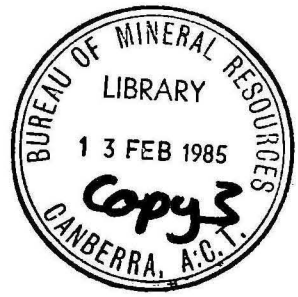

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1984/34

RECORD

MURRAY BASIN HYDROGEOLOGICAL PROJECT

PROGRESS REPORT 12

for half year ending 30 September 1984

compiled by

W.J. Perry

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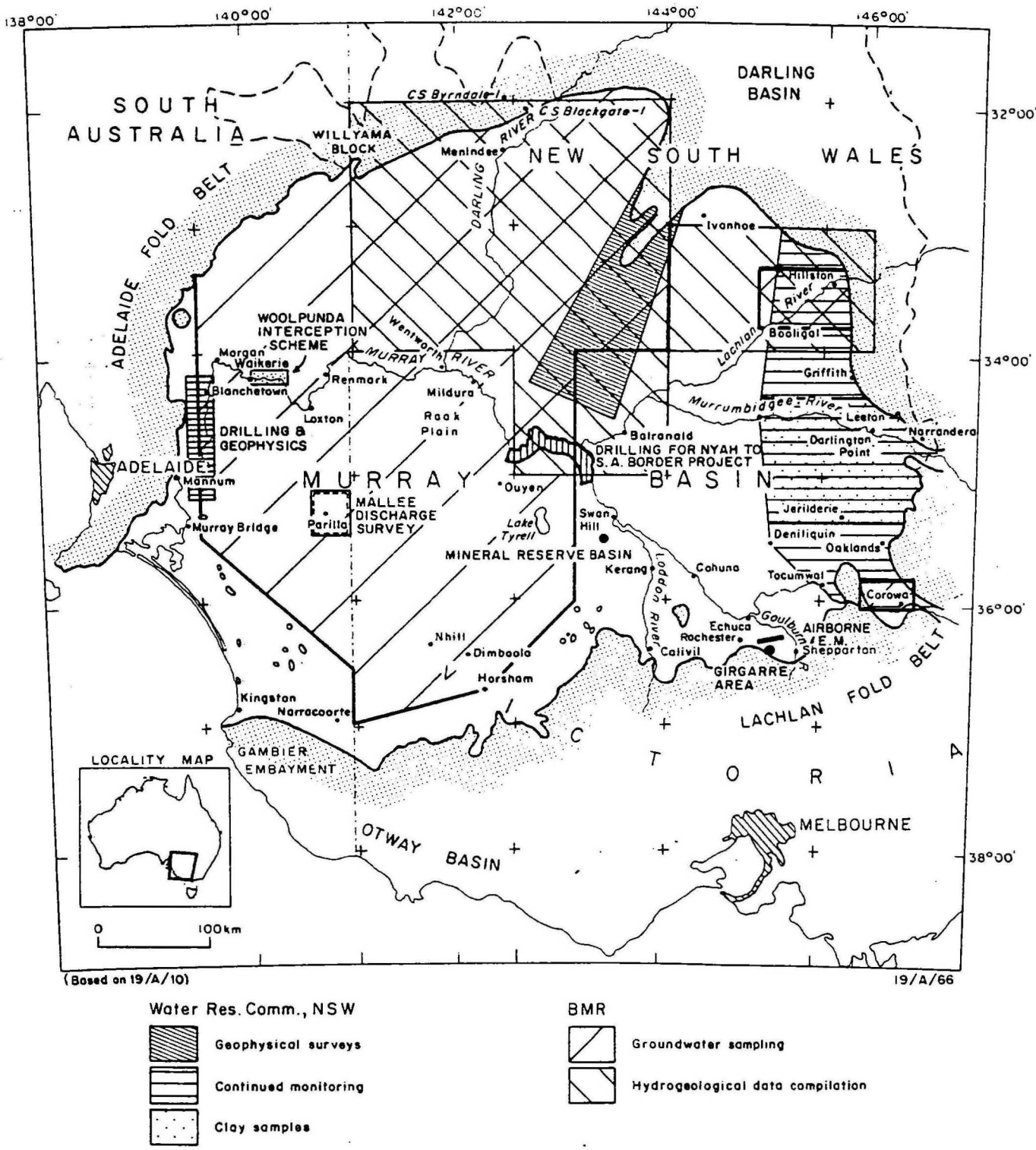

Fig. 1. Locality diagram

INTRODUCTION

During the period BMR staff completed a compilation of the 1:1 000 000 scale Cainozoic geology map and associated figures, and drawing for publication of a preliminary edition of the map was in progress. The hydrogeological phase of the Project gained momentum, with data for six 1:250 000 scale map sheets being compiled, and a program of water sampling in collaboration with participating organisations begun.

SOUTH AUSTRALIAN DEPARTMENT OF MINES AND ENERGY

by

S.R. Barnett

Five cored holes were drilled between Waikerie and Overland Corner as part of the feasibility study for the Woolpunda Interception Scheme. A very consistent lithology and sequence of fine grained limestone of the Murray Group was revealed. An average value of 0.5 m/day for the hydraulic conductivity was obtained from well recovery tests and a value of 0.75 m/day using laboratory permeability tests. These values are considerably lower than the value of 2.25 m/day used in the consultant's report to balance the rate of groundwater inflow to the river calculated by Darcy's method with that obtained by the salt balance method. An aquifer testing program is in preparation. The use of thermal imagery to detect groundwater inflows to the Murray is being investigated.

Routine monitoring is continuing in the Mallee area. A discharge survey was carried out on selected irrigation wells to assist in the preparation of a water budget for the region. In addition to the two standby town water supply wells drilled earlier, a further three replacement wells have been completed at Lameroo and Karoonda. All of these wells will have 72 hours aquifer tests carried out on them in the near future.

On the western margin, three holes were completed in the Renmark Beds confined aquifer in the Blanchetown and Mannum areas. A throw of approximately 150 m is estimated for the Morgan Fault in the Blanchetown area. Geophysical surveys (Sirotem and resistivity) over areas of suspected shallow basement were carried out.

Wells with good stratigraphic information throughout the Murray Basin in S.A. are being entered on a computer file which will produce cross-sections and contour plans.

WATER RESOURCES COMMISSION OF NEW SOUTH WALES

by

D.R. Woolley

1. Drilling

Micropalaeontological examination by V. Scheibnerova, Department of Minerals and Energy, N.S.W. of samples from the first bore at Mallee Cliffs is still being undertaken.

Seven bores in the Tocumwal-Deniliquin area are planned; however, the commencement date is unknown. They will be used to monitor the good quality groundwater associated with Tertiary sediment aquifers known to supply large yields of good quality groundwater to suitably constructed bores.

2. Geophysical Surveys

A total of 57 km of seismic refraction traverses were carried out during the period in the Lachlan and Murrumbidgee groundwater areas of the Murray Basin.

Preliminary electromagnetic (EM) soundings were carried out. The results indicated that penetration to the pre-Tertiary basement was not possible in deep sections with the commercially available equipment owing to a highly conductive surface. The maximum penetration under the field conditions was between 150 and 200 metres.

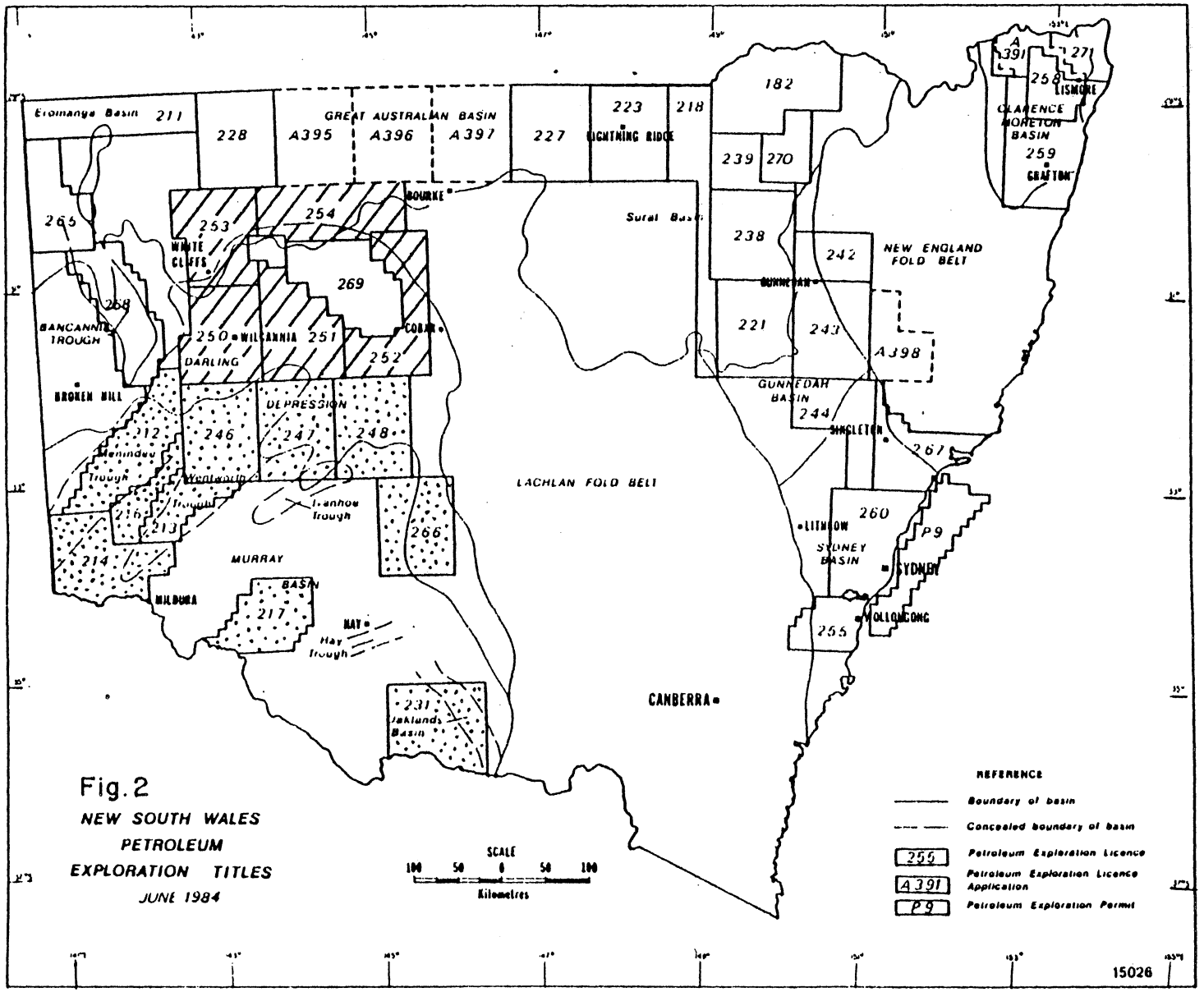

Fig. 2

NEW SOUTH WALES PETROLEUM EXPLORATION TITLES

JUNE 1984

3. Water Level and Water Quality Recording

Monitoring of water levels and water quality continued in the Commission's observation bore network in the eastern part of the Basin.

4. Clay Analysis Samples

A report based on clay samples from 25 bores in the Coleambally-Darlington Point area is currently in a draft stage, and awaiting draughting of figures. The completion of the report depends largely on the availability of draughting staff.

GEOLOGICAL SURVEY OF NEW SOUTH WALES

by

D.H. Probert

1. Petroleum Exploration

All Petroleum Exploration Licences over the Murray Basin were subject to title changes (Figure 2).

(a) PEL 231 previously held by Meekatharra Minerals was not renewed. Material including seismic surveys carried out by the company is now available.

(b) Claremont Petroleum N L has purchased Comserv (No 779) Pty Ltd and has interests in PEL's 212-214, 216, 217, 246-248, 250-254 and 266.

(c) BHP Petroleum completed the Darling seismic survey over part of the northern section of the Murray Basin and the Darling Depression i.e. PEL's 246-248, 250-254 and 266. The survey (1000 km) extends from 25-75 km south west of Wilcannia towards Ivanhoe as far south as Mount EMU No. 1 well. Some interesting good quality data have been obtained although results are patchy.

2. Coal Exploration

Kembla Coal and Coke Pty Ltd have been continuing hydrogeological geotechnical and environmental studies as part of a conceptual mining study to evaluate the possibility of providing fuel for a 1600 MW power station.

Mitsubishi Pty Ltd nearby has prepared a feasibility study on the conversion of Oaklands Coal. The study concludes that the coal is unsuitable for liquefaction but suitable for gasification. A combined cycle power generation plant and fuel production facility is possible.

RURAL WATER COMMISSION OF VICTORIA

by

R.S. Evans

1. Girgarre Area. Three well point systems have been installed and tested. When operational they will provide protection from salinity and high watertables for approximately 570 hectares. One pump will dispose water to an evaporation basin. Testing of vertical permeabilities at the site of the proposed basin indicates high leakage rates may result. Options on how to reduce the amount of leakage are now being considered.

2. Mineral Reserve Basins. Exploratory drilling at the site of 10 proposed interception bores has commenced. The bores show a variable thickness of sandy clay overlying Parilla Sand to a depth of 50 metres. Preliminary tests suggest transmissivities of the Parilla Sand are low.

3. Geophysical Surveys. Dipole-dipole resistivity surveys have been carried out at approximately 20 separate locations in the Shepparton Region. Results have been received from Geoterrex Pty. Ltd. for the airborne electromagnetic survey flown in April. The profiles indicate very low resistivities in salinised areas, but low salinity aquifers are not well defined. One reason for this may be that the technique is penetrating too deep, and that only a fraction of the 12 channels may be relevant for shallow aquifer detection. The interpretation of this data is continuing.

4. Nyah to South Australian Border Hydrogeological Investigation. Piezometers have been installed in 75 bores drilled along 11 section lines between Nyah and Wemen. The bores have been drilled to minimum depths of 25 metres to penetrate the upper part of the Parilla Sand aquifer. Complementary piezometers have been constructed where hydraulically separated shallow aquifers are present.

In the east of the investigation area, Parilla Sand occurs at a shallow depth beneath aeolian and fluviolacustrine sediments as a generally unconfined aquifer which in places has direct hydraulic connection to the River Murray. Westward, Parilla Sand occurs as a confined aquifer at increasing depth beneath a thickening wedge of fluviolacustrine Blanchetown Clay. Near Robinvale the Blanchetown Clay exceeds 55 metres in thickness on the downstream side of the Tyrrell Fault. To the west of the fault Parilla Sand occurs as an unconfined aquifer with riverbank outcrop between Robinvale and Wemen. Survey and groundwater salinity data are not yet complete but influent and effluent reaches of the river are indicated.

GEOLOGICAL SURVEY OF VICTORIA

by

C.R. Lawrence

The groundwater studies in the Victorian part of the Murray Basin carried out by the Department of Minerals and Energy have concentrated on salinity. This has been in response to the schedule of the Parliamentary Salinity Committee whose final report was due for completion in October, 1984; the work has involved hydrogeological data acquisition and analysis particularly directed toward the development of strategies.

A relevant paper on "The implications of Northern Victorian regional hydrogeology for salinity control" was prepared by Dr P.G. Macumber working as a member of a study team of specialists from the Victorian Government led by consultants Dwyer Leslie Pty Ltd in association with Maunsell and Partners Pty Ltd. This report analyses the state of the

hydrological equilibrium of each of the river "valleys" within the basin as well as the Mallee Region to the west. It predicts that under present rates of recharge, for the Campaspe River valley the area to the north of Rochester will become a zone of regional groundwater discharge in 60-70 years; the Goulburn River valley will be similarly affected; also the Highlands Province is predicted to have an increasing influence on the salinity of streams entering the Murray sedimentary basin.

As well it has been possible to comment on the hydrogeological implications of salinity control techniques, for although there is a general rise in groundwater pressures with the resultant appearance of stream and land salinity, the heterogeneity of the aquifer types and the groundwater regimes does not permit the use of a single control technique. On the basis of hydrogeological criteria a three-fold subdivision is considered appropriate: the Riverine Plain and associated major highland valleys, the Highland/Bedrock Province, and the Mallee; the report discusses these aspects in detail.

An inter-governmental report by representatives from the Rural Water Commission, the Department of Minerals and Energy, and the Department of Agriculture has examined data collection methods, and has recommended that there be a common format for observation bores.

V. Archer has completed a report on the palynology of the Olney No. 1 Bore, and is extending her work to other deep bores.

A mapping project is being completed on the Stavely Belt on the Highlands on the southern boundary of the basin, including interpretation with respect to plate tectonics.

The Geophysics Section is collating and interpreting all the gravity and aeromagnetic maps of the Murray Basin.

In preparation for the ratification of the groundwater agreement for the border zone between Victoria and South Australia, drilling of a network of observation bores in Victoria has begun at Murrayville.

BUREAU OF MINERAL RESOURCES

Geological Phase

by

C.M. Brown and A.E. Stephenson

Compilation of the 1:1 million scale geological map and accompanying block diagrams, palaeogeographic maps and cross-sections was completed during the review period. The presentation of Cainozoic geology in previous geological map legends, elsewhere in Australia, has been relatively perfunctory; however, in the Murray Basin, integration of the results of research undertaken at a number of spot localities over the past decade has facilitated the development of Tertiary and Quaternary stratigraphic frameworks for the Basin. Magnetic reversals, degree of pedogenesis, presence or absence of calcrete, and palaeowind direction, for example, have all been utilised to define Quaternary stratigraphic units. Many surface units are essentially morphostratigraphic rather than conventionally lithostratigraphic in character, and a map legend has been devised to emphasise this. Drafting of the map for production at preliminary edition towards the end of 1984 is also well advanced.

Interpretations of the downhole stratigraphy of some 3000 boreholes were compiled during the course of the project. This data synthesis has formed the basis for development of a subsurface stratigraphic framework, by documenting the distribution and geometry of stratigraphic units and aquifers of the basin. During the review period, interpretations of borehole stratigraphy were entered into a microcomputer database to allow retrieval of individual bore records, and to facilitate automated production of subsurface maps. The stratigraphic database can be interrogated using a number of retrieval strategies, which allow sorting of the data into various useful permutations of stratigraphic units and regional aquifers. A microform report documenting the major data sets that were generated is in preparation.

A.E. Stephenson completed a paper on the palaeoclimatic and sedimentological implications of a Pleistocene mega-lake, Lake Bungunnia, which was formed by tectonic damming of the lower reaches of the River Murray some 2.5 Ma ago. Parameters such as lake area, catchment, runoff

rates, rainfall and evaporation were integrated to give two "end-member" models for the mega-lake. Conclusions reached were that Lake Bungunnia filled gradually, to a maximum areal extent of some 33 000 sq km, over a period of several thousand years. It filled to a maximum depth of around 60 m, and small climatic variations would have caused large changes in the area of the lake. Palaeoclimatic deductions suggest a climate significantly wetter than that of today. Sedimentological characteristics of the Blanchetown Clay, Bungunnia Limestone and younger gypsiferous deposits were compared to the two possible "end-member" models of the history of the mega-lake. These comparisons suggest a model intermediate between the two proposed extremes. Features of the intermediate model explain sedimentological characteristics of the Pleistocene geological units. The major deduction is that Pleistocene climates were significantly wetter than the present day climate, and that Lake Bungunnia could not exist under the current climatic regime.

Hydrogeological Phase

by

R. Evans

BMR has received copies of hydrogeological data from the Water Resources Commission of NSW. The transcription of these and other data, received previously, into the data-base has stalled owing to problems of software. If feasible, a small micro-computer data-base will be built.

Field work was carried out during Sept-October, involving the collection of about 250 samples. As analytical results become available, probably early in 1985, they will be relayed to the relevant authorities.

The compilation of existing hydrogeological data at 1:250 000 scale commenced. The first sheets compiled were MENINDEE, ANABRANCH, MANARA, POONCARIE, BALRANALD and BOOLIGAL. Contours of water heads and electrical conductivities for each aquifer in the area have been produced. First indications are that large deficiencies exist in the data. Problems arising, and needing urgent resolution, are -

1) lack of surveyed bore levels
2) lack of aquifer definition in each bore.

These problems may be a function of the areas first compiled.

RECENTLY PUBLISHED AND UNPUBLISHED REPORTS ON THE GEOLOGY AND HYDROGEOLOGY OF THE MURRAY BASIN

Cook, P.J., 1884 - Whither the Murray? Search, 15, Nos 5-6, p. 149-150.

Tickell, S.J., & Humphreys, W.G., 1984 - Groundwater resources and associated salinity problems for the Victorian part of the Riverine Plan, in press.

Reports and discussion papers published by the Victorian (Parliamentary) Salinity Committee

Progress Report on the Barr Creek Catchment, Mineral Reserve Basins and Lake Tyrrell Schemes First Report to Parliament of the Salinity Committee (December, 1982).

The Activities of the Salinity Committee. Second Report to Parliament of the Salinity Committee (October 1983)

Causes, Extent and Effects of Salinity in Victoria. A report by ACI Australia Pty. Ltd. in association with Australian Groundwater Consultants Pty. Ltd., Gutteridge Haskins and Davey Pty. Ltd., and Melbourne University School of Agriculture and Forestry (November, 1983).

The Application of Salinity Control Techniques in Victoria. A report by Gutteridge Haskins and Davey Pty. Ltd. in association with Australian Groundwater Consultants Pty. Ltd., ACI Australia Pty. Ltd., and Melbourne University School of Agriculture and Forestry (November 1983).

Inter-Governmental Co-operation in Salinity Control. A discussion paper by Professor Sandford D. Clark (March, 1984).

Financing Salinity Control in Victoria. A discussion paper by Michael Read and Associates (March, 1984).

The Organisation and Management of Salinity Control in Victoria. A discussion paper by M. Mackay and Associates (March, 1984).

Irrigation and Groundwater Accessions. A report prepared by Professor T.A. McMahon on the Proceedings of a Technical Seminar (June, 1984).

Salinity Control in Northern Victoria. A Strategic Study for the Salinity Committee of the Victorian Parliament by Dwyer Leslie Pty. Ltd. in association with Maunsell and Partners Pty. Ltd. and a Specialist Group from Departments of the Government of Victoria (September, 1984).

Salt of the Earth: Final Report on the Causes, Effects and Control of Land and River Salinity in Victoria. Third Report to Parliament of the Salinity Committee (October, 1984).

Water Allocations in Northern Victoria. Fourth Report to Parliament of the Salinity Committee (October, 1984).

Copies of these publications are available from:

Parliament House
Melbourne 3002

or

Victorian Government Bookshop
PO Box 203
North Melbourne 3051

APPENDIX

Murray Basin Hydrogeological Project

Description and status, December 1983

This project is a long-term study which is being undertaken jointly by South Australian, Victorian and New South Wales geological surveys and water authorities and by the Commonwealth Bureau of Mineral Resources, Geology and Geophysics. It is co-ordinated by a Steering Committee comprising members of those organisations.

The Murray Basin is a geological structure with an areal extent of some 300 000 km^2. In each of the three States the basin sediments contain very large groundwater reserves. Where the groundwater has a low salinity it is increasingly being used for irrigation and town water supply purposes. In much of the basin, the groundwater is suitable only for stock use and is extensively used for this purpose. In other parts of the basin the groundwater is too saline for any use. There is a complex interaction between groundwater and surface water which may be beneficial, as in recharge areas in some parts of the basin, or harmful as in areas of saline groundwater discharge to rivers. In recent years, the states involved have stepped up the rate of assessment of the groundwater regime in the basin.

The primary aim of the Project is to improve the understanding of the groundwater regime of the basin by examining it as a single entity, unencumbered by State boundaries. Since a knowledge of the geology of an area is basic to the understanding of groundwater occurrence, a geological study of the basin is an essential part of the Project and as a consequence it will also be possible to make an assessment of other mineral resources.

The Project was planned initially to last five years and is organised in five phases:

(1) Geological synthesis, using all available geological and geophysical data.

(2) Hydrogeological assessment, on the basis of available data.

(3) Documentation of deficiences in geological and hydrogeological information and formulation of proposals for appropriate work programs.

(4) Additional work as approved which could include stratigraphic drilling, aquifer testing, biostratigraphic analysis and isotope hydrology studies.

(5) Development of numerical model(s), if found to be appropriate in the light of the data then available.

The geological synthesis is nearing completion, and a draft document reporting results with accompanying 1:1 scale geological maps is expected to be finished by late 1984.

Phase 2 began at BMR in 1983. Hydrogeological data available from the States are being entered into a BMR data base designed for the Project; BMR and State workers will prepare a report assessing these data, and the results will be illustrated on several maps including the following: 1:1 million scale maps showing water table, potential contours and salinity variations for the three or four most important hydrostratigraphic units; 1:2.5 million scale maps showing (i) amount of water abstracted-added per unit area (ii) recharge-discharge areas, distribution of aquifer parameters for a 7 layer hydrogeological model. (Both Victoria and South Australia have tested the feasibility of making a preliminary model of the basin as a whole based on a coarse (75 km) rectangular grid).

The hydrogeological assessment and phase 3, the documentation of deficiencies in geological and hydrogeological information are scheduled for completion in 1986.

Additional work required in Phase 4 (e.g. stratigraphic drilling, geophysical investigations) may be conducted by BMR or by appropriate State authorities. The development of a numerical model (Phase 5) if found to be feasible, may be undertaken by BMR or by State authorities. The Project will depend on the close co-operation of staff from all organisations involved, and some movement of staff between organisations for short periods will be necessary. Throughout the study, individuals and organisations will be encouraged to publish results to various aspects of the work. Results of the overall Project will be incorporated into joint publications.