RN. 14522

Bore location: PINE GAP
Client/owner: J.D.S.R.F.
Client’s reference:
Purpose of supply: Water Supply for Facility

Map: SF 53.14
Grid reference: 373200 - 736200

RECOMMENDATIONS
Pumping rate: 40 L/s. Pump setting: 160 m below ground level
General recommendations are given on the reverse side.
The aquifer and bore cannot sustain higher pumping rates with deeper pump settings or for short periods in favourable seasons. Further advice can be obtained from:
(In all correspondence refer to the bore’s RN number).

BORE DATA AQUIFER TEST
Finished depth: 211.5 m. Completion date: 28.11.1985
Standing water level 131 m on 3.11.1985
Test rates: 32.4 L/s
Test duration 24 hrs

Interval (m) Description
0 - 211.5 Sandstone

Notes: 1. Top of casing as constructed was 0.27 m above ground
2. All depths are measured from natural ground level
3. Test rates are not indicative of safe long term pumping rates.

WARNING: MINIMUM INTERNAL BORE DIAMETER IS 250 mm

COMMENTS
1. Provision should be made to obtain water samples at the well head
2. An air line should be placed in the bore to permit easy measurement of standing water level.

WATER QUALITY

See water laboratory report (Analysis No. 85/86/1218 )

WRD4020
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. Maintain pumping equipment in good order to prevent pollution. 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. The first tap on the pipeline should not be less than 5 m from the bore head.

5. Pumping the bore at higher than recommended rates may fork the bore leading to instability or pump maintenance problems. Seek the professional advice of an hydrogeologist or groundwater engineer.

6. If the bore is no longer required, the casing is to be removed or securely capped and the bore backfilled with clayey material. A cement plug may be required in some instances.

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
These curves are based on a 1 day pumping test at a discharge of 19.2 litres per second. They assume that hydrologic conditions will not change for other pumping rates and periods.

WATER RESOURCES DIVISION
DRAWDOWN-YIELD RELATIONSHIP
PINE GAP
Reg. No. 14520 Date Tested 14/11/1985
These curves are based on a 1 day pumping test at a discharge of 32.4 litres per second. They assume that hydrologic conditions will not change for other pumping rates and periods.

WATER RESOURCES DIVISION
DRAWDOWN-YIELD RELATIONSHIP
PINE GAP

Reg. No. 14522    Date Tested 28/11/1985
WATER RESOURCES DIVISION

DEPTH (m) | BORE CONSTRUCTION LOG | GRAPHIC LOG | STRATA DESCRIPTION | AQUIFERS (WATER STRUCK)

0 | 203 mm OD STEEL CASING | 152.4 mm OD STEEL CASING | 3.0m x 355mm OD STEEL CASING | SAND: fine coarse, angular

20 | SANDSTONE: fine medium, angular QUARTZ grains, weak

40 | fine grained below 12m

60 | CONGLOMERATE: with red brown SANDSTONE

80 | SANDSTONE: with CLAY

100 | SWL 127.6

120 | 21/8/84

140 | ~ 1.5 L/s

160 | ~ 3.0 L/s

180 | ~ 8.0 L/s

200 | AIRLIFT ~ 20.0 L/s

220 | COMPOSITE LOG OF BORE PINE GAP RN 14094

240 | Viewed at 03:02:10 on 18/02/2010
**WATER RESOURCES DIVISION**

**DEPTH** (m) | **BORE CONSTRUCTION** | **GRAPHIC LOG** | **STRATA DESCRIPTION** | **AQUIFERS (WATER STRUCK)**
--- | --- | --- | --- | ---
0 | 0 | SANDY GRAVEL | 0 |
20 | | | 20 |
40 | | | 40 |
60 | | | 60 |
80 | | | 80 |
100 | | | 100 |
120 | | | 120 |
140 | | | 140 |
160 | | | 160 |
180 | | | 180 |
200 | | | 200 |
220 | | | 220 |
240 | | | 240 |

**203mm Ø PLAIN Casing**

**152mm Ø PLAIN Casing**

**OPEN HOLE**

**SANDSTONE**: fine grained, angular QUARTZ, brown

well developed
CEMENT-MATRIX below 27m

iron strained below 171m

weak and friable
SANDSTONE

**SWL** 128.6
6/9/84
~ 3.7 L/s

~ 4 L/s

~ 18 L/s

**COMPOSITE LOG OF BORE**

**PINE GAP**

**RN 14096**

Viewed at 03:02:10 on 18/02/2010
### WATER RESOURCES DIVISION

#### DEPTH (m) | BORE CONSTRUCTION LOG | GRAPHIC | STRATA DESCRIPTION | AQUIFERS (WATER STRUCK)

| 0 | 203mm OPEN HOLE | | CLAYEY SILT & SAND | |
| 20 | | | SANDSTONE: medium coarse, angular QUARTZ grains, weak pale brown |
| 40 | | | well developed cement, strong yellow, slight iron staining |
| 60 | | | strong grey |
| 80 | | | |
| 100 | | | |
| 120 | | | |
| 140 | | | |
| 160 | | | |
| 180 | | | |
| 200 | | | |
| 220 | | | |
| 240 | | | |

**COMPOSITE LOG OF BORE** PINE GAP RN 14097

- SWL 125.9
- 14/9/84
- 0.2 L/s
- 3.5 L/s
- 10 L/s
- 18 L/s
### Composite Log of Bore - Pine Gap RN 14520

<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>0-20</td>
<td>72.1m x 35.5mm Ø Steel Casing</td>
<td>Top of Packer Set at 59.6m</td>
<td>Sandy Silt</td>
<td>-0</td>
</tr>
<tr>
<td>20-40</td>
<td>150.1m x 25.4mm Ø Steel Casing</td>
<td>3.17mm Hole</td>
<td>Sandstone: fine medium angular, Quartz grains, banded yellow grey</td>
<td>-20</td>
</tr>
<tr>
<td>40-60</td>
<td>4.44mm Hole</td>
<td></td>
<td></td>
<td>-40</td>
</tr>
<tr>
<td>60-80</td>
<td></td>
<td></td>
<td></td>
<td>-60</td>
</tr>
<tr>
<td>80-100</td>
<td></td>
<td></td>
<td></td>
<td>-80</td>
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<tr>
<td>100-120</td>
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<td></td>
<td></td>
<td>-100</td>
</tr>
<tr>
<td>120-140</td>
<td></td>
<td></td>
<td></td>
<td>-120</td>
</tr>
<tr>
<td>140-160</td>
<td></td>
<td></td>
<td></td>
<td>-140</td>
</tr>
<tr>
<td>160-180</td>
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<td>-160</td>
</tr>
<tr>
<td>180-200</td>
<td></td>
<td></td>
<td></td>
<td>-180</td>
</tr>
<tr>
<td>200-220</td>
<td></td>
<td></td>
<td></td>
<td>-200</td>
</tr>
<tr>
<td>220-240</td>
<td></td>
<td></td>
<td></td>
<td>-220</td>
</tr>
</tbody>
</table>

**Note:**
- SWL 130.3
- 5/10/85
- ~0.5 L/s
- ~6 L/s
- ~20 L/s

**Construction Details:**
- 2.75Ø REG BOX 240mm LONG WELDED ON CASING BASE PLATE
- Stainless Steel Screen 4mm SLOT FROM 188.3 - 203.5m
### WATER RESOURCES DIVISION

<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</td>
<td>125.5m x 254mm Ø STEEL CASING</td>
<td>317mm HOLE</td>
<td>SANDSTONE: fine coarse, angular QUARTZ grains with well developed CEMENT-MATRIX below 30m, colour banded yellow grey with iron staining below 120m</td>
<td>SWL 131 3/11/85 4 L/s</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>67.83m x 355mm Ø STEEL CASING</td>
<td>TOP OF PACKER SET AT 60.16m</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>444mm HOLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>2½&quot; REGULAR PIN WELDED ON CASING BASE PLATE</td>
<td></td>
<td>STAINLESS STEEL SCREEN</td>
<td>4mm SLOT FROM 175 - 185.2m</td>
</tr>
<tr>
<td>120</td>
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**COMPOSITE LOG OF BORE PINE GAP RN 14522**
<table>
<thead>
<tr>
<th>Analysis</th>
<th>Value</th>
<th>Unit</th>
</tr>
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<tbody>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>1.5</td>
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</tr>
<tr>
<td>Suspended solids (mg/L)</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td><strong>Chemical</strong></td>
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</tr>
<tr>
<td>Sodium (Na)</td>
<td>138</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>150</td>
<td>mg/L</td>
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<tr>
<td>Potassium (K)</td>
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<td>mg/L</td>
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<tr>
<td>Sulphate (SO₄)</td>
<td>90</td>
<td>mg/L</td>
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<tr>
<td>Calcium (Ca)</td>
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<tr>
<td>Nitrate (NO₃)</td>
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<td>mg/L</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>29</td>
<td>mg/L</td>
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<tr>
<td>Bicarbonate (HCO₃⁻)</td>
<td>339</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Hardness (as CaCO₃)</td>
<td>257</td>
<td>mg/L</td>
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<tr>
<td>Carbonate (CO₃⁻)</td>
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<td></td>
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<tr>
<td>Total Alkalinity (as CaCO₃)</td>
<td>278</td>
<td>mg/L</td>
</tr>
<tr>
<td>Fluoride (F)</td>
<td>0.6</td>
<td>mg/L</td>
</tr>
<tr>
<td>Iron (total Fe)</td>
<td>0.2</td>
<td>mg/L</td>
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<tr>
<td>Orthophosphate (PO₄)</td>
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<tr>
<td>Silica (SiO₂)</td>
<td>20</td>
<td>mg/L</td>
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<tr>
<td>NaCl (calc. from chloride)</td>
<td>246</td>
<td>mg/L</td>
</tr>
<tr>
<td><strong>Additional</strong></td>
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</tr>
<tr>
<td>Copper (Cu)</td>
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<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
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<tr>
<td>Arsenic (As)</td>
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</tr>
<tr>
<td>Manganese (Mn)</td>
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</tr>
<tr>
<td>Zinc (Zn)</td>
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</tr>
<tr>
<td>Cadmium (Cd)</td>
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<td></td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobalt (Co)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**The sample as analysed complies with Northern Territory Drinking Water Standards as recommended by the Northern Territory Department of Health.**
**Analysis - Chemical (mg/L)**

<table>
<thead>
<tr>
<th>Ion</th>
<th>Concentration (mg/L)</th>
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<tr>
<td>Sodium, Na</td>
<td>141</td>
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<tr>
<td>Potassium, K</td>
<td>9</td>
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<tr>
<td>Calcium, Ca</td>
<td>53</td>
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<tr>
<td>Magnesium, Mg</td>
<td>29</td>
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<tr>
<td>Total Hardness (as CaCO₃)</td>
<td>252</td>
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<tr>
<td>Total Alkalinity (as CaCO₃)</td>
<td>276</td>
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<tr>
<td>Fluoride, F</td>
<td>0.5</td>
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<td>Orthophosphate, PO₄</td>
<td>0.7</td>
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<td>Silica, SiO₂</td>
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**Analysis - Additional (mg/L)**

<table>
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<tbody>
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<td>Copper, Cu</td>
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<td>Lead, Pb</td>
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<tr>
<td>Arsenic, As</td>
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<tr>
<td>Manganese, Mn</td>
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<td>Zinc, Zn</td>
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<td>Cadmium, Cd</td>
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<td>Nickel, Ni</td>
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</tr>
<tr>
<td>Cobalt, Co</td>
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</table>

The sample as analysed complies with Northern Territory Drinking Water Standards as recommended by the Northern Territory Department of Health.