WATER RESEARCH COMMISSION

REPORT

1 SEPTEMBER, 1971
TO 31 MARCH, 1973

WATER RESEARCH COMMISSION

P.O. Box 824,
Van der Stel Building,
Pretorius Street,
PRETORIA.
Telegraphic Address: WATERKOM

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WATER RESEARCH COMMISSION

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The Honourable S.P. Botha, M.P.
Minister of Water Affairs

Water Research Commission,
P.O. Box 824,
PRETORIA.
1st April, 1973

Dear Sir,

It is with pleasure that we herewith submit to you the Report of the Water Research Commission.

This report covers the period 1st September, 1971 to 31st March, 1973.

Balance Sheets and Statements of Revenue and Expenditure for the financial years ending 31st March, 1972 and 31st March, 1973, as certified by the Controller and Auditor-General, are included as annexures 6 and 7 of this report.

Respectfully yours,

J.P. Kriel
CHAIRMAN

G.J. Stander
VICE-CHAIRMAN:
CHIEF EXECUTIVE OFFICER

The Honourable S.P. Botha, M.P.,
Minister of Water Affairs,
P.O. Box 23,
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Secretary for Water Affairs
Chairman

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Retired Secretary for Department Agricultural
Technical Services

Establishment of the Commission

When the Report of the Commission of Enquiry into Water Matters R.P. 34/1970 was submitted to Parliament, the Honourable S.P. Botha, Minister of Water Affairs, stressed the necessity of the efficient generation of new knowledge and the application thereof in the development and utilization of water resources and that it was of national importance that a statutory body with the necessary powers and funds be established to promote and expedite the country's water research purposefully.

Realising the important role water research can fulfil in the optimization of the country's water resources, Parliament passed the Water Research Act (Act No. 34 of 1971) in 1971 and promulgated it on 19th May, 1971. The Act came into operation by Proclamation No. 174 of 1971 on 6th August, 1971.

Composition of the Commission

In accordance with the provisions of Section 4(1)(a) of the above Act, the Secretary for Water Affairs, Mr. J.P. Kriel, is ex officio Chairman of the Water Research Commission.

In accordance with the provisions of Section 4(1)(b) and 4(3) of the Act, the State President appointed Dr. G.J. Stander Vice-Chairman and Chief Executive Officer of the Commission, as well as the following six members on grounds of their special knowledge:

Mr. V.N. Bolitho
Professor B.J.V. Botha
Mr. N.A. Lever
Professor S. Meiring Naudé
Professor D.C. Midgley
Dr. P.W. Vorster

First meeting of the Commission

In terms of Section 7(1) of the above Act the first meeting of the Commission was held on 15th September, 1971. The Honourable S.P. Botha, Minister of Water Affairs, opened this meeting, welcomed the members of the Commission and gave a broad outline of possible directions which the Commission could pursue in accordance with its own views and policies, in order to eliminate constraints in the water economy of the Republic.

Objectives and Activities

In the execution of its working programme the Commission endeavoured to develop guidelines for the promotion and acceleration of water research which were oriented towards the most important constraints in the present and future water economy of the Republic, to frame a key water research and development plan and to establish the necessary organizational infrastructure and procedures to attain the aims of the Commission in accordance with Section 2(3) of the Water Research Act, viz:

"to co-ordinate, to promote, to encourage or to cause to be undertaken, as determined by the Minister specifically or in broad outline, research in respect of –

(a) the occurrence, preservation, conservation, utilization, control, supply, distribution, purification, pollution or reclamation of water supplies and water;

(b) the use of water for –

(i) agricultural purposes;
(ii) industrial purposes; or
(iii) urban purposes"

During the period covered by this report, the Commission held six meetings. At this early stage it is already clear that the Commission is in possession of information which enables it to make recommendations on better co-ordination, control and rationalization of water research and on the acceleration, promotion and extension of existing water research as well as on further research and development work which is necessary, and on where and by whom it should be undertaken and how it could be financed. To meet these important responsibilities, the Commission came to the conclusion that its task had several main facets, each with its own particular requirements in respect of policy, planning, programming, implementation and management.

Personnel

An initial nucleus of personnel of the Commission, consisting of an Expert Adviser (General) a Secretary and Private Secretary for the Vice-Chairman, were appointed by the Minister of Water Affairs and assumed duties on 1st October, 1971 in the offices of the Commission, Van der Stel Building, Pretorius Street, Pretoria. Since then additional posts have been made available, viz an Adviser (Publications and Information), two Administrative Assistants and two typists.

Implementation of the Water Research Act in South West Africa

On the recommendation of the Commission all the provisions of the Water Research Act were made applicable in the territory of South West Africa by the State President, in terms of Proclamation No. 279 of 27th October, 1972.

Basic guidelines for evaluating the status of water research

It is the well considered opinion of the Commission that the promotion of water research at the level of the research worker can only be effective where co-ordination has been accepted as a prescribed executive function at the highest level and is extended as such. It is therefore, also of the utmost importance to obtain an overall picture of such research. The Commission, therefore, set itself the task of conducting an extensive survey and of investigating all aspects of current water research in the Republic of South Africa.

In several cases it was found that there is not a clear understanding of the concept of research and development work. Numerous important tasks which must be performed by Government organizations as part of their normal functions are often not considered as research and development work, while it is in fact research related, or essentially technological development, which may be of key importance in a comprehensive programme of research and investigation. For example, meteorological survey data for air and sea traffic do not lose their value when their operational purposes have been achieved and even less so rainfall measurements that may have been made at a specific station. In fact there are several organizations which need this important data – collected at high cost – in their respective working programmes. Consequently, with a view to obtaining meaningful information in respect of research and development work, contact at the highest level has been made with all organizations which are concerned with water research, requesting the submission of information in accordance with the basic guidelines outlined below.

The concepts "research" and "development"

For the formulation of policy and especially with a view to financial implications and allocation of priorities with regard to the Commission's working programme, it is necessary to establish a system for the classification of projects. After careful consideration the Commission accepted the following categories as the most practical:

(i) **Basic research** is considered to be orginal research of which the only objective is the promotion of scientific knowledge and although it is not directed towards specific practical application, it can be of value to all other levels of research.

(ii) **Applied research** is investigation aimed at the promotion of scientific knowledge which has a specific application for the solution of a practical problem or for a practical development that has not been attained previously. This concept emphasizes the objective rather than the process or procedures by which it is attained. Applied research may include both technological development and basic research.

(iii) **Technological development** is the activity by which the design of a process or product or the

improvement of an existing process or product is being extended to the level where it satisfies specific functional or economical requirements and where it may be applied or used in practice.

(iv) **Research-related activities include:**
- (a) Communication and application of information.
- (b) Compilation of data through systematic surveys, e.g. daily collection of meteorological information, routine hydrographical surveys, measuring of rainfall etc.
- (c) Data processing.
- (d) Training in science, engineering and technology in respect of research connected with the development of water resources (hydrology, hydraulics, water utilization, reclamation, abatement of pollution, etc.).

It should be kept in mind that the above classification does not aim at a strict demarcation and allows for an interplay and shift of emphasis between the different categories of research and related activities with basic research and technological development as the two ends of a spectrum .

The implementation of water research with the emphasis on the basic principles of management, viz.

(i) Identification of problems which require investigation.
(ii) Motivation of proposed research and development work.
(iii) Programming, budgeting and financing.
(iv) Co-ordination.
(v) Continuous operation of projects.
(vi) Reporting.
(vii) Publication and distribution of information.
(viii) Implementation of findings.

Main task areas of water research and development work

In order to establish a complete picture of the Commission's task it has been accepted as a basic premise that the key to the prevention or restriction of constraints in the Republic's water economy in so far as it is related to socio-economic development lies in a synchronized interaction between the water utilization and hydrological cycles. All problems in connection with water economy are related to the interaction between the main components of the two cycles, viz:

(i) the relative distribution of water within the hydrological cycle;
(ii) the withdrawal of water by way of the utilization cycle;
(iii) the return of water to the hydrological cycle.

After due consideration of the two cycles and of information already submitted, the Commission has outlined broadly the main task areas of water research as set out in Annexure 1.

The most important constraints or problems in the existing and future water supply of South Africa and South West Africa.

The Commission delineated the following constraints in order to determine priorities for the co-ordination and promotion of water research.

(i) Insufficient and intermittent rainfall as well as its disproportional distribution.

(ii) Conditions in catchment areas which influence the run-off:
- (a) Afforestation.
- (b) Farming practices which expose soil surfaces and cause inconstant runoff, high silt loads in the runoff, with consequent siltation and decreased storage capacity of dams.
- (c) Management of catchment areas.

(iii) High evaporation losses from dams, rivers, canals and soil.
(iv) Uneconomic and inefficient use of water (surface and underground) by:
- (a) agriculture,
- (b) industries and mines,
- (c) cities, towns etc.

(v) Water pollution.
(vi) Underground sources:
- (a) Over-utilization and insufficient supplementation.
- (b) Mineralization.

(vii) Unsatisfactory co-ordination, publication and communication of water research and development work.
(viii) Inadequate training of scientists, engineers, technologists and other experts required for water research and the development of the water resources of the Republic.

Survey of water research and development work

Government, statutory and private institutions

Several government departments, provincial administrations, statutory and private institutions, by virtue of their specific needs and as part of their normal functions and duties, undertake water research and development work which to a greater or lesser extent falls within the Commissions's general objectives.

The following institutions which are concerned in this survey have already submitted to the Commission a delineation of their existing water research activities as well as of the management, communication and financing thereof:

(i) Department of Water Affairs.
(ii) Department of Agricultural Technical Services.
(iii) Department of Forestry.
(iv) Department of Transport (Weather Bureau).
(v) Council for Scientific and Industrial Research.
(vi) Atomic Energy Board.
(vii) Rand Water Board.
(viii) Department of Mines.
(ix) Chamber of Mines.
(x) Department of Health.
(xi) Various universities.
(xii) The Provincial Administrations of Natal, Cape Province, Transvaal, Orange Free State and the Administration of South West Africa.

Senior representatives of the first nine institutions have already appeared before the Commission to elaborate on their submissions personally, to exchange views concerning specific aspects of their organizations' water research and to bring to the Commission's attention specific problems experienced by them in the implementation of their research work.

Universities

The survey of water research at universities was preceded by visits and discussions with interested research personnel to explain the role of the Water Research Commission as well as the type of information required from universities. The specific information furnished by universities included the following:

(i) Current water research projects under way and the sources of finance involved, e.g. students theses for degree purposes and research projects on behalf of industries, local authorities and Government departments.
(ii) Research facilities which could be made available for water research.
(iii) Research staff with their special expertise who could supervise and direct water research projects.
(iv) Categorization of problems in connection with the planning and conduct of water research.

(v) Categorization of areas of water research which could effectively be carried out within the existing research climate of the University.
(vi) A forecast of water problems which may develop within the next 20-30 years as seen by scientists and engineers engaged in water research activities, particularly regional problems and suggestions as to how these should be tackled on a co-ordinated basis.

Thus far the following universities have already submitted the necessary information:

(i) University of Natal.
(ii) University of Cape Town.
(iii) University of Pretoria.
(iv) University of the Witwatersrand.
(v) Randse Afrikaanse Universiteit.
(vi) University of Potchefstroom.
(vii) University of the Orange Free State.
(viii) Rhodes University.
(ix) University of Stellenbosch.
(x) University of Port Elizabeth. .

Senior representatives and research leaders of some of these universities have already appeared before the Commission to elaborate on submissions and to exchange views with the Commission. Although this survey has not yet been finalised and it is intended to include, through the appropriate government departments, Non-White universities, it is clear that there is considerable scope for the promotion of water research at universities and the effective exploitation of their potential so that, with financial support from the Commission, research projects which are important to the water economy of the country can be carried out. In this respect the Commission has already formulated a policy for negotiation with the Council for Scientific and Industrial Research and with government departments that have an interest in water research at universities.

Municipalities, industries and mines

Contrary to general belief, much useful water research and development work is being done by some of these institutions. Although this work is of specific interest to the organizations concerned, the Commission is well aware of its national importance and of the necessity to co-ordinate it with related research and development work being undertaken by various research organizations. Apart from promoting and co-ordinating such activities, the Commission considers it advisable to collect information on the particular problems of water supply and pollution with which the above institutions have to cope in complying with pollution control requirements and with responsibilities which are associated with the Republic's economic development programme in general.

In view of the above considerations and because of the very wide field to be covered in order to effect a properly organized survey, the Commission obtained the co-operation of the United Municipal Executive of South Africa, the Chamber of Mines, the South African Federated Chamber of Industries and of manufacturers associations not associated with the Chamber. These organizations notified their members by way of circulars of the Commission's intended survey and requested them to furnish the required information. The Vice-Chairman has already addressed several meetings of interested institutions in the Republic's most important urban and industrial areas and established contact on a personal level. The spirit of trust and co-operation engendered in this manner will certainly ensure the success of the Commission's survey. The Vice-Chairman has also presented papers at several conferences to communicate the Commission's objectives and activities to these sectors.

In order to simplify the collection of information the Commission proposed the following guidelines for use by local authorities and industries in the preparation of their submissions.

(i) Past and present research and development work undertaken in connection with all aspects of water supply and distribution, usage, pollution and re-use.
(ii) Methods developed in these fields in order to cope with specific problems and the degree of success achieved.
(iii) Problems to be solved in complying with pollution control requirements.
(iv) Research and development work which is regarded as essential and which in their opinion should be supported at a national level, in order to assist them in solving and preventing water pollution problems.
(v) Long-term problems, say within the next 20 to 30 years, which are foreseen in connection with water supply, usage, pollution and re-use and the necessity of co-ordinated research.

Publication and communication

In the execution of the Commission's working programme, it became clear that effective communication should be maintained with and among all bodies concerned with water research and development work on a national and international level. The Commission has therefore decided to develop its activities in this connection at four levels.

The establishment of liaison and active co-operation with overseas organizations undertaking water research

In view of the Republic's shortage of qualified scientists, engineers and technologists for optimizing the utilization of its limited water resources, it is essential that the Republic's research potential should be strongly supported by dynamic contact with new knowledge and expertise generated abroad. In the opinion of the Commission, specific arrangements should be initiated and maintained to acquire such knowledge and expertise in order to strengthen the Republic's various research programmes and to avoid unnecessary research.

The establishment of a South African journal on water research of high scientific and international status

Scientists and engineers undertaking water research in the Republic are, to a large extent, dependent on overseas journals for the publication of their work. In fact, only a small percentage of the outstanding water research in the country is published as a result of limited space in journals and due to the fact that research results are often of specific national or local interest only. The Commission holds the view that the achievements of scientists can best be disseminated through the publication of research findings at national and international levels. By this means research scientists are activated and their potential developed to the highest level. This can only be achieved by the establishment of a national scientific journal for water research and the Commission has already committed itself to this ideal.

The co-ordination of documentation and information services of various bodies concerned with water research and water resources development

Several bodies must, in compliance with their operational functions, and as part of their normal duties, maintain documentation and information services oriented to their needs. Because of the high cost of such services, the development of undesirable and excessive overlapping (healthy overlapping is desirable) and the necessity of filling in gaps, the Water Research Commission has set itself the task of developing the necessary guidelines for co-ordination and of ensuring that the documentation and information services of the various bodies be made compatible and be maintained as such.

Promoting the national and international distribution of documentation and information on water research

Apart from the domestic functions of the various publication, documentation and information services being operated by the different organizations concerned with research, the merits of a national and international distribution network should also be considered. Local authorities, industries, provincial administrations, professional organizations, universities, consultants, Members of Parliament, provincial councils, municipal councils and the public should have organized and unrestricted access to such documentation and information. The Water Research Commission has accepted responsibility for this important task and will endeavour to bring about the co-ordinated collection and distribution of documentation and information on a national and international basis. The proposed scientific journal mentioned above, together with scientific newsletters, would probably be suitable media for such a distribution service.

Guidelines for co-ordination

On account of the broad structure of regulations, laws, policy and financing within which organizations involved in the Commission's survey of water research have to function, it was necessary that contact be initiated at the highest level in order to ensure that the objectives of the Water Research Act be achieved in a meaningful manner.

Furthermore, arising from these surveys, the necessary guidelines for effective co-ordination should be developed. Submissions already considered and discussed at high level with the various organizations, involve a broad spectrum of research and development programmes.

Based on the main emphases in the respective research and development programmes, the various research and task areas and management aspects can be categorized as follows for the proper evaluation, co-ordination and promotion of water research:

(i) The planning and development of water supply schemes.
(ii) Surface and subsurface water, including rainfall and weather forecasting.
(iii) Agriculture and forestry.
(iv) Industries, local authorities, mining and power generation.
(v) Communication, publication, financing, research management and training.

The processing and evaluation of the information submitted to the Commission will be done according to the following guidelines:

(i) Identification and classification of the task areas of water research in their respective categories (Annexure 1), and the identification of any relationships with task areas in other categories.
(ii) Evaluation of constraints in the country's water economy and the identification of those task areas of water research which require emphasis in order to relieve these contraints.
(iii) The establishment of research priorities, related research and development programmes, related task classifications and the initiation of new, or the amendment of existing programmes in accordance with contraints in the country's water economy.
(iv) Determination of research and financial requirements, expertise, man-power and facilities necessary for the successful execution of research and development programmes.
(v) Delineation of co-ordination, secondment of staff, the composition of research teams and research management.
(vi) Reporting, communication, publication and implementation.

Financing of water research and development work

Water Research Fund

In order to achieve the general objectives of the Water Research Commission and in particular to enable it to fulfil its functions in terms of Sections 2 and 3 of the Water Research Act, provision was made in terms of Section 12 for the establishment of a water research fund which will consist of:

(i) Moneys appropriated by Parliament for the benefit of the fund.
(ii) Rates and Charges levied in terms of Section 11 of the Act.
(iii) Donations, bequests or contributions which the Commission may receive from any other sources.

On the advice of the Commission, the Honourable the Minister of Water Affairs levied rates and charges for the financial year 1972/1973 in terms of Section 11 of the Water Research Act as detailed in Annexure 2.

The expected income from this source is estimated at R2 335 500 (Annexure 5). Apart from an advance of R66 000 made with the approval of the Treasury from the Department of Water Affairs' budget vote, no income has up to now been received from any other source.

Policy in the appropriation of the Water Research Fund

The purpose of the establishment of the Water Research Commission was to identify and eliminate deficiencies in water research in respect of the country's future needs and not to take over and finance existing water research work. It is the intention to use the funds derived from rates and charges to promote water research which does not fall within the normal functions of the various government departments and statutory institutions. It is not envisaged that the Water Research Commission will take over financial obligations in respect of the normal functions of the aforementioned institutions. The policy of the Commission in respect of financing of water research and development work by these institutions is that the existing practice of covering the expenditure for work carried out by these institutions out of their respective budget funds, will remain unchanged.

The specific functions of the Commission in respect of the promotion of the normal water research activities of the latter institutions are mainly directed at the identification, evaluation, co-ordination and rationalization of water research projects according to the problem areas in the water economy of the country. Consequently it is logical that the Commission is the proper institution to advise the government in this regard through recognized channels, as well as to keep the Scientific Advisory Council abreast of water research.

It is felt that in the financing of projects out of the Water Research Fund, the Commission will confine itself to projects which are not financed out of Treasury funds. However, should research organizations consider that projects, which have been initiated and carried out with Treasury funds, have reached a stage where further research or development work falls outside the scope of their budgets, the Commission could consider further financing thereof. The Commission's objective, therefore, of providing financial support is to ensure acceleration of water research at a high rate. Should the Commission find that water research and development is progressing too slowly in critical task areas, or is not carried out by any institution, or that the development work should be accelerated in the national interest and that it is beyond the capacity or the budget of any institution, the Commission may consider the financing of such water research and development work and it may assign the execution thereof to those institutions that are best qualified to undertake it.

Grants for research and development projects

In its budget for 1972/73 (Annexure 5) the Commission made provision for grants totalling R396 000. Of this amount R273 000 has already been appropriated to organizations that have submitted motivated submissions. The main reason why the full amount has not yet been allocated is that the Commission wishes to ensure that the financing of water research and development work is oriented to constraints in the country's water economy, and until such time as the present survey of water research activities has been finalized, the Commission will consider only urgent development projects.

The Commission's survey of water research in the Republic will require considerable time to complete and only after all the information has been fully evaluated and priorities established as previously outlined in this report, will the Commission be in a position to rationalize fully the appropriation of funds for water research and development work. It is clear from the information which is progressively elicited by the survey that, in spite of considerable deficiencies in water research and development work, appreciable potentialities exist which could be exploited and refined by effective co-ordination and financial support. The Commission, therefore, requires that applications for grants that are received while its survey is still in progress should be fully motivated with regard to co-ordination, the strengthening of shortcomings in water research and the acceleration of existing projects which have already reached an advanced stage of development and which clearly fit into the overall pattern of water research which is emerging from the Commission's activities.

Appropriations for the following specific development projects were made on conditions approved in terms of section 3(1)(c) by the Honourable the Minister of Water Affairs and embodied in formal research contracts.

Desalination of brackish water

The Republic has considerable subterranean brackish water sources which, to a large extent cannot be fully utilized. Some of these sources also contain noxious salts which are inimical to health e.g. fluorides and nitrates.

Current investigations in connection with the desalination of brackish water are confined to specific areas where fresh water supplies are limited or not available. These studies are mainly confined to "ad hoc" evaluations under local conditions of commercially available desalination plants to render water suitable for human consumption. The value of these studies for the solution of the problems of the Republic as a whole is limited. It is therefore necessary to initiate a programme of comprehensive and directed research of desalination techniques and their general application with a view to the development of criteria which could be applied in the design, construction and operation of desalination plants with the minimum evaluation of local conditions.

Prevention of the eutrophication of rivers and dams

Nuisance growths of obnoxious and undesirable plants and algae in some of the Republic's important dams (e.g. the Hartbeespoort Dam) and rivers create serious problems and the Commission has been requested by the Department of Water Affairs and the South African Bureau of Standards to examine the present status of technology to remove nutrients from effluents to a level where such effluents will not be conducive to the growth of noxious aquatic plants and algae.

Technological development of water reclamation and pollution control

Research done by the National Institute for Water Research and other bodies on water reclamation has already shown its technological and economic feasibility. This development can be of major importance because of South Africa's limited water supplies. Consequently the stage has now been reached where development work to apply water reclamation on a practical scale, has become essential.

It is also important to note that water reclamation is not only a method for the purification of waste water for re-use for various purposes, but it can also be an effective means of limiting the growing pollution of water sources.

This development work is presently at an advanced stage and the Commission has decided to accelerate it with the intention of establishing an information guide which will cover in detail all aspects regarding design, operation, economy, health and the large-scale application of reclamation plants.

Adaptation of the Windhoek water reclamation plant to the latest research data and technological development work

Since January, 1968 the Windhoek water reclamation plant which had been designed in accordance with criteria which were available at the end of 1965, supplied 4,54 Ml per day of reclaimed sewage effluent to augment Windhoek's water shortage. As a result of the Swakop River Water Supply Scheme at the Sartorius von Bach Dam coming into operation and good rains at the beginning of 1971, Windhoek's water problems were solved for a few years. For this reason and because of changes in the chemical composition of Windhoek's sewage, with consequent changes in the intake of purified sewage effluent to the water reclamation plant, the reclamation of purified sewage effluent came to a standstill. Consequently a serious interruption in the research and development work on this important project occurred at a critical stage when important epidemiological and other studies had reached an advanced stage.

The continuation of this project is of national importance since an indefinite interruption thereof will mean a loss of valuable research date which cost thousands of rand. Furthermore, South Africa's image may suffer internationally since the Windhoek project enjoyed worldwide acclaim.

Realising the aforementioned implications as well as the importance of effective water utilization for Windhoek's future development when the Swakop River Water Supply Scheme is exploited to its full capacity within the next five years, the Municipality of Windhoek has agreed to continue with water reclamation as a research and development project with the support of the Commission. The Commission decided to give its full support to this project by financing the modernization of the existing reclamation plant in accordance with the most recent research data.

Development work on the WAT-process for the desalination of sea water

The WAT-process has been developed by the CSIR and after discussions on 27th September, 1971, with the Honourable the Minister of Water Affairs, the Secretary for Water Affairs, the Manager of the Industrial Development Corporation, the Chairman of the Electricity Supply Commission and the Director of the National Institute for Water Research, it was decided to proceed with the recommendation that a detailed market survey and the technical feasibility study be carried out as proposed by the Industrial Development Corporation. Depending on the results of these studies a pilot plant will be designed and constructed.

Storage and purification of water in the natural sand beds of the Cape Flats as well as the construction and operation of a 4,54 Ml/day reclamation plant for the development of design criteria required for large scale application of water reclamation in the Cape Peninsula and other areas of the country

The Cape Peninsula is a typical example of an area where the re-use of water can provide a possible solution to a water shortage. The Cape Peninsula imports as much as 95 percent of its present water consumption from other areas. The greater proportion of this water discharges to the sea after one cycle of use since it is not practical to return the used water to the orginal catchment area.

Surveys of sewage flows in the Cape Peninsula indicated that they constituted 60 to 70 percent of the total water consumption. Under the present circumstances, therefore, there is 54 million m^3/year of sewage effluent available for reclamation. By the year 1990 and at the turn of this century 180 million m^3/year and 270 million m^3/year of sewage effluent will be available respectively.

Due to the availability of relatively large quantities of sewage effluent and taking into consideration the seasonal and daily fluctuations in water demand, it has been deemed necessary to investigate the possibilities of water reclamation and the storage of the reclaimed water.

In view of the fact that no suitable dam sites are available in the vicinity of Cape Town, attention has been focussed on the possibilities of underground storage. The use of the natural sand beds of the Cape Flats consequently seemed to offer the obvious solution. However, little information is available about the physical, chemical and hydraulic properties of these deposits, consequently investigations have been initiated to evaluate these properties.

Organization and management

It has become very clear that the Commission should have an organizational structure which allows external liaison at the highest managerial level. In his capacity as Chief Executive Officer, the Vice-Chairman is responsible for the management and control of work authorized by the Commission. Consequently it is necessary that he be assisted by senior specialist and administrative staff who can operate at high level in the Commission's contact with other organizations. Because of the multi-disciplinary nature of the Commission's activities, this nucleus of senior personnel should have outstanding scientific and administrative ability for the planning and execution of their tasks.

The Commission has decided that its permanent specialist staff should be appointed at senior level and should provisionally be limited to the key disciplines of Civil Engineering, Chemistry and Chemical Technology, Physics and Geo-physics, Agriculture and Business Economics. Furthermore, it has been decided to employ specialist consultants in cases where expertise in other disciplines is required.

In view of these considerations, the Commission is of the opinion that the decisive factor in the achievement of its objectives will be the ability of its personnel to activate institutions and individuals and to mobilize manpower, expertise and facilities along routes which concentrate on the constraints in the Republic's water economy.

The organizational structure shown in Annexure 3 has been accepted by the Commission as guidelines until 1975 for the development of its activities and for the appointment of staff, with due consideration of adjustments dictated by experience.

Balance sheets and statements of income and expenditure

These statements, drawn up in terms of section 14(2) of the Water Research Act and certified by the Auditor-General, appear as Annexure 6, for the period 6th August, 1971 to 31st March, 1972, and as Annexure 7, for the period 1st April, 1972 to 31st March, 1973. As far as these statements are concerned, it should be noted that at its inception the Commission did not derive any income from rates and charges and that with the concurrence of Treasury, the Department of Water Affairs advanced funds from its budget votes for 1971/72 and 1972/73 to the Commission for initiating its activities. The Statements show that these advances were repaid to the Department of Water Affairs during the 1972/73 book year, in accordance with the conditions stipulated by Treasury.

Furthermore, it should be pointed out that the relatively large amount not expended during 1972/73 is ascribable to the fact that during the first eighteen months of its existence, the Commission had to explore the field and could not act prematurely in the allocation of funds. The Commission wants to be certain that, in its allocation of funds, it only supports high priority research directed at problem areas in the country's water economy. The surplus for 1972/73 will serve to consolidate the levy on water usage at a stable level for the foreseeable future and to stabilize the Water Research Fund, thereby ensuring continuity in the financial support of water research.

ANNEXURE 1

The main task areas of water research

A. HYDROLOGICAL CYCLE

1. **Atmosphere**
   - 1.1 Rain and effective rainfall – collection and processing of data.
   - 1.2 Climate – collection and processing of data.
   - 1.3 Stimulation of rainfall.
   - 1.4 Extraction of moisture from the atmosphere.
   - 1.5 Interception of rainfall.
   - 1.6 Weather forecasting.

2. **Catchments**
   - 2.1 Management.
   - 2.2 Conservation.
   - 2.3 Characteristics.
   - 2.4 Effects of afforestation and farming practices on river flows.
   - 2.5 Erosion and the protection of sponges.
   - 2.6 Interconnection of rivers.

3. **Runoff and storage**
   - 3.1 Collection and processing of data.
   - 3.2 Measurement of river flow.
   - 3.3 Runoff/rainfall ratios.
   - 3.4 Storage of water.
   - 3.5 Flood Control.
   - 3.6 Management and control of dam basins.
   - 3.7 Silt loads and the siltation of dams.
   - 3.8 Assured yields.
   - 3.9 Factors affecting quality.
   - 3.10 Effect of natural vegetation.
   - 3.11 Effect of burning.

4. **Soil moisture**
   - 4.1 Infiltration.
   - 4.2 Conservation.
   - 4.3 Evaporation.
   - 4.4 Transpiration: natural vegetation, crops, measurement and control.
   - 4.5 Recovery of soil moisture.
   - 4.6 Techniques for measurement of soil moisture.

5. **Subsurface water**
   - 5.1 Occurrence and detection.
   - 5.2 Quantitative determination of groundwater supplies.
   - 5.3 Dolomitic water bearing formations.
   - 5.4 River beds.
   - 5.5 Hydraulic properties of aquifers.
   - 5.6 Origin, infiltration and natural replenishment.
   - 5.7 Water quality.
   - 5.8 Evaporation of subsurface water.
   - 5.9 Effects of vegetation.
   - 5.10 Effects of dams.
   - 5.11 Effects of mining.
   - 5.12 Effects of soil utilization.
   - 5.13 Artificial replenishment.
   - 5.14 Storage in sand beds.
   - 5.15 Side-effects of dewatering.
   - 5.16 Regional development.
   - 5.17 Management and control of ground water resources.
   - 5.18 Geo-hydrological techniques.

6. **Evaporation – open surfaces**
   - 6.1 Measuring techniques.
   - 6.2 Control.
   - 6.3 Effect of water quality.

7. **Limnology and Oceanography**
   - 7.1 Rivers.
   - 7.2 Dams and lakes.
   - 7.3 Coastal lagoons.
   - 7.4 Estuaries.
   - 7.5 Sea.

8. **Droughts**
   - 8.1 Analyses of occurrence, duration and intensity.
   - 8.2 Water management during droughts.
   - 8.3 Effect on groundwater and yield of bore-holes.

B. WATER UTILIZATION CYCLE

1. **Agricultural utilization**
   - 1.1 Irrigation: problems of existing irrigation schemes.
   - 1.2 Irrigation: planning and lay-out of new schemes.
   - 1.3 Irrigation: soil surveys.
   - 1.4 Irrigation: water quality and its effect on soil and crops.
   - 1.5 Irrigation: pollution and mineralization of irrigation water.
   - 1.6 Irrigation: infiltration and soil compaction.
   - 1.7 Irrigation: mineralization, prevention and reclamation of mineralized soils.
   - 1.8 Irrigation: waterlogging and drainage.
   - 1.9 Irrigation: drainage techniques and standards.
   - 1.10 Irrigation: techniques and systems.
   - 1.11 Irrigation: evaluation and standardization of equipment.
   - 1.12 Irrigation: requirements of specific crops.
   - 1.13 Irrigation: requirements of plots at different schemes.
   - 1.14 Irrigation: frequency and quantities.
   - 1.15 Irrigation: lysimeter studies.

1.16 Irrigation: acclimatized crops and the selection and breeding of more suitable crops.
1.17 Irrigation: production practices such as cultivation, plant density, etc.
1.18 Irrigation: influence on product quality.
1.19 Irrigation: climate- soil- plant- water relationships.
1.20 Irrigation: maximum production per unit of water.
1.21 Irrigation: economic studies.
1.22 Stock watering: quality standards.

2. **Utilization by forestry**
   2.1 Water requirements.
   2.2 Production per unit of water consumption.

3. **Municipal, mining and industrial utilization**
   3.1 Development of water supply schemes.
   3.2 Purification for domestic use.
   3.3 Distribution systems.
   3.4 Quality requirements.
   3.5 Conservation techniques.
   3.6 Metering of water.
   3.7 Internal reuse of water in industry and mining.
   3.8 Increased industrial production per unit of water.
   3.9 Cooling.
   3.10 Purification of effluents.
   3.11 Water management – municipalities, provincial administrations, etc.
   3.12 Water management – industry and mining.
   3.13 Marine disposal of effluents.
   3.14 Industrial processes: modification and development.

4. **Recreational use**
   4.1 Development and management of water environments for recreation.
   4.2 Economic value of the recreational utilization of water.
   4.3 Quality requirements.
   4.4 Aquatic life.
   4.5 Health requirements.

C. POLLUTION

1. Domestic sewage effluents.
2. Industrial effluents.
3. Mining effluents.
4. Agricultural effluents.
5. Storm water and topographical pollution.
6. Quality surveys of rivers, estuaries, dams, lakes and the sea.
7. Quality criteria for water environments.
8. Quality criteria for effluents.
9. Parameters of pollution.
10. Mineralization problems.
11. Sanitation systems.
12. Utilization of polluted effluents.
13. Effects on living organisms.
14. Measurement and evaluation of specific pollutants.
15. Health aspects.
16. Control systems.
17. Eutrophication.
18. Groundwater pollution.
19. Solid wastes.
20. Influence of air pollution.
21. Legal and administrative aspects.

D. WATER RECLAMATION

1. Process development.
2. **Quality criteria**
   2.1 Human consumption.
   2.2 Animal consumption.
   2.3 Industrial and mining utilization.
   2.4 Agricultural utilization.
   2.5 Recreational utilization.
3. Health aspects.
4. Quality evaluation.
5. Sub-surface storage of purified effluent.
6. Regional schemes.

E. DESALINATION

1. Sea water.
2. Brackish water.
3. Mineralized effluents.

F. DISSEMINATION AND APPLICATION OF INFORMATION

1. Documentation.
2. Collection and publication of data, research findings and information (national and international).
3. Communication, dissemination of information and demonstration units.
4. Follow-up surveys of the application of research findings and information.

G. INSTRUMENTATION

H. ECO SYSTEMS

I. SPECIAL WATER SCHEMES

1. Orange river scheme.
2. Makatini Flats scheme.
3. Vaal river catchment.
4. Ground water potential of the Cape Peninsula and of certain dolomitic areas.

J. ANALYTICAL TECHNIQUES

K. CONSUMPTION TRENDS

L. VALUE OF WATER IN VARIOUS USES

M. SYSTEMS ANALYSES

N. MATHEMATICAL MODELS

O. RESEARCH TRAINING

P. HYDRAULIC PROBLEMS

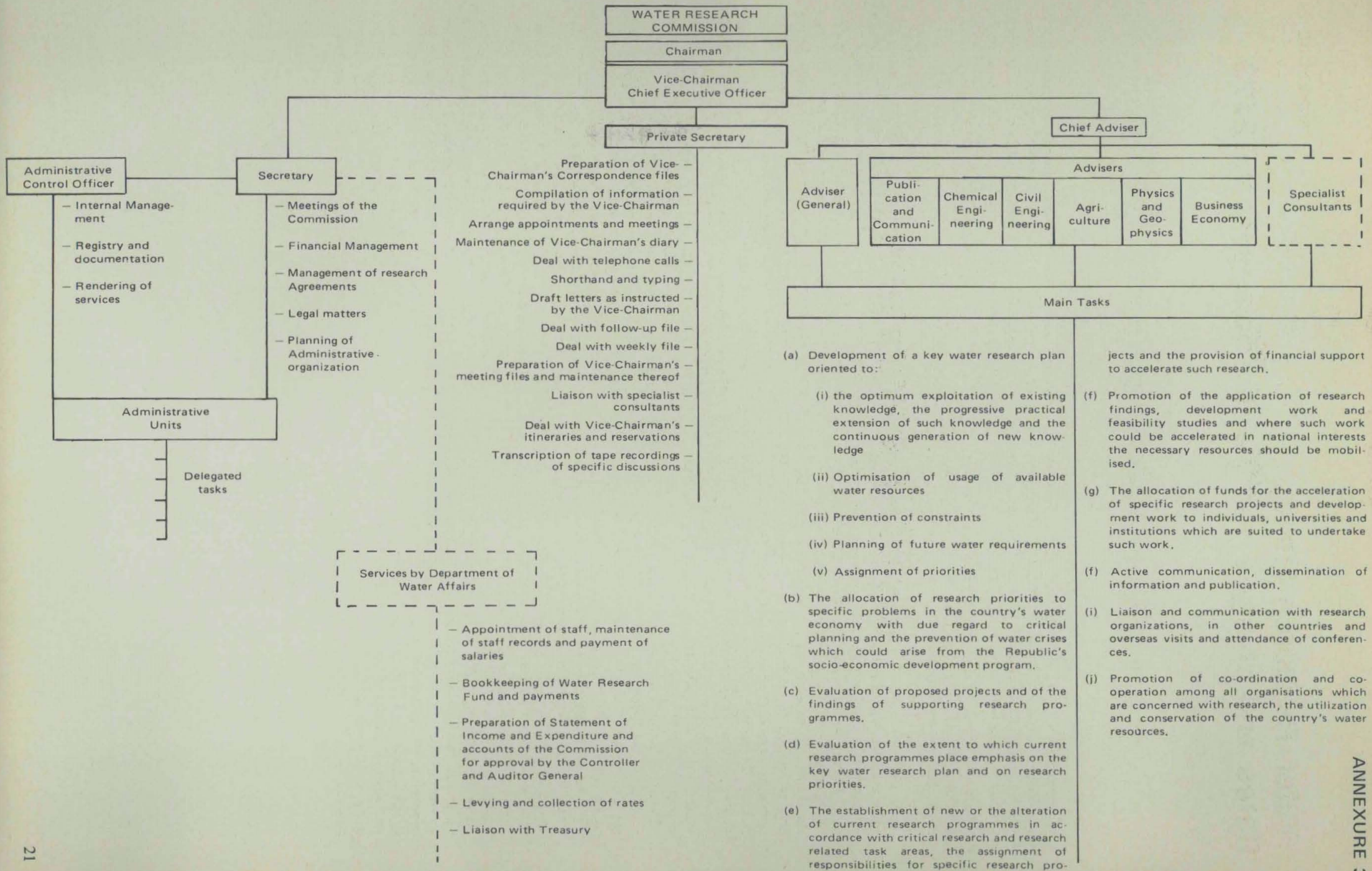
1. Flow measurement equipment.
2. Current effects.
3. Transport of sediments and deposits.
4. River hydraulics.
5. Prevention of sediments in pipelines.
6. Hydropower.

Water Research Fund: Rates and charges for the financial year 1972/73

In accordance with the provisions of article 11 of the Water Research Act 1971, announced by Government Notice No. 214 of 18th February, 1972, the following rates and charges were levied:

1. "Forty (40) cents in respect of each hectare of land scheduled in terms of section 63 (7) or, where applicable, section 88 of the Water Act, 1956 (Act 54 of 1956), to be irrigated at any time during the period 1 April 1972 to 31 March 1973 with water supplied or made available from a Government dam and distributed by means of a canal, irrespective of whether or not such canal belongs to or is controlled by an irrigation board or other statutory body. This rate shall be recovered simultaneously with any rate which the Minister may levy in respect of the land concerned during the said period in terms of section 66 or 56 (3) of the said Water Act by the Secretary for Water Affairs or any other person or body responsible for the recovery of the last-mentioned rate, or, if no such rate is levied, by the Secretary for Water Affairs, and shall be payable upon demand."
2. "Twenty (20) cents in respect of each hectare of land scheduled in terms of section 63 (7) or, where applicable, section 88 of the aforementioned Water Act to be irrigated at any time during the period 1 April 1972 to 31 March 1973 with water supplied or made available from a Government dam but not distributed by means of a canal. This rate shall be recovered in the manner described in paragraph (1)."
3. "Twenty (20) cents in respect of each hectare of land scheduled in terms of section 88 of the afore-mentioned Water Act to be irrigated at any time during the 1972/73 or, as the case may be, the 1972 financial year of any irrigation board or other statutory body with water supplied or made available from a water work belonging to such irrigation board or other statutory body. This rate shall be recovered by the irrigation board or other body concerned simultaneously with any rate the irrigation board or other statutory body may levy in respect of the land concerned during the financial year concerned or, if no such rate is levied, by the Secretary for Water Affairs, and shall be payable upon demand. The whole amount recovered by an irrigation board or other body shall be remitted to the Secretary for Water Affairs within thirty (30) days of the close of the financial year of the board or body concerned."
4. "Two tenths of a cent (0,2c) per cubic metre in respect of metered water supplied or made available during the period 1 April 1972 to 31 March 1973 from a Government water work for purposes other than the irrigation of land. This charge shall be recovered by the Secretary for Water Affairs simultaneously with any charge the Minister may levy in terms of section 56 (3) or 66 of the afore-mentioned Water Act in respect of the supply of such water during the said period."
5. "Two tenths of a cent (0.2c) per cubic metre in respect of the quantity of water supplied or made available during the period 1 April 1971 to 31 March 1972 by the Rand Water Board, by any regional water supply corporation established in terms of the Water Supply Ordinance, 1945 (Ordinance 21 of 1945), of Natal, by the Western Transvaal Regional Water Company (Pty) Ltd, by any water board established in terms of section 108 of the afore-mentioned Water Act and by any local authority serving a White population in excess of 2 000 according to Report 02-05-01 published by the Secretary for Statistics: Provided that where any local authority was during the said period supplied with water by the Rand Water Board, any regional water supply corporation of Natal, the Western Transvaal Regional Water Company (Pty) Ltd., a water board or any other public supplier of water, the charge shall be payable only in respect of water supplies derived from any other source. One fourth of the total amount payable in respect of this charge shall be remitted by the supplier of Water concerned to the Secretary for Water Affairs, Private Bag X313, Pretoria, not later than 30 September 1972 and three fourths not later than 31 March 1973."

ORGANIZATIONAL STRUCTURE



(a) Development of a key water research plan oriented to:

(i) the optimum exploitation of existing knowledge, the progressive practical extension of such knowledge and the continuous generation of new knowledge

(ii) Optimisation of usage of available water resources

(iii) Prevention of constraints

(iv) Planning of future water requirements

(v) Assignment of priorities

(b) The allocation of research priorities to specific problems in the country's water economy with due regard to critical planning and the prevention of water crises which could arise from the Republic's socio-economic development program.

(c) Evaluation of proposed projects and of the findings of supporting research programmes.

(d) Evaluation of the extent to which current research programmes place emphasis on the key water research plan and on research priorities.

(e) The establishment of new or the alteration of current research programmes in accordance with critical research and research related task areas, the assignment of responsibilities for specific research projects and the provision of financial support to accelerate such research.

(f) Promotion of the application of research findings, development work and feasibility studies and where such work could be accelerated in national interests the necessary resources should be mobilised.

(g) The allocation of funds for the acceleration of specific research projects and development work to individuals, universities and institutions which are suited to undertake such work.

(f) Active communication, dissemination of information and publication.

(i) Liaison and communication with research organizations, in other countries and overseas visits and attendance of conferences.

(j) Promotion of co-ordination and co-operation among all organisations which are concerned with research, the utilization and conservation of the country's water resources.

ANNEXURE 3

FINANCIAL STATEMENTS

WATER RESEARCH COMMISSION BUDGET

1971/72

STATEMENT NO.1

FUNDS	
Advances from Department of Water Affairs' budget vote	R26 000
EXPENDITURE	
Salaries	14 700
Subsistence and travel expenses	540
General Expenditure	10 760
	R26 000

ANNEXURE 5

WATER RESEARCH COMMISSION BUDGET

1972/73

STATEMENT NO. 2

FUNDS		
Expected revenue from rates and charges		2 335 500
Advance from Department of Water Affairs' budget		40 000
		R2 375 500
EXPENDITURE		
Administration expenses:		
Salaries	47 700	
Specialist, Consultation and Legal Services	50 000	
Subsistence and travel expenses	13 500	
General Expenditure	29 350	
Refund of advances to Dept. of Water Affairs, 1971/72 and 1972/73	66 000	206 550
Research Projects		
Desalination of brackish water	10 000	
Research in connection with salt water control systems on the Witwatersrand	15 000	
Research in connection with physical feasibility of regional sewage purification plants with reference to the possible utilization of water by industry, possible integration with water reticulation systems and the prevention of pollution	15 000	
Effect of the disposal of industrial effluents in sewerage systems	10 000	

Prevention of eutrophication of rivers and dams	12 000	
Technological development of water reclamation and pollution control	30 000	
Other	38 000	130 000
Feasibility studies and Development Projects		
Adaptation of the Windhoek water reclamation plant to the latest research data and technological development work	131 000	
Abstraction of moisture from the atmosphere	10 000	
Development work on the WAT process for the desalination of sea water	50 000	
Storage and purification of water in the natural sand beds of the Cape Flats as well as the construction and operation of a 4,54 Ml/day water reclamation plant for the purpose of developing design criteria for the large scale application of water reclamation in the Cape Peninsula and other areas in the country	40 000	231 000
Support of water research at universities		
Development of mathematical models for the optimization of systems for the development of water resources	10 000	
Ground Water: Geohydrological research	15 000	25 000
Research and other grants		10 000
Amount to be invested with the Public Debt Commissioner in terms of section 13(b) of the Water Research Act, 1971		1 772 950
		R2 375 500

WATER RESEARCH COMMISSION

INCOME AND EXPENDITURE ACCOUNT FOR THE
PERIOD 6 AUGUST 1971 TO 31 MARCH 1972

STATEMENT No. 3

EXPENDITURE	R
Salaries and Allowances	16 857 61
Subsistence	195 82
Motor transport	191 03
General transport	619 70
Postal services	38 06
Telegraph services	9 47
Telephone services	274 89
Printing	18 88
Stationery	156 12
Publications	5 72
Hire and maintenance of office equipment	49 10
Entertainment	138 63
Hire of offices	295 02
Depreciation	376 21
Miscellaneous petty expenses	638 96
	R19 865 22

REVENUE	R	R
Contribution in respect of motor transport:		
Received	40 00	
Outstanding	10 00	50 00
Excess of expenditure over revenue		19 815 22
		R19 865 22

ANNEXURE 6

WATER RESEARCH COMMUSSION

BALANCE SHEET AS AT 31 MARCH 1972

LIABILITIES	R	ASSETS	R	R	R
Sundry creditors (Advances from Department of Water Affairs)	26 000 00	Capital assets –			
		Motor vehicle	5 019 00		
		Less depreciation	375 60	4 643 40	
		Office equipment	421 23		
		Less depreciation	33	420 90	
		Office furniture	67 60		
		Less depreciation	28	67 32	5 131 62
		Current assets –			
		Advance payments		220 50	
		Sundry debtors and debit balances		10 00	
		Cash on hand		20 00	
		Cash in bank		802 66	1 053 16
		Fund Account:			
		Excess of expenditure over revenue as at 31.3.72			19 815 22
	R26 000 00				R26 000 00

J.P. KRIEL
Chairman (Secretary for Water Affairs)

The above Balance Sheet has been audited in accordance with the provisions of section 56 of the Exchequer and Audit Act, No. 23 of 1956, as amended, as read with section 14(1) of the Water Research Act, No. 34 of 1971, and in my opinion it has been drawn up so as to reflect a true and fair view of the financial affairs of the Water Research Commission.

F.G. BARRIE
Controller and Auditor-General

Department of the Controller and Auditor-General

PRETORIA 11/9/72

ANNEXURE 6 (cont.)

WATER RESEARCH COMMISSION

INCOME AND EXPENDITURE ACCOUNT FOR THE PERIOD 1 APRIL 1972 TO 31 MARCH 1973

STATEMENT No. 4

EXPENDITURE				REVENUE			
1971/72			1972/73	1971/72			1972/73
R			R	R		R	R
16 857	Salaries and Allowances		35 715 70		Rates: Government Irrigation with canal systems:		
196	Subsistence		6 378 80				
191	Motor Transport		1 004 96				
620	General Transport		2 376 42		Received	43 032 43	
38	Postal Services		182 29	–	Outstanding	11 888 41	54 920 84
9	Telegraph Services		128 71				
275	Telephone Services		873 08		Rates: Government Irrigation		
19	Printing		723 68		Schemes without canal system		
156	Stationery		1 903 34				
–	Advertisements		5 419 58		Received	519 97	
6	Publications		44 00	–	Outstanding	1 658 51	2 178 48
49	Hire and maintenance of office equipment		780 03				
139	Entertainment		499 38		Rates: Irrigation Board		
295	Hire of offices		4 781 59		Schemes		
–	Maintenance of and alterations to offices		407 64				
–	Maintenance of and hire of furniture		119 21		Received	22 151 98	
376	Depreciation		1 202 24	–	Outstanding	10 909 11	33 061 09
639	Miscellaneous petty expenses		1 041 68				
–	Typing Services		237 50		Charges: Metered water from		
	Abstraction of moisture from the atmosphere by				Government Schemes:		
–	means of the L-L-process		1 497 71				
	Development work on the WAT-process for the				Received	246 101 60	
–	desalination		23 309 41	–	Outstanding	49 107 05	295 208 65*
–	Specialist consultation and legal services		3 788 65				
–	Excess of revenue over expenditure		2 107 219 63		Charges: Municipalities		
					Received	1 386 759 92	
				–	Outstanding	432 386 25	1 819 146 17≠
				50	Contribution in respect of motor transport		120 00
				19 815	Excess of expenditure over revenue		–
R19 865			R2 204 635 23	R19 865			R2 204 635 23

Includes the following estimated amounts

* R170 000 ≠ R427 000

ANNEXURE 7

WATER RESEARCH COMMISSION

BALANCE SHEET AS AT 31 MARCH 1973

1971/72	LIABILITIES	1972/73
R		R
	Sundry Creditors	
	Advances from Department of Water	
26 000	Affairs	–
–	Revenue paid in advance	5 274 64
	Fund Account: Excess of revenue	
–	over expenditure as at 31.3.1973	2 087 404 41
R26 000		R2 092 679 05

1971/72	ASSETS			1972/73
R		R	R	R
	Capital assets			
4 643	Motor vehicle	4 643 40		
	Less depreciation	930 24	3 713 16	
421	Office equipment	6 526 92		
	Less depreciation	150 85	6 376 07	
	Office furniture	10 515 09		
67	Less depreciation	121 15	10 393 94	20 483 17
	Current assets:			
	Expenditure paid in advance			
221			151 70	
	Sundry debtors:			
10	Outstanding revenue	505 949 33		
–	Advances to CSIR	92 700 00	598 649 33	
20	Cash on hand		50 00	
803	Cash in Bank		1 473 344 85	2 072 195 88
	Fund Account: Excess of expenditure over revenue as at			
19 815	31.3.72			–
26 000				R2 092 679 05

J.P. KRIEL
CHAIRMAN (SECRETARY FOR WATER AFFAIRS)

G.J. STANDER
VICE-CHAIRMAN (CHIEF EXECUTIVE OFFICER)

The above Balance Sheet has been audited in accordance with the provisions of section 56 of the Exchequer and Audit Act, No. 23 of 1956 as amended, as read with section 14(1) of the Water Research Act, No. 34 of 1971, and in my opinion it has been drawn up so as to reflect a true and fair view of the financial affairs of the Water Research Commission.

Department of the Controller and Auditor-General

CAPE TOWN

F.G. BARRIE
CONTROLLER AND AUDITOR-GENERAL

ANNEXURE 7 (cont.)