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TENEMENT: Not Related.

TENEMENT HOLDER: Australian Water Resources Council.

REPORT:	Technical Committee On Underground Water 5th May 1971.	Pgs. 3-146

PLANS: Nil.

AUSTRALIAN WATER RESOURCES COUNCIL
Technical Committee on Underground Water

Agenda and Notes

on Agenda Items

8th Meeting

Wednesday, 5th May, 1971

commencing at 9.30 a.m.

9th Floor Theatrette, Mineral House,
66 Adelaide Terrace, Perth, Western Australia

AUSTRALIAN WATER RESOURCES COUNCIL

TECHNICAL COMMITTEE ON UNDERGROUND WATER

Eighth Meeting - May 5-6, 1971 in Perth

Draft Agenda

1. Opening, adoption of agenda.
2. Confirmation of previous minutes.
3. Business arising out of minutes (not covered elsewhere).
4. Education - Report of sub-committee.
5. Groundwater maps of Australia - Report of sub-committee.
6. Forward assessment of useable water resources.
7. Groundwater Nomenclature - Report of sub-committee
8. Groundwater investigation programmes
   (a) Presentation of Annual Reports
   (b) Accelerated Programme of Water Resources Measurement
9. Current Research Activities
   (a) W.R.E.S.C. Activities
   (b) Reports on Water Research Fund projects
   (c) New research programme approved by A.W.R.C.
   (d) Other Research Items
10. Liaison with other A.W.R.C. Committees.
   (a) Matters raised by T.C.S.W.
   (b) Establishment of T.C.W.Q.
11. Recent developments in groundwater investigation and exploitation.
12. Great Artesian Basin project
13. Handling and storage of hydrologic data.
   (a) Automatic Data Processing
   (b) Metrication
14. Groundwater Administration
   (a) Measurement of Groundwater withdrawals
   (b) Australian Water Well Association
15. International activities
   (a) International Hydrologic Decade
   (b) International conferences
16. State Working Sub-committees
17. Other business.

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Item 1: Opening, Adoption of Agenda

1. In accordance with its earlier decision that there be regular changes of Chairmen of Technical Committees the Standing Committee has agreed that Dr. N.H. Fisher be succeeded by Dr. K. Miles who will act as Chairman of the eighth meeting of T.C.U.W.

2. A copy of the draft agenda is attached.

3. A full list of members of T.C.U.W. is attached for the information of members.

Technical Committee on Underground Water

List of Members and Addresses

(as at 1st April, 1971)

Dr. K.R. Miles,
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ADELAIDE. S.A. 5001.

Dr. N.H. Fisher,
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CANBERRA CITY. A.C.T. 2601.

Mr. C.S. Christian, C.M.G.,
C.S.I.R.O.,
P.O. Box 225,
DICKSON. A.C.T. 2602.

Mr. A.I. McCutchan,
Department of National Development,
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Mr. C.E. Hounam,
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P.O. Box 1289K,
MELBOURNE. VIC. 3001.

Mr. J.H. Lord,
Geological Survey of W.A.,
66 Adelaide Terrace,
PERTH. W.A. 6000.

Mr. D.B. Collett,
Public Works Department,
2 Havelock Street,
WEST PERTH. W.A. 6005.

Mr. D. Kingston,
Engineering and Water Supply Department,
G.P.O. Box 641F,
ADELAIDE. S.A. 5001.

Mr. J.L. Knight,
Geological Survey of Victoria,
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MELBOURNE. VIC. 3000.

Mr. D.T. Currey,
State Rivers and Water Supply Commission,
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ARMADALE. VIC. 3143.

Mr. J.C. Symons,
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Mr. W.J. O'Dea,
Water Conservation and Irrigation Commission,
Box 2708 G.P.O.,
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Mr. J.N. Cramsie,
Geological Survey of New South Wales,
Box R216 Royal Exchange P.O.,
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Mr. J.T. Woods,
Geological Survey of Queensland,
2 Edward Street,
BRISBANE. QLD. 4000.

Mr. G.W. Pearce,
Irrigation and Water Supply Commission,
P.O. Box 74,
NORTH QUAY. QLD. 4000.

Mr. A.T. Laws,
Water Resources Branch,
Northern Territory Administration,
DARWIN. N.T. 5790.

Mr. P.W. Crohn,
Mines and Water Resources Branch,
Northern Territory Administration,
DARWIN. N.T. 5790.

Secretary: F.A. Hatfield,
Department of National Development,
CANBERRA. A.C.T.

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AGENDA ITEM 2

Item 2: Confirmation of Previous Minutes

1. Draft minutes of the seventh meeting of T.C.U.W. were circulated to members on 29th April, 1970. A few minor amendments have been received and incorporated in the final minutes, which are attached.

AUSTRALIAN WATER RESOURCES COUNCIL
TECHNICAL COMMITTEE ON UNDERGROUND WATER

Final Minutes

Seventh Meeting

Held at the Port Lincoln Hotel, Port Lincoln, 4th March, 1970

Members present

Commonwealth	Dr. N.H. Fisher	Bureau of Mineral Resources
	Mr. R.J.Richards (proxy for Mr.McCutchan)	Department of National Development
	Mr. J. Hogan (proxy for Mr. Hounam)	Bureau of Meteorology
	Prof. J.W. Holmes (proxy for Mr.Christian)	CSIRO
South Australia	Dr. K.R. Miles	Department of Mines
	Mr. P.H. Hicks	Engineering & Water Supply Department
Northern Territory	Mr. I.R. Binch	Mines & Water Resources Branch
	Mr. P.W. Crohn	Mines & Water Resources Branch
Western Australia	Mr. D.B. Collett	Public Works Department
	Mr. J.H. Lord	Department of Mines
Tasmania	Mr. J.G. Symons	Department of Mines
New South Wales	Mr. [illegible].J. O'Dea	Water Conservation & Irrigation Commission
	Mr. G.R. Wallis	Department of Mines
Victoria	Mr. J.L. Knight	Department of Mines
	Mr. D.J. Little (proxy for Mr. Currey)	State Rivers & Water Supply Commission
Queensland	Mr. G.[illegible].Pearce	Irrigation & Water Supply Commission
	Mr. J.T. Woods	Department of Mines

Observers present

Commonwealth	Mr J.N. Casey (acted as Secretary for Dr N. Jones)	Bureau of Mineral Resources
	Mr G.M. Burton	Bureau of Mineral Resources
	Mr T.W. Plumb	Department of National Development
South Australia	Mr C. Bleys	Department of Mines
	Mr J. Painter	Department of Mines
	Mr W.H. Deer	Engineering & Water Supply Department
Tasmania	Mr P.C. Stevenson	Department of Mines
New South Wales	Mr W.H. Williamson	Water Conservation & Irrigation Commission
	Mr J.N. Cramsie	Department of Mines
Victoria	Mr W. Esplan	Department of Mines
Queensland	Mr H. McDonald	Irrigation & Water Supply Commission
	Mr K.W. Wolff	Department of Mines

1. Opening Remarks

Dr Miles welcomed the 29 delegates and observers on behalf of the South Australian Government and the Chairman/ Convener, Dr Fisher, opened the formal discussion at 9.30 am.

The Chairman welcomed new members and observers, and specially mentioned the establishment of the new Geological Section of the Mines and Water Resources Branch in the Northern Territory. The Chief Geologist is Mr P. Crohn, now a member of the Committee.

2. Agenda

The agenda was agreed to without comment.

3. Confirmation of Minutes of Sixth Meeting

The Minutes of this meeting held in Hobart were adopted without amendment on a motion from Mr Woods, seconded by Dr Miles.

4. **Education**

(i) 1970 Groundwater School

Mr Williamson read a letter from the U.S.G.S. which inferred that Mr Ferris would be available as principal lecturer for the school; the meeting requested that this arrangement be confirmed as soon as possible, which the Chairman agreed to do, as the school depended on the attendance of Mr Ferris.

The timetable for the school was circulated. Lecturers at the school would be Mr Ferris, Prof. Watson and Dr Pilgrim (University of N.S.W.), Dr Denmead (CSIRO), Dr Morton (Flinders University) and Messrs Shepherd and McPharlin (S.A. Dept. of Mines). The manager for the school would be Mr Adam from the S.A. Mines Department.

The cost for each contributing organization is expected to be about $270, which would be about $80-$90 per individual if an estimated 50 people attend.

Standing Committee has previously indicated that consultants should be admitted to the School and on a motion put by Mr Lord, seconded by Mr Knight, their registration fee was set at $200 a head.

The proposed timetable was discussed, and it was generally agreed that the lectures by Mr Ferris concentrated as they are at the beginning of the course, and a summing up by him at the end, was appropriate. The Chairman indicated that attendance at only part of the course by individuals should not be encouraged, and that the school was meant to be an advanced school and organizations should bear this in mind when making nominations. It was desirable that nominees should have at least read the paper presented by Mr Lohman at the 1967 school.

As no night lectures would be given, the previously proposed sessions on bore logging and development of bores were deleted.

(ii) University Courses

Views were sought on the results and benefits of the ten weeks course given by the University of N.S.W. on surface and groundwater hydrology (1969 was the first time this course was held), and on the groundwater symposium held in August 1969 at the University of New South Wales.

The ten weeks course was attended by eighteen students, six of whom took the groundwater option (all from Government

instrumentalities). Some organisations felt the course was adequate, others had some criticism, particularly of the groundwater investigations section in which the discussion of geophysical techniques was not related specifically to groundwater search, and the geological aspects were not as appropriate as they might have been.

The course would be given again in 1970, and it is intended that the groundwater investigations section be improved and emphasised. A fee of $400 per person was charged in 1969.

The meeting felt that authorities should give more support to future courses, and that participants should be required to take the examinations at the end of the course, creating an air of formality and giving check on their performance to the authorities sponsoring them.

The symposium in August was judged to be a good meeting, with over 100 attending, and it was felt that the effort involved was thoroughly worthwhile.

The Universities that give, or propose to give lectures in hydrology were briefly mentioned; Macquarie, will have some lectures in hydrology in 1970; New England and Canberra College of Advanced Education may give lectures in 1971; Melbourne and Western Australia Universities are accepting higher degree work in hydrology; Flinders University will take students for groundwater hydrology and the University of N.S.W. was accepting part-time students for higher degree courses; Queensland did provide a course but Dr Watkins had not been replaced. The proposed Australian Mineral Sciences Centre in Adelaide would cater for post-graduate courses and Professor Holmes mentioned that the Waite Institute gave a interesting course on soil science and irrigation; this is co-ordinated by Dr Greenland and C.S.I.R.O. provides most of the lecturers; it runs for the full year with two lectures per week plus laboratory work, and it counts

as half a credit towards an M.Sc. The course was initiated following enquiries by Colombo Plan trainees and this is the first year it has been given; if the response is good then courses would be held at 2-3 year intervals. So far six overseas students, plus others, have enrolled.

The meeting decided that a letter should be sent to the University of N.S.W. complimenting them on the symposium and the 10-weeks course, and supporting the holding of the course again in 1970.

5 . Handling and Presentation of Hydrological Data

The method of recording water analyses was discussed, and the point made that analyses of groundwater normally record inorganic constituents only. Perhaps consideration should be given to the recording of pollutants although it was unlikely that there would be any quick standardisation of the recording of pollutants.

A discussion was held on whether the Subcommittee on the Handling and Storage of Hydrologic Data be reconstituted (the only original member available is Mr Hind). The various State members gave their opinions and discussed the status of their investigations and progress in computer handling of data. It seemed that provided all States had their information in a machine readable form, each could use the data to fit the system best suited to its requirements. A representative of an organisation who wished to look at the systems of other organizations, or to discuss the methods used would be welcome to visit all centres. Services of an expert on the staff of any of the various authorities could be provided to help another authority establish its storage and retrieval system (Mr Pearce mentioned that the services of Mr Eden could be made available).

A motion that the Sub-Committee be not reconstituted, moved by Mr Pearce and seconded by Mr Woods, was carried 11 votes to nil.

A motion proposed by Mr Wallis, seconded by Mr Binch, that the Secretary should endeavour to gather, co-ordinate and distribute material on groundwater data systems from other groups to all member authorities was carried 10 to nil.

The Chairman reported that the Secretary had not yet prepared the summary paper on presentation of groundwater data which had been agreed to at the last T.C.U.W. meeting.

A discussion was held on the effect of the metric system on such presentation of data. It was felt that serious thought should be given now to the terms and measures in metric language as it is inevitable that the system will be adopted in Australia.

The Meeting suggested that the metric system and its introduction might be noted in a suitable paragraph in the Water Resources Newsletter.

6. Groundwater Nomenclature

Mr. Williamson reported that many overseas organizations were working on nomenclature, and he recommended that the Committee should wait for their results to become available; he had had discussions with Mr. Lohman of the U.S.G.S. on this matter.

7. Hydrology of Interstate Groundwater Basins

A one page paper prepared by Mr. Currey would be distributed to members by the Secretary.

The meeting noted that this topic arose when the Victorian Minister for Mines asked the Commission about the possible effects on one State's water resources of water withdrawal and use in an adjoining State - similar problems would occur in oil production. It was felt that most of the problems could be resolved by the State bodies concerned and that the R.C.U.W. really did not need to be involved.

8. Groundwater maps of Australia

The general groundwater maps of Australia were displayed, together with the enlarged scale maps of South Australia. Mr. Burton gave a progress report on the work and outlined some problems still to be solved. It was proposed to switch Sheet 4(the composite groundwater picture) to Sheet 1 and the original Sheet 1 would then become Sheet 2 etc. It was hoped that the final drafting would start in July 1970 (January was the formerly accepted date) and to complete printing by July 1971. The Explanatory Notes are lagging and these must be to hand before final drafting commences.

All States were asked to meet the deadline of July 1970 for the notes - the reputation of T.C.U.W. would be enhanced by the maps, and all members should endeavour to get the job completed as soon as possible.

Members were not clear on the format the notes were to take and requested that the Secretary circulate all members with the suggested framework for the report; a copy of the draft legend should also be sent to all organizations. Queensland would co-ordinate the Great Artesian Basin section in the notes, and other States have been allotted various basins which transgress State borders. Any sections or structure contours would go into the notes and not on the map; sand dunes may be printed as an overlay on the map showing unconsolidated aquifers.

Mr. Bleys discussed the South Australian maps and illustrated how the problem of showing more than one aquifer was overcome by an overlay of dots in one instance and by a suitable inset in another. These State maps would be published separately.

9. Forward Assessment of Usable Water

It would not be possible to make a forward assessment until after the groundwater maps were compiled; the surface water group (T.C.S.W.) will have their assessment completed by August 1970, but the meeting felt that because of the delay in completing the groundwater maps and notes T.C.U.W. would not be in a position to make a forward assessment until some time after August 1970. The Secretary was to inform T.C.S.W. and Standing Committee that the groundwater part of the forward assessment of usable water would not be completed by the agreed date of August 1970.

10. States Grants (Water Resources) Act

Mr. Richards reported on the present position. The Act expires in June 1970 and a submission has been prepared for Cabinet consideration based on the States' estimated programmes for the next three years. When a decision is made the Prime Minister will write to the Premiers. It was hoped to get the necessary legislation into the first

session of Parliament in 1970.

Members discussed whether there was a need for a register of observation bores, and of the types of data recorded. The States felt there was so little call for such a bore list that it was hardly worth the effort in preparing a composite one; each State could provide the information on an ad hoc basis to any enquiries, even though all stream gauging stations are registered and the U.S.A. has set up a register of observation bores and their performance.

Tasmania felt that more effort could be devoted to the development of suitable recorders for observation bores, rather than in preparing a register of them.

11. Water Research

The progress on water research fund projects relevant to T.C.U.W. was discussed.

A report on project 68/7, "Interpretation of geophysical logs", was given by Mr. Stevenson. The literature survey had been completed and an appraisal of Australian logging practices had revealed some deficiencies; the second phase of the project, a handbook on log interpretation, would require another year to complete. It is a readjustment of a number of accepted Schlumberger methods.

Mr. Williamson reported on the progress of project 68/8, "Extraction of Water from Unconsolidated Sediments". He said that the literature survey was completed and that the full-scale pilot facility had been designed and should be completed in May. The result of the field test would be brought out in a symposium at Flinders University on the 6th March. Some concern was felt that the project was rather too comprehensive and that it should be broken into smaller components.

Mr. Burton reported on groundwater aspects of the Representative Basins programme; this work is proceeding and by the next meeting it is anticipated that Dr. Chapman will have a considerable amount of material to report on. The group working on representative basins in each State

includes a member from the State Water Supply authority, the Geological Survey, and the Bureau of Meteorology.

The Water Research Conference held under A.W.R.C. auspices in Canberra in February was briefly reviewed by Mr. Richards. He pointed out that there would be no published proceedings from the Conference but that some notes on the chief items of interest that arose from the conference had been circulated to participants. WRESC would consider the information arising out of the Conference at its next meeting in May. Mr. Woods inquired as to the basis of selection of representatives of this conference. He was informed that Dr. Watkins had been invited from Queensland, but had withdrawn. Mr. Haigh had attended.

Mr. Lord asked whether projects nominated for a water research grant and not given funds would automatically be included for consideration if further funds became available. The Chairman said he would make certain of the procedure and advise members.

In reply to Mr. Knight's question about what happens to equipment bought under the Research Grant after the project was completed, the Chairman said that it remains the property of the Commonwealth, but it may be assigned to the body that was conducting the research.

The Chairman said the B.M.R. would arrange or undertake a literature survey of aquifer recharge; after this, consideration would be given to staffing to see how it would be possible to carry out the rest of the project requested by the Council.

12. Measurements of Groundwater Withdrawals

South Australia has introduced restrictions on groundwater development in the North Adelaide Plains Basin and a statement on the procedures was made by Dr. Miles. The allocation of water is based on a recent land usage survey. The restrictions were introduced after it was found that 6/7th of the water produced was in fact being "mined" from the Basin.

It was reported that Western Australia has legislation to meter bores, and this is done in the Carnarvon area where

100% of the bores (about 100) are restricted. New South Wales and Queensland also reported on the procedures for restrictions on the use of ground water for irrigation in some areas. In New South Wales all new licences are granted for only 5 years, but the old licences have no expiry date and withdrawals under these licences are not controlled. In Queensland over 80% of the State is a controlled area for use of underground water and licences are required.

13. Drought

Mr. Lord distributed a report on the groundwater investigations in Western Australia for drought relief and made a very informative statement on the results.

14. Role of Consultants in Groundwater Investigations

The State members reported on the results of some consultant activity in their State. New South Wales reported that three major groundwater projects were being carried out by French consultants (B.R.G.M.), but it is not always the most economic way of achieving the results and the results are often not up to standard expected; the cost is about $15 per hour per consultant. Western Australia has only had experience with two consulting firms working for private companies. These are Australian Groundwater Consultants, and Leggett Brashears and Graham of New York, and Mr. Collett advised that both firms appeared to do quite good work.

Mr. Lord advised that other local consultants are available in Western Australia, and their charges are $100 per day for water work. The South Australian authorities have not used consultants but have been in contact with those who are working for mining companies in the State. N.S.W. reported that the Hunter Valley Research Foundation had consultants but seemed to have some difficulty in getting results from them. Queensland reported that there were no recognized groundwater consultants operating there now; however some companies employed consultants (C.S.R. employed

(Mr. Eric Smith) for specific research.

Mr. Wallis reported that Mr. Campbell (ex Continental Oil) representing the National Water Well Association had left him with material to circulate to try to form similar associations in Australia.

Tasmania reported that diviners charge $15 per site. Mr. Burton described the efficient operation of an Israeli hydrological group, Tahal, which seemed to have an excellent approach to the integrated study of groundwater. The Bureau used Down Under Well Services for contract logging of water bores in the Artesian Basin, and found the results acceptable - however Mr. Lord said this company had had difficulties in logging wells in the Alcoa refinery area.

15. International Hydrologic Decade

Mr. Plumb gave a review of the activities of the I.H.D. Working Group on Hydrological Maps, displayed various types of maps from overseas, and on behalf of the I.H.D. Working Group sought the advice of T.C.U.W. on the need for groundwater maps of various kinds. The Chairman commented that Australia's main contribution to the I.H.D. is the study of 100 representative basins.

Mr. Wallis reported that mapping of the intake beds in N.S.W. at 1:100,000 scale would begin shortly. Queensland was putting out some groundwater maps at 1:50,000 scale and to satisfy a need for regional hydrological maps they were preparing 1:1,000,000 maps of the geology and hydrology of areas. Mr. Burton drew members' attention to the interesting series of U.S. hydrological atlas maps. The meeting felt there certainly was a need for groundwater maps but the shortage of staff prevented enough effort being put into it at this stage.

16. International Conferences

Mr. Williamson briefly reported on the international conference on hydrogeology and geophysics he attended in Europe in 1969, and expressed disappointment with certain aspects of the meeting; 8 papers were presented, 2 in French and 6 in English.

17. State Working Sub-Committees

N.S.W., Tasmania and Northern Territory did not have meetings; Queensland and Victoria tabled their reports; South Australia does not have a Sub-Committee and Western Australia reported two meetings since the last T.C.U.W. meeting. The main topic discussed by the W.A.Sub-Committee was a major research project on salt encroachment in the South West of Western Australia involving C.S.I.R.O. Agriculture, Forestry, Public Works Departments and Geological Survey for which support had been sought from the Water Research Fund. Progress of groundwater investigations in Western Australia was also reviewed.

Victoria was interested in the use of remote sensing techniques. Mr. Knight remarked that he would recommend that the Mines Department help to drill any observation bores in Representative Basin areas in Victoria.

18. Venue and Date of Eighth Meeting

Members accepted Mr. Lord's invitation to hold the next meeting in Perth starting Wednesday 5th May, 1971.

General Business

It was strongly supported that arrangements be made for Mr. Ferris to visit all State capitals following the hydrological school to give talks to various bodies; the cost could come out of any funds that might be left over after the school; particularly as it was expected that the consultants would provide extra funds to the school. The Secretary would endeavour to arrange for this visit to be made.

It was requested that the final agenda for future T.C.U.W. Meetings be sent to the participants well beforehand.

The Chairman thanked the South Australian hosts for arranging the meeting that went so smoothly, and after a vote of thanks by Mr. Pearce to the Chairman and staff of National Development for the Secretarial work, the meeting closed at 5.10 p.m.

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AGENDA ITEM 3

Item 3: Business Arising Out of Minutes (not covered elsewhere)

1. There appears to be no business arising from the minutes other than that covered elsewhere in the agenda.

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ITEM 4: EDUCATION - REPORT OF SUB-COMMITTEE

1. A list of members of the Education Sub-Committee is attached (Attachment 1). A replacement member for Mr. C. Bleys is required for the Education Sub-Committee.

2. Mr. E.P. O'Driscoll has written to the Secretariat suggesting that Mr. R.G. Shepherd (S.A.) be asked to fill Mr. C. Bleys' position. Mr. O'Driscoll has also suggested that it is time he stood down from this sub-committee and that Mr. T.T. Bestow (W.A.) replace him as member and Mr. Shepherd replace him as convener. However, he is content to leave these matters to the members of T.C.U.W.

3. A report by the Education Sub-Committee on the 1970 Groundwater School is expected to be distributed before the meeting. This report reviews the school from the dual points of view of education and management. Together with the resume of courses currently available in hydrology, this report provides a bench mark for determining the future policy in education of T.C.U.W. The meeting should give the Sub-Committee some guidelines as to whether such schools should be held in the future; what type of school is called for; what other educational activities might achieve the objectives of T.C.U.W.? A resume of current professional and sub-professional courses available in the fields of hydrology and groundwater hydrology is also expected to be distributed before the meeting.

4. A paper by P. Meyboom has been already circulated to members for their information. The paper reviews the current situation in hydrogeology in a country which is well to the fore in this field and which is at present making great advances.

MEMBERSHIP OF EDUCATION SUB-COMMITTEE

E.P. O'Driscoll (Convener)	-	Geological Survey of Western Australia
B.L. Credlin	-	Irrigation and Water Supply Commission, Queensland
W.J. O'Dea	-	Water Conservation and Irrigation Commission, New South Wales
C. Bleys (Since resigned)	-	Geological Survey of South Australia

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AGENDA ITEM 5

Item 5: Groundwater Maps of Australia

1. At the 5th Meeting of T.C.U.W. a sub-committee was appointed to arrange the compilation and publication of a set of four maps and explanatory notes on Australia's groundwater resources.

The present membership of the sub-committee is as follows:-

Mr. G.M. Burton (convener)	Commonwealth
Mr. K.W. Wolff	Queensland
Mr. A.T. Laws	Northern Territory
Mr. C.R. Lawrence	Victoria
Mr. P.C. Stevenson	Tasmania
Mr. M.C. Hind	New South Wales
Mr. R. Shepherd	South Australia
Mr. J. Lord	Western Australia
Mr. T.W. Plumb	Commonwealth
Dr. N.O. Jones	Commonwealth

2. A report of the Groundwater Maps Sub-committee is attached (Attachment 1). It will be noted that this project is nearing completion and should be finalised before the next meeting of T.C.U.W.

3. For the information of members, a display of the groundwater maps in their draft form will be available at the meeting.

4. The following recommendation from the sub-committee (reproduced from the minutes of the last sub-committee meeting) requires consideration by this meeting.

Form of Publication

"The Sub-committee agreed that the intention was to publish a document entitled "Groundwater Resources of Australia" in five parts consisting of four maps and one set of notes.

It was decided to recommend to T.C.U.W. that the publication take the form of a hard-cover book incorporating the notes with the maps in a pocket at the rear."

5. In view of the imminent change to metric units and the probable date of publication of these maps (1971-2), members may feel it desirable to use metric units in the legends on the maps and the notes to accompany the maps. In this context item 13(b) of the agenda is relevant.

GROUNDWATER MAPS SUB-COMMITTEE - REPORT OF THE ANNUAL MEETING OF T.C.U.W., PERTH, 5TH MAY, 1971

General. The Sub-committee met formally once since the last meeting of TCUW on 4th March, 1970. The Sub-committee meeting was held in Sydney on 17th February, 1971. Smaller groups of the Sub-committee met when opportunity offered during independent visits to State capitals or in Canberra.

Progress on the sheets has been much slower during the past 14 months than was expected when reporting in March, 1970 and the expected distribution date of the maps is now June, 1972. Map 4 - Principal Groundwater Resources, proved more difficult than expected, particularly in the late stages of compilation. It also revealed difficulties in Maps 1 - 3 and the time taken in resolving these was considerable. The references for all maps were revised after the Port Lincoln meeting; a major change - the addition of information on the suitability of the different classes of water, to make the maps more meaningful - was undertaken and required considerable checking between committee members. Late changes on all sheets fell very much on the shoulders of senior members of all organisations and in many cases these men were very heavily occupied with other tasks of equal priority.

Maps. The state of the maps at 16th April is:

Maps 1 - 3, including revised reference complete, apart from minor retouching and late editing.

Map 4 compilation complete apart from several changes in the N.T. Compilation will be sent to committee members about 29th April for approval. The map with new reference will be displayed in Perth on 5th May.

The publication schedule is as follows:

(1) Tender documents for fair drawing are being dispatched on 16th April.

(2) The successful tenderer should receive the copy for all 4 maps in mid-July.

(3) Fair drawing should be complete in November - December

(4) Printing should be complete and first distributions should be made in June, 1972.

The Sydney meeting of the Sub-committee decided to change the name of Map 2 from "Principal Sedimentary Basins" to "Sedimentary Basins". The names of the Basins are to be included, if possible, on both Maps 2 and 4.

Explanatory Notes. The explanatory notes are proving far more difficult than expected and the Sydney meeting of 17th February decided to restrict detail considerably. Detail will be available by the sound selection of the bibliography and careful reference in the text to it.

The Sydney meeting set a schedule to suit the publication date of June for the maps but considerable effort and co-operation will be needed to maintain the programme. The help of TCUW delegates is urgently requested in this.

Conclusion Progress has been disappointing but this progress has required a major effort by all organisations and their work is gratefully acknowledged.

Attention of delegates of TCUW is invited to the problems of compiling data for publication. Staff in most organisations is heavily committed to expanding services needed in the development of water resources and to training staff recruited from Universities that gave practically no training in hydrology. Staff for compilation of data is extremely limited and the task falls to senior members who have the training and knowledge but little uninterrupted time; compilation is best done by continuous work. The importance of publishing existing data as a basis for future work deserves, I believe, further careful consideration and serious action by TCUW; the development of groups within all organisations specifically to compile data is one answer.

(G.M. Burton)
Convener

6

Item 6: Forward Assessment of Useable Water Resources

1. At the sixth meeting of T.C.U.W. it was noted that the forward assessment of surface water resources had been under consideration for some time and it was agreed that a comparable assessment of groundwater resources was needed even though only very approximate estimates could be prepared for much of the continent. It was further agreed that this assessment logically followed the compilation of the groundwater maps and would amount to an extension of the explanatory notes intended to accompany the maps. The meeting decided that a formal sub-committee should not be established at this time for the forward assessment and confirmed the T.C.U.W. representatives nominated by the convener to attend the joint discussions with T.C.S.W. on the detailed terms of reference for the assessment. These discussions took place immediately following the sixth meeting of T.C.U.W. and a copy of the report from this joint meeting, as presented to the tenth meeting of Standing Committee, was included in the Agenda Notes for the seventh meeting of T.C.U.W.

2. The thirteenth meeting of T.C.S.W. (held in December, 1970) was advised that reports on assessment of useable water resources had been received from three States with reports in preparation in the other States.

3. The eleventh meeting of Council (held in July, 1970) was advised that the groundwater section of the study was largely dependent on the compilation of Sheet 4 of the new Groundwater Maps of Australia. Council was told that this work was behind schedule and that the groundwater part of the assessment would probably be delayed until the latter part of 1971.

4. With the imminent completion of the groundwater maps project, T.C.U.W. will now need to consider the task of making this

assessment. Members may now wish to form a working group or sub-committee to expedite this project.

5. For the information of members a copy of the original terms of reference for this project as recorded in the minutes of the ninth meeting of Council is attached (Attachment 1), together with a copy of a circular letter from the Chairman of T.C.U.W., dated 16th January, 1969 (Attachment 2).

FORWARD ESTIMATE OF USEABLE WATER RESOURCES

Terms of Reference

Because of various difficulties in determining a satisfactory basis for an assessment of useable water, T.C.S.W. had been asked to prepare suitable terms of reference.

Following consideration of advice received from T.C.S.W., Standing Committee recommended to Council -

- that the study would aim at determining the total quantity of transportable water that could with present technology be expected to be made available for use. This is summarised as useable water. Transportable water is distinct from the very large quantity of water used in the processes of evapo-transpiration.

- that this should properly include underground as well as surface water although it is recognised that there are generally greater difficulties in assessing useable underground water.

- that the available data on both surface and underground water is being improved rapidly during the current the-year accelerated programme.

- that in the view of this there would be considerable merit in planning a revision of the 1965 Review of Australia's Water Resources using data as at 1973 or 1974, and in basing the assessment of useable water on this revised document.

- that in determining useable water there were many factors which must be taken into consideration and on which it was difficult at this stage to lay down procedures to be adopted. Some factors to be considered are:-

  - Rainfall
  - Occurrence, nature and quality of stream flow
  - Size and distribution of potential storages
  - Acceptable costs of storage
  - Distribution, availability and quality of underground water
  - Present stage of development

- That if it is agreed that the major task should be deferred for six years or so, there would be considerable merit in preparing as soon as possible a descriptive report which would set out for individual basins, groups of basins or regions, depending on circumstances, the factors affecting the quantity of useable water, the present level of knowledge concerning these factors for particular areas, and general forms of water use which might be expected in the foreseeable future. This first report should as far as possible contain quantitative estimates as well as general descriptions, and give some indication of anticipated capital costs involved in providing additional supplies.

- that the above compilation while it might not be suitable for general use could be expected to be useful to the authorities involved in its compilation. It would also serve to define gaps in present knowledge and to provide a basis for a more precise definition of the requirements for the subsequent task.

At this stage Standing Committee did not consider that any level of acceptability of costs should be determined.

The Council endorsed the Standing Committee recommendations.

Council noted that the Standing Committee had requested the Technical Committee on Surface Water and the Technical Committee on Underground Water, using the above resolution as a guide to prepare more detailed terms of reference for the assessment study, and report to Standing Committee at its next meeting.

ATTACHMENT 2

AUSTRALIAN WATER RESOURCES COUNCIL

Office of Deputy Chairman and
Secretary of Technical Committee
on Underground Water

0 38

Address: C/- Bureau of Mineral
Resources,
P.O. Box 378,
CANBERRA CITY. A.C.T.

16th January, 1969

All members

Forward Assessment of Useable Water

The Standing Committee of A.W.R.C. has requested T.C.S.W. and T.C.U.W., using the attached statement as a guide, to prepare detailed terms of reference for a forward assessment of useable water resources. The Technical Committee are required to report to Standing Committee at its next meeting (April, 1969).

T.C.S.W. has appointed a sub-committee with representatives from all States and the Northern Territory to consider the detailed terms of reference. This sub-committee proposes to meet in Melbourne on 6th March, 1969 and has suggested tnat T.C.U.W. representatives might attend part of the meeting for joint discussions. I believe it essential that these joint discussions be held.

The next T.C.U.W. Meeting is scheduled for 4-5th March, 1969 and it will be necessary to arrange representation for the discussions on 6th March in advance of the T.C.U.W. meeting. I am accordingly requesting one representative of each State and the Northern Territory, selected from T.C.U.W. members and observers at previous meetings of T.C.U.W., to represent T.C.U.W. at the discussions in Melbourne on 6th March and to accept nomination to a sub-committee on the forward assessment if the 6th Meeting decides that a sub-committee be appointed. In addition I propose that Mr. Burton (convener of the Sub-Committee on the Groundwater Maps) and Dr. Jones (Secretary of T.C.U.W.) should attend the meeting to assist in planning the forward assessment as a logical development from the groundwater maps now in preparation.

The proposal for the forward assessment arose from a paper by Mr. F.B. Haigh: "Suggested investigation of location of possible future irrigation development", presented at the 6th Meeting of Standing Committee (1966). Following discussion of Mr. Haigh's paper the Secretariat of A.W.R.C. was asked to prepare an estimate of the available water yield using data for existing water projects and for proposed projects for which investigations were complete. Difficulties were met in compiling an assessment using only data from reported investigations and the Secretariat report was referred by Standing Committee to T.C.S.W. which passed a resolution which formed the basis of the attached statement. The Secretary of T.C.U.W. will distribute

copies of papers relevant to this topic with the agenda notes for the 6th Meeting of T.C.U.W. and the subject will be discussed at the Meeting.

The following points are among those which may need consideration in preparing the terms of reference:

(i) The required assessment should preferably be expressed quantitatively as storages and yields of water, no matter how tentative the figures may be. (The 1963 assessment expressed groundwater resources only as equivalent surficial areas).

(ii) The emphasis should be on resources which may be adequate to support irrigation or other concentrated demands.

(iii) A distinction is necessary between the "rechargeable" groundwater resources and the "mineable" groundwater storages (even though many intermediate cases will be recognized).

(iv) The effect of groundwater development on the baseflow of streams and the role of groundwater storage in the optimum utilisation of surface water resources (conjunctive use).

(v) Water quality as a factor in assessing useable water.

(vi) The capital and operating costs for groundwater projects, including the costs of possible artificial recharge schemes.

(vii) The present stage of development of groundwater resources and the present yield of groundwater systems (as distinct from bore capacities).

(viii) The present accelerated programme of groundwater assessment and its relation to the forward assessment.

I would be grateful if members would prepare comments on the possible terms of reference in advance of the T.C.U.W. Meeting as there will be very little time for briefing of the T.C.U.W. representatives after that Meeting.

(N.H. FISHER)
Deputy Chairman/Convener

7

Item 7: Groundwater Nomenclature

1. Following Mr. Williamson's brief report at the last meeting of T.C.U.W. a draft of the report by Lohman of the U.S.G.S. has become available. This has already been circulated to members for their information.

2. A report by the Nomenclature Sub-committee is attached. (Attachment 1).

3. A list of sub-committee members is also attached. (Attachment 2). It will be noted that Mr. C. Bleys has now resigned and if the sub-committee is to continue he may need to be replaced. However, the convener has recommended that the sub-committee be dissolved.

ATTACHMENT 1

0 42

Sub-committee on Groundwater Nomenclature

Report to 8th Meeting of T.C.U.W.

The Sub-committee on Groundwater Nomenclature has not met since the 7th Meeting of T.C.U.W. Mr. C.Bleys resigned from the sub-committee in 1970 and the membership is now N.O. Jones (convener) and W.H.Williamson.

A copy of the U.S.Geological Survey paper "Definitions of selected groundwater terms" has been distributed to all members. Progress on the UNESCO/WMO "Multilingual glossary of hydrology" is unknown but there is some common membership of the U.S.G.S. and UNESCO groups.

As noted in the Sub-committee's 1970 report, "within Australia the trend toward adoption of American nomenclature has continued under the influence of American journals and textbooks although certain local usages (e.g. bore = drilled well, artesian = flowing) are still maintained". These continuing local usages, some of which vary from State to State, are mainly a result of the formal definition of terms in legislation and may take many years to disappear no matter what nomenclature is adopted for Australian use.

No specific nomenclature can be recommended for formal adoption by T.C.U.W. at this time.

The U.S.G.S. nomenclature has not yet received general acceptance in the U.S.A., and some definitions could be disputed, but the sub-committee recommends that it be adopted as an interim guide by Australian authorities until a consistent international nomenclature is completed.

We consider little purpose will be served by continuing the Sub-committee on Groundwater Nomenclature which cannot take further action until other, slow-moving, overseas groups have completed their task, and dissolution of the Sub-committee is recommended. The Sub-committee could be reconvened at some future date if this was considered desirable by T.C.U.W. but the members believe that if consistent international nomenclature is completed no sub-committee action will be necessary prior to T.C.U.W. endorsement.

N.O. Jones
(convener)

8A

Item 8: Groundwater Investigation Programmes

(a) Presentation of Annual Progress Reports:

1. The States Grants (Water Resources Measurement) Act 1970, assented to on 11th November, 1970, provides for an increase over the previous Act in the amount of subsidy for both surface and underground water resources investigation and assessment. A condition of this subsidy is the requirement to furnish reports,

"to the satisfaction of the Minister, setting out particulars of the works carried out, the facilities provided, and the things done, by the State during that period in connection with -

(i) The measurement of the discharge of the rivers in the State; and

(ii) the investigation and measurement of underground water resources of the State".

2. These reports have been regularly submitted by the appropriate State authorities but the following resolution was passed at the eleventh meeting of Standing Committee.

"4.6 It was agreed to request T.C.U.W. to explore the possibility of presenting annual progress reports in a way which would give a better indication of the effort put into the programme, and the results achieved."

3. This resolution lead to the attached letter being sent from the Minister for National Development to the appropriate State Ministers (Attachment 1). Members may wish to discuss this letter and to decide on courses of action in the future to most satisfactorily provide the information required.

ATTACHMENT 1

0 45

Parliament House,
CANBERRA. A.C.T. 2600.

1st December, 1970

My dear Minister,

The States Grants (Water Resources Measurement) Act 1970, was passed by the Commonwealth Parliament in the recent session, and has received the Royal Assent. As soon as the Act is available from the Government Printer I shall arrange for copies to be sent to you and also your Department for information. The provisions of the Act are as generally outlined at the meeting of the Australian Water Resources Council in July this year. I will advise you shortly regarding approval of the programme for the current year, which you submitted some time ago.

With regard to the provision of information referred to in Section 8(1) of the Act, I think you will agree that summaries of developments in gauging station networks and of availability of data, prepared by the Secretariat from State submissions, have provided a useful picture of the programme generally. It is much more difficult to summarise developments in the underground water programme, and I do not think that simple figures such as number of holes or total footage drilled give any real indication of results obtained.

You will recall that Council has requested the Technical Committee on Underground Water to examine this matter with a view to bringing forward suggestions as to the form of reporting that may be most useful. Without in any way limiting that examination, I would ask that my Department might receive a copy of any report setting out the results, or the progress being made, for any investigation carried out under the terms of this programme. I hope this can be done not only in the case of published reports, but also with internal reports prepared for use within the authority concerned. The contents of such reports would, if requested, be regarded as confidential, but I hope that this would rarely be needed, and that they might be taken as supplementing any information that may be provided through the Technical Committee. I realise that studies of underground water are also carried out in the Mines Department, and I should be grateful if this request could be conveyed to that Department.

Yours sincerely,

(R.W. Swartz)

8B

Item 8: Groundwater Investigation Programmes

(b) Accelerated Programme of Water Resources Measurement

1. The attached statement on progress of investigations under the States Grants (Water Resources Measurement) Act was provided by the A.W.R.C. Secretariat to the 11th Meeting of Council held last year. Council was advised by Standing Committee that an extension of the programme to a total of 15 years would be needed to cover requirements for installation of gauging stations. In addition there would be a continuing need for assistance with gauging station operation as well as with underground water investigations, beyond that time, but the whole position might be re-assessed toward the end of the 15 year period.

2. Council agreed that experience with the accelerated programme of water resources assessment had shown that the programme should be extended to 15 years. It was also noted that the States had increased their expenditure at a rate greater than necessary to attract maximum Commonwealth grants and Council believed that all Governments should seek to make more funds available for the water measurement programme.

3. The Commonwealth Government has agreed to extend the present scheme for a further three years and has given approval in principle for extension of the programme for 3 years after the current triennium.

(a) Progress Report

Surface Water and Groundwater

1. Under the terms of the States Grants (Water Resources Measurement) Act the sum of $1,610,150 was available from the Commonwealth in 1969/70 to assist the States' programmes. The total base expenditure by the States is $2,006,400 and an additional expenditure of $590,275 is needed to qualify for the maximum amount of grant. These three amounts total $4,206,825 but actual expenditure during 1969/70 is likely to be considerably greater than this, as some States' programmes are greater than is necessary to attract maximum grants.

2. Details of gauging station development are summarised in the table on the next page. The decline in total number of gauging stations from 1963 to 1965 stems partly from the fact that some existing stations were discontinued, and partly from the adoption of a more stringent definition of a gauging station when the accelerated programme was adopted. Many stations were discontinued in the Snowy Mountains area in particular, during the period.

3. The attached Schedule A summarises the financial programme for 1969/70 and Schedule B indicates the increasing expenditures on water resources assessment over the period of two Acts.

4. The following work is being undertaken by the States in connection with the assessment of underground water resources.

(a) New South Wales

Work on investigations in 18 locations is being undertaken by the Water Conservation and Irrigation Commission and the Department of Mines. In addition gamma logging, geophysical surveys and compilation of geological maps are proceeding. Purchases of equipment, general groundwater investigations, studies of groundwater pollution and palynological studies are also included in the programme.

(b) Queensland

The Irrigation and Water Supply Commission and the Department of Mines report that investigations in 20 localities are in progress. Of these 20 projects, 5 are new. Work is also going ahead with preparation of hydrogeological reports and maps and observation of water levels and quality throughout the State.

(c) South Australia

The Department of Mines is undertaking investigations in 7 localities. General investigations for town and school supplies are in hand and analyses are being made of bore samples collected by the Department and members of the public. A programme of geophysical logging of exploratory boreholes including those drilled seeking town water supplies has been commenced.

(d) Western Australia

The Department of Public Works and the Geological Survey are investigating 7 localities and water supplies for 20 towns. Geophysical investigations and mapping are also proceeding as are general groundwater investigations for landholders. Major activities continue to centre around the search for large supplies of potable water and for water suitable for industrial use. 0 49

(e) Tasmania

Investigations are being made by the Department of Mines in 5 localities. The preparation of geological mapping in various areas is continuing and routine investigations throughout the State are proceeding. Some geophysical work is also being undertaken. Purchase of equipment is also included in the programme.

(f) Victoria

The Department of Mines is investigating 5 basins in the State. Work on hydrogeological reports on the basins is continuing and studies in recharge of aquifers is being undertaken in two of the basins. Water quality distribution and quantitative assessment is also in hand.

(g) Northern Territory

Five localities are being investigated by the Mines and Water Resources Branch of the Northern Territory Administration. In addition investigations are being carried out in 3 basins whilst geological surface mapping is being undertaken in another basin. Water quality measurement and assessment of maximum pumping rates are being undertaken on a continuing basis.

5. The staff situation is shown on schedules C and D.

STREAM GAUGING STATIONS - AUSTRALIA

ANNUAL GROWTH 1965-1969

Drainage Division		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		Total
1963	Total Stations	168	405	97	531	11	77	1	104	23	21	1	0		1439
1965		162	434	100	470	7	88	3	97	18	34	0	7		1420
														Total Annual Increment	Cumulative Total
1966	Annual Increment	57	47	3	97	3	15	2	15	4	14	7	5	269	1689
1967		29	19	3	38	--	2	14	37	13	13	2	5	175	1864
1968		14	44	7	39	3	1	-	11	32	2	-	7	160	2024
1969		6	85	7	38	8	21	5	18	18	7	-	-	213	2237
Total Increment 1966-1969		106	195	20	212	14	39	21	81	67	36	9	17	817	
Total Stations 1969		268	629	120	682	21	127	24	178	85	70	9	24		2237

SCHEDULE A

EXPENDITURE ON WATER RESOURCES ASSESSMENT
ESTIMATED EXPENDITURE 1969/70 COMPARED WITH BASE EXPENDITURE, AND MAXIMUM GRANT 1969/70

State	Base Amount	Max. Grant 1969/70	Exp. req. for Max. Grant 1969/70	Est. Exp. 1969/70
New South Wales				
Surface Water	299,400	183,100	482,500	887,000
Underground Water	136,000	210,950	452,425	1,086,000
Totals	435,400	394,050	934,925	1,973,000
Victoria				
Surface Water	199,000	86,000	285,000	415,000
Underground Water	379,000	76,800	494,200	600,000
Totals	587,000	162,800	779,200	1,015,000
Queensland				
Surface Water	180,000	360,800	721,600	721,600
Underground Water	180,000	166,900	430,350	430,350
Totals	360,000	527,700	1,151,950	1,151,950
South Australia				
Surface Water	10,500	23,500	47,000	128,000
Underground Water	82,000	126,350	271,525	310,000
Totals	92,500	149,850	318,525	438,000
Western Australia				
Surface Water	176,000	230,400	460,800	460,800
Underground Water	260,000	81,150	381,725	518,850
Totals	436,000	311,550	842,525	979,650
Tasmania				
Surface Water	89,500	42,200	131,700	140,000
Underground Water	15,000	22,000	48,000	53,000
Totals	104,500	64,200	179,700	193,000

TOTAL EXPENDITURE ON WATER RESOURCES ASSESSMENT

BASE YEAR COMPARED WITH SUBSEQUENT YEARS

State	1962/63	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70(a)
	$	$	$	$	$	$	$
New South Wales							
Surface Water	299,400	402,746	448,740	570,861	653,939	744,200	887,000
Underground Water	136,000	195,456	290,397	453,041	550,771	744,250	1,086,000
Total	435,400	598,202	739,137	1,023,902	1,204,710	1,488,450	1,973,000
Victoria							
Surface Water	199,000	280,916	297,773	368,879	406,415	384,800	415,000
Underground Water	379,000	513,465	553,146	608,372	618,806	500,000	600,000
Total	578,000	794,381	850,919	977,251	1,025,221	884,800	1,015,000
Queensland							
Surface Water	180,000	373,428	510,299	562,413	614,882	654,000	721,600
Underground Water	180,000	328,730	351,626	387,409	454,408	430,000	430,350
Total	360,000	702,158	861,925	949,822	1,069,290	1,084,000	1,151,950
South Australia							
Surface Water	10,500	19,358	34,067	39,974	58,105	52,000	128,000
Underground Water	82,000	204,806	213,838	190,250	366,200	300,000	310,000
Total	92,500	224,164	247,905	230,224	424,305	352,000	438,000
Western Australia							
Surface Water	176,000	232,060	311,270	351,724	364,299	384,200	460,800
Underground Water	260,000	389,966	514,620	398,210	490,189	381,725	518,850
Total	436,000	622,026	825,890	749,934	854,488	765,925	979,650
Tasmania							
Surface Water	89,500	106,462	116,580	122,624	152,369	163,000	140,000
Underground Water	15,000	42,150	33,358	38,656	59,037	53,000	53,000
Total	104,500	148,612	149,938	161,280	211,406	216,000	193,000
Northern Territory							
Surface Water		240,000	270,000	290,000	351,600	405,000	306,000
Underground Water		310,000	330,000	390,000	429,000	533,000	541,000
Total		550,000	600,000	680,000	780,600	922,000	847,000
Totals six States incl. N.T.	2,006,400	3,639,543	4,275,714	4,772,413	5,570,020	5,729,175	6,597,600

(a) - proposed

SCHEDULE C

STAFF ENGAGED ON THE ASSESSMENT OF SURFACE WATER RESOURCES

State	Classification	Number of employees as at- 31.12.68	31.12.69
New South Wales	Professional	18	18
	Sub-professional	55	67
	Wages	12	15
	Total	85	100
Victoria	Professional	4	4
	Sub-professional	43	46
	Wages	15	19
	Total	62	69
Queensland	Professional	5	5
	Sub-professional	24	28
	Trainee Sub-professional	15	13
	Wages	22	23
	Total	66	69
Western Australia	Professional	5	6
	Sub-professional	22	19
	Trainees	12	14
	Wages	7	16
	Total	46	55
Tasmania	Professional	4	1F.T.
	Sub-professional	35	1P.T. 18
	Total	39	20
South Australia	Not included in submission.		
Northern Territory	Professional	3	3
	Sub-professional	22	25
	Trainee	1	-
	Wages	23	21
	Total	49	49

Note: F.T. means Full time; P.T. means Part time.

STAFF ENGAGED ON THE ASSESSMENT OF UNDERGROUND WATER RESOURCES

State	Classification	Number of employees as at 31.12.68	31.12.69
New South Wales	Professional	29 F.T. 9 P.T.	31 F.T. 8 P.T.
	Sub-professional	12 F.T. 4 P.T.	13 F.T. 4 P.T.
	Clerical	12 F.T. 3 P.T.	12 F.T. 4 P.T.
	Wages	23 F.T.	26 F.T.
	Total	92	98
Victoria	Not included in submission.		
Queensland	Professional	9	9
	Sub-professional	16	17
	Trainee sub-professional	9	6
	Wages	25	26
	Total	59	58
Western Australia	Professional	5 F.T.	18
	Sub-professional	8 P.T.	9
	Total	13	27
Tasmania	Prcfessional	30 man months	n.a. months
South Australia	Not included in submission		
Northern Territory	Professional	6	6
	Sub-professional	28	28
	Wages	69	69
	Total	103	103

F.T. Full Time

P.T. Part Time

n.a. not available

ATTACHMENT

Accelerated Programme of Water Resources Measurement

(a) Progress Report

Surface Water and Groundwater.

1. A progress report prepared by the Secretariat, based on information provided by the State water authorities was considered by the Standing Committee.

2. It was agreed that figures should be presented giving a comparison between the present position and the base year with regard to the gauging station network.

3. An additional table giving this information has been included in the progress report attached.

4. It was also agreed to request T.C.U.W. to explore the possibility of presenting annual progress reports in a way which would give a better indication of the effort put into the programme and the results achieved.

Attachment

(b) Next Triennium

1. The Commonwealth Government has agreed to extend the accelerated programme for a further three years.

2. A table showing maximum grants which will be available to the States is attached.

3. It is expected that legislation will be introduced into the autumn session of the Commonwealth Parliament to authorise these grants which will be available with respect to expenditure as from 1st July 1970. The only substantial change in this legislation from the previous Acts will be in the method of computing grants for underground water investigation. It is proposed that the current formula will be discontinued and the present surface water formula be used. In short this means that the Commonwealth grant will be the amount by which expenditure exceeds the base year figure, until the base expenditure is doubled, after which the grants is on a dollar for dollar basis up to the maximum. The base amounts will be unchanged.

4. It might be noted that whereas Council sought an extension of the programme, in principle, to a total of 15 years, approval was given for a total of 12 years. It is expected that the whole programme will be reviewed towards the end of that period.

5. The delay in finalising the programme for the next three years is greatly regretted.

	1970/71	1971/72	1972/73
NEW SOUTH WALES			
Surface Water	308,400	321,500	334,500
Underground Water	554,500	557,900	565,000
TOTALS	862,900	879,400	899,500
VICTORIA			
Surface Water	180,500	189,700	198,800
Underground Water	210,400	231,900	254,500
TOTALS	390,900	421,600	453,300
QUEENSLAND			
Surface Water	331,700	326,200	334,100
Underground Water	206,600	217,500	228,400
TOTALS	538,300	543,700	562,500
SOUTH AUSTRALIA			
Surface Water	52,000	23,300	25,900
Underground Water	134,900	134,900	134,900
TOTALS	186,900	158,200	160,800
WESTERN AUSTRALIA			
Surface Water	249,700	296,200	318,400
Underground Water	321,900	374,100	391,500
TOTALS	571,600	670,300	709,900
TASMANIA			
Surface Water	47,400	47,400	47,400
Underground Water	23,100	23,100	23,100
TOTALS	70,500	70,500	70,500

9A

ITEM 9: CURRENT RESEARCH ACTIVITIES

(a) WRESC Activities

Changes in Membership

The Council has reviewed the functions and membership of WRESC and has agreed that the membership of WRESC should be amended to be as follows:

1. One representative each of the Bureau of Meteorology, the C.S.I.R.O. and the Department of National Development.
2. Four members appointed on the nomination of Standing Committee, not less than three to be members of State authorities. One of these four should preferably have experience and technical background in the groundwater field, and one in the field of water quality.

The members nominated by Standing Committee were:

Mr. A.L. Tisdall	-	State Rivers and Water Supply Commission, Victoria (Chairman)
Mr. A.F. Reddoch	-	Water Conservation and Irrigation Commission, New South Wales
Mr. E.P. O'Driscoll	-	Geological Survey of Western Australia
Mr. K.W. Lewis	-	Engineering and Water Supply Department, South Australia

The next meeting of WRESC will be on the 16th June, 1971.

Progress of Advisory Panels and Studies

(i) Effects of Rural Land Management on Run-off

The report of this Advisory Panel will be received by WRESC at its next meeting.

(ii) Measurement of Evaporation from an Area

The report of the Advisory Panel on the Measurement of Evaporation from an Area is being edited prior to its publication in the A.W.R.C. Hydrological Series.

(iii) Operation of Representative Basins Programme

The Advisory Panel on the Operation of the Representative Basins Programme will be meeting on the day prior to the commencement of the meeting of T.C.S.W. in Perth at the end of May, 1971. The following notes give an outline of some of the geological and groundwater aspects of this programme.

The basis of the Representative Basins Programme is set out in Report No. 2 in the A.W.R.C. Hydrological Series The Representative Basins Concept in Australia. This report details the type of data being collected in the programme, the basis for selection of basins and the form of mathematical model to be developed as an analytical tool for runoff prediction. Implementation of the programme is being co-ordinated by the A.W.R.C. Advisory Panel on the Operation of the Representative Basins Programme.

The implementation of the programme involves the provision of stream gauging stations (generally by State stream gauging authorities), precipitation and climatological equipment (generally by the Bureau of Meteorology), aerial photography and topographic mapping (by appropriate State and

Commonwealth Authorities co-ordinated within the National Mapping programme), and the monitoring of groundwater levels and groundwater quality. State Working Groups, the Panel, WRESC and the Council's Research Advisory Committee are giving consideration to ways and means of having this groundwater monitoring work undertaken.

The testing of the mathematical model which is being developed as the central part of the representative basins programme will involve obtaining groundwater data relating both to changes in storage and flow rates. In selecting observation bore sites, consideration will be given to catchment geology and groundwater processes in the basin. In some basins a greater number of boreholes might be required for a more intensive investigation in relation to soil moisture stores and as a guide to recharge processes. In catchments where groundwater flow is very significant a special model will be developed.

State working groups are also considering requirements for geological and hydrogeological mapping including the choice of scale. For model development purposes the scale of 1:30,000 for geological map was considered desirable. State working group conveners will be reporting to the next meeting of the panel on the 25th May on progress in respect to geological mapping within each of their States. It is envisaged that as with other aspects of the programme the provision of geological mapping will be a joint effort involving a number of State and Commonwealth Authorities.

(iv) Hydrology of Smooth Plains Areas

The final meeting of the Advisory Panel was held in December, 1970. Work on completion of the panel's report is

underway and the report will be presented to WRESC at its next meeting in June.

(v) Water Resources Technical Information Services

The Panel has met on three occasions since its formation last year. Following the circulation of a questionnaire to libraries with substantial water resources holdings and the analysis of the information received a draft panel report is now being prepared. It is expected that the final meeting of the panel will be held later this month and that a final report will be presented to WRESC at its meeting in June.

(vi) Soil Moisture Measurement

At its twelfth meeting in April, 1971 the A.W.R.C. agreed to establish the Advisory Panel on Soil Moisture Measurement with the following terms of reference and membership:

TERMS OF REFERENCE

(a) To undertake a critical review of current practice for the measurement and recording of soil moisture and the assessment and recording of the soil moisture status of catchments.

(b) To establish the accuracies and limitations of the techniques reviewed, the costs of sensors, arrays of sensors and recording systems and to make recommendations on the most appropriate techniques for use in the Representative Basins and related A.W.R.C. programmes.

(c) To develop guidelines for

1. Catchment instrumentation and configuration sampling frequency and extent of replication desirable for particular situations

2. Suitable means of ensuring quality control of measurement and

3. Any activities desirable to supplement soil moisture observations.

MEMBERSHIP

Dr. A. Peck (Chairman), C.S.I.R.O. Division of Soils, Western Australia

Dr. D. McIntyre, C.S.I.R.O. Division of Soils, Canberra

Mr. P.M. Fleming, C.S.I.R.O. Division of Land Research, Canberra

Mr. B.G. Richards, C.S.I.R.O. Division of Soil Mechanics, Melbourne

Mr. B. Gilmour, Department of Forestry, Queensland

Dr. K.K. Watson, University of New South Wales

Dr. R.H. Fawcett, North West Wheat Research Institute, Narrabri

Professor J.W. Holmes, Flinders University, Adelaide

A nominee C.S.I.R.O. Ranglands Unit, Canberra.

9B

AGENDA ITEM 9(b)

ITEM 9: CURRENT RESEARCH ACTIVITIES

(b) Reports on Water Research Fund Projects

Attached are reports on progress of the following research projects.

(i) 68/7 - Interpretation of Geophysical Logs in Bores in Unconsolidated Sediments (Attachment I)

(ii) 68/8 - Extraction of Water from Unconsolidated Sediments (Attachment 2)

In connection with the former project the following matter has been referred to T.C.U.W. by the Reference Panel:

It was recommended by the panel that T.C.U.W. hold a workshop on borehole logging sometime in 1972. The aim of this activity would be to disseminate the results of the research project to persons concerned directly with logging operations. The panel felt that maximum benefits would be obtained from such a workshop if it were held 6 to 12 months after the final report of the project was released. Members may wish to make a decision on this recommendation.

A.W.R.C. RESEARCH PROJECT 68/7

Interpretation of Geophysical Logs in Bores Unconsolidated Sediments

Report on Progress to February 1971

General

Phase II of this project began in January 1970 and two interim reports have been prepared detailing research progress.

Sediment Properties

An extensive literature review has been carried out on formation factor/porosity/permeability/yield relationships; these have been examined both in using data from Australian hydro-geological environments and in controlled experimental conditions.

Water Resistivity/Salinity Relationships

Water resistivity/total dissolved salts relationships have been investigated on an empirical basis for a large number of Australian locations and calibration curves established for these.

Log Interpretation

A review has been carried out of logging methods commonly used by water authorities in Australia and a number of examples of bore logging exercises have been examined for interpretation purposes. In general, logging data currently available has been found to be inadequate and incomplete for interpretation. With the co-operation of the I.W.S.C., Queensland, an experimental program has recently been carried out near Dalby using an extensive suite of logging tools and close supervision. Complete interpretation of this work is at present being carried out and is expected to show the usefulness and limitations of conventional methods.

Future Work

An additional experimental program of logging is planned at Wagga in May 1971. This program will make use of logging equipment from the W.C. & I.C. and a micro-logging unit from the Geological Survey of South Australia.

Following discussions at the 68/7 Reference Panel meeting in February 1971 it is intended to include in the project report a review of new logging methods such as micro-focussed logs not yet being used in the water industry in Australia. The project report will be prepared in two forms - one a complete coverage of all theoretical and experimental aspects of the project suitable for the researcher or designer; and the other containing practical considerations of log application and interpretation, i.e. a handbook of well-log interpretation. It is expected that the draft project report will be available in early December 1971.

Attachment 2.

A.W.R.C. Project 68/8 - Extraction of Water from Unconsolidated Sediments.

0 68

Report on Progress to 31st December 1970.

1. Introduction

Since the last panel meeting and progress report, work has been concentrated mainly on

(i) completing the experimental facility and getting it ready for a series of preliminary tests;

(ii) continuing the numerical studies to provide predictions of optimum well design for different types of aquifer material;

(iii) preparing the results of the literature survey for printing as an annotated bibliography.

Because of the previously reported delays in the construction of the tank and the employment of a second engineer, the experimental programme is now between 6 and 9 months behind schedule. However, it is anticipated that sufficient experimental work will be completed to verify the predictions of optimum well design for various types of aquifer material by the end of 1971.

2. Tank Construction

The experimental tank is now complete and all necessary services have been provided.

A flexible arrangement of 6 inch and 4 inch diameter pipes allows gravity feed or pumped water supplies to be fed to and drawn from wells placed either centrally or at a corner of the tank. Appendix I shows the water supply layout in diagrammatic form.

Power has been provided for pumping, instrumentation, lighting and hoist operation.

A movable monorail with electric hoist is in position. It will be used for handling materials, equipment and decking inside the tank and transferring it to and from the tank as necessary.

Long delays in the delivery of rolled steel sections have prevented the completion of the pressure resisting lid. This will not, however, delay the experimental programme as the lid will not be required for several months. The steel decking is already to hand and trusses to hold the decking down will be fabricated when steel arrives.

3. Numerical Studies

We now have fast working computer programmes which allow the relationship between drawdown, discharge and well diameter to be studied for both Darcy and non-Darcy flow near the well. A graphical output for a typical aquifer material has been achieved and it is now just a matter of allowing the computer to run through the programme for the range of aquifer constants, discharges, drawdowns and well diameters which are considered to be of practical interest. The next phase of this work is to provide, through permeameter tests in the laboratory, a classification of aquifer properties which can be used to select for design purposes the constants in the relationships mentioned.

Good progress has also been made on a programme which will relate well and flow parameters with aquifer characteristics for unsteady flow conditions. It is hoped to be able to use the results eventually to predict the non-linear characteristics of the aquifer surrounding a small diameter pilot hole for subsequent use in selecting an optimum production well design.

Contacts have been established with American and Canadian researchers working in this field.

Thanks to the hard work of research assistant, P. Huyakorn, and C.S.I.R.O. research student, R. Cox, our achievements in this aspect of the project have been very good. The results give an analytical backing to the experimental work in the tank.

4. Literature Review

The search for relevant literature is now complete except for scanning current literature as it becomes available. More work is required on annotation and the classification system before the literature review will be ready for publication. It was hoped to publish this before the February 1971 panel meeting but it was decided to give priority to the numerical work which was required before the experimental programme could begin. Completion of the literature survey will be a

priority item when two absent members of the team return from holidays at the end of February.

5. Field Visits

Two visits to field sites were planned for the last half year, one to the Namoi River valley and the other to Dubbo and the Macquarie River valley. The first visit was carried out in November with the assistance of Mr. D. Roberts of the W. C. & I. C. The second was postponed because of the Christmas holiday period and subsequent wet weather. Visits to Dubbo to make contact with the boring engineers of the W. C. & I. C. office and to Victoria will be arranged as soon as possible this year. Mr. Huyakorn is at present on leave in Thailand where he has had discussions with research workers at the Asian Institute of Technology. Mr. Cox, the C. S. I. R. O. student associated with Project 68/8, is at present on vacation in Perth where he will make contact with staff of the W. A. Mines Dept.

It has been found that discussions with engineers, geologists and drillers and visits to drilling sites have played a large part in keeping the planning of the numerical and experimental work practically oriented.

6. Field Drilling

It is proposed to commit the funds allocated for field drilling as soon as possible after the February 1971 panel meeting. Suitable locations for experimental wells would appear to be near Dubbo or Wagga because of proximity to W. C. & I. C. drilling facilities. These locations are reasonably accessible to Sydney and it may be possible to fit the work into the current investigation programme of the W. C. & I. C.

Current proposals are to select two sites with aquifers in which non-linear losses might be expected and to drill and test pilot holes which would subsequently be enlarged to production holes designed in accordance with the criteria established using the results of the numerical and laboratory studies.

It is not proposed at this stage to drill an experimental well in fine grained coastal aquifers. It is anticipated that data typical of this class of aquifer will become available from the University's experimental well in the Botany sands at Daceyville. Discussions concerning the use of and possible assistance with instrumenting this well have been suspended until Assoc. Professor Watson returns from overseas study leave.

7. Proposals for Experiments in Tank during 1971.

It is still planned to carry out in the following order, prototype scale tests to

(i) verify the results of the numerical and permeameter studies concerning optimum well design for different types of aquifer material;

(ii) determine the conditions under which gravel packs are desirable and the optimum design;

(iii) investigate the processes which occur during development of the aquifer material surrounding the well.

8. Finance

The cost of construction of the tank has exceeded the estimate of $13,000 by about $4,000. This is mainly attributable to increases in materials and labour costs since the estimates were prepared and over-optimistic estimates of the cost of some of the novel features of the tank design. Part of the increase can also be attributed to the failure to appoint a second engineer. An additional person to assist with the design, taking off quantities, ordering materials and supervising construction would have resulted in some savings. It is likely, however, that the salary charges for the time involved would have exceeded the savings possible.

Two more inadequacies in the estimates have become apparent.

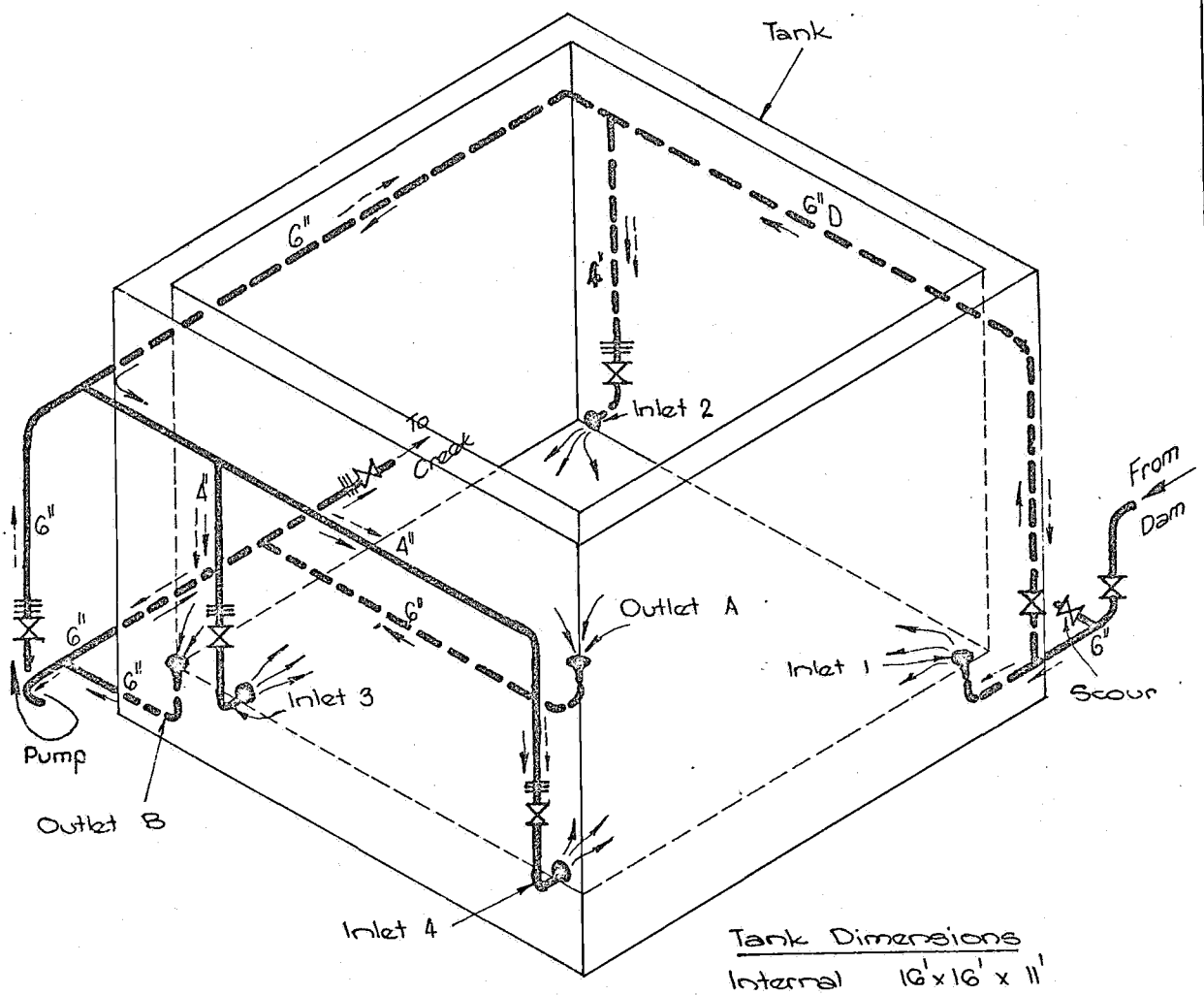
The first is the failure to allow a sufficient amount for computer charges. It was expected that the bulk of the computing costs would be chargeable to normal higher degree research with a small sum for cash time on the University's I.B.M. 360/50 or outside computers being chargeable to the materials or operating expenses categories. However, because of delay on the University's computer, several hundred dollars cash had to be spent to speed the numerical work. More cash time will be required this year.

The second is the provision of an inadequate amount in the estimates for sundry items of materials and equipment apart from the aquifer materials.

A revised list of estimates to the end of 1971 is provided in Appendix 2. Approval of the panel and the Research Council will be sought for a rearrangement within the allocated sum in line with the estimated figures.

EXTRACTION OF WATER FROM UNCONSOLIDATED SEDIMENTS

EXPERIMENTAL TANK PIPE & FLOW DIAGRAM



Tank Dimensions

Internal	16'x16' x 11'
External	18'-8" x 18'-8" x 12'-3"

LEGEND

≡ Orifice Plates shown thus

1. With $\frac{1}{4}$ well under investigation Inlet 1 only to be used and Outlet A, to be blank flanged; valves on Inlets 2,3,4 to be closed.
2. With full well under investigation use all Inlets and blank flange outlet B.
3. With pump in operation flow shown ---→; gravitate →

Appendix 2.

A.W.R.C. Project 68/8 - Extraction of Water from Unconsolidated Sediments.

Revised Estimates for Period Jan. 1970 to Dec. 1971.

Item	Previous Estimate	New Estimate
Salaries		
Project Officer	$15,000	$5,400
Research assistant	9,300	9,900
Laboratory assistant	3,700	4,100
Travel	1,500	1,500
Construction of tank	13,000	17,000
Printing	1,500	1,600
Materials (Aquifer materials and sundry equipment and materials)	2,000	4,000
Computing		2,000
Field testing	9,500	10,000
Operating expenses	500	500
	$56,000	$56,000

9C

AGENDA ITEM 9(c)

ITEM 9: CURRENT RESEARCH ACTIVITIES

(c) New Research Programme Approved by A.W.R.C.

1. The research programme which has been distributed to members was approved in full by the Council at its meeting on 15th April 1971.

2. It was recommended by the 68/8 Panel that T.C.U.W. make a recommendation to Standing Committee on the most appropriate body to carry out the proposed new research project - 71/H - "A Review of Downhole Groundwater Exploration Sampling Techniques". The Panel has suggested that the Irrigation and Water Supply Commission, Queensland and Australian Groundwater Consultants are organisations that could be considered. Both of these organisations have indicated they are willing to undertake the project. Members might make a decision on this matter to allow a recommendation to be forwarded to Standing Committee. Members may also wish to comment on the Schedule for this project which is attached.

AUSTRALIAN WATER RESOURCES COUNCIL

WATER RESEARCH FUND

Project No. 71/27 - Draft Schedule

PROJECT TITLE

A Review of the Literature and Current Australian Practice on Downhole Samping Procedures.

RESEARCH UNIT

An appropriate groundwater consultant or State Authority to be selected by T.C.U.W.

SIGNIFICANCE OF PROJECT

A.W.R.C. Project 68/8 (Extraction of Water from Unconsolidated Sediments) is an all inclusive project aimed at improving the efficiency of extracting water from bores and wells in alluvial and other unconsolidated sediments. The proposed A.W.R.C. Research Project 71/25 (Drilling and Development Problems in Unconsolidated sediments is a continuation of this work.

Unconsolidated sediments constitute the greatest and the most important sources of groundwater throughout Australia and a significant increase in the efficiency of utilisation of these supplies would be of considerable benefit. To date Project 68/8 has involved both field work and the setting up of laboratory facilities and it is now approaching the stage where work will commence in relating laboratory work to field conditions. This phase is mentioned in paragraph 8.4 of the original proposal submitted by the University of New South Wales, viz.

> "This work should attempt to deal with the types of aquifer which offer the greatest potential for water supply (e.g. non-uniform sands and gravels with and without appreciable clay content and uniform sands).

One aspect of the laboratory investigation will be to consider geological environments in Australia and the frequency of occurrence of the various types of aquifer material so that the materials chosen for laboratory investigation will represent those likely to be of economic importance."

The Bureau of Mineral Resources has noted that one of the major problems incurred in more efficient extraction of water from unconsolidated sediments is that of lack of knowledge of the aquifer and of its geological environment. This results from poor sampling during test drilling, inadequate geological and geophysical studies, and finally unsuitable pumping tests. The Irrigation and Water Supply Commission in Queensland has pointed out that a frequent problem encountered in well drilling is the proper sampling of the aquifer material and the enclosing strata and they themselves have developed tools and techniques to overcome some of these problems. This lack of generally suitable equipment paves the way for poor sampling during drilling of holes.

If the results of A.W.R.C. Projects 68/8 and 71/25 are to find practical application in groundwater development in Australia it is essential that the best possible down-hole sampling procedures be employed. These will allow the best relationships to be developed between laboratory results and field conditions.

OBJECTIVES

To review the available literature and the current practices of Australian organisations in sampling materials from boreholes and wells and prepare a report

comprising a critical review and an annotated bibliography.

WORK PLAN

The project officer should review all available literature on downhole sampling procedures. This would involve at least several weeks at the Water Reference Library of the University of New South Wales at Manly Vale. In addition, the project officer would be expected to visit each of the appropriate States and authorities and obtain from them, by discussion, details of their current practices in sampling procedures. He would then prepare a suitable report to be submitted to the Australian Water Resources Council.

STAFFING

It is proposed that this project should be undertaken by a project officer with considerable practical experience in drilling and groundwater development. He should be engaged upon the project on a full-time basis.

PROPOSED PURCHASES OF CAPITAL ITEMS

There are no capital items required for this project.

BUDGET

Salary	$3,000
Travel	$1,000
Total funds required	$4,000

TIMING

This project will have a duration of approximately 3 months. The proposed period is from September, 1971 to December, 1971.

REFERENCE PANEL

At this stage a reference panel for this project is not envisaged; however, it could be useful in the concluding stages of the project to have the draft report reviewed by the reference panel selected for project 71/25. (Drilling and development problems in unconsolidated sediments). From the discussion of such a panel, the final report would be prepared.

9D

Item 9: Current Research Activities

(d) Other Research Items

(i) Applications and Limitations of Surface Resistivity Methods:

This project is linked with A.W.R.C. Project 71/G - Conjunctive Use of Surface and Ground Water Resources. At the last meeting of Standing Committee approval was given to the latter project on the understanding that work would proceed concurrently on the use of surface resistivity methods in groundwater exploration. It was noted that the Bureau of Mineral Resources would undertake an assessment of experience in Australia in this field. Standing Committee also noted that the Secretary of T.C.U.W. would assist the Bureau on this work. Action is now under way to commence this work and the first step is a questionnaire which has been circulated to all members of T.C.U.W. A copy of this questionnaire is attached (Attachment 1).

(ii) Application of Remote Sensing Techniques to Hydro-Geological Problems

Action is being taken by the Research Advisory Committee towards formulation of a project involving the preparation of a critical review of the application of remote sensing techniques to hydro-geological problems. Following formulation consideration will be given to including the project in a future recommended programme.

(iii) It was noted at the last meeting of T.C.U.W. that the Bureau of Mineral Resources would arrange for or undertake a literature review on aquifer recharge. This project is at present under way and a report from the B.M.R. is attached. (Attachment 2).

ATTACHMENT 0.83

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

CNR. CONSTITUTION AVENUE AND ANZAC PARADE, CANBERRA

Postal Address: Box 378, P.O. Canberra City 2601

Telephone: 49 9111 *Telegrams:* Buromin *Telex:* 62109

In reply please quote:

All members of T.C.U.W.:

Use of Resistivity Surveys in Groundwater Exploration

The Standing Committee of the A.W.R.C. has asked the Bureau of Mineral Resources to review the use and applicability of surface resistivity methods for hydrological studies in Australia; the review is intended to cover both the techniques used and the success achieved. Accordingly I would appreciate information on surveys carried out in recent years by, or for, your organization. It would also help if you would list any other groups that you know have conducted resistivity surveys within the State.

At this stage the information requested is a brief statement of:-

1) location of survey,
2) group which carried out the survey,
3) purpose of the survey and why resistivity methods were chosen,
4) general geological and hydrological setting,
5) techniques used (traverse/probing; energy source; electrode configuration, etc.),
6) general comments on success or failure of the project,
7) how success was evaluated,
8) who could be contacted for more detailed information should this be desired.

One of the aims of this survey is to determine whether research into the method or its application under Australian conditions is desirable. With this in mind you may wish to suggest aspects of resistivity survey methods which should be examined in detail.

Thank you for your assistance.

(N.H. Fisher)
Director

Groundwater Recharge Review
Report to 8th Meeting of T.C.U.W.

The Bureau of Mineral Resources has been requested by the A.W.R.C. to "carry out a study of aquifer recharge, natural and artificial, taking account of geologic and hydraulic aspects and including a literature survey and submit proposals for a specific research project or projects including recommendations on research bodies that may be able to carry out the proposed work".

A systematic research of the Australian literature in fields related to recharge studies is in progress and a draft bibliography will be completed mid-1971. This draft will be circulated to all TCUW authorities for comment. One problem in the search has been the limited reporting of Australian hydrologic studies in formal widely-distributed publications and members are invited to advise BMR of any relevant but unpublished reports and data to ensure that the bibliography is as complete and informative as possible.

Some of the more recent overseas literature on both natural and artificial recharge is also being examined to provide a basis for review of the state of knowledge of recharge processes in the Australian environment and to indicate the most profitable topics for Australian research. Again the Bureau would welcome any comment from members.

10A

AGENDA ITEM 10(a)

Item 10: Liaison with other A.W.R.C. Committees

(a) Matters raised by T.C.S.W.

All matters raised by T.C.S.W. have been raised elsewhere in the agenda.

10B

Item 10: Liaison with other A.W.R.C. Committees

(b) Establishment of Technical Committee on Water Quality

1. In July, 1970 the Australian Water Resources Council was provided with a report from the Standing Committee recommending the establishment of the Technical Committee on Water Quality. The Council endorsed this report and as a consequence steps were taken to establish the Committee. A copy of the report as adopted by the Council is attached for the information of members.

2. A list of members and the Departments or other authorities which they represent is attached for the information of all members. It might be noted that the Committee has power to co-opt members in special circumstances.

3. The A.W.R.C. is concerned with terrestrial waters and it is expected that the Committee would not generally be concerned with seawater.

AUSTRALIAN WATER RESOURCES COUNCIL

REPORT OF SUB-COMMITTEE OF THE STANDING COMMITTEE ON THE ESTABLISHMENT OF A TECHNICAL COMMITTEE ON WATER QUALITY

Introduction

(1) At the 11th Meeting of the Standing Committee on 18th June, 1970, it was decided that a Sub-Committee should examine the need for the establishment of a technical Committee on Water Quality and report on the scope of activities of such a Committee and its membership if it was decided that such Committee is desirable. The Standing Committee appointed Mr. Tisdall (Convenor), Mr. Beaney and Mr. Reddoch as members of the Sub-Committee.

A.W.R.C. Functions

(2) The functions of the Water Resources Council were examined and the Committee considered that authority to deal with aspects of water quality was conveyed in terms of function (c) :

> "(c) Provide collaboration in the broad field of Hydrometeorological research, biological research, the efficiency of engineering structures and the use of natural water courses as water conveyors with the aim of controlling runoff, decreasing evaporation, transpiration and seepage losses and promoting re-use of water."

The Sub-Committee was of the opinion that the references to biological research and to the promotion of re-use of water could reasonably be construed as relating to water quality.

(3) In addition, item (g) of the functions of the Council refers to investigations in the field of water resources and it is felt that a proper interpretation of the field of water resources must include quality as well as quantity.

(4) Practice overseas, particularly in the United Kingdom and North America, has indicated that management of water resources requires complete integration of both quantity and quality aspects.

(5) In view of the above, the Sub-Committee considered that there was a strong case for the establishment of a Technical Committee on Water Quality within the A.W.R.C. frame-work and that there was no need for a variation in the functions of the Council to obtain proper authorisation to establish this Committee.

Scope of Technical Committee on Water Quality

(6) Consideration was given to the scope of activities and functions of a Technical Committee on Water Quality and the following list has been compiled as appropriate:-

Preparation of information and advice for the Standing Committee on -

(a) Equipment and methods for the measurement collection, processing and presentation of water quality data, with a view to achieving uniform and adequate standards;

(b) Programmes for assessment of quality of water resources of Australia;

(c) Water quality management practices in Australia and overseas;

(d) The compilation of criteria on water quality to serve as a guide for limits of quality permissible for various beneficial uses, particularly for public water supplies, agricultural requirements, recreation in inland waters, fish and wildlife culture and industrial purposes.

Proposed Membership

(7) In considering the membership of a proposed Technical Committee on Water Quality, the Sub-Committee felt it desirable to have a reasonably broad coverage of Australian Water Authorities together with other technically qualified and experienced people in the field. With this in view, it was agreed that appropriate membership would be:

(a) A representative of the major Water Authority in each State and the Northern Territory.

(b) A representative of a principal urban Water Authority in each State and the A.C.T.

(c) A specialist drawn from each of the four disciplines, chemistry, agriculture, fisheries and wildlife and human health.

(d) One representative each from the following Commonwealth Departments or Authorities - Department of Works, Department of National Development, C.S.I.R.O.

Representation as above would mean a Committee of twenty-one members. The Sub-committee considers this to be the maximum number, but the committee should have the power to co-opt in special circumstances.

Recommendations

(8) The Sub-Committee recommends to the Standing Committee that a Technical Committee on Water Quality be established with functions as outlined in paragraph 6 and membership nominated by the Authorities listed in paragraph 7.

TECHNICAL COMMITTEE ON WATER QUALITY

List of Members

Mr. D.W. Beattie,
Irrigation and Water Supply Commission,
Queensland.

Mr. S.E. Flint,
Water Conservation and Irrigation Commission,
New South Wales.

Mr. J.C. Fraser,
State Rivers and Water Supply Commission,
Victoria.

Mr. D.G. Schaffner,
Metropolitan Water Board and Rivers and
Water Supply Commission,
Tasmania.

Mr. J. Johnston,
Engineering and Water Supply Department,
South Australia.

Mr. K.J. Kelsall,
Public Works Department,
Western Australia.

Mr. I.S. Watson,
Northern Territory Administration.

Mr. L. de W. Henry,
Department of Local Government,
Queensland.

Mr. A.A. Crispe,
Metropolitan Water Sewerage and Drainage
Board,
New South Wales.

Mr. C.H. Wilks,
Melbourne and Metropolitan Board of Works,
Victoria.

Mr. W.D. Benson,
Metropolitan Water Supply Sewerage and
Drainage Board,
Western Australia.

Mr. F.C. Speldewinde,
National Capital Development Commission,
Canberra.

Mr. H.L. Jones,
Commonwealth Department of Works.

Dr. D.E. Weiss,
Division of Applied Chemistry,
C.S.I.R.O.

Mr. A.I. McCutchan,
Department of National Development.

Dr. N. Mitchell,
Commonwealth Department of Health.

Dr. A.J. Gilmour,
Department of Fisheries and Wildlife,
Victoria.

Mr. J.A. Beare,
Department of Agriculture,
South Australia.

Mr. D.M. Robbins,
Department of Public Health,
New South Wales.

11

AGENDA ITEM 11

Item 11: Recent Developments in Groundwater Investigation and Exploitation

1. This item has been included to give members an opportunity to discuss and exchange new ideas, techniques and equipment that their organisations have found useful.

2. Last year the Bureau of Mineral Resources undertook an airborne photographic survey to locate zones of seepage and underground water drainage lines in an area in northern Victoria. A short paper (Attachment 1) on this work is attached and a display of some of the results obtained will be on display at the meeting.

3. Other members may wish to briefly describe any items undertaken by their organisation that may be of interest to T.C.U.W.

BUREAU OF MINERAL RESOURCES

SALINE LAND AND CHANNEL LEAKAGE INVESTIGATION

NORTHERN VICTORIA

At the request of the Victorian State Rivers and Water Supply Commission, the Airborne Group of the Geophysical Branch of the Bureau of Mineral Resources flew experimental simultaneous colour and colour-infrared 70 mm vertical aerial photography over three areas in northern Victoria during February, 1970. These were the areas adjoining the East Goulburn Main Channel and the Waranga Western Channel and the Kerang-Kow Swamp area. The purpose was to locate zones of seepage from channels and underground water drainage lines.

1. Photography

Details of the photography are as follows:

Films: Kodak Ektachrome Infrared type 8443, with Wratten 12 filter, 70 mm x 30.84m.

Kodak Ektachrome Aero Colour type 2448, without filter, 70 mm x 38.1m. (Kodak has now replaced these films by Aerochrome Infrared Film, Type 2443, 70 mm x 30.84m. and Aerocolour Negative Film, Type 2445, 70 mm x 30.84 m).

Cameras: 2 x Vintern 70 mm.

Lens focal length: 44.45 mm ($1\frac{3}{4}$ inches)

Flying Altitude: 4,500 feet above average ground level

Nominal negative scale: 1:30,000

Both film types were processed to the negative stage and contact prints made from all negatives; five rolls of each type were exposed. For ease of handling, both in the field and in the office, prints of several runs were affixed to cardboard sheets of convenient size, colour prints on one sheet and colour-infrared prints of the same area on another. This arrangement made features such as channels easy to follow from a given run to adjacent runs, and also allowed ready comparison between film types to be made.

2. Interpretation:

It was found that prints could be viewed in strip form with a pocket stereoscope, the magnification enabling details to be resolved more easily than with the unaided eye. Furthermore the stereoscopic view provided a blending of hues in those frames in which the hues in one frame did not exactly match the hues of the same points of detail in the adjoining frame. However for most of the interpretation the stereoscopic view was found to be not necessary. Geologists W.J. Perry and C.J. Simpson (both of B.M.R.) and D. Brown (of Victorian SRWSC) visited the Kerang-Kow Swamp area in June, 1970 to obtain ground data. This visit confirmed that the following features could be reliably detected by photointerpretation.

Channel leakage
Waterlogging
Old drainage courses
Salt contaminated ground
Crop failure
Rising water tables
Poor farm management
Details of vegetation type
Estimates of yield per acre

With experience these elements could be interpreted on either colour or colour infrared photographs. In most cases the colour infrared allowed better identification because of the different colour contrasts involved. However, the most accurate interpretation was obtained through study and comparison of both colour and colour infrared photographs of the one area. Mr. D. Currey (Senior Geologist of the Victorian SRWSC) has stated that the use of these photographs in the field for a period of two weeks has given results (over an area of 1300 sq. km) that may have taken up to 2 years to obtain by conventional ground survey.

3. Costs

The total flying time involved in the project including the time taken to fly Canberra-Melbourne and return was 19 hrs. 45 mins., the particular aircraft used being the BMR DC.3 VH-MIN. The task could have been carried out more economically by a smaller aircraft, such as an Aero Commander, based in Melbourne.

Assuming a hire charge for such an aircraft of $100/hour and a total flying time ex Melbourne of 16 hours for the job,

Flying cost would be - $1600

Film Cost: 5 rolls of Ektachrome Aero Colour @ $57.50 per roll - $287.50

	5 rolls of Ektachrome Infrared @ $46.74 per roll	- $233.70
Processing Cost:	Development to a negative product 10 rolls @ $30.00 per roll	- $300.00
	Colour Contact Printing	- $2185.00
	Total Cost	$4606.00

4. Results

A display folder has been prepared containing selected example photographs (enlarged to 1:8800 scale) from the Kerang-Kow Swamp area and a Victorian SRWSC map interpreted from the original 1:30,000 colour and colour infrared contact prints.

This folder will be on display at the meeting of T.C.U.W.

12

AGENDA ITEM 12

Item 12: Great Artesian Basin Project - Progress Report

1. This project is a joint Commonwealth-State project being co-ordinated by the Bureau of Mineral Resources. A report of progress to date is attached (Attachment 1) for the information of members. A second item is attached (Attachment 2) to give members information on the scope of this project.

ATTACHMENT 1

Hydrogeology of the Great Artesian Basin

Report to 8th Meeting of T.C.U.W.

At the request of Standing Committee of the A.W.R.C. a sub-committee of T.C.U.W..in 1966 prepared a programme for a hydrogeological study of the Great Artesian Basin. The 6th Meeting of T.C.U.W. was advised that the Bureau of Mineral Resources would be the authority to collate the results of these studies when sufficient progress had been made on the basic geologic mapping.

Although geologic mapping of the Basin is not yet complete, good progress has been made in recent years and, accordingly, in August 1970, B.M.R. advised that other authorities concerned with studies of the Basin that it intended to proceed with the overall hydrogeological study using contract personnel for 2 years to assist the Bureau staff engaged on the project. Following discussions with State officers in October-November 1970 about the amount of data to be handled and arrangements to be followed, specifications were prepared for the required contract assistance and it is hoped to call tenders shortly.

The scope of the project, shown in the attached papers, follows the general programme laid down by the T.C.U.W. sub-committee for the "single authority" with the following two exceptions. Firstly, the greater part of the comprehensive stratigraphic study will not have to be done by the hydrogeology project team because of progress made in other geologic studies. Secondly, the data processing and modelling are being treated as integral parts of the main study rather than separate projects which could be passed to post-graduate scholars.

A tentative timetable for the two-year period of contract assistance is also attached. The major component of the contract effort during this 2-year period will be devoted to the transcription of available data into computer-compatible form. The need for and nature of any further contract assistance after these two years will be decided at that time.

Dr. N.O. Jones and Dr. M.A. Habermehl, the Bureau officers working on the project, have commenced a study of the permeability distribution throughout the basin. It is intended that B.M.R. and State officers make a joint examination of representative stratigraphic sequences along the eastern margin of the basin in Queensland and New South Wales during July 1971. This will help resolve problems in delimiting and correlating the several different aquifers throughout this area and assist in the interpretation of the available permeability data.

ATTACHMENT 2

Hydrogeology of the Great Artesian Basin

Scope of Project

Area: The Great Artesian (hydrologic) Basin includes, for the purpose of this study, the Carpentaria, Eromanga and Surat Basins and at least the Mesozoic portions of the Bowen and Galilee Basins, but excludes the Clarence-Moreton and Sydney Basins. The study shall include the hydrogeology of all Mesozoic and Cainozoic sediments in the area and may, at the discretion of the geologist-in-charge, include other rock units in hydrologic continuity adjacent and underlying these sedimentary basins.

Sources of data: The principal sources of data for the project will be the records held by the Commonwealth Bureau of Mineral Resources; the Irrigation and Water Supply Commission and Department of Mines of Queensland; the Water Conservation and Irrigation Commission and Department of Mines of New South Wales; the Department of Mines of South Australia; and the Mines and Water Resources Branch of the Northern Territory Administration. However data may be obtained from other authorities, companies and individuals, and in critical areas some additional data collection may be undertaken by the project team.

Proposed programme: The programme is expected to include the following items:

A - Preparation of a 3-dimensional appreciation of the permeability distribution the extent of aquifers, their interconnection, and relation to recharge and discharge areas.

B - Compilation of the available hydraulic and chemical data using a standardised format suited to computer applications.

C - Preview study of the problems of modelling the basin and techniques which could be applied, as a prelude to items D, E and H below.

D - Study of basin hydraulics, first by reworking the existing data and later by running some additional field tests in selected areas. This would include any hydraulic interpretation of the available bore logs and extensive modelling studies.

E - Study of the groundwater chemistry of the basin. Some field work will be required plus model studies of the relation of the groundwater chemistry to lithologic and hydraulic factors.

F - Complementary work including age determinations and thermal studies. The nature and extent of these studies will be largely determined by the results of previous stages of the project.

G - Study of the recharge areas including geological mapping and shallow drilling (with emphasis on the Cainozoic sediments, weathered zones and fracture patterns), plus soil moisture and streamflow studies and measurement of water table fluctuations.

H - Assessment of the basin's groundwater resources and recommendations on how these should be managed in the light of the foregoing studies.

0103

TENTATIVE TIMETABLE FOR GREAT ARTESIAN BASIN HYDROGEOLOGY CONTRACT

Before the contract is awarded B.M.R. staff will carry out:

1. Literature review.
2. Preview study of requirements for the data storage and retrieval system.
3. Check of data available for permeability studies.
4. Undertake tour of representative stratigraphic sequences on eastern margin of basin in Queensland and New South Wales. (Note. If contract is awarded in time, hydrogeologist will take part in this tour before systems specialist is started).

CONTRACT PERIOD

Month		Project	BMR Hydro-geol.	BMR "	Hydrogeol.	Systems Anal.	Hydrau Eng.	Contract Staff: Hydrochem.	Cartog.	Draft.Asst	Tech. Off.	Tech. Asst.
1	(a)	Review of requirements for a hydraulic model of the basin										
	(b)	Preparation of detailed programme for permeability studies and data collection	x	x	x	x						
2 to 9	(a)	Permeability studies, with emphasis on three-dimensional mapping of hydrogeologic units from geological and geophysical data.										
	(b)	Design and write programmes for computer-based data storage and retrieval system										
	(c)	Carry out preliminary design of hydraulic model of basin	x	x	x	x			x	x	x	x
	(d)	Transcription of data from State and Commonwealth Records										
	(e)	Preparation of base maps and illustrations as required										

Month	Projects	BMR Hydrogeol.	BMR Hydrogeol.	Contract staff: Hydrogeol.	Systems Anal.	Hydrol. Eng.	Hydrochem.	Cartog.	Draft. Asst	Tech. Off.	Tech. Asst.
10 to 15	(a) Permeability studies, with emphasis on quantitative measurements, using aquifer tests, drill stem tests and laboratory tests on cores.										
	(b) Study hydraulic data for suitability as input to hydraulic model.	X	X	x	a	a		x	x	x	x
	(c) Transcription of data from State and Commonwealth Records										
	(d) Compilation and drafting of maps and other illustrations			(a = alternatives)							
16 to 18	(a) Preparation of three-dimensional permeability model as basis for hydraulic modelling of basin.										
	(b) Design hydraulic model of basin.										
	(c) Draw up programme for chemical and recharge studies	X	X	x	x			x	x	x	x
	(d) Transcription of data from State and Commonwealth records.										
	(e) Compilation and drafting of maps and other illustrations.										
19 to 24	(a) Verify hydraulic model of basin and re-assess permeability fabric and hydraulic data as required.										
	(b) Prepare report on permeability and hydraulic studies	X	X	a	x		a	x	x	x	x
	(c) Review available chemical data on the basin and transcribe.										
	(d) Drafting of maps and other illustrations.			(a = alternative)							

13A

AGENDA ITEM 13 (a)

Item 13: Handling and Storage of Hydrologic Data

(a) Automatic Data Processing

1. It was decided at the seventh meeting of T.C.U.W. not to reconstitute the Sub-Committee on Handling and Storage of Hydrologic Data. The meeting felt that provided each authority had its information in machine readable form, each could use a system best suited to its requirements. It was decided that the Secretary should gather, co-ordinate and distribute material on groundwater data systems from other groups to all member authorities.

2. In accordance with this decision a copy of the publication describing the punched card system by the U.S.G.S. has already been distributed to the members of T.C.U.W. for their information. Members may wish to discuss relevant parts of this document.

3. It would probably be of assistance to members if each could briefly outline the current situation with respect to A.D.P. within his own organisation. This could be usefully followed up by a short written report submitted to the secretary shortly after the meeting.

13B

Item 13: Handling and Storage of Hydrologic Data

0108

(b) Metrication

1. Members have already been advised that a Metric Conversion Board has been formed to co-ordinate and implement the conversion to metric units over a period of about 10 years. This Board has established a number of Advisory Committees on specific subjects and the Commonwealth representative on the Land, Fuel, Power and Public Services Advisory Committee was asked to nominate a chairman for an Advisory Sub-Committee on water. This request was referred to the Standing Committee which agreed that Mr R.J. Shannon, Assistant Director, Engineering Services, of the Engineering and Water Supply Department of South Australia, would be a suitable nominee as Chairman of the sub-committee.

2. At its thirteenth meeting last year, T.C.S.W. had a paper presented to it by the Secretariat giving details of the International (S.I.) and W.M.O. systems of metric units. A copy of this paper is attached (attachment 1). For the next meeting of T.C.S.W. in May, 1971, the Secretariat is now preparing a more comprehensive tabulation of metric units and copies of this will be distributed to all T.C.U.W. members as soon as it is available. This work was endorsed by Standing Committee at its last meeting and T.C.S.W. has been asked to report back to Standing Committee on Metrication.

3. A list of some commonly used metric units is also attached. (Attachment 2) this list is by no means comprehensive or exhaustive. Members may wish to comment on the contents of this list.

4. Members may wish to form a sub-committee possibly with the other Technical committees to investigate the effect of metrication on groundwater activities in Australia and recommend any action which may seem to be required.

METRICATION

0109

1. The Secretariat was requested to prepare a paper comparing S.I. (International System of Units) and the W.M.O. system.

2. A list of units used in hydrology both in S.I. and W.M.O. units is attached. It has not been possible to ascertain the S.I. units in a considerable number of cases. This is due to the unavailability of publications which fully cover the range of units used in hydrology. However it is known that the S.I. system is based on -

(1) the metre (based on the wavelength of the krypton - 86

(2) the kilogram (based on the mass of a particular platinum - iridium cylinder)

(3) the second (based on the radiation of the cesium - 133 atom)

(4) the degree Celsius or Kelvin (at present it is defined as 1/273.16th of the thermodynamic temperature of the triple point of water (.01 degree C). Previously it was defined as 1/100th of the interval between the freezing point of water (0 degrees C) and the boiling point of water (100 degrees C)

(5) the ampere (based on the constant current which produces between two parallel conductors one ~~meter~~ metre apart a force equal to 2×10^{-7} newton per ~~metal~~ metre of length)

(6) the candela (based on the luminous intensity of a black body under certain conditions)

3. The units are reviewed when required by a General Conference of Weights and Measures.

4. Further efforts will be made to obtain more information on the S.I. system of units. Any help available from the various authorities would be appreciated.

5. The Standards Association of Australia has published Standard No. AS 1000 - "An International System (S.I.) - Units and their Application". Enquiries have been made and the Association advises that the abovementioned publication is in general terms and would not adequately cover all of the units used in hydrology. With this in mind the Association is preparing another publication which will deal with units used in hydrology. The Association was not able to give an indication of when this publication will become available.

6. Owing to the difficulty in obtaining applicable literature the problem of ascertaining the correct units which will cover the activities of T.C.S.W. (and in the future other Committees) is greater than originally realised. The W.M.O. has had the problem of suitable units under review for many years and although their problems might be considered greater, it appears that water assessment authorities will have to put a great deal of effort into reaching suitable interchangeable (including international) units.

The literature survey on this topic covered the publications listed below. Those publications containing relevant material are labelled with an asterisk.

* 1. Guide to Hydrometeorological Practices W.M.O. - NO. 168 TP 82

2. Green, Marvin H. International and metric units of measurement.

3. Guide to Climatological Practices W.M.O. publication

4. Guide to meteorological instrument and observing practice W.M.O. publication

5. International Codes
W.M.O. publication

6. International Meteorological vocabulary
W.M.O. publication

7. Commission for Hydrometeorology - abridged final report of the session
W.M.O. publication.

* 8. International Meteorological tables
W.M.O. publication.

* 9. W.M.O. Bulletin 1952-1969

* 10. Journal of Hydrology Vol. 8 No. 2 1969

* 11. Senate Committee report.

Element	S.I. Unit	W.M.O. Unit	Other Units Commonly used
length	metre		
mass	kilogram		pound, UK ton
time	second		
electric current	ampere		
thermodynamic temperature	degree kelvin (K)	degree Celsius	degree Fahrenheit
luminous intensity	candela		
plane angle	radian		
solid angle	steradian		
mass precipitation	mm	mm	in.
precipitation intensity	mm h^{-1}	mm h^{-1}	in. h^{-1}
potential evapotranspiration	mm		
mass infiltration	mm		
infiltration rate	mm h^{-1}		
run-off	m^3, mm. depth	mm	in.
discharge	$m^3 s^{-1}$	$M^3 s^{-1}$	cusec, million UK gallons per day, cusec per sq. mile
area	m^2	km^2	
volume	m^3	m^3	
velocity	m. sec^{-1}		
density	$kg.m^{-3}$		ft. sec^{-1}, mile h^{-1}
density of snow		g. cm^{-3}	
Vapour density		g. cm^{-3}, $g.m^{-3}$	
force	newton (N)		dyne, poundal
pressure	N m^{-2}		
vapour pressure		mb.	mm. Hg, in. Hg
atmospheric pressure		mb.	mm. Hg, in. Hg
energy (heat)	joule	cal. (gramme)	
power	watt		
sediment discharge		metric ton per day	UK ton per day
sediment concentration	Kg. m^{-3}	Kg. m^{-3}	ppm.
chemical quality	ppm.	ppm.	
water - level (stage)		cm.	
unit discharge		$m.^3 sec^{-1} km^{-2}$	

Element	S.I. Unit	W.M.O. Unit	Other Units Commonly used
snow depth		cm.	ft.
snow cover area	%	%	
water equivalent of snow pack		mm.	in.
ice thickness		cm.	in.
evaporation		mm.	in.
evapotranspiration		mm.	in.
soil moisture	kg. kg^{-1}, m^3m^{-3}	%, volume	%, weight
soil moisture, deficiency		mm.	in.
radiaton		cal. cm^{-2} joules cm^{-2} mill.watt hrs cm^{-2}	~~ly~~
radiation intensity (radiative flux)		cal.cm^{-2}, min^{-1} or milliwatts cm^{-2}	~~ly min.~~ $^{-1}$
sunshine		% possible	hrs
wind speed	m.sec^{-1}	knots, m. sec^{-1}	mi. hr^{-1}
relative humidity	%	%	
wind direction		degrees from N, or on scale 0-36 where 36 is wind from N & o9 wind from E.	
visibility		metres, kilometres	
cloud height		metres	
cloud amount		octas, tenths	
dewpoint	degree kelvin	degreè celsius	
moisture content		g. kg^{-1}	
mixing ratio		g. kg^{-1}	
viscosity (dynamic viscosity)	N. sec. m^{-2}		
viscosity (kinematic viscosity)	m^2sec.$^{-1}$		
electrical potential	volt		
electrical capcitance	farad		
electrical resistance	ohm		

METRICATION IN SCIENTIFIC PUBLICATIONS

Readers will have noticed that a change has been taking place in the units of measurement used in scientific and technical publications, both in New Zealand and in other English-speaking countries. This change-over — to the system of units known as SI — has been achieved in one step in some journals and gradually in others. It must eventually involve all branches of science and engineering.

SI (which is the abbreviation in many languages of Système International d'Unités) is an extension and refinement of the traditional metric system. It embodies features which make it logically superior to any other system as well as practically more convenient; it is rational, coherent and comprehensive.

The metric system, which has spread to several countries in the aftermath of the French Revolution, began to displace Imperial units in scientific work during the last quarter of the nineteenth century. Its use extended more and more widely, although there are still branches of science where Imperial units have continued to predominate. It is fortunate that, now that the time has come to discard completely the time-honoured traditional units (which are not without their advantages), there is a fully developed international system to take their place. Over the years much thought has been given to extending and improving the metric system, until finally in 1960 the Conférence Générale des Poids et Mesures, the body responsible for maintaining standards of measurements, formally approved SI. Already nearly 30 countries have decided to make it the only legally accepted system, and it is clearly destined to become the universal currency of science and commerce.

A periodical such as the *Journal of Hydrology*, circulating among both scientists and engineers, can play a crucial role in helping to end the confusion and wastefulness (both mental and material) resulting from the present multiplicity of units.

The main features of SI are as follows:

1. There are six basic units (see list), the metre and kilogram taking the place of the centimetre and gram of the old metric system.

* This article is based on material compiled and published by the U.K. Royal Society Conference of Editors.

– Journal of Hydrology (N.Z.), Vol. 8 No. 2 (1969).

2. The unit of force, the newton ($kg\ m\ s^{-2}$), is independent of the Earth's gravitation, and the often confusing introduction of g into equations used in some branches of science and technology is no longer necessary.

3. The unit of energy in all forms is the joule (newton × metre), and of power the joule per second (watt): thus the variously defined calories, together with the kilowatt hour, the B.t.u. and the horsepower are all superseded.

4. 'Electrostatic' and 'electromagnetic' units are replaced by SI electrical units.

5. Multiples of units are normally to be restricted to steps of a thousand, and similarly fractions to steps of a thousandth.

Lists are appended of the basic SI units, of some derived SI units, of compatible units, and also examples of units which run counter to SI — the use of which is accordingly to be actively discouraged. Also listed are the names and symbols of the prefixes representing numerical factors; these are both convenient in obviating the need to write large numbers of zeros or in some instances high powers of 10, and also helpful in establishing familiarity with the numerical framework of modern science.

The *Journal of Hydrology* will continue to publish papers in which Imperial units are used; authors are, however, encouraged to adopt the international system of units. In order to avoid tedious and error-producing conversions from one system of units to another, it is best that work be reported in the units used in the original measurements. Full metrication may therefore have to wait upon the availability of metric equipment and data, although it is hoped that this goal can be achieved with a minimum of delay.

Basic SI units

Physical quantity	*Name of unit*	*Symbol for unit*
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	degree Kelvin	°K
luminous intensity	candela	cd

Symbols for units do not take a plural form.

Supplementary units

Physical quantity	*Name of unit*	*Symbol for unit*
plane angle	radian	rad
solid angle	steradian	sr

These units are dimensionless.

Derived SI units with special names

Physical quantity	*Name of unit*	*Symbol for unit*	*Definition of unit*
energy	joule	J	$kg\ m^2\ s^{-2}$
force	newton	N	$kg\ m\ s^{-2} = J\ m^{-1}$
power	watt	W	$kg\ m^2\ s^{-3} = J\ s^{-1}$
electric charge	coulomb	C	A s
electric potential difference	volt	V	$kg\ m^2\ s^{-3}\ A^{-1} = J\ A^{-1}\ s^{-1}$
electric resistance	ohm	Ω	$kg\ m^2\ s^{-3}\ A^{-2} = V\ A^{-1}$
electric capacitance	farad	F	$A^2\ s^4\ kg^{-1}\ m^{-2} = A\ s\ V^{-1}$
magnetic flux	weber	Wb	$kg\ m^2\ s^{-2}\ A^{-1} = V\ s$
inductance	henry	H	$kg\ m^2\ s^{-2}\ A^{-2} = V\ s\ A^{-1}$
magnetic flux density	tesla	T	$kg\ s^{-2}\ A^{-1} = V\ s\ m^{-2}$
luminous flux	lumen	lm	cd sr
illumination	lux	lx	$cd\ sr\ m^{-2}$
frequency	hertz	Hz	cycle per second
customary temp.	deg. Celsius	°C	°C = °K − 273.15

Fractions and Multiples

Fraction	*Prefix*	*Symbol*	*Multiple*	*Prefix*	*Symbol*
10^{-1}	deci	d *	10	deka	da*
10^{-2}	centi	c *	10^2	hecto	h *
10^{-3}	milli	m	10^3	kilo	k
10^{-6}	micro	μ	10^6	mega	M
10^{-9}	nano	n	10^9	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f			
10^{-18}	atto	a			

* To be restricted to instances where there is a strongly felt need.

Compound prefixes should not be used, for example 10^{-9} metre is represented by 1 nm, not 1 nμm.

The attaching of a prefix to a unit in effect constitutes a new unit, for example $1\ km^2 = 1\ (km)^2 = 10^6\ m^2$, not $1\ k(m^2) = 10^3\ m^2$.

Where possible any numerical prefix should appear in the numerator of an expression, for example $kg\ m^{-1}$, not $g\ mm^{-1}$.

Examples of units contrary to SI, with their equivalents

Physical quantity	*Unit*	*Equivalent*
length	millimicron	10^{-9} m = nm
	inch	25.4 mm
	foot	0.3048 m
	yard	0.9144 m
	chain	20.12 m
	mile	1.609 km
area	square inch	645.2 mm^2
	square foot	0.0929 m^2
	square yard	0.8361 m^2
	acre	4047 m^2
	square mile	2.59 km^2
volume	cubic inch	1.639×10^{-5} m^3
	cubic foot	0.02832 m^3
	cubic yard	0.7645 m^3
	UK gallon	0.004546 m^3
	acre-inch	102.8 m^3
	acre-foot	1233 m^3
velocity	foot/second	0.3048 m s^{-1}
	mile/hour	0.447 m s^{-1}
mass	pound	0.4536 kg
	UK ton	1016 kg
density	pound/cubic foot	16.02 kg m^{-3}
force	dyne	10^{-5} N
	poundal	0.1382 N
	pound-force	4.448 N
	kilogram-force	9.807 N
pressure	atmosphere	101.3 kN m^{-2}
	pound (f)/sq.in.	6895 N m^{-2}
energy	erg	10^{-7} J
	foot-poundal	0.04214 J
	foot pound (f)	1.356 J
	calorie (thermochemical)	4.184 J
	B.t.u.	1055 J
	kilowatt hour	3.60 MJ
power	horsepower	745.7 W
temperature	degree Fahrenheit	°F = °C(9/5) + 32
sediment	UK ton/day	0.01176 kg s^{-1}
flow	million UK gallons/day	0.05262 m^3 s^{-1}
	cusec	0.02832 m^3 s^{-1}
	cusec/square mile	0.01093 m^3 s^{-1} km^{-2}

Examples of derived SI units used in hydrology

Physical quantity	*Usual symbol for quantity*	*SI unit*
mass precipitation	P	mm
precipitation intensity	i	mm h^{-1}
potential evapotranspiration	E_t	mm
mass infiltration	F	mm
infiltration rate	f	mm h^{-1}
soil moisture content	M_s	kg kg^{-1}, m^3 m^{-3}
run-off	Q	m^3, mm depth
discharge	q	m^3 s^{-1}

Examples of units to be allowed in conjunction with SI

Physical quantity	*Name of unit*	*Symbol of unit*	*Definition of unit*
area	hectare	ha	10^4 m^2
volume	litre	l	10^{-3} $m^3 = dm^3$
pressure	bar	bar	10^5 N m^{-2}
mass	tonne	t	10^3 kg = Mg

The common units of time (for example hour, year) will persist, and also — in appropriate context — the angular degree.

Until such time as a new name may be adopted for the kilogram as the basic unit of mass, the gram will often be used, both as an elementary unit (to avoid the absurdity of mkg) and in association with numerical prefixes, for example, μg.

Metric Units for Groundwater Studies in Europe

1. It had been hoped to provide details of some commonly used metric units for groundwater studies. However it appears that there is no uniformity between various countries or organisations. Further enquiries by the secretariat are proceeding to obtain more details on this matter.

2. For the present, the following units have been abstracted from plans and reports by T.N.O. - a CSIRO - type organisation in the Netherlands. It is not suggested that this is a complete or an official listing of the units used by T.N.O. but it may give members an idea of the kinds of metric units in practical use in the groundwater field.

Quantity	Unit
Depth (distance, thickness)	metres
Particle concentrations (T.D.S., ions)	milligrams litres^{-1}
Transmissibility	metres^{2} days^{-1}
Hardness	German degrees (^{o}D)
Coeff. of permeability	metres days^{-1}
Yield of well	metres^{3} years^{-1}
Electrical conductance	micro-siemens

14A

Item 14: Groundwater Administration

(a) Measurement of Groundwater Withdrawals

1. At the tenth meeting of T.C.S.W. concern was expressed at the effect of unmeasured diversions from streams and rivers on the runoff record at gauging stations which have a long period of record. Even when annual licences are issued, actual quantities used and distribution through the year were unknown. Of particular effect was the increasing utilisation of groundwater aquifers which are recharged from streams, this effect in some cases being responsible for the cessation of stream flow in what were previously favourable stream flow periods.

2. T.C.S.W. agreed that this was a matter of considerable importance related to both investigations and operations, and that the only solution likely to be effective was full metering of diversions both surface and subsurface, even though it was recognised that there were many problems associated with this.

3. Council and Standing Committee noted the necessity for metering diversions from streams and rivers in order to ensure the validity of measurements of discharge at gauging stations. The significance of withdrawals from groundwater aquifers was also referred to, and hence the desirability of metering discharge from bores. The Secretariat was requested to obtain a statement on current practice and legislative authority from all States, and to compile a summary for the information of Council and Standing Committee. So far no information has been received and a request may have to be sent to compile this information.

4. At the last meeting of T.C.U.W. each State gave brief details of current practices as far as measurement of withdrawals is concerned. Members may care to detail any changes made since the last meeting and give details of any future proposals for measurement.

14B

Item 14: Groundwater Administration

(b) Australian Water Well Association

1. The above association is now functioning as a national successor to the various state drillers associations. T.C.U.W. has had some correspondence with this Association which is showing an interest in T.C.U.W. affairs. The attached letter (Attachment 1) is the latest item of correspondence received.

2. The Chairman of T.C.U.W. was asked last year to open the first national convention of the A.W.W.A. It thus appears that the contacts being built between T.C.U.W. and A.W.W.A. will be to the advantage of both.

3. Also attached (Attachment 2) for the information of members is a copy of the aims and objectives of A.W.W.A.

ATTACHMENT 1

AUSTRALIAN WATER WELL ASSOCIATION

0124

President- MR. T. H. SIDES
MELBOURNE - 560 8655

Executive Committee-
MR. L. J. PREISS - President S.A. Branch
MR. R. CLYDESDALE - President Vic. Branch

P.O. BOX 228
CLAYTON, VIC., 3168

BA:MH:

15th April, 1971.

Mr. F.A. Hatfield,
Secretary,
Technical Committee on Underground Water,
Water Resources Council,
Department of National Development,
P.O. Box 850,
CANBERRA CITY. A.C.T. 2601.

Dear Mr. Hatfield,

Following a recent conversation with Mr. J.B. Anderson of the Victorian Committee of our Association, I wish to assure the Council of our support and co-operation on a national basis and throughout each State of Australia.

The Association, which incorporates all segments of the industry including Contractors, Technical Personnel and Manufacturers, is directly concerned with continued improvements of standards and expertise. Therefore our interests will also involve technical education and the practical application of research developments.

I personally congratulate you on your appointment and I am confident the Association will develop a happy liason with your Council. May we look forward to progressive conservation together with beneficial development and usage of ground water in the best interests of Australia.

Yours truly,
AUSTRALIAN WATER WELL ASSOCIATION

T.H. SIDES, PRESIDENT.

per V.J. Schumann,

AUSTRALIAN WATER WELL ASSOCIATION. 0125

PROPOSED CONSTITUTION.

ARTICLE 1 - NAME.

The name of this association shall be the AUSTRALIAN WATER WELL ASSOCIATION, INC.

ARTICLE 11 - OBJECTIVES

The objectives of this association shall be: to assist, promote, encourage, and support the interests and welfare of the water well industry in all of its phases; to foster, aid and promote scientific education, standards, research, and techniques in order to improve methods of well construction and development, and to advance the science of groundwater hydrology; to promote harmony and co-operation between well contractors and scientific agencies relative to the proper development and protection of underground water supplies; to encourage co-operation of all interested groups relative to the improvement of drilling and pumping equipment; to encourage, serve, assist and promote closer co-operation among the existing state water well contractors' associations and to foster the development of such associations in states where they do not exist; to collect, analyze, and disseminate to the public facts about the role of the water well industry in the economy of the nation; and to advance generally the mutual interests of all those engaged in the water well industry, in their own and the public interest.

ARTICLE 111 - MEMBERSHIP.

SECTION 1 - Nature of the Association. The Association is a voluntary organization without capital stock, and its membership shall be composed of persons engaged in the water well industry who may from time to time be admitted to membership as prescribed by this Constitution.

SECTION 2 - Industry Definitions. The term "water well industry" as used in this Constitution embraces all industries and persons engaged in drilling or constructing water wells, manufacturing or supplying equipment to accomplish that task, studying, teaching or perfecting related technology, or evaluating or developing water resources.

SECTION 3 - Membership. The membership of the Association shall consist of active members, associate members and honorary members.

SECTION 4 - Active Members. The active members of the Association shall be divided into four divisions, as follows:

(a) Contractors Division. Any person, firm or corporation engaged in the business of water well drilling.

-/2.

(b) Manufacturers Division. Any person, firm or corporation engaged in manufacturing equipment, materials or supplies used in the water well industry.

(c) Water Equipment Wholesalers and Suppliers Division. Any person, firm or corporation which does no contracting for the drilling of water wells and which:

(1) is an established wholesaler maintaining a warehouse and stock of pumps, pump parts and other water handling equipment which are sold regularly to dealers and/or contractors for resale; or

(2) is engaged in the business of supplying equipment, rigs, or tools or rendering specialized services to the water well industry from an established place of business in its trading area.

(d) Technical Division. Any person, firm or corporation engaged in the supervision, regulation, evaluation, development or investigation of underground waters or ground water supply installations or related technology or any individual in an accredited university, college or preparatory school, public or private, studying or teaching subject matter embracing the water well industry.

SECTION 5 - Associate Members. Any eligible person, firm or corporation interested in the work of the Association who is not eligible to become an active member may become an Associate Member.

SECTION 6 - Honorary Members. Persons of acknowledged eminence in the well drilling profession, or who have contributed some special service in the furtherance of the art or to this Association, may be elected to Honorary membership upon recommendation of the Committee on Awards, by two-thirds vote of the Board of Directors. Honorary Members elected from the active membership shall retain all the privileges of an active member. Others so elected are entitled to all privileges except voting and holding office. All Honorary Members are exempt from membership fees.

SECTION 7 - Application and Eligibility.

(a) Any eligible person whose application is received by the Secretary properly completed and whose annual dues are fully paid shall be deemed an active member of the Association upon being so notified. An eligible person shall be any person, firm or corporation meeting the qualifications set forth in Section 4 of this Article as determined by the appropriate Division.

(b) Any person whose application is received by the Secretary properly completed, payment of whose annual dues is tendered, and who is declared eligible for associate membership in the Association by the Membership Committee shall be deemed an associate member of the Association upon being so notified.

15A

AGENDA ITEM 15 (a)

Item 15: International Activities

(a) International Hydrological Decade

1. The sixth session of the Co-ordinating Council of the International Hydrological Decade resulted in further steps in the reorganisation of its working groups and panels of experts. A copy of the resolution is attached (Attachment 1) This material is included for the information of members and there may be some points they would like to discuss.

2. Since the last meeting of T.C.U.W., the report of the Australian delegation to the I.H.D. Mid-Decade Conference held in Paris on December 8 - 16, 1969 has been circulated. This report has not been reproduced because of its bulk and its indirect bearing on T.C.U.W. matters. However a copy of the summary of resolutions passed is attached for the information of members. (Attachment 2).

ATTACHMENT 1

0129

UNITED NATIONS EDUCATIONAL
SCIENTIFIC AND CULTURAL ORGANIZATION

INTERNATIONAL HYDROLOGICAL DECADE

CO-ORDINATING COUNCIL

(Sixth Session, Geneva, 6-11 July 1970)

EXTRACT FROM FINAL REPORT

5. FUTURE PROGRAMME OF THE INTERNATIONAL HYDROLOGICAL DECADE

5.1 Terms of reference of the working groups of the Council

The Council considered the documents presented by the Secretariat on this item and the recommendations of the Bureau made at its tenth session. These recommendations took into consideration the written comments from the National Committees of the IHD Council members. The Council decided that in the future it would establish only "Working Groups" reserving the title of "Sub-Working Groups" for the working parties established by the working groups themselves to carry out part of their programmes. The Council also agreed to the denomination of "Committee of Experts" which may be established by the Secretariat of IHD to carry out the parts of the programme entrusted to the Secretariat. The term "Panel of Experts" should no longer be used for bodies established or recommended by the Council. Details on the bodies responsible for the establishment of working groups, sub-working groups and committees of experts and for defining their terms of reference and work plans are included in the report of the Bureau (document SC/IHD/VI/17) which was approved by the Council.

After extensive discussion on the problem of functions and tasks of its working groups the Council adopted resolution VI.2, taking into due consideration the resolutions and recommendations of the Mid-Decade Conference and, in particular, the wish of the Conference that the needs and problems of developing countries are taken into full account in the activities of the working groups.

During the discussion on functions and tasks of the working groups, the Council was of the opinion that, in the composition of working groups, in addition to adequate technical qualifications, appropriate representation depending on the task assigned to the body in question, will be taken into account either on the basis of general geographical representation or on the basis of representation of the areas in which the phenomena to be studied occur.

RESOLUTION VI.2

The Council,

1. Noting the request of the Mid-Decade Conference (December 1969) for a review of the future programme of action of the working groups of the Co-ordinating Council of the IHD for the second half of the IHD (1970-1974) and particularly putting into effect those resolutions of the

Conference that specifically relate to working groups, and its request that the working groups confine their attention to attainable objectives within specific time limits before the end of the Decade,

2. Considering the necessity of increasing the efficiency of the Co-ordinating Council working groups' activities to achieve greater results on the major scientific problems, as well as in the field of education and training of specialists, and the exchange of information and publications until the end of the Decade,

3. Taking into account that the contribution of international governmental and non-governmental organizations to the implementation of the IHD programme in the second half of the Decade may also be considerable,

4. Decides to maintain or establish the following working groups of the Co-ordinating Council for the second half of the IHD:

   1. On water balances

   2. On ground water studies

   3. On floods and their computation

   4. On the influence of man on the hydrological cycle

   5. On representative and experimental basins

   6. On nuclear techniques in hydrology

   7. On information and publications

   8. On education and training of hydrologists

   9. On hydrology of carbonate rocks of the Mediterranean basin

   10. On hydrological problems related to water quality;

5. Adopts the terms of reference of the Co-ordinating Council working groups as outlined in Annex IV;

6. Decides, however, that these terms of reference constitute a general framework and leave to each group latitude to adapt its work plan to the time and means of which it disposes;

7. Terminates with thanks all other current working groups and panels of experts of the Co-ordinating Council not mentioned in point 4 above;

8. Authorizes working groups to establish, when necessary, "sub-groups" to accomplish specific tasks within their terms of reference, it being understood that the activity of such sub-groups is confined to the programme and budget approved for each working group as a whole. The sub-groups report to the respective working groups on activities performed;

9. Invites the IHD Secretariat to designate, whenever necessary, "committees of experts" for specific tasks recommended by the Co-ordinating Council not covered by the terms of reference of the working groups;

10. Directs the working groups established in point 4 above to outline clearly in their work plans for the second half of the Decade the specific types of work which they will carry out, to concentrate on the major specific tasks which can be completed within the period 1970-1974 and to give priorities to the preparation of material for publication;

11. Directs further the working groups, in their final reports to the Council, to stress the problems which remain to be studied after the end of the Decade and which should be followed up on a national, regional and international basis;

12. Invites all international organizations, now participating in the IHD to continue to support the activities of the working groups and to contribute to other projects of the IHD not covered by the terms of reference of the above-mentioned working groups, and in particular invites:

(a) The United Nations Educational, Scientific and Cultural Organization (Unesco) to continue:

(i) All activities relevant to the tasks of working groups 1, 2, 3, 5, 7, 8 in paragraph 4 above, including provision of technical secretariat for these groups;

(ii) Its activities on inventories of water resources, hydrological maps, other research activities concerning scientific hydrology and its application to water management problems, the activities on education and training of specialists in hydrology at various levels, as well as other problems delegated to it by the Mid-Decade Conference and the Co-ordinating Council;

(iii) Its joint activity:

with FAO or problems relevant tc the influence of man on hydrological cycle;

with WHO on hydrological problems related to water quality;

with WMO on the preparation of International Glossary of Hydrology;

with IASH on relevant projects (snow and ice, sedimentation and erosion); mathematical models in hydrology and water balance of lakes; and on groundwater;

with IAH on the Hydrogeological Map of Europe and on the scientific activities related to the working group on groundwater.

(iv) Its support for the activities of the IHD Co-ordinating Council in general.

(b) The World Meteorological Organization (WMO) to continue its activity in the fields of:

(i) Meteorological and hydrological network design and operation;

(ii) Standardization of instruments, methods of observation and processing of data;

(iii) Hydrological forecasting of surface waters;

(iv) Methodologies of computation of design data with inadequate basic observations, mainly on the basis of hydrometeorological elements;

To continue to provide the technical secretariat for specific IHD projects, in particular those connected with methods of computation of hydrometeorological elements for purposes of water balances and operational systems for acquisitions, transmission and processing of data in hydrology related to the WMO system of World Weather Watch;

To continue to participate in other IHD activities such as education and training in hydrology and organization of symposia and seminars;
and

To continue its joint activity with Unesco on the preparation of an International Glossary of Hydrology and to provide the technical support for that activity until its completion.

(c) The Food and Agriculture Organization (FAO) to continue:

(i) All activities relevant to the tasks of working groups 4 and 9 in paragraph 4 above, including provision of technical secretariat for these working groups.

(d) The World Health Organization (WHO) to continue:

(i) All activities relevant to the task of working group 10 in paragraph 4 above, including provision of technical secretariat for this working group.

(e) The International Atomic Energy Agency (IAEA) to continue:

(i) All activities relevant to the task of working group 6 in paragraph 4 above, including provision of technical secretariat for this working group.

(f) The International Council of Scientific Unions (ICSU) to:

(i) Continue its rôle of scientific adviser to the various working groups in which it is requested to participate;

(ii) Continue its activities through its constituent unions, associations and scientific committees, in particular:

IASH (International Association of Scientific Hydrology) with its Commission on Snow and Ice, Erosion and Sedimentation as well as its Committee on Mathematical Models;

IAH (International Association of Hydrogeologists);

IBP (International Biological Programme).

13. Recommends that terms of reference of the inter-organization bodies dealing with the implementation of specific IHD activities should be established by mutual agreement of the organizations concerned on the basis of the pertinent recommendations or resolutions of the Council.

Attachment 2

RESOLUTIONS ADOPTED BY THE MID-DECADE CONFERENCE (8-16 DECEMBER 1969)

I FUTURE PROGRAMME OF THE INTERNATIONAL HYDROLOGICAL DECADE

A. Co-ordinating Council

Res. 1 Increase in membership
Res. 2 Review of Council working groups
Res. 3 Responsibilities of International Organisations in the Decade programme

B. Priorities - general

Res. 4 General recommendation on future programme of the IHD
Res. 5 Project priorities for future programme of the IHD
Res. 6 Priority projects and Unesco's hydrology publications programme

C. Priorities - projects

1. Basic data collection

Res. 7 Classification of Decade stations

2. Research

Res. 8 Influence of Man on the hydrological cycle
Res. 9 Land phases of the hydrological cycle
Res. 10 Standardization - intercomparison of instruments

3. Exchange of Information, publications, maps, and symposia

Res. 11 Symposia
Res. 12 Data exchange
Res. 13 Soft-ware library
Res. 14 Use of artificial satellites
Res. 15 Publications
Res. 16 Maps and publications
Res. 17 Catalogue of IHD research projects
Res. 18 Hydrogeological map of the African Arid Zone

4. Education and Training

Res. 19 IHD fellowships
Res. 20 Audio-visual aids

15B

Item 15: International Activities

(b) International Conferences

1. International conferences to be held later this year are listed for the information of members. (Attachment 1)

2. Also attached (Attachment 2) is a copy of a prospectus for two courses to be held by H.K. van Poollen and Associates. This information was received by the Secretariat earlier this year.

Title	Organisation	Dates	Place
Symposium on Water Resources	Indian Institute of science	May, 1971	Bangalore, India
7th International Symposium on Remote Sensing of the Environment	The Centre for Remote Sensing Information and Analysis	May 17-21, 1971	Ann Arbor, Michigan, U.S.A.
Planning for Water Quality and Standards	American Water Resources Association	June 14-18, 1971	University of Milwaukee, U.S.A.
National Symposium on Social and Economic Aspects of Water Resources Development	American Water Resources Association	June 21-23, 1971	Ithaca, N.Y., U.S.A.
Symposium on Pollution of Groundwater and Surface Water	International Association for Scientific Hydrology	July 28- August 14, 1971	Moscow, U.S.S.R.
International Symposium on Mathematical Models in Hydrology	I.A.S.H., U.N.E.S.C.O., W.M.O. and I.H.D.	July 26-31, 1971	Warsaw, Poland
Post Graduate Training Course on Groundwater Tracing Techniques	U.N.E.S.C.O. and Republic of Austria	August 28-October 2 1971	Graz, Austria
Symposium on Remote Sensing of Hydrological Elements	I.A.S.H. and U.N.E.S.C.O.	August 2-14, 1971	Moscow, U.S.S.R.
Symposium on Salinity and Water Use	Australian Academy of Science	November 1-3, 1971	Canberra, Australia
Institution of Engineers Hydrology Symposium	Institution of Engineers, Australia	November 8-9, 1971	Adelaide, Australia
Scientific Seminar on Groundwater Forecasting	U.N.E.S.C.O. and I.A.H.	Summer, 1971	Paris, France

GENERAL RESERVOIR ENGINEERING

Date: July 19-30 Fee: $500 Place: Sydney, Australia

This course is a general refresher of reservoir engineering and includes new techniques, such as Higgins-Leighton, front tracking and reservoir modeling. Engineers from disciplines other than reservoir engineering will find this course useful for a general background.

Outline

Mathematics Refresher

Basic Reservoir Data
- Permeability
- Porosity
- Relative Permeability
- Compressibility
- PVT
- Viscosity

Gas Storage

Material Balance
- Gas
- Oil
- Water Drive

Waterflooding
- Buckley-Leverett
- Dykstra-Parsons
- Stiles
- Potentiometric Models
- Front Tracking
- Higgins-Leighton
- Water Sensitivity

Well Testing
- Pressure Buildup and Drawdown
- Well Interference
- Drill Stem Tests
- Gas Well Testing
- Field Measurements
- Interpretation

Reservoir Modeling
- General Description
- Application
- Limitations

WELL TESTING

Date: August 9-13 Fee: $300* Place: Copenhagen, Denmark

A course aimed at practicing engineers, geologists and ground water hydrologists. The application of the fundamental fluid flow equations to oil, water and gas well testing will be given. Testing techniques, instrumentation and interpretation techniques will be discussed. Numerous example problems will be worked. The application of well test information to production and reservoir engineering will be discussed.

Outline

Monday, Aug. 9	Introduction to basic flow equations and their solutions; drawdown equations
Tuesday, Aug. 10	Superposition principle and applications, pressure buildup
Wednesday, Aug. 11	Well interference, pulse testing, instrumentation
Thursday, Aug. 12	Varying rate tests, heterogeneous reservoirs, faults, barriers multiwell analyses
Friday, Aug. 13	Applications to production, well bore damage, multiphase flow, test design, applications to exploration and reservoir engineering General discussion

REGISTRATION FORM

Fill in title and dates of course for which you are registering:

_____ _____
(title) (dates)

Name _____

Company _____

Address _____

Send Invoice: Yes____ No____

RETURN FORM AND MAKE CHECK PAYABLE TO: RESERVOIR FLUID FLOW
c/o H. K. van Poollen
1088 West Caley Avenue
Littleton, Colorado 80120

16

AGENDA ITEM 16

Item 16 : State Working Sub-Committees

1. This item is included for the presentation of reports by State Working Sub-committees and the consideration of topics raised by the State Sub-Committees.

2. Statements concerning Queensland (Attachment 1) and New South Wales (Attachment 2) activities are attached.

ANNUAL REPORT QUEENSLAND WORKING SUB-COMMITTEE OF TECHNICAL COMMITTEE OF UNDERGROUND WATER.

Objectives

The main objective of this sub-committee is to co-ordinate activities in Queensland connected with the Technical Committee of Underground Water and to provide liaison between those organisations involved in the investigation of underground water in Queensland.

Period of Report

This report covers the period from April 1970, to April 1971, inclusive.

Membership

The membership of the sub-committee as at May 1971, is as follows -

(a) Mines Department - Mr. J.T. Woods, Chief Government Geologist and Mr. K.W. Wolff, Principal Geologist.

(b) Irrigation and Water Supply Commission - Mr. W.A. Peak, Chief Investigation Engineer, Mr. G.W. Pearce, Senior Engineer Underground Water and Mr. B.L. Credlin, Senior Engineer and Minute Secretary to the Committee.

Meetings

The sub-committee met on three occasions during the period, namely -

7th July, 1970. (Mr. H.G.S. Cribb deputised for Mr. J.T. Woods).
3rd December, 1970.
7th April, 1971.

Business Discussed

Business discussed by the sub-committee included the following -

1. Consideration of existing and proposed groundwater investigation projects;
2. Underground water resources of the Fitzroy Basin - Assistance to Commonwealth;
3. Availability of hydrogeological data from private mining;
4. Groundwater response to Recent Rainfall and Flooding;

5. Technical Education of Groundwater investigation and management staff;

6. Commonwealth participation in the financing of State groundwater investigation;

7. Research into some aspects of groundwater investigation and use;

8. Underground water maps of Australia;

9. T.C.U.W. Groundwater School;

10. Liaison between the two Departments of underground water investigations.

Minutes

Minutes of all meetings have been kept and copies are held by the two Departments concerned.

G.W. PEARCE
CONVENER.

Attachment 2

STATE WORKING SUB-COMMITTEE OF N.S.W.

The convener of this committee reports that no meetings have been held this year as a new state committee, called "The Committee for N.S.W. Co-ordination of Geological Programmes", was formed last year under the auspices of the Scientific Advisory Committee to the N.S.W. Public Service Board. This new co-ordinating committee is in fact carrying out the work of the T.C.U.W. State Working Sub-committee. An oral report of the activities of the new committee will be given at this meeting of T.C.U.W.

17

AGENDA ITEM 17

Item 17 : Other Business

1. The only item of business listed under this item is the date and venue of the next meeting. For the information of members a list of past venues is attached.

Attachment

VENUE AND DATE OF NINTH MEETING

Standing Committee recorded at its first meeting in March, 1963 that Technical Committees would meet at least annually at times and places they think fit.

Venues of meetings of T.C.U.W. have been :-

1st Meeting	Melbourne	6-7th April, 1964
2nd Meeting	Sydney	6th May,1965
3rd Meeting	Bundaberg	21st-23rd June, 1966
4th Meeting	Alice Springs	20-21st June, 1967
5th Meeting	Canberra	28-29th May, 1968
6th Meeting	Hobart	4-5th March, 1969
7th Meeting	Port Lincoln	4-6th March, 1970
8th Meeting	Perth	5-6th May, 1971