WATER SUPPLY - AYERS ROCK

A REVIEW

AT

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1. PURPOSE OF THE REVIEW

This review has been prepared for the information of Members of The Ayers Rock Advisory Committee and for consideration at the Committee meeting scheduled for 30th July 1976. It provides information in respect of points raised by the Reserves Board in letters dated 15th June and 21 June 1976, and points raised in the Department of Construction comment dated February 1976. It includes a summary of information available at July 1976.

2. AYERS ROCK - SOUTH EAST AQUIFER

Ayers Rock is surrounded by deserts. The median annual rainfall is 150 mm and the annual evaporation 3000 mm. Apart from those features providing the tourist attractions, the area is one of low relief. These facts suggest the conclusion that has now been proved. Water in the area will be scarce. Such water as exists will be saline except where recharge to the groundwater is concentrated by run-off, captured in permeable surface materials and fed directly to a significant deeper reservoir.

R.E. Read (Appendix 11.1 Groundwater Potential Dune Plains, Eggington & Kingwell 1975) states: "At both the basin near the Olgas and South at Ayers Rock, thick alluvium over soft rocks occurs close to areas of outcrop which provide recharge. It seems likely that usable supplies will only be found in this type of setting".

When usable supplies are available at such a setting, as is the case in the South East Ayers Rock Aquifer where 0.1 million kilolitres per year have been proved by consistent pumping of this quantity, a valuable resource exists. Environmental or conservation objectives can be satisfied by development using headworks set entirely below ground level. The resource is too valuable to be ignored, particularly as this is a renewable resource capable of providing the planned yield without long term depletion or other environmental cost.

An annual supply of 0.1 million kilolitres provides a base consumption of 100 kilolitres per day for general use plus a "personal allowance" of 50 litres per head per day for 5000 tourists over a 200 day tourist season.
3. AYERS ROCK - DUNE PLAINS AQUIFER

R.E. Read (op. cit.) states in his conclusions:

"The Cainozoic geology (and hence the occurrence of groundwater) is governed by the pre-Tertiary erosion surface."

In the Ayers Rock vicinity no bore with a useful yield was drilled in any of the bedrock (pre-Tertiary) formations. The present day surface of sediments deposited on the pre-Tertiary surface essentially is horizontal. Thickness of the sediments therefore is greater and the potential for occurrence of aquifers is greater where valleys or basins exist in the pre-Tertiary erosion surface. The most significant valley known to exist is that occupied by the Dune Plains Aquifer.

The aquifer and its potential were described in the 1975 Water Resources Branch Report. (Groundwater Potential - Dune Plains between Ayers Rock and the Olgas, Echington and Kingwell) A preliminary copy only of this report was made available to the Ayers Rock Advisory Committee. The full report includes a Supplement comprising maps and graphs not reproduced earlier, the geologists report and an explanation of the basis for the recommendations. A copy of Paragraph 11 of the report appears at Appendix A of this review.

The Summary of the Report sets out the \"vital statistics\" (Appendix B to this Review).

Water Resources Branch proposes that this aquifer be developed to provide 100 kilolitres per day base consumption plus 250 litres per head per day for 5000 tourists throughout a 200 day tourist season.

This water (0.3 million kilolitres annually) would be softened but not desalinated, requiring the use of hot water systems designed to resist the aggressive water. Special hot water units would be cheaper in capital and maintenance costs than desalination units. Problems of disposal of saline effluent would not arise.

Sewage water would be treated and returned to the ground at selected soakage points.
Gardens would not be watered as such practice would create a moist micro-environment foreign to the nature of the arid area. Landscaping would be by native arid zone trees and "dry" gardens.

Air conditioning would be by air cooled units. The aquifer is "fed" by an underflow of 0.1 million kilolitres annually. The balance of 0.2 million kilolitres annually would be mined. This could proceed with confidence at the stated qualities for at least 20 years and probably much longer. Note that the volume of water in the basin as defined on the plans is 40 million kilolitres; at 0.2 million kilolitres per year it would take 200 years to exhaust the storage. At 20 years gradients will have been established from the pumping field to the remote and saline parts of the aquifer. After 20 years some salinity increases are expected. If after (say) 50 years the increasing salinity becomes too much of a problem, the likelihood is that a satisfactory desalination unit will have been developed to handle the situation.

Development of this aquifer provides what may well be a near permanent supply for the number of visitors judged by Ovington to be the maximum the environment is capable of carrying.

Development of this aquifer would not have any undesirable environmental effects nor would it deprive Aboriginal People of existing water facilities.

Development could be staged to suit any desired rate of expansion of the village up to 5000 tourist capacity level.

4. OTHER AQUIFERS

Other known aquifers and likely aquifers within an 80 km radius of Ayers Rock have been discussed in the "Interim Report" (Kingwell 1973).

Possible aquifers between the Ayers Rock Park and the George Gill Ranges were examined without success. Drilling at an area of rock outcrop some 95 km north-north-east of Ayers Rock yielded supplies with a salt content greater than that of sea water.
The Water Resources Branch in 1968 proved that the George Gill Range itself would provide useful supplies if problems of distance to the eastern end were surmountable (at the Terowie Arkell south of Tempe Downs Station or the Levi Range).

The Western end of the range might provide supplies if access could be gained to the plateau on top of the range.

5. SCOPE FOR DEVELOPMENT

The already proved Ayers Rock South Eastern aquifer is adequate to provide potable water requirements for the 5000 visitor level. The Dune Plains Aquifer can provide other water requirements for this number of visitors.

A much greater number of day visitors could be catered for if the overnight visitor level were to be held down by limiting accommodation and roads were to be improved to provide day-trip access.

Further examination of water resources will improve definition of the recognized sources but existence of any unrecognized significant sources within 200 km of Ayers Rock is unlikely. Scope exists for devising improved management procedures to permit greater tourist access within the known water availability but there is little likelihood for benefit from expenditure of money on water exploration.

6. ALTERNATIVE DEVELOPMENT POSSIBILITIES

Since the availability of water to a village at Ayers Rock is limited and importation of water from 120 km to 170 km distant sources would be expensive, there would appear to be scope for transporting the tourists rather than the water.

A satellite tourist village at the Levi Range, Terowie or, if access could be found, on the George Gill Range Plateau would put tourists within day trip range of Ayers Rock and of other attractions at King Canyon and Palm Valley.
7. IMMEDIATE REQUIREMENTS

To cater for present needs and to improve the environmental impact new bores should be constructed in the Ayers Rock South East Aquifer.

The bores should be designed to provide long life with a minimum of attention and with all equipment concealed beneath ground-level covers. A management plan must be prepared to permit the aquifer to cater for immediate peak loads but remain within its established annual capacity of 0.1 million kilolitres.

As soon as practicable the accommodation should be relocated at the proposed new village site adjacent to the Dune Plains Aquifer. This aquifer should then be progressively developed to cater for required draft in excess of the capacity of the Ayers Rock South East Aquifer. Dual reticulation should be provided at the new village from its inception.

The stated long term requirement of 80 million gallons (0.4 million kl) annually can be satisfied by this procedure, with shorter term requirements being met as required. Until this development programme is implemented the Board will be forced to restrict visitor numbers or devise a method of rationing water so that each tourist has a stated allocation.
SUPPLEMENT

This supplement sets out the basis on which the recommendations are founded and presents material which could not be reproduced in time to accompany the "Preliminary Copy" incorporating Sections 1 to 10.

The most significant topographical feature in the area is Ayers Rock, hence it is reasonable to expect that if any zone of groundwater is to differ appreciably in quality from the generally "poor" level pertaining in the region, such zone will be in the vicinity of Ayers Rock. R. Read (Supplement 11.1) states: "It seems likely that useable supplies will only be found in this type of setting".

The Water Resources Branch "Interim Report on Groundwater Potential of the Ayers Rock Area - January 1973" estimated the long term yield of water having a quality better than 1500 mg/l T.D.S. from the aquifer in Quaternary age sediments as being 25 million gallons (0.11 x 10^6 cubic metres) per year. This is a significant water source in an area devoid of potable water. Its development has environmental considerations but it should not be ignored on this count. Submersible pumps with the head works set below ground level would virtually remove environmental impact.

If it can be assumed that the 0.11 x 10^6 cubic metres annually is to be re-developed to provide a perennial base supply, development of the Dune Plains Aquifer can be undertaken to provide a supplement to bring the total availability to 0.4 x 10^6 cubic metres annually.

A bore field established at the site recommended in Paragraph 8 will provide water made up of three components:

(a) That component provided by the through-flow defined in Paragraph 5 and captured by the bore field.

(b) That component provided by extraction from storage within the defined aquifer studied in this report.

(c) That component provided by inflow to the depleted storage. This inflow may be partly from induced recharge and partly from storage in adjacent aquifer systems.
From a point of convenience a 20 year term was selected to provide a reference period. Twenty years represents the probable useful life of a treatment plant.

The aquifer area immediately available to the pumping field is some 4 square kilometres. To achieve the best long term yield this area should not be dewatered to the extent that the hydraulic conductivity permitting water to flow to the pumps is sensibly diminished. The potentiometric head naturally stands at R.L. 485 only 15 metres above the top of the aquifer at R.L. 470.

With pump suction set at the bottom of the aquifer at R.L. 435 it would be possible to lower the potentiometric head to R.L. 465. A small quality of water is released in consequence of artesian elasticity as the head is brought down from R.L. 485 to the top of the aquifer. Useful quantities of water become available as the aquifer itself is dewatered below R.L. 470. A minimum desirable figure of 200 m²/day was adopted for aquifer transmissivity and this figure would be reached when the dewatering approaches R.L. 465. At this stage 15% of the aquifer thickness would be dewatered.

The recommended yield is based on reaching this level at the bore-field after a pumping period of 20 years. The recommended yield thus includes components (a) and (b) as defined above.

Component (c) is at that stage virtually untapped. With a transmissivity of 200 m²/day available and a reduction in head of 20 metres which will generate a gradient of 0.005 towards the bore-field, the bore-field is now capable of attracting its design yield of 0.3 x 10⁶ cubic metres annually from remote parts of the aquifer. The quality of the water supplied by this inflow will depend on the relative proportions of induced recharge and ancient storage making up the yield.

Poorly drained arid areas such as this exist under a natural balance with very small natural gradients. The creation of higher artificial gradients will cause water to move towards the bore-field from considerable distances and quite possibly will induce the recharge of surface water which otherwise is lost to evaporation. The balance of these likely effects cannot be determined until pumping has developed a significant reduction in the local potentiometric surface. If the balance favours continued extraction of stored water, the quality of the water pumped will decline; if the balance favours induced recharge of fresh water, the water quality could improve.
The Dune Fields Aquifer system holds water sufficient for postulated yields for over 100 years. The quality of the water which will be produced cannot be defined at this stage. Failure to develop the aquifer will prevent its potential being defined.

Utilization of water initially having a quality of 1700 mg/l T.D.S. possibly deteriorating to 2500 mg/l T.D.S. over the first 20 years is restricted to non-drinking uses. The water would need softening to improve the 650 mg/l hardness tending to 900 mg/l. A softened water could be used in a hot water system designed to withstand the aggressive nature of the saline water. Such a use would provide a lower cost supply than could desalination. A separate low pressure reticulation would utilize water from the South East Ayers Rock aquifer to provide water for drinking and cooking purposes. The South East Ayers Rock Aquifer is in all respects chemically suitable for human consumption.

The area within 100 km of Ayers Rock holds no hope for development of groundwater supplies superior to those at the South East Ayers Rock and the Dune Plains Aquifers. Looking further afield, Water Resources Branch has investigated likely aquifers adjacent to the Petermann Ranges without success. The possibility remaining is in the vicinity of the George Gill Ranges. Here another significant tourist attraction, the Kings Canyon, could provide a reason for development of a second tourist village.

Within the George Gill Ranges the useful Mereenie Sandstone aquifer is known to exist. The best opportunity for recharge and consequently the most likely site for low salinity water occurs where the Palmer River traverses the range. Water Resources Branch examined this area in 1968 when 15 holes were drilled as part of its "Terowie Investigation". Yield of 3.5 litres per second were obtained. Potable water (700 mg/l T.D.S.) is available in the immediate vicinity of the river but quality falls off with distance from the river. The Terowie Site is some 170 km from Ayers Rock. The George Gill Ranges at their closest to Ayers Rock are some 125 km distant and the chances of locating water of satisfactory quality at that point are small.
APPENDIX B

2.0 SUMMARY AND CONCLUSIONS

2.1 A groundwater basin exists in the dune plains area about 16 kilometres north-west of Ayers Rock. This basin covers an area of about 17 square kilometres.

2.2 The quantity of water stored in the basin, above a nominal base level of 440m A.H.D., is about 40 x 10⁶ cubic metres (8,000 million gallons).

2.3 Annual through-flow of the basin is estimated at 0.1 x 10⁶ cubic metres per year (20 million gallons per year).

2.4 Supply from the basin requires desalination if it is to be used for drinking. Total dissolved salts vary from 1,700 mg/l on the western edge to 3800 mg/l on the southern side. Magnesium levels vary from about 60 to 110 mg/l, fluoride from 1.3 to 3.2 mg/l and permanent hardness from 300 to 700 mg/l.

2.5 For planning purposes the adopted perennial annual yield of the basin is 0.1 x 10⁶ cubic metres per year. Controlled mining of the stored water will provide another 0.2 x 10⁶ cubic metres per year for at least 20 years. Thus on a limited life basis the reservoir will yield water at the rate of 0.3 x 10⁶ cubic metres per year for at least 20 years, with the probability that supplies will continue to be available, with restrictions on rate and quality for much longer periods.

2.6 The basin can be fully developed by the construction of six production bores totalling about 545 metres of drilling. About 255 metres of aquifer material will be intersected. The aquifer will require gravel packing and screening. A further 1,100 metres of drilling should be carried out in conjunction with the production drilling to provide 12 observation bores for the long term monitoring of the effects of pumping on the basin.

2.7 Joint development of the source, at present in use, South East of Ayers Rock with the Dune-Plains source would provide up to 5,000 tourists with a daily per capita 50 litres of potable water plus 250 litres of non-potable water.

2.8 Stringent management will be required. Factors such as average per capita water consumption and average tourist stay time will need to be controlled to ensure that best use is made of the limited but useful resource.

2.9 Development of the "Dune-Plains" groundwater reservoir will exhaust the potential for groundwater development within 100 km of the proposed Ayers Rock Village.